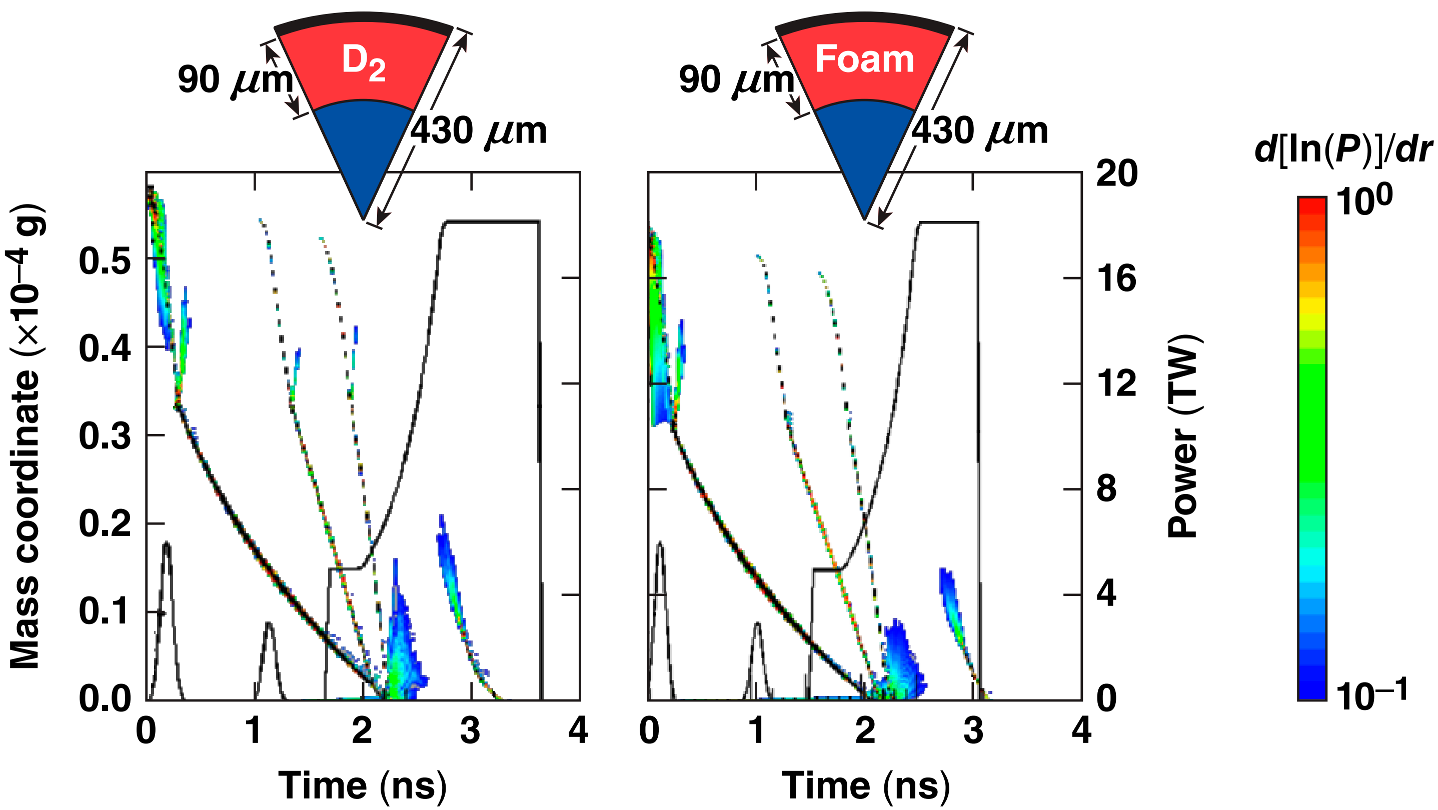
Optimization of Multiple-Picket, Direct-Drive Laser Pulse Shapes with Foam Shells



J. P. Knauer
University of Rochester
Laboratory for Laser Energetics

50th Annual Meeting of the
American Physical Society
Division of Plasma Physics
Dallas, TX
17–21 November 2008

180-mg/cm^3 foam layers are used to study shock propagation in multiple-picket pulse shapes

- Targets have been developed that retain 9 atm of D_2 gas for nuclear diagnostics.
- Experimental areal density (ρR) data are higher than those predicted by 1-D hydrodynamic simulations.
- Absorption differences between experimental data and simulation results do not explain this ρR discrepancy.

Collaborators

UR LLE

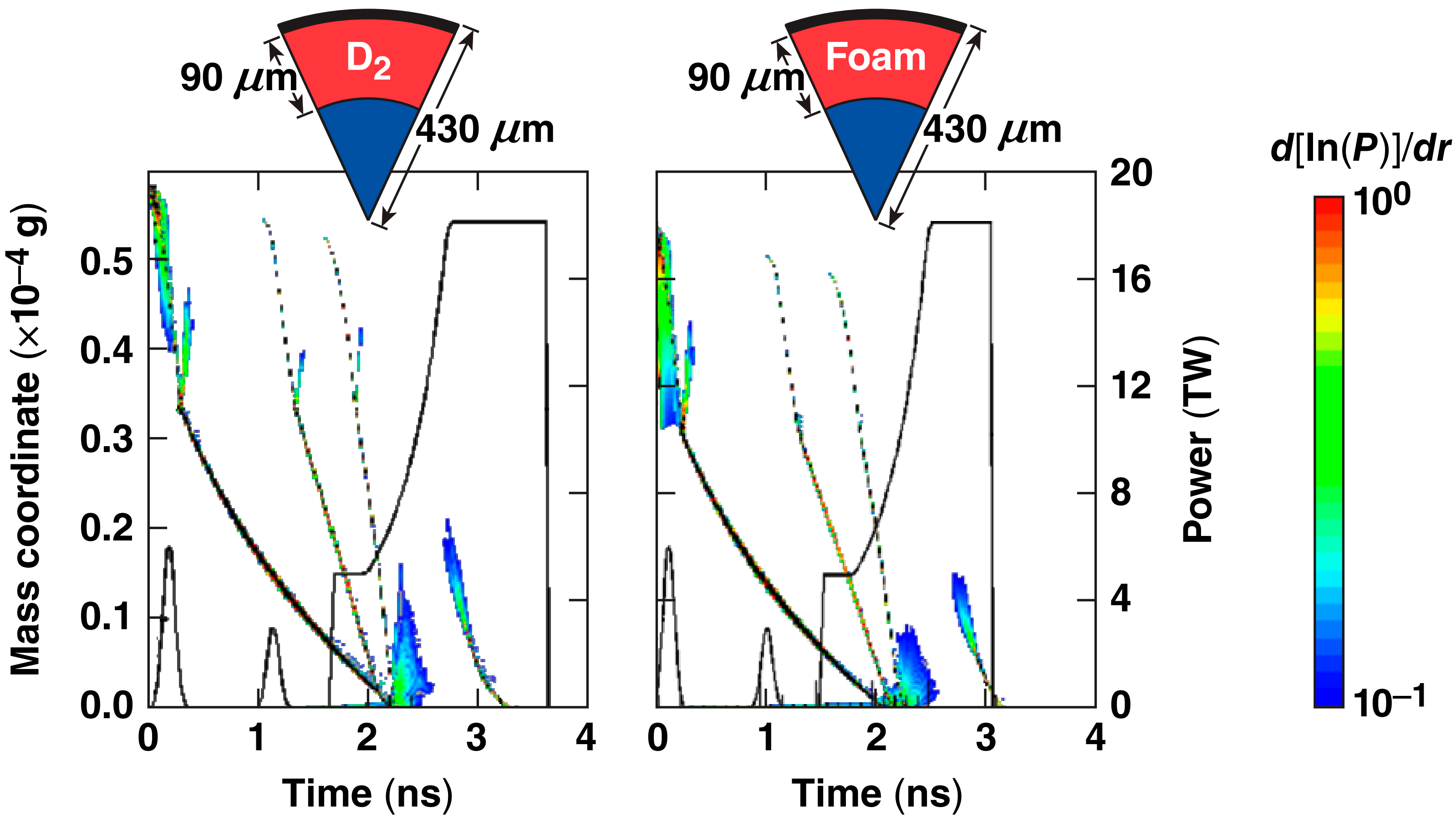
V. N. Goncharov
P. B. Radha
J. A. Delettrez
V. Yu. Glebov
F. J. Marshall

