THURSDAY AFTERNOON, 11/19/98 –

Session R8Q. : Poster Session: Direct and Indirect Drive Target Physics

Thursday afternoon, 14:00, Imperial Ballroom, Fairmont

R8Q.001 Mass Perturbation Growth in Ablatively Driven Weakly Non-Uniform Laser Targets

A.

L. VELIKOVICH, G. HAZAK, Berkeley Research Associates, J. P. DAHLBURG, R. H. LEHMBERG, Plasma Physics Division, Naval Research Laboratory, J. H. GARDNER, LCP&FD, Naval Research Laboratory — Foam materials used in laser fusion pellet design will explode and homogenize, but will inevitably leave some very small but finite local density variations. We analyze the interaction of an ablatively driven shock wave with a small pre-shock density variation during the shock transit to estimate contribution of this source of non-uniformity to the mass perturbation growth. A constant supply of random density perturbations through the shock front is shown not to contribute to the total mass perturbation growth, because the plasma particles carrying the start-up vorticity that drives the instability are lost through the ablation front, and there is no preferential direction of vorticity generated at the shock front interacting with the pre-shock density modulation. This conclusion changes if the density variation is structured rather than random (examples are joints and gaps in laser targets and "thermal layer"). New results on other cases of phase-sensitive, RM-like perturbation growth in accelerated plasmas will be presented

Supported by U.S. DoE.

R8Q.002 Reduction of Early-Time Perturbation Growth in Ablatively Driven Planar Laser Targets Using Tailored Density Profiles

, N. METZLER, Nuclear Research Center Negev, Israel, A. L. VELIKOVICH, Berkeley Research Associates, J. H. GARDNER, LCP&FD, Naval Research Laboratory — We investigate numerically and analytically the effect of tailoring the density profile in the target to reduce imprinting of mass perturbations due to the long-wavelength modes. Shock waves slow down propagating into higher density layers. Hence, the effective gravity near the ablation front has the same direction as the density gradient. Inverting the unstable surface (ablation front) acceleration during the shock transit time causes the mass perturbations near it to oscillate instead of growing exponentially. We compare evolution of small perturbations due to surface roughness and non-uniformity of the laser beam in planar targets with flat and tailored density profiles, and demonstrate the decrease in perturbation growth for the latter case. Implications of this result for the direct drive target design will be discussed.

Supported by U.S. DoE.

R8Q.003 Radiatively Driven **Ablative Raleigh-Taylor Instability** in Thin Planar Foils

, R. J. MASON, D. E. HOLLOWELL, G. T. SCHAPPERT, S. E. CALDWELL, Los Alamos National Laboratory — We have extended earlier computational and experimental studies of Raleigh-Taylor instability of thin planar copper foils radiatively driven in NOVA hohlraums. The foils were typically 18 m thick with 45 m sinusoidal perturbations of 0.5 m amplitude. They were accelerated by a "NOVA PS26" pulse yielding a maximum radiation temperature of 195 eV after about 1.5 ns. The developing bubble-and-spike pattern was studied with a 6.7 keV backlighter. Fourier analysis of the integrated axial dz data yields an effective amplitude of the first harmonic growing to 4 m during by 3 ns in agreement with LASNEX and RAGE calculations. RAGE is a 2T grey diffusion Eulerian code with automatic mesh refinement. Both 3T and LTE multi-group diffusion were employed with LASNEX. Additional studies have included a 5 m layer of beryllium on the drive side. The foil dynamics will be described for cases with the beryllium attached to the copper - adding to the drive pressure - and separated, so as to mildly filter the spectrum.

G. T. Schappert, W. W. Hsing, S. E. Caldwell, D. E. Hollowell, R. P. Weaver, and B. A. Remington, Bull. Am. Phys. Soc. **7**, 1515 (1996).

Work supported by the USDOE.

R8Q.004 Effects of P and P Asymmetries on Indirect Drive Implosions

, O.S. JONES, S.M. POLLAINE, S.W. HAAN, L.J. SUTER, Lawrence Livermore National Laboratory — We have performed a parametric study of the effect of higher order (P and P) Legendre modes on indirect drive capsule performance. There will be some relatively low level of P and P on the capsule. These modes have been studied less than the lower order modes because they are smoothed by hohlraum transport to very small amplitudes, and calculations generally have indicated that the amplitudes would be small enough to not affect the implosion seriously. The current work addresses this estimate in more detail. The effect of P and P Legendre modes on the target were studied using Lasnex, which is a radiation hydrodynamics code. The calculations were done by imposing various levels of P and P perturbations on the capsule and then running the calculations until implosion and examining the capsule symmetry and yield. First we examined the effects of the modes separately during the foot, rise, and peak of the indirect drive pulse. Then we examined their effects in combination with each other and in combination with lower order modes.

This work was performed under the auspices of the U. S. DOE by the LLNL under Contract No. W-7405-ENG-48

R8Q.005 Simulation of Nike Radiation Heated Ablator Experiments

, J.P. DAHLBURG, Plasma Physics Division, NRL, J.D. SETHIAN, Plasma Physics Division, NRL, S.P. OBENSCHAIN, Plasma Physics Division, NRL, V. SERLIN, Plasma Physics Division, NRL, A.J. SCHMITT, Plasma Physics Division, NRL, D. COLOMBANT, Plasma Physics Division, NRL, J.H. GARDNER, LCP&FD, NRL, L. PHILLIPS, LCP&FD, NRL, T. LEHECKA, SAIC, M. KLAPISCH, ARTEP, G. HAZAK, Berkeley Research Associates, A.L. VELIKOVICH, Berkeley Research Associates — Our simulations predict that radiating plasma structures (RPS) [J.P.Dahlburg et al., JQSRT vol 54, 113 (1995)] can form in Nike radiation-heated ablator experiments. Two experimental series are analysed. One [S.P.Obenschain et al., this conference] uses solid plastic (CH) targets coated with a solid gold layer. The other [J.D.Sethian et al., this conference, invited] uses plastic (rf) foam targets wicked with cryogenic deuterium and coated with a gold-kapton laminate. The supporting multimaterial and multidimensional simulations were performed with NRL FAST running in non-LTE mode, and using NRL-STA opacities. We will present an analysis of target stability including the effects of RPS, and a comparison of the simulations with experiment.

Work supported by US DoE and ONR.

R8Q.006 Modeling Line Emission from ICF Capsules in 3 Dimensions

, STEVEN H. LANGER, Lawrence Livermore National Laboratory, HOWARD A. SCOTT, MICHAEL M. MARINAK, OTTO L. LANDEN, Lawrence Livermore National Laboratory — Line emission from ICF implosions can be used to diagnose the temperature of the fuel and provides an indication of the distortion in the fuel-pusher interface. The modeling presented in this paper is carried out in three dimensions and is run on parallel computers. The capsule has realistic initial multi-mode surface perturbations and radiation drive asymmetries like those in experiments on the Nova laser. The drive includes both intrinsic asymmetries and asymmetries due to beam-to-beam power balance and pointing errors. At the time of peak compression, the interface between the fuel and the plastic shell can have large perturbations that lead to reduced neutron yield and alter the line emission. These models compute line emission from argon in the fuel and titanium in the plastic. The predicted line emission is compared to experimental data to evaluate its utility as a diagnostic of capsule performance.

