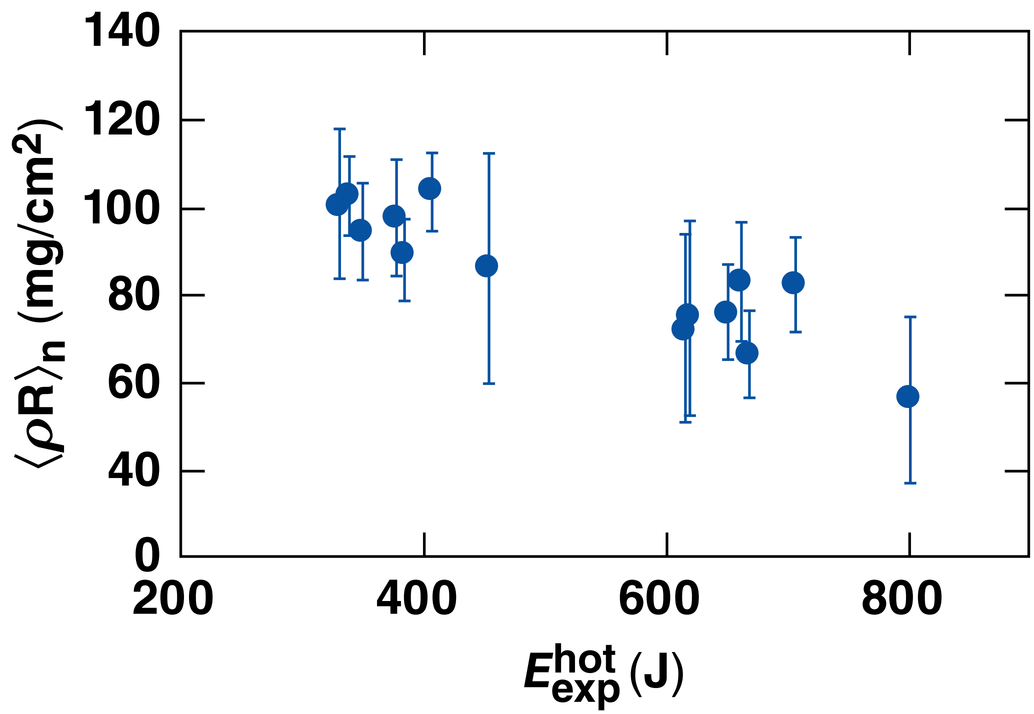
Analysis of Fast Electrons in Shock-Ignition Implosions on OMEGA



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Summary

Areal-density degradation in shock-ignition (SI) experiments is well correlated with measurements of hot electrons from the spike

- Hot-electron generation is investigated at shock-ignition–relevant intensities
- Experimental hard x-ray data indicates ~35-keV Maxwellian electrons are generated with 5% to 15% conversion efficiency
- The analysis shows that the hot-electron coupling efficiency to the shell increases with the shell areal density

