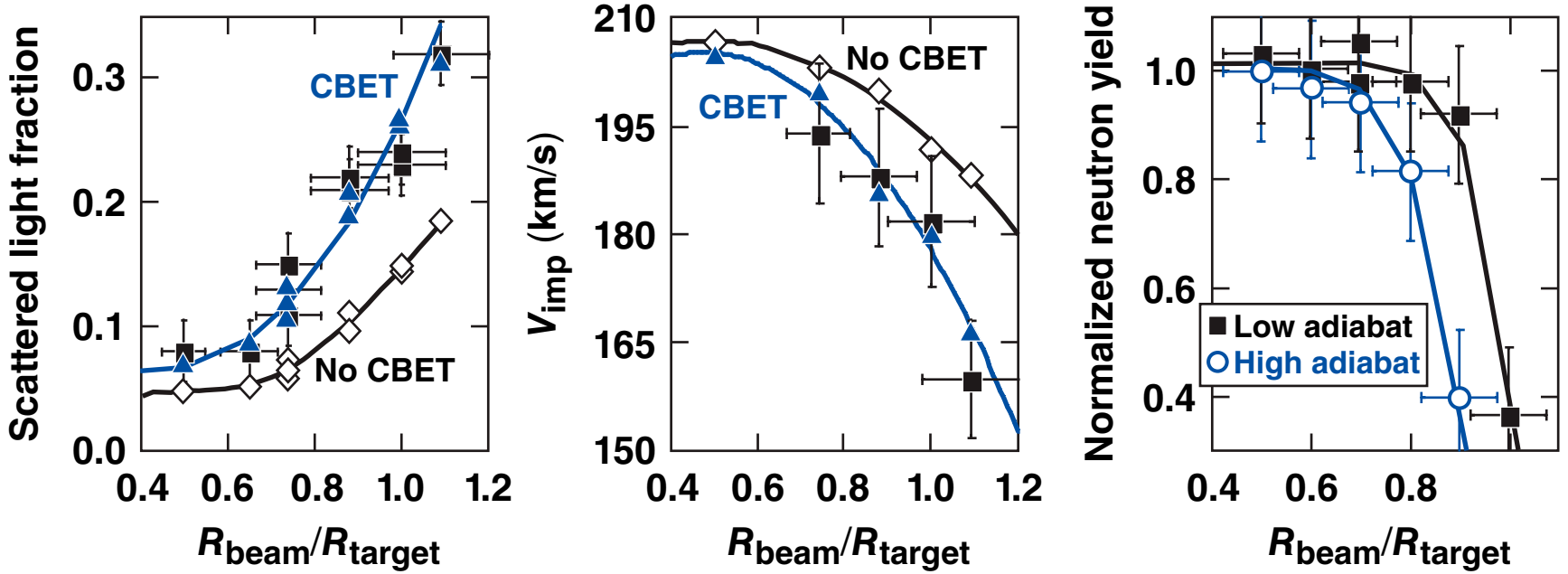
Measurements of an Increased Neutron Yield with Reduced CBET



D. H. Froula
Plasma and Ultrafast Physics Group Leader
University of Rochester
Laboratory for Laser Energetics

53rd Annual Meeting of the
American Physical Society
Division of Plasma Physics
Salt Lake City, UT
14–18 November 2011

Collaborators

I. V. Igumenshchev*, D. T. Michel, D. H. Edgell, R. Follett,
V. Yu. Glebov, V. N. Goncharov, J. Kwiatkowski, F. J. Marshall,
P. B. Radha, T. C. Sangster, W. Seka, C. Sorce, and S. Stagnitto

