T-^{3}He Deuterons as a Diagnostic for Capsule Implosions on OMEGA

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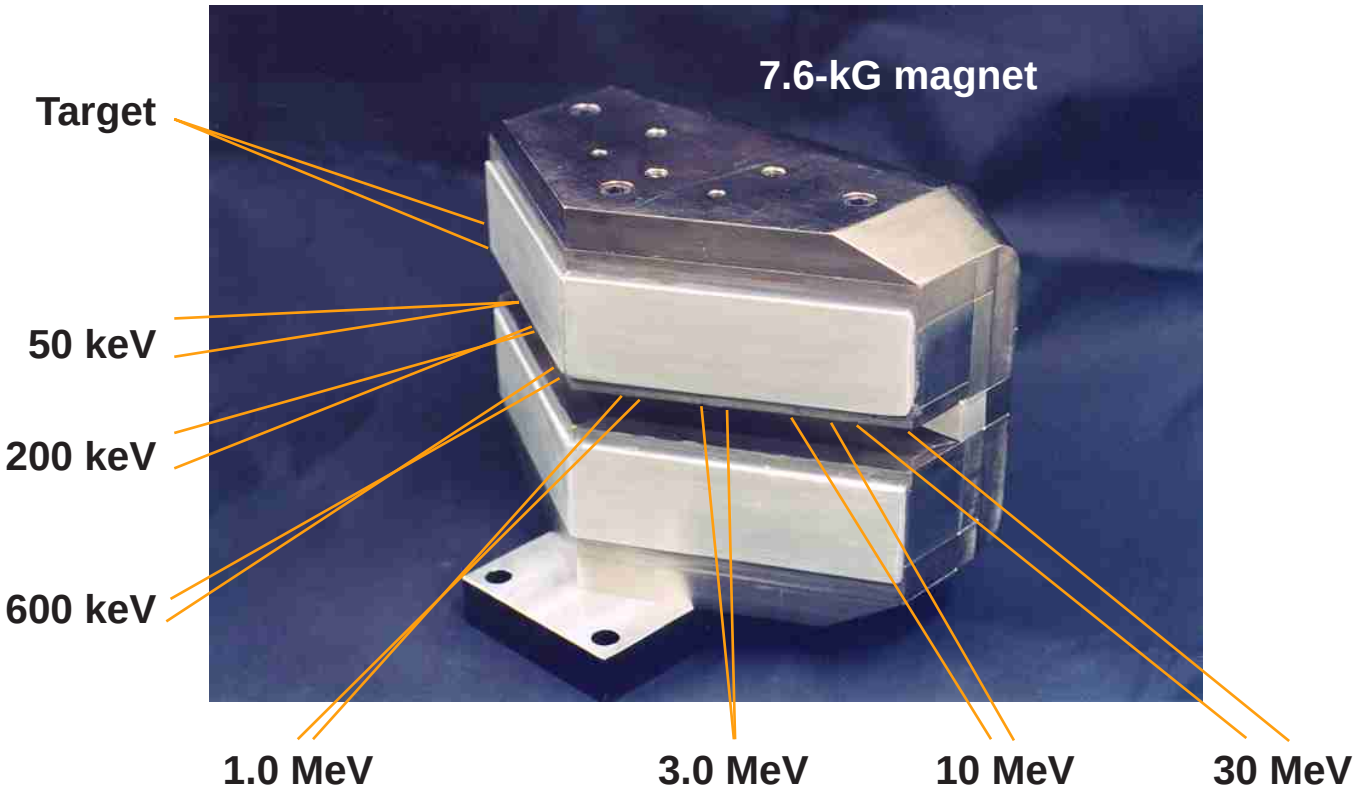
We are studying the feasibility of utilizing energetic T-^{3}He deuterons as a new diagnostic for ICF capsule implosions. High-resolution, 9.5-MeV deuteron spectra from T-^{3}He reactions were obtained and were used to deduce various physical quantities. Individual line profiles were simultaneously obtained from D-T-^{3}He capsule implosions and include T-^{3}He deuterons, D^{3}He protons, D-T alphas, and D-D protons. Based on these lines, we have self-consistently determined shell areal densities, fuel ion temperatures, and particle anomalous accelerations for a variety of capsule implosions. In the future, we will study thicker- shell D-T-^{3}He capsule implosions from which knock-on deuterons, in addition to the above multiple lines, will be simultaneously obtained and used to deduce fuel areal density. This work was performed in part at the LLE NLUF supported in part by the U.S. Department of Energy Contract #DE-FG03-99SF21782, LLE subcontract #PO410025G, LLNL subcontract #B313975, and the U.S. Department of Energy Office of Inertial Confinement Fusion under Cooperative Agreement No. DE-FC03-92SF19460.

