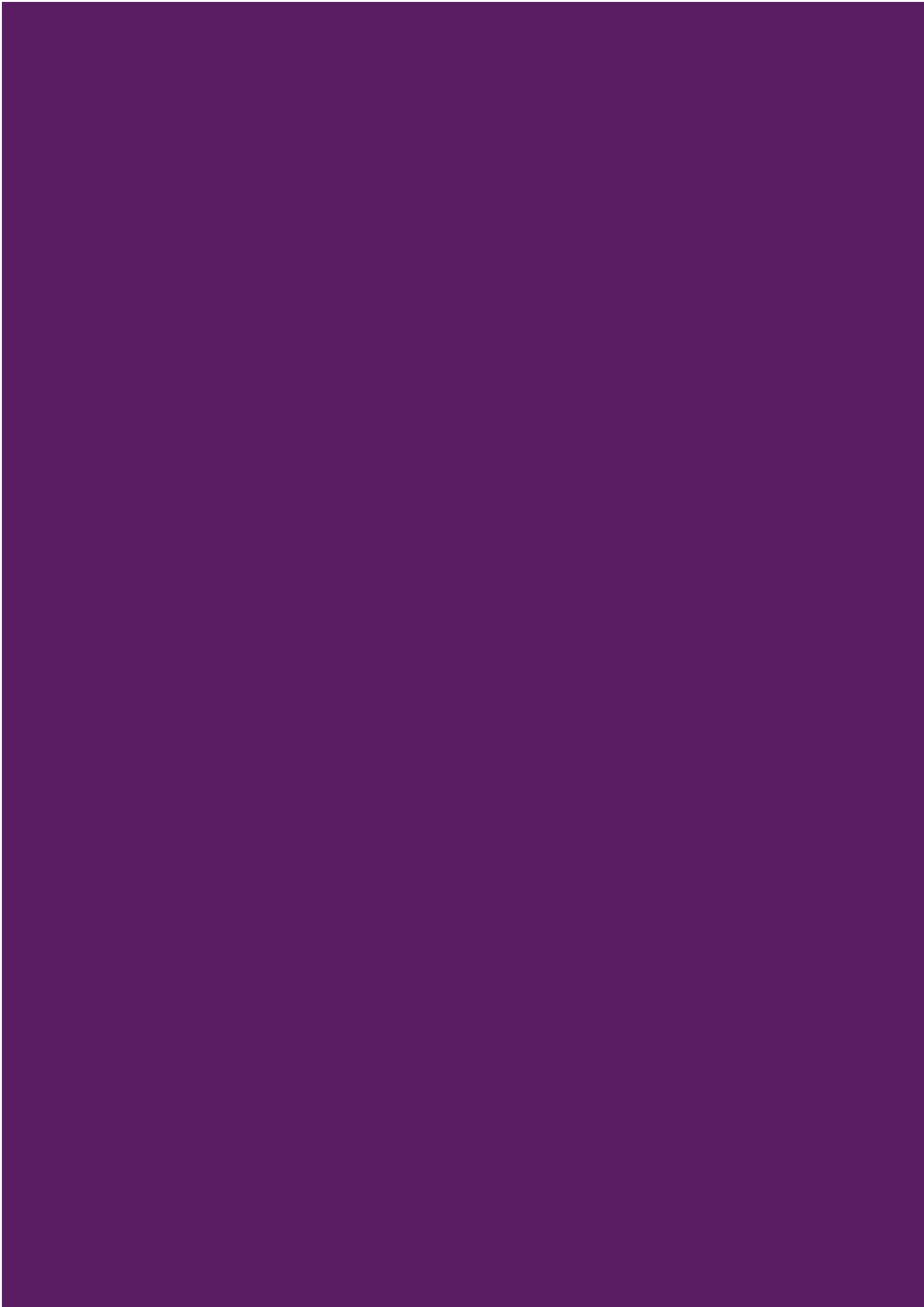


# Keele Observatory Annual Report 2020/2021





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**Figure 1** Hope for a better future.

