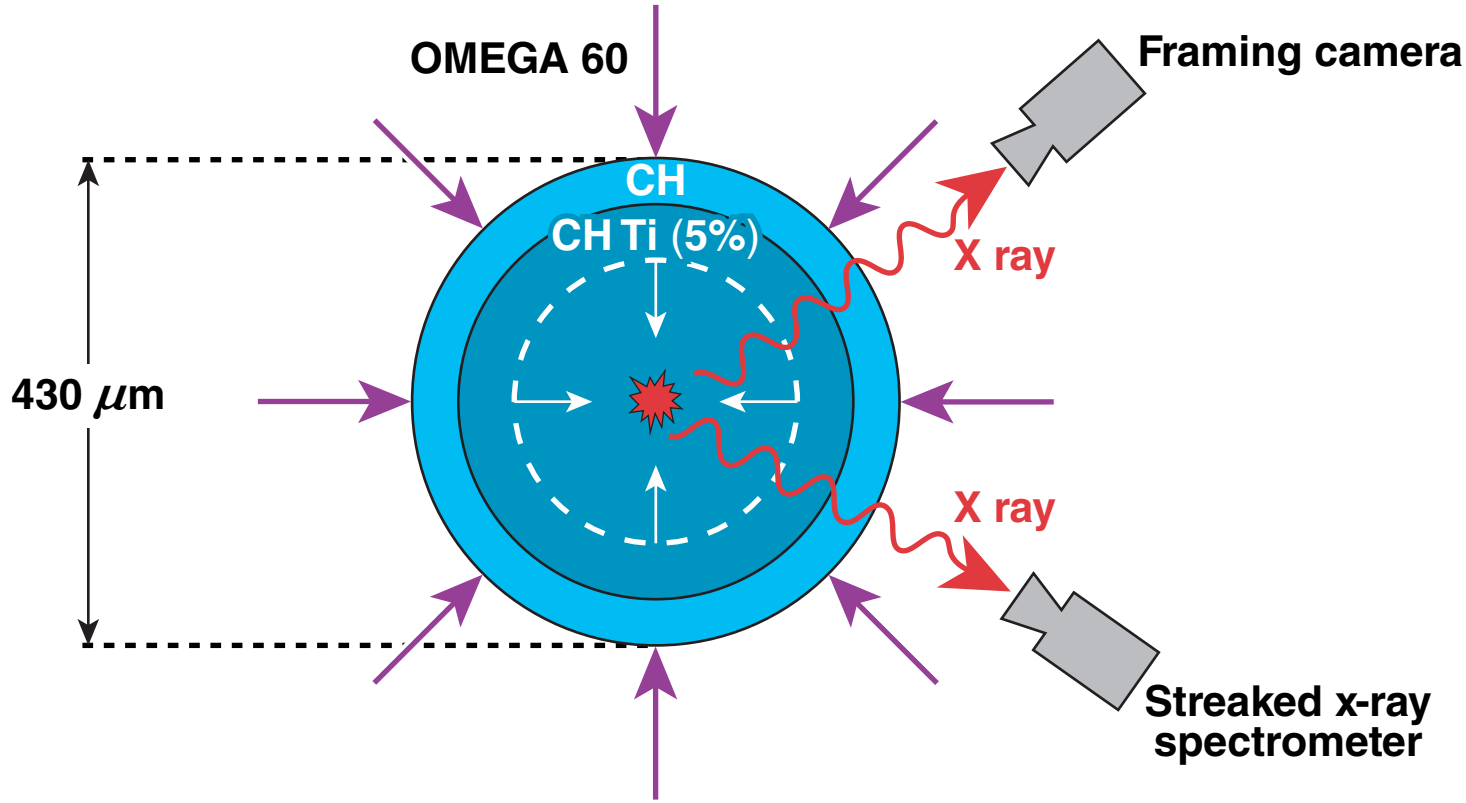
Gigabar Spherical Shock Experiments on OMEGA



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Summary

Effective ablation pressures exceeding 600 Mbar were inferred in spherical targets

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- A new experimental platform on OMEGA is being used to infer the shock strength of laser-driven shocks at shock-ignition–relevant intensities
- *LILAC* simulations, constrained by the measured x-ray flash time, suprathermal electrons, and laser absorption, are used to infer the shock and ablation pressure
- An effective ablation pressure scaling for absorbed laser intensities ~1 to 4 × 10^{15} W/cm^2 is

$$P_a^{\text{eff}}\,(\text{Mbar}) \approx 90\left(I_{15}^{\text{abs}}\right)^{1.4}$$

The inferred effective ablation pressures meet the requirements for robust shock-ignition designs.