TC10348

Collaborators

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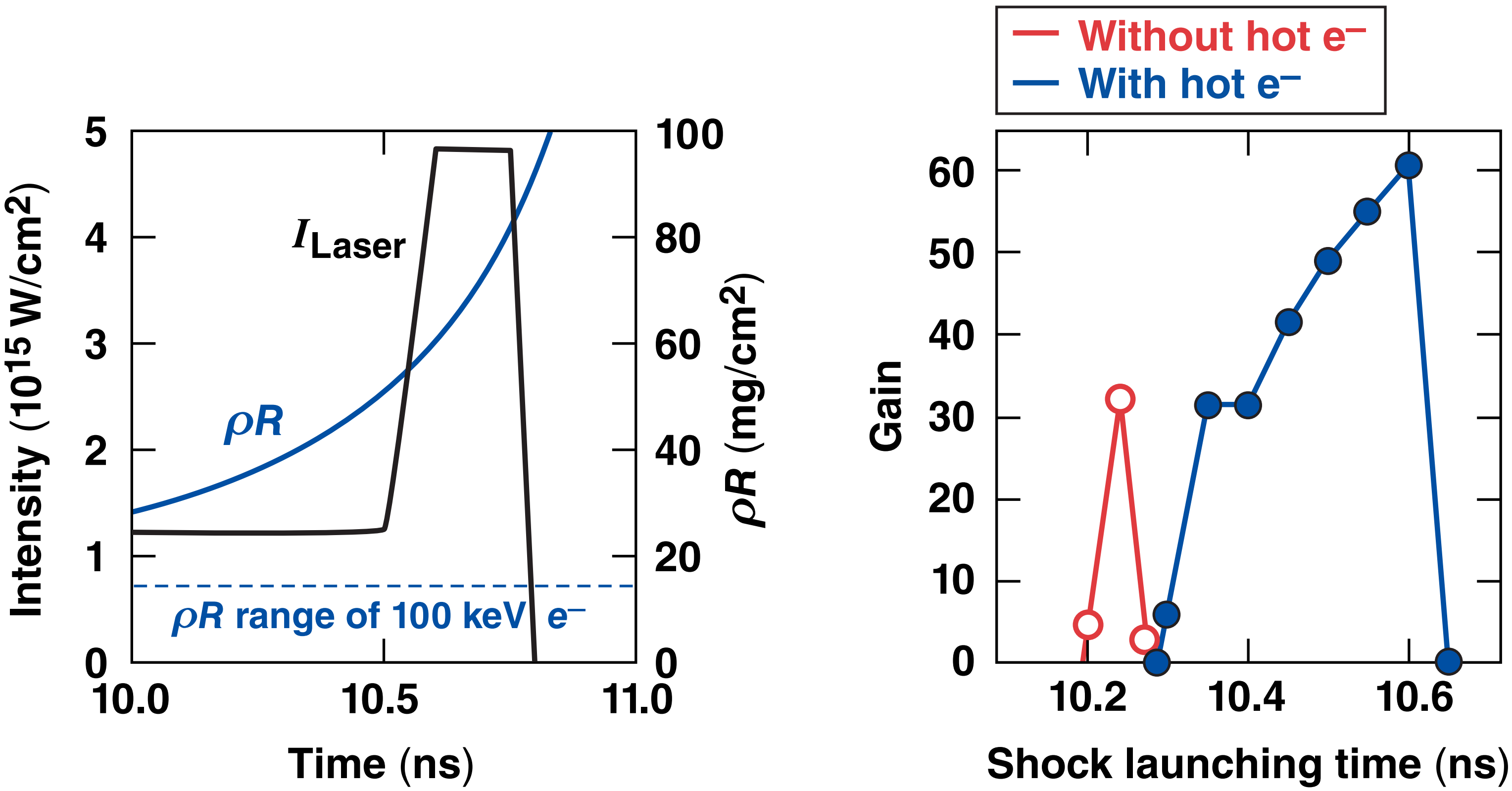
*K. S. Anderson, UI2.00005, this conference.

In ignition-scale SI implosions, hot electrons can strengthen the ignitor shock if their energy is below ~100 keV*



*R. Betti, *et al*., J. Phys.: Conf. Ser. 112, 022024 (2008).

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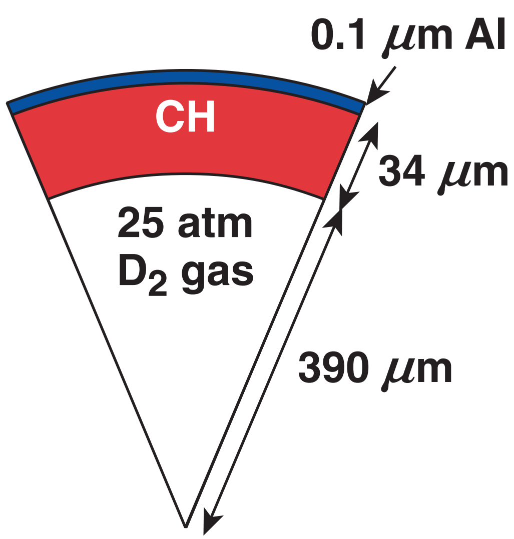
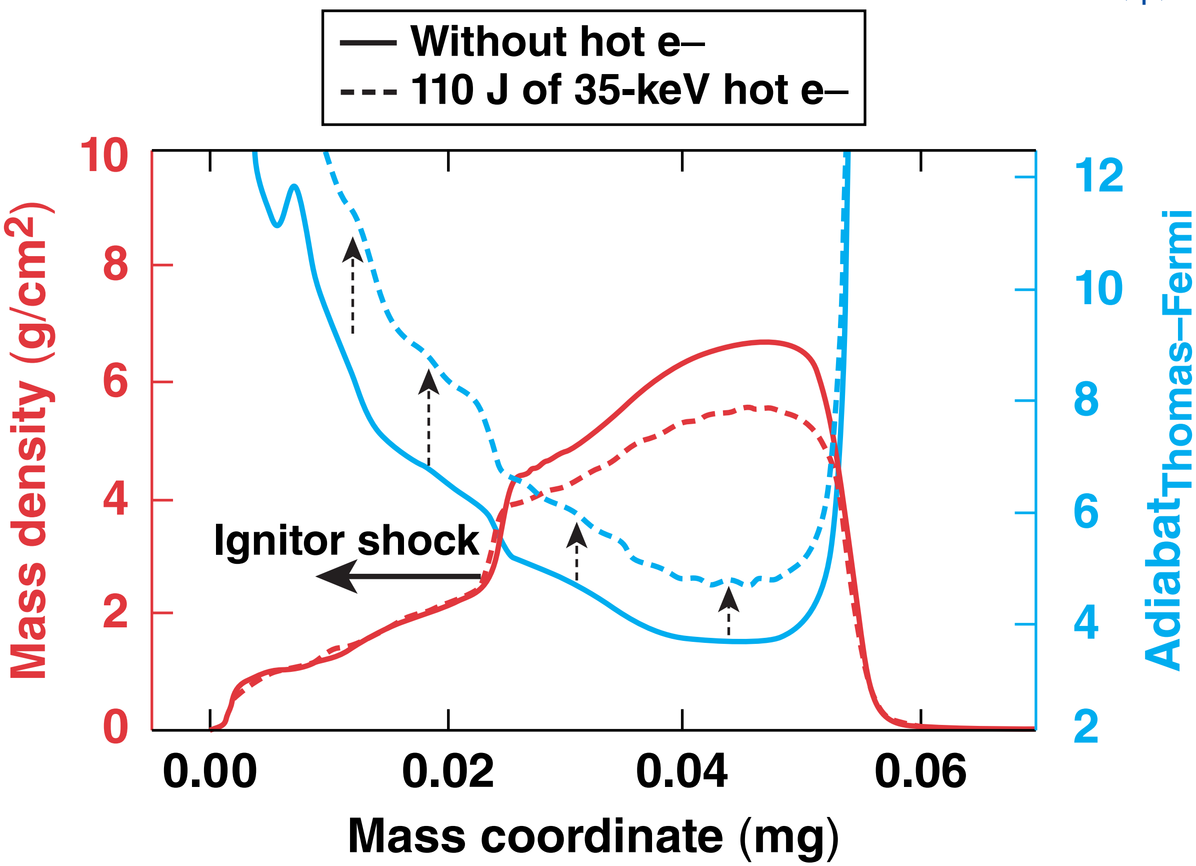
On OMEGA, the areal density is low enough that hot electrons degrade (rather than improve) implosion performance





