

# **Armagh Observatory and Planetarium**

## **Annual Report and Accounts For the year ended 31 March 2024**

*Laid before the Northern Ireland Assembly*

*under clause 8 of The Armagh Observatory and Planetarium (Northern Ireland) Order 1995,*

*as amended by Schedule 1, clause 6 of the Audit and Accountability (Northern Ireland)*

*Order 2003, by the Department for Communities*

*on*

*18 November 2024*

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# Armagh Observatory and Planetarium

## Annual Report and Accounts For the year ended 31 March 2024

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# The Trustees' Annual Report for the year ended 31 March 2024

The Board of Governors and Management Committee, who are the Trustees for Armagh Observatory and Planetarium (AOP) have pleasure in presenting the annual report and financial statements for this charity for the year ended 31 March 2024. These financial statements have been prepared in accordance with the accounting policies set out in note 1 to the accounts, with the guidance issued by the Department of Finance on the form and contents of the Annual Reports and Accounts of Executive Non-Departmental Public Bodies, *The Armagh Observatory and Planetarium (Northern Ireland) Order 1995* and Accounting and Reporting by Charities: Statement of Recommended Practice (SORP) applicable to charities preparing their accounts in accordance with the Financial Reporting Standard applicable in the UK and Republic of Ireland (FRS 102). The Remuneration and Staff report is prepared in accordance with the direction set out in The Government Financial Reporting Manual (FRM) 2023-24.

The sponsor Department for Armagh Observatory and Planetarium is the Department for Communities (DfC) (the Department).

## Background to Charitable Status

Historically the Armagh Observatory and the Armagh Planetarium were treated as being distinct institutions; being two component divisions of a single statutory corporation and arms-length body (ALB), 'The Governors of The Armagh Observatory and Planetarium' as described in *The Armagh Observatory and Planetarium (Northern Ireland) Order 1995*.

The principal function of the Armagh Observatory, founded in 1789 as part of Archbishop Richard Robinson's vision to see the creation of a university in the City of Armagh, is to undertake original research of a world-class academic standard that broadens and expands our understanding of astronomy and related sciences.

The Armagh Planetarium was founded by Dr Eric Mervyn Lindsay, the seventh director of the Armagh Observatory, and was officially opened on 1 May 1968. The Planetarium's primary activity is to disseminate scientific and technical knowledge of a wide range of science, technology, engineering, arts and mathematics (STEAM) subjects, and to promote public understanding of astronomy and science through its programme of educational services for schools and the wider public.

From 1 April 2016 the Charity Commission for Northern Ireland registered *The Governors of The Armagh Observatory and Planetarium*, (changed to *The Armagh Observatory and Planetarium* in 2023) as a charity under reference number NIC 103948.

## Objectives and Activities

The organisation's statutory functions are set out at Article 4 of *The Armagh Observatory and Planetarium (Northern Ireland) Order 1995* (the Order). The Order requires that '*the Governors shall, for the purpose of developing and improving the knowledge, appreciation and practice of astronomy and related sciences, maintain and manage the Armagh Observatory and Planetarium and may take such other action as the Governors may think proper for the purpose of acquiring or disseminating knowledge relating to astronomy and related sciences*'.

In accordance with Paragraph 8(1) of Schedule 1 of the Order, the Armagh Observatory and Planetarium (AOP) Board of Governors has delegated the primary responsibility for the governance and management of AOP to a Management Committee with the statutory purpose of 'developing and improving the knowledge, appreciation and practice of astronomy and related sciences'.

The AOP Management Committee has corporate responsibility for ensuring that AOP fulfils the aims and objectives set by the Department for Communities (our sponsor Department) and approved by the Minister and for promoting the efficient, economic and effective use of resources.

As the primary responsibility for the governance and management of AOP has been delegated to a Management Committee, the Governors considered the role of Charity Trustees would more appropriately align with their remit too. The Board of Governors agreed in principle to this. The Charity Commission of Northern Ireland recommended that the Members of the Management Committee be appointed as Trustees for the Charity alongside the Members of the Board of Governors. Accordingly, both the Members of the Board of Governors and the Members of the Management Committee are Charity Trustees.

Armagh Observatory is the oldest scientific institution in Northern Ireland, and the longest continuously operating astronomical research institute in the UK and Ireland. Armagh Planetarium is also the oldest operating planetarium in the UK and Ireland.

Our Mission:

*“Our mission is the pursuit of knowledge and understanding of the cosmos, and the sharing of that knowledge in order to inspire future generations and enrich the intellectual, economic, social and cultural life of all.”*

Our Vision:

*“Our vision is to be recognised as an international centre of scientific excellence for the pursuit of astronomy and the public understanding of science, for our capacity for innovation and our extraordinary heritage, a place our community can be proud of.”*

The organisation operates on the international stage and is underpinned by core funding from the Department and the receipt of external grants from the UK Science and Technology Facilities Council (STFC), and other grant-awarding bodies.

A Strategic Plan for 2021-26 was launched in September 2021 and this is now being implemented. The strategy is built around four strategic themes – Enduring Relevance, National and International Standing, Offering More and Pursuing our Priorities.

As at 31 March 2024, there were 29.8 full time equivalent permanent employees which comprised approximately one-third Research, one-third Education and one-third Corporate. Additionally, there were 3.6 full time equivalent temporary employees, some of whom were engaged on short term temporary projects. AOP also employs a number of casual staff on an ad hoc basis to meet operational needs. In addition, there is an Emeritus Director, an Emeritus Research Astronomer and 8 external research associates and academic visitors who are unpaid.

## **Public Benefits**

The Trustees confirm that they have complied with their duty to have regard to the guidance on Public Benefit produced by the Charities Commission of Northern Ireland under Section 4 of the Charities Act (Northern Ireland) 2008 (the public benefit requirement statutory guidance) and that this has informed the activities of the organisation in the year to 31 March 2024. This is demonstrated in the following summary of Principal Activities which provides detail on how the organisation has delivered against its objectives and the public benefit which has flowed from this.

## **Principal Activities**

### **Introduction to AOP Research and its International Standing**

AOP is one of the oldest scientific research institutes in the UK and Ireland with a long-established reputation of research excellence. It is also one of very few astronomical institutions in the world to have a modern planetarium through which its research can be effectively communicated and where a research-informed outreach and public engagement activity can be sustained.

AOP is strategically engaged in front-line research in several key areas of astrophysics. These range from the study of our Sun and the Solar System to that of distant galaxies, in keeping with the long and varied history of scientific achievements of the Armagh Observatory and with the desire to be perceived by the public as leaders in of all strands of astronomical research that are communicated through the Planetarium.

Typically, around a third of AOP research is funded by the award of project-specific external grants mainly from the STFC, together with several ad hoc grants. These grants support projects led by individual research astronomers with the provision of PhD scholarships, post-doctoral research assistant salaries, computing equipment and observation/conference travel funding. Early in 2024, AOP researchers secured one new STFC grant providing funding for one Post-Doctoral Research Assistant (PDRA) plus salary staff contribution and estate costs until March 2027. AOP researchers also secured Leverhulme Trust funding to support an additional PDRA who will be dedicated to solar-system studies based on the use of immersive technologies and AOP’s data visualisation laboratory.

AOP research requires the use of state-of-the-art observing and computing facilities internationally in order to obtain new astronomical data and allow their analysis. STFC and UK government support provides access to world-class international facilities, and AOP research staff regularly win telescope time on some of the best and most sought-after telescopes in the world such as the European Southern Observatory (ESO) Very Large Telescope (VLT) or the Hubble Space Telescope (HST).

In addition, through the AOP’s membership of the UK SALT Consortium, its research staff have access to the 11-metre diameter Southern African Large Telescope (SALT). Similarly, AOP is also a founder member of the international Gravitational-wave Optical Transient Observer (GOTO) project; a member of the UK consortia involved

in building the detectors for Inouye Solar Telescope (IST); LOFAR (Low Frequency Array) radio telescope project and a consortium member of the Cherenkov Telescope Array (CTA) gamma-ray observatory and the BlackGem project which conducts optical surveys from Chile. Finally, AOP is in a leadership position for nearly a quarter of all the observing time dedicated to Large Programs run by the 15-meter diameter James Clerk Maxwell Telescope (JCMT) in Hawaii which detects sub-mm radio waves.

These facilities can be extremely expensive to run (e.g., the running cost of one observing night at VLT is about £40,000 and a mid-size observing program with HST would be ten times more) so that through the award of their use, the international astronomical community essentially entrusts astronomers at Armagh to make effective use of the data. On average AOP researchers secure telescope time corresponding to a value of more than £300,000 per year, and the value of the telescope time obtained at facilities to which AOP has unique access far outweighs the costs of such arrangements.

AOP research staff also play a full role in the international astronomical community. For instance, they serve on committees of bodies such as the Royal Astronomical Society (RAS), the UK Science and Technology Facilities Council, the International Astronomical Union (IAU) - with three commission vice-presidents and two former presidents, ESO time allocation panels, assess grant and research proposals on behalf of external funding agencies, review scientific papers and edit international academic journals, and act as external PhD examiners in the UK and beyond. AOP researchers also sit on scientific advisory panels or lead specific projects with future ground-based observing facilities (Vera Rubin Observatory, ELT-METIS, VLT-BlueMUSE), space satellites and missions (European Space Agency's future Plato and Comet Interceptor missions) and large-scale surveys (MOONs).

The international reputation of AOP research staff is also testified by their ability to attract their international peers to Armagh either on research visits or organising international conferences and workshops at the Planetarium. This year was rather exceptional as regards the latter, as AOP welcomed over 120 delegates during three back-to-back research conferences in September 2023, which were delivered thanks to the concerted efforts of AOP staff and students and to funding from both the Armagh, Banbridge and Craigavon Council and the RAS.

Finally, AOP research staff are involved in the training of PhD students who also play a key part in AOP outreach and public engagement activity. AOP students are usually registered at Queen University Belfast (QUB), through an advantageous student fee arrangement that over time has allowed AOP to attract students from all over the world and achieve a vibrant diversity in our cohort that in turn prepares our students to be STEM champions, promoting equal opportunities in physics when they help at the Planetarium. This year AOP underwent a quinquennial review of the memorandum of agreement with QUB for the supervision of PhD students. This had a positive outcome, commending the AOP PhD program, the quality of our underlying research and the unique research environment, with a recommendation to setup an AOP/QUB studentship to further joint research opportunities.

## Research Highlights

To provide a practical understanding of how the work of AOP research contributes to the region's international reputation and understanding of the cosmos, the following provides some highlights of the research undertaken at AOP in the financial year. This draws from international collaborations and the award of observing time on highly competitive facilities, as well as direct support from the Department allowing AOP to participate in several key international projects (such as SALT, GOTO, IST, I-LOFAR, Comet Interceptor, CTA and BlackGem). Full bibliographic references can be found in the publication list appended to this report.

## Stellar and Galaxy Evolution

### *Introduction*

When we look up on a dark night, we may think that stars are immutable and isolated. Yet, although stars can live for as long as the age of the Universe, they can also undergo dramatic changes in matter of seconds. They are also not isolated from other stars. Some are found in pairs or tight groups and more generally stars are related to each other through the very way in which they form and evolve. Stars are born from giant clouds of gas and return matter to those clouds, seeding the birth of new stars as they fade away or sometimes explode in dramatic events. Furthermore, stars produce the heavy elements necessary for the formation of rocky planets and of life as we know it.

In turn, the formation history of stars relates to the formation and evolution of the galaxies that contain them. Some galaxies no longer appear to form stars, unlike the case of the Milky Way. This may depend on whether fresh gas is available around them, on whether they have collided with other galaxies in the past or possibly also on whether their central supermassive black hole suddenly becomes active and pours out tremendous amounts of energy capable of clearing its host galaxy of any star-forming gas material. Finally, galaxies are carried by the general expansion of the Universe and the evolution of the dominant, yet unknown dark-matter material in which they themselves are embedded. Understanding the formation and evolutions of stars and galaxies therefore ultimately means understanding our origin in relation to the very fabric of the Universe.

## Recent results

AOP stellar studies range from the most massive and brightest young stars to the faintest and ageing stars or stellar remnants such as white dwarfs and black holes.

The research in the group of Professor Jorick Vink is both theoretical and observational and is supported by STFC grants run in collaboration with Keele and York Universities. The theoretical work focuses on understanding of the formation of the heaviest stars and stellar black holes in the Universe. These stars are up to 10 million times brighter than the Sun. Key science questions involve the production of pair instability supernovae, where the entire star is disrupted, and one such event enriching galaxies with more heavy elements than all the lower mass stars combined. Recent studies lead by Vink's students and post-doctoral research assistants uncovered that the most massive stars undergo strong wind mass loss (e.g. *Sabhahit et al. 2023; Higgins et al. 2023*). On the observational side, Vink is leading an ESO-VLT Large Programme called X-Shooting ULLYSES (XShootU; *Vink et al. 2023*) with a team of ~100 massive stars experts from around the globe trying to understand the stellar and mass-loss properties of massive star in pristine low-metallicity environments of the Large and Small Magellanic Clouds. These environments provide a key stepping stone to understand the very first stars in the distant Universe, which were likely very massive. Based on observations with the James Webb Space Telescope (JWST) of the discovery of huge amounts of Nitrogen in the distant Universe, Vink suggested that very massive stars (VMS) are the key sources (Vink 2023). Together with Gautham Sabhahit, Vink developed a new mass-loss framework for how the most massive stars evolve until they collapse into a black hole (Vink and Sabhahit 2023) In collaboration with Drs Aline Vidotto and Luca Fossati, the proceedings of IAU Symposium 370 with the Topic: "Winds from Stars and Exo-planets" were published (Vidotto, Fossati and Vink 2023).

The vast majority of stars will end their life as a "white dwarf", a very compact object with a mass comparable to that of the Sun but a size similar to that of the Earth. Stefano Bagnulo, working with AOP Visitor John Landstreet, led an international team of scientists in discovering a unique signature of the process by which white dwarf stars cannibalise their planetary systems. The research was conducted using the ESO's Chile-based VLT and outlines how a scar has been found imprinted on the surface of a magnetic white dwarf called WD0816-310. This object is an Earth-sized remnant of a star in the neighbourhood of our Solar System. The scar is a visible by-product of the process by which white dwarfs ingest the surrounding planets and asteroids that they are born with them. The scar is composed of a concentration of metals that originate from a planetary fragment as large as, or possibly larger than, the asteroid Vesta, which is about 500 kilometres across. The observations also provide clues as to how the star got its metal scar. The strength of the metal detection in the star changes as the star rotates, suggesting that the metals are concentrated on a specific area on the star's surface. The team found that these changes were synchronised with fluctuations of the white dwarf's magnetic field and discovered that the metal scar is located at one of the star's magnetic poles. This shows that the metals were funnelled onto the star by its magnetic field, so creating the scar. This research was the subject of an ESO press release (<https://www.eso.org/public/news/eso2403/>) that has attracted media attention at international level. Bagnulo has capitalised on the impact of his research by the organisation of a 4-week workshop in Garching (Germany) on stellar magnetic fields at the Munich Institute for Astro and Particle Physics (MIAPP) in October 2023 (<https://www.munich-iapp.de/magnetic-fields>).

Stars may pass through a number of stages after leaving the long-lived hydrogen-burning phase and becoming white dwarfs. Many become red giants, and a few become hot subdwarfs. Professor Simon Jeffery and his team study the latter, including stars that are in transition from one to another. By studying their distribution in the Galaxy, the team has shown that the extreme helium stars must come from both old and recent star formation (*Philip Monai et al. 2023*). Some hot subdwarfs evolving to become white dwarfs show large-amplitude pulsations, but their precise histories remain obscure (*Zhang et al. 2023*). Other hot subdwarfs have surface which are excessively rich in unusual elements such as lead. The team is working to discover whether this excess is of nuclear origin or due to the formation of thin clouds in their atmospheres (*Scott et al. 2024, in press*).

Linking to external galaxies, Marc Sarzi's main research focus remained the impact of galactic environment of galaxy evolution, particularly in dense cluster such as the Fornax cluster. For this he is pursuing follow up studies stemming from his past Fornax3D survey and relating to the evolution of cold-gas reservoirs around galaxies in Fornax while connecting this information to their star-formation formation history. The work led by his PDRA (*Loni et al. 2023*) exemplifies this approach, as it showed how the particular morphology of the peculiar galaxy NGC1436 is the result of a recent stripping of its outer gas reservoirs as this galaxy flew by the centre of the Fornax cluster, a process that also triggered a tremendous amount of star formation in the inner part of this galaxy. This is causing NGC1436 to gradually transform from a spiral to a lenticular galaxy, through an environmental process that may indeed contribute to explain the prominent lack of spiral galaxies in cluster environments. Future work combining Fornax3D MUSE data with S-PLUS imaging data (*Smith Castelli et al. 2024, in press*) will lead to even better reconstructions for the star-formation history of Fornax galaxies. The formation history of galaxies in dense environment is also dominated by direct interactions between galaxies. The impact of such encounters can be particularly well traced when focussing on the most fragile structures in galaxies, such as stellar disks. This was done by Sarzi's PhD student Pablo Galan de Anta through two sophisticated computer simulation studies (*Galan de Anta et al. 2023 a,b*)

A landmark survey of the molecular gas distribution in along the plane of Galaxy has been published by AOP. The programme was conceived by the Director in 2009 with the first observations taken in 2011 (following a near-catastrophic fire that engulfed, but fortunately didn't destroy, the telescope). Observations were completed in 2018 and the data then reduced leading to its publication in August 2023 (led by recently graduated Armagh PhD student Kerem Osman Çubuk) with the data being made publicly available through a data repository; see <https://mopracosurvey.wordpress.com>. The survey used the Mopra radio telescope in Australia and measured the millimetre-wavelength line emission from 4 isotopic variants of the CO molecule in its fundamental  $J=1-0$  transition, achieving a spectral and spatial resolution of 0.1 km/s and 0.6 arcmin respectively, and covering 215 square degrees of the sky. The survey charts the distribution of the emission from the carbon monoxide molecule (the second most abundant molecule in space) across the southern Galactic plane. It covers approximately one-third of the great circle drawn around the celestial sphere that passes along the plane of the Milky Way.

This work is also close to the research of AOP's Öpik fellow, Dr David Eden who, by using the data from multiple JCMT Large Programs, is investigating the causes of star formation in the Milky Way. These Large Programs investigate multiple stages of the star-formation process from the formation of new molecular clouds (the sites of star formation; *Rani, Moore, Eden et al., 2023*) to the role dense-gas (the gas most closely aligned to star formation) takes in the earliest stages of star formation (*Xu, Wang, Liu, Eden et al., 2024*). *Rani et al. (2023)* identified a number of molecular clouds in the Galactic Plane, finding that the conditions for star formation are fairly uniform across the Inner Galaxy, regardless of whether they are located in or out of spiral arms. *Xu et al. (2023)* investigated the lack of dense gas outside of the Galactic Plane and found that the scarcity of it favours turbulence as the driving force behind star formation across the Universe, as opposed to supernovae.

### *The role of SALT*

The Southern African Large Telescope (SALT) is the largest telescope in the Southern Hemisphere, providing unparalleled access to the skies for its shareholders, of whom AOP through its membership of the UK SALT Consortium is one. Participation in this major international facility brings visibility throughout the worldwide research community and allows AOP and just a few other UK universities to engage in collaborations with other SALT international partners. In turn, through such partnerships, AOP receives a return in terms of telescope time allocation that is equivalent to roughly 10 times its contribution. In 2023, a long-standing program led by Professor Simon Jeffery at AOP was awarded 130 hours and obtained over 290 unique astronomical observations, targeting some of the most exotic stars in the Universe. Indeed, 123 observations were made during one week in May alone. These contribute to a growing series of discovery papers and to the training of postgraduate research students at AOP. Participation in SALT also allows AOP to explore opportunities through the SALT Collateral Benefits Programme to develop links between local schools in Northern Ireland and in South Africa. AOP carries out the administration function for the UK SALT Consortium, which includes four other academic partners – Keele University, Open University, University of Central Lancashire and University of Southampton.



