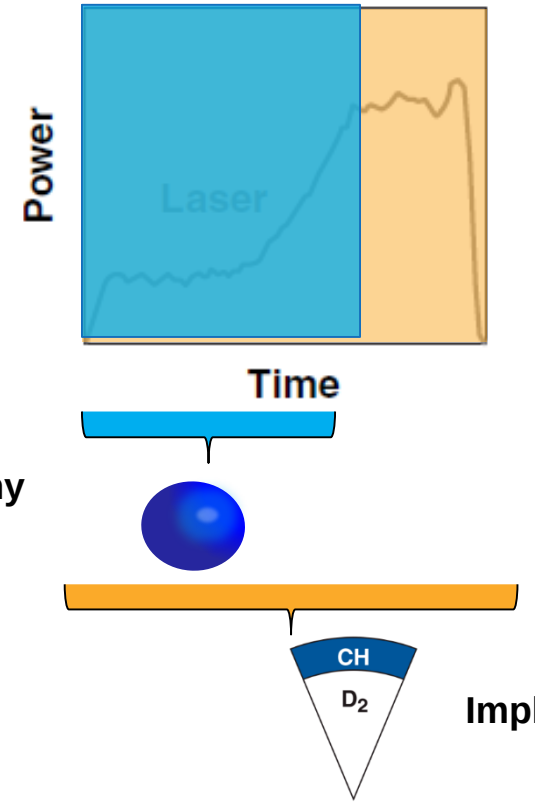
Validation of energy coupling models from kJ to MJ scale



Shock radiography
in solid spheres

Implosions

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Summary

Solid spheres and room-temperature plastic shell implosions are being used to study laser drive and validate models

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- **Designs for OMEGA and the NIF are hydrodynamically scaled, but physics beyond hydrodynamics including laser energy deposition, heat conduction, radiation and fast-electron preheat is important to model accurately for predictability.**
- **Solid spheres probe early and mid-stages of laser drive, whereas implosions are sensitive to drive throughout the laser pulse.**
- **Good agreement is obtained for shock trajectories radiographed in solid sphere experiments[1] driven by a range of on-target intensities, however discrepancies remain during the main drive in implosions.**
- **Implosions with a range of complementary diagnostics will be studied on the NIF as a function of laser intensity to separate the effects of laser drive and preheat.**

[1]NIF results: W. Theobald, this conference; OMEGA results: C. Stoeckl, this conference

Collaborators

C. Stoeckl, W. Theobald, M. Rosenberg, M. Porcelli, R. Betti, E. M. Campbell, D. Edgell, V. N. Goncharov, J. Knauer, S. P. Regan, A. Shvydky, and A. Solodov

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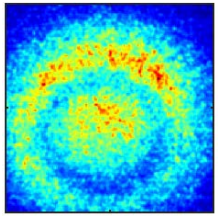
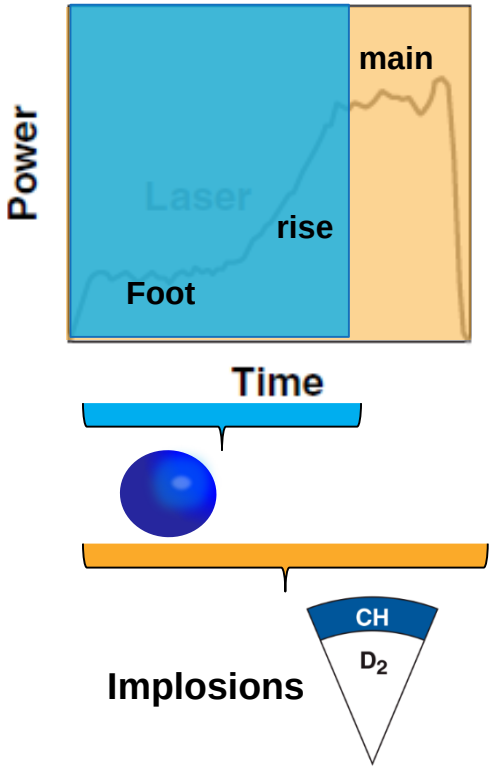
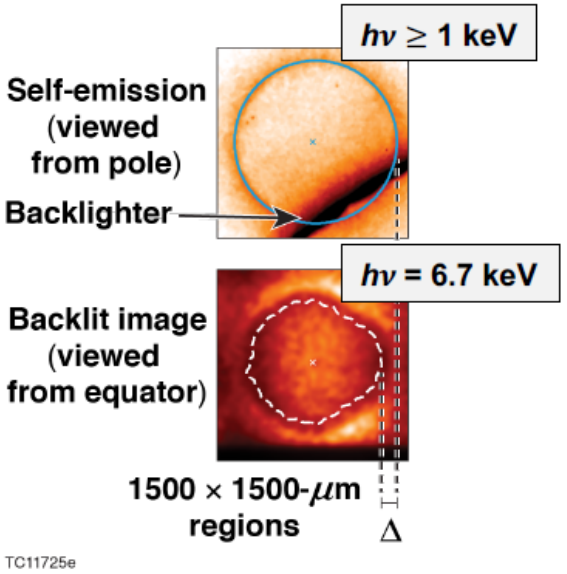
Coupling is being studied on OMEGA and the NIF with platforms that are sensitive to different phases of direct drive ICF

