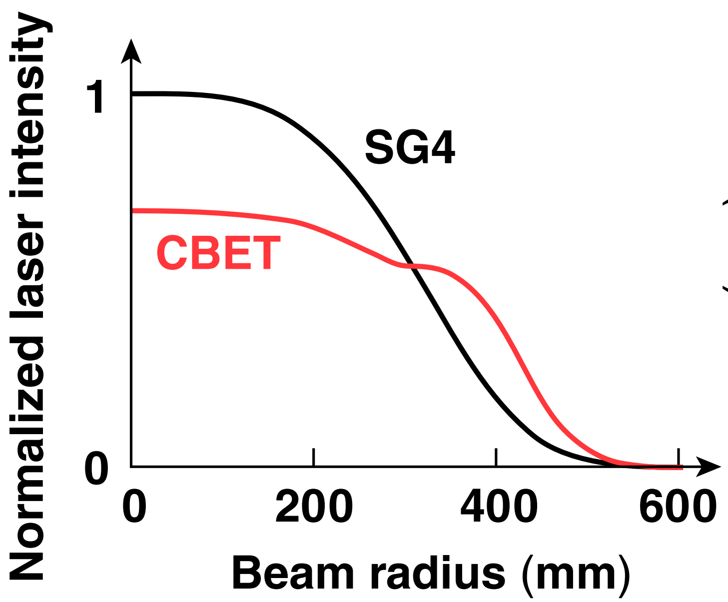
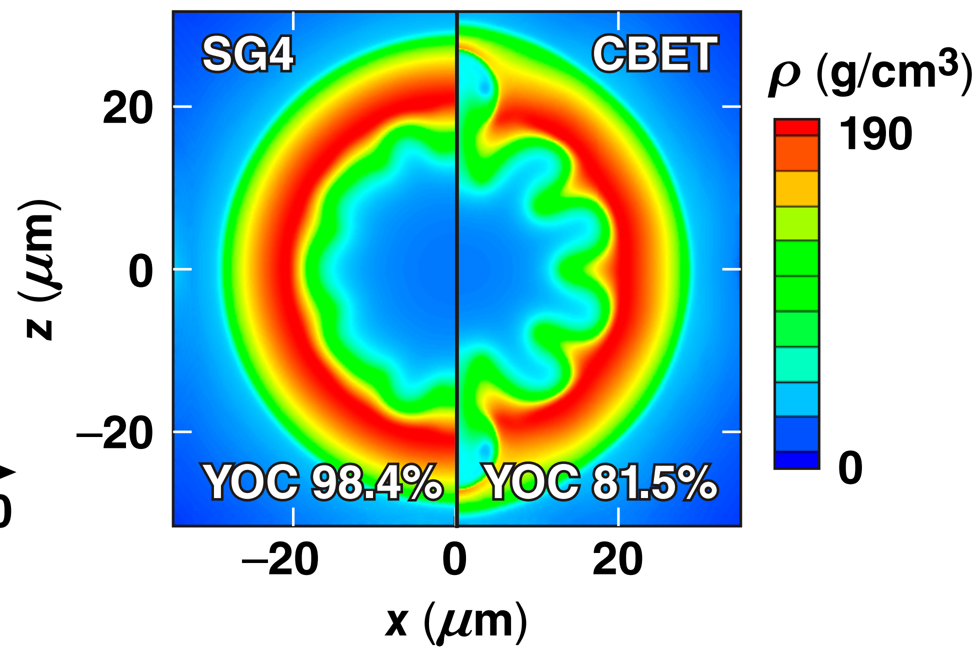
Numerical Investigation of the Effects of Cross-Beam Energy Transfer (CBET) on the Drive Uniformity of OMEGA Implosions

SG4 and CBET laser-beam profiles
Low-adiabat, cryo implosion



Mass density
at peak burn (*DRACO*)



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Summary

Target uniformity is more susceptible to the effects of CBET as the adiabat of the implosion is lowered

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- Effective laser-beam profiles were calculated with the CBET model implemented in 1-D *LILAC*
- Time-independent laser-beam profiles, representing a "worst-case" scenario, were used in 2-D *DRACO* simulations to evaluate the effects of CBET on target performance for a range of implosion adiabats
- CBET was found to have little or no effect on high- to medium-adiabat implosions
- Simulations indicate that CBET does act to reduce target performance in low-adiabat implosions

TC8693

*D. H. Edgell (JO5.00014); I. V. Igumenshchev (JO5.00015).