The 10-metre diameter Southern African Large Telescope (SALT), in the semi-desert region of the Karoo, South Africa.

Using SALT, Simon Jeffery leads a survey of chemically peculiar subdwarf stars in the southern sky. These are stars that are in the final stages of their lives but their histories from birth to the present are very diverse. By exploring the abundances of key elements such as hydrogen, helium, carbon, oxygen, and iron, and of exotic elements such as lead and zirconium, these histories and internal physics can be explored. These AOP-led SALT observations have already led to a first data-release and are now building towards a second data-release, including classifications, coarse analyses and kinematics for over 600 hydrogen-deficient hot subdwarfs. A treasure trove of data for exotic

stars is yielding exciting new discoveries. EC 19529-4430 is the most carbon-poor and metal-poor extreme helium star discovered to date (*Jeffery et al. 2024*); although it must have formed recently from the merging of two white dwarf stars, the original binary star system probably formed some 11 billion years ago. Meanwhile, the hot subdwarf Ton S 415 was discovered to be a double star system containing a white dwarf and a hot subdwarf spinning around each other every 84 minutes, separated by only 5 times the radius of the subdwarf (*Snowdon et al. 2023*). Jorick Vink and a team of international astronomers are using SALT to study the long-term polarised light from the most famous Luminous Blue Variable Eta Carina, which is quite possibly the most massive star in the Milky Way.

## Transient and Periodic Variable Stars

### *Introduction*

Apart from the bright planets and the occasional comet, the night sky might appear to be unchanging, with stars appearing to be the same brightness and place as they always are. However, astronomers from the ancient world detected new stars, “novae” or “supernovae”, which suddenly appeared in the night sky and then gradually faded from view over weeks or months. We now know that many of these “transient” events occur when one star circling a companion star unloads enough matter through the process of “accretion” to its companion to make it explode. Supernovae have now been used to show the universe is expanding at an accelerating rate. Other “variable stars” were first detected in the early 17th century when a star now called “Mira” was observed to change in its brightness on a timescale of nearly a year. We now know that Mira is a star several hundred times as large as the Sun, and contracts and expands in size over time. In fact, practically all stars are variable at some level. However, in many cases it is only recently that astronomers have been able to detect this variability.

By studying the brightness of stars in detail we can test physical models which set out to explain their observed behaviour. However, the diversity of variable stars requires different observing strategies. Explosive events can be extremely rare and short-lived, so that in order just to catch their initial rise to outburst it is necessary to observe the entire sky every night. On the other hand, targeted monitoring lasting many months is necessary to unravel the tiny vibrations of Sun-like stars. Professors’ Simon Jeffery and Gavin Ramsay have been using data from the *Kepler* and *TESS* satellites to better understand both the interior of stars and the accretion process. Further, Armagh astronomers have access to the GOTO, BlackGem and other telescopes which are used for many research areas including transients and variable stars.

### *Recent results*

In the study of periodic phenomena, long continuous monitoring with extremely high accuracy has proved necessary to discover the signals due to exoplanets, star spots and gentle vibrations present in or around many stars. For these, space craft are essential to overcome poor weather and day light, with *Kepler/K2* (NASA 2000-2018), *TESS* (NASA 2018-ongoing) and *Plato* (ESA, from 2026) being pivotal missions. Using *TESS* data, Ramsay was a co-author of a study (*Hawthorn et al. 2024*) using *TESS* data which reported the discovery of 85 candidate exo-planets which have orbital periods (the planets year) longer than 20 days, with a number having periods longer than 100 days. Even today, planets with longer periods are difficult to detect. Ramsay was also a co-author of two studies (*Moulton et al. 2023*, *Smith et al. 2023*), which used data obtained from the New Generation Transient Survey (NGTS located in Chile) to study the rotation period and disc structures of very young stars in the Orion nebula.

### *GOTO and Transients and Variable stars*

AOP became a founding partner of the international project the *Gravitational-wave Optical Transient Observer* (GOTO) through a successful bid for funds from the Northern Ireland Executive in January 2015. Its prime goal is to detect the optical counterpart of gravitational wave events such as the neutron star binary merger GW170817. The prototype GOTO node of telescopes was built in 2017 on the summit of the island of La Palma in the Canaries. Early in 2020 GOTO was awarded £3.2m by STFC to allow a second node to be built on La Palma and two nodes in Australia which were installed in April 2023. GOTO now images the whole observable sky every few nights and is ready and waiting for new gravitational wave events made by Ligo and Virgo. The current Ligo observing run started in May 2023 and is expected to continue until the Spring of 2025. GOTO was awarded £1.1M by STFC in March 2024 to cover the costs of operations and support over the next three years.



The two sites of the Gravitational-wave Optical Transient Observer (GOTO) at La Palma, the Canaries and Siding Spring Observatory, Australia.

As GOTO images the sky every night, many new transients and variable stars are discovered. It is now one of the most productive surveys for discovering supernovae in the world. In the current reporting period, GOTO and BlackGem (which targets nearby galaxies) reported more than two hundred new supernovae discoveries. In August 2023 and February 2024, GOTO had dedicated time on the Isaac Newton Telescope in La Palma to take spectra of newly discovered events by GOTO. For one event, the team obtained a spectrum just an hour or so after discovery and only six hours after the stellar explosion took place. Very early observations are key to revealing the nature of these events. GOTO has also been very productive in identifying the optical counterpart of Gamma-ray bursts which are caused by distant neutron stars or black holes events. As data continues to be obtained over the next few years, we expect many new galactic compact binaries to be discovered – these are expected to be the verification sources for LISA, the space based gravitational wave observatory, due to be launched in the mid-2030s.

## Solar and Stellar Flares

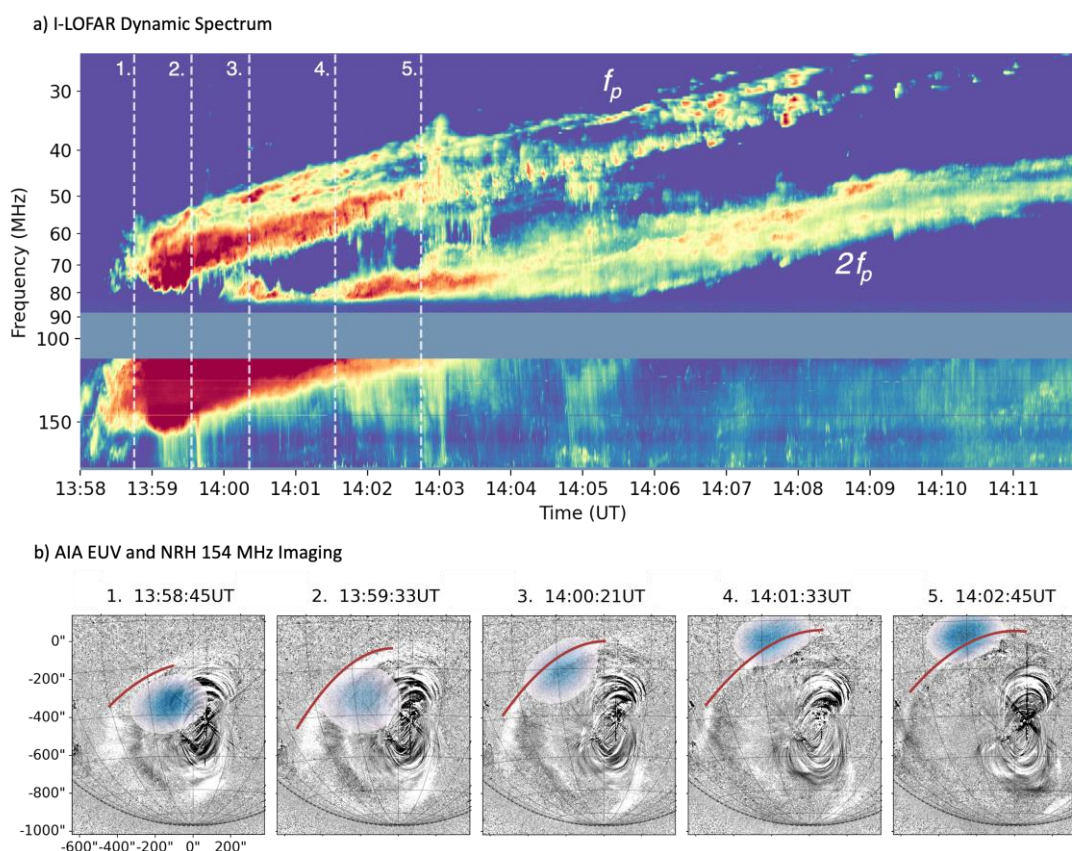
### Introduction

Aurora, or Northern Lights in the northern hemisphere, were seen over much of the UK and Ireland in the first few months of 2024. The link between aurora and flares from the Sun date back to Richard Carrington who observed a white light flare on the Sun from England in 1859, which was followed by aurora only 18 hours later that were recorded in Armagh. We now know that flares are caused by regions of strong magnetic activity on the Sun whose intensity varies over the course of the ~11 year *Solar Cycle*. Although one of the wonders of the natural world, these auroral storms can also cause disruption to human activity: in 1989 the electricity grid in Canada was disrupted by a flare causing widespread blackouts. More recently, in February 2022, a solar storm caused forty newly launched Starlink satellites to prematurely enter the Earth's atmosphere costing up to \$20m. The first flares from stars other than the Sun were seen from low-mass dwarf stars nearly a century ago. With space missions such as *Kepler* and *TESS* which can study many stars continuously for many days or months, we can now study flares from many types of stars which can be used to help us determine how often the Sun can release intense flares.

### Solar Physics

Solar Physics at AOP is led by Leverhulme Emeritus Fellow Gerry Doyle, whose student Nived Vilangot Nhalil obtained his PhD in Solar Physics in 2023 and now works at the Inter-University Centre for Astronomy and Astrophysics, India. Doyle's research uses data obtained from ground-based telescopes and satellites. One of these telescopes is the LOFAR array which observes the sky at low frequency radio waves. AOP joined I-LOFAR, the Irish consortium which now includes nine partners, in 2016 through capital funding from the NI Executive. The Irish station at Birr Castle links up with stations in ten European countries and strengthens Irish North-South collaboration and the more recent formal links made between AOP, Dunsink Observatory and Birr. It's a prime example of 'big-data' science with all stations in Europe being recently upgraded to LOFAR 2.0 which allows faster data transfer and more rapid data reduction.

In collaboration with colleagues in Dublin Institute for Advanced Studies (DIAS), Gavin Ramsay and Gerry Doyle supervise Jeremy Rigney (Lindsay PhD Scholar) who used data from I-LOFAR to study the intense solar storm of 10 May 2022. These data allowed them to investigate a moving source of low frequency radio emission as a Coronal Mass Ejection and associated Extreme Ultra-Violet wavefront, which was channelled along a region of lower density in the solar corona. Observations like these give insight to the physics processes in the Sun which can cause space weather which can be detected on Earth. Rigney, Ramsay and Doyle are also using the full LOFAR array to search for flares in other stars using simultaneous optical data from the TESS satellite.



Observations of an intense Solar radio flare on 10 May 2022 using I-LOFAR in Birr, Ireland. The top panel shows how the radio spectrum changed over the course of time, with the lower panels showing in grey, ultra-violet images made using the Solar Dynamic Observatory. The blue region shows radio emission obtained from the Nancay telescope in France, while the solid curved line shows the position of the shock front obtained from the I-LOFAR data (Rigney *et al.* 2024).

### Stellar Activity

Gavin Ramsay and Gerry Doyle continue to study flares from low-mass stars and Solar type stars. Stars with a wide range of masses and age can produce flares whose energy can be millions of times greater than events from the Sun. Over the last few years, Ramsay and Doyle found a population of very rapidly rotating low mass stars which appear to be flare inactive. Since we expect rapidly rotating stars to be very active this was a great surprise. We have obtained spectroscopic observations of rapidly rotating stars and stars which are rotating much slower. These include data using the SAAO 1.9m telescope in South Africa and the 10.4m Gran Telescopio Canarias (GTC) which are being used to search for evidence of stellar activity using different spectral features. Ramsay and Doyle also obtained high speed observations of a low mass star using HiPERCAM on the GTC to search for short duration low amplitude flares from one of these rapidly rotating apparently inactive stars and are using TESS data to search for evidence of activity cycles in low mass stars.

## Solar System Studies

### Introduction

Our Solar System is an extraordinary natural laboratory to study the formation and evolution of planetary systems around the Sun and other stars. Our work here feeds into fundamental questions about how the Solar System and the Earth formed and the development of life in the Universe. Our study of comets, asteroids and planets impacts on models of solar system formation, the ever-present hazard to civilization if asteroids or comets hit our planet and

on the origin of water and organic compounds necessary for life to exist. The space industry benefits from improved detailed knowledge and understanding of the near-Earth and interplanetary environment.

### *Recent results*

Apostolos Christou reports that significant progress has been made in the ongoing collaboration with Professor Stanley Dermott (University of Florida at Gainesville, FL, USA) and Dr Dan Li (NSF NOIRLab, Tucson, AZ, USA) to understand the origin and early evolution of our solar system. During this reporting period, Christou applied for and secured a £135k grant from the Leverhulme Trust to help develop advanced statistical methods designed to sift through the huge volume of data from the latest sky surveys to help identify the original planetesimal building blocks from which the rocky planets, including the Earth, came to be. The project focus is the asteroid belt between Mars and Jupiter, the broken-up fragments of leftover planetesimals. A continuous flow of asteroid data from ground-based telescopes and space missions will soon be complemented by the most comprehensive survey of the sky to-date by the Vera Rubin telescope currently under construction at the Atacama Desert in Chile. Existing analytical tools are not suited for the very high volume and complexity expected in the Rubin data. The grant will allow to advance the state-of-the-art in asteroid data analysis tools by hiring a professional data scientist and by borrowing methods and techniques from the emerging new field of Artificial Neural Networks, the ultimate aim being to reconstruct the original form and number of asteroids present in the primordial solar system.



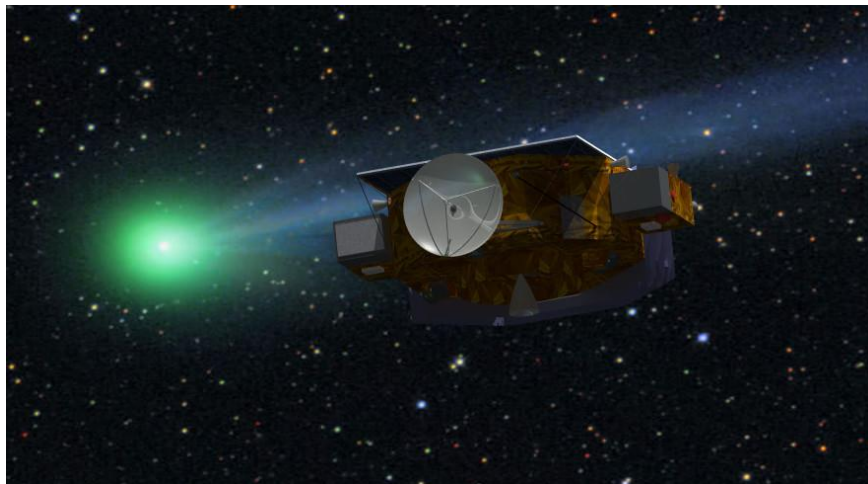
The Rubin telescope, seen here under the glittering light of the Milky Way at the Atacama Desert in Chile. The facility is expected to begin commissioning operations in 2025.

Another international collaboration, this time with Dr Auriane Egal (Paris Observatory, France; U. Western Ontario, Canada) and with Nick Georgakarakos (New York U., United Arab Emirates) succeeded in advancing our understanding of how the streams of material left behind by comets can interact with planetary bodies and measurably affect their environment. Observations in the Earth's atmosphere and in near-Earth space show that the Earth is subject to a continuous flow of particles or meteoroids raining down from space, the debris from comets and asteroids that cross our planet's path around the Sun. Since the time of Ernst Öpik, Armagh has been a leading centre of research to understand the Earth's meteoroid environment and in extending that understanding to other planetary bodies. Past work by Christou and by former Armagh astronomer Dr David Asher, had identified a meteor stream that appears both at the Earth and at the planet Mercury, helping to maintain a tenuous atmosphere around the planet made up of calcium atoms ejected from the surface. The new research that appeared in *Monthly Notices of the Royal Astronomical Society* in January 2024 (Christou, Egal and Georgakarakos, 2024) shows that some denser parts of the stream ("clumps") rich in large, fireball-producing meteoroids identified in the Earth observations also reach Mercury at certain times in the past and in the future. Significantly, the next encounter between the clump and Mercury will occur as the ESA/JAXA BepiColombo (BC) probe and its suite of instruments will be entering orbit around the planet. The fortuitous timing of the encounter presents a rare opportunity to document the effect of the clump in the Hermean environment during BC's short tenure at the solar system's innermost planet.

Stefano Bagnulo and his PhD student Zuri Gray secured telescope time at the ESO VLT to study the consequences of the impact of Double Asteroid Redirection Test (DART), a planetary defence mission to test a method of deflecting an asteroid on course to hit Earth. DART arrived at near-Earth asteroid Didymos on 26 September 2022. The spacecraft crashed into the asteroid's small moon Dimorphos, testing whether the kinetic impactor technique works. Because of the impact, dust clouds were ejected from Dimorphos, which was studied by Bagnulo and Gray from ground-based telescopes using polarimetric techniques (Bagnulo, Gray and Granvik 2023). Their work formulated two distinct scenarios for the formation of the dust on the surface of the impacted asteroid and has attracted international interest including through an official ESO press release.

Finally, AOP work on our Solar system links also to extra-solar planetary systems and in particular to ESA's Plato mission, which is due to be launched towards the end of 2026, has a prime goal of identifying Earth sized planets around Solar type stars in its habitable zone. Gavin Ramsay is one of two ESA Plato Community Scientists and member of the ESA Plato Science Working Team. At the start of the mission, Plato will point at region in the southern hemisphere covering 2,250 square degrees for at least two years.

### *The COMET INTERCEPTOR Space Mission*



*Artist impression of COMET INTERCEPTOR Space Mission*

ESA recently approved a space mission to encounter a comet coming from the edge of our Solar System; the launch is expected in 2028. A novel idea sets this mission apart. So far, spacecraft have approached comets that are already well known and have gone around the Sun already several times. Therefore, it is very likely that the comet material has been “processed” by solar radiation and the space environment, and it is no longer in pristine condition. By contrast, here we are interested in comets on their first trip around the Sun, made of unprocessed material preserved in the cold outer parts of the solar system. To achieve the goal of visiting such a new comet, the spacecraft will be launched before the comet is found and will wait in deep space for instructions. Once a suitable target comet is found, instructions will be sent from the ground to guide the spacecraft to the comet (hence the name **Comet Interceptor**). Studying the material brought for the first time to the heat and light of the Sun will give us the opportunity to look at the solar system as it was when it formed. AOP is contributing to the development of the instrument that will send to Earth comet images (including polarimetric images) obtained with a fish-eye lens. Stefano Bagnulo is an expert in polarimetric observations and is one of the co-Investigators of the project, and his PhD student Zuri Gray is also involved in the mission team. Most recently, Bagnulo has officially become a Co-Investigator of the EnVisS instrument on-board Comet Interceptor, and member of the Comet Interceptor “Near Environment” working group. He has participated to the second CI Working Group meeting at the European Space Research and Technology Centre in March 2023.