Solid sphere

Shock radiography

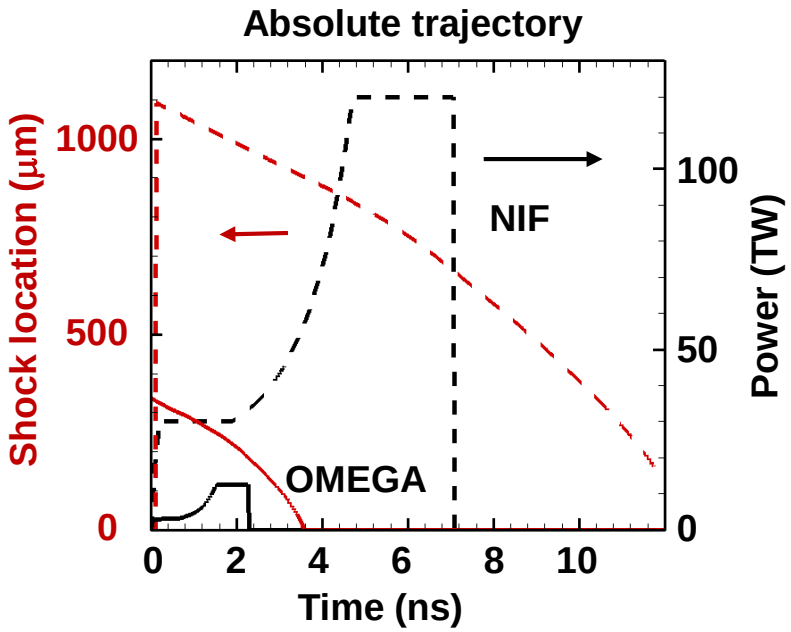


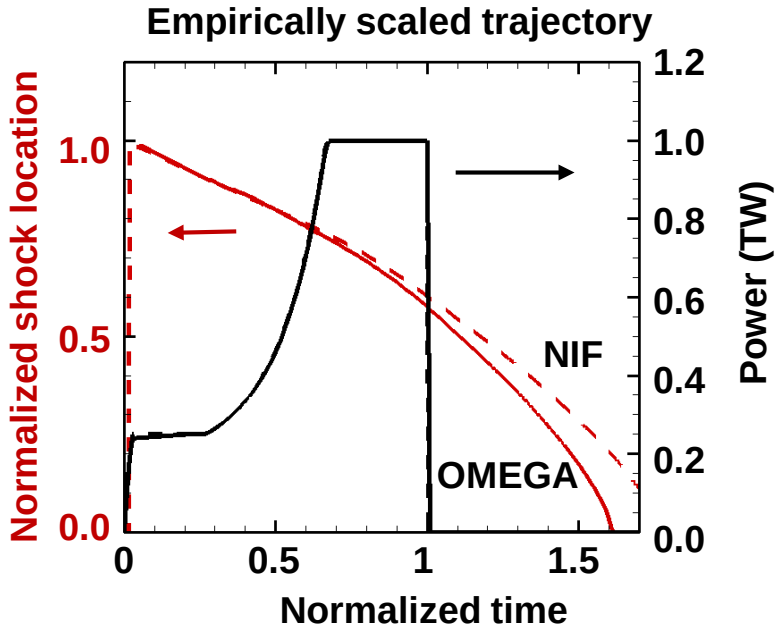




Hydrodynamically scaled designs are being explored on OMEGA and the NIF

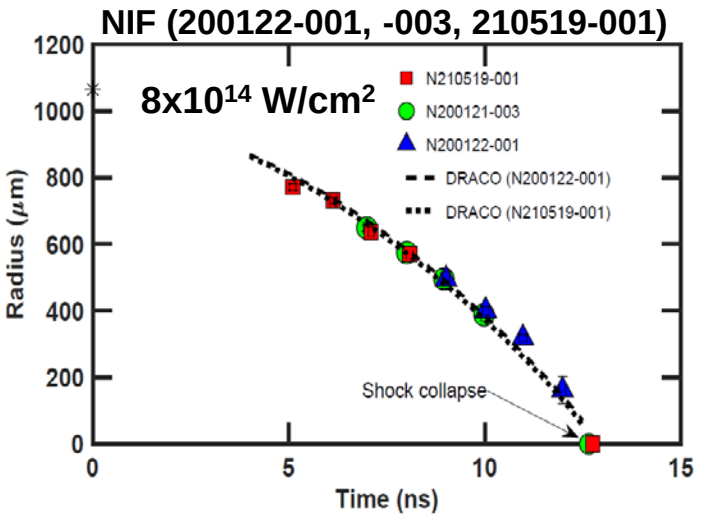
NIF: R_{tar}=1100 μm → $E \sim R^3$; $P \sim R^2$; $T \sim R$ → OMEGA: R_{tar} = 340 μm