Collaborators

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S. Skupsky, and R. L. McCrory

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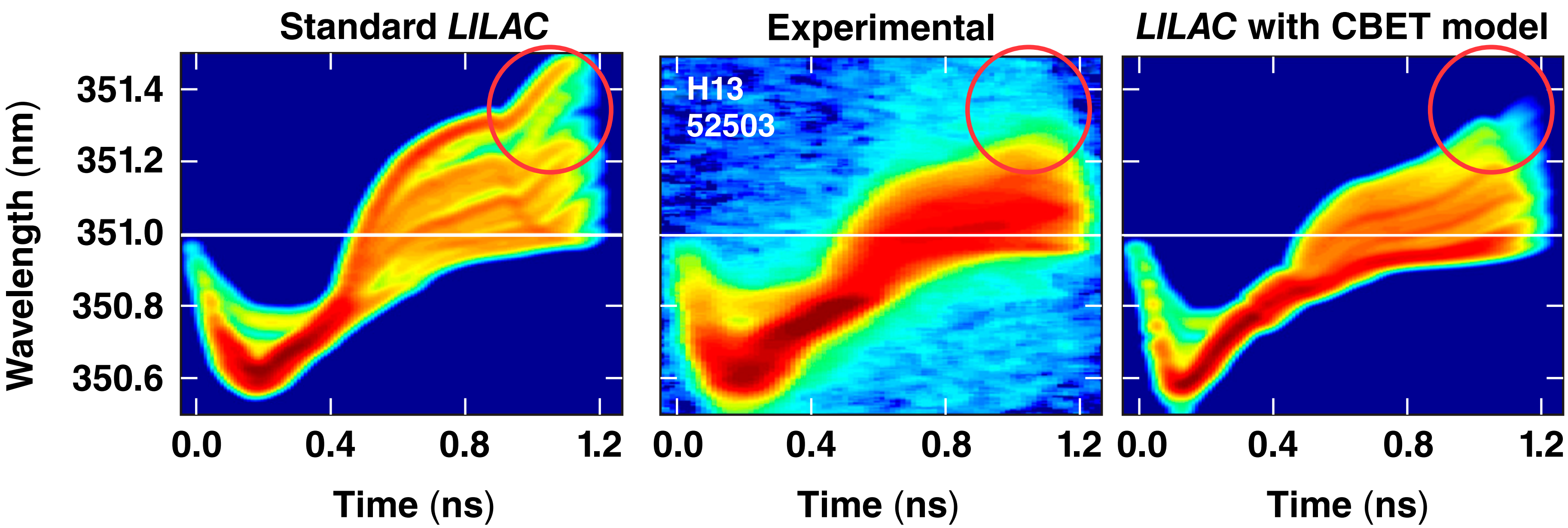
Simulations using the CBET model better reproduce the experimental FABS scattered-light spectrum*



- Red-shifted "fingers" are reproduced more accurately with the CBET model

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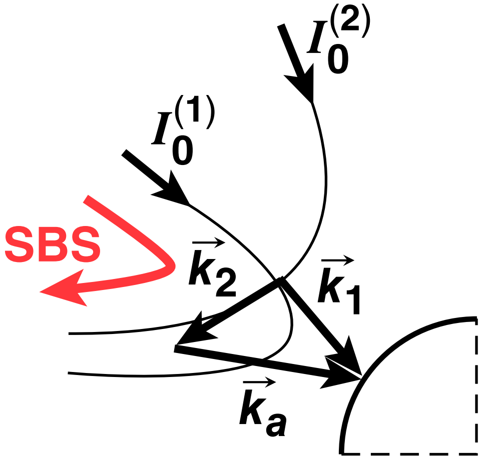
Effective beam profiles are used to emulate the CBET in 2-D *DRACO* simulations

- **The CBET model is implemented into the 1-D code *LILAC****

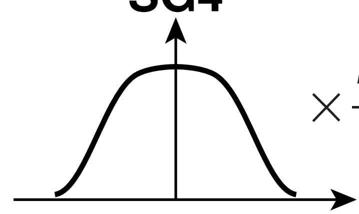


$$\begin{cases} \vec{k}_1 = \vec{k}_2 + \vec{k}_a \\ \omega_1 = \omega_2 + \omega_a \end{cases}$$

