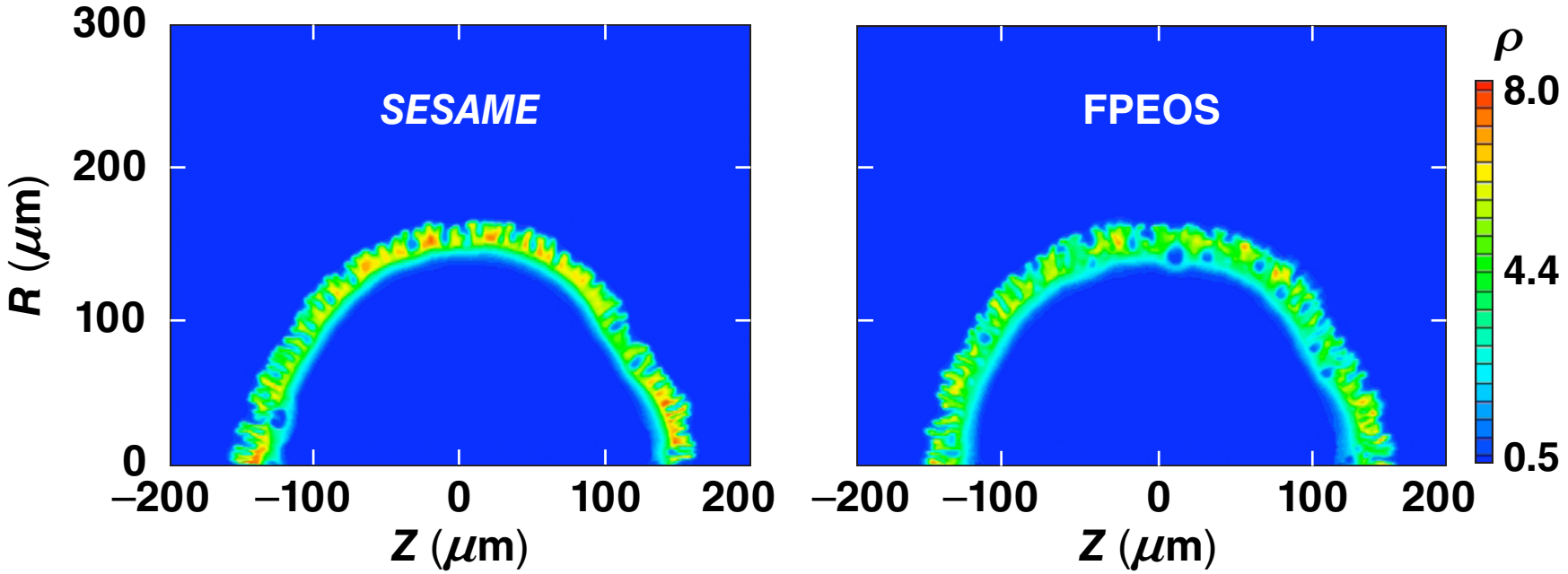
Equation-of-State Dependence of Nonuniformity Growth in Cryogenic-DT Implosions on OMEGA



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Summary

The nonuniformity growth in cryogenic-DT implosions depends on the DT equation-of-state used

UR LLE

- 1-D hydro simulations using the first-principle equation-of-state (FPEOS) table* for deuterium predict ~20% lower neutron yield in uniform when compared to the *SESAME* prediction
- By including experimental perturbation sources, *DRACO* simulations of cryogenic-DT implosions using FPEOS table show ~30% less neutron yield and ~10% lower ion temperature than the *SESAME* simulations
- *DRACO* simulations with the FPEOS table give better agreement with the experimental observations of neutron yield and ion temperature

*S. X. Hu *et al.*, Phys. Rev. Lett. 104, 235003 (2010).