On OMEGA the hot electrons penetrate through the shell, raise the adiabat, and lower the areal density.

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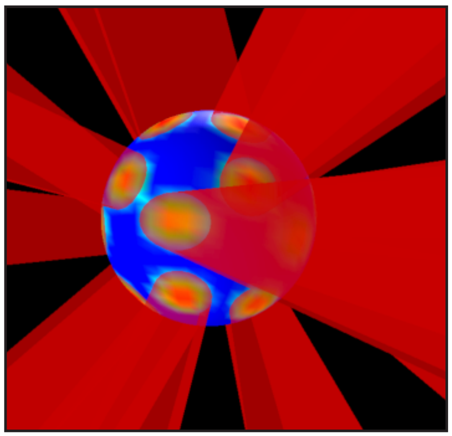
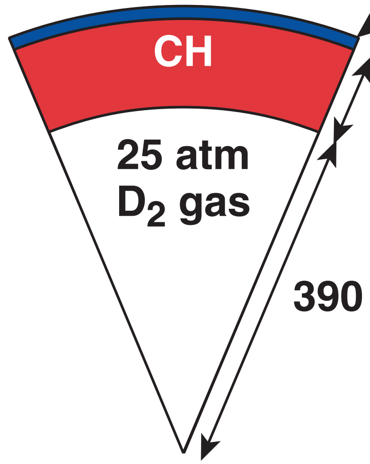
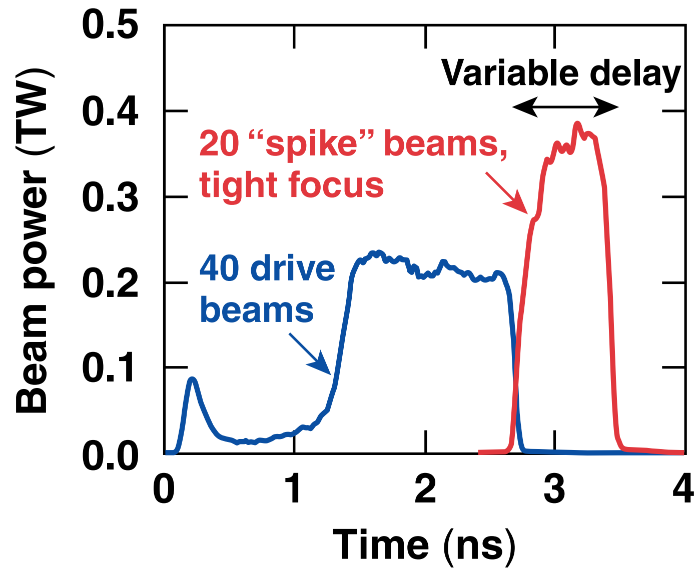
40 OMEGA beams were used to implode the capsule and 20 beams were tightly focused on the imploding shell