TC11470

Collaborators

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W. Theobald, CI1.00002, this conference (invited).

Demonstrating high ablation pressure is essential to validate the shock-ignition (SI) scheme*

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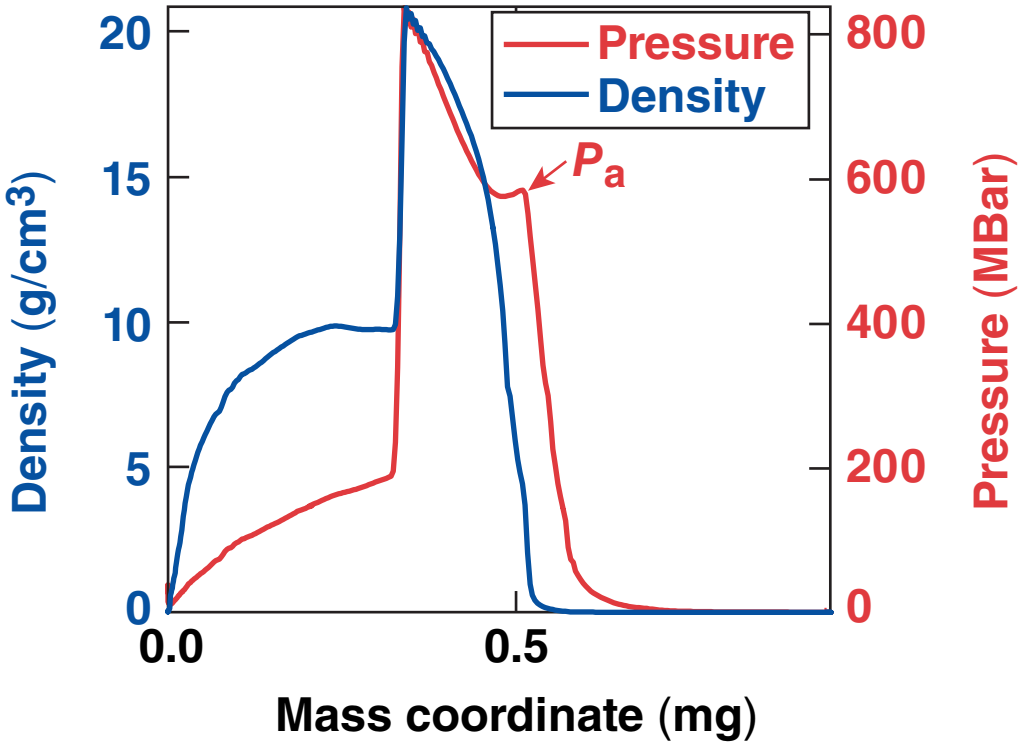
700-kJ NIF SI point design**
$I_a = 6.7 \times 10^{15}$ W/cm^2
1-D ignition-threshold factor (ITF) = 4



A robust shock-ignition implosion requires ~600-Mbar shocks at absorbed laser intensities of ~7×10^{15} W/cm^2.

*R. Betti *et al.*, Phys. Rev. Lett. 98, 155001 (2007).
**K. Anderson *et al.*, Phys. Plasmas 20, 056312 (2013).

