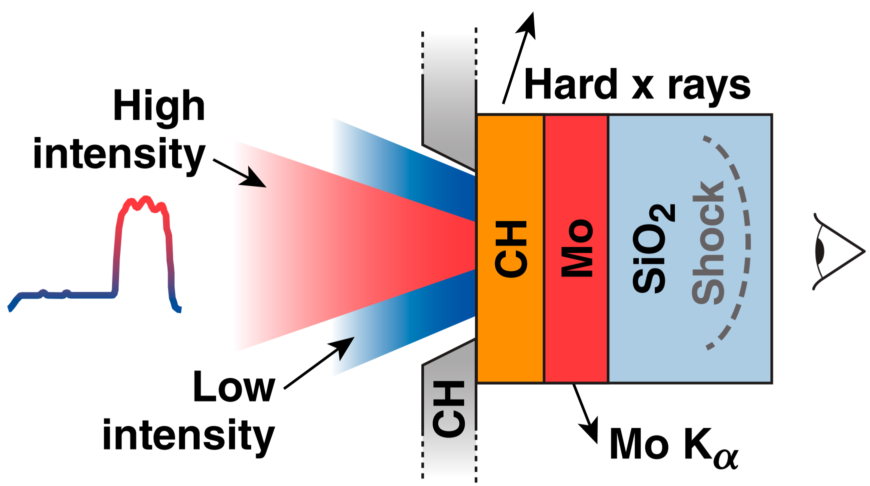
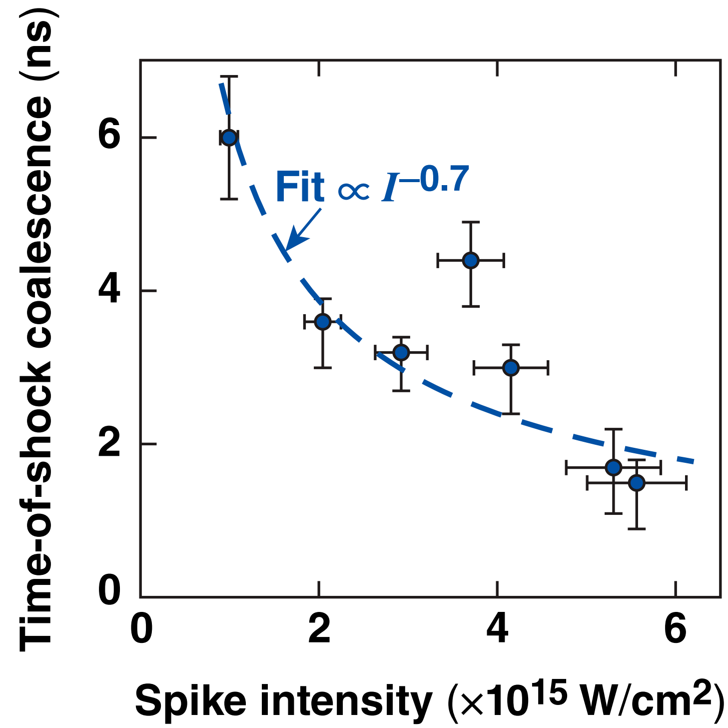
Shock-Ignition Studies in Planar Geometry on OMEGA





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Summary

Strong-shock generation and laser–plasma instabilities (LPI) at shock-ignition–relevant intensities are investigated in planar experiments

- At 5×10^{15} W/cm^2, 4% of the laser energy is converted into hot electrons with $T_e \sim 80$ keV
- Shock propagation data show efficient coupling of the high-intensity spike at intensities of mid-10^{15} W/cm^2
- Preliminary 2-D *DRACO* simulation results suggest peak pressures of ~180 Mbar were achieved at a drive intensity of 5×10^{15} W/cm^2