This work was performed under the auspices of the U. S. Department of Energy by the Lawrence Livermore National Laboratory under Contract No. W-7405-ENG-48.

R8Q.007 Linear Feed-out of Rear Surface Nonuniformities in Planar Geometry

, V. LOBATCHEV, R. BETTI, Laboratory for Laser Energetics, U. of Rochester — The propagation of a small perturbation from the back to the front surface of a laser-accelerated planar foil is investigated both analytically and numerically. The foil is described by the ideal gas model. The front surface is flat, while the back surface is rippled. When the initial shock reaches the back surface, a rarefaction wave propagates backward toward the front. The rippled rarefaction wave transfers the perturbation from the back to the front. Once the front becomes rippled, the Rayleigh-Taylor instability is seeded and the perturbation grows exponentially in time. The analytic theory is developed by solving the linearized compressible fluid equations in a lagrangian frame of reference. The equations cannot be exactly solved inside the rarefaction wave. An approximate solution can be found when the ripple wavelength is longer than the compresed foil thickness. Then, the ripple temporal evolution is determined by matching the solutions inside and outside the rarefaction wave. The analytic solution is compared with the results of 2-D Lagrangian numerical simulations. The code used in the simulations is based on the explicit second-order difference scheme with assigned pressures on both surfaces. The RT growth seeded by rear-surface nonuniformities is also compared with the one seeded by front-surface imperfections and laser imprinting. This work was supported by the U.S. Department of Energy Office of Inertial Confinement Fusion under Cooperative Agreement No. DE-FC03-92SF19460.

R8Q.008 Resistivity Limited M=0 Instability of Surfaces of Magnetically Imploded Cylindrical Liners

, R. E. REINOVSKY, Los Alamos National Laboratory, R. L. MORSE — Implosion of cylindrical aluminum liners driven as Z-pinches by the Pegasus pulsed power machine show M=0 magneto Raleigh-Taylor instability structure with highly regular wavelength in Z, of approximately 1mm, on outer surfaces of liners, under conditions that melt the surface material. Typical conditions are, initial liner dimensions R=2.5cm, DR=1.14mm, H=2.0cm, maximum current 12MA, implosion time approximately 8mus, outer temperature .1-.3eV. It will be shown, through analytic and simulation calculations, that the peaked spectrum of M=0 growth rates required to generate the observed regular mode structure must be produced by resistive diffusion in Z of previously embedded magnetic field, which strongly limits growth rates of modes with wavelengths shorter than those observed.

R8Q.009 Analysis of Hydrodynamic Instabilities at Photoevaporation Fronts in Astrophysical Settings*

, D.D. RYUTOV, K.S. BUDIL, S.G. GLENDINNING, B.A. REMINGTON, LLNL, R.P. DRAKE, U. of Michigan, Ann Arbor, J.M. STONE, U. of Maryland — Molecular clouds situated near bright newborn stars are exposed to intense fluxes of ionizing radiation. In particular, the spectacular Eagle Nebula belongs to this class of objects. Photoionization of the gas produces an intense ablative flow from the surface of the cloud and the acceleration of the cloud material in the opposite direction, a situation where hydrodynamic instabilities such as the Rayleigh-Taylor (RT) and Richtmyer-Meshkov (RM) instabilities may develop.[L. Spitzer. ApJ **120**, 1 (1954).]. New observational data from the Hubble Space Telescope warrants revisiting the question of whether features in the Eagle nebule might be caused by hydrodynamic instabilities.[J.J. Hester et al. AJ **111**, 2348 (1996); M.W. Pound. ApJ **493**, L113 (1998); J.M. Stone, J. Xu, and L.G. Mundy, Nature **377**, 315 (1995).] We will discuss the effects of initial density non-uniformities, compressibility, shocks, variations of the ionizing flux in time and space, ablative stabilization, and possible “fire-polishing”. *Work performed under the auspices of the U.S. Department of Energy by the Lawrence Livermore National Laboratory under Contract W-7405-ENG-48.

R8Q.010 Direct-Drive Cylindrical Implosions on the OMEGA Laser

, CRIS W. BARNES, D.L. TUBBS, J.B. BECK, J.A. OERTEL, N. SHAMBO, S.A. VOSS, R.G. WATT, Los Alamos National Laboratory, T.R. BOEHLY, D.K. BRADLEY, J.P. KNAUER, Laboratory for Laser Energetics — Studies of convergent hydrodynamics in cylindrical geometry are being conducted at the OMEGA laser facility at the Laboratory for Laser Energetics at the University of Rochester. Polystyrene cylinders that are 20- m thick, 2.25-mm long, and 0.9-mm in diameter with 60 mg/cc polystyrene foam are directly illuminated with 19 kJ from 50 laser beams in a 2.5-nsec linear ramp pulse shape. The imploding cylinder is then radiographed from the x-rays generated using laser beams to illuminate a titanium foil. Very symmetric implosions (few percent asymmetries at ablator convergence ratios of) are achieved. Targets both unperturbed and with machined sinusoidal perturbations of varying wavelength (m=14 to 58) and amplitude (0.5 m to 1.5 m) are used to study the ablative Rayleigh-Taylor instability in this convergent geometry. Using either deuterated or chlorinated doped foams, neutron and spectroscopic diagnostics are used to determine the temperature and density of the cylindrical implosion. Details of the experiment and its comparison to hydrodynamic simulation will be presented. This work was performed under the auspices of the U. S. Department of Energy by the Los Alamos National Laboratory under contract No. W-7405-Eng-36.

R8Q.011 X-ray Spectroscopy of Directly Driven Cylindrical Implosions

, D. HAYNES, C. HOOPER, University of Florida, N. DELAMATER, C. BARNES, J. OERTEL, G. POLLAK, D. TUBBS, R. WATT, Los Alamos National Laboratory, T. BOEHLY, D. BRADLEY, P. JAANIMAGI, J. KNAUER, Laboratory for Laser Energetics, University of Rochester — X-ray spectra from a chlorinated polystyrene marker layer in a series of directly driven cylindrical implosions are presented and analyzed. The m thick, m long C H Cl (1.42g/cc) annular spectroscopic tracer layer is centrally located on the interior surface of the m thick, m long polystyrene (1.044g/cc) m inner diameter cylindrical shell. The shell is filled with polystyrene foam (60mg/cc). The implosions are driven by 50 beams of the OMEGA Laser facility. The temperature and density sensitive K-shell Cl spectra are recorded by a time-resolved spectrograph, and compared to calculated spectra in order to infer the evolution of electron temperature and density in the marker layer.

