Talk 1

Nick Hopps - AWE

Experimental capability of the Orion laser

The Orion laser facility at AWE is a significant new asset for the study of high energy density physics. It is capable of delivering 5kJ of UV light in 1ns with additionally two 1PW short pulse beams, each delivering 500J at 1054nm. An overview of the facility design is presented and the performance characteristics achieved to date are described. The target diagnostics that will be available are listed. The opportunities arising from the near-term programme will be discussed.

Talk 2

Gabriele Mogni

Shock induced phase transition

By making use of ab-initio computational techniques such as Density Functional Theory and classical Molecular Dynamics Simulations, we have investigated the shock-induced phase transition in single-crystal Silicon and Germanium from the equilibrium cubic-diamond structure to the high-pressure beta-tin phase. In particular, by investigating the lowering of the transition pressure as a function of uniaxial shear stress, we have found evidence in support of the idea that this phase transition provides the mechanism for the relief of shear stress and not conventional plastic deformation as was believed previously.

Talk 3

Ross Howie

Dense hydrogen conditions in a diamond anvil cell

The behaviour of hydrogen at very high pressures is still poorly understood due to the limitations imposed on conventional experimental techniques. We have recently used Raman and visible transmission spectroscopy to investigate dense hydrogen (deuterium) up to 310 (275) GPa at 300K, conditions previously inaccessible in a diamond anvil cell. At 220 GPa, a new phase of hydrogen has been discovered, with the analysis of the Raman spectra suggesting a peculiar graphene-like structure consisting of both atomic and molecular layers. This result not only has important consequences for the hydrogen phase diagram, but also provides a gradual route to the long sought after insulator-metal transition.

Talk 4

G J Appleby-Thomas
PJ Hazell and D C Wood

More studies in shocked materials using lateral gauges

Lateral manganin gauges provide a potential route to measure dynamic changes in material properties under shock loading. While the finer points of their interpretation is currently the subject of significant debate, relatively few studies have focused on the potential effects of errors in target preparation on subsequent gauge behaviour. Here, lateral response in both PMMA and Al 7010 is explored in this context.

Talk 5

Chris Braithwaite

Recent Research at the Cavendish Laboratory, Cambridge

The talk will briefly examine the wide range of current topics of research in the Fracture and Shock Physics Group at the Cavendish. Additionally a case study will be presented to examine one of these areas in more detail.

Talk 6

P J Hazell
G J Appleby-Thomas, E Wielewski, C Stennett and C Siviour

Shock and spall morphology in the magnesium alloy, Elektron 675

In this work, the plate-impact technique was employed to shock an armour-grade wrought Mg-alloy (Elektron 675). The effect of sample orientation and heat treatment on the shock characteristics were examined using both manganin gauges and Heterodyne velocimetry.

Talk 7

Dan Eakins

Optical method for characterizing ultrafast behaviour of laser-shocked materials

Laser-driven shock loading techniques can be used to access extreme strain-rates, permitting study of the kinetics of ultrafast structural/chemical transitions in materials. At these short sub-ns time scales, new diagnostics are required to simultaneously characterise both the shocked state evolution and change in electronic properties. In this talk, I will present a method of measuring ultrafast optical phase changes in the ps-response of laser-shocked silicon films, and new modelling approaches to extract shock characteristics across a range of pressures.

Talk 8

David Jones

Characterisation of failure modes in explosively loaded cylinders and rings

A series of experiments using explosives contained in steel and copper liners to expand rings of Ti6Al4V have been performed. The aspect ratio of the rings (wall thickness: axial length) was adjusted to control the stress state in the ring, and the effect on the fracture mechanism observed. Point VISAR records of the radial velocity along with analysis of recovered fragments have enabled strain rate, failure strain and stress calculations along with observation of the fracture surfaces which are then compared with simulation.

Talk 9

Simon Case

Dynamic Strength Modelling at AWE

AWE's current strength modelling capabilities and future plans will be described. Continuum strength models are extensively used at AWE to simulate deformation in the dynamic regime. In parallel, the development of multiscale modelling techniques is being pursued in order to account more comprehensively for the physical processes of relevance to strength. Modelling work is supported by experimental studies which provide parameterisation, validation, and fundamental understanding of strength mechanisms.