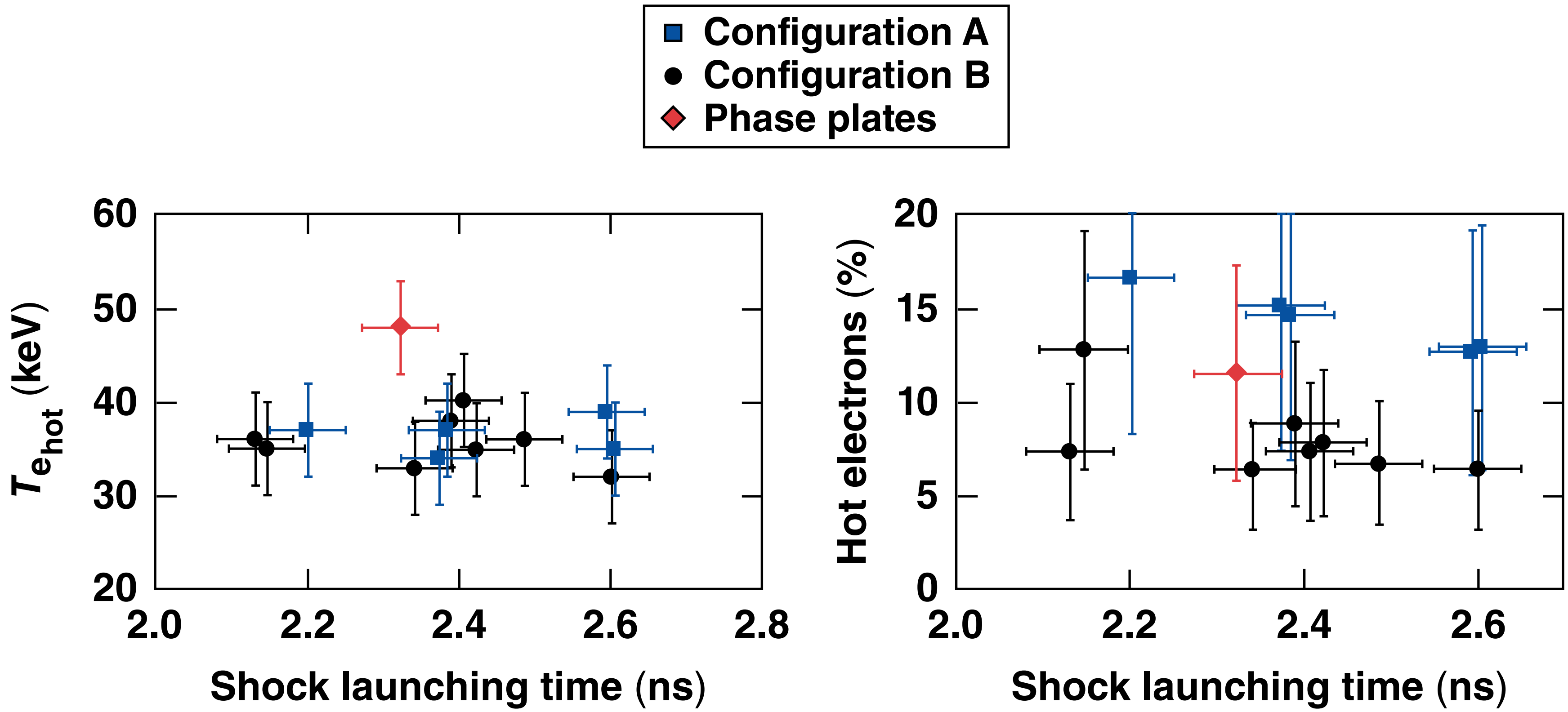




- Two beam-pointing configurations were used
  - Configuration A: all beams pointed to target chamber center
  - Configuration B: beams repointed to minimize power imbalance
- 40 drive beams: SG4, distributed polarization rotator (DPR) [no smoothing by spectral dispersion (SSD)], ~14 kJ
- 20 spike beams: no phase plates, ~5 kJ

W. Theobald *et al.*, Phys. Plasmas 19, 102706 (2012).

~35-keV electrons were produced with 5% to 15% efficiency with respect to the spike-beam energy*