Collaborators

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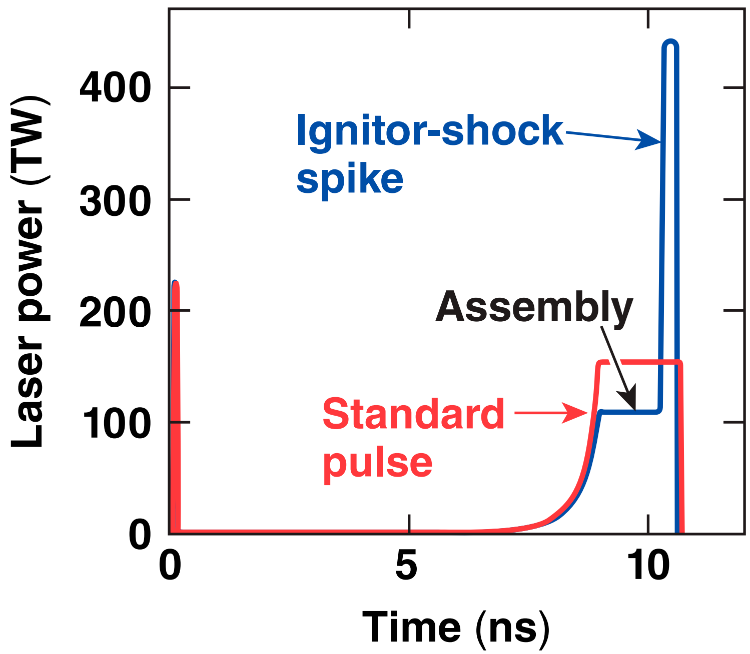
Shock ignition (SI) uses a non-isobaric fuel assembly to achieve a lowered ignition condition*

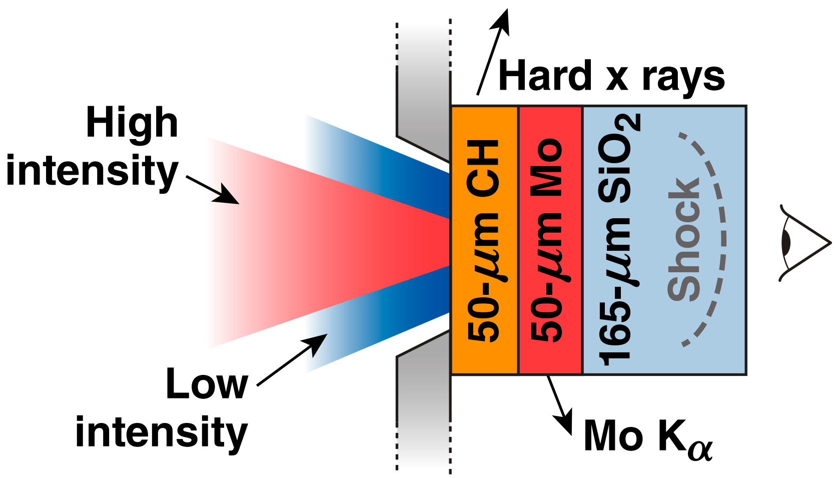


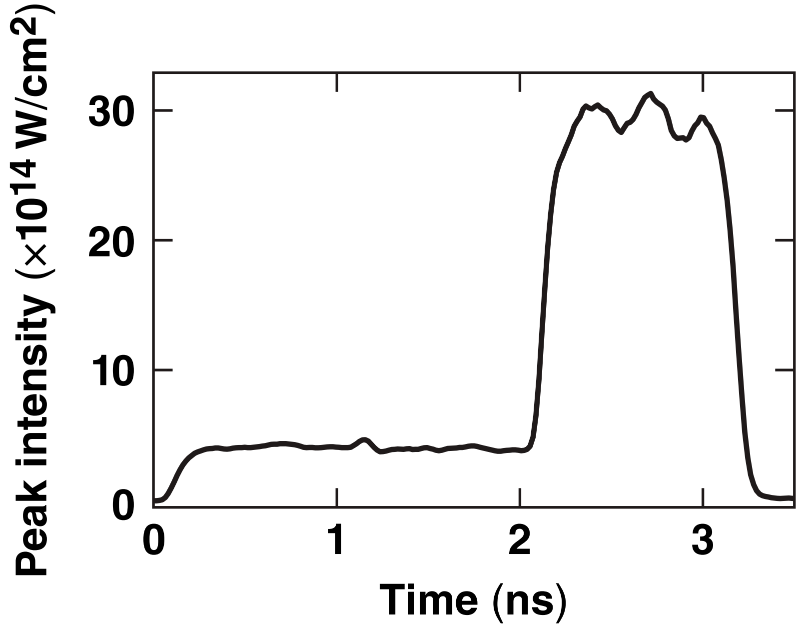
The high-intensity spike needs to generate ~300-Mbar of ablation pressure.**