Laboratory for Laser Energetics
University of Rochester

* I. V. Igumenshchev, YI3.00001, this conference

Summary

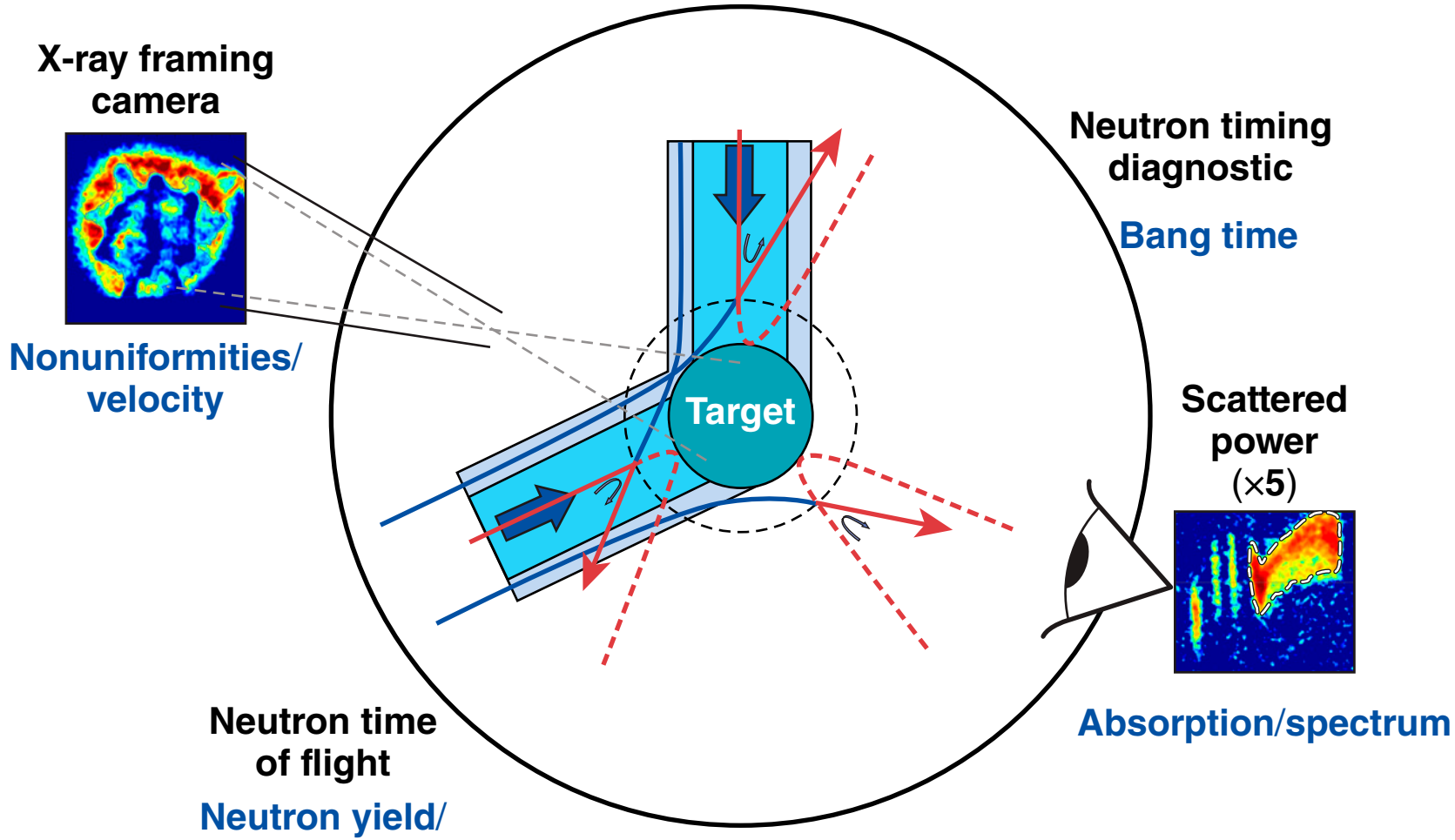
Reducing the spot size is shown to reduce crossed-beam energy transfer (CBET) and increase the absorption, implosion velocity, and neutron yield

UR LLE

- All measurements are consistent with the reduction of CBET when the laser spot size is reduced
- A 20% reduction in spot size leads to
  - a 15% increase in absorption
  - a 17% increase in implosion velocity
  - a 15% reduction in bang time
  - a 20% increase in the ion temperature
  - a factor of 2.5 increase in neutron yield
- Nonuniformities are measured to be >8 μm for normalized radius below $R_{beam}/R_{target} \sim 0.8$