## From the Director

Through the ages, comets have often been seen as bad omens, heralding war, famine or pestilence. When the comet C/2020 F3 (NEOWISE) was discovered in March 2020, the world had just plunged into the worst pandemic since living memory. The UK had locked down, and our lives had changed overnight. Silence descended upon the country, airplane trails all but vanished from the skies and calm weather lured our eyes to the Heavens. The comet quickly became a naked-eye object (under dark skies), and then left us in its wake, leaving humanity grapple with a deadly disease and question social values and governance.

We all lost something those years. Someone, sanity, time... That's why this report exceptionally covers two calendar years, comprising less than a year of actual Observatory life. Sadly, it ended with the passing in December 2021 of Alan Mason, at the age of 89. Alan was a great asset to the Observatory in Ron Maddison's days and followed its progress ever since.

In spite of everything, we gained something, too. An appreciation of what truly matters, often seemingly small, and near. After one and a half year being closed to the public, with just sporadic checks of the safety of the building and equipment and technical work resuming only in the final couple of months, when we emerged at last we found ourselves to be as popular as ever. The fall-out from the impact on our lives will take years to heal, if at all, but meanwhile we raise our head and spread our wings, a phoenix rising from its ashes.

*Jacco van Loon*

## Administrative report

### Personnel

The Keele Observatory is operated and maintained through a unique partnership between the School of Chemical and Physical Sciences at Keele University and a

group of skilled and dedicated volunteers and the coming and going of students.

In 2020/2021 the team comprised James Albinson, Alan Bagnall, Dave Caisley, Ian Johnson, Paul Klimczak, Richard and son Patrick Oppenheimer, StJohn Robinson, Matthew Stretch, Andrew Shepherd and John Webb, with veteran Stephen Doody remaining affiliated at a distance.

Undergraduate students Camilla Jones (Computer Science), Daniel Abbott (Astrophysics + Chemistry) and Jordan Richmond (Astrophysics + Education) were joined by Duke of Edinburgh sixth form student Livvy Purcell, Logan Dennis (Physics and Astrophysics) and Matthew Baker (Science Foundation Year).



Figure 2 A historical document as edited by the ever witty Andrew Shepherd.

### Equality, Diversity and Inclusion

Our team embraces diversity and inclusion, though we would like to see this reflected more visibly in its membership. Our unwritten (for now) 'Code of Conduct' is aimed at making marginalized or under-represented visitors feel valued and stood up for. We re-enforce this message when entertaining groups of children.

For the second time in a row we organized a multi-disciplinary event for the United Nations International Women and Girls in Science Day, which takes place every year on 11<sup>th</sup> February. Like in 2019, it drew 80 visitors up to the Observatory. We've also kept buying and giving away Rachel Ignotofsky's hugely popular Women in Science postcards.



Figure 3 Covid-19 lockdowns and restrictions.

We tweeted about Women's Day, International Women in Engineering Day, in memory of female astronomer Margaret Burbidge and space scientist Katherine Johnson, thanking COVID-19 key workers, and a poem on World Mental Health Day.

### Sustainability

The sustainability effort concentrated on getting the building and its infrastructure, as well as the Observatory Team through the pandemic safely, both physically and mentally. Routine checks were performed during the lockdowns but otherwise the building was off limits, and when we re-opened late in 2021 we did this with strict control of numbers of visitors and spacings between visits, the wearing of personal protection and providing hand sanitisers. As a result, we were able to gradually and smoothly return back to normal operations early in the following year.

An internal energy audit was used to flag up the lack of a thermostat and time switches. We must thus use our judgment and planning to adjust the radiators (and lights). This is challenging, also as we have

no control over what domestic or technical staff do in our absence.

It was in October 2021 when the Nurture project started in earnest. Led by Keele student Ellie-kay Dawe as employee of the community organisation Mondrem, this involved sowing a lush meadow of wildflowers in front of the Observatory, to promote insect life.



Figure 4 Launching the Nurture project, with lead student Ellie-kay Dawe (on the right).



Figure 5 January 2020, and a spider's web trapping a constellation of droplets trapping light and darkness.

### Finances

For the second, if consecutive, time since 2010, the expenditure in the 2020+2021 period exceeded the income – though only by a small amount given that the total volumes of income and expenditure were both greatly reduced due to the lockdowns which started on the 18<sup>th</sup> of March 2020.