Collaborators

V. N. Goncharov, T. R. Boehly, S. Skupsky, T. C. Sangster, D. D. Meyerhofer, and R. L. McCrory

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DRACO simulations* using the *SESAME*-EOS table are compared to cryogenic-DT implosions** on OMEGA

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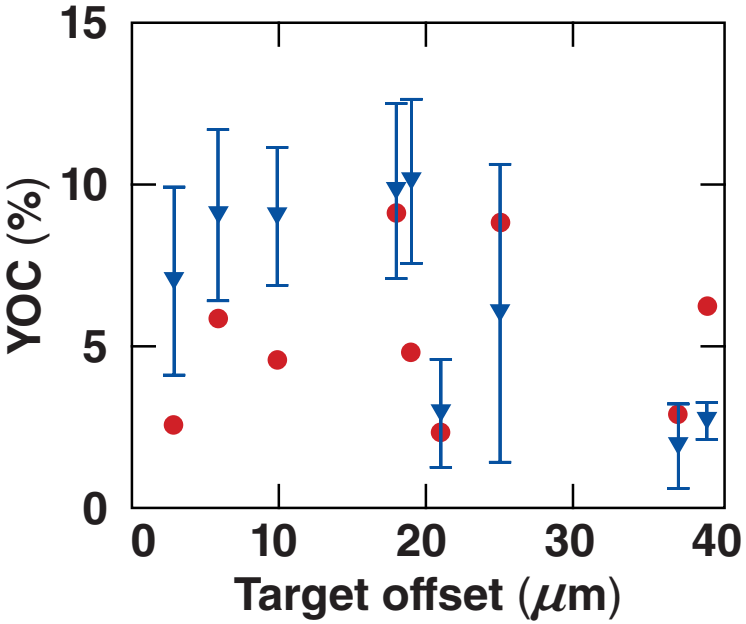
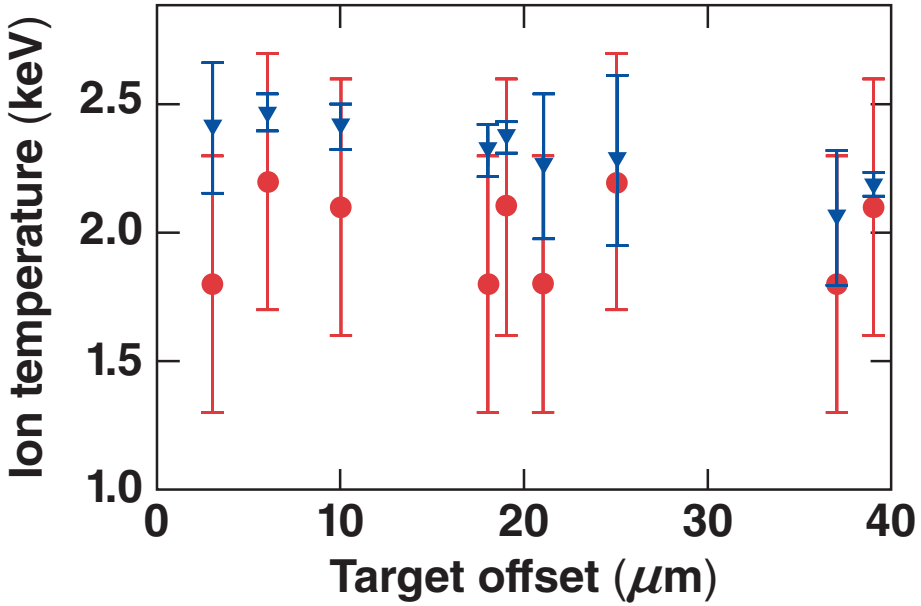
YOC: within a factor of ~2 or better

$\langle T_i \rangle$: ~10% to 15% difference only

Nonuniformities included
- **target offset**
- **laser perturbations**
- **ice roughness**





● Experiments —▼— *DRACO* (with *SESAME*)

*S.X. Hu *et al.*, Phys. Plasmas 17, 102706 (2010).
**V. N. Goncharov *et al.*, Phys. Rev. Lett. 104, 165001 (2010); T. C. Sangster *et al.*, Phys. Plasmas 17, 056312 (2010).