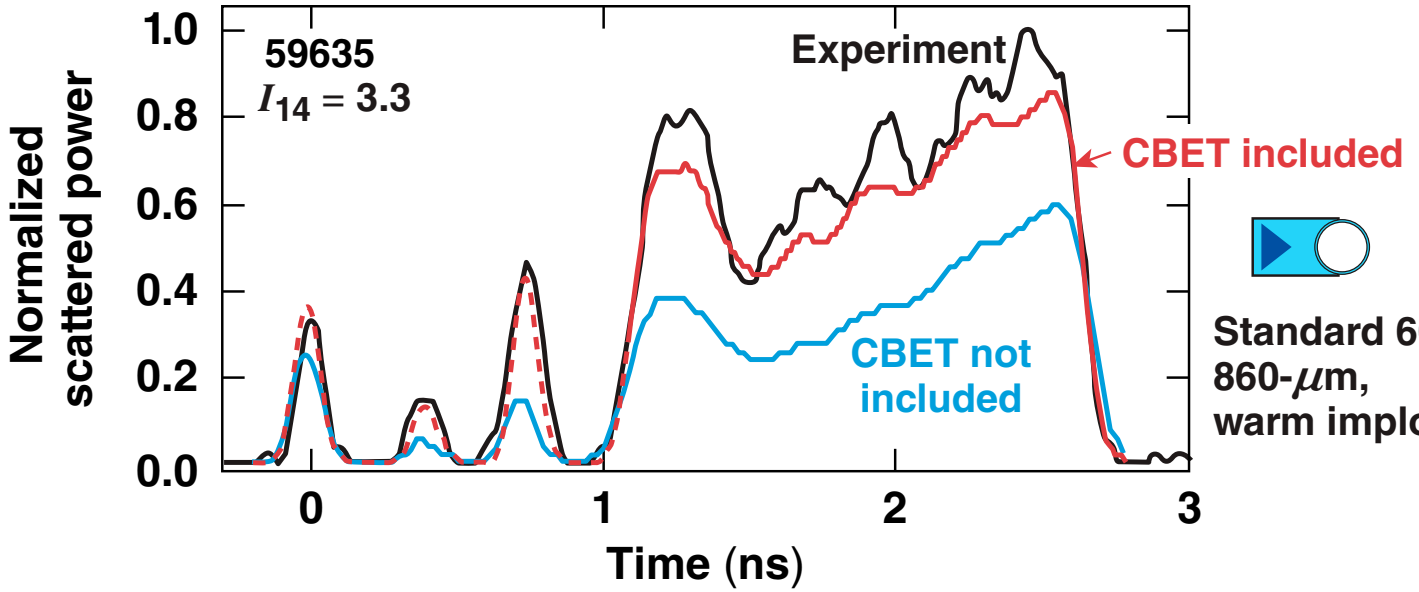
The CBET modeling is in good agreement with all of the observables.

Direct-drive low-adiabat implosion experiments are well diagnosed at the Omega Facility



E20335

CBET is required to match the measured target performance from standard OMEGA direct-drive implosions