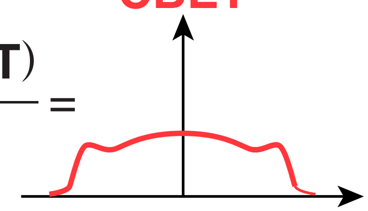
- **Ray intensity along its trajectory****

$$I^{(1)} = I_0^{(1)} \exp\left(\int L^{-1} d\ell\right),$$

$$L^{-1} \propto \frac{n/n_c}{1 - n/n_c} \frac{I^{(2)}}{f(Z)T}$$



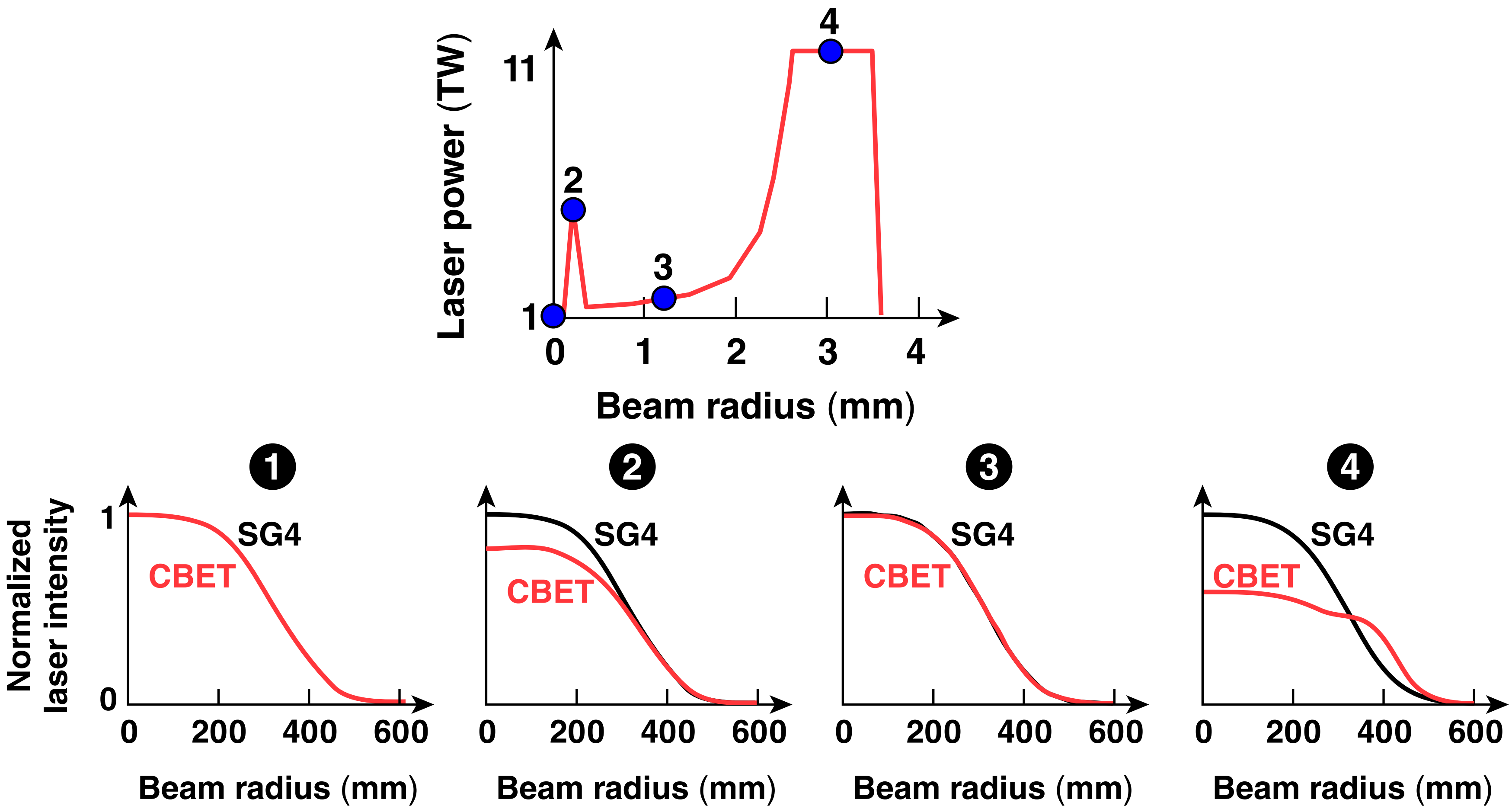
$$\times \frac{E_{abs}(\mathrm{IB} + \mathrm{CBET})}{E_{abs}(\mathrm{IB})} =$$



*I. V. Igumenshchev (JO5.00015)

**C. J. Randall, J. R. Albritton, and J. J. Thomson, Phys. Fluids 24, 1474 (1981); J. A. F. Hittinger *et al.*, J. Comput. Phys. 209, 695 (2005).