*R. Betti *et al.*, Phys. Rev. Lett. 98, 155001 (2007).
**See invited talk by K. S. Anderson, UI2.00005, this conference

TC8918c

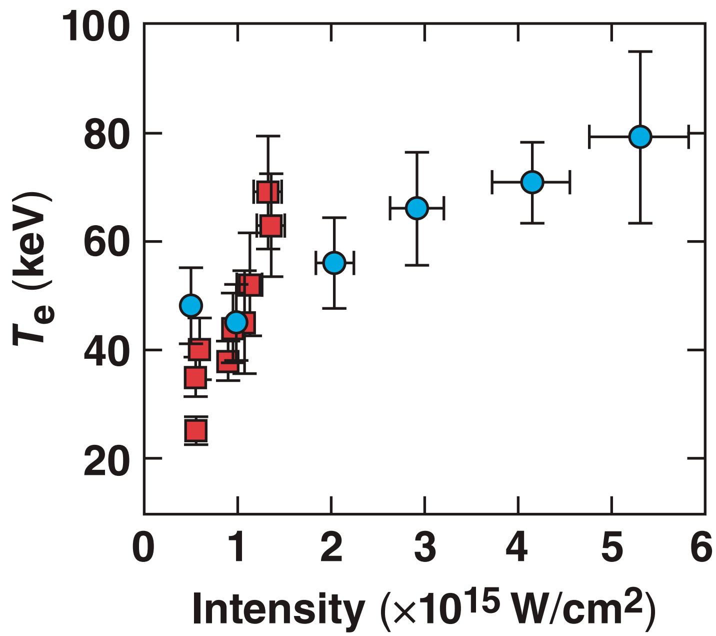
We have developed a basic-science platform to investigate strong-shock formation and LPI at SI-relevant conditions

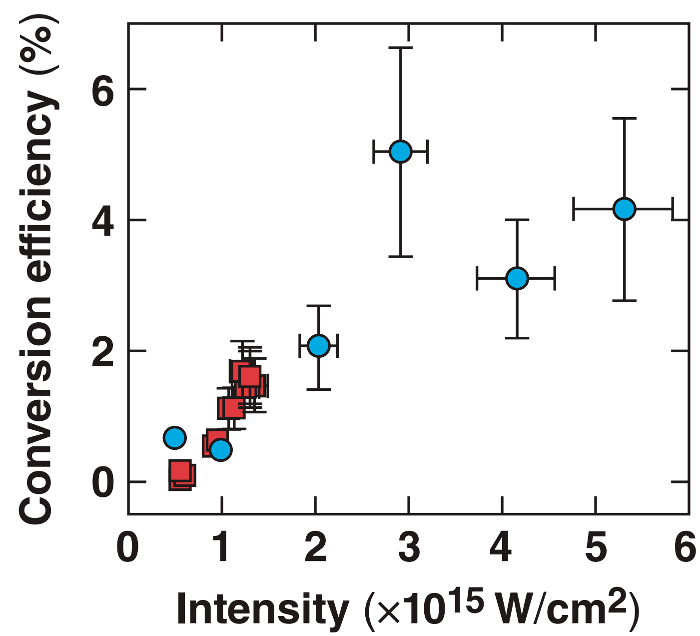




- Planar targets are irradiated with overlapping beams
- 800-μm focal spots in plasma-generating beams
- 260-μm focal spot in strong-shock beams