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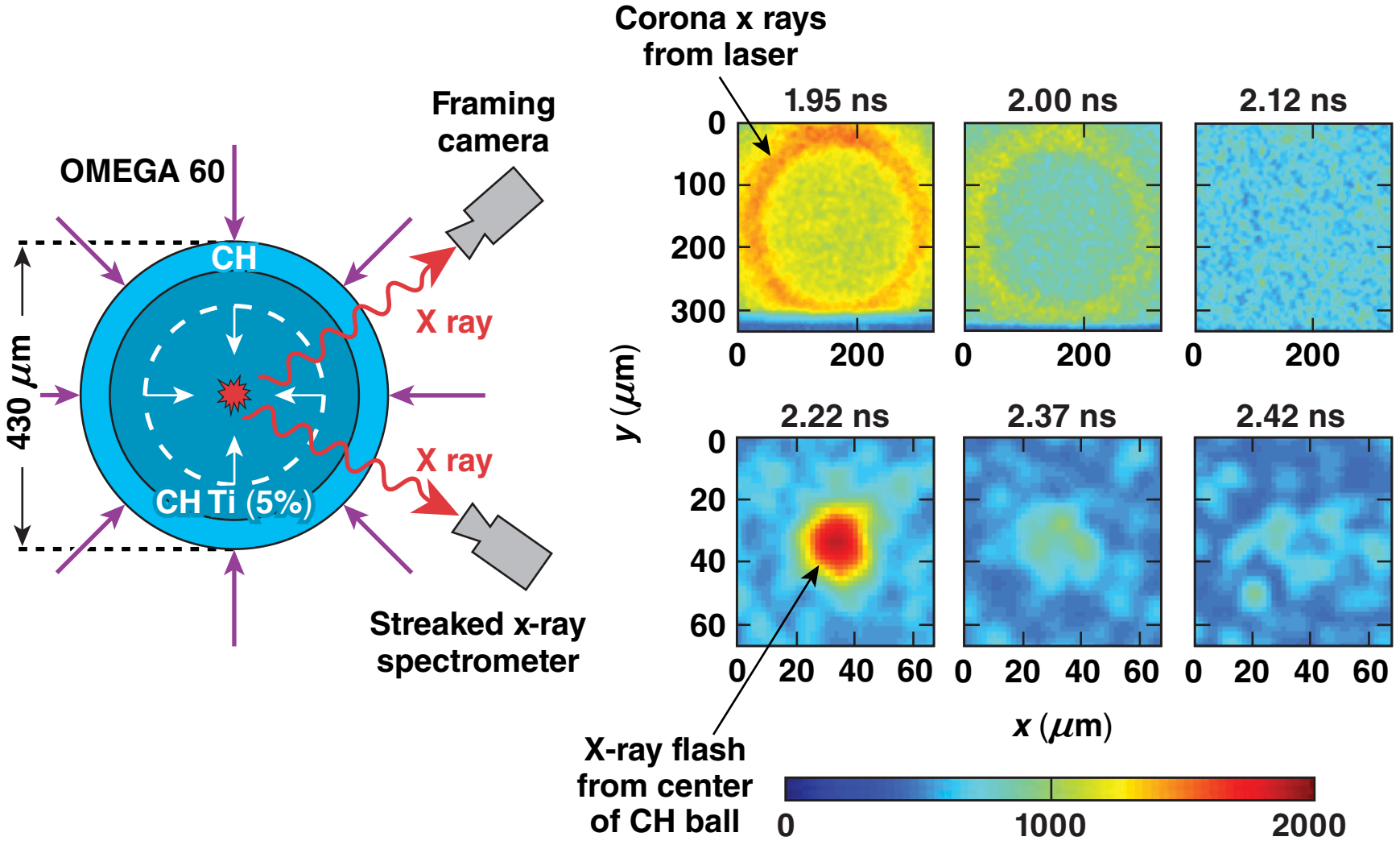
An x-ray framing camera detects the x-ray flash at the time when the shock converges in the center