An initial investigation of CBET shows that the effective beam profile changes during the implosion



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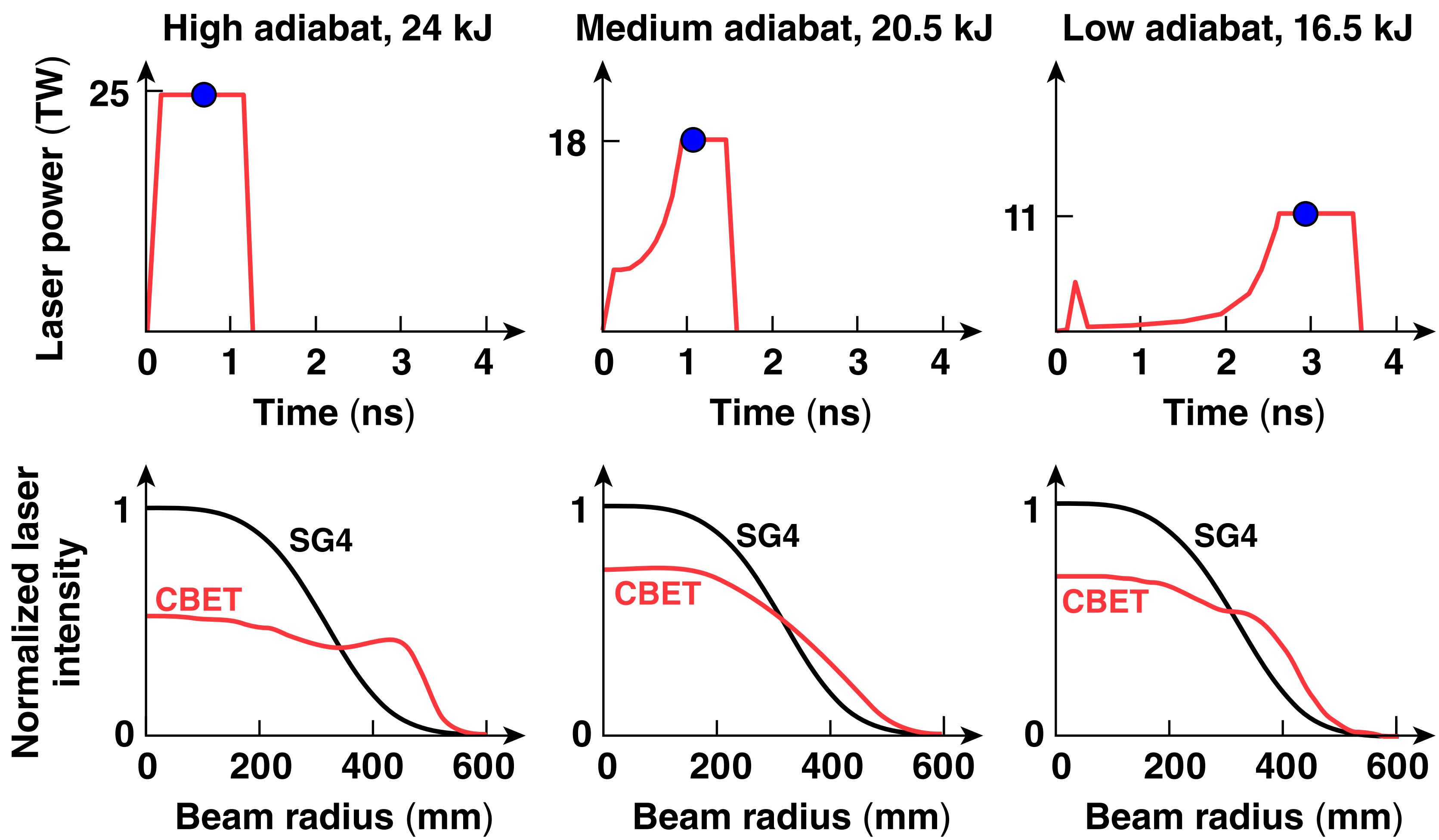
Time-independent effective beam profiles were selected for each considered implosion



- CBET profiles were rescaled to have the same energy as SG4 to reproduce the drive