The hot electron temperature and conversion efficiency have been measured up to 5×10^{15} W/cm^2





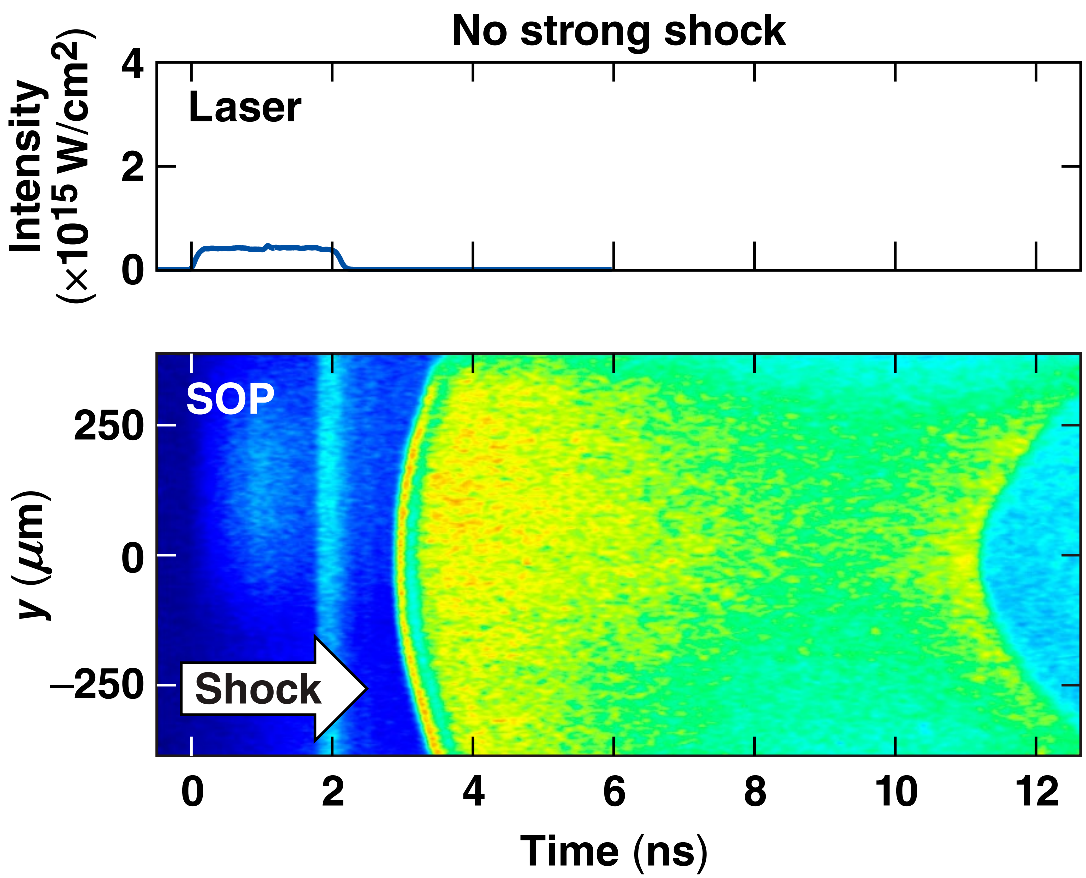
- T_{hot} is measured with time-resolved, four-channel hard x-ray detector*
- E_{hot} is determined through absolute Mo K_α yield and Monte Carlo simulations of electron stopping**

At 5×10^{15} W/cm^2 approximately 5% of the spike laser is converted to hot electrons at a temperature of ~80 keV.