University of Rochester
Laboratory for Laser Energetics

J. A. Frenje
C. K. Li
R. D. Petrasso
F. H. Séguin

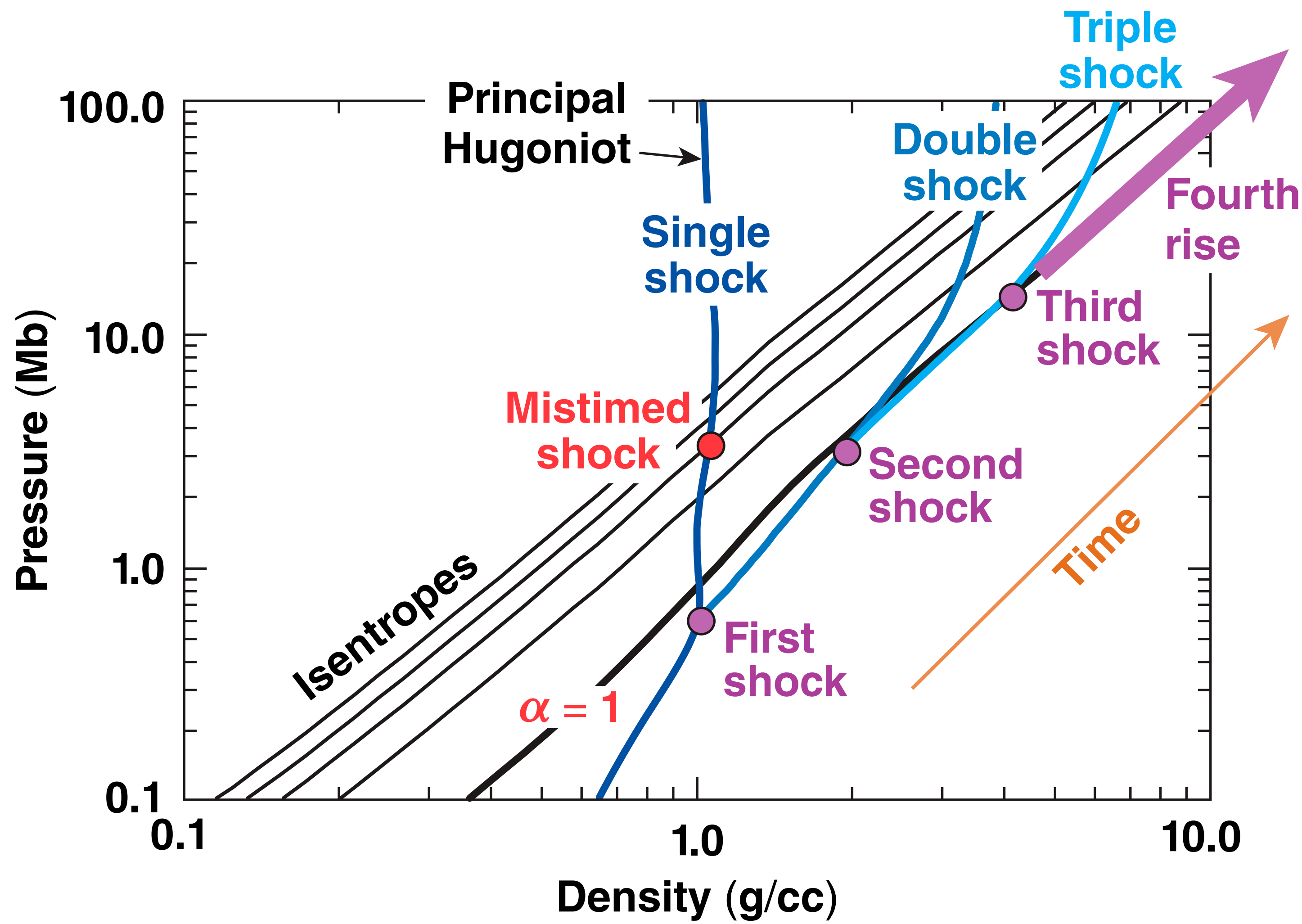
Plasma Science and Fusion Center
Massachusetts Institute of Technology

Multiple-shock transit and catch-up through the thick foam shells is very similar to cryogenic shells



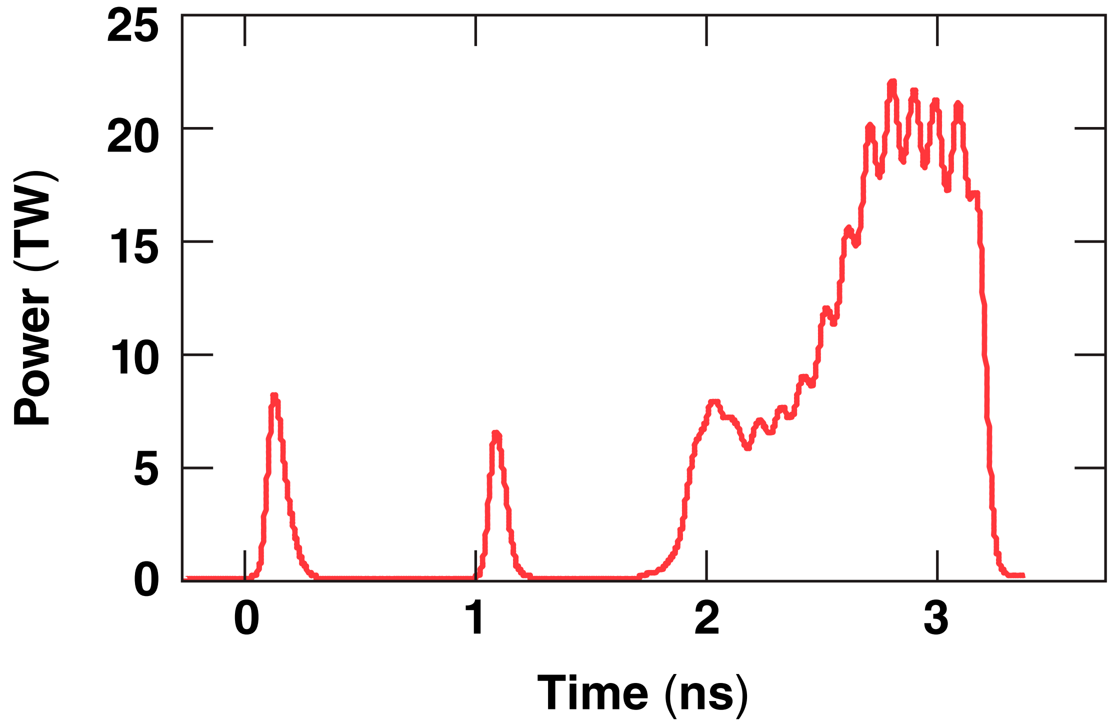
E17376

Ignition targets use precisely timed multiple shocks to approximate an isentropic compression