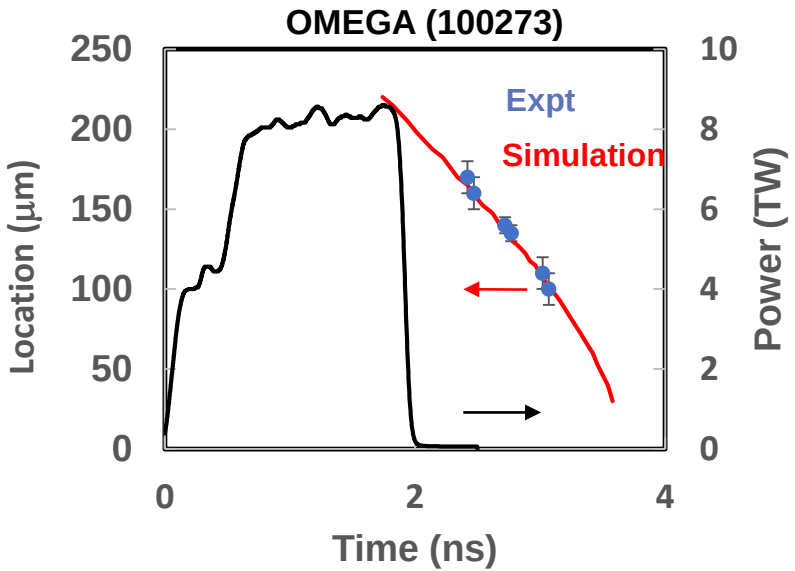




Good agreement is being obtained for shock trajectory on OMEGA and the NIF

- DRACO simulations include the effect of Polar Drive geometry (PDD), Cross-Beam Energy Transfer, and non-local heat conduction
- Shock trajectories are extracted from synthetic images generated by postprocessing simulations with Spect3D.