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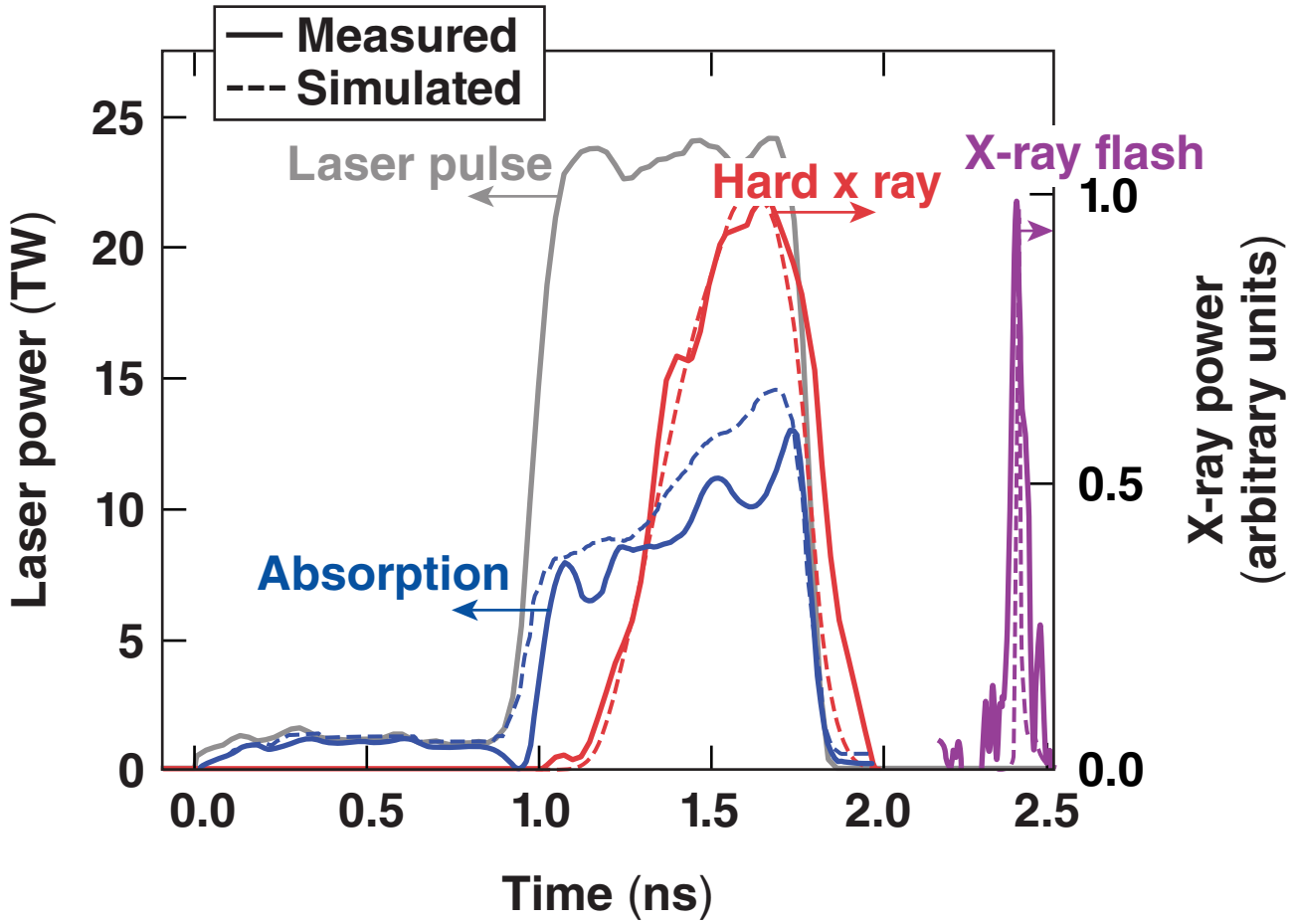
Hydrodynamic *LILAC* simulations are constrained by the hard x-ray emission, laser absorption, and x-ray flash time



Up to 9% of the laser energy is converted into moderate temperature (~80-keV) suprathermal electrons.

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The shock and ablation pressure is significantly enhanced by the deposition of suprathermal electrons

