

IRISH ASTRONOMICAL ASSOCIATION 49th AGM

Wednesday 12th April 2023

I hope you are keeping well in these (hopefully) post-pandemic times. This year our lectures resumed as in-person events, held at the Larmour lecture theatre, Queen's University. Many of the lectures have also been recorded and posted on the IAA website for all to view. The lecture summary of the 2022/23 season is given below and, as can be seen, the lectures covered a wide range of leading-edge astronomical subjects.

A big thank you to Andy McCrea who, as President of the association, has chaired the bi-weekly lectures and Council meetings while also continuing in the role of Editor of the Stardust magazine. We are very grateful for everyone who contributed articles to Stardust including Stardust Kids and to Tony and Eve Kempston for coordinating the printing and distribution of the magazine to over 200 members.

Paul Evans has yet again done great work both as Vice President and Webmaster, presenting his bi-weekly sky guide talks, recording the guest lectures and maintaining and updating the IAA website, ably assisted by Tony Kempston.

Our thanks are also due to John McClintock who, as Vice President, has been involved in the printing and distribution of the News Sheet and Sky Guide and in supporting the observing events at Clondeboye and outreach events during the year, ensuring that all runs smoothly. A big thank you is also due to David Stewart our Observing Section coordinator who, together with Andy McCrea, John McClintock and Chris Seaton, have hosted successful observing events both at Delamont and, more recently, at Clondeboye.

Mary Kirwan-Mackey, our Membership Secretary, continues to do great work in maintaining our membership database and actively communicating with our members.

We are grateful to Terry Moseley for his work behind the scenes in organising the bi-weekly lecture programme and the highly successful outreach event at Oxford Island, including 'rocket-launching' ably assisted by Danny Collins. We also thank Terry for producing the regular association newsletter emails.

Our thanks are also due to Pat O'Neill for his continuing expert management of the association finances in his role as Treasurer.

We are also grateful to Simon Hearne (and Poppy) for coordinating the refreshments that we all enjoy after each lecture.

We continue to be grateful to Queen's University Astrophysics Research Centre for continued support in providing a venue for the association to hold our lecture programme.

Finally, thank you to all our members, old and new, for your support and interest which has been magnificent throughout the year makes the association what it is today.

IAA Lecture Programme Summary 2022-23:

<p style="text-align: right;">21/09/2022</p> <p>01. 'Last Horizons: The Solar System beyond Pluto' <i>Dr. Steph Merritt, ARC QUB.</i></p> <p>Steph began by outlining the history of the possible existence of a mysterious Planet X beyond the orbit of Neptune, leading to the discovery of Pluto in 1930.</p> <p>With the discovery of Eris and other Trans-Neptunian Objects (TNOs) in 2005, this led to the IAU demoting Pluto to the status of a dwarf planet in 2006. We now know there are thousands of TNOs.</p> <p>The discovery of Sedna in 2003 and six other TNOs with highly eccentric orbits with apogee clustered on one side of the Sun, led to Planet X being proposed in 2016 as a possible cause of this clustering effect. Planet X is postulated to be a 'mini-Neptune' gas giant planet, ejected from the inner Solar System and currently slowly-moving in the sky somewhere in the constellation of Orion. Its existence is controversial and it is hoped that the new Legacy Survey of Space and Time (LSST) at the Vera C. Rubin observatory in Chile will shed light on the mystery, during its planned 10 year sky survey beginning in 2023.</p>	<p style="text-align: right;">05/10/2022</p> <p>02. 'Moving an asteroid – did we do it?' <i>Prof. Alan Fitzsimmons, ARC QUB.</i></p> <p>Alan began by speaking of surveys underway (ATLAS and PANSTARRS) to identify and track asteroids that pose a risk to Earth. Alan then described the NASA DART mission, a kinetic impactor spacecraft designed to deflect the asteroid Dimorphos which orbits another asteroid Didymos. DART arrived on 27th September 2022, striking the asteroid at a speed of 6.1 km m⁻¹.</p> <p>Immediately before impact the asteroid was imaged and seen to be a 'rubble pile': an aggregate of rocks, stones, grit and dust. An accompanying spacecraft with camera imaged a cone of material ejected from the impact crater to form a dust tail of small particles. By measuring changes in the light curve of the orbiting system it will be possible to determine by how much the orbital period of Dimorphos was changed. The next phase of the work involves the launch of the HERA mission in October 2024 and due to rendezvous with Dimorphos in January 2027 to investigate more closely the effects of the impact.</p>
<p style="text-align: right;">19/10/2022</p> <p>03. 'Planetary nebulae and their role in the cosmic distance ladder.' <i>Prof. Marc Sarzi, AOP.</i></p> <p>We can detect planetary nebulae at great distances, even in other galaxies in the Virgo cluster. The luminosity of a planetary nebula can be used as a standard candle, using the fact that there is a rough maximum brightness for planetary nebulae, allowing the distance to the galaxy to be estimated. It is therefore a step in the cosmic distance ladder to determine the size of the universe.</p>	<p style="text-align: right;">02/11/2022</p> <p>04. 'A history of Astronomy part 2: from Newton to now.' <i>Mr. Brian MacGabhann, Galway Astronomy Club.</i></p> <p>Brian described the development of our understanding of the universe from the time of Newton through to the present day, noting how we determined what stars are, how stars shine, how big the universe is and how the universe came about.</p>
<p style="text-align: right;">16/11/2022</p> <p>05.a. 'Hunting for exoplanets using Citizen Science.' <i>Mr. Sean O'Brien, PhD student, ARC QUB.</i></p> <p>Sean described his use of the transit method (dip in a star's light curve) to detect exoplanets orbiting around stars outside our solar system, using the ground-based Next Generation Transit Survey (NGTS). The volume of data generated is such that public volunteers can get involved in spotting transits in light curves and find exoplanets missed in initial searches of the datasets.</p> <p>05.b. 'Discovery and characterisation of supernovae in the local universe.' <i>Mr. Thomas Moore, PhD student, ARC QUB.</i></p> <p>Thomas began by explaining that Supernovae are cataclysmic explosions of stars that grow so bright that they outshine their host galaxies. Type I supernovae (hydrogen absent in spectrum) are formed from the explosion of white dwarf stars and Type II supernovae (hydrogen lines present in spectrum) are formed from the collapse of a massive star. The ATLAS Sky Survey which hunts for exoplanets also processes data to find stationary transients which may be supernovae.</p>	<p style="text-align: right;">30/11/2022</p> <p>06. 'First science with the James Webb Space Telescope.' <i>Prof. Jorick Vink, AOP.</i></p> <p>Jorick began his lecture by describing the new James Webb Space Telescope (JWST). The primary mirror is 6.5 metres in diameter. JWST is also equipped with cameras and spectrographs. Its mission is planned to last for at least the next 10 years.</p> <p>The JWST is designed to observe in the infrared region of the EM spectrum, allowing it to peer through dust clouds and allow the study of star formation. Jorick showed a JWST image of the Wolf-Rayet 140 star displaying 17 shells of structure in the nebula blown out from the star explosion, with an 8 year time duration between each shell.</p> <p>The JWST will observe formation of first stars and spectra will identify high redshift proto-galaxies in the very early universe, 100 million years to 1 billion years after the 'big bang'. JWST spectra can also confirm that gravitational lensing arcs around a black hole belong to the same distant object: galaxies or individual stars.</p>