E17298a

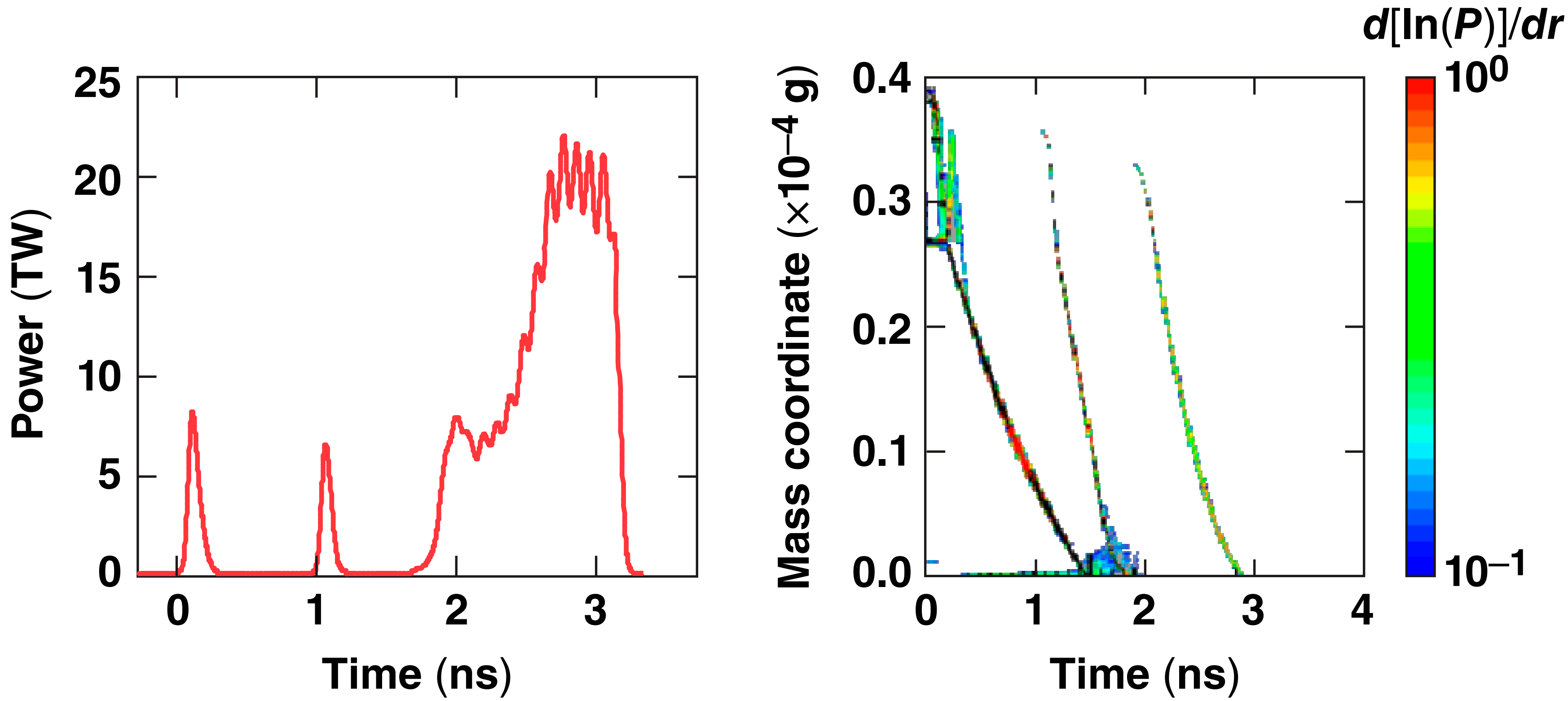
Variations on a double-picket pulse shape were used for the foam-shell implosions



- Reference Pulse Shape
- Increase second-picket intensity 30%
- Decrease second-picket intensity 30%