Experimental Studies of Double- and Triple-Layer DT-Gas Capsule Implosions on OMEGA



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Summary

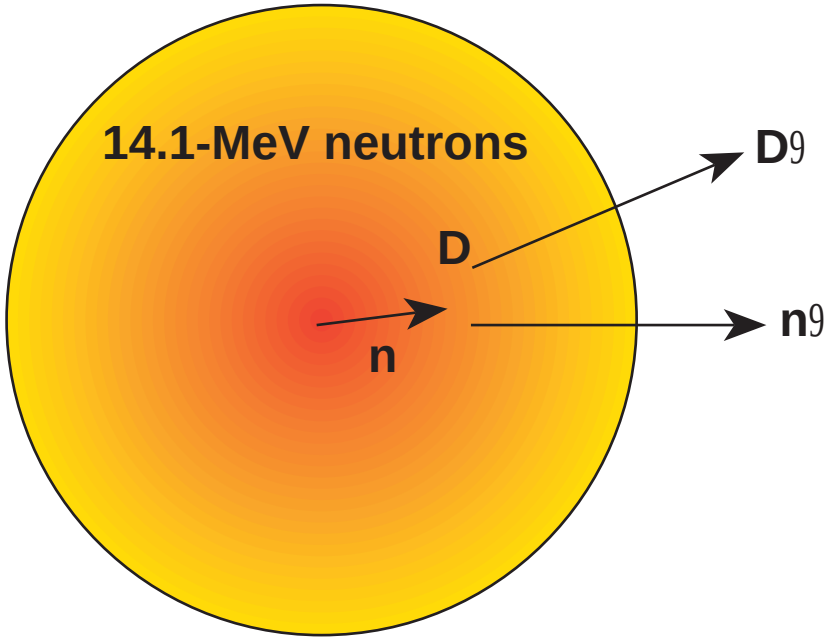
Knock-on diagnostics provide ρR information about the fuel and shell of DT-gas capsules

- The areal density of each individual layer of imploded multilayer DT-capsules is uniquely determined by knock-on D, T, and P spectra.
- Total ρR is also independently determined by spectral downshifts of the knock-on particles.
- Knock-on particles will be useful for diagnosing cryogenic targets.

Outline

- Knock-on diagnostics for double- and triple-layer DT targets
- Experimental results
- Comparison to 1-D simulations
- Knock-on particles' role in diagnosing cryogenic DT targets

ρR measurements are determined by knock-on D, T, and P



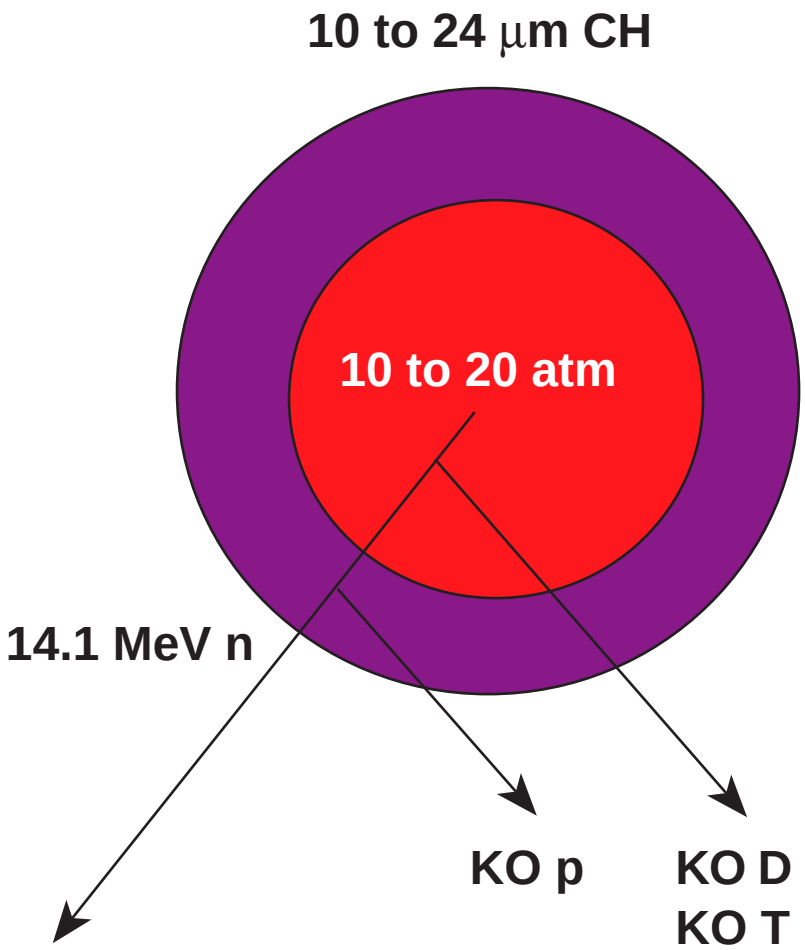
$n + D \rightarrow n\vartheta + D\vartheta$ (<12.5 MeV)