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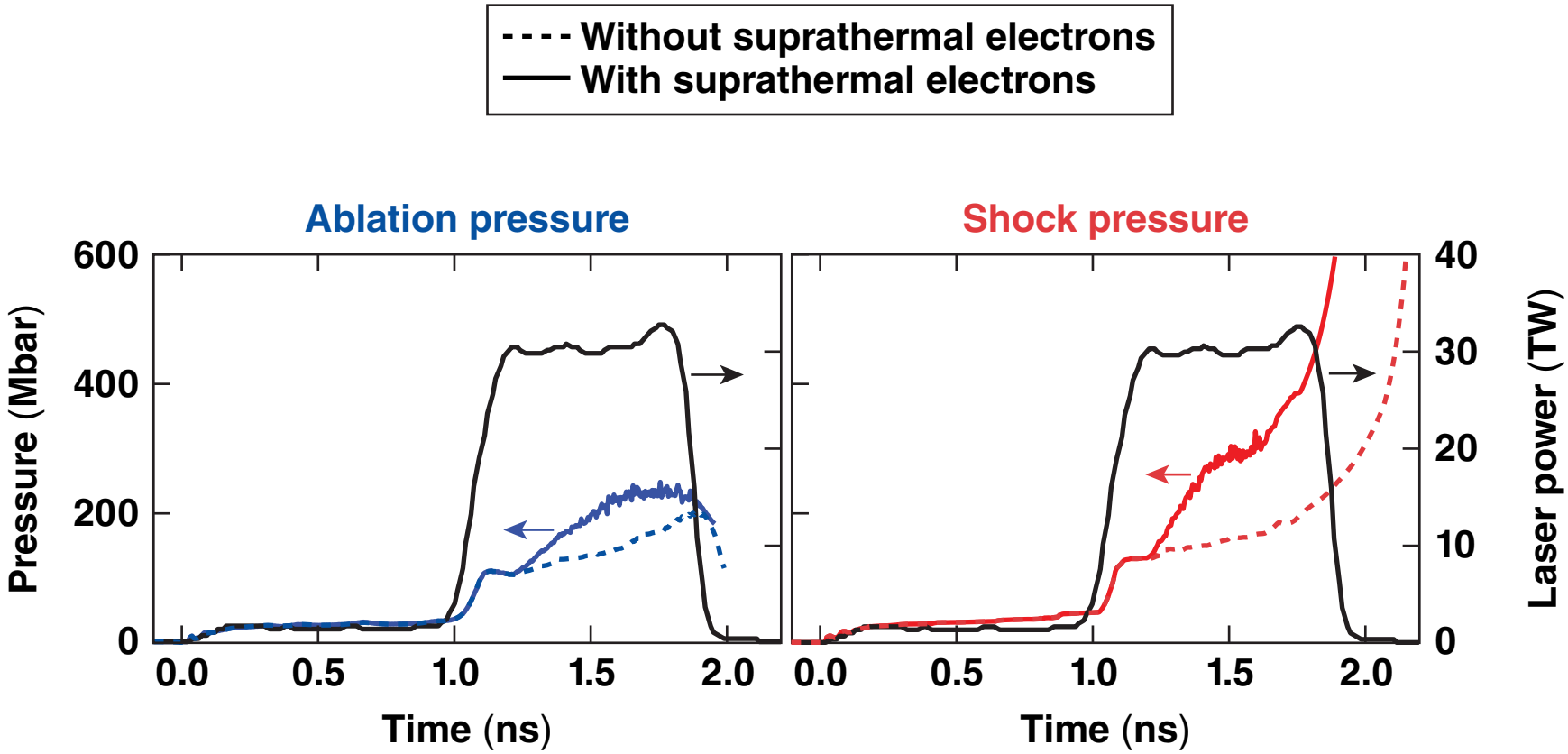

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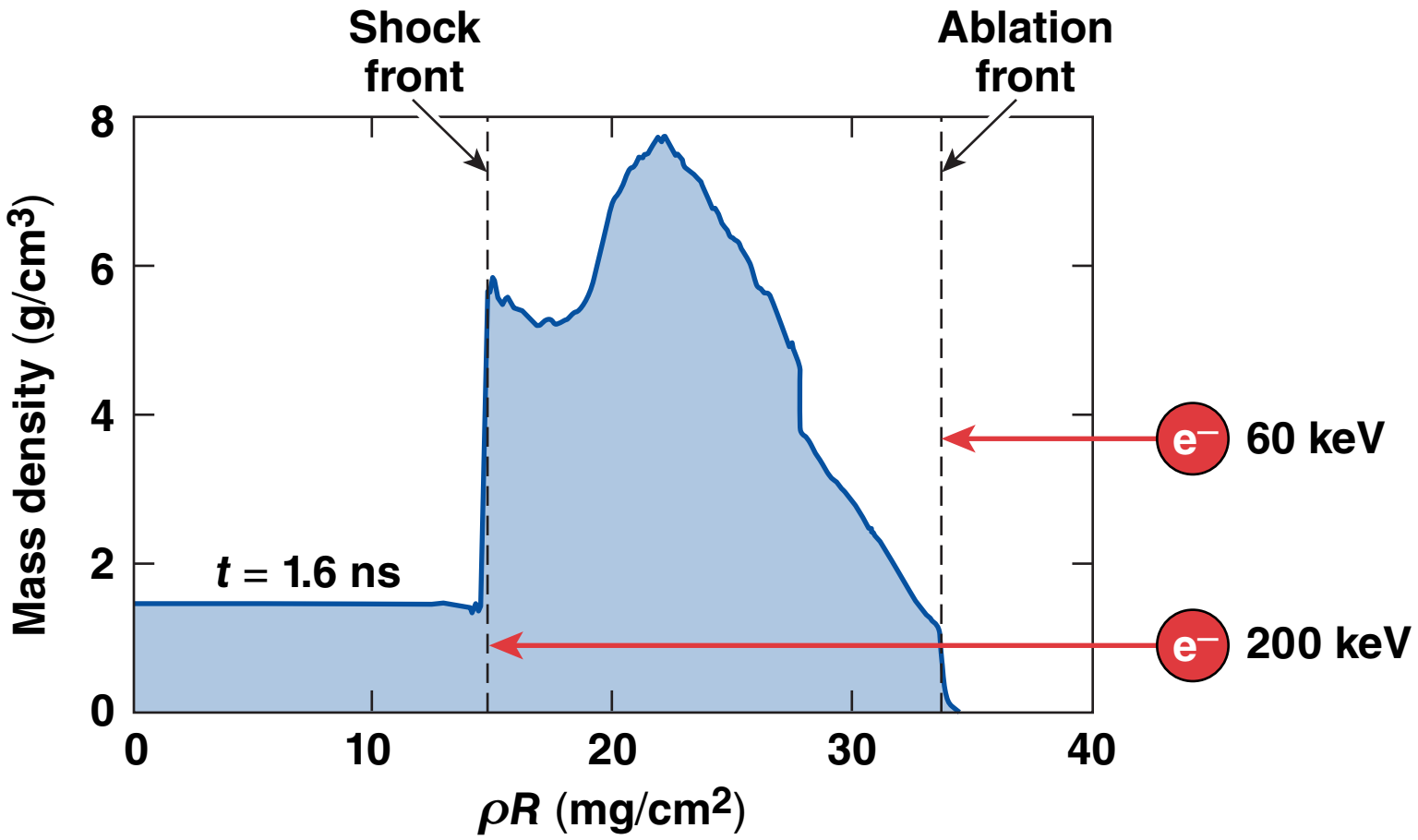
55% of the suprathermal electron energy is deposited between the ablation front and shock front