We finally re-opened on the 27<sup>th</sup> of September 2021, after nine cancelled arranged visits due to Covid-19 (and two due to industrial action). We then offered ten bespoke visits (of which three virtual)

without asking for donations, as we were fully aware that the pandemic had already demanded a lot of people's finances. The Astronomy Club had become a casualty of the pandemic (as the North Staffordshire Astronomical Society had been as well). Meanwhile, the main technical project – and associated spending – had become the upgrade of the 12" dome control.

In preparation for the arrival of the new 20" telescope, after having removed the binoculars and their installation the roll-off enclosure was refurbished (rust treatment, painting, door replacement) paid for by the School at £1517 + VAT.

**Table 1 Financial account for 2020+2021.**

<i>1. Balance brought forward</i>	£7889
<b>Income</b>	
School activities	£46
Community group visits	£275
Astronomy Club	£34
Donations	£147
<i>2. Total income</i>	£502
<b>Expenditure</b>	
General maintenance	£188
12" dome control upgrade	£394
<i>3. Total expenditure</i>	£582
<i>Surplus (items 1 + 2 – 3)</i>	£7809

**Table 2 Budget for 2022.**

<i>1. Balance brought forward</i>	£7809
<b>Income</b>	
Hospitality	£800
Donations	£100
<i>2. Total income</i>	£900
<b>Expenditure</b>	
General maintenance	£100
12" dome control upgrade	£600
Printing Annual Report 2019	£60
<i>3. Total expenditure</i>	£760
<i>Surplus (items 1 + 2 – 3)</i>	£7949

Based on the most recent accounts and projections for upcoming activity, we set a budget for 2022, aiming for (only) a slight surplus. We anticipate further costs pertaining to the upgrade of the 12" dome control, and there remains a great deal of uncertainty surrounding post-pandemic public visits and events.

## Infrastructure and equipment

The lockdowns and restrictions due to the pandemic required various versions of risk assessments and approvals. The University installed a hand sanitiser and provided abundant signage about facial coverings and social distancing. We finally resumed technical work on the last day of July 2021, making up for the overdue PAT testing.

We also took the opportunity to make various cosmetic improvements, such as properly mounting and displaying artwork (Paul Doherty's Saturn painting and the Indian school children's galaxy painting), moving one of the noticeboards to the entrance hall, as well as clearing out and preparing the roll-off shed for the arrival of the new telescope.

The large format (20'x30' on the 12" refractor) ATIK-11002 CCD camera and filter wheel were commissioned. While it has its limitations (longer readout time, 0.03s minimum exposure time, and often some vignetting) it provides great imaging at easier acquisition. It does have some bad columns that are difficult to completely remove with bias and flatfield calibration frames. It was meant to be used routinely in combination with the 10" Meade; its control box failed, again, though, and this forces us to rethink how (if at all) we store and operate it in the roll-off shed.

Unfortunately, vandalism had increased around the Observatory site. CCTV caught both the damage being inflicted upon the bike stand (in November 2020) and Solar System models at the Sustainability Hub (December 2020). In the former case the images were too poor to identify anyone but in the latter case a

student was identified and disciplined. We offered community service in lieu of an academic penalty but this was dismissed. The bike stand was repaired by Estates. After a lot of litter including broken glass after 2020's New Year celebration, after the 2021 Solstice, too, the telescope pier and mount at the viewing platform were again the target of inappropriate leisure activity – some of the removed parts were recovered. The protective bicycle cover was lost to storm Ciara.

### Engineering work on the Thornton

We did not have much opportunity to make much progress with AWR's control system of the 24" telescope, though we inched closer to understanding the system and regaining control. Aside from mothballing over the lengthy period of lockdowns, this was further hampered by the tripping of power by the dome rotation, which also stalled the 'Starchaser' project to slave the motion of the dome to that of the telescope.

### Maintenance of the Grubb and its dome

The 12" refractor's dome control project also did not get much chance to progress, but the 12" lens cover was repaired. The 12" dome control, dome rail and indeed the dome itself have moved up the priority list. At some point, the walls (and telescope) might need a lick of paint, too.

## Research activities



Figure 6 Cave Nebula by Steve Doody, near Whitby.

