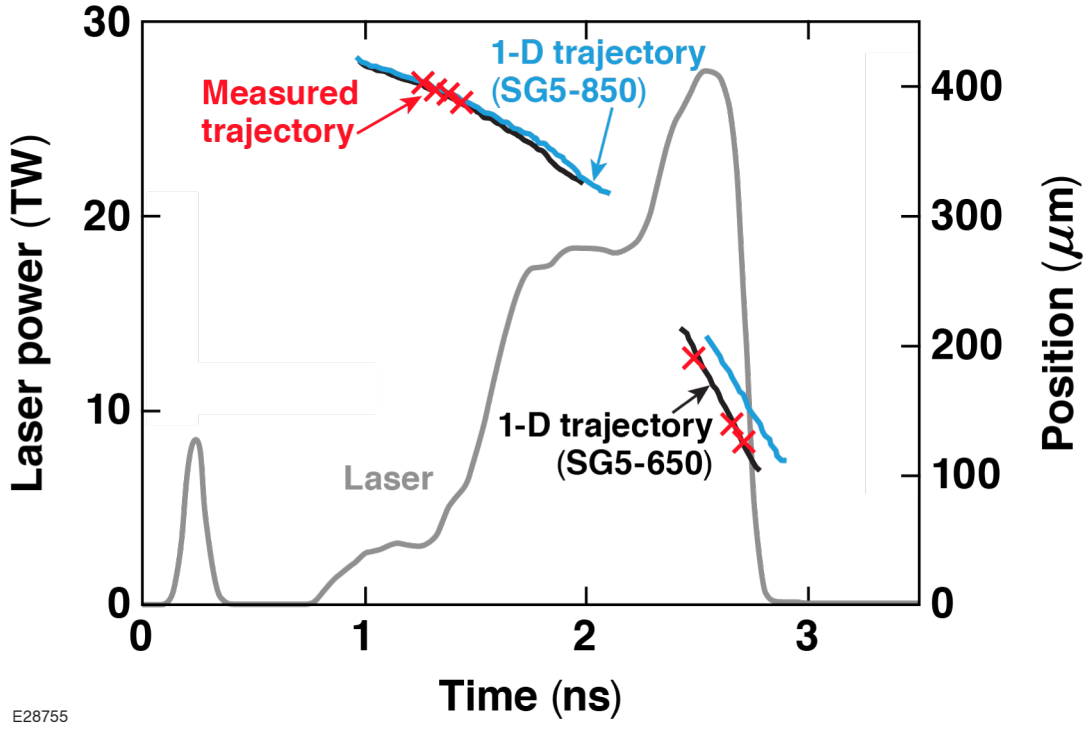
Enhanced Laser Energy Coupling with Small-Spot Distributed Phase Plates (SG5-650) in OMEGA Cryogenic Implosions



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Summary

Mitigation of CBET and improved energy coupling are demonstrated in cryogenic DT ice target implosions on OMEGA with new small-spot ("SG5-650") phase plates

- The ablation-front trajectory, backscattered laser energy, and neutron bang time were found to be consistent with a 10% increase in energy coupling, providing an increase of the hydrodynamic efficiency from 4.5% to 5.0%
- Implosion performance was limited by an increase in hot-electron production and increased hydrodynamic instabilities associated with the smaller distributed phase plate (DPP) spots*

CBET: cross-beam energy transfer

* D. Cao *et al.*, NO5.00010, this conference.

