Institution: University of Central Lancashire

Unit of Assessment: UoA9 Physics

a. Context

The main non-academic user groups, beneficiaries and audiences for this unit's research are industrial users and partners, educators and school students, and the public-engagement audiences within the UK and abroad, including radio and television audiences. The industrial and environmental impacts include influences on the design of new materials for advancing technology, the optimisation of characteristics of existing materials for industrial purposes, and the development of new theoretical techniques for understanding the detailed behaviour of nano-materials. The public and educator impacts include media impact and diffusion of research knowledge through public and school-student events, educator training, world-class public lectures and a broad-ranging media presence.

b. Approach to impact

Physics and Astronomy research at UCLan during this reporting period has been increasingly developing and intimately linked to (and always mindful of widening) its impact on a range of users and the general public.

The Nanophysics and Magnetic Materials Group has focused its research around topics which either (a) influence the design of new materials such as nanostructured polymeric materials and magnetic materials, which would advance our technology, improve the environment and improve people's quality of life, or (b) lead towards a better theoretical understanding of the behaviour of nano-materials. In order to enhance this approach, a new Institute was established in 2010 by UCLan, the Institute of Nanotechnology and Bioengineering, which combines the efforts of researchers from different University disciplines. The Nanophysics and Magnetic Materials branch of UoA9 continuously supports collaboration with industry. For example, our Impact Case on Magnetic Materials is based on research that was funded partly via an EPSRC Specialist Grant and partly directly from industry, via the Information Storage Industries Consortium (INSIC), which represents companies such as Hewlett Packard, Hitachi, Sony, Seagate and other major players. Our Impact Case on Polymer Modelling is based on research that was carried out in collaboration with the Zeon Corporation of Japan (see attached supporting letters and contacts).

Our astrophysics-based public-engagement activities and approach have spanned a very wide range of astronomy and related science. Our astrophysics and solar-physics staff members give numerous public lectures and media interviews around the world to large audiences, and work with other UCLan colleagues in mathematics, engineering and computing, to raise knowledge, awareness and interest in these subjects, matched to the needs of local schools and community groups. This includes using our purpose-built Alston Observatory and Moor Park Observatory facilities. We have many years' experience of providing curriculum-enhancing support for school teachers, training and astronomy development, based on this unit's international-level research programmes and projects. In addition, we support local outreach companies. One example is our on-going academic support and research input for the "Beauty in the Universe" (www.facebook.com/Beautyintheuniverse) social enterprise, established as a not-for-profit spin-off enterprise by a former UCLan student, with support from UCLan's Northern Lights business incubation service. This company provides support to local schools and colleges, as well as general outreach lectures and on-line resources. Another example is the Sun Trek web-based resource for educators and school students (www.suntrek.org), for which we provided information about the Solar Dynamics Observatory (SDO) – we host the UK data hub for SDO at UCLan. Our

astrophysics and solar physics research has also impacted on the development of strong links with NASA technology and part of its sounding-rocket programme, and has provided consultancy to a European industrial contractor for space missions. Our staff have appeared on radio and television, to wide audiences, explaining their research. Ward-Thompson, Kurtz, Walsh and Gibson in particular have appeared extensively on television and radio, and have given many public outreach lectures. Ward-Thompson is particularly well-known in amateur astronomical circles, having been a regular guest on the BBC 'Sky at Night' programme, and he is currently the President of the Society for Popular Astronomy (SPA), which has over 2000 members (www.popastro.com). We have been present at every annual Astrofest event that has ever taken place (the largest space conference and exhibition in Europe dedicated to members of the public and amateur astronomers) for 20 years, and have had a lively and busy stand every year. No other University Physics or Astronomy group has done this.

This unit has had a very long-term and proven track record of generating impact from its research through its outreach activities. We have an outreach officer (Debattista), who spends 50% of his time dedicated to carrying out outreach, and coordinating the outreach activities of all of our staff. We have also recently appointed a lecturer (Bibby), who is partly supported by the Ogden Trust (www.ogdentrust.com) to carry out outreach in local schools and colleges. The University has a very detailed workload model, which is instigated for all staff, and which contains full and proper recognition of time spent on outreach activities.

We instigated, in conjunction with our UCLan colleagues from other scientific disciplines, the Lancashire Science Festival in 2012. This was a 3-day event which attracted 5500 members of the public, and included display stands, public shows, and hands-on interactive exhibits in physics and astronomy. It was originally planned to be a biennial event, but by popular demand it returned in 2013 for one day only and attracted some 3000 members of the public. Planning has already begun for a 4-day event in 2014 (www.lancashiresciencefestival.com) and we will again have a substantial presence for physics and astronomy. The University as a whole supports public outreach in a number of ways. For example, the University employs a full-time `Public Engagement Manager' to coordinate engagement activities across the University. She works closely with our Outreach Officer and Ogden Trust Lecturer.