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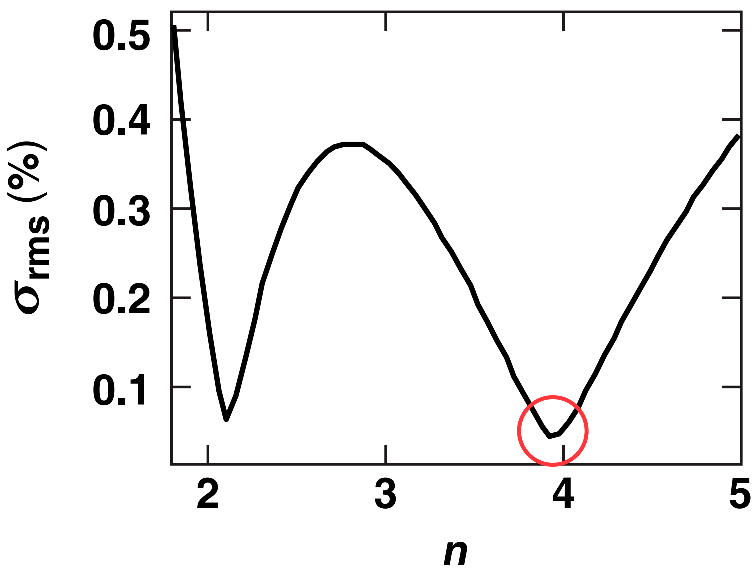
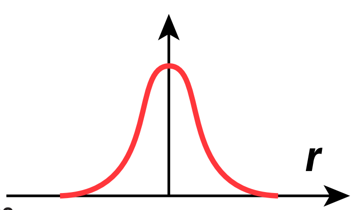
An analysis of the effective laser-beam profiles shows an increase in medium-wavelength illumination nonuniformities

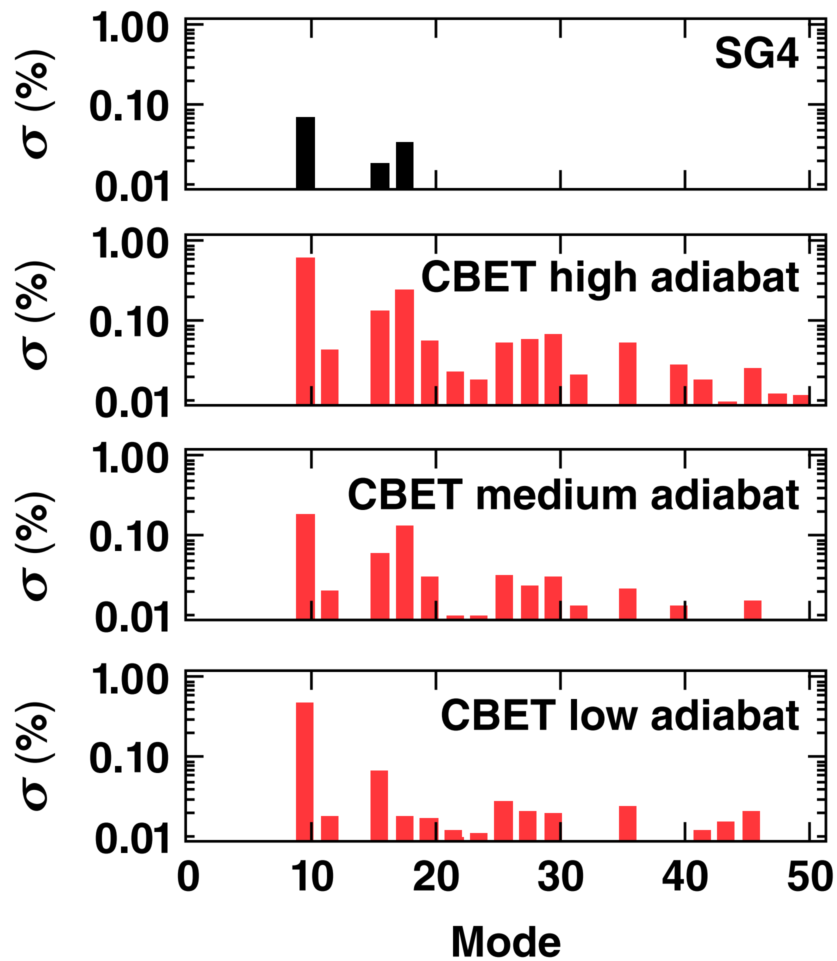
- **SG4 laser-beam profile was designed to minimize σ_{rms}**