<p style="text-align: right;">14/12/2022</p> <p>07. 'Life as a solar/stellar astronomer: 50 telescopes and counting.' <i>Prof. Emeritus Gerry Doyle, AOP.</i> Gerry took us on a fascinating tour of his time in astronomical research, starting with his PhD research at QUB applying atomic calculations to solar data. He has used 50 different telescopes (and counting) around the world (and in space) including the radio telescope in Arecibo, the reflector on Mount Wilson and the Isaac Newton telescope at La Palma to name but a few. More recently he has also made use of data derived from the I-Lofar radio telescope at Birr. He mentioned successes and failures in his observing career, the latter including mis-interpreting data that could have led to the discovery of the first exoplanet and flare star observations at Kitt Peak with Dr. Pat Byrne being clouded-out for the entire trip! Although now officially retired Gerry is still active in research, jointly supervising two PhD students.</p>	<p style="text-align: right;">04/01/2023</p> <p>08. 'The final fate of massive stars.' <i>Prof. Stephen Smartt, Oxford University & ARC QUB.</i> Stephen explained that when a supernova occurs, the core of the star implodes to a neutron star (pulsar) about 10 km in diameter, in a fraction of a second, releasing a shock wave of energy which explodes the outer regions of the star. Stars of mass 8 to 20 times the mass of the Sun can produce supernovae. The ATLAS all sky survey scans the sky every night, out to a distance of 100 Mpc and computer analysis of the data allows identification of static transients that might be supernovae. Examples of type II supernovae observed are SN 1987A in the Large Magellanic Cloud in 1987 and SN2008bk in the spiral galaxy NGC7793 in 2008. However the fate of stars above 20 solar masses is not clear as a statistically significant number of supernovae that should be seen are not seen in the data, leading astronomers to believe that they die without a supernova explosion. A possible candidate of such a massive star that dies a 'dark death' is currently being studied in the spiral galaxy NGC6946. It is a star that suddenly 'disappeared' in 2015 leaving only a faint infrared trace behind. It is thought that such massive stars with very high gravitational potential energy and rotational (kinetic) energy may implode to form a black hole, preventing the outer layers of the star from exploding outwards. The Vera C Rubin LSST survey telescope will come online in 2023 and allow astronomers to probe deeper and detect fainter transients allowing further investigation of the question.</p>
<p style="text-align: right;">18/01/2023</p> <p>09. 'Searching for molecules in the atmospheres of exoplanets.' <i>Dr. Ernst de Mooij, ARC QUB.</i> Exoplanets can be detected by the host star wobbling about their shared centre of gravity and observed by the periodic blue-shift and red-shift of the star's spectrum. Alternatively we can observe the dip in the light curve of the star as the exoplanet transits across the star. The rotational velocity of exoplanets can be detected by observing blue-shift and red-shift of the planet's spectrum. During the transit of 'hot Jupiter' planets (gas giants close-in to the host star) part of the light from the star is absorbed by the planet's atmosphere. In this way, the James Webb Space Telescope has detected carbon dioxide in the atmosphere of exoplanet WASP-39b and water in the atmosphere of WASP-96b. Ernst's current research involves investigating the secondary eclipse, where the planet disappears behind the host star and then re-appears and during which reflected light from the planet is blocked by the star. It is possible in this case to measure the temperature of the planet, detect possible storms in the planet's atmosphere and even generate a temperature map of the exoplanet.</p> <p style="text-align: right;"><i>Total Attendance: 45</i></p>	<p style="text-align: right;">01/02/2023</p> <p>10. 'The Winchcombe Meteorite 28th Feb 2021: My part in its downfall.' <i>Dr. Mike Simms, National Museums NI.</i> On 28th February 2021 a fireball was reported over Gloucestershire and observed by numerous observers who were alerted to its arrival. By triangulation of observations it was possible to predict its likely impact zone on the ground. About 350 g of grey powder from the meteorite were found on the driveway of a house in the village of Winchcombe. A 150 g fragment was found in a sheep field and other smaller fragments were also found. Mike visited the fall area to search for more fragments but was unsuccessful in his search. The meteorite is a CM carbonaceous chondrite: a crumbly material made up of chondrules (small beads) and containing organic compounds (amino-acids). Its initial mass is thought to be 13 kg but only 650 g have been recovered. It is estimated to be 4.6 billion years old, originated in the outer part of the asteroid belt between Mars and Jupiter and is estimated to have taken 300,000 years to make its way from the asteroid belt to Earth.</p> <p style="text-align: right;"><i>Total Attendance: 51</i></p>