Barnes, C. W., *et al.* 1998, to be published in *Rev. Sci. Instrum.*, Tubbs, D. L., *et al.* 1998, to be published in *Lasers and Particle Beams*

This work was performed under the auspices of the U. S. Department of Energy by the Los Alamos National Laboratory under contract No. W-7405-Eng-36

R8Q.012 Convergent Ablation Front Instability Experiments on Nova

, A.L. RICHARD, C. CHERFILS-CL´EROUIN, N. DAGUE, D. GALMICHE, P. SALVATORE, CEA/Centre d'Etudes de Bruy ` eres, BP12, 91680 Bruy ` eres le Chatel, France, S.G. GLENDINNING, S. HAAN, B. REMINGTON, R. TURNER, R. WALLACE, LLNL, Livermore, CA 94550, USA — We have carried out a new set of experiments on the ablation front RT instability in spherically convergent geometry on the Nova facility. We have modified the experimental configuration compared to previous one so as to allow the study of the convergence effect on the growth of the perturbations with a higher convergence ratio 3-4. We have used standard Nova cylindrical "scale 1.5" hohlraums. The samples were 1 mm diameter, 42 m thick, CH(1.2%Ge) capsules with no fill pressure. The perturbations were pure Legendre mode. The growth of the instability was observed by face-on radiography of the samples. We used eight laser beams for the drive in a 4.5 ns in duration 7:1 contrast pulse shape. The radiation drive was measured, with a 130 eV peak.

C. Cherfils et al. p116 ; S.G. Glendinning et al. p173 ; 6th IWPCTM, Marseille, France, June 1997

R8Q.013 Hydrodynamics Experiments on Intense Lasers

, B.A. REMINGTON, S.G. GLENDINNING, D.H. KALANTAR, K.S. BUDIL, S.V. WEBER, J. COLVIN, T. DITMIRE, D.D. RYUTOV, LLNL, J. KANE, E. LIANG, Univ. of Arizona, Tucson, W.M. WOOD-VASEY, Univ. of CA, Berkeley, K. MOORE, Harvey Mudd College, K. KEILTY, Rice Univ., K. SHIGEMORI, Osaka Univ., A.M. RUBENCHIK, Univ. of CA, Davis — We are pursuing a wide range of hydrodynamics experiments in the areas of inertial confinement fusion, high energy-density physics, and astrophysics, using the Nova, PetaWatt, Falcon, and Omega lasers. Our research encompasses the hydrodynamics at ablation fronts, at embedded interfaces, shock initiated versus driven by protracted acceleration, in planar and in nonplanar geometries, both in the linear and in the nonlinear regimes. Most of the samples under study are in the plasma state, but we have a new initiative to investigate the "hydrodynamics" of the solid state. An overview of our work will be given, emphasizing common themes, and scale transformations between regimes.

Work performed under the auspices of the U.S. Department of Energy by the Lawrence Livermore National Laboratory under Contract W-7405-ENG-48.

R8Q.014 Hydrodynamic instability studies on Nike

, C.J. PAWLEY, J.P. DAHLBURG, S.P. OBENSCHAIN, A.J. SCHMITT, J.D. SETHIAN, V. SERLIN, Plasma Physics Division, Naval Research Laboratory, J.H. GARDNER, Laboratory for Computational Physics, Naval Research Laboratory, Y. AGLITSKIY, Y. CHAN, A.V. DENIZ, T. LEHECKA, SAIC — We are extending our study of Rayleigh-Taylor instabilities to 3-D structures. Studies in planar plastic targets with Sin(x)+ Sin(y) patterns impressed on them are planned. Saturation modes for three wavelengths (60, 30, and 20 m) will be examined experimentally and in simulations. Preliminary experiments with deuterium loaded foams are also planned. Various diagnostic configurations and limitations will be presented.

Work supported by the U.S. Dept. of Energy

R8Q.015 Transient X-ray Diffraction from Shock Compressed Si Crystals on the Nova Laser

, A. LOVERIDGE, J.S. WARK, Univ. of Oxford, D.H. KALANTAR, J. COLVIN, B.A. REMINGTON, S.V. WEBER, L. WILEY, LLNL, A.A. HAUER, B. FAILOR, LANL, M.A. MEYERS, UCSD, G. RAVICHANDRAN, CalTech — A series of experiments has been done to study the shock compression of Si crystals using a hohlraum x-ray drive on Nova. We have shock compressed Si along the (111) and (400) lattice directions at peak pressures of up to 500 kbar. We observe up to a 10% compression in the lattice spacing. The diffraction from a compressed (400) lattice shows evidence of a 2-wave shock structure. Additional experiments on the Trident laser at LANL and Nova at LLNL are designed to look at the simultaneous diffraction from (400) and (040) lattice planes in order to characterize the transition from elastic to plastic deformation in the crystal lattice. [2] Results from the experiments and simulations of the Bragg diffraction data generated by post-processing hydrodynamics calculations will be presented.

Work performed under the auspices of the U.S. Department of Energy by the Lawrence Livermore National Laboratory under Contract W-7405-ENG-48.

R8Q.016 Modeling of Blast Waves Generated on the Falcon Laser

, K. KEILTY, E. LIANG, Rice Univ., T.R. DITMIRE, B.A. REMINGTON, A.M. RUBENCHIK, K. SHIGEMORI, LLNL, K. MOORE, Harvey Mudd College — We are simulating experiments being done on the Falcon laser to generate strong, cylindrically diverging blast waves of relevance to astrophysics [J.T. Larsen and S.M. Lane, JQSRT **51**, 179 (1994).]. These experiments extend to cylindrical geometry earlier work by Grun et al. on spherical blast waves [J. Grun et al., Phys. Rev. Lett. **66**, 2738 (1991).] The Falcon laser generates pulses of a few hundred mJ in 30 fs at a wavelength of 820 nm, imaged with =46/15 optics into an Ar gas-jet target of ion density 10 cm . The energy is deposited over a cylindrical volume of dimensions 1 mm length by 50 m diameter. For our numerical simulations, we use the radiation-hydrodynamics code HYADES [C.F. McKee and B.T. Draine, Science **252**, 397 (1991).] in cylindrical geometry to simulated the evolution of this cylindrical shock wave, and comparing the simulations with the data and with Sedov-Taylor blast wave theory. The goal of this effort is to develop a laboratory setting for studying strong shocks of relevance to supernova remnants, gamma-ray bursts, and other high energy astrophysics phenomena. * Work performed under the auspices of the U.S. Department of Energy by the Lawrence Livermore National Laboratory under Contract W-7405-ENG-48.

Work performed under the auspices of the U.S. Department of Energy by the Lawrence Livermore National Laboratory under Contract W-7405-ENG-48.