TC9049

The first-principle equation-of-state (FPEOS*) table for deuterium has been recently established from path-integral Monte Carlo (PIMC) calculations

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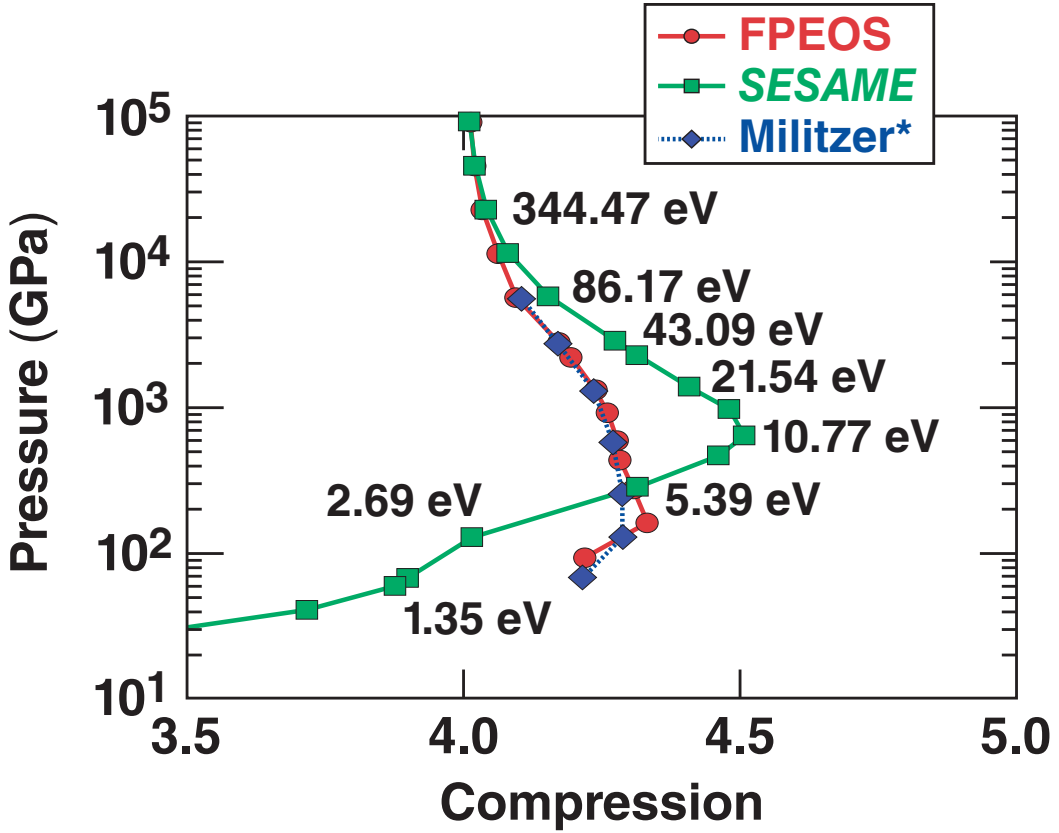
FPEOS Table:

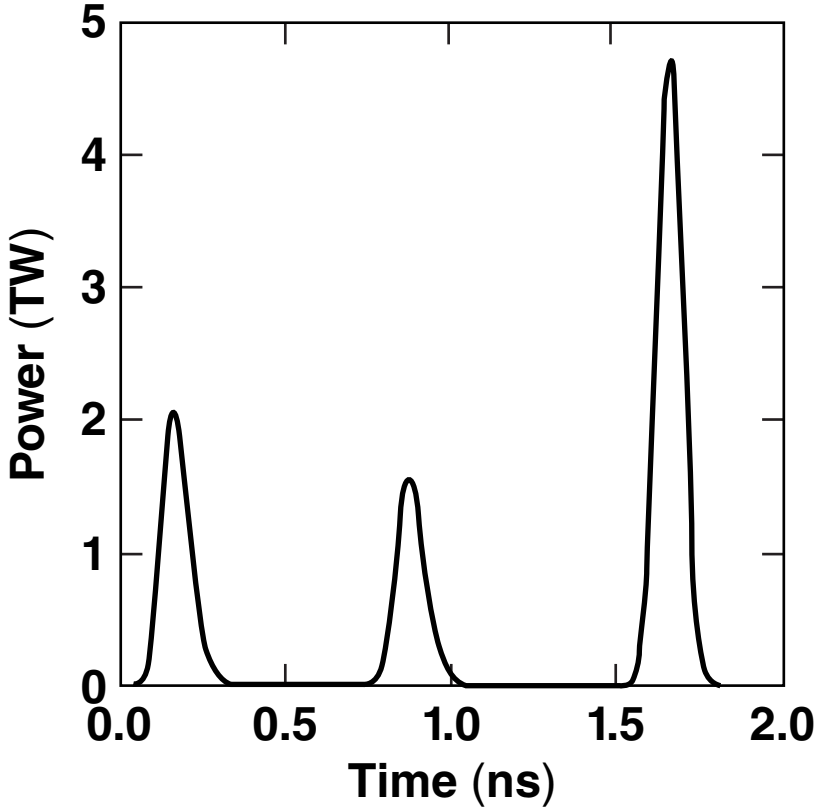
Covering the whole ICF implosion density and temperature ranges: $0.002 \leq \rho \leq 1596$ g/cm^3 and 1.35 eV $\leq T \leq$ 5 keV

