ISSUE
107
August 7th 2017

Orion news

This week:

Orion news

The newsletter aims to keep the Orion Team up to date with progress in the experimental campaigns, work programmes and general information of interest.

Editorial Team:
Stefan Parker
James McLoughlin
Colin Danson

Send your comments and news items to our dedicated mailbox
orionnews@awe.co.uk

Orion Academic Access Campaign a Great International Success

In a campaign to explore laser driven ion beams to heat matter to extreme conditions an international team led by University of Strathclyde (P McKenna, R Gray, A Higginson) used the unique capabilities of the Orion laser.

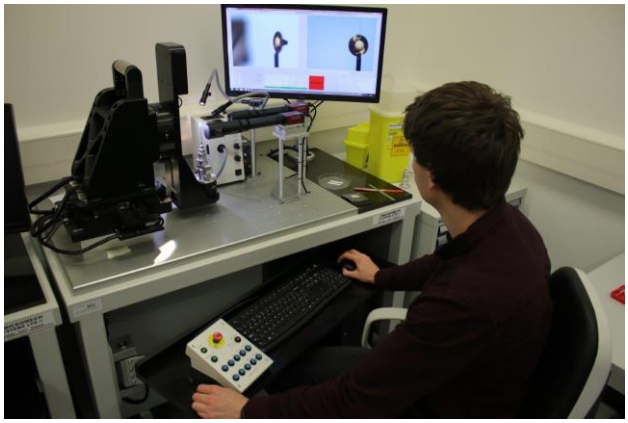
Researchers from University of California San Diego (C McGuffey, F Beg), Universität Darmstadt (M Roth, G Schaumann, J Ohland), Queens University Belfast (T Hodge) and General Atomics (MS Wei) joined to use the two powerful short pulse beams of Orion together with up to four long pulse beams to explore focusing laser driven ion beams into a small sample.

The team used the TNSA acceleration mechanism to drive proton beams off the rear side of a hemispherical target into a guiding cone structure and onto small samples of copper with different initial densities. The detailed analysis is ongoing, but first results indicate the Orion laser to be capable of driving proton currents of more than 100 kA into a test object, thereby creating extreme conditions that would be similar to planetary interiors. The power of Orion led to proton energies above 60 MeV from these complex targets indicating an efficient energy transfer from the laser into the ion beam.

Part of the experiment team: Colin Danson, Steve James, David Neely, Markus Roth, Adam Higginson, Ross Gray, Thomas Hodge, Gabriel Schaumann, Steve Gales, Graham Cooper and Jonas Ohland

Jonas Ohland (foreground) and Thomas Hodge prepare radiochromic film packs

The temporal evolution of the experiment was monitored using the second beam of Orion to operate as a driver for proton radiography with picosecond temporal resolution. Finally, first successful tests were conducted using up to four additional long pulse laser beams to create a plasma on the outside of the guiding cone structure to mimic the conditions in a possible fast ignition scenario in inertial confinement fusion.



Adam Higginson prepares a target on the metrology rig prior to it being handed over to be loaded in to the Orion target chamber

The campaign targeted the use of powerful short pulse lasers for laboratory astrophysics and was also the latest step in an international integrated Fast Ignition experimental effort with the collaborators mentioned above extending prior experiments on LFEX (Japan) and OMEGA EP led by Dr. Chris McGuffey (UCSD) (US).

Markus Roth

Orion Wows Students

On Monday 31st July two 16 year old students who were on work experience at AWE visited Orion. Robert Smith from Abingdon School and Harvey Holliday-Williams from Bradfield College spent a week at AWE with a busy schedule seeing several areas of site.

Robert said about his placement at AWE: 'The opportunity arose and I thought that it would be great to experience what it is like working for a large science based company like AWE. I have always had an interest in science and engineering and I thoroughly enjoyed my time working here.' And gave his impressions of his visit to Orion: 'I was amazed with the precise engineering of Orion, from the earthquake protection to stop any movement of the laser before it hits the target to the sub millimetre length of the short pulse beams. I was very excited by the possibility of creating fusion energy from the laser as it could have a big impact on energy production in the future. I was impressed because of the important research that goes on in Orion and the fact that the facility can be used to do so many different things, which has given way to more exiting plasma physics phenomena. I think that this could be a possible career for me in the future as I find the science behind the system very interesting.'

Harvey also said: 'As I aspire to study mechanical engineering in the future I was delighted to be offered some work experience in, and around, the AWE sites. Upon visiting Orion I was astounded by the elaborate design of the project. My visit gave me an insight into what sort of options there will be for me in the future. The combination of Orion being so unique and new to me and meeting knowledgeable and interesting people who really care and love what they do made me feel even more excited and inspired to start studying mechanical engineering.'