Member-at-large Steve Doody continued producing amazing astrophotography and image processing results – see also the portfolio at the back of this report, while comet NEOWISE was imaged from Audlem.



Figure 7 Comet NEOWISE by Jacco van Loon, Audlem.

### Undergraduate laboratory work

The third and fourth editions of the Year One laboratory classes in observational astronomy were again successful, albeit the 2020 edition curtailed by lockdown and the 2021 edition done remotely by the Observatory Director from their home (under darker skies) in Audlem using the Observatory instrumentation on their own 8" Schmidt-Cassegrain Telescope.

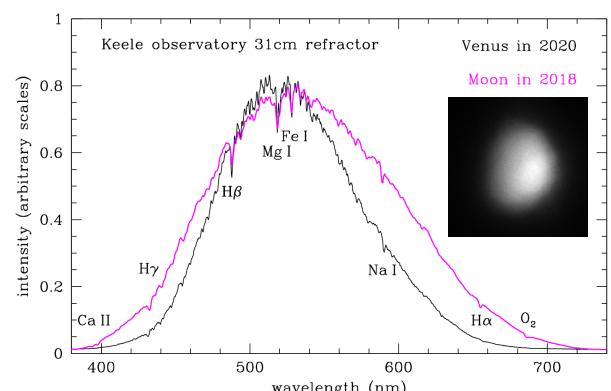


Figure 8 Spectrum of Venus compared to an archival spectrum of the Moon, both representing sunlight but reflected by different media, with an insert picture of Venus, all obtained in 2020 at the 12" refractor.

Venus was imaged on 28 January 2020 with the ATIK-314 mounted on the 12" refractor (no filter, 0.001s exposure), and a spectrum was obtained on the same night (0.4s exposure). On 4 February 2020 the Moon was imaged with the ATIK-11002 camera on the 12" refractor (R band, 0.03s



Figure 9 Moon in 2020 with the new ATIK-11002 on the 12" refractor, full frame (top) and zoom (bottom).

exposure which is the minimum exposure time for this large format CCD). Spectra were obtained of Mars on 9 February 2021 (60s) and compared with twilight (120s), the 7 filters in the ATIK-11002 filter wheel were scanned on 23 February 2021 (30s) using a light bulb (also scanned separately with 10s but without telescope), and the stars Aldebaran, Betelgeuse, Capella and Be-type star  $\gamma$  Cassiopeia (all 10s) were spectroscopically observed on 2 March 2021, all using the 8" SCT in Audlem.

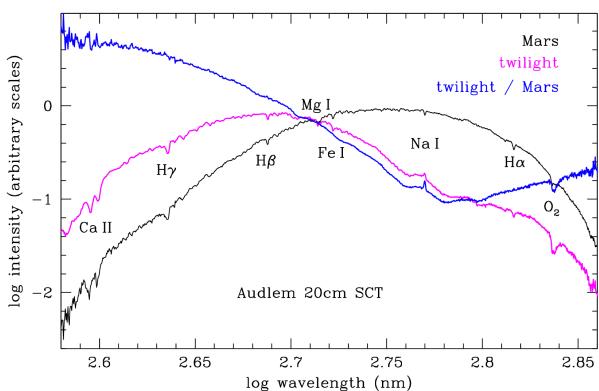


Figure 10 Spectrum of Mars compared to twilight, showing different modes of reflection – red albedo of Mars and Rayleigh scattering in Earth's atmosphere.

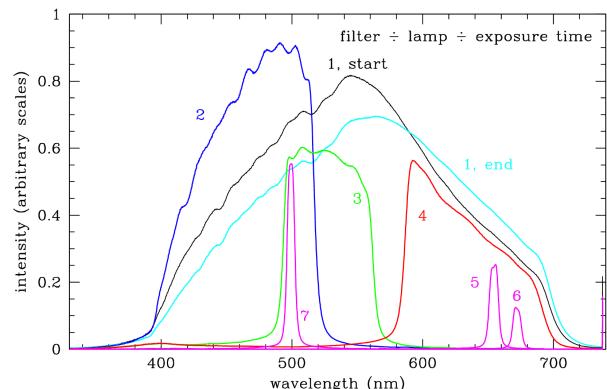


Figure 11 Filter transmission curves for the ATIK-11002 filter wheel: L, B, V, R, [O III], H $\alpha$ , [S II] and L.