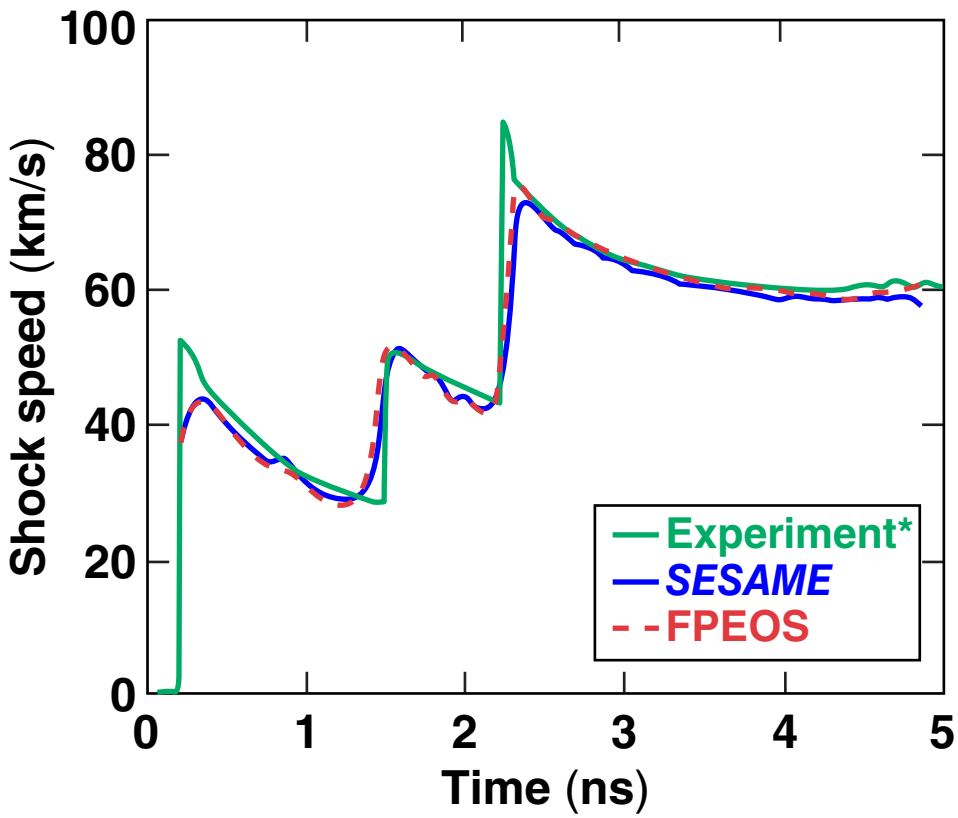


FPEOS predicts deuterium will be slightly softer under ~2 Mbar, but stiffer than *SESAME* for ~2 Mbar < *P* < 100 Mbar.

*S. X. Hu *et al.*, Phys. Rev. Lett. 104, 235003 (2010).

