Institution: University of Central Lancashire

Unit of Assessment: UoA9 Physics

Title of case study: Outreach and research-informed public engagement in astronomy

1. Summary of the impact (indicative maximum 100 words)

Published and grant-awarded research in astrophysics and solar physics at UCLAN has underpinned a very large number of public lectures throughout the world (e.g. Edinburgh Science Festival, Harvard, NASA, IAC Tenerife, Perimeter Institute Canada, University of Cape Town, Astrofest London, etc.) during the impact reporting period 2008-2013, delivered by Professors Gibson, Kurtz, Ward-Thompson, Walsh and the rest of the staff in UoA9. The most prestigious of these have been delivered to large (typically several hundred to a few thousand people) sell-out audiences. Our staff have appeared on TV and radio to audiences of millions. In addition, public outreach events led by astrophysics and solar physics staff members at UCLAN have further increased the societal impact of our research.

2. Underpinning research (indicative maximum 500 words)

The research underpinning this societal, outreach and public-engagement impact, was undertaken by staff members returned as Category A staff in this REF submission, while they were at UCLAN.

Professor Gibson has pioneered the field of Galactic Archaeology during his tenure at UCLan (2006-present). As a Builder within the international RAVE Survey, he was responsible for the field and target selection since the project's initiation, resulting in nearly 50 papers since 2006 (see outputs). RAVE's chemical and dynamical "tagging" of individual stars complements the leadership role Gibson has played in driving the fields of galactic chemical evolution and cosmological chemodynamical simulations. His recognition that energy feedback plays a pivotal role in shaping the “chemical structure" of galaxies, has led to entirely new insights into the origins of the thick disc and stellar halos of galaxies, and the distribution of metals throughout the Universe and its galactic constituents. As the author of GEtool (an industry-standard chemical evolution software package – MN 290, 471; PASA 20, 189; Science 303, 59) and the chemistry patches to the cosmological adaptive mesh refinement code RAMSES (MNRAS 424, L11), Gibson has positioned himself to be heavily involved in the interpretation of ESA's Gaia mission data, and its ground-based complements. Active in outreach on the subject of "chemical tagging", Gibson has reinforced that international research reputation with the general public through his series of lectures (see evidence web page).

Professor Kurtz was awarded a Fellowship of the Japanese Society for the Promotion of Science in 2008. His research was undertaken at UCLAN continuously, during the period 2001 to 2013, and concerns fundamental observational and theoretical astrophysics in the area of asteroseismology and related astronomy. This has informed and underpinned in some detail all of the >150 public lectures and outreach events which Prof Kurtz has presented on this subject during the impact reporting period. For instance, his “Sounds of the Stars” and “The real music of the spheres” lectures present asteroseismology in a very clear way to a public or secondary school audience. The research has included numerous discoveries with spectra obtained with the ESO VLT, and with ultra-high precision photometry from the NASA Kepler mission, including:

- a new technique for measuring radial velocities photometrically;
- discovery of a class of eccentric binary stars with dynamic tidal distortions;
- discovery of strongly magnetic Ap stars;

- discovery of a giant planet orbiting an extreme HB star;
- extreme ground-based photometric precision with the Whole Earth Telescope.

In parallel with his public lectures, Prof Kurtz has given over 30 invited plenary talks, reviews and conference summaries at international scientific conferences in the last 10 years.

Professor Ward-Thompson joined UCLAN in July 2012. Since then he has published a Science paper (337, 69) on the formation mechanism of brown dwarfs, and >20 other papers about his work with the Herschel Space Telescope, and has given public talks and written popular articles about his research in 2012/13. In 2013 he is also the President of the Society for Popular Astronomy (SPA), which has over 2000 members, and has given numerous talks around the country to Society meetings, including in Edinburgh, Belfast, Cambridge & London (all in 2013), and to local astronomical societies in Lancashire. He has also written popular articles for the Society's in-house magazine, Popular Astronomy, on his most recent research, which has a readership of several thousand. He has previously appeared on the BBC Sky at Night programme on half a dozen occasions and is a well-known figure UK-wide in amateur astronomical circles.