Collaborators

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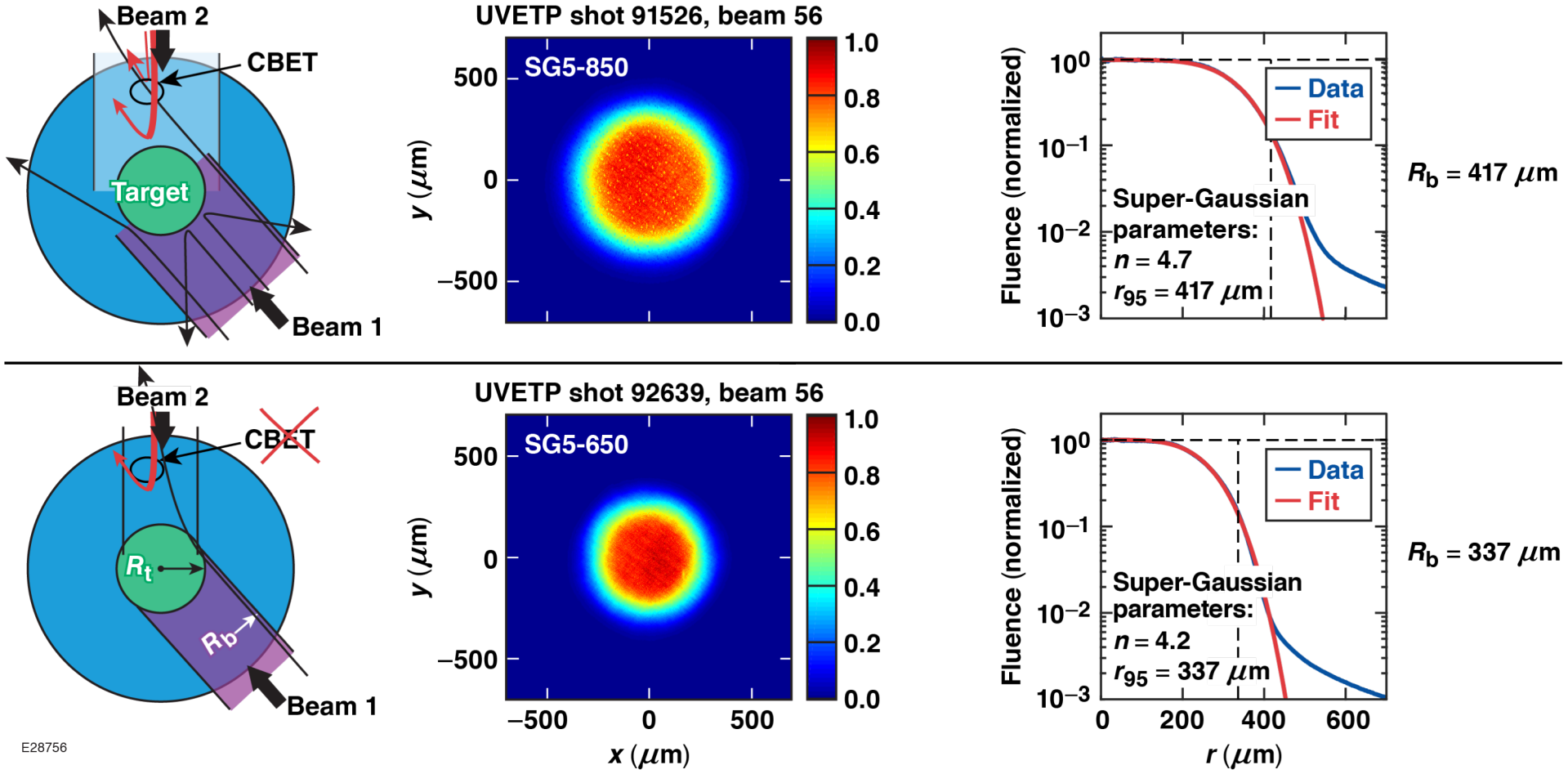
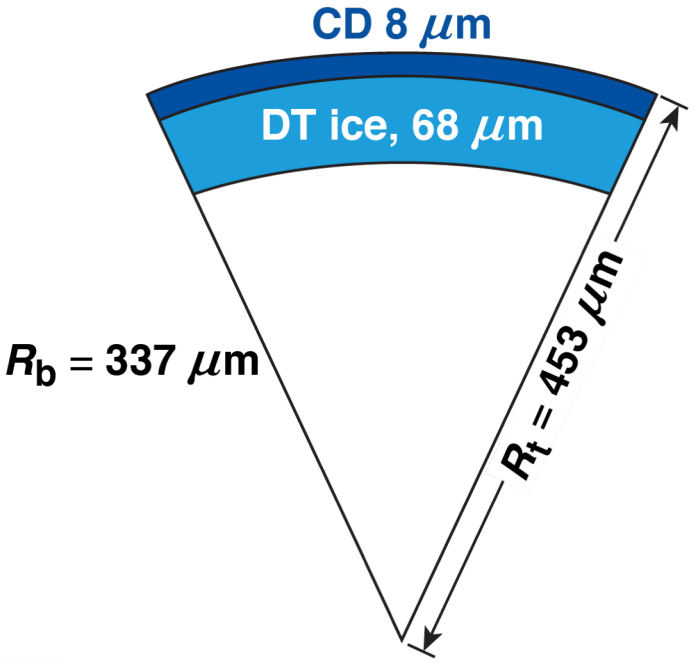
The 60 OMEGA beams were outfitted with new small-spot ("SG5-650") DPP's, with a diameter ~80% of that of the standard SG5-850 DPP's