R8Q.017 The Use of Transient X-ray Diffraction for Shock Wave and High Pressure Materials Science

, A. HAUER, G. KYRALA, R. KOPP, D. THOMA, K. CHEN, F. CHU, D. WILSON, J. COBBLE, P. GOBBY, L. FOREMAN, LosAlamos National Lab., J. WARK,

A. LOVERIDGE, University of Oxford, D. KALANTAR, B. REMINGTON, S. WEBER, J. ASAY, C. HALL, T. TRUCANO, Sandia National Lab. — Transient x-ray diffraction is powerful tool for the study of shock wave propagation and materials effects in the condensed state. Some of the phenomena that can be studied are plastic wave propagation, and the dynamics of phase transitions. We report on an on-going series of experiments on the Trident laser at Los Alamos and the Nova laser at Livermore that illustrate the value of transient diffraction. If significant plastic deformation occurs a diffracted signal from planes orthogonal to the shock propagation might be expected. We have observed such a signal in experiments with LiF crystals. Similar experiments with silicon exhibit other interesting phenomena such as the splitting of diffracted lines which may give temporally resolved information on phase changes. We have applied transient diffraction to the study of Be which is one of the most promising materials for the fuel containing capsule in inertial confinement fusion (ICF) target designs that may achieve ignition. We report on time resolved diffraction measurements using Be crystals that will help to clarify the behavior of Be in laser driven implosions. This work was performed under the auspices of the U. S. Department of Energy by the Los Alamos National Laboratory under contract No. W-7405-Eng-36.

R8Q.018 Solid State Hydrodynamics Experiments on the Nova Laser

, D.H. KALANTAR, E. CHANDLER, J. COLVIN, K. MIKAELIAN, B.A. REMINGTON, S.V. WEBER, L. WILEY, LLNL, J.S. WARK, Univ. of Oxford, A.A. HAUER, LANL — In order to study the high strain rate dependence of the material strength in metal foils, we are developing solid state experiments using a hohlraum x-ray drive on the Nova laser. These experiments require a low adiabat drive and careful preheat control. We have developed a drive to shock compress Cu foils at peak pressures of 3 Mbar using a brominated polystyrene ablator. We have characterized this drive with a range of different measurement techniques including Dante, side-on foil trajectories, and shock timing measurements. The ablator-metal interface is calculated to remain solid under compression, but most of the foil melts. A modified x-ray drive will be used to shock compress Al foils at peak pressures of 1.4 Mbar. In this case the foil is calculated to remain solid and the material strength is calculated to inhibit perturbation growth. We will present results of the experiments and simulations of the drive and instability growth measurements. We also discuss the development of dynamic x-ray diffraction techniques to demonstrate the material state under compression. *Work performed under the auspices of the U.S. Department of Energy by the Lawrence Livermore National Laboratory under Contract W-7405-ENG-48.

R8Q.019 Drive Modeling and Characterization for Solid-State Instability Experiments on the Nova Laser

, J.D. COLVIN, S.V. WEBER, D.H. KALANTAR, B.A. REMINGTON, LLNL — Kalantar et al. at this Conference discuss experiments conducted using the Nova laser at LLNL to investigate material strength stabilization of acceleration-driven instability growth in the solid state. We used a temporally shaped laser pulse to create an x-ray drive inside a cylindrical gold hohlraum to indirectly drive a sequence of shocks that provide a low adiabat compression of a metal foil to a peak pressure of about 3 Mbar while leaving it solid. Considerable attention has been focused on developing the appropriate radiation drive pulse for these experiments. In this presentation we discuss the 2-D hohlraum simulations done with both a radiation-hydrodynamics code and a view factor code to design the nearly adiabatic x-ray drive. Foil trajectory data taken by side-on radiography, radiation temperature measurements taken with a broad band filter x-ray spectrometer, and shock timing measurements taken with a "Michelson" interferometer are compared with simulations in developing our very low isentrope drive.

Work performed under the auspices of the U.S. Department of Energy by the Lawrence Livermore National Laboratory under Contract W-7405-ENG-48.

R8Q.020 Rayleigh-Taylor Growth of Ablation Front Modulations in Indirectly-Driven Be/Cu Planar Foils

, S.G. GLENDINNING, G.W. COLLINS, M.M. MARINAK, S.W. HAAN, S.V. WEBER, R.J. WALLACE, LLNL, N. DAGUE, CEA — We present results of

Rayleigh-Taylor growth of pre-imposed surface modulations in planar foils of 6% copper-doped Be. Beryllium doped with copper is currently under examination as a potential capsule material for ignition targets on NIF. In these experiments, foils m thick were accelerated by ablation using the x-ray drive produced by a gold hohlraum on Nova. Sinusoidal surface modulations on the driven side with wavelengths between 30 and 70 m were imaged by face-on radiography during the foil acceleration. On other experiments a foil with no modulations was imaged by side-on radiography to determine the acceleration. We will present comparisons with LASNEX simulations.

Work performed under the auspices of the U.S. Department of Energy by the Lawrence Livermore National Laboratory under Contract W-7405-ENG-48.

R8Q.021 Coupling of acoustic and gravity waves in a compressible hydrostatic atmosphere

, NELSON HOFFMAN, Los Alamos National Laboratory — The accelerated shell of an ICF capsule resembles, in some respects, an atmosphere in a gravitational field. For example, it can support waves analogous to the acoustic-gravity waves that are observed in the earth's atmosphere. We have examined the extent to which modes in the acoustic and gravity branches of the acoustic-gravity dispersion relation may couple, with empasis on those wavenumbers at which the acoustic mode's frequency is an integral multiple of the gravity mode's frequency. Calculations are carried out in an idealized stable hydrostatic atmosphere in planar geometry with constant gravitational acceleration. We consider acoustic waves generated by stable gravity waves, stable gravity waves generated by acoustic waves, and finally unstable gravity waves (Rayleigh-Taylor instability) generated by acoustic waves.

This work was performed under the auspices of the U. S. Department of Energy by the Los Alamos National Laboratory under contract No. W-7405-Eng-36.

R8Q.022 Modeling of Characterization Experiments for NIF Ablator Materials

, S. V. WEBER, G. W. COLLINS, S. G. GLENDINNING, R. J. WALLACE, F. ZE, Lawrence Livermore National Laboratory, N. DAGUE, J. P. JADAUD, E. DE SAINTE CLAIRE, CEA/Direction des Recherches en Ile de France — Favored ablator materials for ignition capsules for the National Ignition Facility (NIF) and the French Laser Megajoule (LMJ) include Cu-doped Be and polyimide (C H N O). We report on Nova experiments to characterize these materials and on comparison of the results with simulations. Experiments measured shock breakout and x-ray radiation burnthrough of planar foils driven with flat-topped laser pulses of 1-2 ns duration. BeCu experiments examined radiation temperature variations of 200-250 eV and Cu atom fractions of 1-6%. Polyimide experiments will compare 230 eV, 1 ns drive with 215 eV, 2 ns pulses. The fit of simulations to the data depends upon the opacity and equation of state of the materials, as well as on precise characterization of the radiation drive conditions. Sensitivity of the results to the level and spectrum of the radiation drive and to the material properties have been investigated.