### **Researcher Development Concordat**

In February 2023 AOP became a signatory of the Concordat to Support the Career Development of Researchers, which is an aspirational Concordat that aims at increasing the appeal and sustainability of researcher careers in the UK. The Researcher Development Concordat focuses primarily on the rights and responsibilities of researchers who are employed solely or largely to conduct research (e.g. PDRAs and Research Fellows) and is often part of the eligibility criteria for securing research grants. The Concordat has three defining principles covering *Environment and Culture* (for a supportive and inclusive research culture), *Employment* (to ensure that researchers are recruited, employed and managed under conditions that recognise and value their contributions), and *Professional and Career Development*. The Concordat outlines key responsibilities for institutions in each of these areas and expect them to publish an action plan and to report progress in annual reports to their governing bodies.

Considering AOP's strong governance structure, in terms both of its comprehensive set of policies as well as its appraisal, recruitment and induction procedures – all of which reflect the Northern Ireland Civil Service (NICS) ethical and equal-opportunities principles. The following actions have been identified:

#### *On Environment and Culture*

- Ensure awareness of the Concordat for managers and researchers, including at the outset during the recruitment process and following induction.

- Continue to support staff and students' mental health and well-being through the Inspire Wellbeing employee assistance framework from NICS.
- Provide Equality, Diversity and Inclusion training to all AOP staff including managers of researchers.
- Avail of AOP agreement with QUB for the supervision of PhD student to train AOP managers on research integrity through the QUB Epigeum online courses.
- Supplement the periodical formal Research Excellence Framework (REF) and QUB reviews of AOP research environment with specific queries in annual staff surveys.

#### *On Employment*

- Continue to offer our dedicated Öpik fellowship as an opportunity for progression towards independent research.
- Promote researcher contribution to AOP research through presentations for AOP governing bodies and dedicated sections in AOP annual reports.

#### *On Professional and Career Development*

- Promote the commitment to ten annual career development days to researchers and their managers, including using existing reserved AOP training budget and by ensuring managers allow time for career development or researchers.
- Monitor the appetite and uptake on career development opportunities and training through appraisals and the subsequent annual meeting of researchers with the Head of Research (as already implemented through a Juno project action).
- Increase awareness of careers outside academia through dedicated seminars sessions, including from AOP or QUB alumni.

## **Research Integrity Concordat**

The UK Committee on Research Integrity (UKCORI) was established in 2022, following the signing of the Concordat to Support Research Integrity, in order provide a national framework for good research conduct and its governance. The signatories of the Concordat include UK Research and Innovation (UKRI) and Department for the Economy for NI (DfE NI). UKCORI wish to raise awareness at Board level of the principles and importance of Research Integrity. Research integrity is also referenced in the Concordat for Researcher Development. AOP participated in a workshop held in the Ulster Museum that was organised by UKCORI this year designed to raise awareness of the importance of research integrity in Northern Ireland.

Research has integrity when it is carried out in a way that is trustworthy, ethical and responsible.

Research integrity is, therefore, about doing research that not only leads to findings and outcomes that people can trust, and have confidence in, but is carried out in an ethical manner with care and respect for those involved in the process.

When research is carried out with a high degree of integrity, other researchers, those who wish to apply the research, and members of the public have confidence in the findings. While the nature of our understanding of the conclusions drawn from research may change in time, if the research was conducted with high integrity people will still feel able to trust the findings and outcomes as they were understood at the time.

## **Education and Community Outreach**

### **Planetarium**

AOP is a special place that brings together fundamental research and public curiosity about the nature of the cosmos, all within a heritage environment that is rich in scientific history. Four pillars underlie and support the public programme of AOP - education, inspiration, entertainment and outreach. The Planetarium was established in 1968 and is world-renowned as an innovative centre of excellence in promoting the public understanding of science.

At the Planetarium, the primary activity is the education and the dissemination of scientific and astronomical knowledge. The Planetarium also promotes an understanding of astronomy and science to a large audience base of all ages, from nursery to seniors via a school's educational programme and science offering to the wider public through both onsite and outreach means.

In 2022/23 financial year we achieved a record breaking 72,000 visitors to AOP and it was encouraging to maintain this benchmark in 2023/24 having 71,905 visitors through our doors. This year we did not have a stand-out exhibition during the summer, but instead, we held themed weeks which maintained our visitor numbers at that high level. Our

stargazing evening and music shows have also been popular with sell-out events. All credit to our education team for delivering and maintaining a high level of customer service and educational learning for our visitors this year.

One of the largest visitor increases came towards the end of this year in the form of our off-site or outreach visitors. Thanks to funding from Science Foundation Ireland (SFI) and the UK Space Agency we had the opportunity to develop a dedicated outreach programme delivered by Dr Rok Nežič. The funding has allowed us to reach many rural schools that typically cannot engage with us in Armagh due to distance. The programme is fully funded for schools.

The education team also facilitated two Stranmillis College placement students this year, which supports the teaching college and also benefits us as we get students coming with different ideas and angles to help in our education programme. While our school pupil numbers held strong it must be noted that we had many cancellations due to both teachers strikes and Translink transport strikes during this year which did affect our school visitors.

A focus for 2024/25 will be our afternoon visits which we want to grow with afterschool and community groups. This year we made steps towards this goal of increasing afternoon visits through an IAU funded programme where we set up an after-school STEM club. A youth forum of children with additional needs was developed to advise us on programme changes required to make the centre more assessable, thanks to funding from the Association of Science and Discovery Centres (ASDC). The team delivered a pre-school club called "Little Astronomers" which was a monthly sold-out event. We participated in global events such as One Hundred Hours of Astronomy where we held afternoon solar viewing sessions. This has shown us the potential and possibilities we have for increasing that afternoon slot for many groups and families.

Accessibility is always a focus for us at AOP on how we can be as inclusive as possible to ensure that every person gets to experience the stars making us a "space for all". We hold monthly dome shows in British Sign Language (BSL) and Irish Sign Language (ISL). Our screening is of our popular dome show "CapCom Go" and this year we also extended the dome show interpretation to a children's tour of the planets called "Perfect Little Planet". This will be of benefit to schools and to the public as well. We also provided a BSL and ISL interpretation of our live Christmas experience "Mission Santa" and our dome show this year "The Alien who Stole Christmas" was interpreted into BSL and ISL. We added Makaton signing to our "Astronaut George" dome show which is due to be launched in May 2024.

Monthly relaxed dome show sessions are now standard in our programme as well as relaxed event sessions for workshops. We have also renewed our JAM (Just A Minute) Card registration with all front-line staff JAM Card trained and our staff received Level one Makaton training. Our sensory bag provision which was worked on by the Bold Futures forum and made possible through an ASDC Bold Futures fund have been really well received and used by many schools and families.

To enhance the outdoor grounds, we installed and launched a new kids Eco trail with a workbook, sculptures, clues and an augmented reality (AR) app around the grounds. There is also an adult app focusing on a tour of the grounds and Observatory. A lot of work across the organisation went into this new experience over the last year and these outdoor trails have already increased dwell time and been popular with visitors and locals, especially during the sunny days.

This year we held four scientific conferences at the Planetarium during September 2023. This month is the only time when demand on our Copernicus Hall is at a low level which allowed us the opportunity to hold back-to-back meetings. The conferences held were the British Association of Planetaria (BAP) annual conference, 31 August to 2 September, 5th International Workshop on AM CVn Binaries (AMCVn5), 5 to 8 September, 11th International Conference on Hot Subdwarf Stars and Related Objects (sdOB11), 11 to 15 September and, 42nd European Symposium on Occultation Projects (ESOP42), 16 to 17 September.

Successful funding opportunities this year include:

- ASDC: Explore your Universe – £9,500;
- ASDC: Bold Futures – £22,000;
- ASDC: Missions and Mindsets – £2,000;
- ASDC: Our World from Space – £9,500;
- IAU OAD: After Schools – €5,000;
- SFI – Discover Programme – €60,000 "Cosmic Explorers: Igniting STEM and Astronomy in Schools";
- UK Space Agency – Space for All – £66,075.

Other events to note this year were:

- British Orienteering Championships, which took place in Armagh (including AOP's grounds) in May 2023, we held an event for participants;
- Engineers Open House weekend of rocket making;
- Outdoor Creation NI Conference;

- Our World from Space Saturday Club (monthly);
- Events with the ABC Council for the Food and Cider Festival;
- Orienteering in the Astropark during February Half-Term;
- First Light: 230 Years of Observations from Armagh;
- European Open Heritage Day: Experience the Calver Telescope;
- Our Planet and the Universe: IAU 100 Hours of Astronomy;
- Data Visualisation Laboratory (DVL) sessions held during busy school holidays where the researchers and students delivered a presentation on their work in the DVL;
- Our Director who developed and delivered “Director’s Cut” planetarium shows to audiences;
- We opened the Calver dome for special occasions and hope to build upon this with training for the education team this year;
- We held a scouts take-over day where the association booked the Planetarium for the whole day and provided shows and workshops for their members;
- Our staff participated in and delivered presentations at the ASDC annual meeting showcasing the great work being done at AOP;
- Our education team have opened a world of opportunity with dome show development, which started late in the year but is a programme that we would like to develop.

## History and Heritage

### History and Heritage Policy

AOP boasts a collection of over thirty-three thousand historic documents, rare and antiquarian books, scientific instruments and photographs. This collection is unique on the Island of Ireland and one of the best-preserved observatory collections in the United Kingdom. The heritage policies implemented ensure that the collection is cared for in accordance with best practice and has allowed ongoing historical research. AOP is now represented on the Board of Directors of the Northern Ireland Museums Council by the Museum Collections Officer who began their three-year term in September 2023.

During 2023-24 the Observatory has continued to be open to the public for the ‘Legendary Telescope Tour’ package, which has been well received. In 2023 the King George III collection was put on display for the first time in its entirety for the Armagh Georgian Festival in November. The eMuseum has 9,003 objects available for public viewing on the armagh.space website. The Planetarium display cases have hosted one loaned in exhibition ‘The life of William John Roberts’, and three additional exhibitions based on the AOP Historical Collection, ‘Technology Past and Present’, ‘The Planetarium’ and ‘Navigation’. One temporary exhibition off-site was hosted in Dublin at the Bank of Ireland building and Dunsink Observatory for the Robinson Lecture and launch of the Astronomical Observatories of Ireland network. AOP accepted one donation in 2023-24, which was a functional late Victorian ‘Magic Lantern’ projector system from the Ulster Aviation Society.

In accordance with AOP’s policy of making our collection available for the public and researchers to use we have continued to facilitate public information requests. The 2023-24 financial year brought twenty requests facilitated by the Museum Collections Officer. AOP hosted the British Association of Planetaria Annual Conference in September 2023 and a Study Visit by the Scientific Instrument Society in March 2024. Both events were showcases of the outstanding Historical Collection and provided opportunities for sessions delivered by the staff of AOP.

2023-24 saw the second year of the National Lottery Heritage Fund project. This project, ‘Wisdom Begins with Wonder’ is funded to run from May 2022 and it has now been extended to run until August 2024 and has seen the successful implementation of a volunteer program. Since launching, the volunteer program has facilitated over eight hundred hours of voluntary work in AOP, with more volunteers awaiting projects. The project has also funded the position of Museum Collections Officer from June 2022 - August 2024, on a part time basis. At present the five active volunteers are working on varied projects including academic research, archival work, and preventative conservation. In total volunteers have accessioned 1,809 new objects to the AOP Historical Collection in 2023-24.

AOP has also continued to publish historical research, and staff have been involved in a project to publish a book with the International Planetarium Society and have published three papers. The team also provided access to the operated collection of historic scientific instruments. Over the winter observation period, five successful observation sessions were held with the Grubb 10-Inch telescope, and two students were trained in its use. The Grubb 15 Inch and Troughton Equatorial have also undergone successful preventative conservation, and the Earnshaw Number 2 regulator has been returned to operational condition.

### Library and Archives

AOP’s suite of technical equipment is complemented by one of the finest astronomical study libraries on the Island of Ireland. The library provides an essential reference resource for AOP research, and especially for its student and young researcher cohort. It contains approximately 3,400 textbooks, monographs, special reports, and conference proceedings covering nearly all disciplines in astronomy. Some 17,000 volumes from nearly two hundred scientific

journal titles include nearly complete runs of all the major astronomy journals, as well as journals of significant historical interest.

During 2023-24 the collection has been supplemented by forty-eight new books on topics relevant to AOP research. Work continues binding the backlog of unbound journals, including all held copies of the Scientific Instrument Society Bulletin. A scoping audit of the remaining backlog has been conducted to inform future funding requirements. 51 loans have been processed and returned, and 60 volumes are currently on loan to the staff and students. To encourage greater engagement with the loans process, every researcher and student has been provided with a physical copy of the Loans Form QR code.

Whilst still under enormous pressure for space, the AOP library is now an attractive space and a more effective research tool, with potential for further development and revenue generation, and increasingly demonstrating its potential for historical discovery as well as astronomical research. It has been used weekly for the Student Discussion, and the Research Seminar. It has been used monthly by the Armagh and District History group for their meetings and will be opened to the public for the first time in April 2024.

### Meteorological Record

As part of AOP's primary research role, staff and students take daily readings of a wide range of meteorological parameters at Armagh and maintain the Observatory's unique 229-year meteorological record and databank. This is believed to be the longest daily climate series in the UK and Ireland from a single site (though the log book for the period June 1825 to December 1832 appears to have been lost), as well as being one of the longest in the world. The climate station has been continuously maintained since July 1795 with readings currently taken every day at 09:00 (GMT). The World Meteorological Organisation (WMO) has recognised Armagh with Centennial Station status for its longevity and importance in contributing to the climate record.

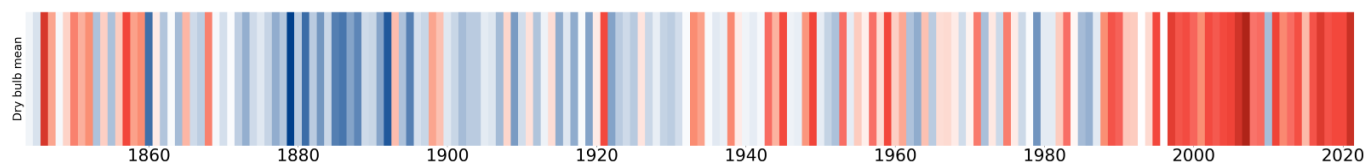
The automated weather station (AWS) was installed by the Met Office in 2019, sampling the weather every minute. This now provides the primary source of weather data in the Met Office records (e.g., temperature, pressure, rain fall, windspeed) since it is automatically uploaded to the Met Office. The instruments are inside a second Stevenson Screen within an expanded meteorological enclosure to ensure that the AWS enclosure is identical to those used by the Met Office in their UK-wide network. In October 2023 a grass minimum thermometer was added to the AWS to complement the similar sensor in the manual station. Manual collection still continues and provides the only source for some of the data collected (e.g. sunshine) at Armagh.

Calibration of these data has enabled researchers and government agencies to use the Armagh series for reports and research into global warming. The data contributes to the UK Meteorological Office's main climate database and are released to the general public on a monthly basis through press releases and on our climate website (<https://weather.armagh.space>) whilst also contributing to the UK Meteorological Office's main climate database.

Climate change is a subject of strategic importance for Northern Ireland in this era of climate variability. Armagh's unique climate record provides an exceptionally long historical baseline, enabling better informed judgements to be made as to how Northern Ireland's climate has responded and is responding to climate change world-wide. AOP has a movable exhibition on the climate change in the Copernicus Hall, centred around an interactive Puffersphere presentation, together with supporting exhibits around the room which expand on local impacts.

We developed a series of python scripts to store, analyse and provide access to the weather data base via the weather webpage listed above. This includes both the manual data as well as the automated weather station data. This takes the monthly observers log, provides a means of entering the information via an online log, and in addition automatically downloads the data received from the automated station, to ingest these data sets into a new database. Analysis scripts then allow this database to be interrogated, e.g. to find climate extrema over any date range of interest. This includes enquiring about weather on any single day (as might be used in a visitor display in the Planetarium), as well as examining the data set over any period of interest and searching for climate records (extrema) over a period of interest. The automated weather station data is now also available to inspect online, in addition to the manual data. Plotting tools allow the user to see the weather over any time period, as well as to find when extrema in the various measured parameters occurred.

The two new PhD students (Kyriakos Trakakis and Arjun Chawla) were trained in 2023 on weather observations, and then accredited as Level 1 Met Observers by the Director. This forms part of their PhD training in the techniques of scientific data measurement and analysis.



Armagh's version of the famous climate stripes that were used at COP26 in Glasgow to graphically demonstrate global warming has been extended to include new data. The colour of the stripes reflects the difference between the mean temperature that year compared to the long-term average. They are a superb example of science communication, for it is not necessary to understand the detail of how it made, the warming trend in the current millennium is clear. AOP's climate stripes extend back to 1844 when Armagh started measuring maximum and minimum temperatures.

Until 2023 for the month of September the hottest day in Armagh since 1838 (when daily temperature max readings began) had stood at 27.6°C, as measured on 1 September 1906. The 10th ranked hottest September day had been 24.9°C, as measured on 4 September 1898. However, the sequence of 5 successive days from 4th to 8th of September 2023 now feature in the top ten of all September highs for Armagh, with the new hottest September temperature being 28.5°C, as measured on 8 September 2023.

In October 2023, the record for rainfall in a single month in Armagh was broken since measurements began in 1838. A total of 195.4mm of rain was recorded in our manual weather station, breaking the previous record month, which was October 1870, when 193.8mm of rain fell.

## Support

AOP is committed to ensuring fit for purpose governance and support services to support the delivery of organisational objectives.

### Information and Communications Technology (ICT)

The comprehensive research computer facilities are used primarily for numerical analysis, computer modelling and data reduction. Update and renewal of computers and peripherals is mainly provided through a planned capital development plan funded by DfC and occasionally by external research grants. Research staff require access to high-end Apple Mac and Linux workstations. In addition to this, Corporate and Education is serviced within a Microsoft environment.

An ICT Strategy was approved in October 2022. Continuous focus and short, medium and long-term activities are considered by the Audit and Risk Assurance Committee (ARAC) each quarter.

AOP continues to modernise and improve its centralised ICT hub. All devices are now managed using Intune and are secured using multi-factor authentication and device registration. Auto patching of all Linux, Windows and Mac devices has reduced our exposure to cyber-attack. The focus now moves to software run on the devices as the next level of risk develops.

The biggest risk to AOP still remains user error through clicking on malicious links in emails. AOP mitigates this through regular reinforcement of messaging and a focus on continuing to educate users in best practice and system etiquette.

### Finance

AOP has a well-established finance function. Financial policies and procedures are continually being enhanced to ensure that AOP meets the governance standards required. This includes the application of public sector procurement controls, meeting prompt payment targets and providing regular and ad hoc financial information within AOP and to DfC.

AOP continues to experience significant cost pressures within a core budget that has remained relatively static for 7 years. In 2023-24 it was able to mitigate some of the cost of the 2023 public sector pay award through an additional resource allocation and income from admissions and trading sales which exceeded expectations.

### Human Resources

A Human Resources Strategy 2022-26 has been developed and approved and is supported by an annual Human Resources Action Plan. The 2023-24 plan has been implemented to include:

- Maintaining a Fit for Purpose Organisation Structure – review of the skills-gap paper and workforce planning papers in light of available budget and future needs; completion of necessary recruitment and training in a timely matter and identifying short term opportunities to plug skills gaps with short term projects or engagements;
- Continual review of Operating Models – supporting the Education Operations Manager with employee working arrangements and reviewing staffing needs in the context of budgets and affordability;
- Employing and Investing in Motivated and Engaged Staff – supporting annual appraisal process; completing/revising a rolling training plan; reviewing implementation of training plans in the context of

available budget; preparing a case for award of a special bonus scheme; preparing for engagement events and supporting the health and wellbeing of PhD students;

- Fair and Equitable Employment Policies and Procedures – completion of the annual Fair Employment return; retention of Bronze Diversity Mark Award; review of policies and induction and refresher training as required.