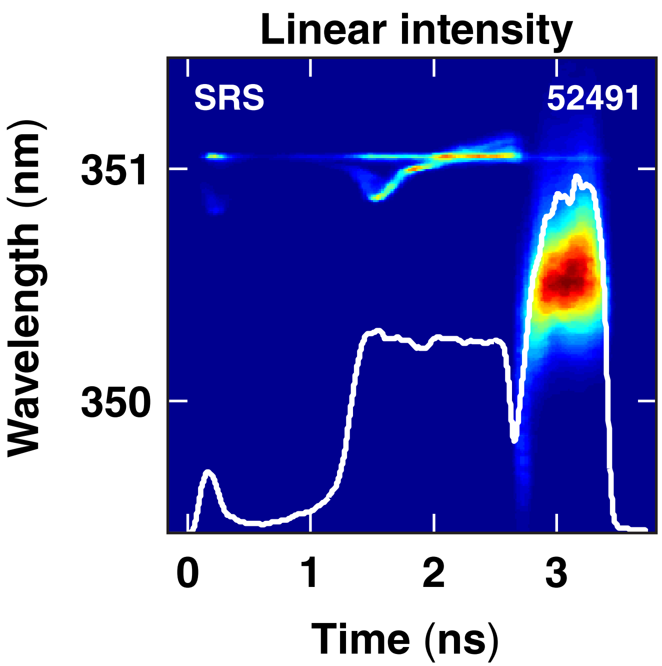


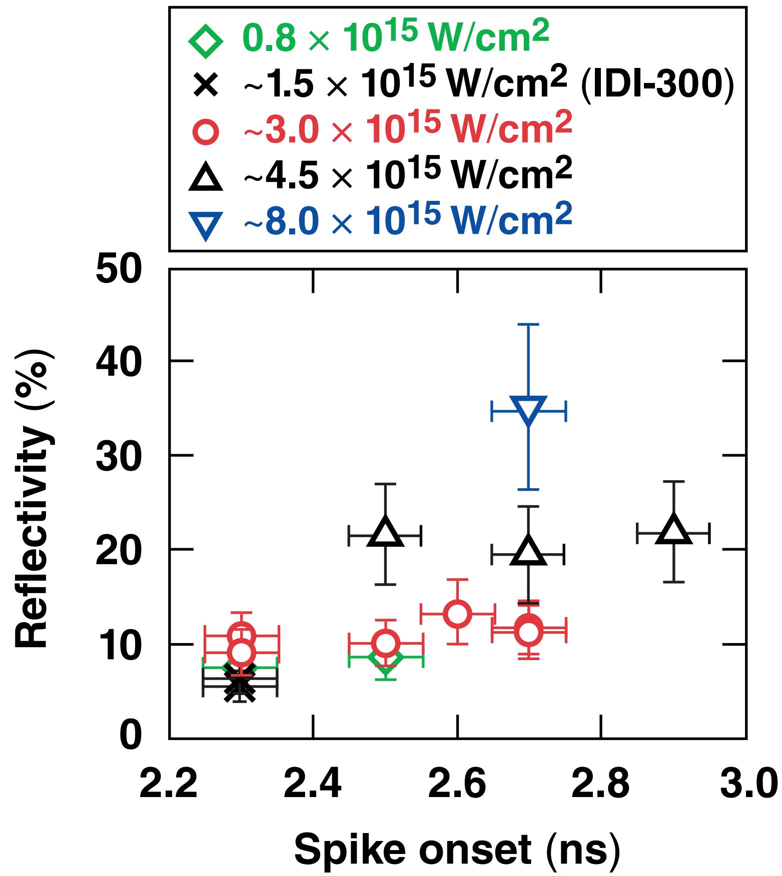
Measured hot-electron temperature is consistent with the results of particle-in-cell (PIC) simulations.**

*C. Stoeckl *et al*., Rev. Sci. Instrum. 72, 1197 (2001).
**O. Klimo *et al*., Phys. Plasmas 18, 082709 (2011).
C. Riconda *et al*., Phys. Plasmas 18, 092701 (2011).
R. Yan, CP8.00093

TC10349

Scattered-light data indicates stimulated Raman scattering (SRS) to be the main generation mechanism of hot electrons