<p style="text-align: right;">15/02/2023</p> <p>11. 'The science of superheroes in film and television.' <i>Prof. Francis Keenan, ARC QUB.</i></p> <p>Francis gave us a definitive guided tour of the various super heroes depicted in modern movie films, including clips from many movies. He compared the super hero powers of various characters (Superman, Batman, Wonder Woman, the Incredible Hulk, etc) and explained how their powers were either technically possible or completely in defiance of the laws of physics.</p> <p style="text-align: right;"><i>Total Attendance: 44</i></p>	<p style="text-align: right;">01/03/2023</p> <p>12. 'Observing solar activity in Lyman-alpha emission.' <i>Dr. Ryan Milligan, ARC QUB.</i></p> <p>Ryan began by explaining that the Sun is in the rising side of solar cycle 25 and we are seeing significant solar activity currently. A powerful X-class flare occurred on 17th Feb 2023 and the associated coronal mass ejection caused an aurora observed from Northern Ireland. Solar flares are classified as X (high energy), M (medium energy) and A, B, C (low energy). Ryan's research focusses on observations of the Sun at the ultraviolet Lyman α wavelength hydrogen emission line (1216 Å). It is the strongest emission line in the solar spectrum and is important as UV radiation has a significant effect on Earth in ozone creation in the mesosphere and in D-layer creation in the ionosphere. In Feb 2020, ESA launched the Solar Orbiter spacecraft which has a Lyα imager onboard, to make observations inside the orbit of Mercury and outside the ecliptic plane, to allow observation of the solar poles. Ryan plans to travel to Alaska in Mar 2024 to take part in a project involving a NASA-launched rocket (SNIFS) to make observations at an altitude of 178 miles (well outside the Earth's atmosphere), recording data during a brief 5-minute window at apogee.</p> <p style="text-align: right;"><i>Total Attendance: 38</i></p>
<p style="text-align: right;">15/03/2023</p> <p>13. 'Diving deeper into the radio sky: solar, stellar and extra-galactic astronomy with the LOW Frequency Array.' <i>Mr. Jeremy Rigney, PhD student, DIAS & AOP.</i></p> <p>Lofar has a baseline of 2000 km between Ireland (I-Lofar) and Poland giving an angular resolution of 0.1" arc with intermediate stations in UK, Netherlands, Sweden and Germany. Lofar is made up of high and low band antennae fixed in the ground to allow observation at low frequency. Lofar can be used for a range of observations including:</p> <ul style="list-style-type: none"> • detecting new galaxies emitting high-energy jets from black holes in galactic centres. • surveying the entire sky; so-far over 1 million new radio galaxies have been discovered. • showing bright regions of star formation in galaxies that are obscured by dust and gas at optical wavelengths. • making radio observations of the Sun at a range of wavelengths from 1 cm to 12 m to show activity such as coronal mass ejections. • measuring radio emission on other stars to determine if they are 'quite enough' not to disrupt potential life on orbiting exoplanets. <p>The future of radio astronomy includes the proposed square kilometre array in Australia and South Africa. NASA is also considering use of a crater on the far side of the Moon in which to suspend a receiver.</p> <p style="text-align: right;"><i>Total Attendance: 35</i></p>	<p style="text-align: right;">29/03/2023</p> <p>14. 'SALT and the super-hot zombie stars.' <i>Dr. Simon Jeffery, AOP.</i></p> <p>SALT is the Southern African Large Telescope, an 11 m diameter telescope made up of 1 m hexagonal mirrors. Simon's research involves using SALT to survey the sky for hot OB stars with temperatures of 100,000K to 200,000 K. They are about 0.5 solar masses but show a rich surface chemistry in their spectral lines, including H, He, C and O. Using SALT over 200 such stars have already been observed, of various types:</p> <ul style="list-style-type: none"> • O(H) hydrogen-rich stars at the centre of old planetary nebulae, evolving to white dwarf stars • PG1159 / GW Vir type stars which fail to become white dwarf stars and become 'zombie stars' by a late re-ignition of helium fusion, expanding to become yellow supergiant stars before fading to become DO white dwarf stars. • O(He) helium-rich stars which started life as a binary star system of two white dwarf stars which merge to form a yellow supergiant star (a second type of 'zombie star') which, again, eventually contracts to become a DO white dwarf star. • Hot DO white dwarf stars which have descended from PG1159 stars and O(He) stars. <p>In the next stage of the SALT survey it is planned to observe 400 more hot sub-dwarfs and potentially detect up to 8 more super-hot 'zombie' stars.</p> <p style="text-align: right;"><i>Total Attendance: 33</i></p>