Work performed under the auspices of the U.S. Department of Energy and Commissariat `a l'´ Energie Atomique (France) by the Lawrence Livermore National Laboratory under contract W-7405-ENG-48.

R8Q.023 Simulations of Implosions with a 3D, Parallel, Unstructured Grid, Radiation-Hydrodynamics Code

, A. I. SHESTAKOV, J. K. MILOVICH, M. K. PRASAD, LLNL — We present results obtained with the code described in [1,2] which solves the equations of compressible hydrodynamics, laser deposition, heat conduction, and one-group radiation transport (flux-limited diffusion approximation). We choose problems of interest to ICF applications: point explosions and spherical implosions. For explosions, the problem couples non-linear heat conduction to hydrodynamics. For implosions, we include radiative effects in order to simulate indirectly–driven ICF capsules. The 3D results are obtained on unstructured tetrahedral grids which are domain-decomposed to run on as many as 128 processors. We compare results to 1D spherical simulations and analytic solutions. Results using laser deposition are presented in a companion paper by Kaiser et al.

1. A. I. Shestakov et al, "The ICF3D Code," Lawrence Livermore National Laboratory, Livermore, CA, UCRL-JC-124448, (1997), to appear in *Comput. Methods Appl. Mech. Engin.*
2. A. I. Shestakov, J. L. Milovich, and D. S. Kershaw, "Parallelization of a 3D, Unstructured Grid, Hydrodynamic-Diffusion Code," Lawrence Livermore National Laboratory, Livermore, CA, UCRL-JC-130988, (1998), submitted to *SIAM J. Sci. Comp.*

R8Q.024 Numerical Analysis of the Magnetized Spherical Pinch

, EMILIO PANARELLA, Advanced Laser and Fusion Technology, Inc. 189 Deveault St., No. 7, Hull, P.Q., J8Z 1S7, Canada, MICHEL DE PERETTI, FREDERIC GUERRIER, CHRISTELLE STANDT, Ecole d'Ingenieurs, Computational Physics Laboratory, 3 bis rue Lakanal, 92330 Sceaux, France, S. SEMISHIN, Ecole Polytechnique, PMI, 91128 Palaiseau, France —
The fluid dynamics and high-temperature hydrodynamics of the spherical pinch can be briefly described as an explosion within an implosion. The structure of the shock waves for such explosion within an implosion is determined by solving numerically the governing equations of the phenomena. A 1-dimensional lagrangian hydrodynamic and heat transfer code has been used to make a detailed analysis of the spherical pinch in terms of density, pressure, and temperature in deuterium-tritium and to reveal the structure of the shock waves. A few cases will be presented where the parameters of the explosion within implosion can lead to breakeven conditions. By magnetizing the central exploding plasma with a suitable magnetic field, it is found that the conditions for breakeven are facilitated.

E. Panarella, J. Fusion Energy, Vol. 6, p. 285 (1987)

R8Q.025 Spectroscopic diagnostics of tungsten-doped CH plasmas

, M. KLAPISCH, ARTEP, Inc. Columbia, MD, D. COLOMBANT, NRL, Plasma Physics Division, T. LEHECKA, SAIC, McLean, VA. — Spectra of CH with different concentrations of W dopant and laser intensities (2.5-10 x10 W/cm) were obtained at NRL with the Nike Laser. They were recorded in the 100-500 eV range with an XUV grating spectrometer. The hydrodynamic simulations are performed with the 1D code FAST1D where non LTE effects are introduced by Busquet's model . They are then post-processed with TRANSPEC , a time dependent collisional radiative code with radiation coupling. The necessary atomic data are obtained from the HULLAC code . The post processing and diagnostics were performed on carbon lines and the results are compared with the experimental data.

Work supported by USDOE under contract with NRL.

J. H. Gardner et al., Phys. Plasmas, 5, May (1998).

M. Busquet, Phys. Fluids B, 5, 4191 (1993); M. Klapisch, A. Bar-Shalom, J. Oreg and D. Colombant, Phys. Plasmas, 5, May (1998).

O. Peyrusse, J. Quant. Spectrosc. Radiat. Transfer, 51, 281 (1994)

M. Klapisch and A. Bar-Shalom, J. Quant. Spectrosc. Radiat. Transfer, 58, 687 (1997).

R8Q.026 A New Laser Driver for ICF Physics Modeling Codes on Unstructured 3D Grids

, T. B. KAISER, J. L. MILOVICH, A. I. SHESTAKOV, M. K. PRASAD, University of California, Lawrence Livermore Laboratory — We present a status report on the current state of development, testing and application of a new scheme for laser beam evolution and power deposition on three-dimensional unstructured grids. We have added a new ray propagator that is second order in time, allowing rays to refract within computational zones as well as at zone interfaces. In a globally-constant free-electron density gradient on a randomized hexahedral mesh, the new integrator produces ray trajectories that agree with analytic results to within machine roundoff. A new method for computing the inverse-bremsstrahlung energy deposition rate that captures its highly non-linear spatial dependence within a zone has also been added. This allows accurate integration of the deposition along the 2nd-order ray trajectories without the necessity of sub-stepping in time. Other enhancements include multiple user-configurable beams, computation of the electron oscillation velocity in the laser electric field and energy-deposition accounting. Results of laser-driven simulations will be presented.

This work was performed under the auspices of the US Department of Energy by the LLNL under contract No. W-7405-ENG-48.

R8Q.027 Thompson Scattering Measurements Compared with LASNEX Simulations

K. G. ESTABROOK

R8Q.027 Thompson Scattering Measurements Compared with LASNEX Simulations

, R.G. ESTABROOK, S.H. GLENZER, Lawrence Livermore National Laboratory, W. ROZMUS, U.Alberta and Institute of Laser Science and Applications, LLNL, J.S. DEGROOT, U.C.Davis and LLNL, C.A. BACK, B.G. WILSON, G.B. ZIMMERMAN, S.H. LANGER, R.W. LEE, J.H. HARTE, D.S. BAILEY, LLNL — We use Thomson scattering to measure electron temperatures, ionization states and drift velocities from beryllium and gold disks irradiated at 64 degrees by a single f/4, 3.6kJ, blue Nova beam. Two scattering spectra of the electron and ion features determine the density, ionization state and some information about the electron velocity distribution 500 from the disk. Four scattering of the ion feature at several places on the axial profile determines the ionization state times the electron temperature. The heat flux is inferred from the return current and compared to simulations. The calculated temperatures and ionization states are sensitive to the atomic physics model so these experiments severely test the simulation modeling.