### **Diversity and Inclusion**

AOP has an obligation under Section 75 of the Northern Ireland Act to ensure that equality of opportunity and good relations are central to policy making, policy implementation and review as well as service delivery. AOP monitors the composition of its workforce in terms of community background and sex and uses an equal opportunities monitoring form questionnaire. AOP submits an annual Fair Employment Monitoring return to the Equality Commission detailing staff composition and that of job applicants to AOP posts.

In the AOP Strategic Plan 2021-26 we state that having Fair and Equitable Employment Policies and Procedures is one of our key elements in delivering high standards. AOP has a number of policies in place including an Equal Opportunities Policy.

AOP retained the Bronze Diversity Mark Accreditation in July 2023. The three Equality, Diversity and Inclusion targets set for the next year are:

- To develop an Equality, Diversity and Inclusion Strategy;
- To increase the number of female research staff at AOP from 2 to 4; and
- To increase female representation on the AOP Management Committee from 3 to 5.

AOP retained Juno Practitioner status in August 2023. This is an award scheme that recognises and rewards university physics departments, schools of physics, and related institutes and organisations that can demonstrate they have taken action to address gender equality at all levels and to foster a more inclusive working environment. An application to become a Juno Champion in April 2023 was unsuccessful. A new Juno award is currently being developed and once launched AOP will assess its suitability against that scheme.

### **Governance**

Governance and accountability continue to be strengthened and improved and risks reduced as demonstrated by external and internal audit reviews. Actions arising from effectiveness reviews undertaken by both ARAC and the Management Committee have also resulted in enhanced arrangements.

One outstanding Internal Audit recommendation, relating to Record Management, is currently being progressed. A Retention and Disposal schedule is actively under consideration by the Public Record Office of Northern Ireland (PRONI). The organisation has moved towards paperless record management systems which will be easier to manage and control in accordance with the approved Retention and Disposal Policy.

### **Future Redevelopment Project**

AOP manages an extensive property estate which includes nine separate buildings, including the Grade A listed Observatory and a circa 20-acre historic estate. There are also several leases associated with land and property.

During the year AOP submitted a draft Outline Business Case (OBC) for redevelopment to the Department and has provided responses to queries raised in respect of same. The OBC is still under consideration with active engagement on final amendments ongoing. AOP views this project as imperative to future proof its role into the next generation. The case for change is predicated by an estate that is outdated and misaligned to expectations of modern-day visitors and future opportunities. On 29 March 2024 AOP was awarded circa £1.3m grant towards the development phase of the project, representing 25% of the funding required to bring the plans to RIBA stage 3. Another funding application to PeacePlus is still under consideration and a bid to DfC for capital match funding for this phase is also being considered.

### **NetZero**

AOP's international research standing, and unique record of uninterrupted meteorological observations has allowed it to effectively communicate on the issue of climate change (CC) to the general public, thanks also to the design and installation of a temporary CC exhibition in the Planetarium and of a CC Puffersphere display given AOP's own commitment to reducing its carbon footprint by 50% by 2030.

Moving in this direction, in the last financial year Department for the Economy (DfE) capital funding was obtained to change the external lighting on AOP grounds to more efficient LED lights and following the standards of the International Dark Sky Association. In fact, one of AOP's key objectives is to achieve Urban Night Sky Place (UNSP)

accreditation through the International Dark-Sky Association and with it serve as beacon for promoting and informing local councils in Northern Ireland on how to reduce their own light pollution and corresponding energy waste.

Along the same line, two new green energy power generation stations based on wind and solar power, the Windtree and the Smartflower (see figure below), have been installed on AOP's grounds using previously allocated DfE funding. While this installation will not generate sufficient power to cover all the needs of the Planetarium, it will serve to illustrate the role that renewable energy technologies can play in harnessing energy from wind and the Sun, also adding to AOP's education offering.



*AOP's Smartflower and Windtree, the only ones of their kind in Britain and Ireland*

## Achievements and Performance

The targets set for AOP in the 2023-24 Business Plan are shown in the following table. Actual performance achieved is shown along with the corresponding achievement in the previous financial year, where applicable.

Targets were achieved or exceeded in many areas; however, three targets were not met. Whilst the total visitors target was exceeded the target in respect of school visitors was not achieved due to a number of school cancellations as a result of education and bus strikes and also snow. Failure to meet the remaining two targets is beyond AOP's control in that they are reliant upon external factors.

KPI	Description	Target	As at 31 March 2024	As at 31 March 2023 (where applicable)	Comments
1	Attract 67,000 visitors (to include 55,000 public visitors and 12,000 school visitors)	67,000	Public 60,097	62,793	Total 71,905 visitors
			School 11,808	9,381	There were a number of school cancellations due to teacher and bus strikes and also snow.
2	Achieve 150 number bed nights from a collaboration with local accommodation providers	150	158	182	
3	Achieve bronze level certification to be a Makaton friendly business			New KPI	Award changed by Makaton Society and there have been delays in getting the new award live. KPI unachievable and beyond AOP's control.
4	Achieve £568,000 income from admissions and sales	£568,000	£592,494	£570,851	
5	Achieve an 80% satisfaction rating of 4 or above out of 5	80%+ evaluation ratings $\geq$ 4	90.83%	88.67%	
6	Provide in-reach or outreach visits to at least 10 special schools (25%)	10	23	New KPI	
7	Deliver 4 dedicated educational days: 2 for GCSE and 2 for Junior Cycle	4	2	New KPI	
			2		
8	Deliver 4 events focused on the work of astronomers and PhD students	4	22	7	
9	Deliver 2 events on Climate Change and AOP green agenda	2	2	New KPI	
10	Deliver one event to raise awareness of the Armagh-Birr-Dunsink partnership	1	1	1	
11	Achieve recognition as an Urban Dark Sky Place			Unachievable	The capital project encountered difficulties at procurement stage.
12	Publish 50 articles in referenced scientific journals	50	63	85	
13	Scientific Outreach:	12	35	39	

	12 scientific talks at international conferences 12 public talks by scientists	12	40	43	
14	Admit 2 new PhD students in October 2023	2	2	3	
15	Attract 8 external bookings for events or seminars	8	10	14	
16	Facilitate 6 onsite scientific visits	6	28	26	
17	Delivery of 3 astronomy conferences hosted by AOP	3	3	New KPI	
18	Develop one non-astronomy partnership in the use of DVL facilities	1	1	1	
19	Develop one new Puffersphere application around AOP research	1	1	2	
20	Submit one major funding application in pursuance of AOP future development	1	2	0	
21	Achieve £323,000 funding from scientific sources to support AOP research	£323,000	£380,732	£359,339	

Progress Key: Complete, Not Achieved

## Financial Review

### Operating Results

In the financial year to 31 March 2024, the value of charity funds increased by £2,111m, summarised below.

	<b>2024</b>	<b>2023</b>
	£	£
Total incoming resources	3,354,210	3,730,874
Total outgoing resources	(3,978,546)	(4,285,869)
<b>Net expenditure</b>	<b>(624,336)</b>	<b>(554,995)</b>
Gains on the revaluation of fixed assets	500,740	255,242
Actuarial gains on defined benefit pension scheme	(121,000)	2,411,000
<b>Net movement in funds for the year</b>	<b>(244,596)</b>	<b>2,111,247</b>
<b>Movement in Unusable Funds</b>		
Capital financing		
Capital grants received	435,000	549,000
Government grant fund	(826,567)	(858,746)
Revaluation reserve	271,372	1,904
Pension reserve	(158,000)	2,035,000
<b>Movement in Usable Funds</b>		
Restricted	(100,091)	(26,080)
Unrestricted	133,690	410,169
	<b>(244,596)</b>	<b>2,111,247</b>

The total income for the year was £3.354m, a decrease of £0.377m from 2022-23, mainly due to a decrease in DfC resource and capital grant income of £0.269m, and the end of the Tourism NI supported capital project, offset by an increase in operating income of £0.036m.

Expenditure was £3.979m, a decrease of £0.307m from the previous year. Staff costs continue to be the largest component of operational expenditure, comprising 63% of all direct costs.

Unrestricted operating costs are funded primarily by DfC grant-in-aid. The balance of such unrestricted operating costs is funded by contributions from external grants, operating income, trading activities and miscellaneous income. We continue to seek other funding streams to maintain this important source of funds. In 2023-24 the Department provided 71% of the total income through recurrent and capital grant allocations (2022-23: 71%).

#### Net Assets

Net assets at 31 March 2024 were £12.476m (31 March 2023: £12.720m).

#### Reserves

The AOP reserves policy is included in note 1 of the accounts. Total accumulated funds are as follows:

<b>Funds at 31 March</b>	<b>2024</b>	<b>2023</b>
	£	£
Restricted funds	47,937	148,028
Unrestricted funds	4,752,692	5,010,569
Revaluation Reserve	7,675,246	7,403,874
Pension Reserve	-	158,000
<b>Total Charity Funds</b>	<b>12,475,875</b>	<b>12,720,471</b>

## Going Concern

The Trustees are satisfied that the organisation is a going concern on the basis that it has a reasonable expectation that it will continue in operation for the foreseeable future. The financial statements are therefore prepared on a going concern basis.

## Pension Reserve

AOP is a member of Northern Ireland Local Government Officers' Superannuation Committee (NILGOSC) which manages Local Government Pension Scheme (LGPS) Northern Ireland, which in turn provides a defined benefits pension to employees. At 31 March 2024 the surplus was calculated by independent actuaries at £1,175,000 (2023: surplus £158,000). The assets, defined benefit obligation and current service cost shown in note 19 to the accounts have been calculated based on the data and results of the 2022 triennial actuarial valuation. AOP has applied the principles of IFRIC14 in relation to pension surplus restriction. IFRIC14 requires allowances to be made for a minimum funding requirement, which limits the amount of economic benefit available to the excess of the value of prospective current service costs above the funding requirement.

## Key Risks and Uncertainties

At year end, the key risks were identified as:

- Reputation – loss of confidence in AOP's ability to deliver acceptable level of research of international value;
- Engagement:
  - Visitors – failure to provide experiences that attract new and returning visitors and/or failure to engage local pride in AOP as a cherished asset;
  - Partners and collaborators – failure to attract support and commitment from key stakeholders to be able to deliver future vision;
- Resources:
  - Staff - failure to maintain an appropriately skilled, highly motivated and engaged workforce of sufficient capacity to satisfactorily deliver AOP objectives;
  - Budget – insufficient or poor management of budget could result in objectives not being met and/or value for money not being achieved;
- Asset Management:
  - Buildings and Heritage – failure to plan for the long term development needs of the estate and assets resulting in increasing reliance on remedial intervention and failure to protect heritage assets from irreparable decline;
  - Other physical assets including ICT – failure to plan for the upkeep and renewal of plant and equipment resulting in reduced service delivery; and
- Governance and Planning:
  - Failure to embed best practice approaches to corporate governance and risk management resulting in loss of confidence and reputational damage and/or legal challenge;
  - Inadequate information/data security measures resulting in information breaches and/or cyber security breaches.

As part of the Risk Management Strategy, management regularly review the inherent level of risk for each of the above and how the risk is currently managed. An Action Plan is documented to reduce the level of risk, mindful of the risk appetite of the organisation. This Risk Register is reviewed on a quarterly basis by the Audit and Risk Assurance Committee and approved by the Management Committee. Many of the above risks derive from the uncertainty around funding. Until AOP has both a budget appropriate to its needs and long-term security of funding, this situation is likely to continue. In managing these funding risks, the organisation has developed and maintained close communication links with the Department and submitted in-year monitoring bids for additional funding while carefully monitoring spend and budgets. For many of the above risks all reasonable steps within AOP's control are being taken to manage the risk.

The above risks also take account of recommendations from internal and external audit exercises and reports. Significant progress has been made in addressing the weaknesses identified in previous years and considerable effort has been put into the management of these risks going forward.

## Plans for Future Periods

In 2021, AOP published a Strategy for 2021-26 with the four key themes of Enduring Relevance, National and International Standing, Offering More and Pursuing our Priorities.

Leading on from this AOP has prepared a Business Plan for 2024-25 for consideration by the Department. The business plan has been developed in the context of an unclear and uncertain financial environment, however AOP remains focused and optimistic towards continued achievements within its key priority areas.

AOP, in conjunction with the Dublin Institute of Advanced Studies, Dunsink Observatory, and the Birr Science and Heritage Foundation, have embarked on a formal strategic process to develop an inter-institutional partnership for mutual benefit, the "Astronomical Observatories of Ireland". This takes place in acknowledgement of the potential for strengthening the partner institutions' collaborative working capacity and for our wider national and international impact. This also includes taking into account emerging opportunities for strengthening the long-standing North-South connections between Armagh, Dunsink and Birr in a way which maintains the integrity of each partner's core mission, and also promotes the intrinsic value of scientific knowledge and heritage represented by the body of work carried out over the three sites since their establishment and ongoing collaborative activities. This will continue to be a key area of work in 2024-25 and will include an application to be included in the Republic of Ireland Tentative List for UNESCO World Heritage Status as a transnational bid with the UK.

Following on from the submission of an Outline Business Case for future development AOP will continue to work with partners and stakeholders to identify funding opportunities and other resources to move the project forward to the next phase of planning.

## Structure, Governance and Management

Armagh Observatory and Planetarium is a single statutory corporation and arms-length body (ALB). ‘The Governors of The Armagh Observatory and Planetarium’ are as described in *The Armagh Observatory and Planetarium (Northern Ireland) Order 1995*.

This 1995 Order superseded the original 1791 Act of the Irish Parliament entitled ‘*An Act for Settling and Preserving a Public Observatory and Museum in the City of Armagh For Ever*’, and an Amendment of 1938 (‘The University and Collegiate and Scientific Institutions Act [Northern Ireland], 1938’).

AOP is a registered charity under the title “The Armagh Observatory and Planetarium”.

### Board of Governors

AOP is governed by a Board of Governors. Membership of the Board of Governors consists of:

- the Church of Ireland Archbishop of Armagh;
- the Dean of the Church of Ireland Cathedral of Armagh;
- the other members of the Chapter of the Church of Ireland Cathedral of Armagh;
- one Department nominee;
- one Queen’s University Belfast (QUB) nominee; and
- up to three additional members nominated by the Board of Governors.

The Order places a statutory duty on “the Governors of Armagh Observatory and Planetarium” to maintain and manage AOP with the purpose of “developing and improving the knowledge, appreciation and practice of astronomy and related sciences.”

The Board of Governors (the Board) has retained a role to ensure that the culture and character, history and patrimony embodied in AOP are protected and preserved and that the institution is managed in line with the statutory purpose outlined in the Order. This role will normally be fulfilled through an Annual Review meeting (visitation) where the Board will receive assurance as to the management and performance of AOP from the Management Committee.

### Management Committee of Armagh Observatory and Planetarium

The Board has delegated primary responsibility for the governance and management of AOP to a Management Committee. The Management Committee has corporate responsibility for ensuring that AOP fulfils the aims and objectives set by the Department and approved by the Minister and for promoting the efficient, economic and effective use of resources. The Management Committee provides leadership, challenge, oversight, support and encouragement to the Director and staff.

The Management Committee comprises:

- three nominees from the Board of Governors;
- six nominees from the Department appointed through open competition;
- one nominee of Queen’s University, Belfast;
- one nominee of the Science and Technology Facilities Council (STFC);
- one nominee of the Dublin Institute for Advanced Studies (DIAS);
- a Chair appointed through open competition; and
- up to three additional members co-opted by the Board of Governors. This is by exception and subject to Departmental approval.

The following committees are established as sub-committees of the Management Committee.

### Audit and Risk Assurance Committee (ARAC)

The ARAC is a sub-committee of the Management Committee established in accordance with DAO (DFP) 06/13 - Corporate governance in central government departments: Code of Good Practice NI 2013, and in line with the HM Treasury Audit and Risk Assurance Committee Handbook (DoF 03/18) to advise the Board of Governors, the Management Committee and the Director of AOP as Accounting Officer and to support them in their responsibilities

for issues of organisational risks, internal control, governance and their associated assurances and in reviewing the reliability and integrity of these assurances.

#### Staffing Policy and Remuneration Committee

The Staffing Policy and Remuneration Committee is a sub-committee of the Management Committee and provides advice and recommendations to the Management Committee on employment issues.

#### Research and Education Advisory Committee

The Research and Education Advisory Committee is a sub-committee of the Management Committee and advises it on research and education issues.

#### Redevelopment Committee

The Redevelopment Committee is a sub-committee of the Management Committee and was established to develop an Outline Business Case for redevelopment proposals.

Further details on the membership of these Committees are set out in the Governance Statement on pages 31 to 40.

## **Reference and Administrative Details**

### **Name of the Charity**

The charity is registered and operates under the title of The Armagh Observatory and Planetarium.

### **Charity number**

Registered with the Charity Commission for Northern Ireland 103948.

### **Principal Office**

College Hill, Armagh, BT61 9DG

### **Trustees**

Archbishop J McDowell, (Board Chair)  
The Very Revd S Forster  
The Venerable E Cairns  
The Venerable Dr P Thompson  
Revd Canon W M Adair BEM  
Revd Canon W J A Dawson (to 31 December 2023)  
Revd Canon M Hagan MBE  
Revd Canon D Hilliard  
Revd Canon B Paine  
Revd Canon R J N Porteus  
Mr G Cox  
Professor A Fitzsimmons  
Mr R Wilson  
Archbishop E Martin  
Mr J Briggs (Management Committee Chair)  
Professor L Harra (to 30 April 2024)  
Mr S Brown (to 30 April 2024)  
Mr P McGurgan (to 30 April 2023)  
Professor M Mathioudakis  
Professor C Jackman  
Professor M Darnley  
Mr P Kennedy  
Dr K Lemon  
Mr E Rooney  
Ms S Leslie

## **Director and Accounting Officer**

Professor Michael Burton

## **Auditors**

Northern Ireland Audit Office, 106 University Street, BELFAST, BT7 1EU

## **Internal Auditors**

Cavanagh Kelly, 36-38 Northland Row, Dungannon, BT71 6AP

## **Bankers**

Danske Bank, Donegal Square West, Belfast, BT1 6JS

## **Register of Interests**

A Register of Interests is maintained for Board and Committee Members and Senior Management and is available for inspection at the Principal Address. Declared Interests by Board and Committee Members and the Director are available on the AOP website – [www.armagh.space](http://www.armagh.space).

Related party transactions are shown in note 23 of the accounts.

## **Gifts**

AOP adheres to the limits and rules laid out in its Partnership Agreement approved by the Department and the guidance in Managing Public Money Northern Ireland (MPMNI). There were no gifts made or accepted during the 2023-24 financial year that exceeded these limits.

## **Personal Data Related Incidents**

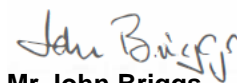
AOP has considered the requirement to report personal data related incidents. It is content that there were no such incidents in the year ended 31 March 2024.

## **Disclosure of Audit Information**

So far as the Accounting Officer is aware, there is no relevant audit information of which AOP's auditors are unaware. The Accounting Officer has taken all necessary steps to make himself aware of any relevant audit information and to establish that AOP's auditors are aware of that information.

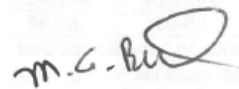
## **Events after the end of the reporting period**

There have been no events since the end of the financial year requiring disclosure.