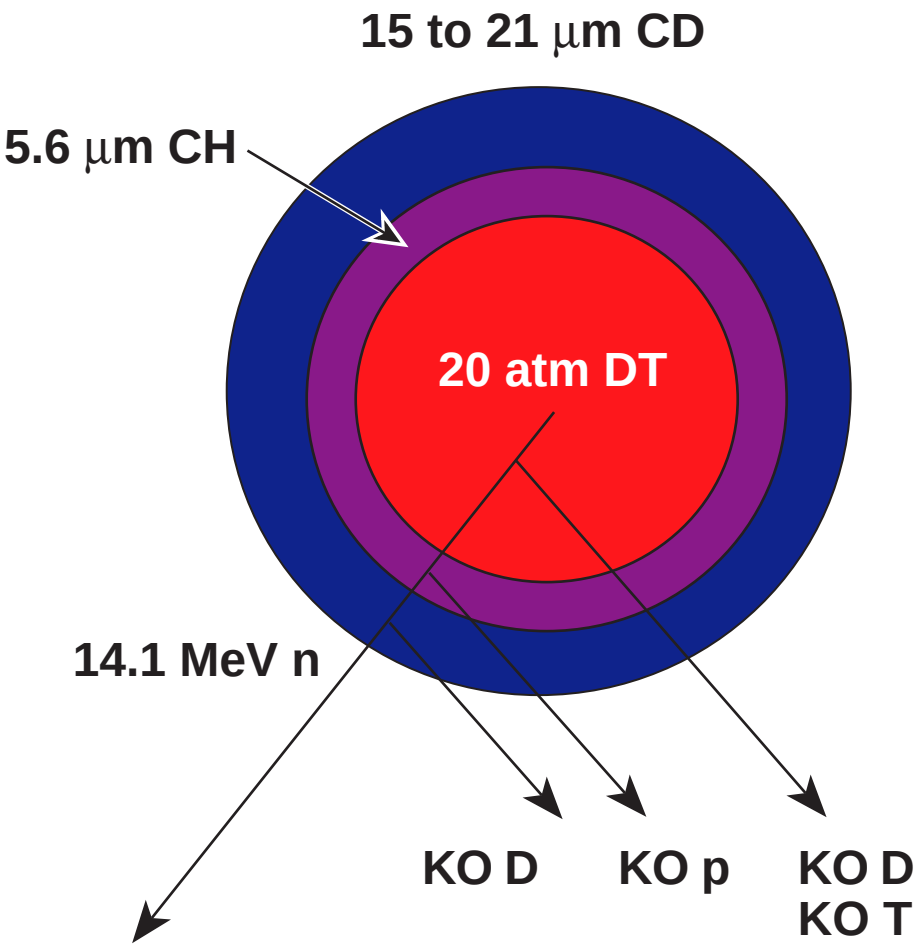
$n + T \rightarrow n\vartheta + T\vartheta$ (<10.6 MeV)

$n + P \rightarrow n\vartheta + P\vartheta$ (<14.1 MeV)

Number of knock-ons $\propto \langle\rho R\rangle$ Y(neutron).