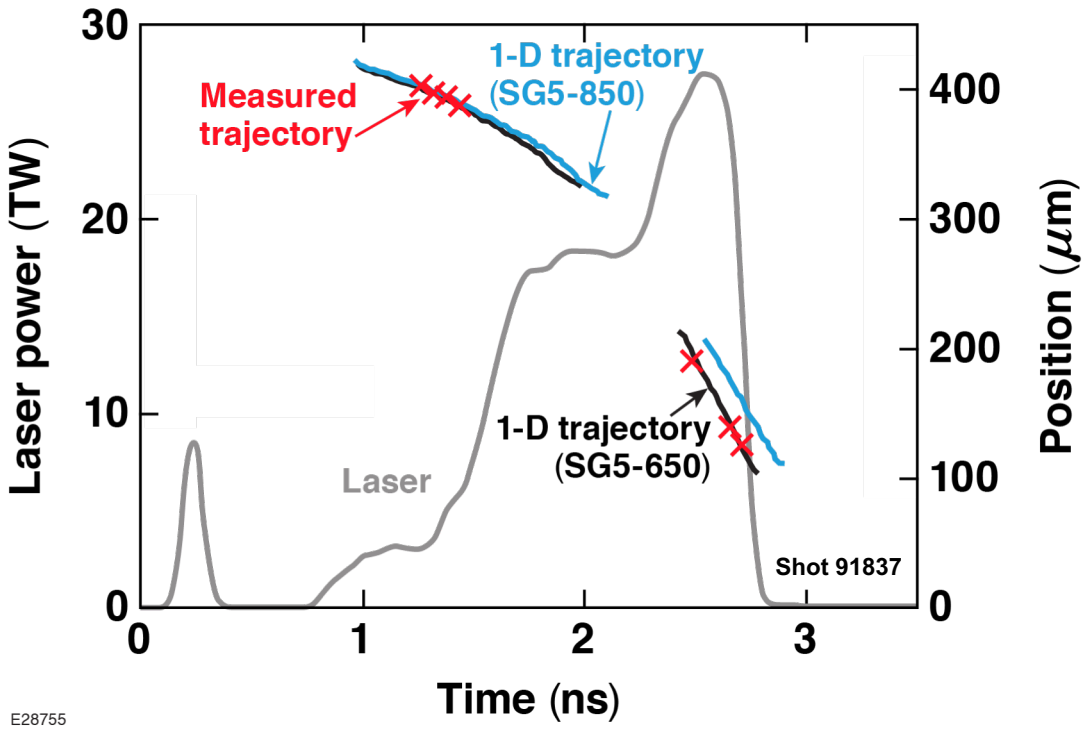


I. V. Igumenshchev *et al.*, Phys. Plasmas 17, 122708 (2010); D. H. Froula *et al.*, Phys. Rev. Lett. 108, 125003 (2012); V. N. Goncharov *et al.*, Phys. Plasmas 21, 056315 (2014).