**Mr John Briggs**  
Trustee

**Date:** 21 October 2024



**Professor Michael Burton**  
Director / Accounting Officer

**Date:** 21 October 2024

# Remuneration and Staff Report

The remuneration and staff report sets out AOP’s remuneration policy for Board members and senior managers, reports on how that policy has been implemented and sets out the amounts awarded to the Director. In addition, the report provides details on remuneration and staff that users see as key to accountability.

## Remuneration Policy

The pay remit for the Northern Ireland Civil Service (NICS), including senior civil servants (SCS), is normally approved by the Minister of Finance. Following the Secretary of State for Northern Ireland’s 27 April 2023 Written Ministerial Statement (WMS) on the budget, the NI public sector pay policy guidance was published on 31 May 2023 in FD (DoF) 05/23. This was subsequently updated on 12 March 2024 in FD (DoF) 04/24 to reflect the return of Executive Ministers and revised departmental budgets.

Annual NICS pay awards are made in the context of the wider public sector pay policy. The pay award for NICS non-industrial staff, including SCS, for 2023/24 has been finalised and was paid in June 2024.

AOP staff remuneration is aligned with NICS pay scales. The Accounting Officer is authorised by DfC to approve its pay remit and business case, notifying same to DfC, prior to implementation of the pay award. Staff received he pay award, including backpay, in June 2024.

## Trustees

Trustees do not receive any remuneration. They receive travel and subsistence allowances at rates and on conditions determined by AOP, subject to Departmental approval. No Trustee receives pension benefits or makes pension contributions in their capacity as a Board member. Management Committee members who were not trustees during the financial year received travel and subsistence expenses of £2,287 (2023: £1,766).

## Service Contracts

The Director of AOP, Professor Michael G. Burton, is the person in a senior position having authority and responsibility for directing and controlling the activities of the organisation. The service contract of the Director commenced on 1 August 2016.

Current terms and conditions for staff are those set out in various policies and individual employment contracts. Senior staff are permanent employees of AOP. The notice period for senior staff is three months. Termination payments are in accordance with contractual terms and those of the principal Civil Service Pension Scheme (NI).

## Director’s Remuneration (including Salary and Pension Entitlements) (Audited Information)

The following tables provide details of the remuneration and pension entitlements of the Director of the organisation.

Single Total Figure of Remuneration of Director							
	Salary (£’000)		Pension Benefits* (£’000)		Total (£’000)		Percentage Change
	2023-24	2022-23	2023-24	2022-23	2023-24	2022-23	
M.G. Burton	85-90	80-85	35	14	120-125	95-100	(9.7%)

*\*The value of pension benefits accrued during the year is calculated as (the real increase in pension multiplied by 20) plus (the real increase in any lump sum) less (the contributions made by the individual). The real increases exclude increases due to inflation and any increase or decrease due to a transfer of pension rights.*

‘Salary’ includes gross salary (on an accruals basis) to the extent that it is subject to UK taxation. There was no overtime, benefit-in-kind, bonus or other allowances. The salary of the Director shown above is based on the Northern Ireland Senior Civil Service Grade 5 pay scale.

## Compensation on early retirement or for loss of office

No payment for compensation on early retirement or for loss of office has been made (2022-23: £nil).

## AOP Fair Pay Disclosures (Audited Information)

AOP is required to disclose the relationship between the remuneration of the Director and the lower quartile, median and upper quartile remuneration of the organisation’s workforce. The banded remuneration of the Director in the financial year 2023-24 was £85,000 - £90,000 (2022-23: £80,000 - £85,000). The relationship between the mid-point of this band and the remuneration of AOP’s workforce is disclosed below.

2023-24	25 <sup>th</sup> percentile	Median	75 <sup>th</sup> percentile
Total remuneration	£21,053	£27,913	£33,780
Pay ratio	4.2:1	3.1:1	2.6:1

2022-23	25 <sup>th</sup> percentile	Median	75 <sup>th</sup> percentile
Total remuneration	£18,783	£29,731	£37,373
Pay ratio	4.4:1	2.8:1	2.2:1

Total remuneration includes salary, overtime and performance-related bonuses. It does not include severance payments, employer pension contributions and the cash equivalent transfer value of pensions. Remuneration ranged from £14,189 to £87,500. The 25<sup>th</sup> percentile remuneration increased following a 12% increase in the NICS AA pay scale. Because overall employment numbers are low, small changes in the staffing structure can appear disproportionate.

The percentage changes in respect of AOP are shown in the following table. It should be noted that the calculation for the Director is based on the mid-point of the band within which their remuneration fell in each year.

Percentage change for:	2023-24 v 2022-23	2022-23 v 2021-22
Average employee salary and allowances	8.6%	2.4%
Director's salary and allowances	6.1%	-5.7%
Average employee performance pay and bonuses	-7.2%	14.9%

No performance pay or bonus was payable to the Director in these years.

### Pension Entitlements (Audited Information)

Official	Accrued pension at pension age as at 31/03/24	Real increase in pension at pension age	Accrued Lump Sum at 31/03/24	Real Increase in Lump Sum	CETV at 31/03/24	CETV at 31/03/23	Real Increase in CETV
	£'000	£'000	£'000	£'000	£'000	£'000	£'000
M.G. Burton	14	2	-	-	247	194	33

The figures enclosed are based on last year's guidance from the Department of Finance on the pension information that should be disclosed in accounts for 2022/23 i.e. these figures exclude the McCloud Remedy from the calculations for any eligible members. The real increase in CETVs is based on the factors in force at 31 March 2024. Due to changes to the non-club transfer factors, provided by the Government Actuary's Department during the year the CETV calculations for the 2022/23 year have been re-run and provided as the starting input CETV value for the start of the 2023/24 year. When calculating the real increase in CETV and the pension benefits accrued during the year 2023-24 for the single total figure of remuneration, NILGOSC takes account of inflation. The CPI increase for September 2023 was 6.7%. The in-service revaluation rate for the Career Average Revalued Earnings Scheme was also 6.7%.

### Pension Scheme

Pension benefits are provided through the Northern Ireland Local Government Officers' Superannuation Committee Pension Scheme (NILGOSC). For members, 1/49<sup>th</sup> of pensionable pay will be added to their pension account each year and retirement pension is based on career average earnings. Details can be obtained at <http://www.nilgosc.org.uk>.

Active members of the pension scheme will receive an Annual Benefit Statement. The accrued pension quoted is the pension the member is entitled to receive when they reach their scheme pension age, or immediately on ceasing to be an active member of the scheme if they are at or over pension age.

Employee contribution rates for all members for the period covering 1 April 2023 to 31 March 2024 are as follows:

Pensionable Pay	Contribution Rate
£0 to £16,900	5.5%
£16,901 to £26,000	5.8%
£26,001 to £43,400	6.5%
£43,401 to £52,800	6.8%
£52,801 to £104,700	8.5%
More than £104,700	10.5%

Employer contribution rates are determined by the Scheme's actuary every three years. Following the results of the 2022 actuarial valuation, the Committee agreed with its actuary the employer contributions of 19% for the following three years, effective from 1 April 2023. The next valuation is due as at 31 March 2025.

### Cash Equivalent Transfer Values

A Cash Equivalent Transfer Value (CETV) is the actuarially assessed capitalised value of the pension scheme benefits accrued by a member at a particular point in time. The benefits valued are the member's accrued benefits and any contingent spouse's pension payable from the scheme. A CETV is a payment made by a pension scheme or arrangement to secure pension benefits in another pension scheme or arrangement when the member leaves a scheme and chooses to transfer the benefits accrued in their former scheme. The pension figures shown relate to the benefits that the individual has accrued as a consequence of their total membership of the pension scheme, not just their service in a senior capacity to which disclosure applies. The CETV figures include the value of any pension benefit in another scheme or arrangement which the individual has transferred to the NICS pension arrangements. They also include any additional pension benefit accrued to the member as a result of their purchasing additional years of pension service in the scheme at their own cost. CETVs are calculated in accordance with The Occupational Pension Schemes (Transfer Values) (Amendment) Regulations 2015 and do not take account of any actual or potential benefits resulting from Lifetime Allowance Tax which may be due when pension benefits are taken.

### Real increase in CETV

This reflects the increase in CETV effectively funded by the employer. It does not include the increase in accrued pension due to inflation, contributions paid by the employee (including the value of any benefits transferred from another pension scheme or arrangement) and uses common market valuation factors for the start and end of the period. However, the real increase calculation uses common actuarial factors at the start and end of the period so that it disregards the effect of any changes in factors and focuses only on the increase that is funded by the employer.

### Total Permanently Employed Staff Costs (Audited Information)

	Permanent staff £	Others <sup>1</sup> £	2023-24 £	2022-23 £
Wages and salaries	1,305,600	141,083	1,446,683	1,341,618
Social security costs	137,506	13,316	150,822	142,108
Employer's pension contributions	233,129	26,111	259,240	250,805
Defined benefit pension additional service cost	51,000	-	51,000	327,000
	1,727,235	180,510	1,907,745	2,061,531

<sup>1</sup> "Others" includes £13,501 for agency staff

### Average staff numbers (Audited Information)

	Permanent staff	Others <sup>2</sup>	2023-24 Total Number	2022-23 Total Number
Average staff numbers	28.5	6.7	35.2	35.3

<sup>2</sup> "Others" includes 4.1 fixed term, 2.3 casuals and 0.3 agency staff

### Staff Composition – permanent employees (full time equivalent)

	Male	Female
Directors/senior managers	2.6	2.0
Other employees	10.7	13.2

### Staff Turnover

	2023-24	2022-23
Leavers as a percentage of average staff in post	1.5%	3.1%

### Sickness Absence (Audited Information)

Staff sickness for the period 1 April 2023 to 31 March 2024 totalled 94 days (2023: 126 days) which equates to an average per FTE of 1.24% (2023: 1.66%).

**Expenditure on External Consultancy (Audited Information)**

Expenditure on external consultancy during the year was £nil (2022-23: £nil).

**Off-payroll Engagements (Audited Information)**

There were no “off-payroll” engagements in place as at 31 March 2024, nor were any arrangements entered into between 1 April 2023 and 31 March 2024.

**Exit Packages (Audited Information)**

Exit package cost band	No of compulsory redundancies	No of other departures agreed	Total no. of exit packages by cost band	Total no. of exit packages by cost band
	2023-24	2023-24	2023-24	2022-23
Total no. of exit packages	-	-	-	-
Total resource cost	Nil	Nil	Nil	Nil

## Statement of the Responsibilities of the Governors and Accounting Officer

In accordance with The Armagh Observatory and Planetarium (Northern Ireland) Order 1995, The Governors shall prepare and submit to the Department a statement of accounts in respect of each financial year, and that statement shall be in such form and contain such information as the Department may direct and shall give a true and fair view of the state of the Governors' affairs at the end of the financial year and of the income and expenditure of the Governors in the financial year.

In preparing the accounts, the Accounting Officer is required to comply with the requirements of the Government Financial Reporting Manual and in particular to:

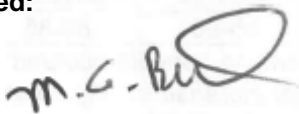
- apply suitable accounting policies on a consistent basis;
- make judgements and estimates on a reasonable basis;
- state whether applicable accounting standards as set out in the Government Financial Reporting Manual have been followed, and disclose and explain any material departures in the accounts;
- prepare the accounts on a going concern basis; and
- confirm that the Annual Report and Accounts as a whole is fair, balanced and understandable and take personal responsibility for the Annual Report and Accounts and the judgements required for determining that it is fair, balanced and understandable.

The Department for Communities has appointed Professor M.G. Burton as Accounting Officer of AOP. The responsibilities of an Accounting Officer, including responsibility for the propriety and regularity of the public finances for which the Accounting Officer is answerable, for keeping proper records and for safeguarding AOP's assets, are set out in Managing Public Money Northern Ireland.

## Statement of Disclosure of Information to the Auditors

As the Accounting Officer, I have taken all the steps that I ought to have taken to make myself aware of any relevant audit information and to establish that Armagh Observatory and Planetarium's auditors are aware of that information. So far as I am aware, there is no relevant audit information of which the auditors are unaware.

Signed:



**Professor Michael Burton**  
**Accounting Officer for Armagh Observatory and Planetarium**

**Date:** 21 October 2024

# Governance Statement

AOP is a Non-Departmental Public Body established under The Armagh Observatory and Planetarium (Northern Ireland) Order 1995.

## 1. Compliance with Corporate Governance Code

In 2013 the Department of Finance and Personnel published Corporate Governance in Central Government Departments: Code of Good Practice NI. The Code draws on best practice in the public, private and charity sectors by: reinforcing the importance of corporate governance as a pre-requisite to achieving good financial management; reflecting changes in governance best practice, including increased emphasis on good leadership; and promoting better governance arrangements within departmental families.

The Code is written for departments, concentrating throughout on key principles which will have wider application for other parts of the public sector. Such bodies (including arms-length bodies (ALBs)) are encouraged to consider and adopt the practices set out in the Code wherever it is relevant and practical and suits their business needs.

AOP in so far as they are relevant for an arms-length body, complies with the principles of good practice in the Corporate Governance Code.

## 2. Governance Framework

### Accounting Officer

Name	In post
Professor Michael Burton – Director and Chief Executive	From 1 September 2016 onwards

### Board of Governors

AOP is governed by a Board of Governors. Membership of the Board of Governors consists of:

- the Church of Ireland Archbishop of Armagh;
- the Dean of the Church of Ireland Cathedral of Armagh;
- the other members of the Chapter of the Church of Ireland Cathedral of Armagh;
- one DfC nominee;
- one Queen’s University Belfast (QUB) nominee; and
- up to three additional members nominated by the Board of Governors.

During 2023-24 one new Member was appointed to the Chapter of the Church of Ireland Cathedral of Armagh and one Member retired. There are currently two vacant positions.

BOARD OF GOVERNORS			
GOVERNOR	DATE OF APPOINTMENT	DATE OF EXPIRY	MEETINGS ATTENDED (max. 1)
Archbishop J McDowell (Chair)	28 April 2020	None	1
The Very Revd S Forster Dean of Armagh	14 February 2021	None	1
The Ven E Cairns Archdeacon of Ardboe	13 December 2020	None	1
The Ven Dr P Thompson Archdeacon of Armagh	13 January 2019	None	1
Revd Canon W M Adair BEM	10 September 2008	None	0
Revd Canon W J A Dawson	1998	31 December 2023 (Retired)	0
Revd Canon D Hilliard	13 March 2016	None	1
Revd Canon W B Paine	7 May 2017	None	0
Revd Canon R J N Porteus	1998	None	0
Revd Canon M Hagan MBE	23 April 2023	None	1
VACANT (from Feb 2023)			
VACANT (from 1 January 2023)			
Professor A Fitzsimmons	18 April 2019	1 May 2024	1

Mr R Wilson	1 December 2019	30 November 2024	0
Archbishop E Martin	1 January 2021	31 December 2025	0
Ms S Leslie	From 1 June 2021	31 May 2026	0
Mr G Cox	1 March 2021	28 February 2026	1

At the annual meeting on 16 May 2023 the Board of Governors endorsed the continuing membership of Messrs Cox and Wilson as its nominees on the Management Committee and afforded the Archbishop time to consider a replacement for Revd Canon Adair as a nominee on the Management Committee. Revd Canon Hagan was subsequently appointed as the third nominee.

The Board considered a paper regarding the Charity Name and Delegation of Charity Trustee Status, which had been prepared following discussions with the Charity Commission for Northern Ireland, and agreed to include the Members of the Management Committee as Charity Trustees (alongside Members of the Board of Governors) and to change the name of the Charity from 'The Governors of Armagh Observatory and Planetarium' to 'Armagh Observatory and Planetarium.'

The Board approved the draft Outline Business Case for AOP Redevelopment Project for submission to DfC.

The Chairs of the Management Committee and Audit and Risk Assurance Committees provided verbal reports to the Board and the minutes of both meetings between June 2022 and April 2023 (draft) were provided.

The Board formally retrospectively approved the Annual Report and Accounts 2021-22 and approved the draft Annual Report and Accounts 2022-23.

The Board noted the Management Report for 2022-23 which included the Director's Report; Corporate Plan Objectives; Key Performance Indicators and the Risk Register as at 31 March 2023 and approved the draft Business Plan 2023-24.

The Board confirmed that it was satisfied that comprehensive arrangements were in place to ensure that high-quality information was received to enable it to make informed decisions. Internal controls were in place to validate the accuracy and completeness of information presented to the Board.

Minutes of the meeting record the business carried out and actions agreed.

### **Management Committee of Armagh Observatory and Planetarium**

The Management Committee comprises:

- a Chair appointed through open competition;
- three nominees from the Board of Governors;
- six nominees from DfC;
- one nominee of the Queen's University Belfast (QUB);
- one nominee of the Science and Technology Facilities Council (STFC);
- one nominee of the Dublin Institute for Advanced Studies (DIAS); and
- up to three additional members co-opted by the Board of Governors. This is by exception and subject to Departmental approval.

During 2023-24 there were three changes to the Membership of the Management Committee. Mr McGurgan retired on 30 April 2023 and Revd Canon Hagan replaced Revd Canon Adair as one of the Board of Governors' nominees to the Management Committee. The term of appointment for both Professor Harra and Mr Brown was extended by one year from 30 April 2023 to 30 April 2024.

There is currently one vacant position, with two further vacancies arising on 30 April 2024. A public appointment process to fill all three of these positions completed in June 2024.

<b>MANAGEMENT COMMITTEE</b>			
<b>MEMBER</b>	<b>DATE OF APPOINTMENT</b>	<b>DATE OF EXPIRY</b>	<b>MEETINGS ATTENDED (max. 6)</b>
Mr J Briggs (Chair)	1 January 2018	31 December 2027	6
Professor L Harra	1 November 2014	30 April 2024	4
Mr S Brown	1 November 2014	30 April 2024	6
Mr P McGurgan	1 November 2014	30 April 2023	1 from 1
Professor M Mathioudakis	11 November 2016	10 November 2026	5

Mr R Wilson	1 December 2019	30 November 2024	2
Professor C Jackman	1 January 2021	31 December 2025	3
Professor M Darnley	1 January 2021	31 December 2025	4
Mr P Kennedy	1 March 2021	28 February 2026	6
Dr K Lemon	1 March 2021	28 February 2026	5
Mr E Rooney	1 March 2021	28 February 2026	5
Mr G Cox	19 May 2021	18 May 2026	5
Revd Canon W M Adair BEM	15 September 2021	16 May 2023	0 from 1
Revd Canon M Hagan MBE	17 May 2023	NONE	1 from 3
VACANT (from 1 May 2023)			

A special meeting of the Management Committee was held in May 2023 to consider the draft Outline Business Case for AOP Redevelopment Project and in April 2023 the Management Committee recommended the final draft for Board approval at a Special Meeting held on Thursday 4 May 2023.

On 17 April 2023, the Committee noted an Armagh City, Banbridge and Craigavon Borough Council Notice of Motion acknowledging, endorsing and supporting the work of AOP and its international linkages and partnership with Birr and Dunsink – the Astronomical Observatories of Ireland.

The draft 2023-24 Business Plan was approved for submission to DfC in April 2023. It was approved by the Permanent Secretary on 14 November 2023.

In April the Management Committee considered a number of papers relating to Whistleblowing/Raising a Concern and approved AOP's updated Policy; reaffirmed its commitment to an ethical culture where all concerns were taken seriously; undertook to provide assurance to the Permanent Secretary regarding staff awareness of the Policy and appointed Mr Greg Cox as AOP's Designated Officer (Whistleblowing Champion).

The Management Committee considered an update on discussions with the Charity Commission for Northern Ireland in relation to changing the Charity Name and the Delegation of Charity Trustee Status in April 2023. In June 2023 it noted that the Charity Commission was comfortable with changing the registered name from 'The Governors of Armagh Observatory and Planetarium' to 'Armagh Observatory and Planetarium' and unanimously agreed that the Management Committee Members take on the responsibility of Charity Trustee alongside the Members of the Board.