*C. Stoeckl *et al.*, Rev. Sci. Instrum. 72, 1197 (2001).
**B. Yaakobi *et al.*, Phys. Plasmas 19, 012704 (2012).

E21662

The shock propagation in the quartz layer gives information about the strong-shock coupling



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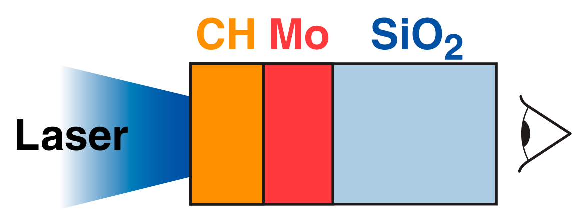
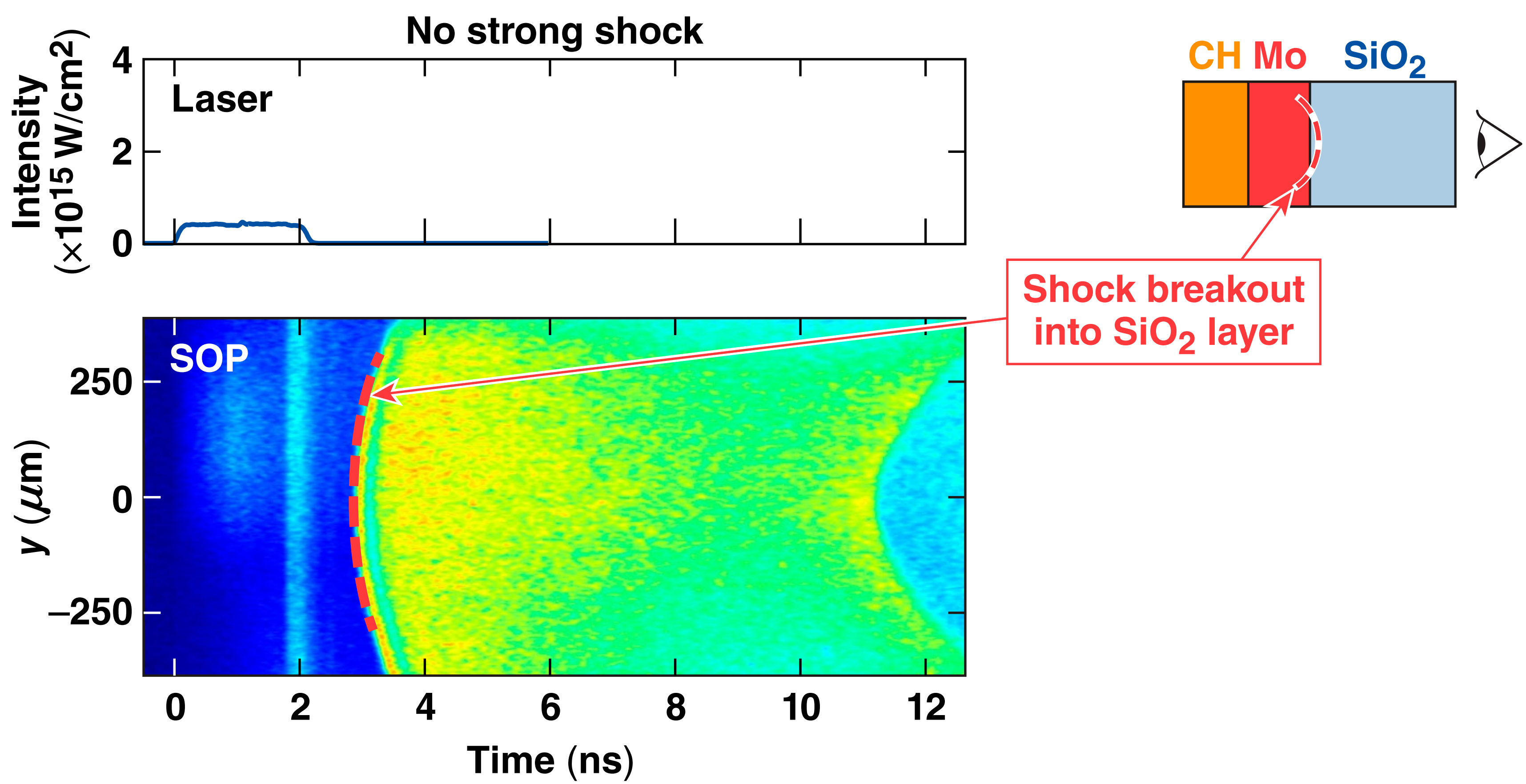