Auspices U.S.Department of Energy by Lawrence Livermore National Laboratory Contract No. W-7405-ENG-48

R8Q.028 Advances in HYDRA and its application to National Ignition Facility (NIF)Capsule Designs

, M.M. MARINAK, Lawrence Livermore National Laboratory, T.R. DITTRICH, N. GENTILE, G.D. KERBEL, S.W. HAAN, O. JONES, Lawrence Livermore National Laboratory — We will outline new capabilities added to the HYDRA 3-D radiation hydrodynamics code. These include a laser raytrace package, implicit Monte Carlo photonics, and new Arbitrary Lagrange-Eulerian (ALE) grid motion algorithms. We will also outline strategies employed in adapting the code for efficient performance on massively parallel architectures. These improvements enable HYDRA to perform 3 D simulations of an expanded range of ICF targets, including simulations of radiation hydrodynamics in hohlraums. Simulations of multimode hydrodynamic instabilities on ignition capsule designs can now include a broader range of modes (L 4-120). These enable us to examine the importance of non linear coupling into the lowest mode range. We will present simulations of standard 300 eV NIF capsule designs and new designs driven at a peak temperature of 250 eV.

This work was performed under the auspices of the U. S. Department of Energy by the Lawrence Livermore National Laboratory under Contract No. W-7405-ENG-48

R8Q.029 Large Scale Filamentation Simulation with pF3D

, C. H. STILL, R. L. BERGER, B. I. COHEN, A. B. LANGDON, E. A. WILLIAMS, Lawrence Livermore National Laboratory — The plasma volumes present inside NIF hohlraums provide much larger path lengths over which laser-plasma instabilities can grow. The need to simulate ignition relevant (larger) plasma volumes has driven the development of a parallel F3D code (pF3D), which is now beginning to deliver results on these larger calculations. As previously reported, F3D is a 3-d fluid code coupling a paraxial wave solver to a nonlinear Eulerian hydrodynamics package, with models for SBS and SRS backscatter, and RPP beams, with smoothing by SSD and polarization smoothing (PS). The parallel code (pF3D) uses domain decomposition to achieve concurrency in the paraxial wave solver and hydrodynamics package, and includes a fairly sophisticated beam package which extends the one in F3D. A full 3-d Langmuir wave solver and models for SBS and SRS are under development. We report on the algorithms and status of pF3D and show simulation results, including filamentation simulations in a 50 m 900 m 2500 m plasma using ignition conditions (W/cm , keV,).

Work performed under the auspices of the U. S. DoE by LLNL under contract No. W-7405-ENG-48.

e c

R8Q.030 Browian Motion for Photons

, WILLIAM BATESON, LLNL, DENNIS HEWETT, LLNL, DMITRI RYUTOV, LLNL — Transport of radiation for arbitrary optical depth is a standing problem. To address some of the issues we have generated a non-recursive solution for the random walk of a constant speed particle. This solution, which requires a fixed number of random numbers, advances the position and direction of drift of a constant speed particle assuming a fixed scattering rate. In addition, we have been investigating a "brute force" implicit recursive solution for arbitrary scattering in the hope that we may adapt the solution for step discontinuities and linear rates into our non-recursive formulation. We will present the derivation of the random walk of a constant speed particle and suggest on how it could be applied to more general scattering media.

Work performed under auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract number W-7405-ENG-48

R8Q.031 Helium-Hydrogen filled targets on Nova

, L. LOURS, Commissariat a l'Energie Atomique, BP 12, 91680 Bruyeres le Chatel, France, C. DECKER, R.L. BERGER, E.A. WILLIAMS, L.S. SUTER, Lawrence Livermore National Laboratory, University of California, L-473 P.O. Box 808, Livermore, California 94550, U.S.A. — Over the last several years, many experiments have been performed on Nova to evaluate backscattering instabilities for plasma conditions similar to those expected on the Laser MegaJoule (LMJ) or the National Ignition Facility (NIF). In particular, the appropriate electron densities and temperatures have been accessed using Carbon-Hydrogen plasmas . However, in order to achieve the LMJ/NIF like ion damping on Nova, targets with helium-hydrogen gas fills must be employed. We will present helium-hydrogen targets designed to achieve the appropriate conditions for emulating LMJ/NIF conditions. Designs for both confined systems, such as hohlraums, as well as unconfined systems, such as gasbags, will be presented.

B.J. MacGowan et al , Phys. Plasmas. 3, 2029 (1996)

R8Q.032 Computational MHD on an Intel Based Windows NT Platform

, SCOTT RABER, University of Washington, URI SHUMLAK, University of Washington, BOGDAN UDREA, University of Washington — For a number of years the Aeronautics and Astronautics Department at the University of Washington has been developing a parallel, implicit, non-ideal MHD Riemann solver (WARP3). It is a distributed code based on the Message Passing Interface (MPI). Recently we have ported the code to a Quad Pentium 233 MHz machine. We used DEC Visual Fortran version 5.0 to recompile our Fortran 90 code. An implementation of MPI for Windows NT was found freely available at University of Coimbra, Portugal. This version of MPI does use shared memory (as opposed to message passing) when run on a multi-processor system. Some problems were encountered pertaining to inter-process communication on our 4 processor shared memory machine and will be described in our paper. Speed-up tests were performed. Runs on scaled-up grids showed an 85% speed-up for a 4 process run. Fixed grid runs showed a speed-up of 2.65 for a 4 process run. In the near future we plan to install and run WARP3 on a Windows NT cluster of 8 Quad Pentium pros and will report our performance results.

S. Raber, U. Shumlak, B. Udrea, University of Washington

R8Q.033 Study of X-Ray Emission From Thin Burnthrough Foils

, ANN SATSANGI, US Department of Energy, CHRISTOPHER KEANE, US Department of Energy, MARCEL KLAPICH, ARTEP, JILL DAHLBURG, Plasma Physics Division, Naval Research Laboratory, DENNIS COLOMBANT, Plasma Physics Division, Naval Research Laboratory, JOHN GARDNER, LCP & FD, Naval Research Laboratory, CHRISTINA BACK, Lawrence Livermore National Laboratory — X-ray emission from laser irradiated targets is important in both indirect- and direct-drive ICF. We have performed 1D planar simulations of thin gold burnthrough foils in which the thickness of the gold foils was varied to observe its effect on the rear-side x-ray emission. The 500-5000 ° A thick foils were irradiated by a 1 ns square pulse of laser light at intensities from X to X for both 0.53 m (green) and 0.249 m (KrF) light. The total x-ray flux was calculated, as well as contributions from soft (1.5 keV) and hard (1.5 keV) x-rays. The calculated temporal evolution of the soft x-ray spectrum is shown and other characteristics of the emission will be discussed.