Radiation Transport: NIF Shots and Target Fabrication

The first shots of AWE's new radiation transport campaign were successfully fielded at NIF in the week beginning 17th July.

Efficient shot operations by the NIF facility allowed the team to obtain five shots in all; three scheduled priority shots plus an additional two reserve shots. The primary diagnostics returned excellent data, which on first inspection is qualitatively consistent with expectation. A ride-along diagnostic fielded to assess background ahead of future radiography shots was partially successful, but was pulled from later shots due to time and debris considerations.

Fielding of these shots was led by AWE's Mike Rubery who is on secondment at LLNL, with support from LLNL staff and the design team, Peter Graham, John Morton and Warren Garbett at AWE. These targets were produced by LLNL target fabrication. The next shots in this campaign are scheduled for October.

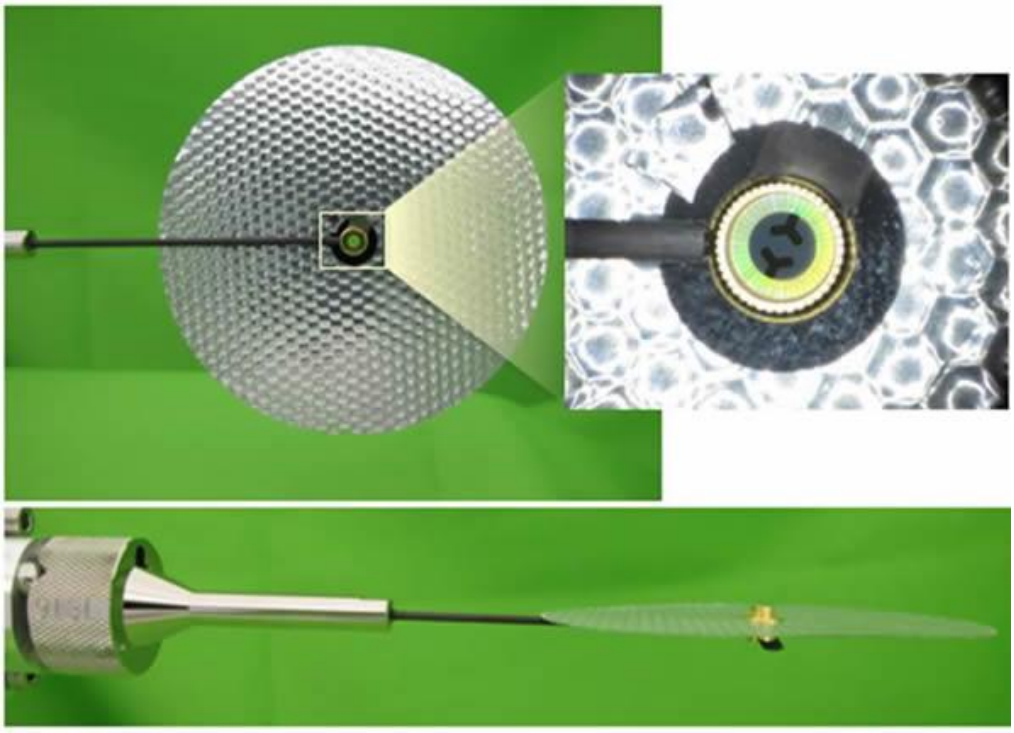
The week beginning 24th July AWE Target Fabrication group (TFG) had four visitors from LLNL TFG. The visit was a great success and has helped with the AWE capability on how to manufacture specific targets for the Radiation Transport Programme.

Highlights of the visit for our guests were a tour of Orion and Phoenix, both of which they gave positive feedback. Much of the week was spent with LLNL helping AWE TFG with hands on training in micro assembly, precision machining and jointly detailing future deliveries. In the wrap up meeting the LLNL team praised AWE for their warm hospitality particularly within TFG and felt the visit had been productive for both organisations.

The specialized targets for this experimental campaign are led by AWE to test the modelling of radiation transport. The pictures below show one of the five targets made by LLNL TFG and fired on NIF (picture courtesy of LLNL). The targets required complex machining of fragile foam physics packages. Diamond turning machining was successfully paired with micro-milling to produce a much higher yield of the foam physics packages, enabling the targets to be assembled successfully and on schedule for the July campaign.

The upper-right photo shows the foam with manufactured features. It is the goal of this collaborative programme for AWE TFG to deliver the physics package of these target types for 2018 campaigns. Successful tests have already taken place to determine the feasibility of transporting these fragile target components between the two laboratories.