Features in the streaked optical pyrometry data (SOP) identify unique events in the shock propagation through the SiO_2 layer



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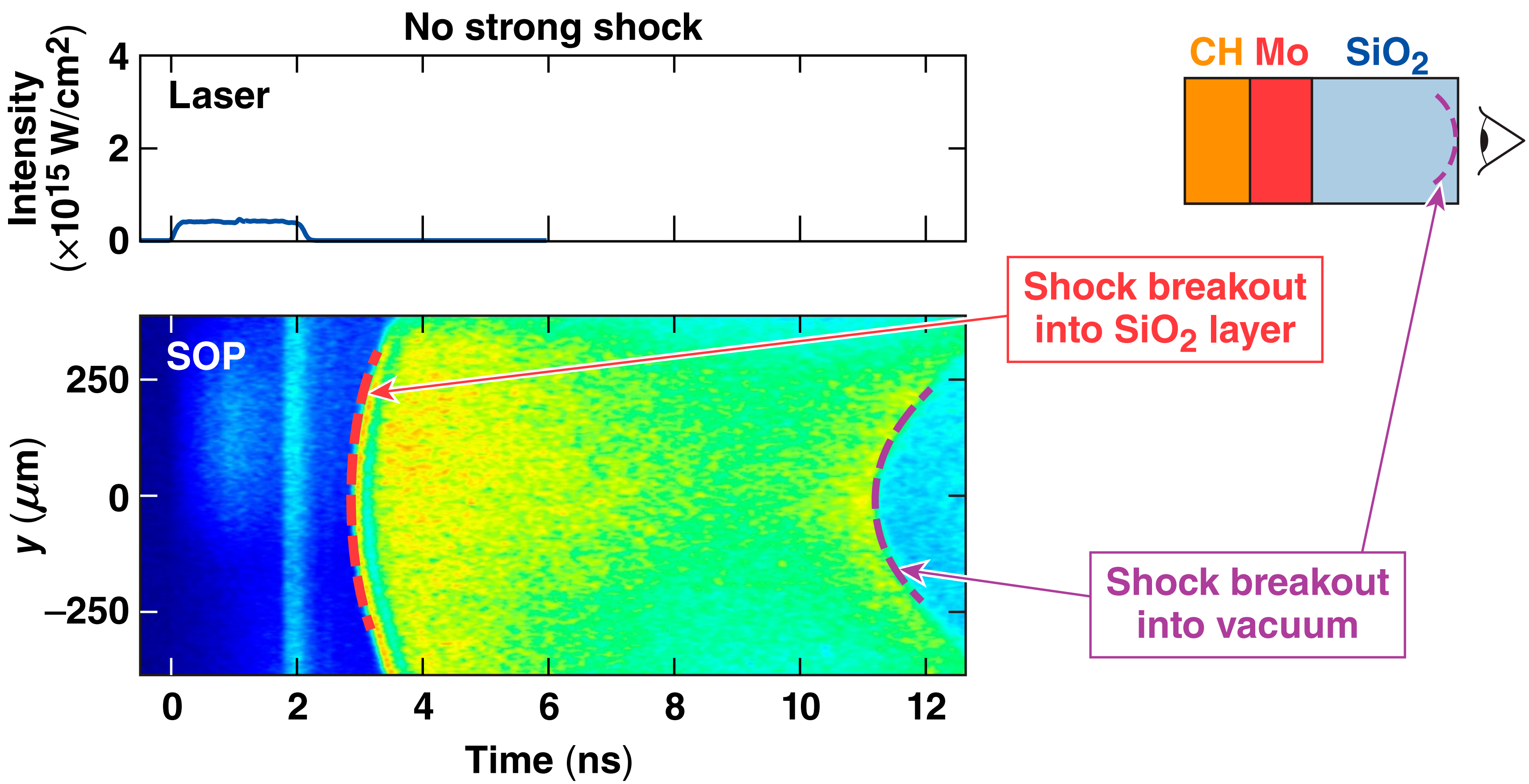
Features in the streaked optical pyrometry data (SOP) identify unique events in the shock propagation through the SiO_2 layer