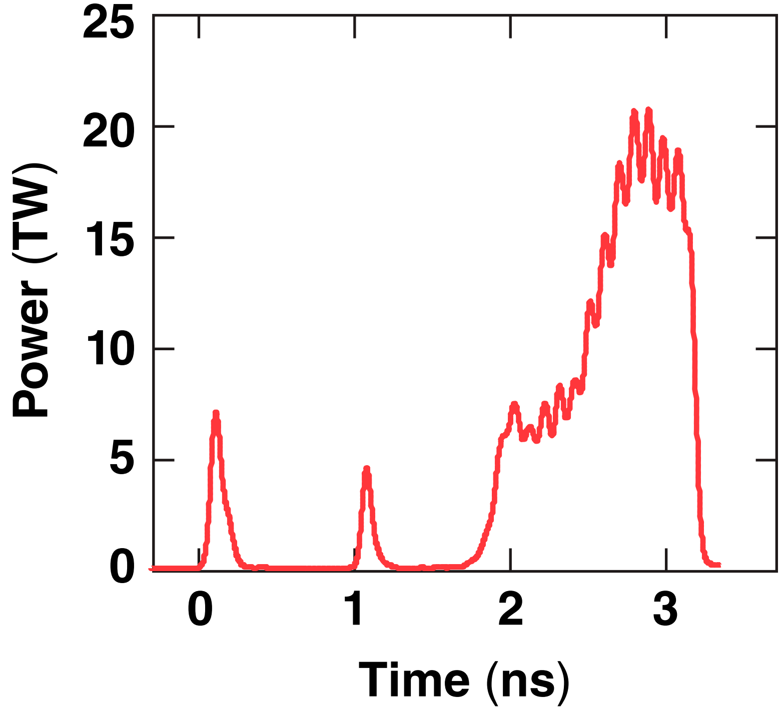
E17378

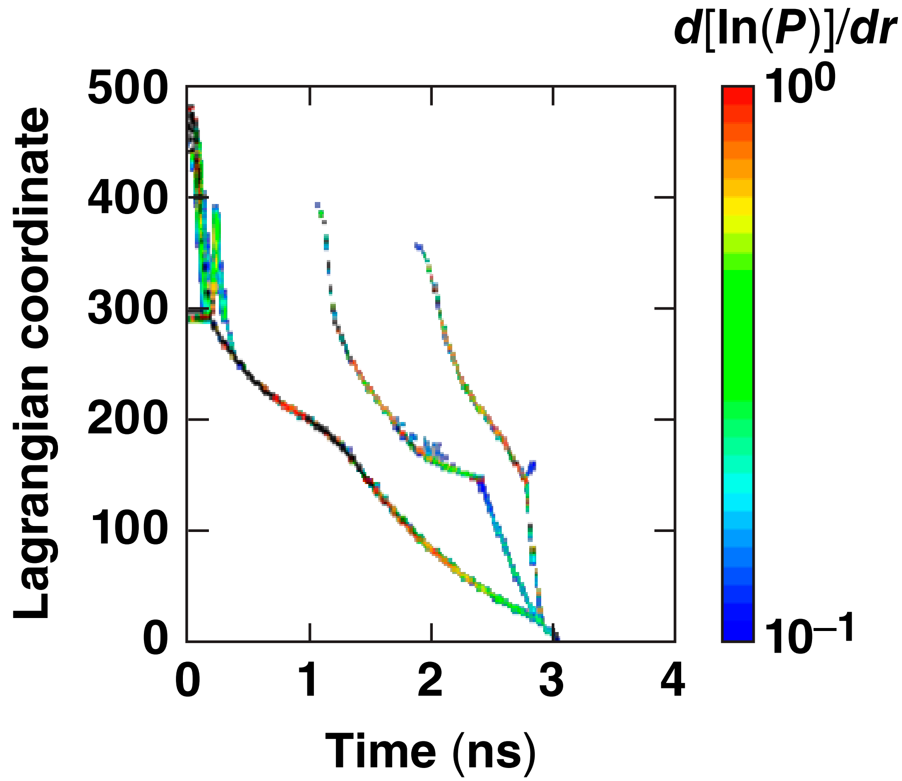
The reference pulse shape generates three shock waves that remain separated in time



E17454

Reducing the picket to 70% of its reference intensity allows the three shock waves to converge

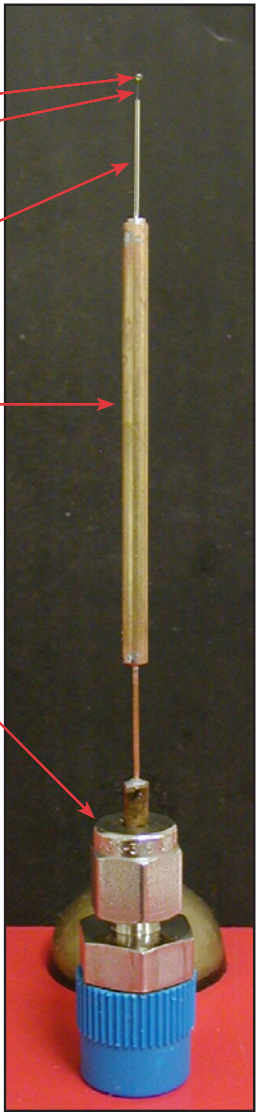


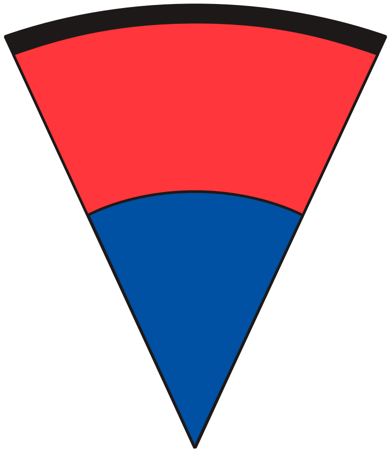


E17455

A mount with a fill tube connected to a large reservoir ensures the target has D_2 gas during the implosion

- Gas cartridge target
  - foam target
  - fill tube
  - small reservoir (large fill tube)
  - large reservoir
  - gas connector