Warren Garbett & Greg Lilleystone



International Conference on Women in Physics

Josie Coltman (representing AWE and IOP Women in Physics Group) attended the 6th IUPAP International Conference on Women in Physics (ICWIP 2017) held at the University of Birmingham from July 16th – 20th, as part of the UK team. AWE was one of the corporate sponsors for this conference.

This was the first time the conference had been held in the UK and there were approximately 200 delegates from 60 countries including Germany, Uganda, Canada, South Korea, Australia, India, USA, and Egypt. The aim of the conference was to agree a set of resolutions to be presented at the IUPAP General Assembly, as well as to network and be inspired by female physicists from around the world. Recommendations from the conference will be sent to physics institutions and professional bodies world-wide.

Josie gave presentations on diversity and inclusion (D&I) at AWE and what we are doing as a company regarding D&I, and also on modelling charged particle stopping power experiments on Orion.

It was recommended that delegates attend just one workshop theme throughout the week. Josie attended the Gender Studies and Intersectionality workshops, which looked at what intersectionality is (a point at which gender, race, class, age, culture, religion, and other categories meet and create unique circumstances for each individual) and whether we should be tackling this, as well as gender equality to attract and retain diverse and highly-qualified physicists.

Jocelyn Bell Burnell (who discovered pulsars and now has an IOP early career medal (since 2016) named after her) gave a fascinating talk on her life and was awarded the IOP President's Medal during the conference.

During the conference there was also a piano concert by a very talented 15 year old girl (Lauren Zhang) who has already won several awards and has appeared as a soloist with the University of Birmingham Philharmonic Orchestra and the Birmingham Conservatoire Junior Symphony Orchestra. There was also a Gala Dinner with sponsors Northrop Grumman giving a talk on the James Webb Telescope and how it will hopefully be used to see the first light of the universe, watch galaxies collide, see stars and planets being born, find and study exoplanets and study our own galaxy. There was also a speech by Julia Higgins (the IOP president-elect). On the final day there was even a surprise visit and talk by Malala Yousafzai (Nobel Peace Prize laureate and activist for female education).

It was a very inspiring conference with lots of female role models, as well as lots of country posters showing that the UK is not alone in trying to get more diversity in physics and other STEM subjects.

If you would like to see/find out more of what went on at the conference, then you can see lots of tweets sent by delegates during the conference using #ICWIP2017 on twitter. There is also a blog entry by Sarah Tesh on ICWIP 2017 at physicsworld.com and a couple of news articles (Malala Yousafzai and Jocelyn Bell Burnell) on the IOP homepage.

Josie Coltman

Orion Academic Access Campaign Paper Published

Following the Orion academic access campaign led by Francisco Suzuki-Vidal, Imperial College London, in a collaboration between groups from The UK, France, Spain and the Czech Republic, we are delighted to announce the second important publication resulting from this work.

Counterpropagating Radiative Shock Experiments on the Orion Laser

Phys. Rev. Lett. **119**, 055001 (2017)

F. Suzuki-Vidal, T. Clayson, C. Stehlé, G. F. Swadling, J. M. Foster, J. Skidmore, P. Graham, G. C. Burdiak, S. V. Lebedev, U. Chaulagain, R. L. Singh, E. T. Gumbrell, S. Patankar, C. Spindloe, J. Larour, M. Kozlova, R. Rodriguez, J. M. Gil, G. Espinosa, P. Velarde, and C. Danson

Abstract: We present new experiments to study the formation of radiative shocks and the interaction between two counterpropagating radiative shocks. The experiments are performed at the Orion laser facility, which is used to drive shocks in xenon inside large aspect ratio gas cells. The collision between the two shocks and their respective radiative precursors, combined with the formation of inherently three-dimensional shocks, provides a novel platform particularly suited for the benchmarking of numerical codes. The dynamics of the shocks before and after the collision are investigated using point-projection x-ray backlighting while, simultaneously, the electron density in the radiative precursor was measured via optical laser interferometry. Modelling of the experiments using the 2D radiation hydrodynamic codes NYM and PETRA shows very good agreement with the experimental results.