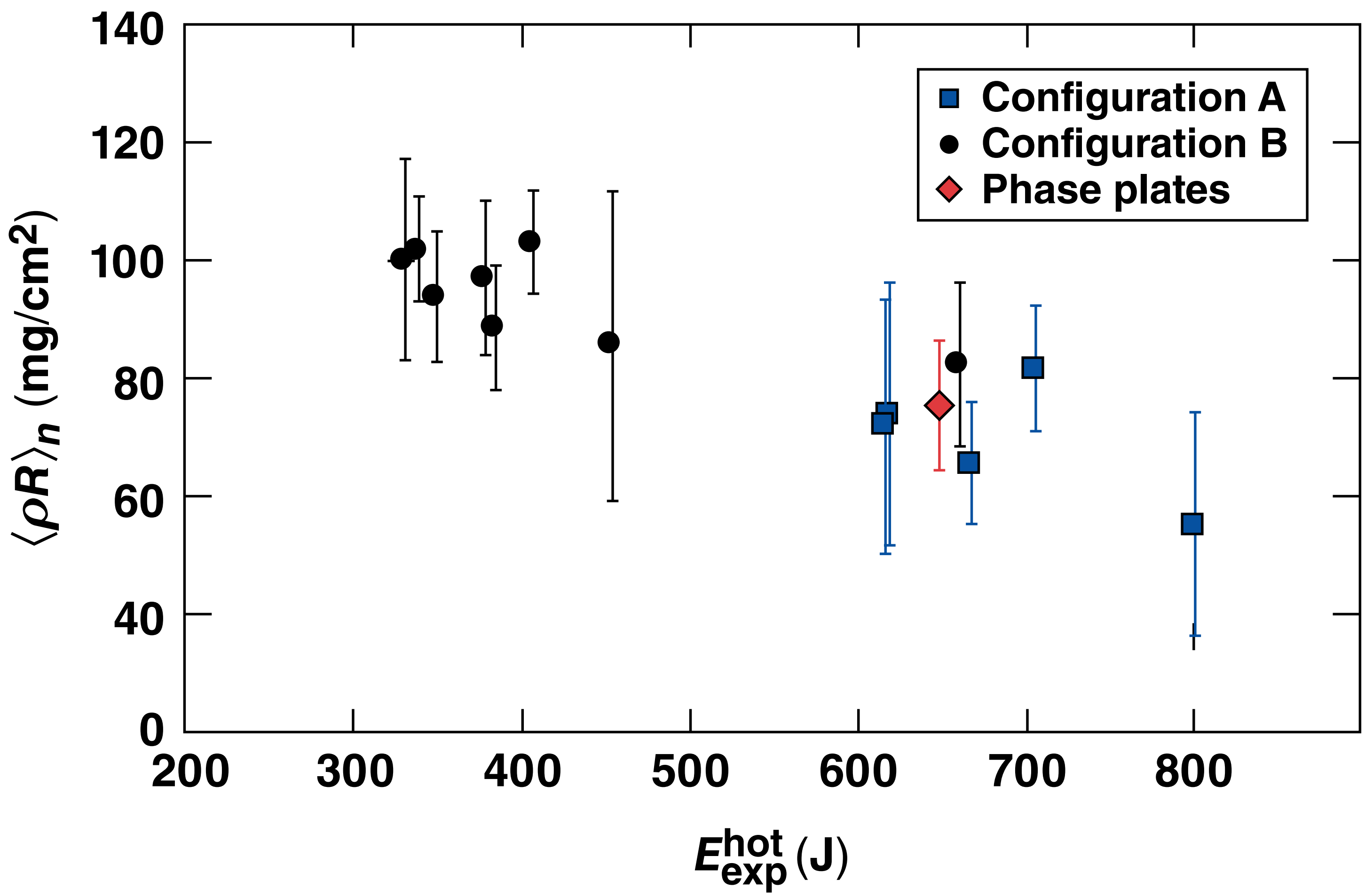




- No evidence of two-plasmon decay ($\omega/2$ or $3\omega/2$)
- Energetic electrons (T_{hot} ~ 35 keV) consistent with SRS

E19526a

Areal density measurements show implosion degradation with increasing hot-electron production



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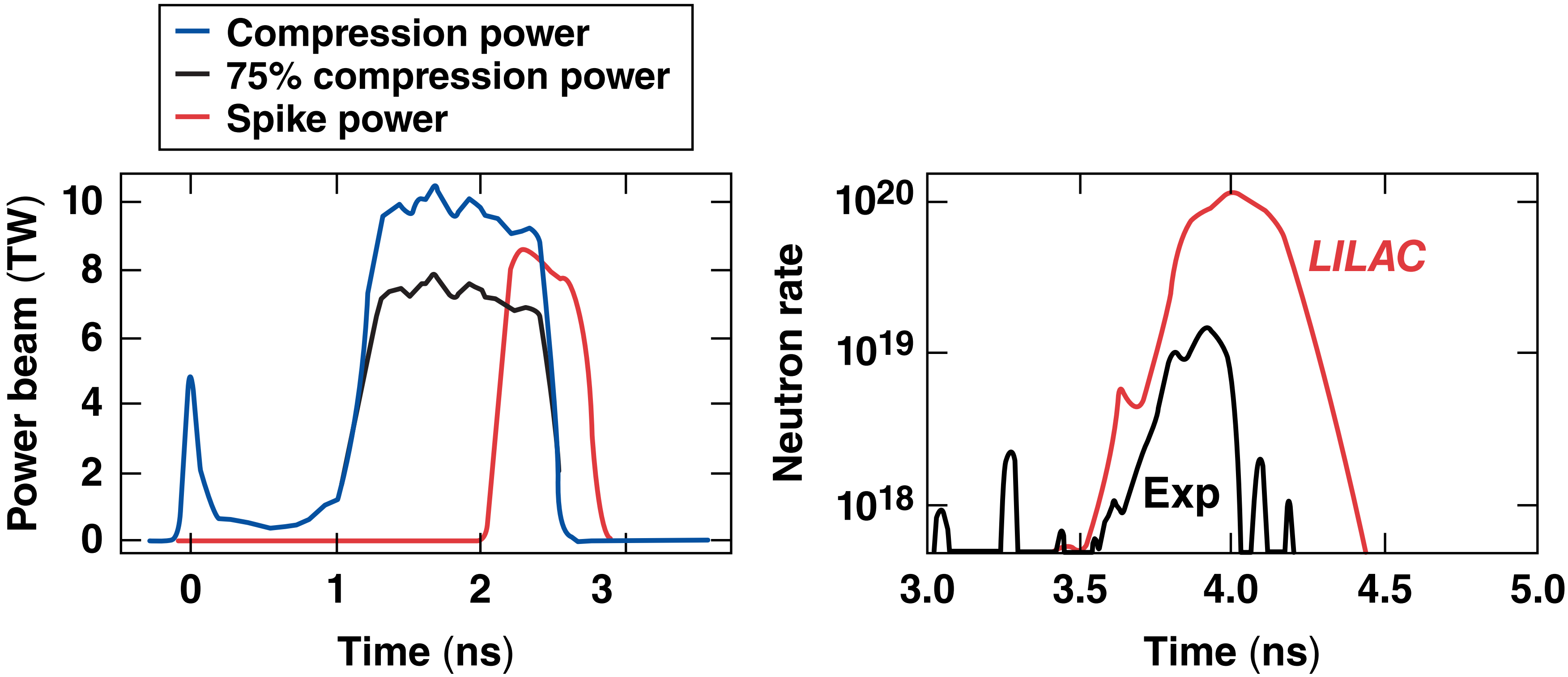
LILAC simulations reproduce experimental results when using realistic amounts of hot electrons