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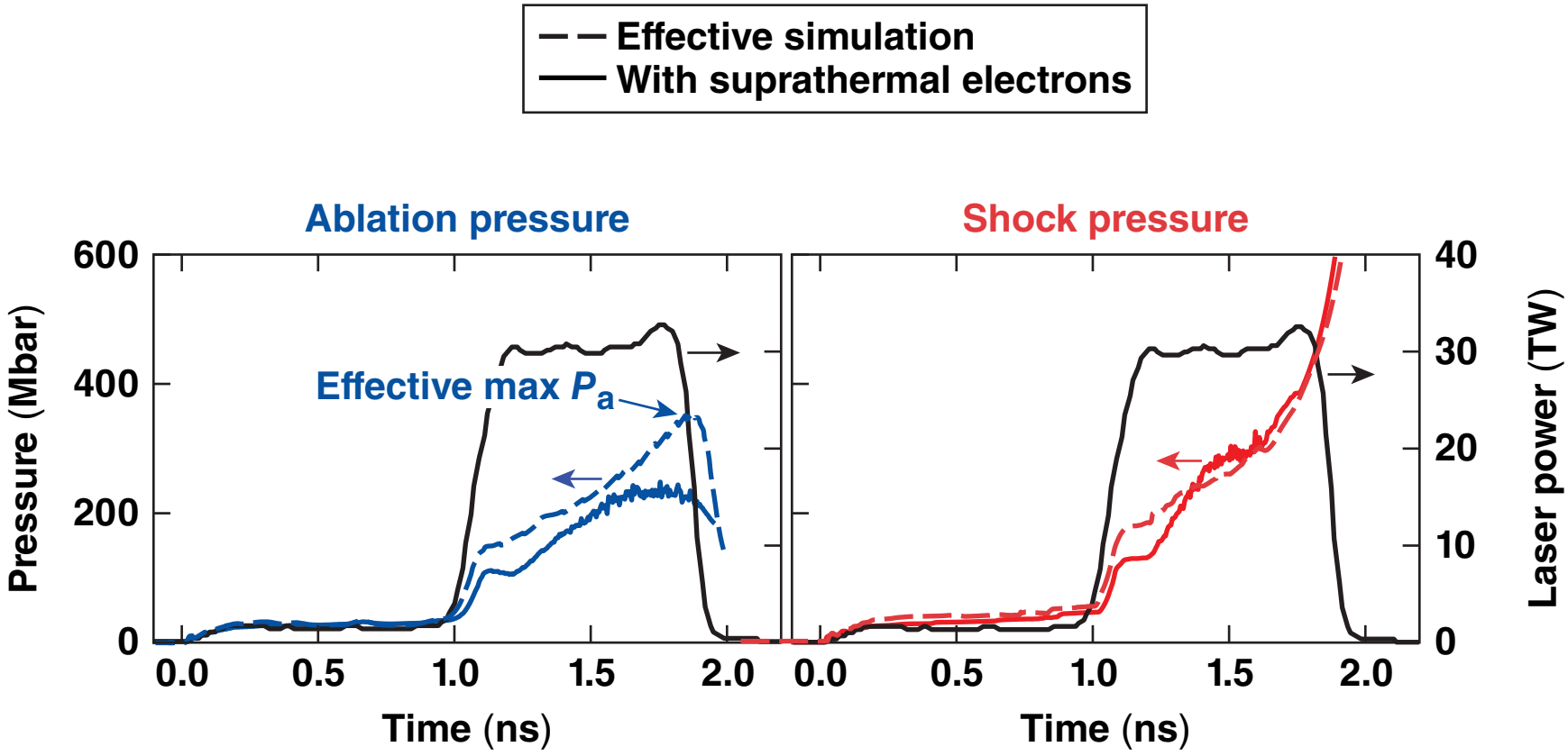
An "effective" ablation pressure can be found via *ad hoc* simulations without suprathermal electrons