Remember to visit the IAA website 'irishastro.org' for any future updates.

IAA Outreach Events 2022-23:

<p>1. New Year Party. 14/01/2023 <i>McBride's on the Square, Comber.</i> About 17 members gathered for Tea/Coffee, sandwiches, George Brannan's table quiz with prizes and a DVD documentary on NASA plans for a space station on the Moon.</p>	<p>2. Northern Ireland Science Festival. 17-19/02/2023 <i>Rathlin Island</i> Partial clear skies allowed some observing in the harbour area and naked eye observing assisted with a laser pointer. Terry also gave an astronomy talk each evening. Attendees staying overnight stayed at the Manor House Hotel on the island. Terry, Danny, Simon and guests attended.</p>
<p>3. Northern Ireland Science Festival. 25/02/2023 <i>Lough Neagh Discovery Centre.</i> Solar observing using a refractor fitted with Baader filter and also direct observing using a Coronado solar telescope. A kid's table, VR setup, solar system models and astronomy gadgets were on display. Star shows were given using the portable planetarium and compressed-air rocket launching was conducted. It was reported that around 1400 people attended the event. Some limited viewing of the Moon and Jupiter was possible in the evening before cloud-cover closed-in.</p>	<p>4. Irish Astronomy Week. 20-26/03/2023 <i>Various venues.</i> Paul Evans gave a range of talks, including: Talk to pupils at Moyle Primary School in Larne about Neil Armstrong. Talk on 'Introduction to Astrophotography' in the dome of Armagh Planetarium. Zoom talk to Larne Camera Club on 'Photographing the Aurora'. Zoom talk to Donegal Dark Skies Group on 'Introduction to Astronomy'.</p>

Thanks to all our members and guests for participating in the outreach events.

IAA Observing Sessions 2022-23:

Date	Venue
16/09/2022	Delamont Country Park
18/11/2022	Clandeboyne Estate
04/02/2023	Clandeboyne Estate
26/03/2023	Clandeboyne Estate

Typical of objects viewed in these observing sessions included:

- Various Messier and NGC objects using David Stewart's 12-inch Dobsonian telescope at Delamont Country Park.
- Observing Jupiter and its Galilean moons using members binoculars.
- Andy McCrea displayed craters on the Moon, M52 Whirlpool galaxy and M22 globular cluster using the 8-inch Newtonian telescope at the Clandeboyne Observatory and viewed on screen for attendees to see in the observatory classroom.
- Chris Seaton imaged the Veil Nebula during an observing session using his Redcat 51 refractor and camera and displayed the results on his laptop.

Thanks to David Stewart the observing section coordinator, John McClintock and Andy McCrea for organising the observing sessions at Delamont and Clandeboyne.