The FPEOS table predicts a shock-timing history similar to that of the *SESAME*-EOS model

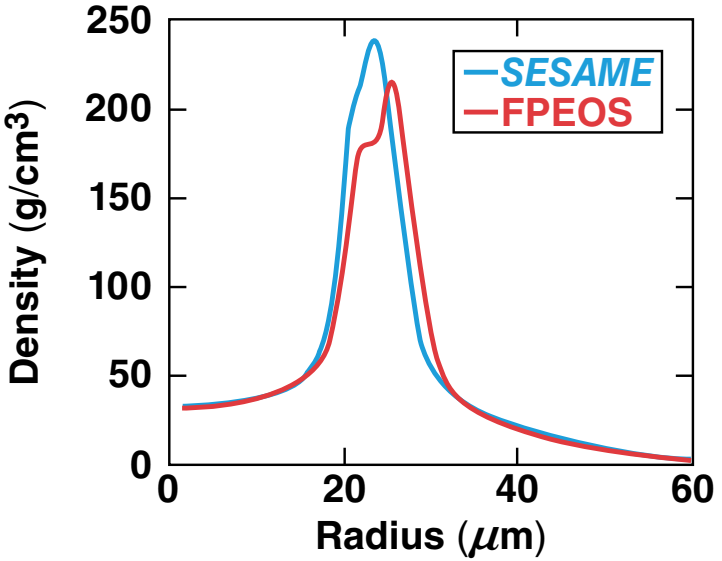


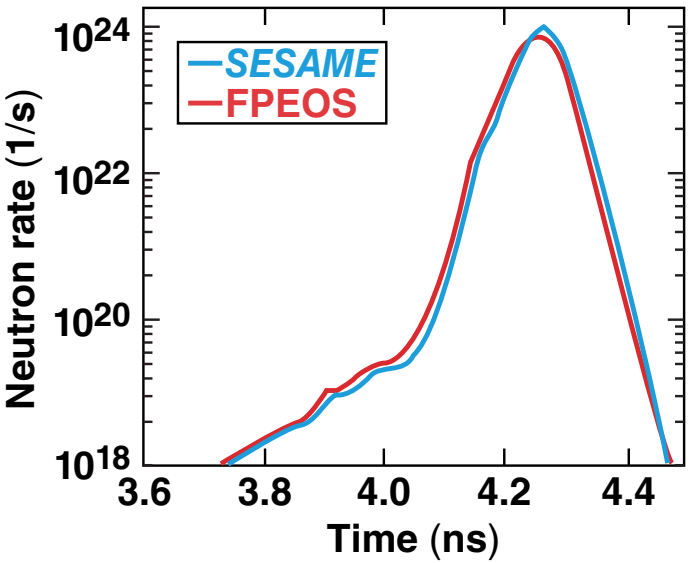


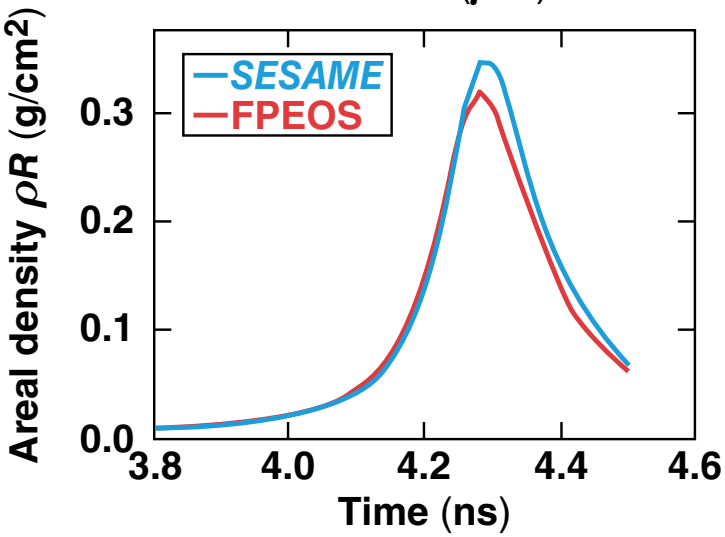
TC9051

*T. R. Boehly (N05.00009).