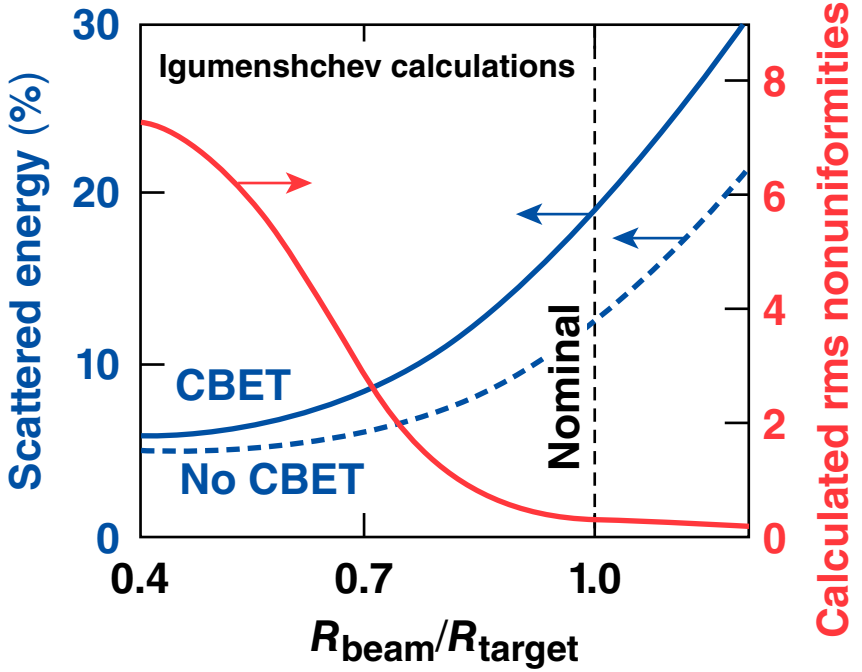


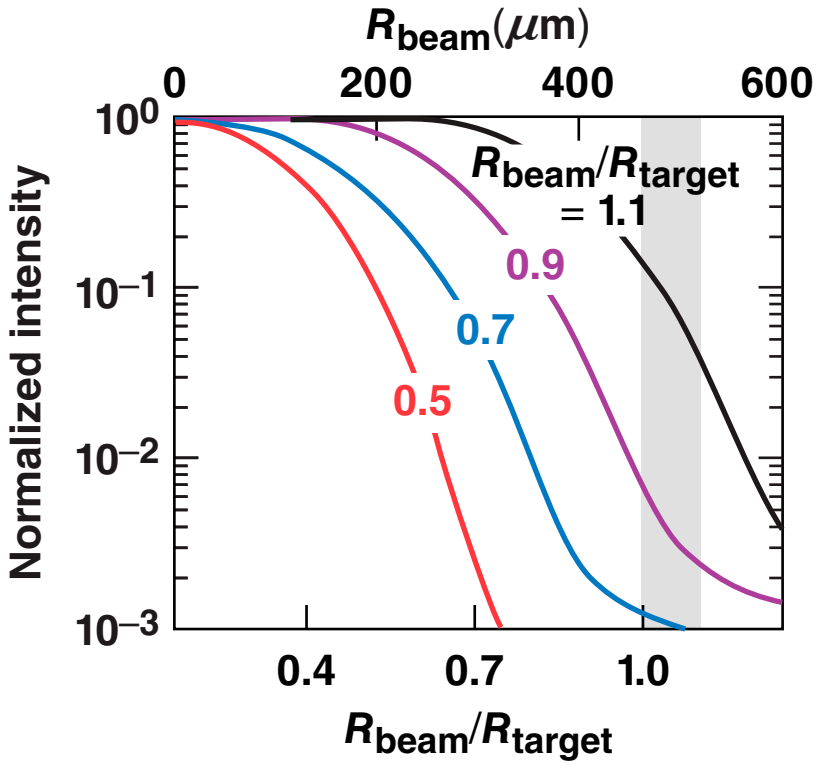
- The model is implemented in *LILAC* (1-D hydrocode), which calculates the beam-to-beam resonant coupling of laser light through the ion-acoustic waves*
- The CBET model is similar to that used in indirect drive**

CBET significantly reduces the absorbed energy in standard OMEGA direct-drive implosion experiments.

* I. V. Igumenshchev *et al.*, Phys. Plasmas 17, 122708 (2010).
** P. Michel *et al.*, Phys. Rev. Lett. 102, 025004 (2009).