A two-day meeting took place in June 2023. In addition to routine business over the two days the Management Committee received a presentation on Carbon Reduction and Action Plan; held an interactive session with staff; undertook practical taster sessions; received a presentation and discussion with the Council in relation to Armagh Place Strategies; received a presentation on DfC's Building Inclusive Communities Strategy and a reviewed the draft Memorandum of Understanding (MoU) which would formally establish the Astronomical Observatories of Ireland. The MoU was signed on Thursday 21 September 2023 in Dunsink, Dublin.

The Committee considered and was content with the summary of its annual Effectiveness Review in September 2023.

In September, on the Chair's recommendation, it approved the establishment of a Liaison Committee between Management Committee and key SMT officers to ensure all issues relating to the redevelopment project were aligned and addressed. The first meeting took place on 17 November 2023.

At the December meeting the Management Committee received a Mid-Term Review of the Strategic Plan. A sub-committee was also established to consider the 2024-25 budget.

At each of its meetings throughout the year the Committee received a report from the Director, a presentation on Research from an Astronomer, updates from each of its standing sub-committees and approved relevant reports. Regular governance reports such as the Bi-Annual Assurance Statement, the Corporate Risk Register, ICT Risk Register, Key Performance Indicators and Finance reports were reviewed and approved. The Committee considered and noted amendments to policies that had been reviewed in line with the policy review process and approved new policies as appropriate.

Throughout the year, the Management Committee also considered progress on AOP's Vision and redevelopment which included updates from the Redevelopment Sub-Committee.

Internal controls are in place to validate the accuracy and completeness of information presented to the Management Committee.

Minutes of the meetings record the business carried out and actions agreed.

### Audit and Risk Assurance Committee

The Audit and Risk Assurance Committee is drawn from the Management Committee and comprises a minimum of four and maximum of five members. A special meeting took place in June 2023 to discuss the Internal Audit Strategy with the reappointed Internal Audit provider.

<b>AUDIT AND RISK ASSURANCE COMMITTEE</b>	
<b>MEMBER</b>	<b>MEETINGS ATTENDED (max. 5)</b>
Mr S Brown Chair (from June 2021)	5
Professor L Harra	3
Mr P McGurgan (to 30 April 2023)	1 from 1
Mr P Kennedy	5
Mr E Rooney	5
Dr K Lemon (from June 2023)	4 from 4

During 2023-24 the Audit and Risk Assurance Committee considered the Internal Audit Charter; the Internal Audit Strategy 2023-2026, Internal Audit Plan 2023-24; reports from Internal Audit on progress against the audit plan and on outstanding recommendations; a revised Report to Those Charged With Governance in respect of the 2021-22 Accounts and reports from external auditors on the 2022-23 Annual Report and Accounts; review of the Accounting Officer's Assurance Statement and review of the Risk Register. In view of the severity of ICT related risks, including data/cyber security, a separate ICT Risk Register was developed.

The Committee is satisfied that the integrated approach, the frequency of meetings, the breadth of the business undertaken, the skills of Members and the range of attendees at meetings of the Committee has allowed the Committee to meet the governance requirements of the organisation and assisted the Management Committee to demonstrate its stewardship of the public resources with which it is charged.

The Committee is satisfied that the organisation has robust risk management arrangements in place which are in line with the good practice in the HM Treasury 'Orange Book' and are reviewed regularly by the Management Committee.

There were 4 Internal Audit recommendations from prior years outstanding, 2 of which have been completed. The Committee is satisfied that progress is being made to complete the remaining outstanding recommendations. There were 6 new internal audit recommendations identified during 2023-24, 3 of which have been implemented.

Minutes of the meetings record the business carried out and actions agreed.

### Staffing Policy and Remuneration Committee

The Staffing Policy and Remuneration Committee is drawn from the Management Committee and comprises a minimum of four and maximum of five members. Special Meetings took place in October 2023 and January 2024 to discuss Strategic Workforce Planning and PDRA pay scales respectively.

<b>STAFFING POLICY AND REMUNERATION COMMITTEE</b>	
<b>MEMBER</b>	<b>MEETINGS ATTENDED (max. 6)</b>
Mr E Rooney (Chair)	6
Mr S Brown	6
Mr J Briggs	6
Dr K Lemon	6
M P Kennedy	6

In 2023-24, amongst other matters, the Committee considered:

- staffing and recruitment, including Skills Gaps Analysis and Strategic Workforce Planning;
- updates to staff related policies, including review of Hybrid Working Policy; and
- a range of Human Resources issues including progress against the Human Resources Strategy and Action Plan.

AOP retained its Diversity Mark (Bronze Award) and Project Juno Practitioner Status. The application for Juno Champion did not meet the standard.

### Research and Education Advisory Committee

The Research and Education Advisory Committee is drawn from the Management Committee and comprises a minimum of four and maximum of five members.

RESEARCH AND EDUCATION ADVISORY COMMITTEE	
MEMBER	MEETINGS ATTENDED (max. 2)
Professor L Harra (Chair)	2
Professor M Darnley	2
Dr K Lemon	1
Professor M Mathioudakis	1

In 2023-24, amongst other matters, the Committee considered:

- education and outreach activities, including visitor reports;
- research activities, including changes to the publication environment; Research Excellence Framework (REF) updates; funding opportunities; PDRA Salaries; UK Committee on Research Integrity; Commentary on AOP Research Strategy; and
- an Intellectual Property Paper.

A Local Organising Committee (LOC) comprising members from across AOP ensured the smooth delivery of 4 Conferences held at the Planetarium in September 2023.

### Redevelopment Sub-Committee

The Redevelopment Sub-Committee's membership is drawn from the Management Committee and comprises of six members.

REDEVELOPMENT SUB-COMMITTEE	
MEMBER	MEETINGS ATTENDED (max. 3)
Mr S Brown (Chair)	3
Mr J Briggs	2
Mr G Cox	1
Mr P Kennedy	3
Dr K Lemon	2
Mr E Rooney	2

The primary purpose of the Sub-Committee was to drive the 'Development of AOP Science and Education Park' Project forward, and oversee the delivery of the outcomes and benefits, most notably initially an Outline Business Case (OBC) by March 2023. It was a very ambitious and challenging timetable and there was a little slippage. The OBC, which was submitted to DfC on 1 June 2023, remains under consideration.

Since submission of the OBC in June 2023, this 'task and finish' Sub-Committee, which will continue until the OBC is approved, has met twice and considered a range of issues associated with project governance including the Business Case, planning / design issues, funding packages and stakeholder engagement.

### Finance Sub-Committee

An interim finance sub-committee was established in December to consider the potential budget constraints faced for 2024/25 and possible actions to be taken. The sub-committee met three times, taking a detailed look at budget proposals and determining cost priorities. This culminated in a letter from the Accounting Officer to the DfC Permanent Secretary in May 2024 setting out identified savings and inescapable costs.

### Conflicts of Interest

The organisation maintains a register of interests to ensure that potential conflicts of interest can be identified and addressed in advance of Board, Management Committee and other Committee discussions. The register is formally revisited on an annual basis. Where conflicts exist, they are recorded in the Committee minutes and the Chair of the meeting decides the most appropriate way of managing the conflict. This may include that member not taking part in discussions or making decisions on certain matters or being excluded for part or all of that meeting.

The Register of Interests for Board of Governors, Management Committee and senior staff is published on the AOP website in accordance with central government guidance.

## **Directors and Secretary**

Professor Michael Burton is Director and Chief Executive.

The Corporate Manager provides a range of secretarial support services to the Board of Governors, Management Committee and Audit and Risk Assurance Committee; the HR and Policy Officer provides secretarial support to the Staffing Policy and Remuneration Committee, and Executive Officers support the Research and Education Advisory Committee and Redevelopment Sub-Committee.

## **3. Business Planning and Risk Management**

### **Business Planning**

*'Our mission is the pursuit of knowledge and understanding of the cosmos, and the sharing of that knowledge in order to inspire future generations and enrich the intellectual, economic, social and cultural life of all.'*

*'Our vision is to be recognised as an international centre of scientific excellence for the pursuit of astronomy and the public understanding of science, for our capacity for innovation and our extraordinary heritage, a place our community can be proud of.'*

The pillars that support us are – Knowledge, Legacy, People and Engagement.

The five-year strategy is built around four strategic themes - Enduring Relevance, National and International Standing, Offering More and Pursuing our Priorities.

The Strategic Plan aligns closely with the aims and objectives of the Observatory and Planetarium's sponsor - the Department for Communities (DfC) – and with the broader aims and objectives of the Northern Ireland Executive's Programme for Government. The organisation's Strategic Plan 2021-26 received Departmental approval on 17 August 2021.

The work of the Observatory encompasses both internationally acclaimed research and a unique cultural heritage — scientific, historical, architectural — as well as maintaining the unique daily climate series (the longest daily series from a single site in the UK and Ireland) and undertaking a world-class programme of science in the community, which complements the Planetarium's main business of education.

The Planetarium's main business is education, and all age and social groups are welcome to visit. The educational programmes and demonstrations are designed to include participation by children of pre-nursery age up to senior citizens and all age groups in between. The primary educational aim of the Planetarium is to endorse and promote the Science, Technology, Engineering, Arts and Mathematics (STEAM) agenda which promotes scientific careers to young people. All of the ancillary activities support the primary aim, with the additional target of offering excellent value for money, both to the visitors taking part and to the public purse. The Planetarium maintains a focus on being inclusive so that all children can enjoy the Planetarium experience.

Full details of all the Observatory and Planetarium's activities are provided in comprehensive Annual Reports which are available online at: [www.armagh.space](http://www.armagh.space).

No Ministerial Directions have been given regarding the work of AOP.

### **Risk Management**

Risk Management is an essential element of AOP's corporate governance framework and is closely linked to the system of internal control and business planning process. HM Treasury Orange Book establishes the concept of risk management and provides a basic introduction to its concepts, development and implementation of risk management processes in government organisations. A robust risk management process assists AOP in identifying and managing issues which may hinder the achievement of objectives. The arrangements are regularly reviewed.

As well as ensuring that there is an effective system in place to deal with threats to AOP's aims and objectives, the organisation encourages a proactive approach to innovation and well-managed risk taking where there is potential to realise sustainable improvements in the organisation's research and educational services. For this reason, the organisation's Risk Appetite is 'Open'.

The Management Committee sets the risk appetite for AOP. The Accounting Officer, Senior Management and other staff are responsible for ensuring that residual risks are reduced to a level as low as reasonably practicable and wherever possible consistent with the level of risk appetite established by the Management Committee.

Updates are provided to the Audit and Risk Assurance Committee on the development and implementation of the risk management process across AOP. The Audit and Risk Assurance Committee provides the Accounting Officer with objective advice on issues concerning the risk, control and governance of the organisation and the associated assurances. An update on the main points considered by the Audit and Risk Assurance Committee is provided to the Management Committee following each meeting and the Management Committee has access to all papers for the Audit and Risk Assurance Committee.

#### **4. Fraud and Information Risk**

The Accounting Officer has overall responsibility for managing the risk of fraud including:

- developing a fraud risk profile and undertaking a regular review of the fraud risks associated with each of the key organisational objectives in order to keep the profile current;
- establishing an effective fraud prevention policy and fraud response plan, commensurate with the level of fraud risk identified in the fraud risk profile;
- designing an effective control environment to prevent fraud commensurate with the fraud risk profile;
- operating appropriate pre-employment screening measures;
- establishing appropriate mechanisms for reporting fraud risk issues, reporting significant incidents of fraud, and coordinating assurances about the effectiveness of fraud prevention policies to support the Governance Statement;
- liaising with the Audit and Risk Assurance Committee;
- ensuring that all staff are aware of the organisation's fraud prevention policy and know what their responsibilities are in relation to combating fraud;
- ensuring fraud awareness training is provided as appropriate and, if necessary, more specific fraud prevention training and development is provided to relevant staff;
- ensuring that vigorous and prompt investigations are carried out if fraud occurs, is attempted or is suspected by the establishment of a Fraud Investigation Oversight Group;
- ensuring, where appropriate, legal and/or disciplinary action against perpetrators of fraud;
- ensuring, where appropriate, disciplinary action against supervisors where supervisory failures have contributed to the commission of fraud;
- ensuring, where appropriate, disciplinary action against staff who fail to report fraud;
- taking appropriate action to recover assets and losses;
- ensuring that appropriate action is taken to minimise the risk of similar frauds occurring in future; and
- ensuring that an anti-fraud culture is promoted throughout the organisation in line with the seven Nolan Principles of Public Life.

Risks to data and information held by the organisation are owned and managed by individuals designated as information asset owners. The Corporate Policy and HR Officer responds to requests for information under the Data Protection and Freedom of Information Acts following consultation with the Accounting Officer and the organisation's governing Committees, as appropriate.

AOP operates a Whistleblowing Policy which informs all members of the organisation of the standards of behaviour expected of them in carrying out their duties, and to provide information on the procedures to follow if a situation arises in which they are required to act in a way which is believed by them to be illegal, improper, or in breach of the Nolan Principles.

#### **5. Governance and Accountability**

AOP seeks to achieve excellence in good governance, in particular the precepts: (1) leadership; (2) effectiveness; (3) accountability and (4) sustainability.

The Chair of the Board of Governors has a particular leadership responsibility for securing the sustainability and vitality of the organisation in the long term; giving advice and direction in formulating AOP's forward look and overall strategy; ensuring that account is taken of guidance provided by the Minister or the Department; promoting the efficient and effective use of staff and other resources; encouraging high standards of probity amongst staff and Board and Committee members alike; and ensuring that the Board and its Committees meet at regular intervals throughout the year and that the Minutes of meetings accurately record the decisions taken and, where appropriate, the views of individual Board members.

Within AOP, the Director, supported by his Senior Management team, has responsibility for the management and effective operation of their organisation. Their operational responsibilities include:

- developing, implementing and monitoring the strategic and operational plans;
- undertaking financial management and Accounting Officer responsibilities;
- managing and developing a team of highly qualified professional and administrative staff;
- identifying and attracting sources of external income;
- promoting their respective organisations in relevant local, national and international arenas; and
- promoting Public Understanding of Science with the objective of improving the level of scientific literacy in the community and to ensure a strong link with government policy and the STEM agenda.

Members of the Board of Governors and of the Management Committee and their various Sub Committees exercise an effective challenge function on the leadership team in accord with their respective roles in the organisation. They also provide guidance and advice on strategic and operational matters such as Human Resource issues, accountability and relationships with stakeholders.

The members of these Committees are drawn from a very wide community background within, and beyond, Northern Ireland, and provide the organisation with a correspondingly wide range of expert knowledge and advice. All the Committees of AOP operate with full transparency and accountability, and over the last year have proved effective in the discharge of their duties and responsibilities.

It was agreed by the Board of Governors and the Management Committee that the governance arrangements in place removed the need for the current Board of Governors to complete an internal self-assessment of its effectiveness.

The Board of Governors and supporting Committees receive assurances from the Director and his Senior Management and Internal Audit that the governance and accountability processes are being managed effectively.

## 6. Sources of Independent Assurance

### Internal Audit

CavanaghKelly was reappointed as Internal Auditors for the 3 years 2023-24 – 2025-26 using CPD as the Centre of Procurement Expertise. Their work was carried out in accordance with the Public Sector Internal Audit Standards.

The three year Audit Strategy was approved by the Audit and Risk Assurance Committee in June 2023.

The Audit and Risk Assurance Committee considered reports on the following areas:

Audit Assignment	Assurance Rating
Governance including Whistleblowing and Risk Management	Satisfactory
Budgetary Control	Satisfactory
Health and Safety and Safeguarding	Satisfactory
Internal Audit Follow Up 2023-24	N/A

An overall satisfactory internal audit assurance opinion has been provided.

### External Audit

The Comptroller and Auditor General (C&AG) is required to audit the financial statements under *The Armagh Observatory and Planetarium (Northern Ireland) Order 1995*. The C&AG is responsible for reporting whether in her opinion the financial statements give a true and fair view and whether they and the part of the Remuneration Report to be audited have been properly prepared in accordance with the Order and DfC directions made thereunder and applicable law and United Kingdom accounting standards. The C&AG is required to report whether, in her opinion, in light of the knowledge and understanding of AOP and its environment obtained in the course of the audit, she has identified any material misstatements in the Trustees' Annual Report and whether the information which comprises the Statement of the Responsibilities of the Governors and Accounting Officers and Governance Statement, as included within the Annual Report, is consistent with the financial statements. She also reports on whether, in her opinion, in all material respects, the expenditure and income presented in the financial statements have been applied to the purposes intended by the Assembly and whether the financial transactions conform to the authorities which govern them.

A representative from the Northern Ireland Audit Office is invited to all Audit and Risk Assurance Committee meetings.

## **7. Review of the Effectiveness of the System of Internal Governance**

The system of internal governance is designed to manage risk to a reasonable level, rather than to eliminate all risk of failure to achieve certain policies, aims and objectives; it can therefore only provide reasonable and not absolute assurance of effectiveness. The system of internal governance is based on an ongoing process designed to identify and prioritise risks to the achievement of the AOP policies, aims and objectives; to assess the likelihood of the events occurring and the impact should they be realised; and to manage the risks effectively, efficiently and economically. The system of internal governance has been in place in AOP for the year ended 31 March 2024 and up to the date of approval of the annual accounts, and accords with Department of Finance guidance.

As previously detailed in Section 2, the responsibilities of the Accounting Officer include the need to maintain a sound system of internal control which supports the achievement of the organisation's policies, aims and objectives. The review of the effectiveness of the system of internal governance has been informed by the assurances provided by relevant parties such as: Internal Audit and the Senior Management team. Where weaknesses have been identified these have been promptly drawn, through normal reporting mechanisms, to the attention of the Audit and Risk Assurance Committee, Management Committee and/or Board of Governors, as appropriate.

The main procedures in place to monitor the effectiveness of the system of internal governance are as follows:

- ongoing independent assessment of the Observatory's research outputs;
- regular reports by financial staff on progress against principal financial targets and the projected financial outcome for the year and progress reports by staff responsible for major projects;
- detailed progress reports to the Management Committee and Board of Governors at their regular meetings and inclusion of performance measures and results against targets in the annual operating plan;
- annual reports on the system of internal control from internal auditors to the Audit and Risk Assurance Committee;
- regular Accountability meetings with officials from the Sponsor Department to consider operational and strategic issues and matters relating to the system of internal control;
- Bi-Annual Assurance Statements submitted to the Sponsor Department;
- periodic review of the AOP Risk Register by the Audit and Risk Assurance Committee, the Management Committee, the Accounting Officer and Senior Management and the Sponsor Department;
- continuous assessment of the quality of research through peer review of grant applications, applications for telescope time, and the submission of scientific papers to academic journals of international standing by AOP staff and students;
- peer review of the research quality, capability and output of the Observatory, and through participation in an objective external Assurance Committee, which provide an opinion on the adequacy and effectiveness of the system and contain recommendations for improvement; and
- annual reports from Northern Ireland Audit Office to the Audit and Risk Assurance Committee, the Management Committee and the Board of Governors on the Annual Report and Accounts, providing an opinion on the state of affairs of the organisation and its total incoming resources and expenditure of resources.

All reports based on the internal and external audits include opinions on the adequacy and effectiveness of risk management and the control framework in place. These matters are considered by the Audit and Risk Assurance Committee and are reported by the Audit and Risk Assurance Committee Chair to the Management Committee and the Board of Governors.

Weaknesses identified in AOP's control systems and internal governances are set out within the next section. Upon identification, plans were immediately put into place to addresses these issues.