Professor Walsh leads the UCLAN Solar Physics Group, and has a long track record of research on the Sun and Solar Physics, which has translated into over 70 public outreach talks and events during the REF reporting period. His 2013 Nature paper, for example, published the highest resolution images ever taken of the Sun's outer atmosphere. The data were taken by the Hi-C camera on-board a NASA sounding rocket, launched from the White Sands firing range in New Mexico. This generated a huge amount of interest from the media, both nationally and internationally. He appeared on numerous BBC News programmes, and the work appeared on very many on-line news outlets world-wide. The highly detailed structure revealed in the images showed a plethora of twisted filaments, indicative of a very complex magnetic field. In addition, the high time sampling of the data enabled the first ever movies to be made at this resolution of clumps of plasma flowing along the field lines. He has since begun to publish a number of papers (e.g. ApJ 771, 21) in which he and his group start to unravel the complex physical processes creating the observed structure.

All other members of the JHI have given many public talks every year (see evidence web page) on all aspects of their research (see UoA9 REF outputs).

3. References to the research (indicative maximum of six references)

Evidence web page: http://www.star.uclan.ac.uk/outreach/

[Also see all Astronomy outputs for this UoA.]

(i)*Andre, Ward-Thompson & Greaves (2012) "Interferometric identification…" Science, 337, 69

(ii)De Silva, Gibson et al (2009) "O & Na abundance patterns…" A&A, 500, L25

(iii)*Fenner, Gibson et al., (2006) `Cosmological implications of … chemical evolution' ApJ 646, 184

(iv)Kirk, Ward-Thompson et al, (2013) "First results from the Herschel Gould Belt Survey…" MN 432,1424

(v)*Kurtz et al (2006) "The discovery of a new type…" MNRAS 370, 1274

(vi)Pilkington, Few, Gibson, et al, (2012) "Metallicity gradients in disks…" A&A 540, A56

*Best indicates quality

4. Details of the impact (indicative maximum 750 words)

During the impact reporting period 2008-2013, all of our Astronomy and Astrophysics staff have given public lectures, talks and demonstrations at a variety of events, both nationally and internationally (see evidence web page).

Professor Gibson enhanced his commitment to public outreach during the REF period, including his invitation to address the European community at AstroFest-2013, before a standing room only crowd of 1000 people. His passion for "Galactic Archaeology" and real-world applications of high performance computational physics permeates his public lectures, including that delivered recently to 250 audience members as the Kevin Westfold Distinguished Visitor at Monash University. These links to real-world physics have led to invitations to Triple Science Celebrations, Lancashire Science Teacher Training events, and local colleges in the northwest.

Professor Kurtz has delivered over 150 highly-regarded, widely-publicised, public lectures throughout the world -- including at the Edinburgh International Science Festival, European AstroFest, Harvard, NASA California, IAC Tenerife, Perimeter Institute Canada and the University of Cape Town. Almost all of these public talks have been delivered to large (typically several hundred to a few thousand) sell-out audiences. In addition, public outreach events and astronomy exhibitions for the public, mostly within the UK, have been led by Prof Kurtz and his astrophysics and solar physics colleagues. These have further increased the societal impact of our research in these areas. Professor Kurtz has also been interviewed regularly and frequently for many years on BBC Radio Lancashire (he now appears in a regular Breakfast Show slot, in which he answers science questions texted in by members of the public), and during the impact reporting period has appeared on the BBC's `Stargazing Live' programme and also on BBC `Sky at Night'. All of these appearances depend on Professor Kurtz's recent research which has been published in leading refereed journals, and which has attracted grant funding from RCUK Research Councils. He has held, as PI, 4 PPARC/STFC Grants totalling ~£600k during the period 2002-2012 to support his research, together with Royal Society International UK-Japan grants.

Professor Ward-Thompson joined UCLAN in July 2012. Since then he has been President of the UK Society for Popular Astronomy (SPA) in its 60th anniversary Jubilee Year of 2013. The SPA has some 2500 members, mostly based in the UK, but with about 10% coming from overseas. He has written about his work in the SPA magazine, Popular Astronomy, in 2012/13 which is sent to all members, and in particular he has written about his July 2012 Science paper on the formation mechanism of brown dwarfs. He has also addressed the SPA at all 8 of its 2013 meetings - typical attendance ~200-250 members. These meetings have taken place all over the country, in Edinburgh, Belfast, Cardiff, Cambridge, Preston and London. He has also addressed many local astronomical societies in northwest England. In the period 2000-2012 he was PI or co-I on grants totalling over £10M and in the period since joining UCLan in 2012 he has already been PI on three successful grant proposals totalling ~£450k to support his star formation research.