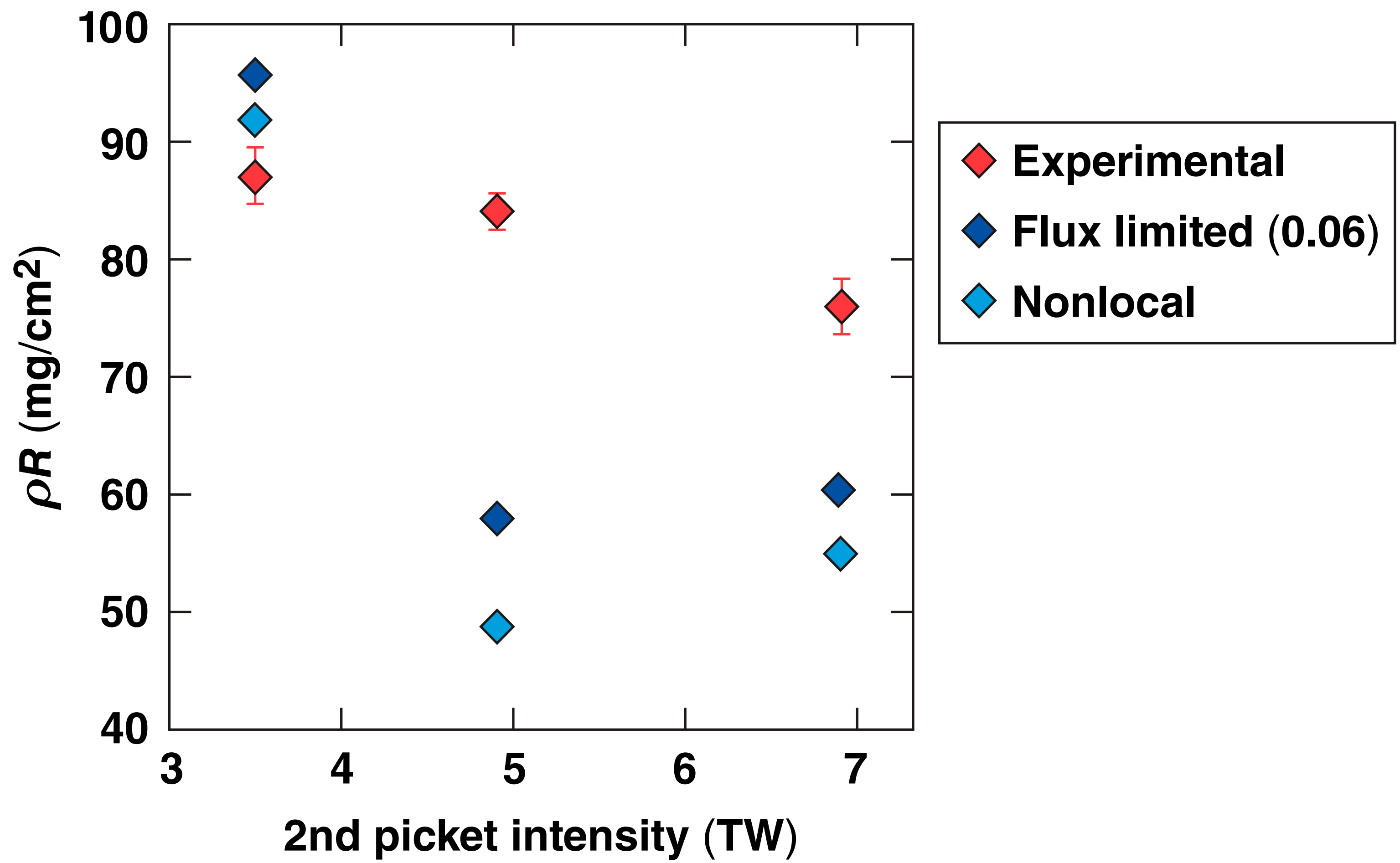




OD	874±7 μm
CH shell	4.6±0.4 μm
CRF 0.18 g/cm^3	83±7 μm
D_2	9.5±0.6 atm

E17377

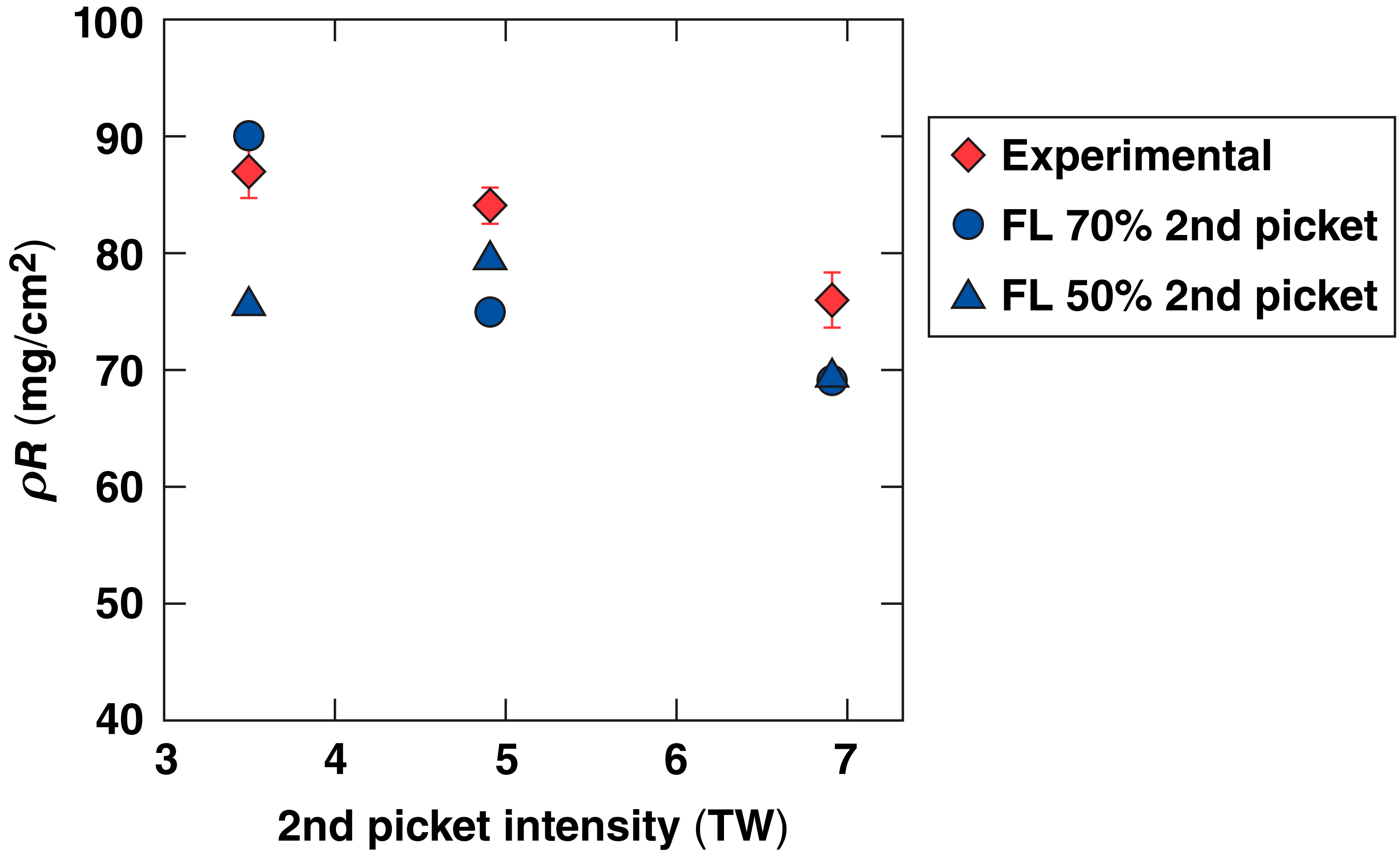
Simulations underpredict the areal density when the intensity of the second picket is increased



Experimental areal density (ρR) data are higher than those predicted by 1-D hydrodynamic simulations.