CBET: cross-beam energy transfer
UVETP: UV equivalent target plane

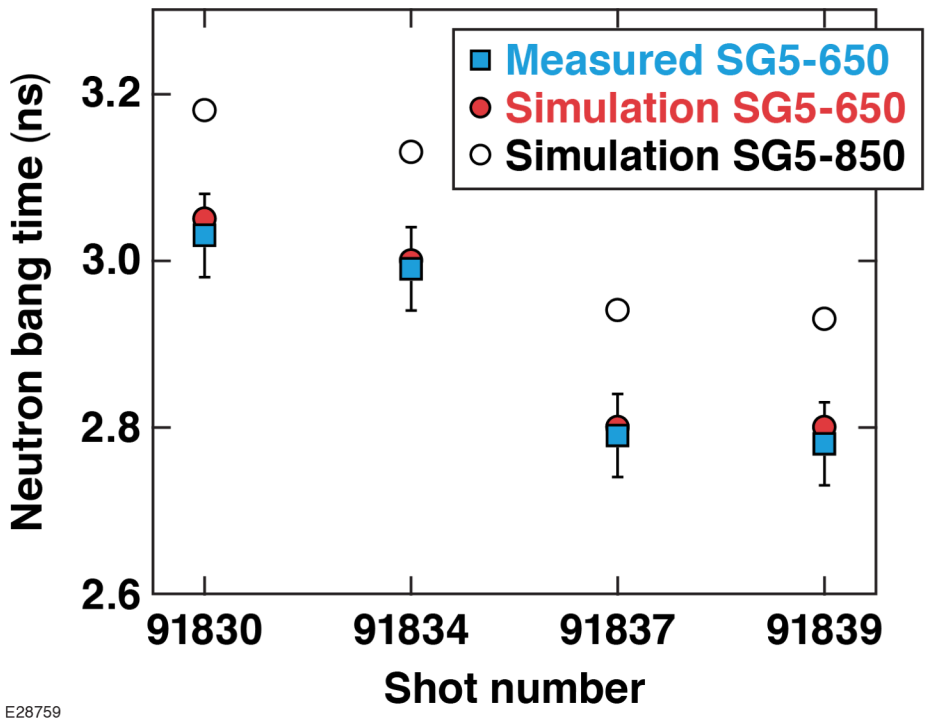
The measured shell trajectory for implosions with R_b/R_t = 0.75 agree with the simulation

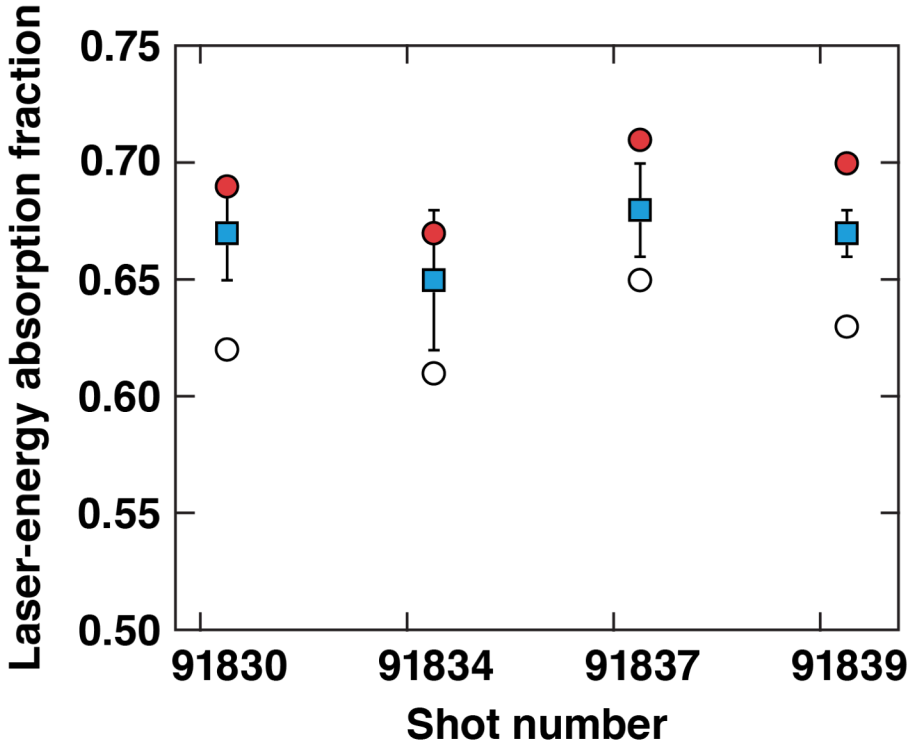




Simulations assuming SG5-850 DPP's with R_b/R_t = 0.9 show a delayed shell trajectory ⇒ the shell is imploding faster with the SG5-650 DPP.