These measurements have provided valuable characterization of our equipment and illustrations of planetary atmospheres and stellar types, and helped bring into use the ATIK-11002 camera and filter wheel.

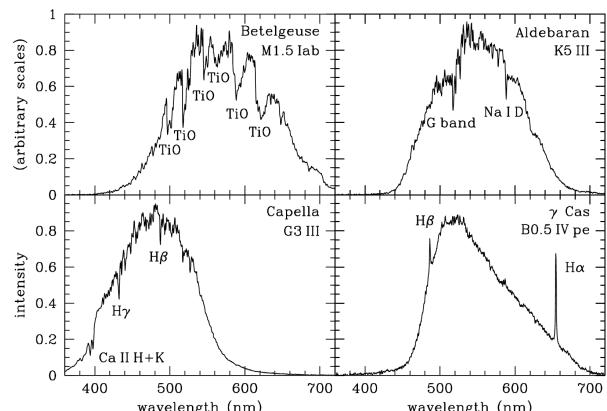


Figure 12 Spectra of the red supergiant Betelgeuse, red giant Aldebaran, quasi-Solar-type star Capella and Be-type star  $\gamma$  Cassiopeia. The different response curves appear to be a strong function of focus and/or positioning on the slit – this is yet to be investigated.

## Outreach activities

Despite the lockdowns and restrictions due to the pandemic we welcomed at least 1270 visitors to the Observatory, and over 100 attending on-line events. Had we had more time to develop these, we would have done more on-line events and perhaps created a more permanent and innovative on-line presence, however the increased pressure on other work duties and lack of academic involvement in the Observatory prevented this from happening.

For the second year running we celebrated United Nations International Women and Girls in Science Day, on the 11<sup>th</sup> of February of 2020 from 1-10pm. We were lucky to have the participation again from Life Sciences (Yolanda Gómez), Geology (Ralf Halama) and Physics (Steven Wye). Of about 80 visitors who braved the blustery weather, some enjoyed views of the Sun or Venus.

As we have done previously, on the 10<sup>th</sup> of November 2021 we opened the doors to the audience of a concert, this time by the Orchestra for the Earth, who played as part of Luke Jarram's exhibition 'GAIA' of a huge Earth globe suspended from the ceiling of the University Chapel. Despite the late hour (9pm) and overcast skies we had 50 people walking up the hill.

### Media activities

Keele Observatory benefits from being named – if not promoted – at the many interviews the Director engages in with national and international radio and television outlets. These can often be listened to or watched on YouTube and visitors sometimes mention this.

Postdoctoral researcher Alex Binks led a full-length show on Pete Williamson's Astro Radio, about The Great Conjunction between Jupiter and Saturn on the 21<sup>st</sup> of December 2020. The Observatory provided a live item from the 12" dome.

We also produced a couple of virtual tours of the Observatory, during the first lockdown, and continued making use of Twitter – you may follow us on @KeeleObs



Figure 13 Daniel Abbott checking the views during a visit by the School of Pharmacy.

### Public viewings

About 350 people visited the Observatory this year on its free Tuesday evenings' and Saturday afternoons' public viewings. When we re-opened after the lockdowns, in Autumn 2021, we operated a booking system, as we had to limit numbers to a maximum of twenty at any one time. This worked quite well, but it meant extra administration and some who booked cancelled at short notice or simply did not turn up. The Saturday openings did not resume until the following year.



Figure 14 Moon through the 12" by Szu Sheng Wong.

### Schools and teachers

We hosted 2 visits by schools, reaching 46 learners and 5 teachers, with many more planned but cancelled due to the pandemic. We also contributed again to the School Physicist of the Year awards, hosted online for an unknown number of attendees by the fantastic Scott Walker.