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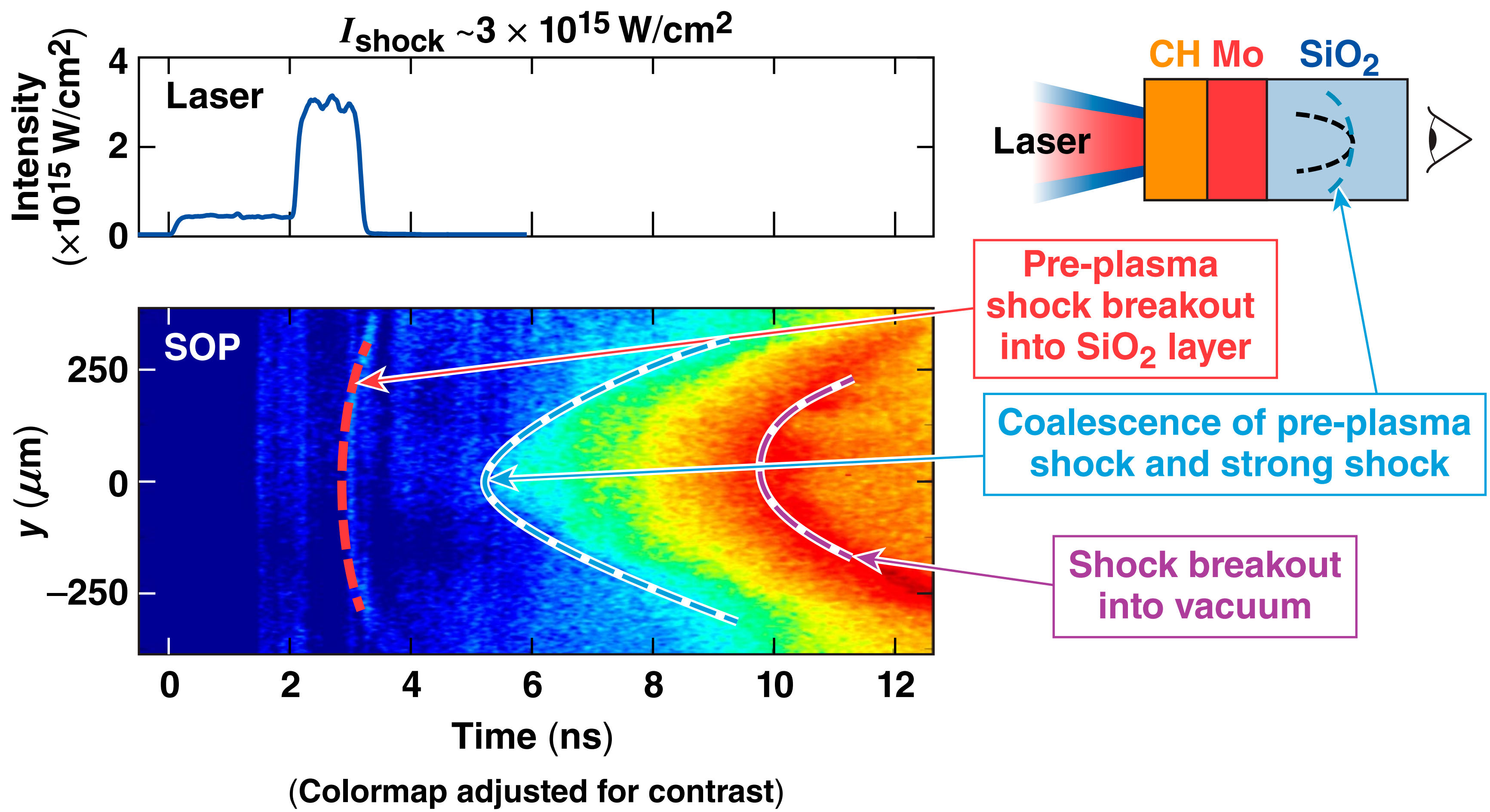
The coalescence of pre-plasma and strong shock is observed in the SOP data