By reducing the diameter of the laser beams, CBET could be eliminated, but nonuniformities will increase



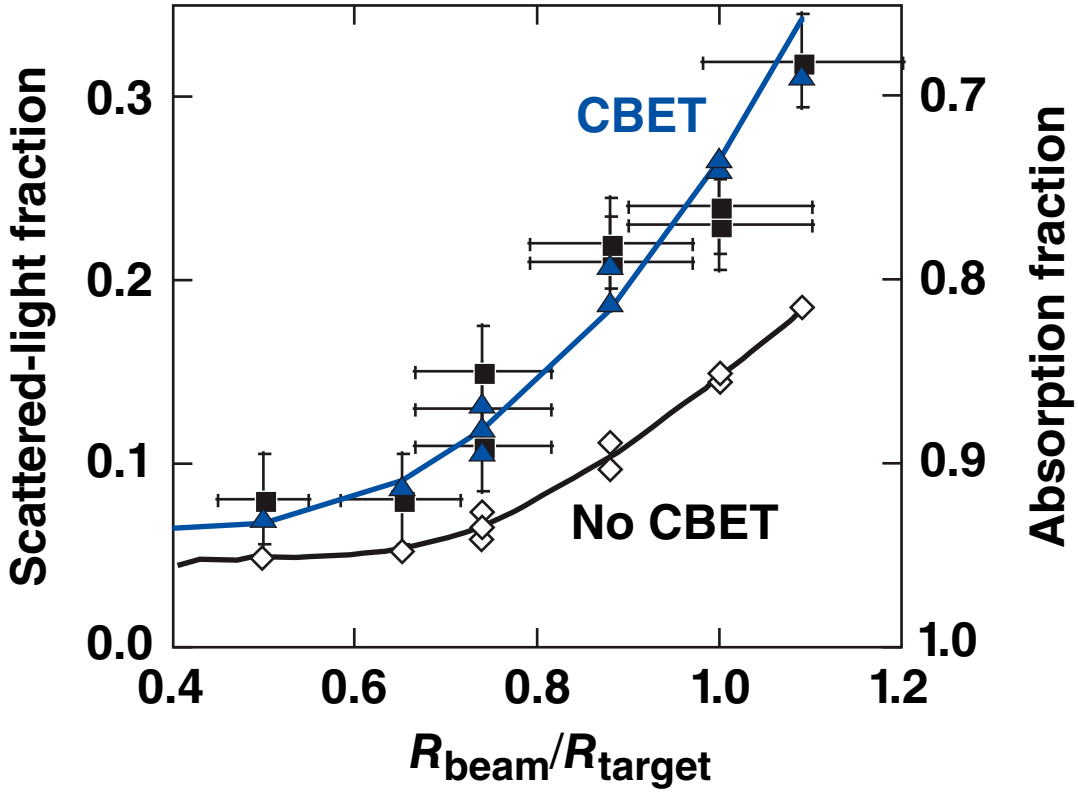


Simulations suggest an optimum laser-beam radius when balancing CBET with nonuniformities.