We 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.

Our Solar Physics Group specialises (amongst other things) in the area of the Sun-Earth connection. Dalla has built a group that has developed a new Solar Energetic Particle (SEP) modelling approach, based on test particle simulations. The novel approach developed by the UCLan group involves full-orbit test particle simulations, as opposed to methods based on the focussed transport equation, which generally neglect cross-field transport. The latter are the methods used by all other Space Weather alert systems.

In fact, our published research on modelling of SEPs has been incorporated into a forecasting tool for radiation storms due to SEPs. The radiation associated with SEPs, mostly due to protons, can affect satellites, astronauts, and air passengers and crew. The tool generates alerts that are distributed via the Regional Warning Centre of the International Space Environment Service (ISES) based at the Royal Observatory of Brussels (sidc.be), into which our software has been incorporated. Alerts are distributed freely to subscribers. We are confident that this will lead to improved forecasting of radiation storms.

c. Strategy and plans

The unit's future strategy involves increasing our impact with all audiences and user groups, in each sector of our future research portfolio.

The Nanophysics and Magnetic Materials group strategy is to continue to conduct a major part of its research in collaboration with industrial partners, as it always has, which provides a direct impact on society, and thus to feedback to those in industry with the most urgent perceived technological needs and problems to be solved. As part of this strategy this group is seeking to enlarge its industrial collaborative circle, in particular in the UK, where Mercer is using his links with the NPL to further this agenda, but also abroad, partly in conjunction with the new UCLAN international campuses in Cyprus and Sri Lanka, which have started to be developed within the 2008-2013 reporting period (UCLAN Cyprus took its first intake of students in 2012 and UCLAN Sri Lanka plans to be operational by 2015). For example, a collaboration has been formed between our Nanophysics and Magnetic Materials Group and the Sri Lanka Institute of Nano-Technology (SLINTEC) to fabricate nano-devices using the new material graphene. This activity is being supported centrally from within the University, with funding for new staff planned in 2014.

The University has also supported this area of activity centrally through its Guild Fellowships Scheme, by the appointment of one of these Fellows in the area of laboratory nano-physics (Smerdon). This scheme is similar to the RCUK Fellowship scheme, whereby a senior Fellow is appointed for 5 years on a 100% research contract, before joining the regular academic staff of the University. Smerdon works specifically in the area of organic junction devices using graphene and fullerene, and their potential use in solar cells for energy generation. This is clearly going to be an important technology for the future, and it is planned to grow a significant group around him.

The strategy for public engagement and educator impact of our international astrophysics research is to widen and deepen these, covering all sectors of the astrophysics research, within UCLAN's overall public engagement strategy and programmes. Our world-wide public lectures and media events will continue and be enhanced to reflect the wide range of international astrophysics research undertaken and promoted within the Jeremiah Horrocks Institute (JHI). A detailed development plan for the JHI's Alston Observatory is being finalised, including a science centre and outdoor classroom. Likewise, a joint bid has been made with Preston City Council to the National Lottery for the enhancement of Moor Park, including the Observatory. Extensive expansion of the `Beauty in the Universe' venture is proposed, to provide a service to the whole of the UK. Impacts in association with NASA and ESA are also part of the emerging strategy of this unit.

In terms of planning for the future, the University provides a 2-week course, compulsory for all PhD students, that includes teaching of outreach, dealing with the media and industry, intellectual property rights, patents, and other aspects of knowledge transfer important to cross-over to the 'real-world' situation beyond academia. We also have an extensive programme of summer intern students, working within our research groups, that takes typically 15-20 students every year – both internal undergraduates and A-level students from nearby schools.

d. Relationship to case studies

Three Impact Case Studies are presented as part of this submission. The case study on public engagement from previous and current international-arena astrophysics research is directly linked to, and is a fundamental part of, this unit's on-going impact strategy for this audience/user sector. Both individual case studies from the Nanophysics and Magnetic Materials Group directly relate to the unit's approach to impact. Indeed, the funding from one industrial partner (INSIC) only supports projects where the underpinning research is a critical component in achieving the advances needed for this essential worldwide technology. Both the case in Magnetic Materials and the case in Polymer Modelling arose directly from our continuing policy of industrial partnership.