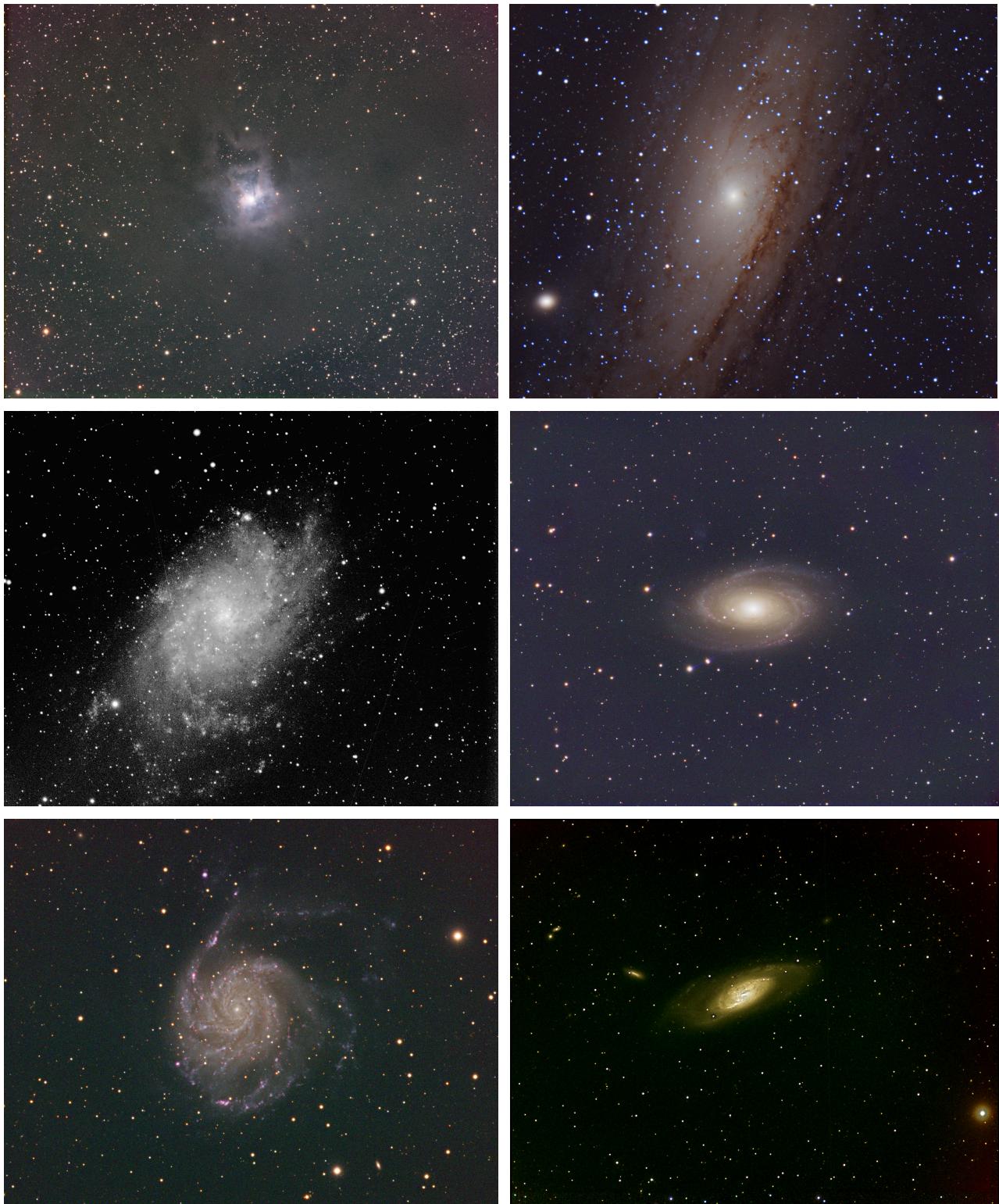
Open Days for prospective students, and other visits by students attracted 320 visitors and another 27 online participants.