E20145a

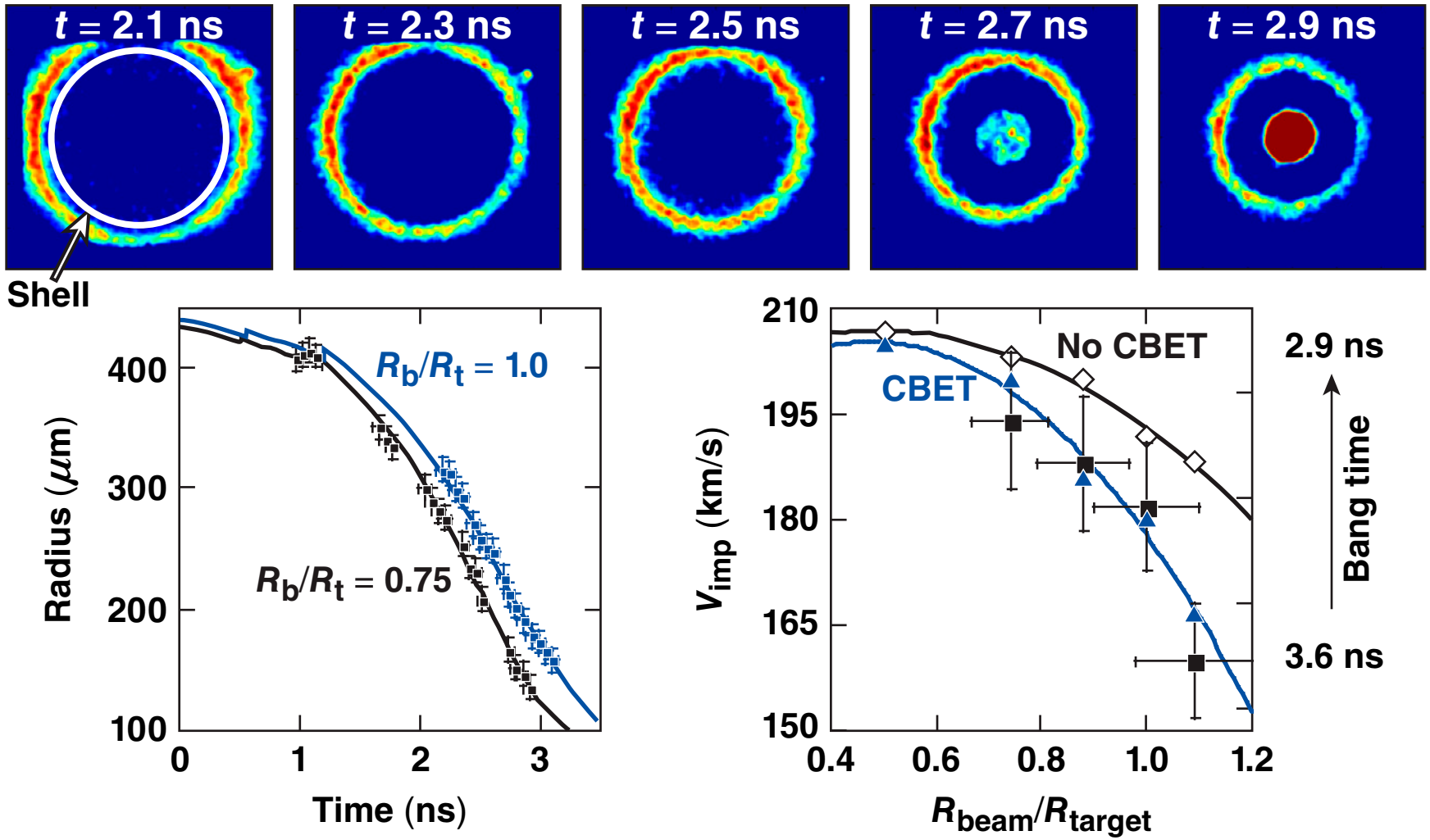
I. V. Igumenshchev, YI3.00001

Reducing the diameter of the laser beams significantly reduces the scattered light



The CBET model is required to match the measured scattered light.