- Flux limiter and laser beam's power are adjusted to mimic cross-beam energy transfer (CBET) and match no-shock experimental areal density and bang time
- Hot electrons are introduced during the spike pulse to match the experimental areal density

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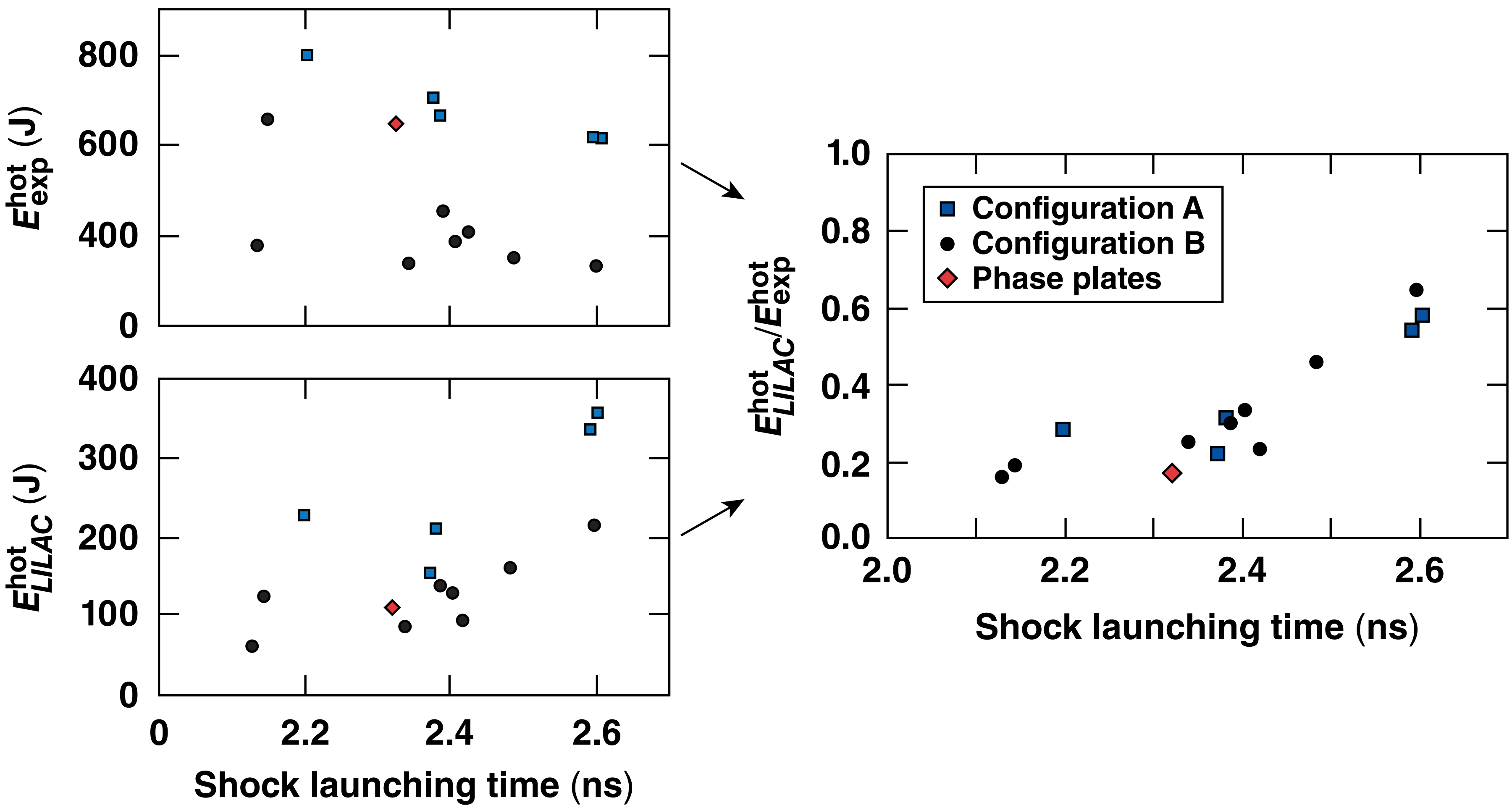
The measured hot-electron energy is well correlated with the *LILAC* hot-electron energy required to explain the $\langle \rho R \rangle_n$ degradation