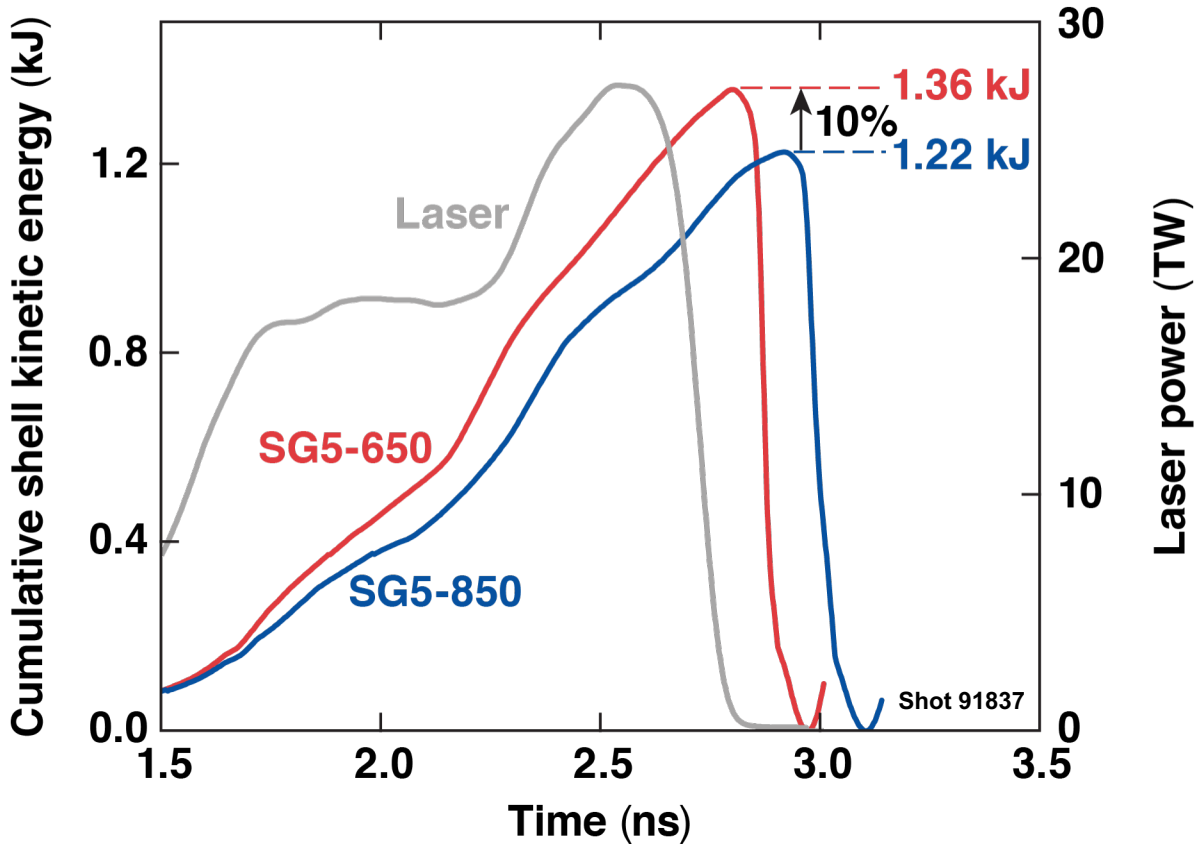
The measured neutron bang time and the absorbed laser energy are in agreement with simulations assuming SG5-650 DPP's