Talk 10

Prof. Paul McMillan

Melting Sn to megabar pressures

Tin is an unusual and important element situated between semiconducting and metallic materials in group 14 of the periodic table. It exhibits unexpected high pressure behaviour with apparently unphysical phase coexistence over a wide pressure range. Likewise its P-T melting relations show an unexpected form with implications for interpretation and design of shock experiments. We discuss these properties in the ight of recent experimental and theoretical investigations.

Talk 11

Simon Bland

G. Burdiak, J. Skidmore, S. Stafford, J.P. Chittenden, M. Weinwurm, S.V. Lebedev, G.N. Hall, L. Pickworth, G. Swadling, F. Suzuki-Vidal, L. Pickworth

Title Pulsed Power Driven (non) Shock Physics at the ISP

Pulsed power offers a highly flexible way to study high pressure waves a variety of materials – from low temperature solids to highly ionised, low density plasmas. The 1.5MA MAGPIE generator has been used to carry out initial isentropic compression experiments of solids; and the extension of this work to measure material strength through the R-T instability is discussed. As it approaches maximum operating current – 2MA - the latest results from the newly installed 2MA MACH generator will be reported, along with experiments that will take place over the next year. Finally, in order to significantly increase the densities achievable on small scale systems, the use of convergent geometries and the diagnostics required to analyse them will be explored.

Talk 12

John Harrigan

Split Hopkinson pressure bar testing of rubbers using polymer bars

Polymer bars have been used to determine the intermediate rate properties of a rubber material at rates of 1000 s-1. A key stage in this is the experimental determination of the propagation coefficient. An analytical investigation of the experimental arrangements used to ascertain the propagation coefficient is reported.

Talk 13

J P Chittenden

M. Weinwurm, J. Pecover

Shock propagation and fusion in magnetically compressed liners

The direct compression of fusion fuel by pulsed multi mega Gauss magnetic fields provides an efficient method of generating inertial confinement fusion plasmas. Controlling shock propagation through the metallic wall of the liner is critical for maintaining control over the temperature of the fusion fuel during compression. We present 3D MHD calculations of proposed experiments on the Z generator which demonstrate fusion yields approaching scientific break-even.

Talk 14

Mark Burchell

Shock impacts and biological materials - organic molecules to seeds

Shock events cause damage to complex structures. But what degree of shock causes what degree of damage? And indeed can it lead to new, more complex systems? A review of experimental results will be given, covering impact experiments at University of Kent and various shock experiments from elsewhere. The GPa scale is the critical one.

Talk 15

Rachael Mitchell PhD Student

Bacteria survivability at GPa pressure

Bacteria show the greatest adaptability, which enables them to occupy extreme habitats on the planet. We have investigated the survivability of E.coli bacteria to 2 GPa using static high pressure techniques and have co-designed a recovery cell to investigate the survivability of E.coli to 2 GPa dynamic high pressure techniques.

Talk 16

Colin Pulham

High-Pressure Phases of Energetic Materials

The performance of explosive formulations depends on several factors that include crystal density, detonation velocity, and sensitivity to detonation by stimulus. These in turn are governed by the solid-state structure of the energetic material. This talk will highlight how static high-pressure studies provide valuable information about pressure-induced structural changes in these materials, and how metastable phases can be recovered to ambient pressure.

Talk 17

Ian Robinson

Towards the dynamic calibration of pressure transducers using shock tube techniques

The wideband pressure sensors that are used for combustion engine development and blast studies need to be calibrated, in SI units, over a wide range of amplitudes and frequencies. We are investigating the use of the pressure step produced by a shock tube for this purpose: either directly or by calibrating the step via measurements made at lower frequencies. A number of effects, such as the breaking of the diaphragm and secondary shock waves, alter the quality of the step waveform produced by the shock tube; such effects must be controlled to produce a 'clean' step suitable for sensor calibration.

Talk 18

Ruth Tunnell

The use of different instrumental methods to study the degradation behaviour of complex hybrid propellants

Composite modified cast double base propellants (CMCDB) were developed to provide high energy and performance compositions, which had excellent physical and ballistic properties at high and low temperatures. This presentation outlines some of the analytical techniques used to study such materials and the benefits and drawbacks of these