$$I(r) = I_0 e^{-(r/r_0)^n}$$ – beam-intensity profile

n – order of super-Gaussian





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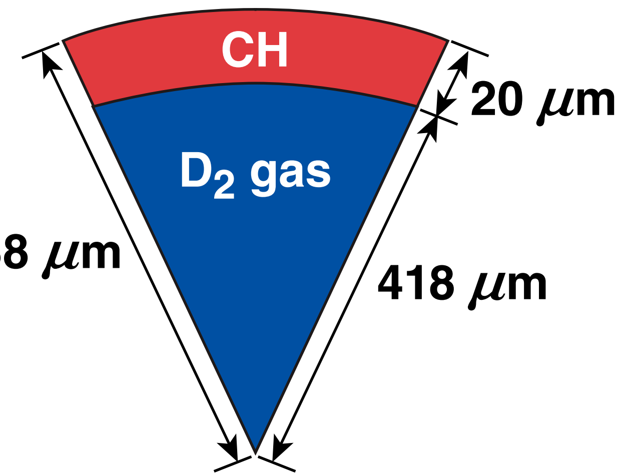
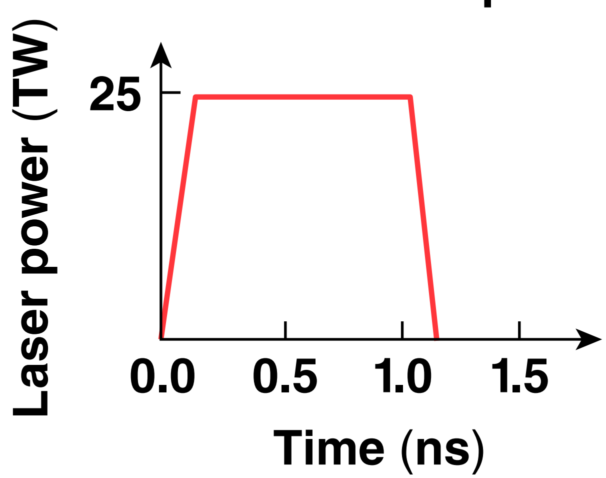
A high-adiabat implosion shows a negligible increase in stagnated shell nonuniformity