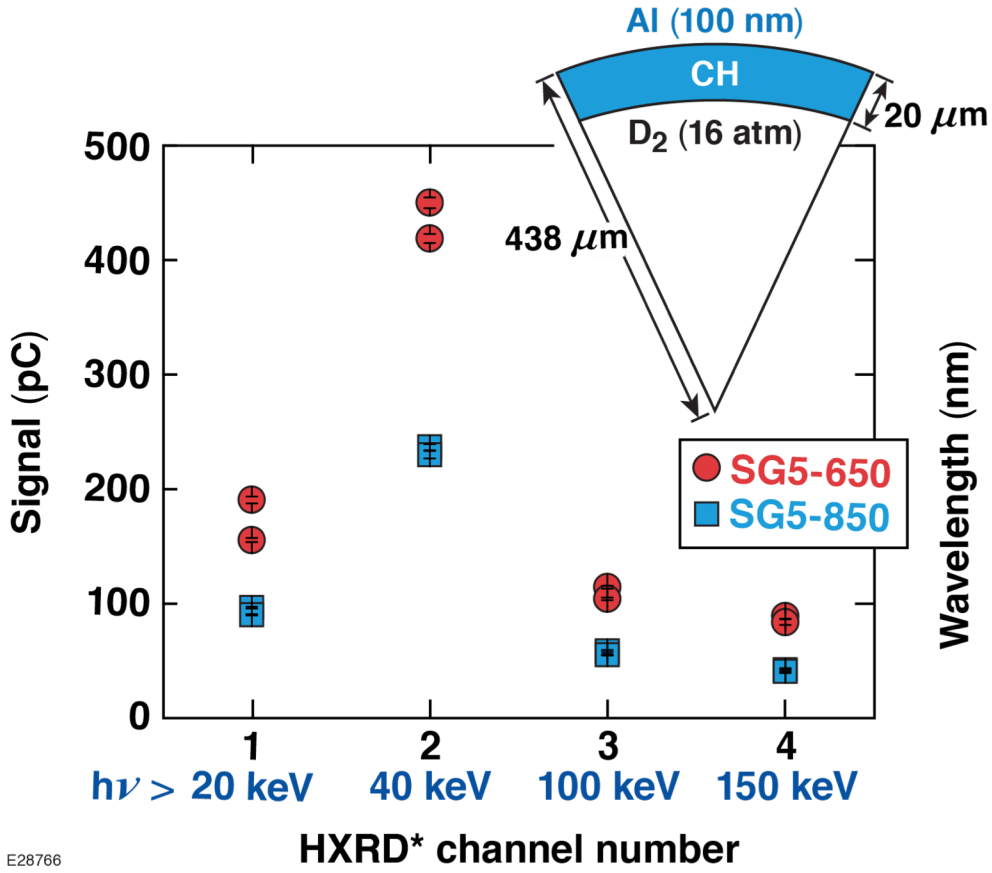


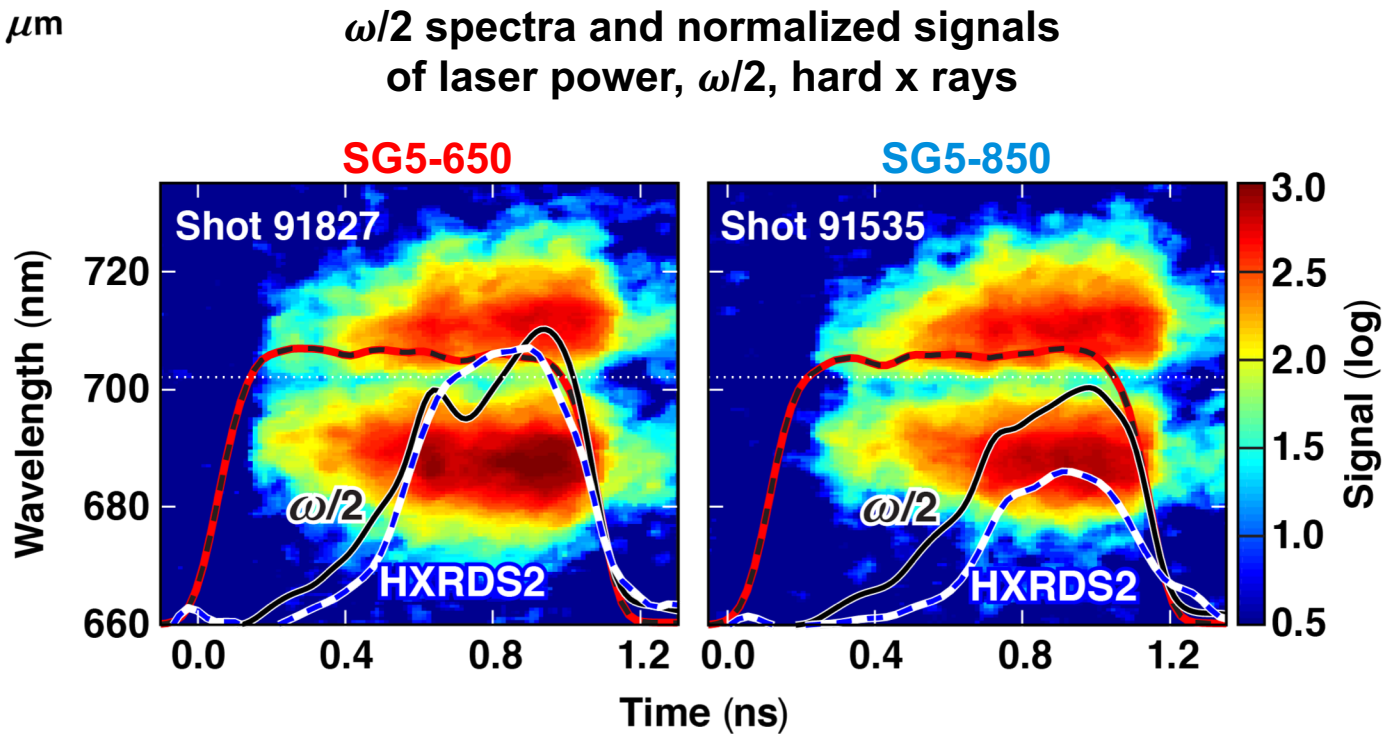
The neutron bang time and laser-energy absorption measurements support the trajectory measurement showing an enhanced energy coupling in the shell.