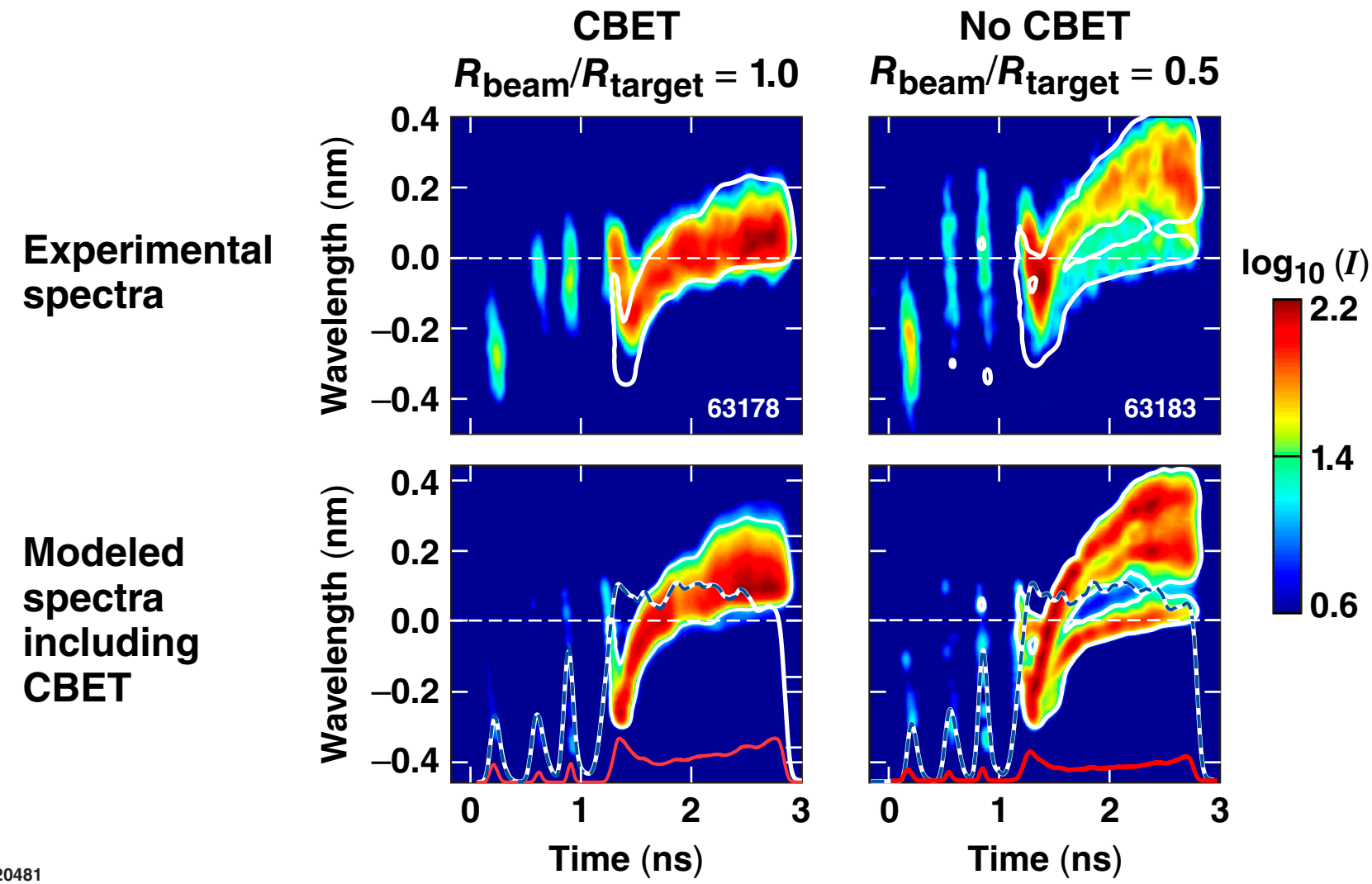
The increased absorption drives the shell to a significantly higher implosion velocity



The reduction in CBET leads to an increase in hydro-efficiency.