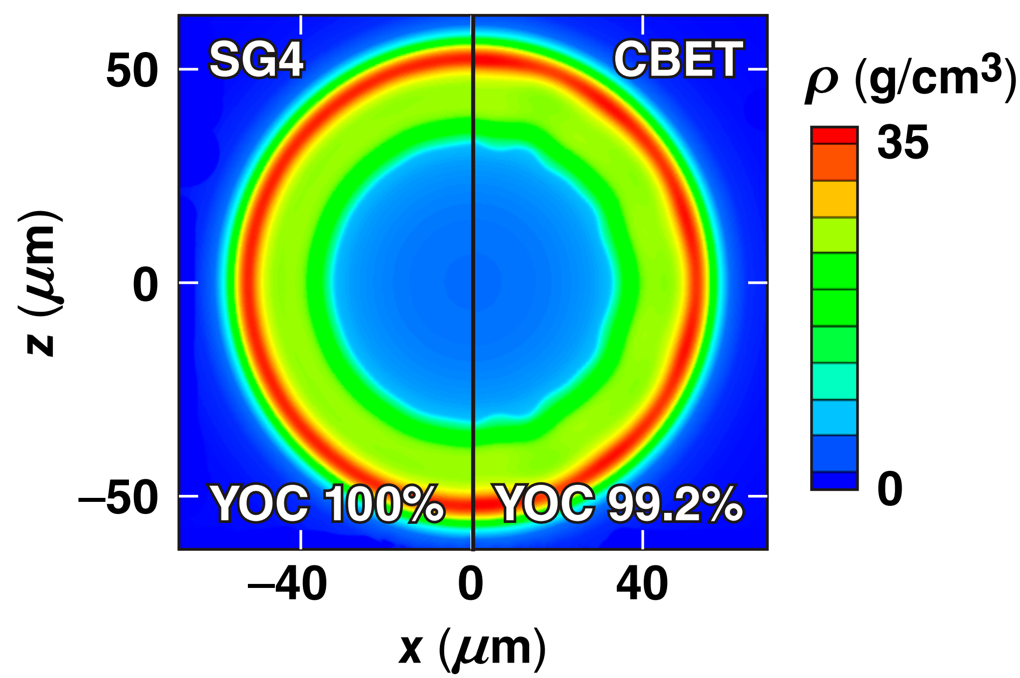
Shot 54881 target



24 kJ SG1018 laser pulse

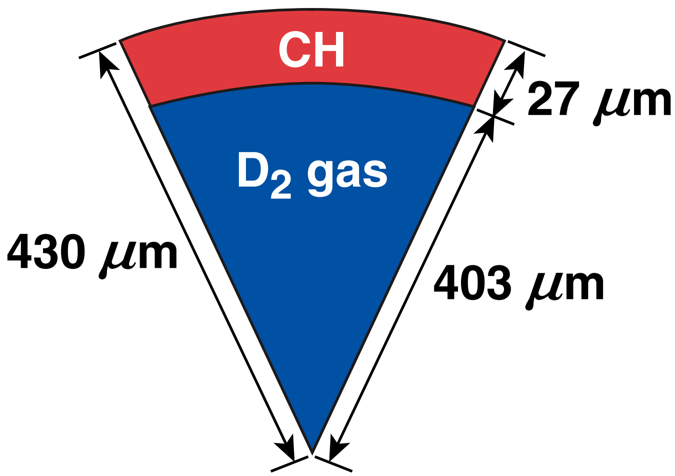


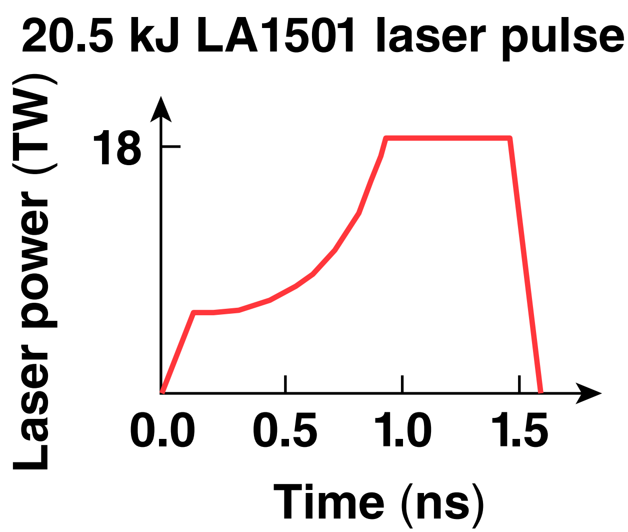
Mass density at peak burn (*DRACO*)

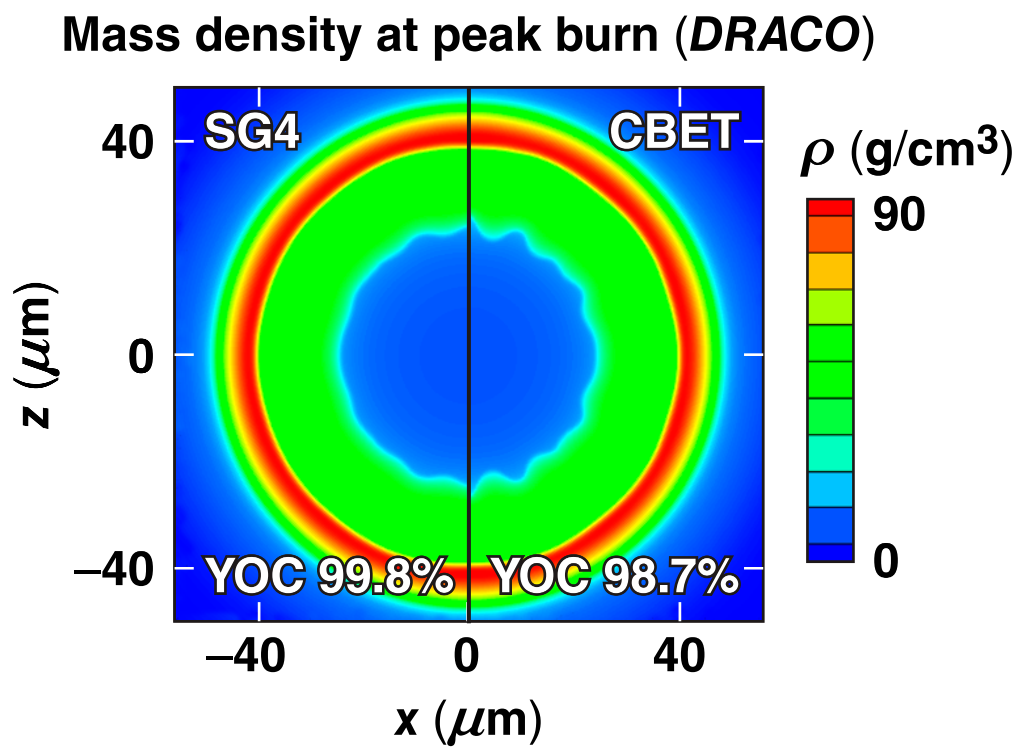


TC8699

A medium-adiabat implosion shows an unimportant increase in $\ell = 16$ perturbation due to CBET