Work supported by US DOE and ONR

R8Q.034 Extension of the GaPH (Grid and Particle Hydrodynamics) Algorithm to Collisionless Electrostatic Plasmas

, J. W. SHON, Lawrence Livermore National Laboratory, W. B. BATESON, Lawrence Livermore National Laboratory, D. W. HEWETT, Lawrence Livermore National Laboratory — GaPH, a new kinetic algorithm [1], combines and retains the strengths of both the kinetic and hydrodynamic methods and is capable of doing transport of both material and radiation. GaPH performs kinetic simulations using finite-size fluid elements. Each element is an independent drifting Maxwellian of particles with finite temperature. The full distribution of each species is made up of a superposition of these elements, which are dynamically generated, transported and merged in phase space. Such elements have been shown to efficiently represent a complex particle distribution. Large elements represent bulk distributions with fluid-like behavior, while smaller elements represent a few energetic particles in the tail of the distribution. Such modeling capabilities are important for such strongly-driven systems where gradient scale lengths of interest become shorter than a mean free path. Extending the GaPH algorithm to couple particles to electrostatic fields can benchmark the dynamics of GaPH code in a PIC limit. Details of our collisionality tests and preliminary results of our effort to run the electrostatic two stream will be presented and compared to ES1. [1] W. B. Bateson, D. W. Hewett, Grid and Particle Hydrodynamics: Beyond Hydrodynamics via Fluid Element Particle-in-Cell, J. Comp. Phys. 138, 1998.

R8Q.035 Simulations of tungsten, tungsten-coated and tungsten-doped targets at low KrF laser intensities

, D. COLOMBANT, NRL, Plasma Physics Division, M. KLAPISCH, ARTEP, Inc. Columbia, MD, T. LEHECKA, SAIC, McLean, VA, J. SEELY, NRL, Space Sciences Division, A. SCHMITT, S. OBENSCHAIN, NRL, Laser Plasma Branch. — High-Z coatings can be used to create X-rays to preheat the ablator, thus reducing the laser imprint and the R-T instability. Targets with tungsten coated on the surface or mixed with CH have recently been irradiated using Nike at intensities of a few 10 W/cm , typical of the foot of a laser fusion pulse. The present simulations in 1D have been carried out to provide an interpretation of these experiments and to validate the code for radiation-preheated target designs . All computations were performed in non-LTE . Low resolution X-ray spectra obtained from on-line computations are compared to time-integrated experimental spectra between 100 eV and 500 eV. Agreements and differences between computations and experiments will be discussed.

Work supported by USDOE under contract with NRL.

S. E. Bodner et al., Phys. Plasmas, 5, 1901 (1998).

M. Busquet, Phys. Fluids B, 5, 4191 (1993); M. Klapisch, A. Bar-Shalom, J. Oreg and D. Colombant, Phys. Plasmas, 5, 1919 (1998).

R8Q.036 Auto-ionization Effects on NLTE Kinetics of Laser Plasmas

, J.R. ALBRITTON, B.G. WILSON, Lawrence Livermore National Laboratory; Livermore, CA 94550 — The ion charge state distribution of laser heated plasmas must often be modeled by a non-Local-Thermodynamic-Equilibrium (NLTE) kinetics scheme. Typically this results from a relatively weak ambient radiation field as compared with the influence of the local thermal (free) electrons. At modest to low densities a familiar picture is that the one-electron transition processes of collisional excitation and ionization are balanced by radiative recombination and decay. In fact, this regime is one in which the two-electron transition processes of auto-ionization and resonant-capture can also play an important role. Here we describe NLTE detailed configuration accounting (DCA) simulations which display the effects of the competition to establish the ion charge state balance of the plasma.

Work performed under the auspices of the U.S. Department of Energy by the Lawrence Livermore National Laboratories under contract No. W-7405-

ENG-48.

R8Q.037 Detailed Configuration Calculations for Non-LTE Modeling

, CHRISTOPHER J. FONTES, JOSEPH ABDALLAH JR., ROBERT E. H. CLARK, DAVID P. KILCREASE, Los Alamos National Laboratory — We continue our work to explore the feasibility of creating detailed atomic models for radiation-hydrodynamics simulations of ICF applications. By further optimizing our atomic data codes we are able to create non-LTE models with a level of complexity approximately one order of magnitude greater (in size) than previously obtained. We present emissivities for gold which include on the order of 75,000 configurations per temperature-density point. The inclusion of additional configurations has yielded improved results for quantities such as the ion fraction distributions, but the question of spectral convergence is yet unanswered. The creation of still larger models will be discussed as well as comparison with experiment and other theories. The possibility of using these models for in-line simulations will also be discussed.

This work was performed under the auspices of the US Department of Energy.

R8Q.038 Experimental Studies for LMJ Target Design

, J.M. REISSE, C. BAYER, E. DATTOLO, C. DREVET, P.A. HOLSTEIN, A. JOLAS, D. JURASZEK, CEA/Centre d'Etudes de Bruy ` eres, BP12, 91680 Bruy ` eres le Chatel, France — The operating space of indirect drive ignition targets depends on limits imposed on one side by the laser plasma interaction in the hohlraum (Brillouin, Raman, filamentation ...) and on the other side by the hydrodynamics instabilities, the ablator characterization and the symmetry of the implosion. These limits are subject to experiments on existing large laser facilities in France (Phebus) and in the United States in the frame of a collaboration with the DOE (Nova). We present here a review of the experiments that were performed. Some of the experimental results are compared with simulations. More results (experiments and numerical simulations) on hydrodynamics and plama instabilities are detailed in other contributions at this meeting.

Work performed in collaboration with LLNL and LANL

R8Q.039 Comparison of Multi-keV X-Ray Emissions from Xe-filled hohlraums and CsI Solid disks

, J. GRUN, Plasma Physics Division, Naval Research Laboratory, C. A. BACK, Lawrence Livermore National laboratory, JOHN L. DAVIS, Alme Associates, A. FISCHER, R. BURRIS, Plasma Physics Division, Naval Research Laboratory, C.D. DECKER, O.L. LANDEN, L. J. SUTER, F. J. SERDUKE, Lawrence Livermore National Laboratory, J. M. LAMING, U. FELDMAN, E.O. Hulburt Center, Naval Research Laboratory — Multi-keV x-ray sources and backlighters are being developed for future high-energy-density experiments on NIF. We have improved the production efficiency of 4-6 keV radiation by using as sources Xe-gas confined within Be hohlraums. The efficiency of these sources will be compared to the efficiency of solid CsI disk sources which emit in a similar x-ray energy regime. The experiments are performed on NOVA utilizing 15-30 kJ, 0.35 micron, 2nsec pulses. The emission is diagnosted with time-gated x-ray imagers, time-resolved and time-integrated spectroscopy, and with Al-XRD, diamond PCD, and Si-PIN detectors. Experimental results will be presented and compared to theoretical calculations.