## **8. Internal Governance Divergences**

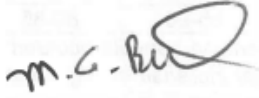
During its audit for 2023-24, NIAO identified no priority 1 issues to be addressed by management in their areas of responsibility.

## 9. Conclusion

AOP has an effective governance structure and is operating to a high standard of integrity and probity. In signing this report, I have taken assurances, where available, from the Audit and Risk Assurance Committee and I will continue to monitor the Internal Audit and Northern Ireland Audit Office recommendations to ensure that all issues are appropriately addressed.

To the best of my knowledge this report provides a fair and accurate reflection of the business of AOP and of the status of the controls and checks that have been put in place to regulate and inform the organisation's committees.

Signed:

A handwritten signature in black ink, appearing to read 'm.c. burton', written over a faint, illegible stamp or watermark.

Date: 21 October 2024

**Professor Michael Burton**  
**Accounting Officer**  
**Armagh Observatory and Planetarium**

## Refereed Journal Publications: April 2023 – March 2024

Albacete-Colombo J. F., et al., inc. **Vink J. S.**, 2023, Diffuse X-Ray Emission in the Cygnus OB2 Association, *Astrophysical Journal Supplement*, 269, 14, doi:10.3847/1538-4365/acdd65, <https://ui.adsabs.harvard.edu/abs/2023ApJS..269...14A>

**Bagnulo S.**, Farihi J., **Landstreet J. D.**, Folsom C. P., 2024, Discovery of Magnetically Guided Metal Accretion onto a Polluted White Dwarf, *Astrophysical Journal*, 963, L22, doi:10.3847/2041-8213/ad2619, <https://ui.adsabs.harvard.edu/abs/2024ApJ...963L..22B>

Bowman D. M., van Saders J., **Vink J. S.**, 2023, The Structure and Evolution of Stars: Introductory Remarks, *Galaxies*, 11, 94, doi:10.3390/galaxies11050094, <https://ui.adsabs.harvard.edu/abs/2023Galax..11...94B>

**Christou A. A.**, Egal A., Georgakarakos N., 2024, The Taurid Resonant Swarm at Mercury, *Monthly Notices Royal Astronomical Society*, 527, 4834, doi:10.1093/mnras/stad3516, <https://ui.adsabs.harvard.edu/abs/2024MNRAS.527.4834C>

Connolly R., et al., 2023, inc. **Butler C. J.**, Challenges in the Detection and Attribution of Northern Hemisphere Surface Temperature Trends Since 1850, *Research in Astronomy and Astrophysics*, 23, 105015, doi:10.1088/1674-4527/acf18e, <https://ui.adsabs.harvard.edu/abs/2023RAA....23j5015C>

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## Armagh Observatory and Planetarium Non Refereed Journal Publications: April 2023 – March 2024

**Bailey M. E., Christou A. A.,** Finnegan J. A., 2023, The Flying Fish Fireball of 2014 July 17, WGN, Journal of the International Meteor Organization, 51, 38, <https://ui.adsabs.harvard.edu/abs/2023JIMO...51...38B>

Belkin S., et al., inc. **Ramsay G.**, 2024, GRB 230911A: The First Discovery of a Fermi GRB Optical Counterpart with the Gravitational-wave Optical Transient Observer (GOTO), Research Notes of the American Astronomical Society, 8, 6, doi:10.3847/2515-5172/ad1876, <https://ui.adsabs.harvard.edu/abs/2024RNAAS...8....6B>

**Christou A.**, Gritsevich M., 2023, in EGU General Assembly Conference Abstracts. Meteor phenomena in the atmosphere of Venus, EGU General Assembly Conference Abstracts. pp EGU–4306, doi:10.5194/egusphere-egu23-4306

Dermott S., Li D., **Christou A.**, 2023, in AAS/Division of Dynamical Astronomy Meeting. Do HED meteorites originate from two large craters on asteroid Vesta?. p. 202.04

**McMahon, M.**, 2023, Herschel Family Papers held at Armagh Observatory and Planetarium. Journal of the Herschel Society 22, 4–13

**McMahon, M.**, 2024, Hugh Breen, Father of Astronomers. History Armagh 5, 38–40

**McMahon, M., Black, A.**, 2024, The Armagh Observatory Troughton Equatorial Telescope (1795) Network. Scientific Instrument Society Bulletin 27–40 (2024).

**McMahon M., Nežič R.**, 2024, Archival research in a planetarium: The first projector at Armagh Planetarium, Communicating Astronomy with the Public Journal, 34, 37, <https://ui.adsabs.harvard.edu/abs/2024CAPJ...34...37M>

Morgan L., Law C. Y., Tan J., **Eden D.**, 2024, in American Astronomical Society Meeting Abstracts. Filaments All the Way Down: Examining the hierarchical nature of the ISM. p. 156.05

Stricklan A., **Shetye J.**, 2023, in American Astronomical Society Meeting Abstracts. What do coronal hole jets eat: A look at these beasts and the mechanisms that feed them. p. 103.02

During the reporting year, G Ramsay published many reports related to the discovery of transients and is directly related to his work on the GOTO and BlackGem projects. The Transient Name Server (TNS) is an IAU supported service which reports newly discovered extragalactic transients. He led or was co-Investigator on 201 TNS Discovery Reports and 14 TNS AstroNotes. In addition, he was co-Investigator on 11 GRB Coordinates Network Circular Services (GCNs), which report the results of optical follow-up of Gravitational Wave and Gamma-ray Burst events. He led 1 Astronomical Telegram (ATel) reporting the outburst of a CV candidate.

## Armagh Observatory and Planetarium Presentations: April 2023 – March 2024

Date	AOP Speaker	Title	Location/Mode	Category
03 Apr 2023	G. Ramsay	Key Tools, Techniques and Methods Over Last 20 Years	Astrobytes, Armagh Observatory and Planetarium, Armagh	Internal Outreach
06 Apr 2023	J.S. Vink	Mixing and Mass Loss in Massive Stars	SDSS-V/IReNA Science Festival, KU Leuven, Belgium (virtual)	Research
16 Apr 2023	J. Rigney	From the Leviathan to LOFAR	Birr Castle, Co. Offaly, Ireland	Outreach
17 Apr 2023	A. Philip Monai	Recap: The Formation of the Solar System	Astrobytes, Armagh Observatory and Planetarium, Armagh	Internal Outreach
17 Apr 2023	J.S. Vink	The Heaviest Stars and Black Holes in the Universe	AOP Management Committee Meeting, Armagh Observatory and Planetarium, Armagh	Outreach
28 Apr 2023	G. Ramsay	Stellar Activity and NGTS	NGTS Consortium Meeting, Queen's University Belfast	Research
29 Apr 2023	M.E. Bailey	Giant Comets and Their Impacts Through Time: The Most Recent Giant Comet and its Impact on Civilization	Society for Interdisciplinary Studies Spring Meeting, Watford, England	Outreach
03 May 2023	J.S. Vink	Space	St Teresa Primary School, Belfast	Outreach
05 May 2023	M. Burton	The Director's Cut – Orienteering the Cosmos	A Special Planetarium Show for Participants in the British Orienteering Championships in Armagh, Armagh Planetarium, Armagh	Outreach
13 May 2023	J. Rigney	From the Leviathan to LOFAR	Birr Castle Co. Offaly, Ireland	Outreach
16 May 2023	M. Sarzi	The Fornax3D Survey	Galaxy Groups and Clusters III Conference, La Serena, Chile	Research
24 May 2023	J. Rigney	Single Station Science	LOFAR Science Summer School Workshop, Sofia, Bulgaria	Teaching
24 May 2023	J. Rigney	Pulsars and Fast Radio Bursts	LOFAR Science Summer School Workshop, Sofia, Bulgaria	Teaching
30 May 2023	D. Eden	MAJORS: Massive, Active, JCMT-Observed Regions of Star Formation.	JCMT Users' Meeting 2023, University College London, London	Research
02 Jun 2023	C.S. Jeffery	The SALT Survey of Hydrogen-Deficient Stars and Hot Subdwarfs	Science Highlights from SALT Conference, Nicolas Copernicus Astronomical Centre, Warsaw, Poland	Research
06 Jun 2023	C.S. Jeffery	The SALT Survey of Hydrogen-Deficient Stars and Hot Subdwarfs	Institut für Physik und Astronomie, Universität Potsdam, Germany	Research
08 Jun 2023	M. Burton	Armagh – Exploring the Cosmos	Lisburn Probus Club, Lisburn Golf Club, Lisburn, Co. Antrim	Outreach
09 Jun 2023	M. Burton	The Director's Cut – The Planets	Armagh Planetarium, Armagh	Outreach
12 Jun 2023	C.S. Jeffery	Shocks and Chaos in Pulsating Helium Stars	Department of Applied Mathematics and Theoretical Physics, University of Cambridge, England	Research
12 Jun 2023	J.S. Vink	Why are the Most Massive Stars not the Largest?	Astrobytes, Armagh Observatory and Planetarium, Armagh	Internal Outreach
13 Jun 2023	J. Rigney	Low Frequency Radio Emission Associated with a CME and EUV Wave	LOFAR Family Meeting 2023 Conference, Olsztyn, Poland	Research

14 Jun 2023	G. Ramsay	Stellar Activity and BlackGem	BlackGem Consortium Meeting, Nijmegen, The Netherlands	Research
15 Jun 2023	M.E. Bailey	Using Kinesthetic Learning to Bring Heaven Down to Earth in a Practical Way	U3A Summer School, Greenmount College, Antrim	Outreach
19 Jun 2023	J.S. Vink	The Fundamentals of the WR Phenomenon	The Wolf-Rayet Phenomenon in the Universe Meeting, Morelia, Michoacán, Mexico	Research
21 Jun 2023	Z. Gray	The Aftermath of the DART Impact: A Polarimetric Study of Didymos-Dimorphos	Asteroids, Comets and Meteors (ACM) Conference 2022, Flagstaff, Arizona, USA	Research
22 Jun 2023	R. Nežič	Sungrazers Through Space and Time: Polarimetric Behaviour of Selected Sungrazing Comets Near Perihelion	Asteroids, Comets, Meteors (ACM) Conference 2023, Flagstaff, Arizona, USA	Research
29 Jun 2023	M. McMahon	Science and Spectacle	Crossing Frontiers: Elements and Environment in the Middle Ages, International Research Conference, Queen's University Belfast	Research
29 Jun 2023	M.E. Bailey	How Astronomy Impacts Our Understanding of the Middle Ages and Its Changing Environment	Panel Discussion, Crossing Frontiers: Elements and Environment in the Middle Ages, International Research Conference, Queen's University Belfast	Research
30 Jun 2023	M. Sarzi	The SAURON Survey and the Oxford Years	Conference Celebrating the Retirement of Prof Roger Davies, Oxford, England	Research
07 Jul 2023	J. Rigney	Stellar Activity	STELLAR BG Final Meeting, Plovdiv, Bulgaria	Research
11 Jul 2023	M. Sarzi	Artificial Intelligence and Data Visualisation in Astronomy	UKRI Summer School in Artificial Intelligence and Astronomy, Canterbury University, England	Teaching
18 Jul 2023	M. McMahon	First Light: 230 Years of Observing in Armagh	Armagh Planetarium, Armagh	Outreach
23 Aug 2023	L. Scott	Heavy Metal Subdwarfs: Testing Chemical Stratification	Irish National Astronomy Meeting (INAM), University College Cork, Co. Cork, Ireland	Research
24 Aug 2023	M. Burton	UNESCO and the Astronomical Observatories of Ireland	Irish National Astronomy Meeting (INAM), University College Cork, Co. Cork, Ireland	Research
24 Aug 2023	J. Rigney	Low Frequency Radio Emission Associated with a CME Shock and EUV Wave	Irish National Astronomy Meeting (INAM), University College Cork, Co. Cork, Ireland	Research
24-Aug-23	C.S. Jeffery	The SALT Survey of Hydrogen-Deficient Stars and Hot Subdwarfs	Irish National Astronomy Meeting (INAM), University College Cork, Co. Cork, Ireland	Research
31 Aug 2023	M. Sarzi	The Fornax3D and MeerKAT Fornax Surveys	MeerKAT Fornax Workshop, Cagliari, Italy	Research
01 Sep 2023	M.E. Bailey	Near-Earth Objects: Origins, Impacts and Risk	North Down and Ards U3A, Bangor, Co. Down	Outreach
02 Sep 2023	M. Burton, H. Alexander, S. Mackle, M. Grimley, M. McMahon	The Armagh Experience Compere [Heather] Small Changes, Big Impact [Sinead] Our Solar System [Mark] Historical Research [Matthew] Present and Future [Michael]	British Association Planetaria Annual Conference, Armagh Planetarium, Armagh	Research and Education

04 Sep 2023	S. Schlagenhauf	Using Adaptive-Optics Assisted MUSE Observations to Measure Galaxy Distances with the Planetary Nebulae Luminosity Function	IAU Symposium, Krakow, Poland	Research
06 Sep 2023	J.S. Vink	Wind and Mass Loss in Hot Stars	Symposium on Chemical Yields, Heidelberg, Germany	Research
08 Sep 2023	M. Burton	The Director's Cut – A Cosmic Journey	AMCVn5 Workshop, Armagh Planetarium, Armagh	Outreach
11 Sep 2023	L. Scott	Surface Abundances of Hot Subdwarfs	Annual Meeting of the UK BRIDGCE and IReNA Network, The University of Edinburgh, Scotland	Research
15 Sep 2023	C.S. Jeffery	Highlights from the SALT Survey of Helium-Rich Hot Subdwarfs	11th Workshop on Hot Subluminous Stars and Related Objects, Armagh Planetarium, Armagh	Research
15 Sep 2023	G. Ramsay	Plato Complementary Science and the Guest Observer Programme	Plato UK Meeting, University of Warwick, England	Research
15 Sep 2023	L. Scott	Modelling Lead Stratification in Heavy Metal Subdwarfs Atmospheres	11th Workshop on Hot Subluminous Stars and Related Objects, Armagh Planetarium, Armagh	Research
19 Sep 2023	G. Ramsay	Report from the Executive Board	GOTO Science Meeting, University of Warwick, England	Research
25 Sep 2023	J.S. Vink	Introduction	The Second XShootU In-Person Meeting, Prague, Czech Republic	Research
01 Oct 2023	K.O. Çubuk	One Planet and the Universe - 100 Hours of Astronomy	Armagh Observatory and Planetarium, Armagh	Outreach
02 Oct 2023	M.E. Bailey	Earth's Place in Space: A Brief Introduction to Astronomy	Causeway U3A, Portstewart, Co. Antrim	Outreach
05 Oct 2023	M.E. Bailey	The Human Orrery: Ground-Based Astronomy for All! (Zoom)	Online Across Scotland: Across Scotland U3A Astronomy Group, Scotland	Outreach
06 Oct 2023	M. Burton	The Director's Cut – Star Formation	Armagh Planetarium, Armagh	Outreach
12 Oct 2023	J. Landstreet	The Magnetic Attraction of White Dwarfs	Stellar Magnetic Fields from Protostars to Supernovae, Munich Institute for Astro-, Particle and Bio Sciences (MIAPbP), Garching, Germany	Research
12 Oct 2023	J. Rigney	The Sun and the (Low Mass) Stars, Searching for Radio Flares and CMEs on M Dwarfs	Seminar, Armagh Observatory and Planetarium, Armagh	Research
13 Oct 2023	A. Humpage, A. Marshall Lee, A. Philip Monai, E. Winch, K. Trakakis, S. Schlagenhauf	PhD Flash Talks	Armagh Planetarium, Armagh	Outreach
18 Oct 2023	J. Landstreet	What is an Ap Star?	Stellar Magnetic Fields from Protostars to Supernovae, Munich Institute for Astro-, Particle and Bio Sciences (MIAPbP), Garching, Germany	Research
20 Oct 2023	D. Eden	Astronomy: From Large to Small	DJK House, Liverpool, England	Outreach

20 Oct 2023	S. Bagnulo	Plus or Minus	Stellar Magnetic Fields from Protostars to Supernovae, Munich Institute for Astro-, Particle and Bio Sciences (MIAPbP), Garching, Germany	Research
22 Oct 2023	M. Sarzi	Italian Stars in Armagh	Event about research and sustainability organised with the Italian Consulate, Armagh Planetarium, Armagh	Outreach
25 Oct 2023	M.E. Bailey	Near-Earth Objects: Origins, Impacts and Risk	University of Northumbria, Newcastle upon Tyne, England	Research
26 Oct 2023	S. Bagnulo	No So fast, Not So Furious, Just Magnetic	Stellar Magnetic Fields from Protostars to Supernovae, Munich Institute for Astro-, Particle and Bio Sciences (MIAPbP), Garching, Germany	Research
27 Oct 2023	M. Burton	Geographies of Outer Space at the Armagh Observatory and Planetarium	“Geographies of Outer Space” QUB Course, Armagh Observatory and Planetarium, Armagh	Teaching
27 Oct 2023	S. Bagnulo	Magnetically Driven Accretion at the Surface of a Metal Polluted White Dwarf	Stellar Magnetic Fields from Protostars to Supernovae, Munich Institute for Astro-, Particle and Bio Sciences (MIAPbP), Garching, Germany	Research
31 Oct 2023	L. Scott	Diffusion in Stars and Stratified Atmosphere Models	PhD Student Discussion Meeting, Armagh Observatory and Planetarium, Armagh	Research
02 Nov 2023	G. Sabhahit	Massive Stars Near the Eddington Limit	Seminar, Armagh Observatory and Planetarium, Armagh	Research
03 Nov 2023	M. Burton	The Director’s Cut – Star Death	Armagh Planetarium, Armagh	Outreach
05 Nov 2023	J. Rigney	The Sun and the (Low Mass) Stars	Mayo Dark Skies Festival 2023, Co Mayo, Ireland	Outreach
06 Nov 2023	J.S. Vink	First Light from JWST	Northern Ireland Amateur Astronomy Society (NIAAS), Ballyclare, Co. Antrim	Outreach
10 Nov 2023	D. Eden	MAJORS: First Results from W49A	New Eyes on the Cold Universe: Star Formation in the Milky Way and Beyond in the Era of JWST and ALMA, Royal Astronomical Society, London, England	Research
15 Nov 2023	L. Scott	Heavy Metal Subdwarfs	Astrophysics Seminar, Queen’s University Belfast	Research
22 Nov 2023	K.O. Çubuk	Engaging Space Facts and Future Space Missions	UK Space Conference, ICC, Belfast	Outreach
01 Dec 2024	M. Burton	The Director’s Cut – Galaxies	Armagh Planetarium, Armagh	Outreach
07 Dec 2023	C.S. Jeffery	The Secret Lives of Ancient Stars	AOP Management Committee Meeting, Armagh Planetarium, Armagh	Governance
15 Dec 2024	J.S. Vink	How Heavy is the Most Massive Star	Seminar, University of Leeds, England	Research
09 Jan 2024	C.S. Jeffery	A Brief Tour of the Universe	Presbyterian Women’s Association, First Presbyterian Church, Armagh, Armagh	Outreach
10 Jan 2024	M. McMahon	UNESCO	Astrobytes, Armagh Observatory and Planetarium, Armagh	Internal Outreach
11 Jan 2024	J.S. Vink	Mass loss History of Very Massive Stars	Supermassive Stars Workshop, University of Geneva, Switzerland	Research