Professor Walsh has given over 70 public lectures in several different countries to the general public, amateur astronomy clubs and schools. He has received a number of national awards for science communication. Since December 2001, when the Royal Institution of Great Britain awarded him the title of "Scientist of the New Century", he has maintained his close connection with the RI through a series of school lectures throughout North West England. In 2005, he obtained the British Association for the Advancement of Science Lord Kelvin Award, while in 2008, he was the Institute of Physics in Ireland's Tyndall Lecturer, undertaking a school lecture tour of 12 different locations around Ireland. He has given numerous press interviews to websites, newspapers, radio and television. As a very recent example, the work resulting from his Nature paper in January 2013 was covered on BBC North West Tonight, as well as via numerous news websites. Also, in February 2013 he was "panel guest" on a morning show for BBC Radio Lancashire. Various other media commitments are on-going. His other public engagement highlights include:

SunTrek.org - an educational website linking science in the National Curriculum to solar topics.
Transit of Venus - UCLan was chosen as the UK focus for ToV activities in the UK.
Sunbeam Digital Projection Project - Images of the Sun projected onto a giant solar tracker.
Lancashire Science Festival – Walsh instigated this event and chairs the steering committee.
Water rocket challenge - he instigated an event that set a new world record for the most water-powered bottle rockets launched in a day.
The Sun at Night – he is working with an artist to produce an art installation for the Preston market.
Communicating Heliophysics – Walsh was a member of an IAU-sponsored panel to promote outreach activities of the international heliophysics community.

In 2009, Professors Ward-Thompson and Gibson were 2 of 44 scientists selected by STFC to represent the community as part of the International Year of Astronomy's "Explorers of the Universe" exhibit, a road-show which travelled the UK for more than a year, including a showing to an audience of over 500 at the Royal Albert Hall.

We also have a spin-out enterprise known as `Beauty in the Universe', run by UCLAN graduates. It uses Astronomy as a vehicle to engage those in disadvantaged circumstances, both children in primary schools and adults in community groups. They have obtained funding to work with schools and community groups to deliver enhancements to the curriculum. JHI staff and research students have participated in the activities in those communities as well as hosting celebration events at UCLAN's Alston Observatory. The programme has now extended its reach to communities in India.

All other staff members have also given many public lectures every year during the REF reporting period (see evidence web page).

We also have the largest award-bearing distance learning programme of adult and continuing education in astronomy in the UK, with over 300 adult distance learners enrolled in 2013/14. Whilst this is clearly bordering on the standard educational aspects of the University's role, we nevertheless treat this as partly an outreach activity, since most of the adult learners enrolled on our courses are taking them purely out of interest rather than for any commercial or work-related benefit, simply to enrich their lives in terms of enhancing their understanding of the Universe around us, in a similar way to that in which they would attend an astronomy outreach seminar. We also run weekend residential courses at our Alston Observatory facility.

5. Sources to corroborate the impact (indicative maximum of 10 references)

Evidence web page: http://www.star.uclan.ac.uk/outreach/

Supporting web pages:
https://www.facebook.com/Beautyintheuniverse/
http://www.perimeterinstitute.ca/en/Outreach/Public_Lectures/Public_Lectures/
http://www.popastro.com
http://www.astronomynow.com/astrofest/fri1000.html
http://www.cfa.harvard.edu/news/2011/fe201114.html
http://www.ifa.hawaii.edu/specialevents/Maikalani2011/June2.jpg
http://www.nasa.gov/mission_pages/kepler/news/Kepler_Talk_12_6.html
http://www.iac.es/divulgacion.php?op1=16&id=658&lang=en
http://www.rave-survey.aip.de/rave/
http://www.star.uclan.ac.uk/~dwt
http://www.24hourrocketchallenge.com
http://kepler.whitedwarf.org/
http://edinburghfestival.list.co.uk/event/245551-invisible-worlds/
http://www.studyastronomy.com/