The calculated hydrodynamic efficiency (shell kinetic energy/laser energy) increased by 10% from 4.5% (SG5-850) to 5.0% (SG5-650)



The hard x-ray signal (photon energies greater than 40 keV) generated by hot electrons significantly increases with $R_b/R_t = 0.75$



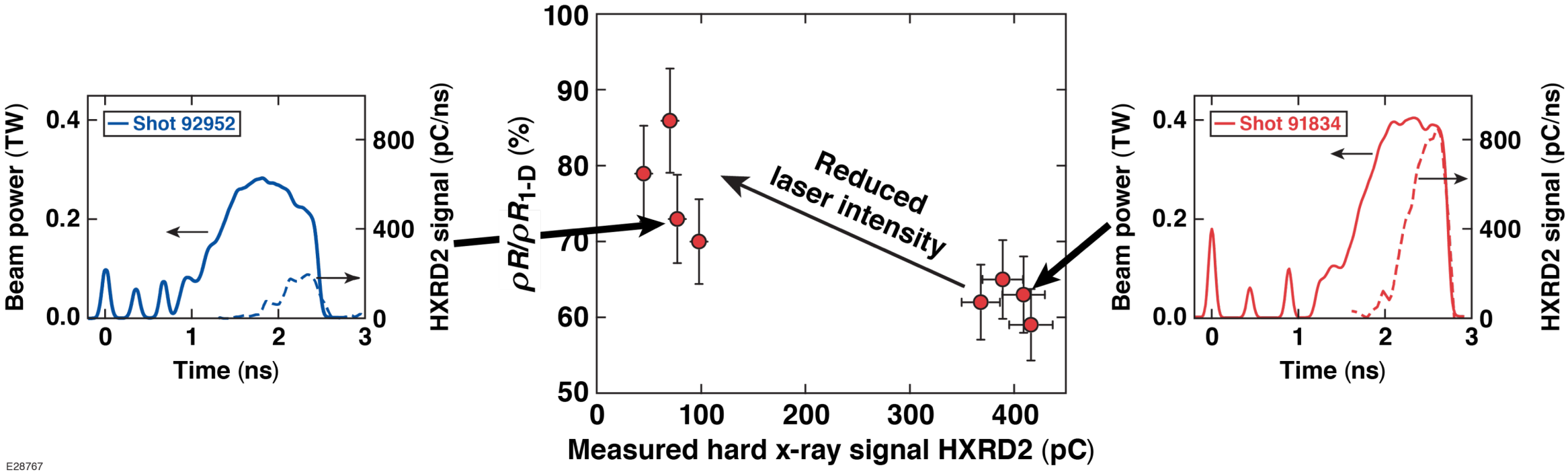


Reducing CBET leads to an increase of the laser intensity at the $n_c/4$ density to drive the two-plasmon decay and generate hot electrons.

HXRD: hard x-ray detector

*C. Stoeckl *et al.*, Rev. Sci. Instrum. 72, 1197 (2001).

An improved compression was achieved in cryo target implosions with SG5-650 DPP's by reducing the laser intensity and lowering the hard x-ray signal