A 1-D comparison of cryogenic implosion performance shows the importance of EOS models*







Uniform 2-D

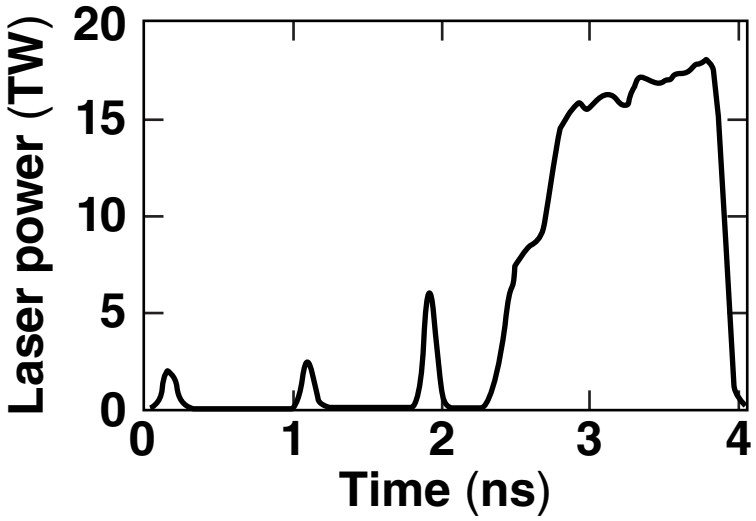
Yield: 8.0×10^{13} (*SESAME*)
6.7×10^{13} (FPEOS)

$\langle T_i \rangle$: 3.15 keV (*SESAME*)
3.05 keV (FPEOS)

TC9052

*S. X. Hu *et al.*, Phys. Rev. Lett. 104, 235003 (2010).

DRACO simulations of cryogenic DT show that the perturbation growth in implosions depends on the EOS table used



Nonuniformities included
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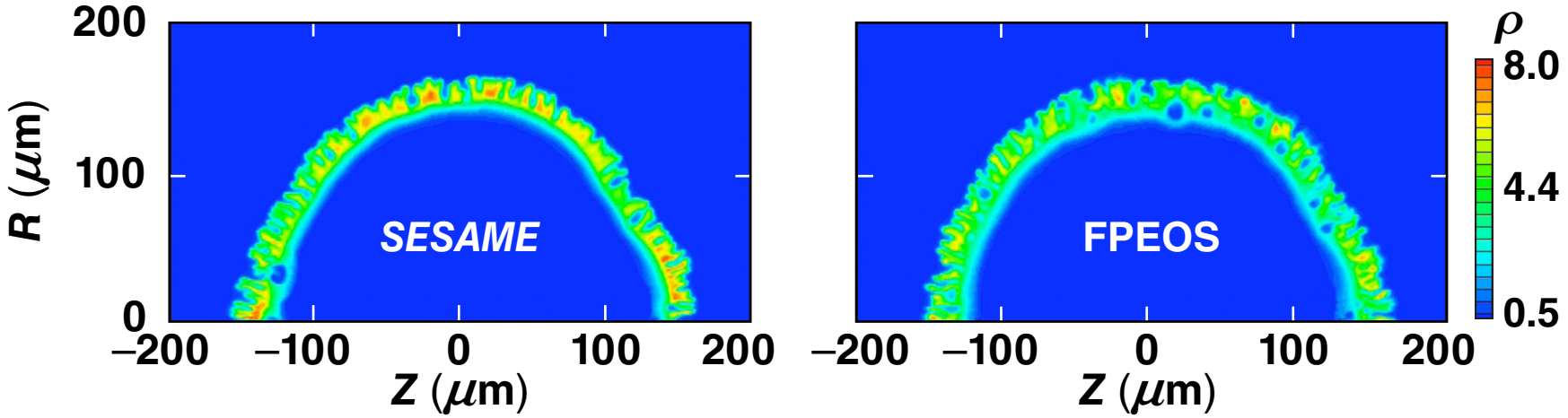
- laser perturbations
- ice roughness



At the end of the laser pulse.