24 Jan 2024	Z. Gray	Placement in La Palma	Astrobytes, Armagh Observatory and Planetarium, Armagh	Internal Outreach
25 Jan 2024	E. Higgins	Nucleosynthesis, Winds and Chemical Yields of Very Massive Stars	Seminar, Armagh Observatory and Planetarium, Armagh	Research
26 Jan 2024	C.S. Jeffery	Highlights from the SALT Survey of Hydrogen-Deficient Stars and Hot Subdwarfs	Institute of Astronomy, Cambridge, England	Research
07 Feb 2024	L. Scott	Heavy Metal Stars	Irish Astronomical Association Seminar, Queen's University Belfast	Outreach
08 Feb 2024	A. Christou	Introduction to Orbital Motion	Topics in Astrophysics, AOP/QUB PhD Programme, Armagh Observatory, Armagh	Research
08 Feb 2024	J. Rigney	Radio Astronomy	Transition Year Workshop, Dunsink Observatory, Co Dublin, Ireland	Outreach
13 Feb 2024	J.S. Vink	Introduction	XShootU Virtual VII	Research
15 Feb 2024	S. Bagnulo	Night Time Astronomy	Topics in Astrophysics, AOP/QUB PhD Programme, Armagh Observatory, Armagh	Research
16 Feb 2024	M. Burton	The Director's Cut – The Lives of Stars	Armagh Planetarium, Armagh	Outreach
21 Feb 2024	M.E. Bailey	Using Kinesthetic Learning to Help Understand Our Place in Space: From Solar System to Near Universe	Irish Astronomical Association, Queen's University Belfast	Outreach
21 Feb 2024	C.S. Jeffery	Highlights from the SALT Survey of Hydrogen-Deficient Stars and Hot Subdwarfs	"Next Generation of Binary Population Synthesis Models for Hot Subdwarf Stars: Theory Meets Observations" Workshop, Bamberg, Germany	Research
22 Feb 2024	M. Burton	Our Galaxy: Gas, Dust and Surveys	Topics in Astrophysics, AOP/QUB PhD Programme, Armagh Observatory, Armagh	Research
22 Feb 2024	D. Eden	Molecular Clouds and Star Formation in the Milky Way	Topics in Astrophysics, AOP/QUB PhD Programme, Armagh Observatory, Armagh	Research
22 Feb 2024	M. Burton	Armagh, Birr and Dunsink: Research and Education Entwined with History and Heritage	Royal Geographical Society, Queen's University Belfast	Outreach
22 Feb 2024	Z. Gray	Careers in Astronomy (4 x talks)	W5, NI Science Festival, Belfast	Outreach
23 Feb 2024	Z. Gray	Careers in Astronomy (4 x talks)	W5, NI Science Festival, Belfast	Outreach
28 Feb 2024	L. Scott	Stars	Astrobytes, Armagh Observatory and Planetarium, Armagh	Internal Outreach
29 Feb 2024	J.S. Vink	Radiative Transfer and Stellar Winds, Massive Stars, Black Holes a GWs	Topics in Astrophysics, AOP/QUB PhD Programme, Armagh Observatory, Armagh	Research
04 Mar 2024	M.E. Bailey	Earth, Moon, and Space: From Planet Earth to the Stars	Carolside Primary School, Clarkston, East Renfrewshire, Scotland	Outreach
04 Mar 2024	M.E. Bailey	Earth, Moon, and Space: From Planet Earth to the Stars	Carolside Primary School, Clarkston, East Renfrewshire, Scotland	Outreach

05 Mar 2024	M.E. Bailey	Earth, Moon, and Space: From Planet Earth to the Stars	Carolside Primary School, Clarkston, East Renfrewshire, Scotland	Outreach
06 Mar 2024	J.S. Vink	Discussion Sample Selection	1st Binarity at LOw Metallicity (BLOeM) Collaboration Meeting, KU Leuven, Belgium	Research
07 Mar 2024	C.S. Jeffery	Topics in Stellar Pulsation	Topics in Astrophysics, AOP/QUB PhD Programme, Armagh Observatory, Armagh	Research
07 Mar 2024	J. Rigney	The Scale of Telescopes	Visitor Night, Dunsink Observatory, Co Dublin, Ireland	Outreach
09 Mar 2024	M. Burton	The Director's Cut – Scientific Instrument Society	Scientific Instrument Society Study Tour, Armagh Observatory and Planetarium, Armagh	Outreach
10 Mar 2024	C.J. Butler	The Armagh Observatory Weather and Climate Record	Scientific Instrument Society Study Tour, Armagh Observatory and Planetarium, Armagh	Research and Heritage Outreach
10 Mar 2024	J.S. Vink	Massive Star Science Goals, Importance of UV	Ulyses: Continuing the Voyage of Discovery Research, Space Telescope Science Institute, Baltimore, USA	Research
13 Mar 2024	D. Eden	What Causes Stars to Form?	University of Leeds, England	Research
14 Mar 2024	C.S. Jeffery	Highlights from the SALT Survey of Hydrogen-Deficient Stars and Hot Subdwarfs	Seminar, Armagh Observatory and Planetarium, Armagh	Research
14 Mar 2024	M. McMahon	The Imagined Planetarium - Building Armagh Planetarium 1937-1968	Armagh and District History Group, Armagh Observatory and Planetarium, Armagh	Outreach
14 Mar 2024	G. Ramsay	1. Super-flares from the Sun and other stars. 2. Multi-Messenger Astronomy and wide-field optical surveys	Topics in Astrophysics, AOP/QUB PhD Programme, Armagh Observatory, Armagh	Research
18 Mar 2024	M. Sarzi	St Patrick Green Day, Climate Change	Armagh Observatory and Planetarium, Armagh	Outreach
19 Mar 2024	K.O. Çubuk	Our Solar System	Ballycraigy Primary School, Antrim, Co. Antrim	Outreach
19 Mar 2024	A. Philip Monai	Groups in the SALT Dample	PhD Student Discussion Meeting, Armagh Observatory and Planetarium, Armagh	Research
21 Mar 2024	M. Sarzi	Galaxy Formation and Evolution, The Use of Integral-Field Spectroscopy	Topics in Astrophysics, AOP/QUB PhD Programme, Armagh Observatory, Armagh	Research
22 Mar 2024	J. Rigney	Leviathan to I-Lofar	UL Conference for Undergraduate Women in Physics, Birr Castle, Co. Offaly, Ireland	Outreach
26 Mar 2024	C.S. Jeffery	Project Sirius	PhD Student Discussion Meeting, Armagh Observatory and Planetarium, Armagh	Teaching
26 Mar 2024	G. Ramsay	Activity on M dwarfs	BlackGem Consortium Meeting, Nijmegen, The Netherlands	Research
27 Mar 2024	K.O. Çubuk	The Distribution of Molecular Clouds Along the Southern Galactic Plane	Seminar, Armagh Observatory and Planetarium, Armagh	Research
29 Mar 2024	S. Bagnulo	Observations of Magnetic White Dwarfs	Current Challenges in the Physics of White Dwarfs Stars Conference, Santa Fe, USA	Research

## Armagh Observatory and Planetarium Education and Outreach: April 2023 – March 2024

Date	Event Description
Apr 2023 – Mar 2024	The Legendary Telescope Tours at Armagh Observatory
Apr 2023 – Mar 2024	Little Astronomers (Monthly)
Apr 2023 – Mar 2024	Our World from Space Club (Monthly)
April 2023 – Mar 2024	STEM Cadets Afterschools Club (Weekly)
5 May 2023	Orienteering the Cosmos – A Special Planetarium Show for the Orienteers attending the 2023 British Championships in Armagh
27 May 2023	2023 Robinson Lecture “From Mars to the Multiverse” by Professor Martin Rees, Astronomer Royal. Hosted by the Astronomical Observatories of Ireland at Armagh, Birr and Dunsink and held in Dunsink Observatory.
29 May 2023	Wee Critters – Interactive Animal Education
4 – 9 Jul 2023	Jurassic Arc – Interactive Workshop
11 – 16 Jul 2023	Bricks 4 Kidz Workshop
18 Jul 2023	First Light: 230 Years of Observatories in Armagh
18 – 23 Jul 2023	Planet Roar – Live Dinosaur Show
26 – 27 Jul 2023	The Ultimate Bubble Show – Live Science Show
15 – 17 Aug 2023	The Science of Dragons with Scientific Sue
3 Aug 2023	Bakineering in Space with Andrew Smyth
Jul – Aug 2023	DVL Summer Public Demonstrations Every Thursday in July and August
9 Sep 2023	Armagh Food and Cider Weekend 2023 Event. Planet Cookies
9 Sep 2023	European Heritage Open Day: Experience The Calver Telescope
12 Sep 2023	Conferences 2023 Public Lecture – The Exciting Lives of Double Stars with Dr Stephen Geier
1 Oct 2023	One Planet and the Universe. IAU 100 Hours of Astronomy Event.
13 Oct 2023	PhD Flash Talks at the Planetarium
18 Oct 2023	Rocket Routes: Navigating with Math with the AmmA Creative Learning Centre. Maths Week Workshop
21 Oct 2023	International Observe the Moon Day
27 Oct 2023	Stargazing Evening at Armagh Planetarium
30 – 31 Oct 2023	Tall Tales and Terror at Armagh Observatory
30 – 31 Oct 2023	The Witches Are Back – Live Show
23 Nov 2023	Stargazing Evening at Armagh Planetarium
25 Nov – 23 Dec 2023	Mission Santa
12 and 14 Dec 2023	Christmas Lecture Live Stream with the Royal Institution
24 – 25 Nov 2023	Armagh Georgian Festival: A Very Georgian Collection Tour
29 Dec 2023	Stargazing Evening at Armagh Planetarium
26 Jan 2024	Stargazing Evening at Armagh Planetarium
15 – 16 Feb 2024	NI Science Festival 2024 Event: Orienteering at the Planetarium
15 – 16 Feb 2024	NI Science Festival 2024 Event: Data Visualisation Laboratory
15 Feb 2024	NI Science Festival 2024 Event: Experience the Calver Dome
16 – 17 Feb 2024	NI Science Festival 2024 Event: The Ultimate Bubble Show
16 Feb 2024	NI Science Festival 2024 Event: Director's Cut – This Month in Astronomy

23 Feb 2024	NI Science Festival 2024 Event: Little Astronomers
23 – 24 Feb 2024	NI Science Festival 2024 Event: Pink Floyd Dome Show
23 Feb 2024	NI Science Festival 2024 Event: Stargazing Evening
24 Feb 2024	NI Science Festival 2024 Event: Legendary Telescopes Tour
24 Feb 2024	NI Science Festival 2024 Event: Our World from Space Family Club
25 Feb 2024	NI Science Festival 2024 Event: CapCom Go – Dome Show
15 Mar 2024	Stargazing Evening at Armagh Planetarium

## Armagh Observatory and Planetarium Intergalactic Craic Podcasts: April 2023 – March 2024

Date	Podcast Title
21 Apr 2023	S3Ep3 – Wee Bitta Craic: Bout Ye Ethan?
26 May 2023	S3Ep4 – Wee Bitta Craic: Bout Ye Alice?
16 Jun 2023	S3Ep5 – Craic with all these moons?
27 Oct 2023	S3Ep6 – Intergalactic Craic On The Road

Presenters: H Alexander, E Wince, A Humpage and Z Gray

All published via [anchor.fm/intergalacticcraic](https://anchor.fm/intergalacticcraic)

See also: <https://podcasters.spotify.com/pod/show/intergalacticcraic>

## **ARMAGH OBSERVATORY AND PLANETARIUM**

### **THE CERTIFICATE AND REPORT OF THE COMPTROLLER AND AUDITOR GENERAL TO THE NORTHERN IRELAND ASSEMBLY**

#### **Opinion on financial statements**

I certify that I have audited the financial statements of the Armagh Observatory and Planetarium for the year ended 31 March 2024 under the Armagh Observatory and Planetarium (Northern Ireland) Order 1995. The financial statements comprise: the Statement of Financial Activities, the Balance Sheet, the Cash Flow Statement; and the related notes including significant accounting policies. The financial reporting framework that has been applied in their preparation is applicable law and United Kingdom accounting standards including Financial Reporting Standard (FRS) 102, the Financial Reporting Standard applicable in the UK and Republic of Ireland (United Kingdom Generally Accepted Accounting Practice).

I have also audited the information in the Trustees' Annual Report that is described in that report as having been audited.

In my opinion the financial statements:

- give a true and fair view of the state of Armagh Observatory and Planetarium's affairs as at 31 March 2024 and of its total incoming resources and expenditure of resources for the year then ended;
- have been properly prepared in accordance with the Financial Reporting Standard applicable in the UK and Republic of Ireland (FRS 102); and
- have been properly prepared in accordance with the Armagh Observatory and Planetarium (Northern Ireland) Order 1995 and Department for Communities directions issued thereunder.

#### **Opinion on regularity**

In my opinion, in all material respects the expenditure and income recorded in the financial statements have been applied to the purposes intended by the Assembly and the financial transactions recorded in the financial statements conform to the authorities which govern them.

#### **Basis for opinions**

I conducted my audit in accordance with International Standards on Auditing (ISAs) (UK), applicable law and Practice Note 10 'Audit of Financial Statements and Regularity of Public Sector Bodies in the United Kingdom'. My responsibilities under those standards are further described in the Auditor's responsibilities for the audit of the financial statements section of my certificate.

My staff and I are independent of Armagh Observatory and Planetarium in accordance with the ethical requirements that are relevant to my audit of the financial statements in the UK, including the Financial Reporting Council's Ethical Standard, and have fulfilled our other ethical responsibilities in accordance with these requirements.

I believe that the audit evidence obtained is sufficient and appropriate to provide a basis for my opinions.

#### **Conclusions relating to going concern**

In auditing the financial statements, I have concluded that Armagh Observatory and Planetarium's use of the going concern basis of accounting in the preparation of the financial statements is appropriate.

Based on the work I have performed, I have not identified any material uncertainties relating to events or conditions that, individually or collectively, may cast significant doubt on the Armagh Observatory and Planetarium's ability to continue as a going concern for a period of at least twelve months from when the financial statements are authorised for issue.

The going concern basis of accounting for Armagh Observatory and Planetarium is adopted in consideration of the requirements set out in the Government Financial Reporting Manual, which require entities to adopt the going concern basis of accounting in the preparation of the financial statements where it anticipated that the services which they provide will continue into the future.

My responsibilities and the responsibilities of the Trustees and the Accounting Officer with respect to going concern are described in the relevant sections of this certificate.

### **Other Information**

The other information comprises the information included in the Trustees' annual report other than the financial statements, the parts of the Trustees' Report described in that report as having been audited, and my audit certificate and report. The Trustees and the Accounting Officer are responsible for the other information included in the annual report. My opinion on the financial statements does not cover the other information and except to the extent otherwise explicitly stated in my certificate, I do not express any form of assurance conclusion thereon.

My responsibility is to read the other information and, in doing so, consider whether the other information is materially inconsistent with the financial statements or my knowledge obtained in the audit or otherwise appears to be materially misstated. If I identify such material inconsistencies or apparent material misstatements, I am required to determine whether this gives rise to a material misstatement in the financial statements themselves. If, based on the work I have performed, I conclude that there is a material misstatement of this other information, I am required to report that fact.

I have nothing to report in this regard.

### **Opinion on other matters**

In my opinion based on the work undertaken in the course of the audit:

- the parts of the Trustees' Report have been properly prepared in accordance with Department for Communities directions made under the Armagh Observatory and Planetarium (Northern Ireland) Order 1995; and
- the information given in the Trustees' Annual Report for the financial year for which the financial statements are prepared is consistent with the financial statements.

### **Matters on which I report by exception**

In the light of the knowledge and understanding of the Armagh Observatory and Planetarium and its environment obtained in the course of the audit, I have not identified material misstatements in the Trustees' Annual Report.

I have nothing to report in respect of the following matters which I report to you if, in my opinion:

- adequate accounting records have not been kept; or
- the financial statements and the parts of the Trustees' Report to be audited are not in agreement with the accounting records; or
- certain disclosures of remuneration specified by the Government Financial Report Manual are not made; or
- I have not received all of the information and explanations I require for my audit; or
- the Governance Statement does not reflect compliance with the Department of Finance's guidance.

## **Responsibilities of the Board of Governors and Accounting Officer for the financial statements**

As explained more fully in the Statement of the Governors and Accounting Officer Responsibilities, the Governors and the Accounting Officer are responsible for:

- the preparation of the financial statements and for being satisfied that they give a true and fair view;
- ensuring such internal controls are in place as deemed necessary to enable the preparation of financial statements to be free from material misstatement, whether due to fraud or error;
- ensuring the Trustees' Annual Report, which includes the Remuneration and Staff Report, is prepared in accordance with the Government Financial Reporting Manual;
- assessing the Armagh Observatory and Planetarium's ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless the Trustees and Accounting Officer anticipates that the services provided by Armagh Observatory and Planetarium will not continue to be provided in the future.

## **Auditor's responsibilities for the audit of the financial statements**

My responsibility is to examine, certify and report on the financial statements in accordance with the Armagh Observatory and Planetarium (Northern Ireland) Order 1995.

My objectives are to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error and to issue a certificate that includes my opinion. Reasonable assurance is a high level of assurance but is not a guarantee that an audit conducted in accordance with ISAs (UK) will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.

I design procedures in line with my responsibilities, outlined above, to detect material misstatements in respect of non-compliance with laws and regulation, including fraud.

My procedures included:

- obtaining an understanding of the legal and regulatory framework applicable to the Armagh Observatory and Planetarium through discussion with management and application of extensive public sector accountability knowledge. The key laws and regulations I considered included the Armagh Observatory and Planetarium (Northern Ireland) Order 1995;
- making enquires of management and those charged with governance on Armagh Observatory and Planetarium's compliance with laws and regulations;
- making enquiries of internal audit, management and those charged with governance as to susceptibility to irregularity and fraud, their assessment of the risk of material misstatement due to fraud and irregularity, and their knowledge of actual, suspected and alleged fraud and irregularity;
- completing risk assessment procedures to assess the susceptibility of Armagh Observatory and Planetarium's financial statements to material misstatement, including how fraud might occur. This included, but was not limited to, an engagement director led engagement team discussion on fraud to identify particular areas, transaction streams and business practices that may be susceptible to material misstatement due to fraud. As part of this discussion, I identified potential for fraud in the following areas: revenue recognition and posting of unusual journals;

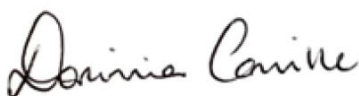
- engagement director oversight to ensure the engagement team collectively had the appropriate competence, capabilities and skills to identify or recognise non-compliance with the applicable legal and regulatory framework throughout the audit;
- documenting and evaluating the design and implementation of internal controls in place to mitigate risk of material misstatement due to fraud and non-compliance with laws and regulations;
- designing audit procedures to address specific laws and regulations which the engagement team considered to have a direct material effect on the financial statements in terms of misstatement and irregularity, including fraud. These audit procedures included, but were not limited to, reading board and committee minutes, and agreeing financial statement disclosures to underlying supporting documentation and approvals as appropriate; and
- addressing the risk of fraud as a result of management override of controls by:
  - performing analytical procedures to identify unusual or unexpected relationships or movements;
  - testing journal entries to identify potential anomalies, and inappropriate or unauthorised adjustments;
  - assessing whether judgements and other assumptions made in determining accounting estimates were indicative of potential bias; and
  - investigating significant or unusual transactions made outside of the normal course of business.

A further description of my responsibilities for the audit of the financial statements is located on the Financial Reporting Council's website [www.frc.org.uk/auditorsresponsibilities](http://www.frc.org.uk/auditorsresponsibilities). This description forms part of my certificate.

In addition, I am required to obtain evidence sufficient to give reasonable assurance that the expenditure and income recorded in the financial statements have been applied to the purposes intended by the Assembly and the financial transactions recorded in the financial statements conform to the authorities which govern them.

## Report

I have no observations to make on these financial statements.



*Dorinnia Carville*  
 Comptroller and Auditor General  
 Northern Ireland Audit Office  
 106 University Street  
 BELFAST  
 BT7 1EU

29 October 2024