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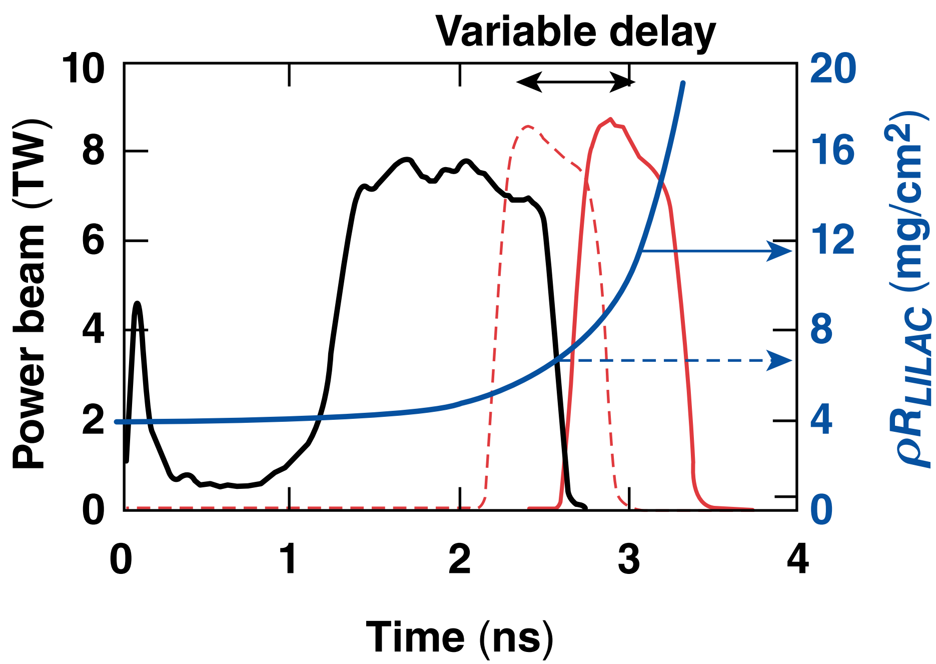
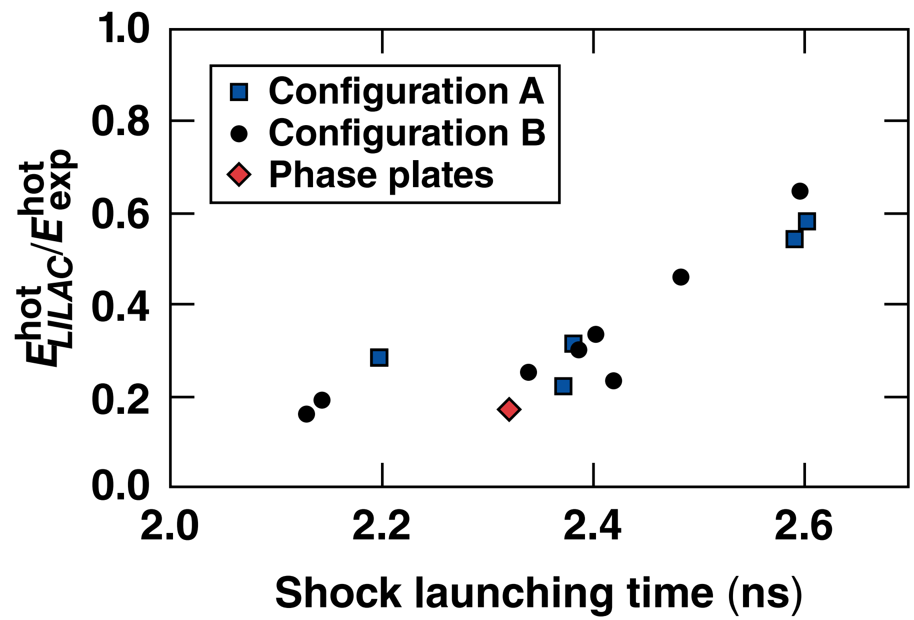
The calculated fraction of hot-electron coupling to the imploding shell is correlated to its stopping power





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