### Community group visits

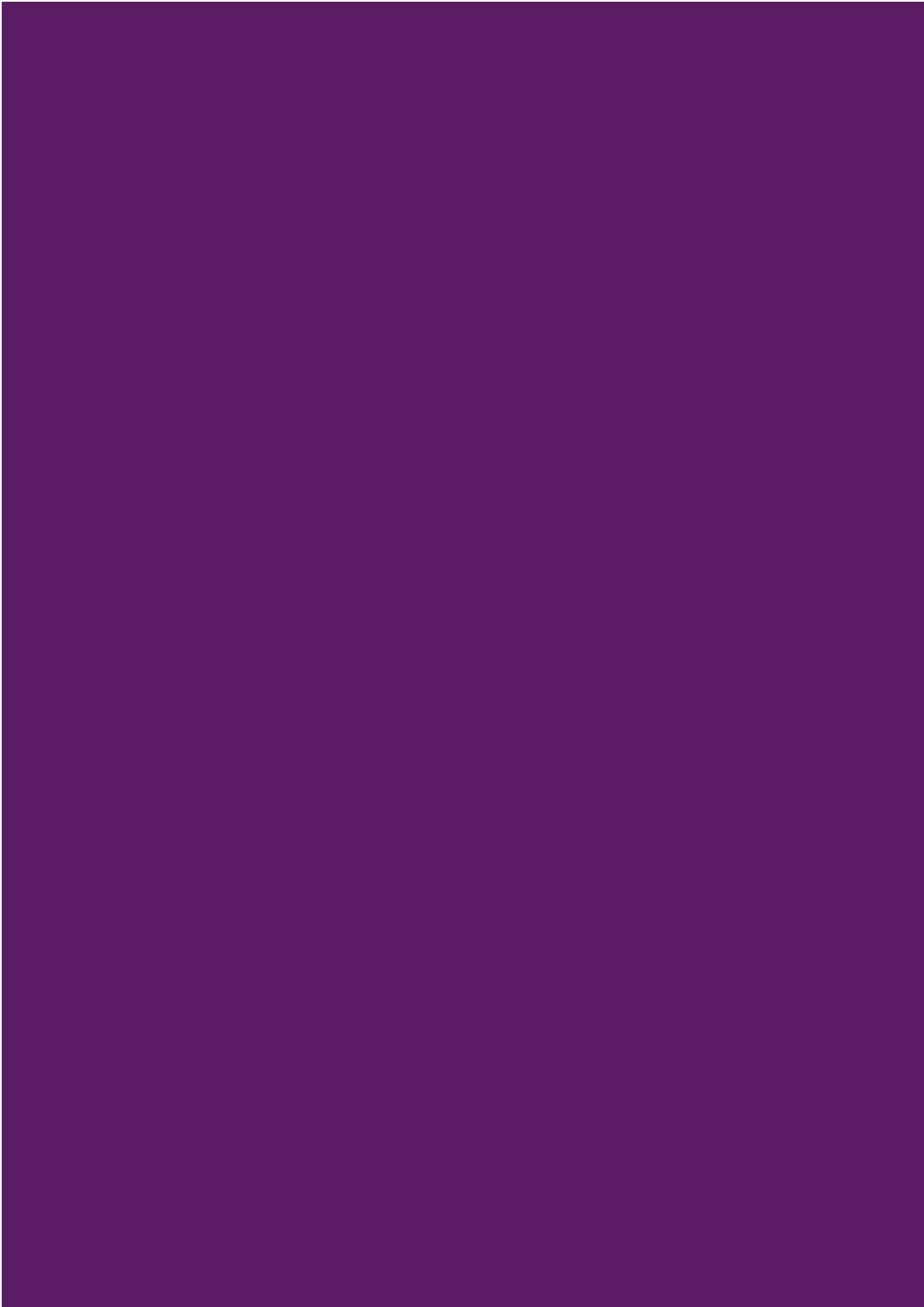
In the end we managed to still entertain 16 societies and scouting groups, mostly in person – about 90 adults and 320 children.

### Adult Education sessions

The 'Astronomy Club' met twice in early 2020, what turned out to be the last time, with a total attendance of 17. Thanks go to Paul Klimczak, having led it for many years.



Pictures by Steve Doody from his Yorkshire coastal residence, in order from near to far, (from left to right and top to bottom): the Iris Nebula in our own Milky Way galaxy, the Andromeda Nebula (M31), the Triangulum galaxy (M33), M81, Pinwheel galaxy (M101), and M106.



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Front cover: comet NEOWISE on 20 July 2020, Nikon DSLR on 8" SCT (credit: Jacco van Loon)