Figure 2, reproduced from the paper, shows: Counterpropagating shock dynamics at different times from (a)–(c) experimental x-ray backlighting and (d)–(f) 2D numerical simulations. Each simulation image shows mass density (top half, log scale), electron temperature (bottom-left quadrant, linear scale) and materials (bottom-right quadrant). The colour bar used to represent mass density in (d) also displays linear values of electron temperature in the ranges (d) 0–35 eV, (e) 0–60 eV, and (f) 0–40 eV.

https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.119.055001

Plasma Physics Papers

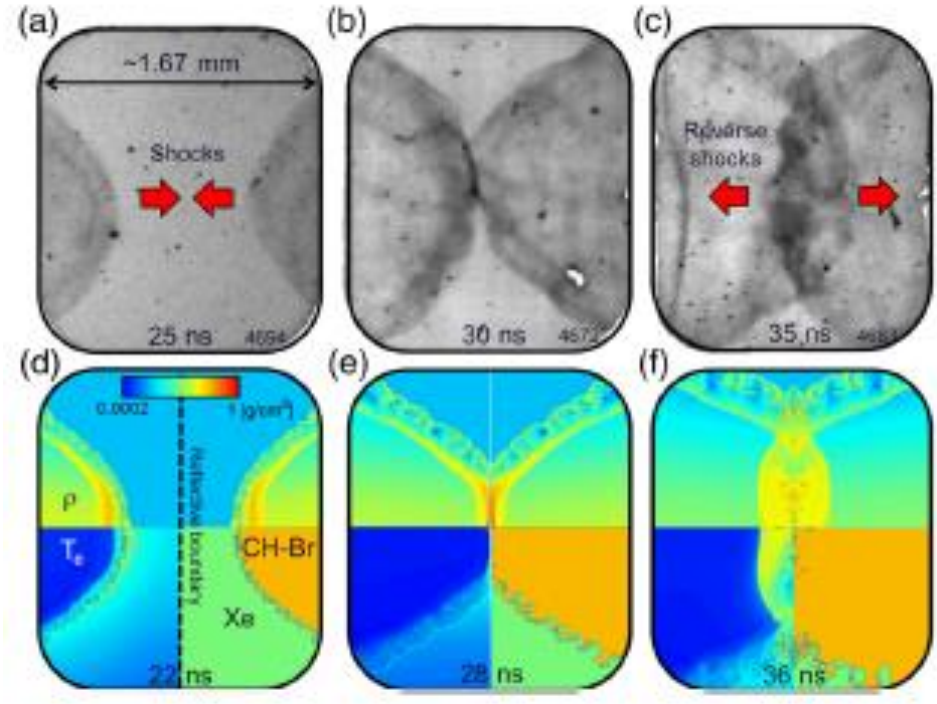
John Foster has recently published a paper in the Journal of Applied Physics. This paper covers research carried out on Orion by a collaboration from AWE, University of Oxford and University of York.

X-ray diffraction measurements of plasticity in shock-compressed vanadium in the region of 10–70 GPa

Journal of Applied Physics **122**, 025117 (2017)

J. M. Foster, A. J. Comley, G. S. Case, P. Avraam, S. D. Rothman, A. Higginbotham, E. K. R. Floyd, E. T. Gumbrell, J. J. D. Luis, D. McGonegle, N. T. Park, L. J. Peacock, C. P. Poulter, M. J. Suggit, and J. S. Wark

Abstract: We report experiments in which powder-diffraction data



were recorded from polycrystalline vanadium foils, shock-compressed to pressures in the range of 10–70 GPa. Anisotropic strain in the compressed material is inferred from the asymmetry of Debye-Scherrer diffraction images and used to infer residual strain and yield strength (residual von Mises stress) of the vanadium sample material. We find residual anisotropic strain corresponding to yield strength in the range of 1.2 GPa–1.8 GPa for shock pressures below 30 GPa, but significantly less anisotropy of strain in the range of shock pressures above this. This is in contrast to our simulations of the experimental data using a multi-scale crystal plasticity strength model, where a significant yield strength persists up to the highest pressures we access in the experiment. Possible mechanisms that could contribute to the dynamic response of vanadium that we observe for shock pressures ≥30 GPa are discussed.

http://dx.doi.org/10.1063/1.4994167

What's in a Name?

People continue to see unusual 'Orions':

Nick Hopps spotted this Orion and commented 'John Lewis also do funky things with light. I think ours is better value though.... '

Have you seen any unusual Orion's on your travels?

Technician Professional Registration

AWE have signed up to being 'Corporate Champions' for this Science Council Programme. The Science Council sets up professional standards for practising scientists and technicians, independent of scientific discipline and has a Royal Charter to enhance professionalism.

There was an initial visit by Agne Sniukstaite from the Science Council on the 26th May to describe the benefits of professional registration for technicians at RSciTech, RSci and CSci levels. This has been followed by a number of workshops to encourage people to register and talk them through the process including one of these was held in Orion on the 13th June. This has created a lot of enthusiasm about the opportunities presented and a number of Orion and Target Fabrication technicians have started their journey through the process.

For the first people going through the process this has culminated in face to face assessments conducted in the Orion building on the 4th August.

Colin Danson & Duncan Broughton