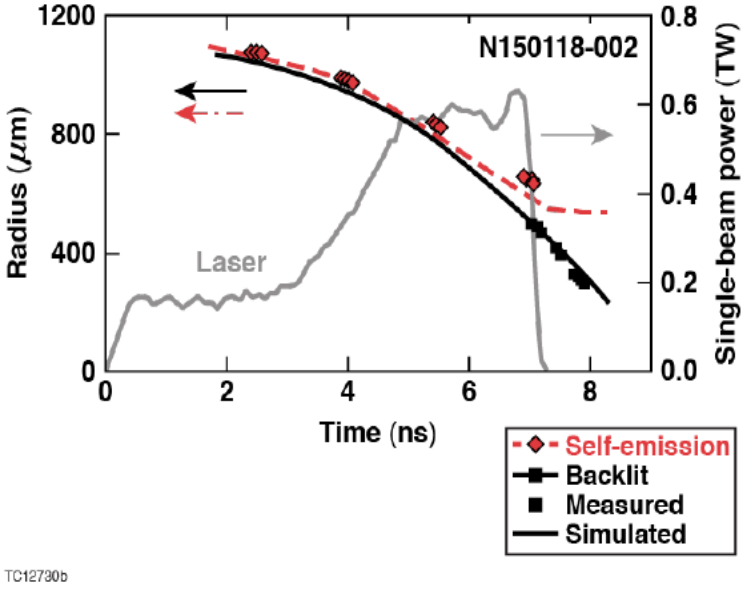




NIF results: W. Theobald, this conference; OMEGA results: C. Stoeckl, this conference;
Spect3D: J. J. McFarlane et al. HEDP Physics (2007).

Well-modeled shock trajectories indicate that observed discrepancies in PDD NIF implosions are likely due to modeling errors during the main pulse

Polar-angle averaged trajectory[1]
(I = 0.8 × 10^{15} W/cm^2)

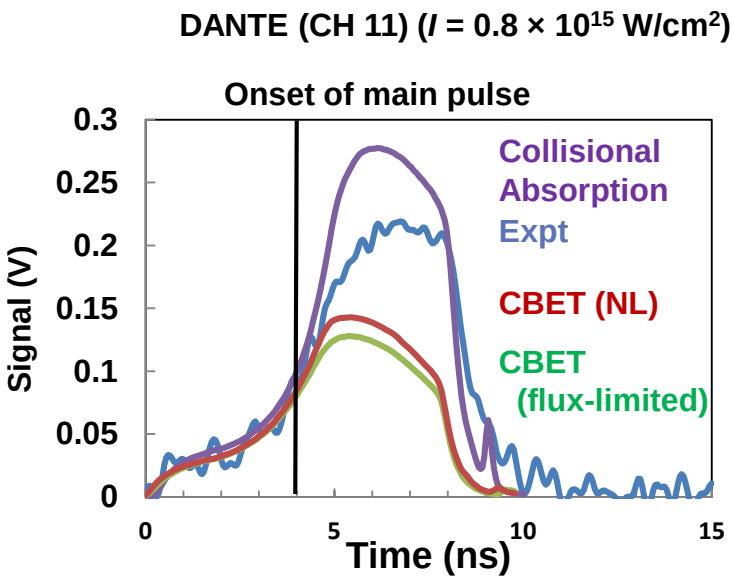


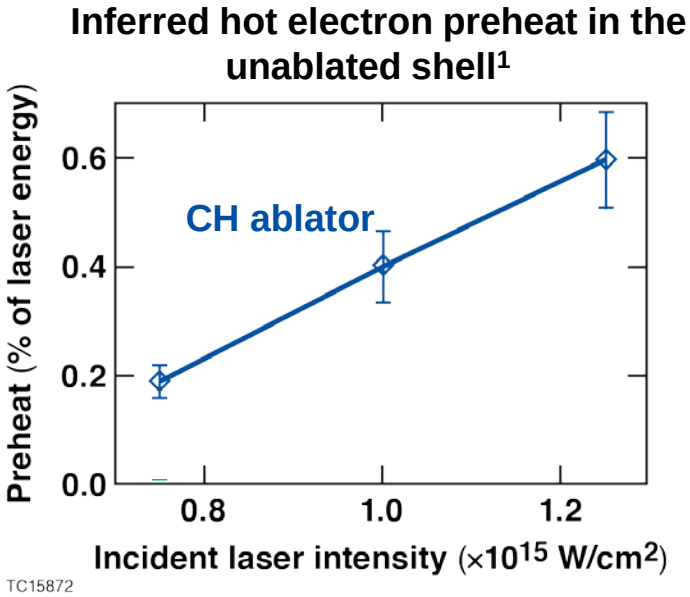
- The observed slowing corresponds to ~9% decrease in apparent implosion velocity

- This difference can be due to preheat, imprint, and error in modeling laser drive.[1]

1 P. B. Radha et al., Phys. Plasmas (2017)

An systematic intensity scan will be performed on the NIF





- **An intensity scan will separate the role of preheat and drive to address the discrepancy.**

[1]A Solodov et al. (this conference); M. Rosenberg et al. (this conference); Imprint – A. Shvydky (this conference)

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