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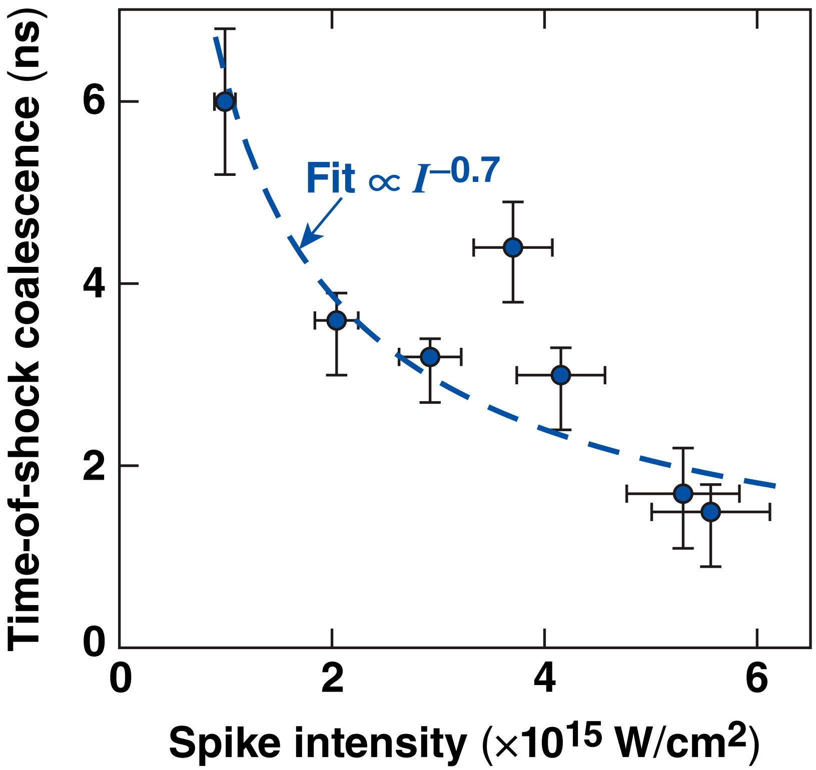
The time of shock coalescence is reduced with increasing intensity



- Time of coalescence is approximated by t ∝ I^{α} with $\alpha < -0.5$, determined by the geometry of both shocks
- Preliminary 2-D *DRACO* simulations suggest peak pressures up to ~180 Mbar were achieved

Data confirm efficient laser coupling at SI-relevant intensities.

Summary/Conclusions

Strong-shock generation and laser–plasma instabilities (LPI) at shock-ignition–relevant intensities are investigated in planar experiments

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- **Shock propagation data show efficient coupling of the high-intensity spike at intensities of mid-10^{15} W/cm^2**
- **Preliminary 2-D *DRACO* simulation results suggest peak pressures of ~180 Mbar were achieved at a drive intensity of 5×10^{15} W/cm^2**