Double- and triple-layer DT-gas-filled capsules





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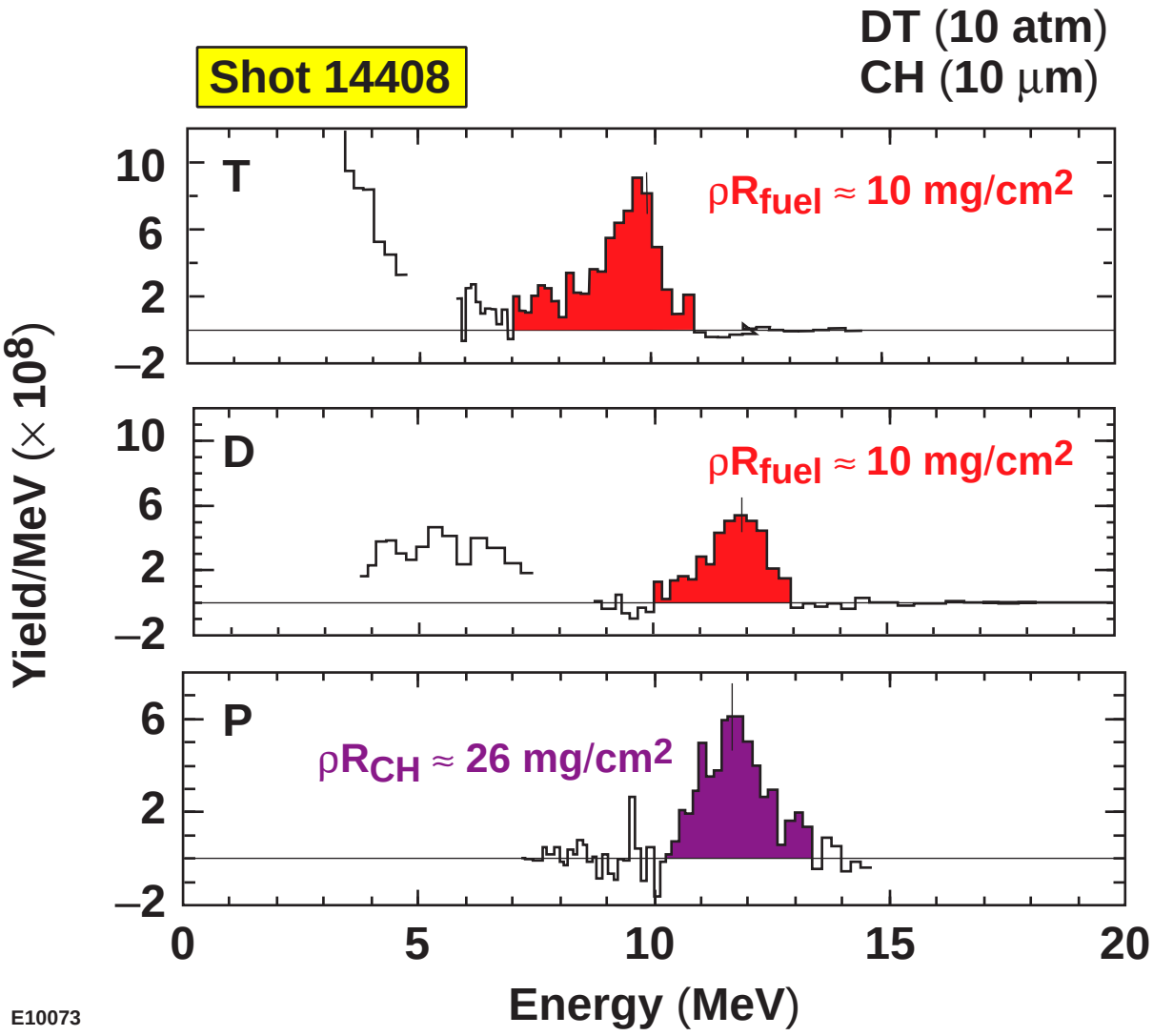
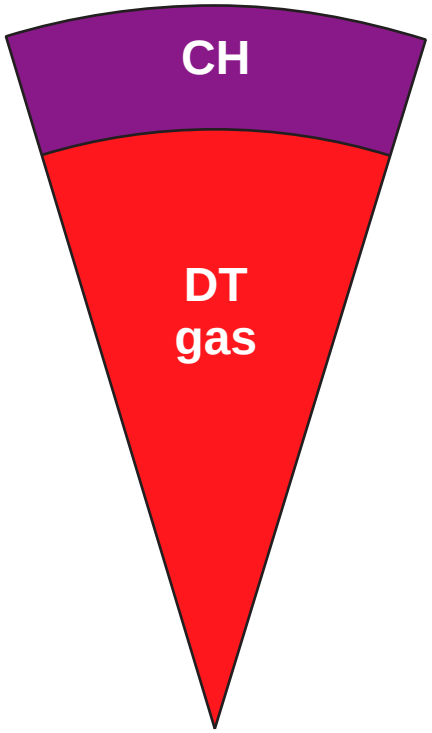
Radha *et al.* submitted

Fuel and shell ρR are determined by knock-on D, T, and P for a double-layer target