Supported by DSWA and DOE

R8Q.040 Analysis of Imploded Capsule Images from Spherical Hohlraums with Tetrahedral Illumination

, T. J. MURPHY, J. M. WALLACE, K. A. KLARE, N. D. DELAMATER, G. R. BENNETT, A. A. HAUER, J. A. OERTEL, Los Alamos National Laboratory, S. M. POLLAINE, LLNL, R. S. CRAXTON, J. SCHNITTMAN, UofR/LLE — Tetrahedral hohlraums (spherical hohlraums with four laser entrance holes) have potential advantages over cylindrical hohlraums for symmetric implosion of ICF capsules. Experiments have been performed at the OMEGA Laser Facility in which "standard" capsules have been imploded using tetrahedral hohlraums. The fuel of the capsule was doped with Argon to allow x-ray images of the imploded core to be obtained. The lowest order mode in an ideal tetrahedral experiment is the Y mode so that the dominant asymmetry in the image is expected to be an m mode. The distortion is defined as the ratio of the maximum to the minimum radius and is designated d AAAA where A is the amplitude of the mn Fourier component of the x-ray emission contour.

This work was performed under the auspices of the USDoE by the Los Alamos National Laboratory under contract W-7405-ENG-36.

J. D. Schnittman and R. S. Craxton, Phys. Plasmas 3, 3786 (1996).

n

D. W. Phillion and S. M. Pollaine, Phys. Plasmas 1, 2963 (1994).

R8Q.041 Cylindrical Radiation Driven Hydrodynamic Experiments in Z-Pinch Driven Dynamic Hohlraums*

, G. CHANDLER, , M. DERZON, , J. LASH, , T. NASH, Sandia National Laboratories, J. AUBREY, , R. BOWERS, , D. PETERSON, Los Alamos National Laboratory — Dynamic hohlraums created by imploding cylindrical liners onto an inner structured foam cushion (converter) in a Z-pinch configuration have been proposed for driving Inertial Confinement Fusion systems and application experiments. Experiments have been performed using the 20 MA, 100 ns Z- accelerator as a first step to drive cylindrical ablators in order to study the energy coupling and drive symmetry.In these experiments a dynamic hohlraum is created using a 1 cm long nested tungsten-wire array. The 2 mg outer array was imploded from an initial radius of 1 cm onto a 1 mg inner tungsten wire array at an initial radius of 1 cm. The nested array stabilizes the pinch with respect to magnetic instability effects and effects associated with drive current asymmetries. The wire array implodes onto an 8 mm diameter, 9 mm long low density foam inner load or converter at 60 cm/s where the kinetic energy of the liner, 550 KJ, is converted into radiation in the central target which drives an inner cylindrical ablator. Experiments are planned using a 2 mm diameter ablator having walls of 10, 20 or 30 m thick made of germanium doped plastic or copper doped beryllium. Drive temperature of 160 eV are calculated. *Supported by U.S. DOE Contract DE-AC04-94AL85000.

R8Q.042 Hohlraum Energetics of Z-pinch-driven ICF Target Configurations

, T.A. MEHLHORN, R.A. VESEY, R.E. OLSON, Sandia National Laboratories, Albuquerque, NM — The Z accelerator has produced z-pinch x-ray powers and energies of up to 290 TW and 2 MJ, respectively with wall plug to x-ray energy generation efficiencies of 15%. This has created great interest in the ICF applications of z-pinches for high yield where large absorbed capsule energies are required. A z-pinch target is comprised of three parts: the pinch implosion region, the fusion capsule, and the enclosing hohlraum case. Three distinct z-pinch targets have already been proposed: the so-called 1) z-pinch-driven hohlraum, 2) static-walled hohlraum, and 3) dynamic hohlraums. We report on the results of hohlraum energetics modeling of these target configurations and comparisons of the strengths and weaknesses of each approach. The issues considered are capsule ignition criteria, radiation transport symmetry and efficiency, and z-pinch x-ray power scaling.

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under Contract DE-AC04-94AL85000.

R8Q.043 Hole Closure Experiments and Simulations on Z

, ROBERT E. CHRIEN, WALTER MATUSKA JR., FRITZ J. SWENSON, DARRELL L. PETERSON, GEORGE IDZOREK, BERNHARD H. WILDE, WALLACE E. ANDERSON, Los Alamos National Lab , STEPHEN P. BREEZE, LAWRENCE E. RUGGLES, MARK VARGAS, Sandia National Lab — Hole closure measurements and simulations are important in determining hohlraum temperatures from x-ray flux measurements and for coupling energy out of a vacuum hohlraum for applications experiments. A low-Z coating is often applied to the aperture to create a high ablation pressure which holds back the high-Z hohraum wall material. However this interface is unstable and may be subject to the development of highly nonlinear perturbations as a result of shocks converging near the edge of the aperture. We have performed a series of hole closure measurements on the Sandia Z facility using gated, filtered x-ray pinhole cameras. These experiments have tested a variety of plastic tamper densities and thicknesses, as well as plastic window materials over the holes to sharpen the radiation pulse on Z. These experiments are being compared with calculations performed using Lagrangian and Eulerian rad-hydro codes.

This work performed under US DOE contract W-7405-ENG-36.

R8Q.044 Radiosity Modeling of Radiation Transport in Z Hohlraum Configurations

, R. A. VESEY, T. A. MEHLHORN, Sandia National Laboratories — Vacuum radiation transport in three-dimensional geometry has been modeled, with simple physics assumptions, using the Lightscape commercial radiosity code. This code utilizes progressive, hierarchical radiosity techniques and adaptive mesh refinement to allow greater spatial resolution and unlimited geometric model complexity compared to traditional radiosity methods. Applications to current Z experiments at Sandia will be presented, including (a) uniformity of the radiation flux driving shock physics samples in offset and direct-viewing secondary hohlraums, (b) radiation temperature gradients and capsule illumination in on-axis secondaries driven by static-walled primary hohlraums, and (c) radiation loss from primary hohlraums into the Z anode-cathode gap and feed hardware.

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under Contract DE-AC04-94AL85000.

R8Q.045 Scaling of dynamic hohlraum radiation temperatures

, STEPHEN SLUTZ, Sandia National Laboratories, Albuquerque,NM 87125 — A dynamic hohlraum is formed when a z-pinch driven cylindrical wire array is driven inward onto a concentric cylinder. Thermal radiation from this collision can be effectively trapped if the wires of the array have coalesced and the wires are made of a high opacity material. The volume of this hohlraum can be much smaller than the more conventional approach of driving the wire array to the axis and trapping the radiation within the return current electrode. Thus the dynamic hohlraum has the potential to reach higher radiation temperatures. The performance of the dynamic hohlraum depends on a number of system parameters. We have developed a relatively simple model to determine the scaling of hohlraum temperatures as a function of both accelerator and z-pinch parameters.

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under Contract DE-AC04-94AL85000.