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The inferred effective ablation pressure demonstrates the generation of several hundred Mbar shocks at shock-ignition–relevant laser intensities

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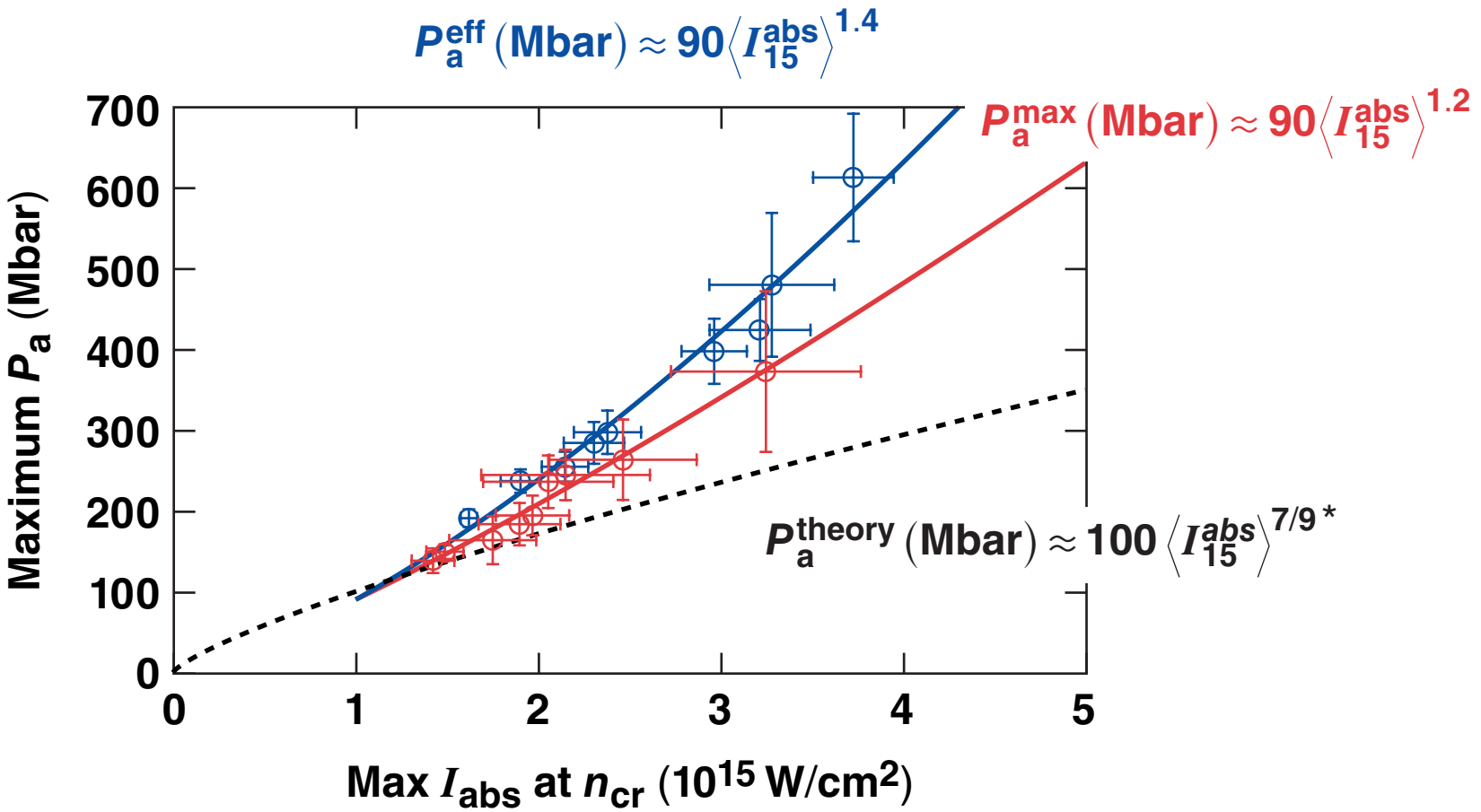

*S. Atzeni, Plasma Phys. Control. Fusion 42, B143 (2000).