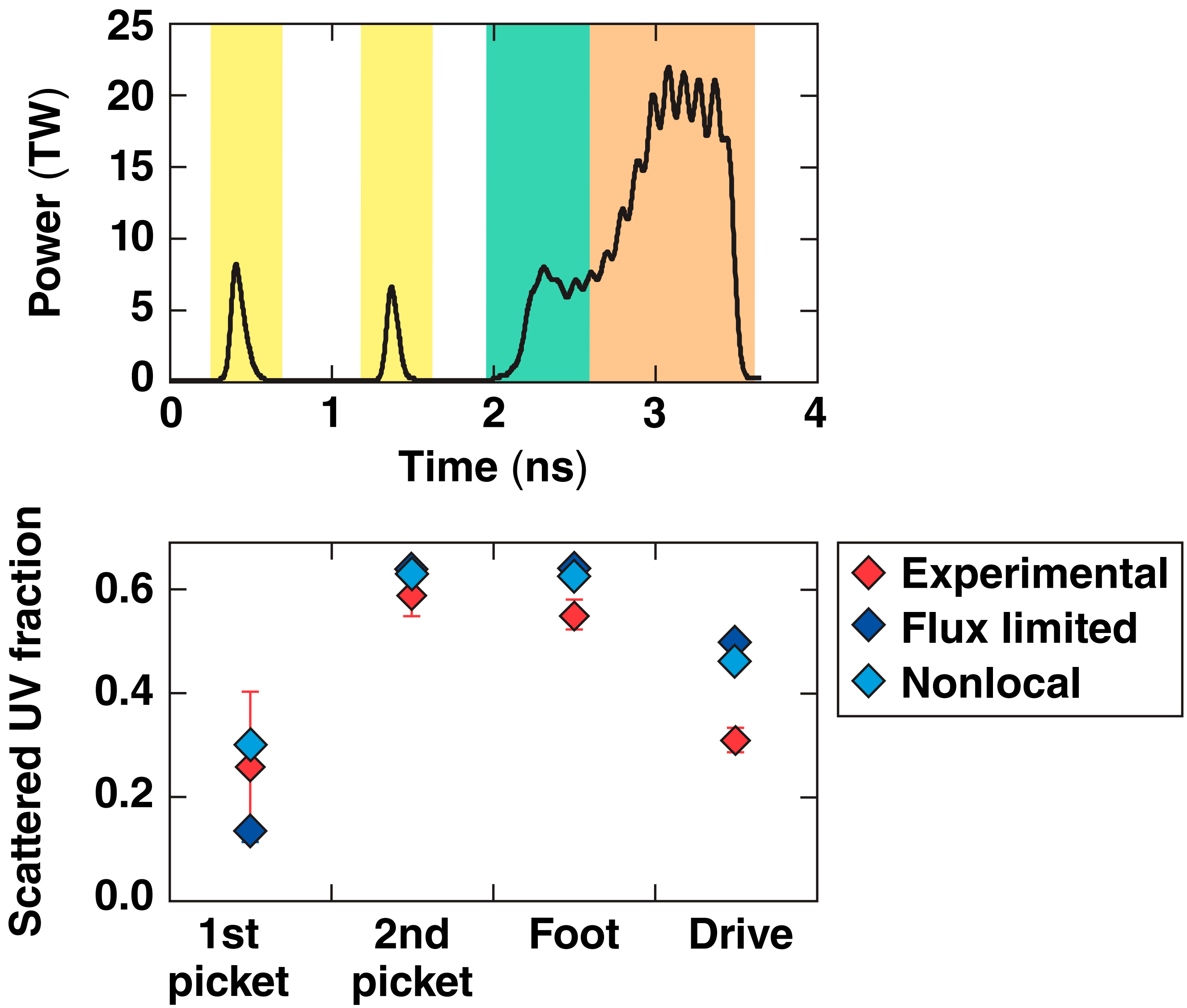
E17383

Simulations are a better match to the data when the absorbed energy in the second picket is reduced



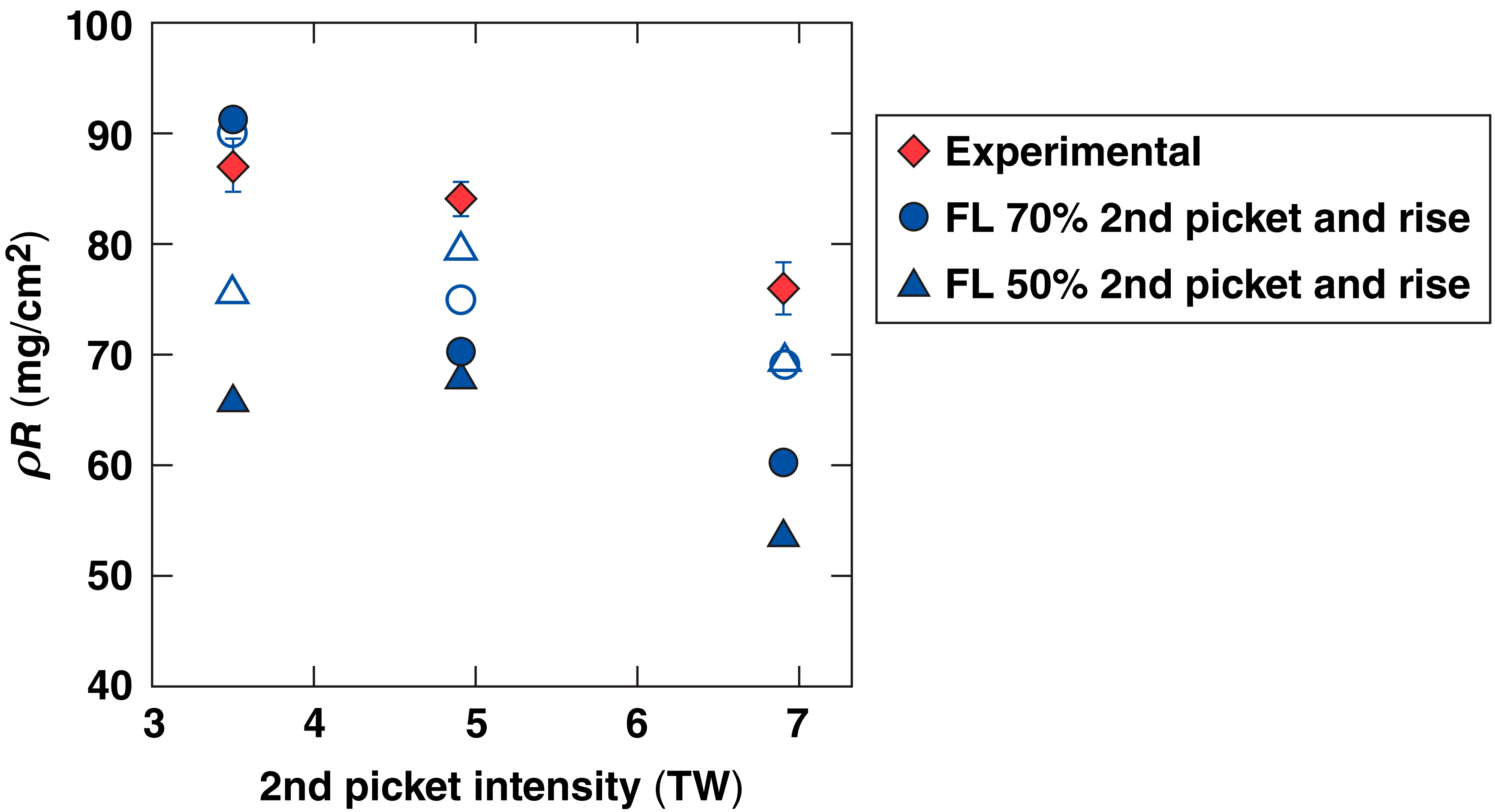
E17383a

Both transport models overestimate the absorption fraction for the pulse shape's foot and drive