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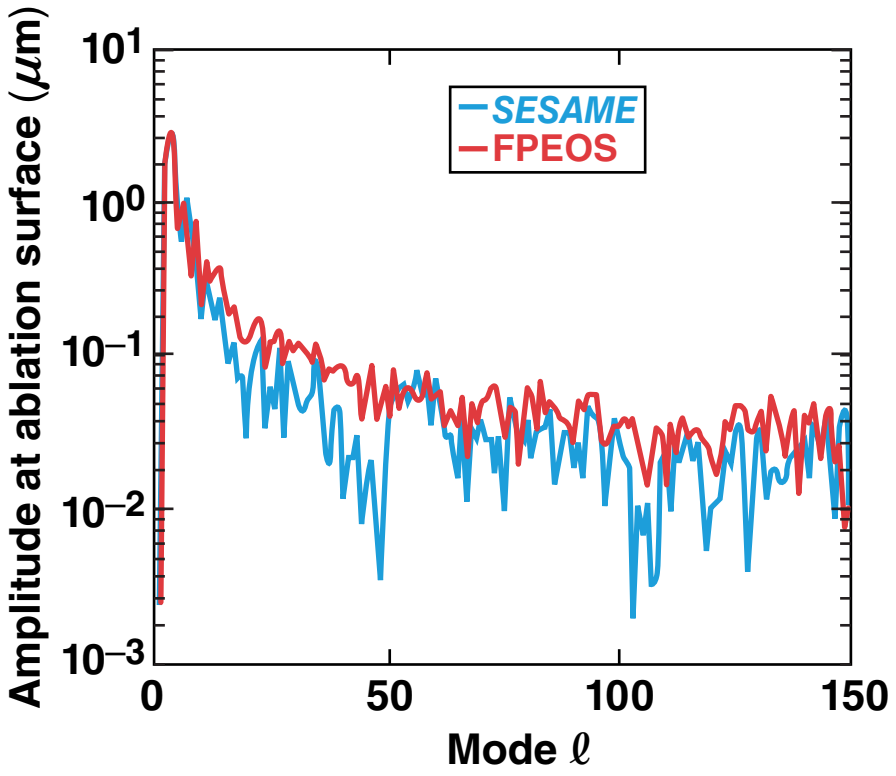
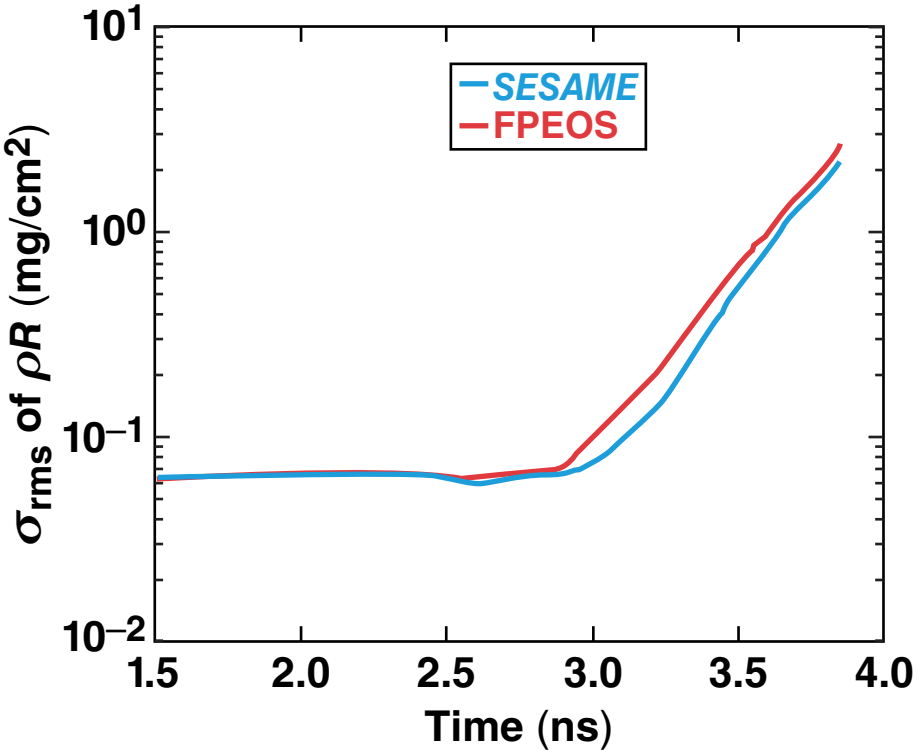
Multimode *DRACO* simulations using the FPEOS table show different growth behavior from the *SESAME* prediction





SESAME:	**Yield = 5.2×10^{12}**	**$\langle T_i \rangle$ = 2.6 keV**
FPEOS:	**Yield = 3.7×10^{12}**	**$\langle T_i \rangle$ = 2.3 keV**
Experiment:	**Yield = 1.9×10^{12}**	**$\langle T_i \rangle$ = 1.8±0.5 keV**

Summary/Conclusions

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