TC11476

Summary/Conclusions

Effective ablation pressures exceeding 600 Mbar were inferred in spherical targets

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TC11470

Up to 2 kJ of suprathermal electrons were generated at moderate temperatures (~80 keV)

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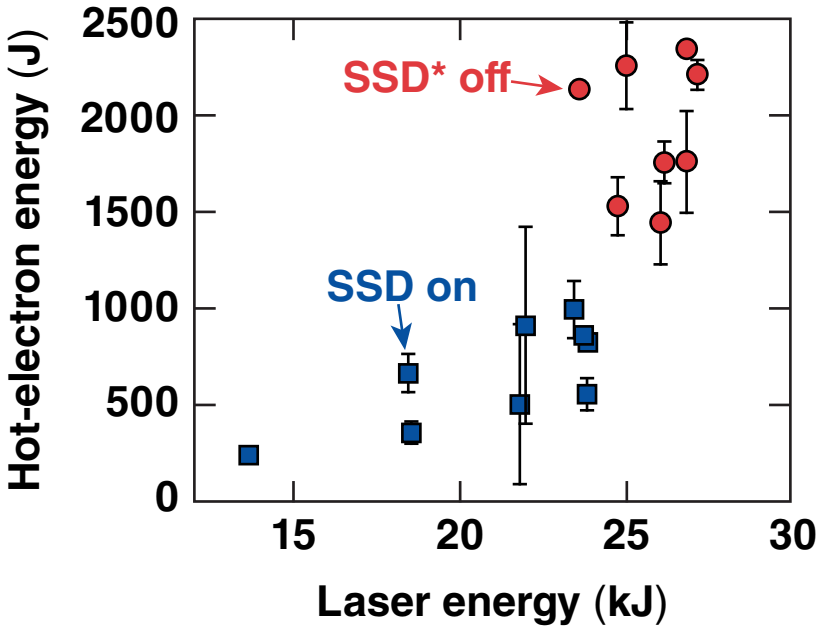

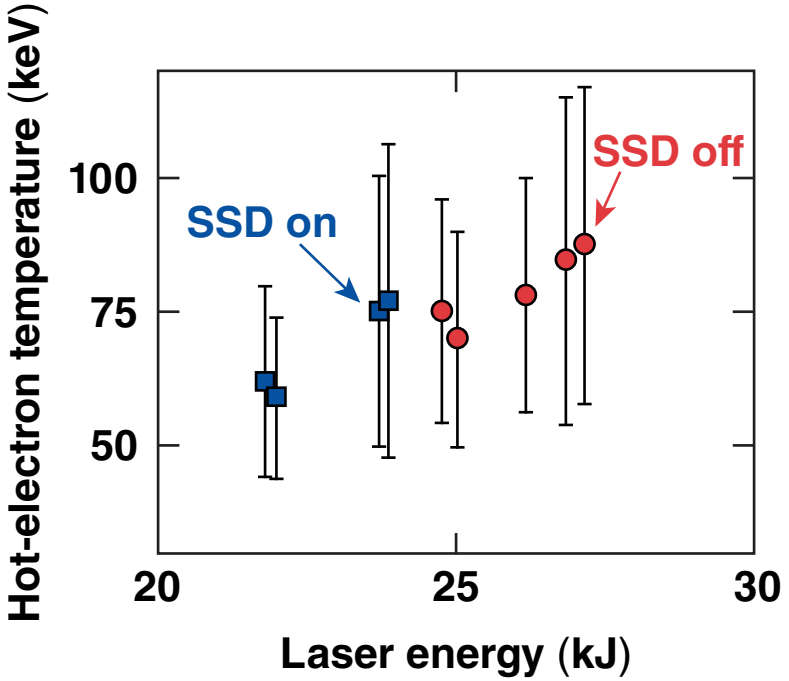

Up to 9% conversion of total laser energy into suprathermal electrons (15% instantaneous).

TC11478

*SSD: smoothing by spectral dispersion