E17380

Reducing the drive-pulse energy lowers the areal density



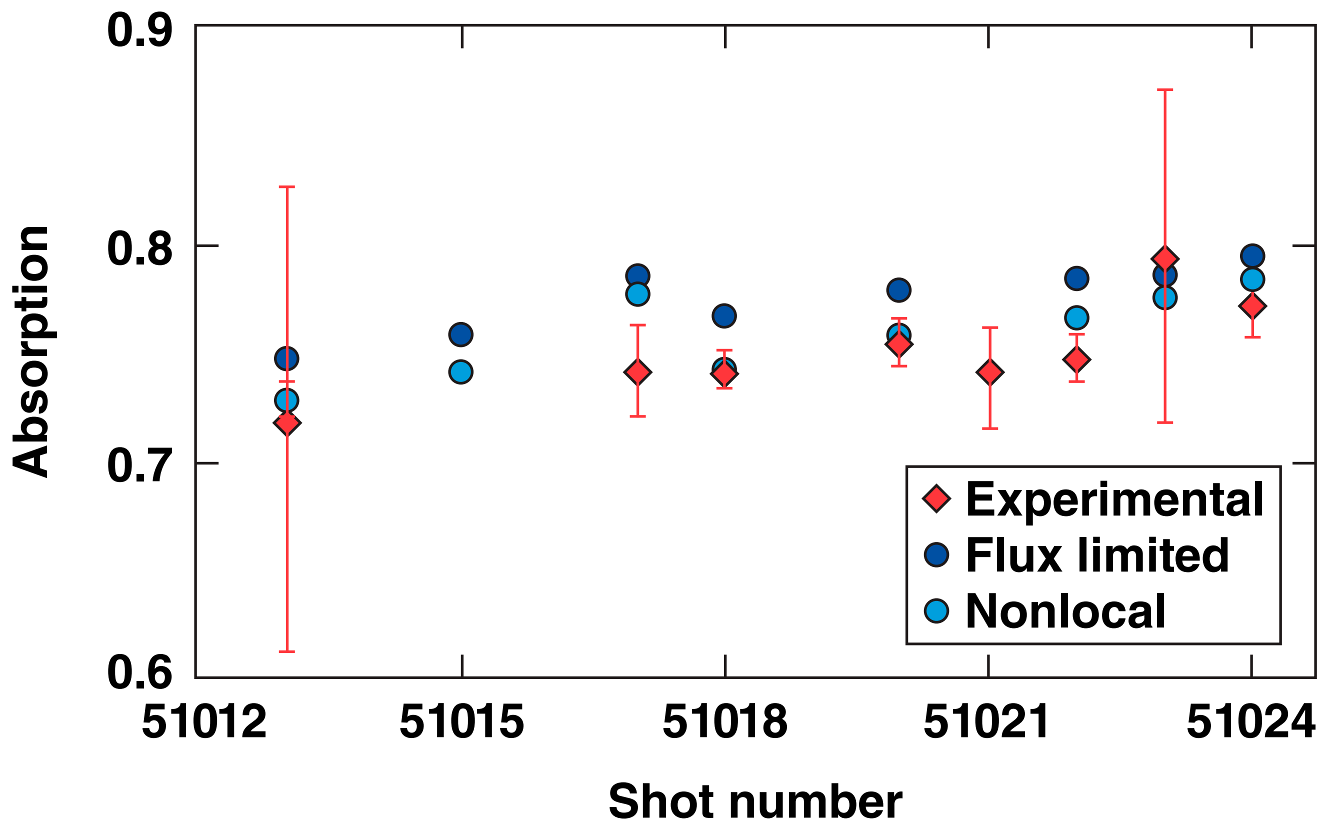
Absorption differences between experimental data and simulation results do not explain the ρR discrepancy.

E17456

180-mg/cm^3 foam layers are used to study shock propagation in multiple-picket pulse shapes

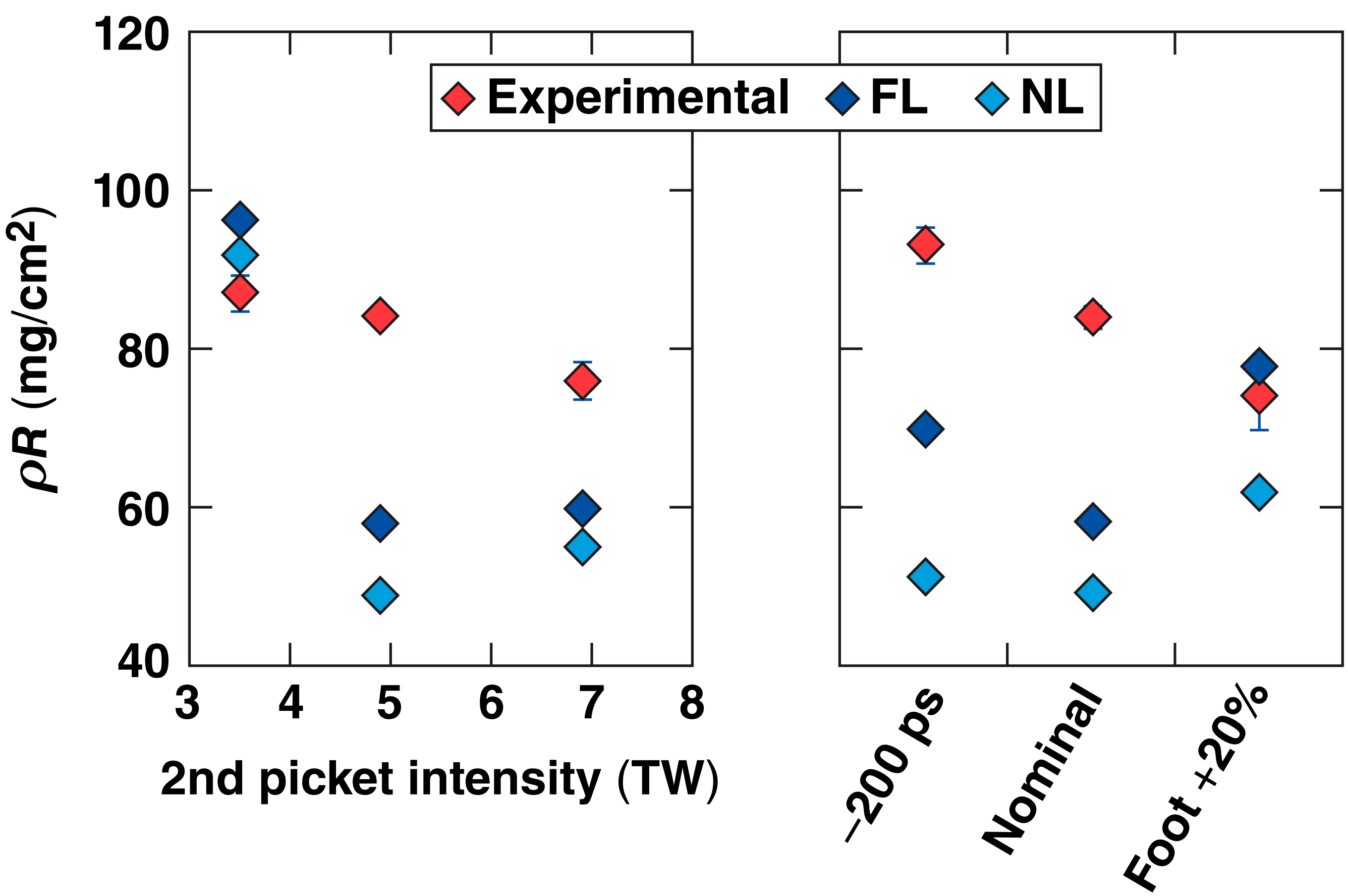
- Targets have been developed that retain 9 atm of D_2 gas for nuclear diagnostics.
- Experimental areal density (ρR) data are higher those predicted by 1-D hydrodynamic simulations.
- Absorption differences between experimental data and simulation results do not explain this ρR discrepancy.