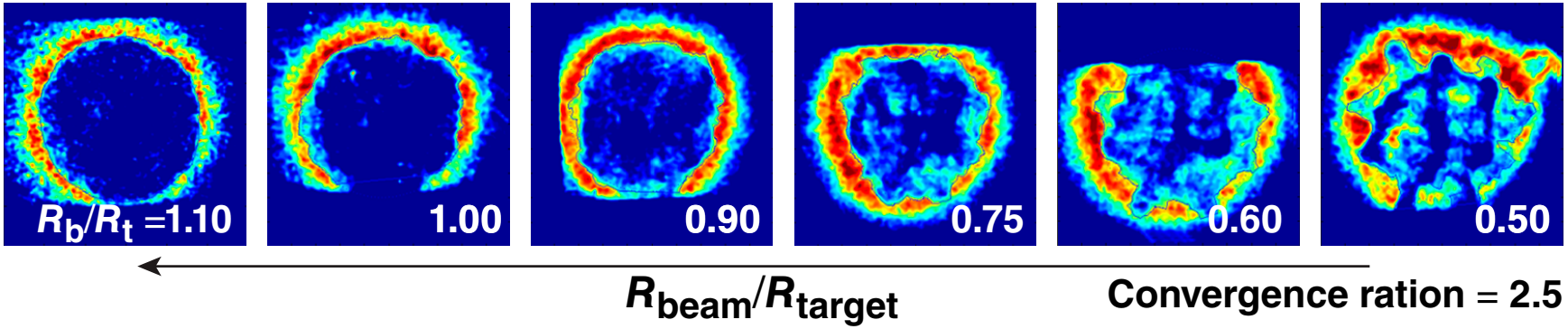
E20337

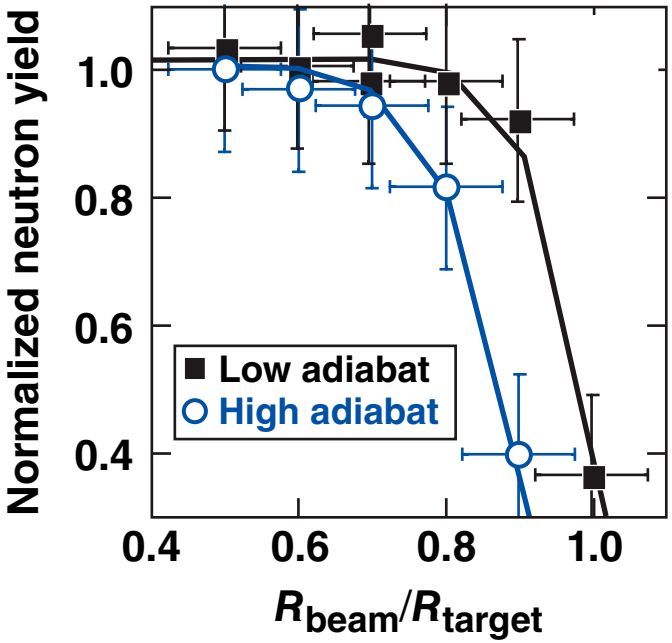
This increased hydro-efficiency is a result of increased coupling of the near-radial rays that penetrate to the critical surface

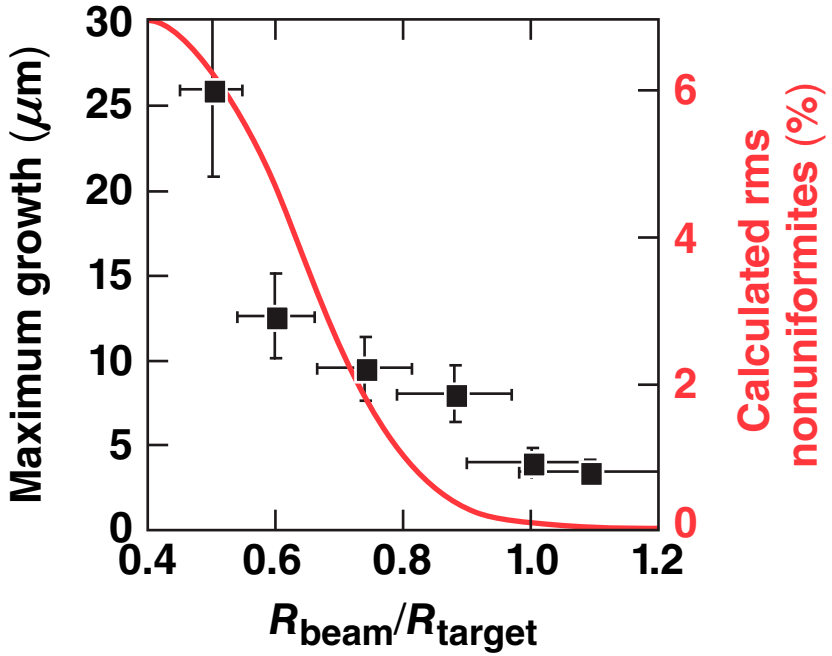


E20481

The neutron yield doubles when the beam diameter is reduced by 10%







U1265b

Summary/Conclusions

Reducing the spot size is shown to reduce CBET and increase the absorption, implosion velocity, and neutron yield

UR LLE

- All measurements are consistent with the reduction of CBET when the laser spot size is reduced
- A 20% reduction in spot size leads to
  - a 15% increase in absorption
  - a 17% increase in implosion velocity
  - a 15% reduction in bang time
  - a 20% increase in the ion temperature
  - a factor of 2.5 increase in neutron yield
- Nonuniformities are measured to be >8 μm for normalized radius below $R_{beam}/R_{target} \sim 0.8$

The CBET modeling is in good agreement with all of the observables.