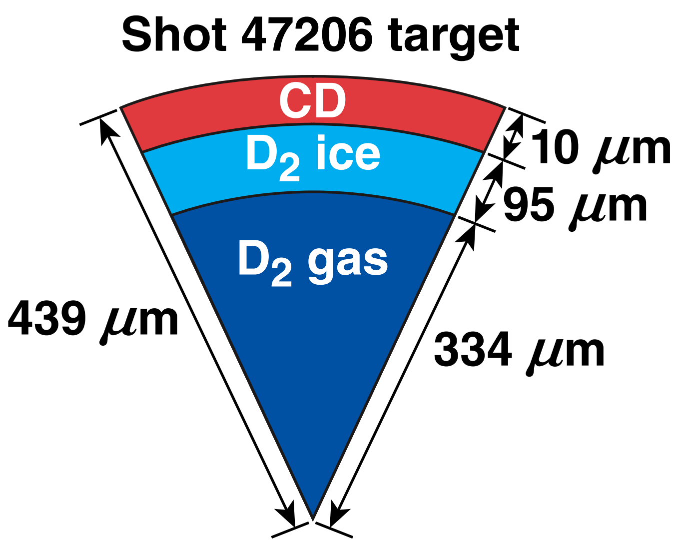


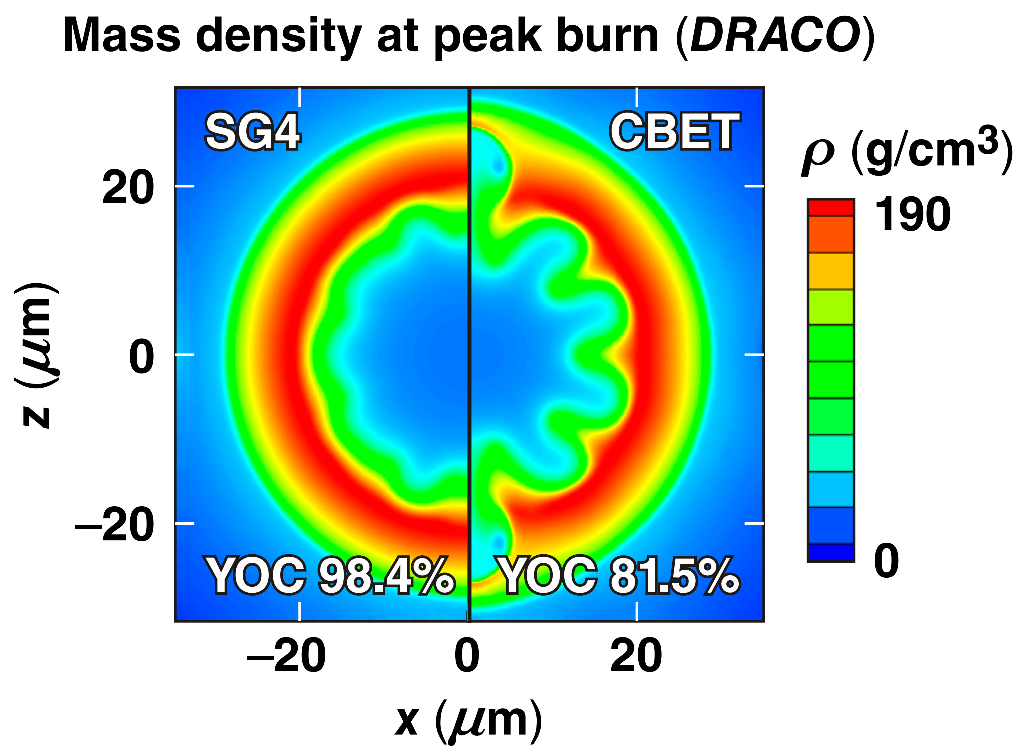


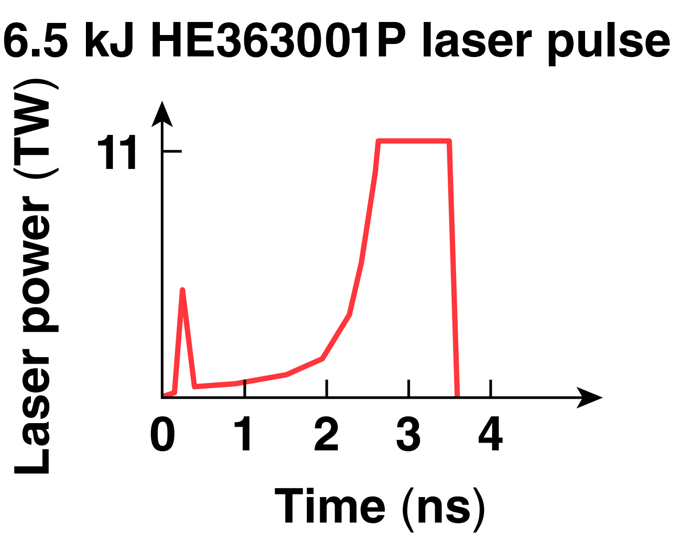


TC8700

A low-adiabat, D_2 cryo target implosion shows much higher nonuniformities and performance degradation







TC8701

Summary/Conclusions

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