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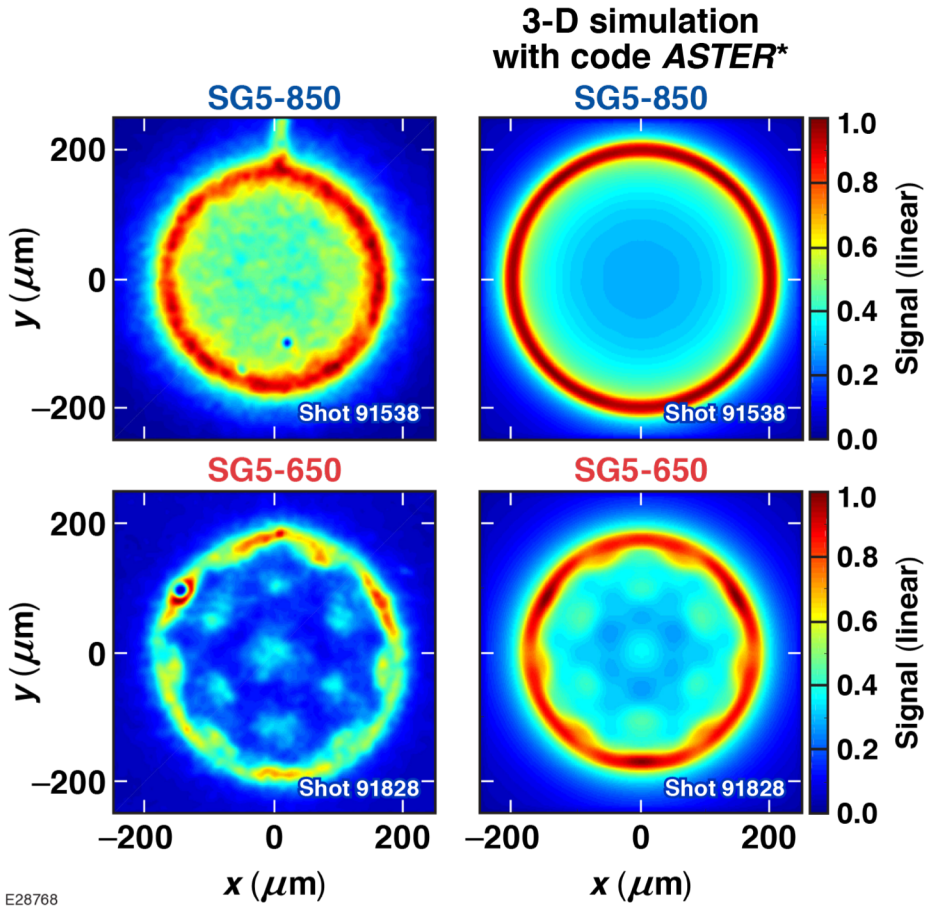
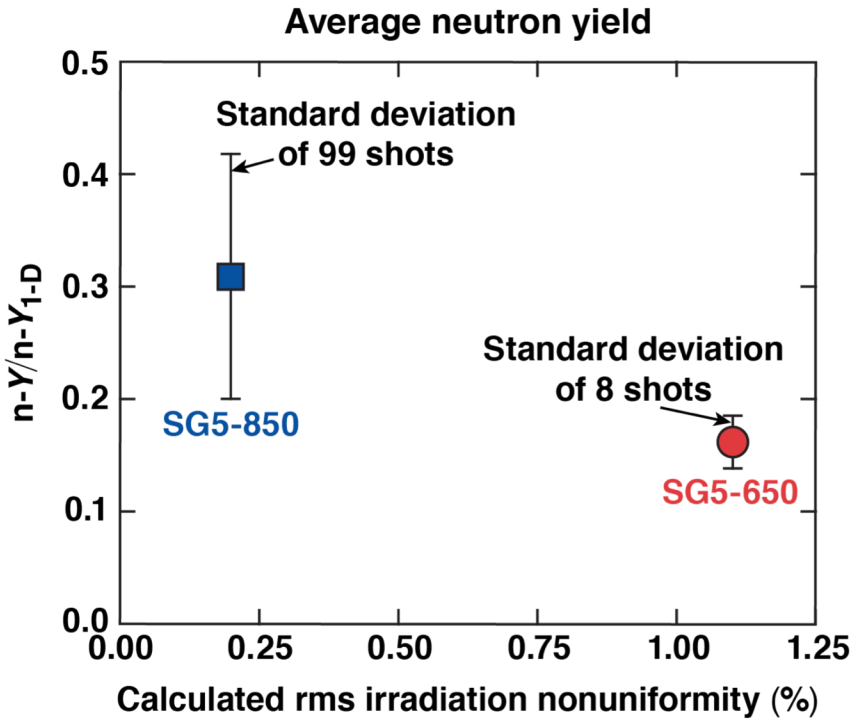
Hot-electron production is maintained at a tolerable level by reducing laser power with R_b/R_t = 0.75.*

* D. Cao *et al.*, NO5.00010, this conference.

Measured gated x-ray images at the end of the acceleration phase show a nonuniform emission pattern with SG5-650 consistent with 3-D simulations





The SG5-650 phase plates will be used for 0.8× hydrodynamic scaling experiments.

I. V. Igumenshchev *et al.*, Phys. Plasmas 23, 052702 (2016).

Summary/Conclusions

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