Both transport models predict a higher time-integrated absorption than what is measured



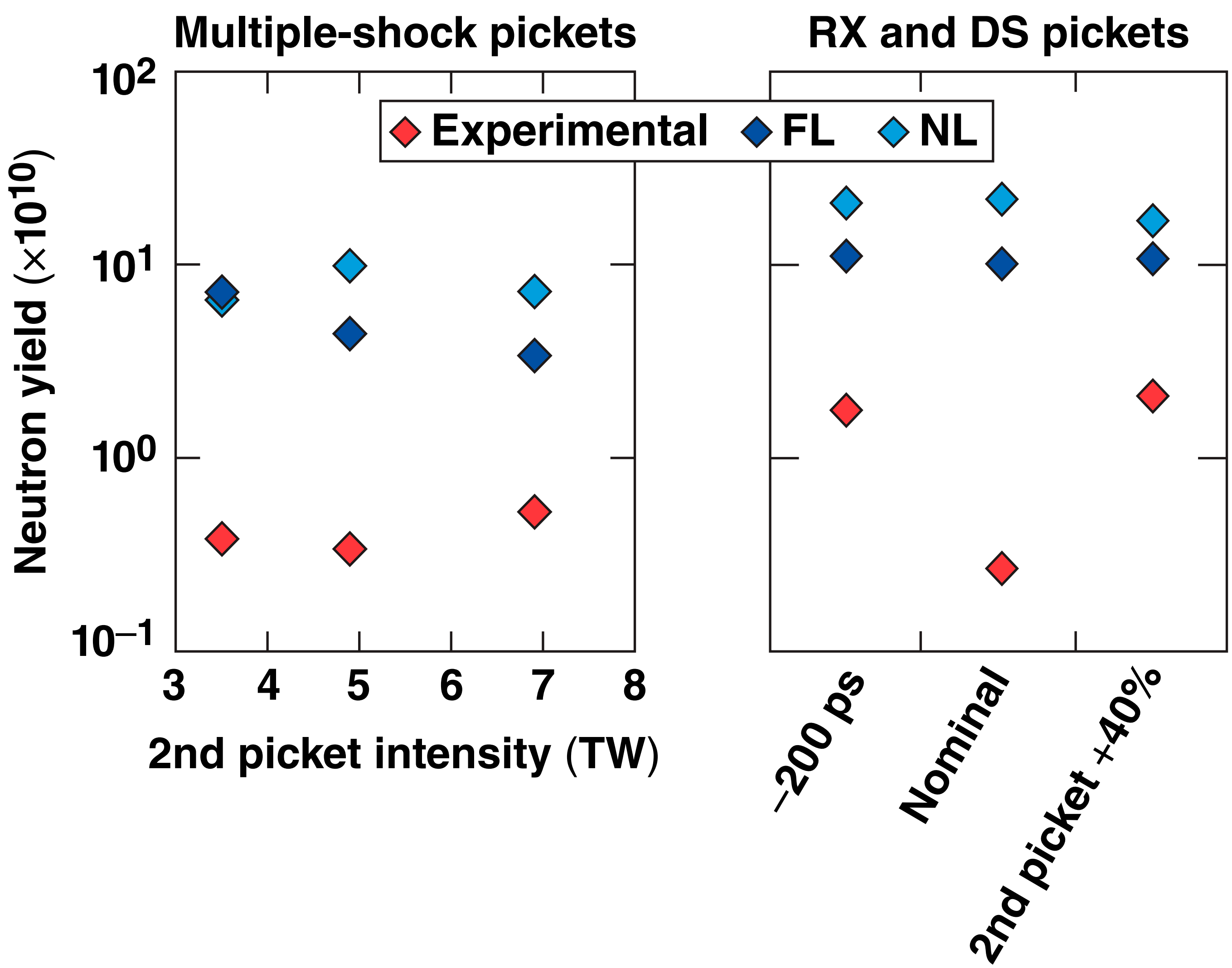
E17379

Trends seen in the experimental ρR data are not matched by 1-D simulations



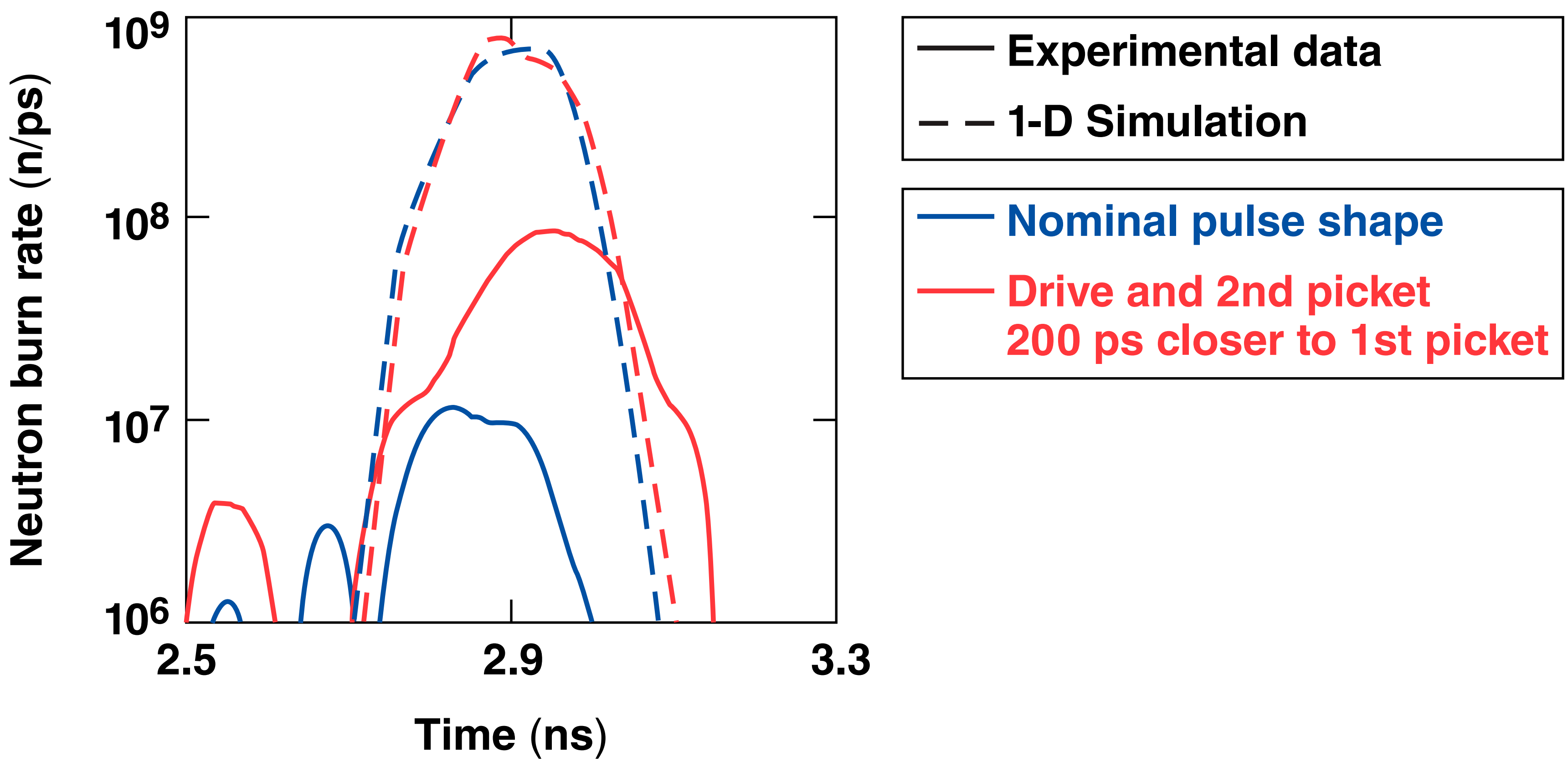
E17382

Neither transport model is a good match to the experimental neutron yields



E17381

Simulations of the start of the neutron burn agree with the experimental data for the RX and DS pickets



E17384