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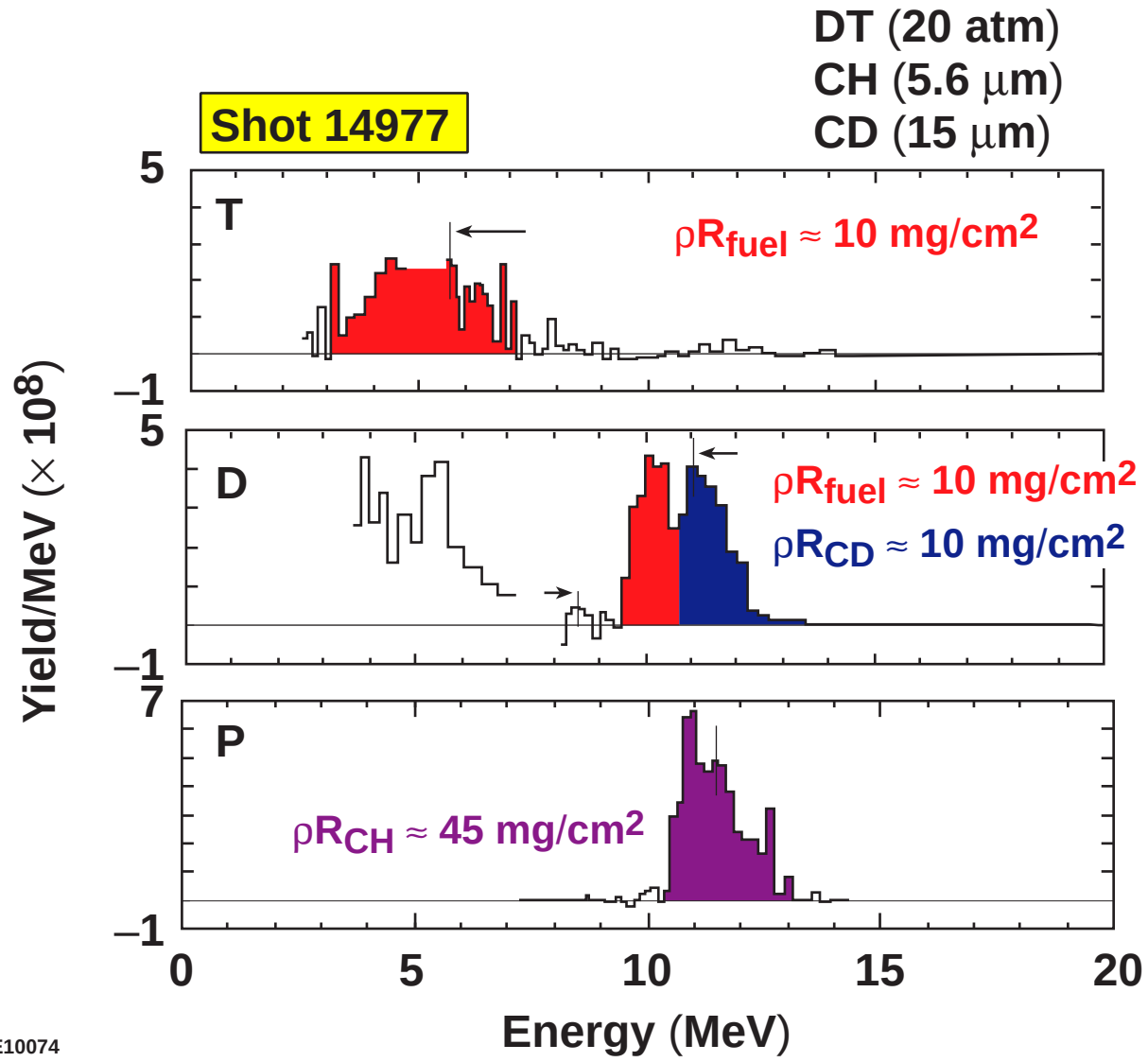
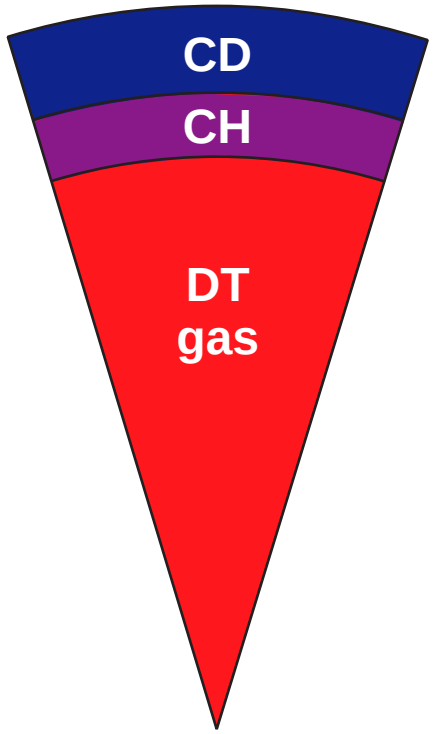
Fuel and shell ρR are determined by knock-on D, T, and P for a triple-layer target





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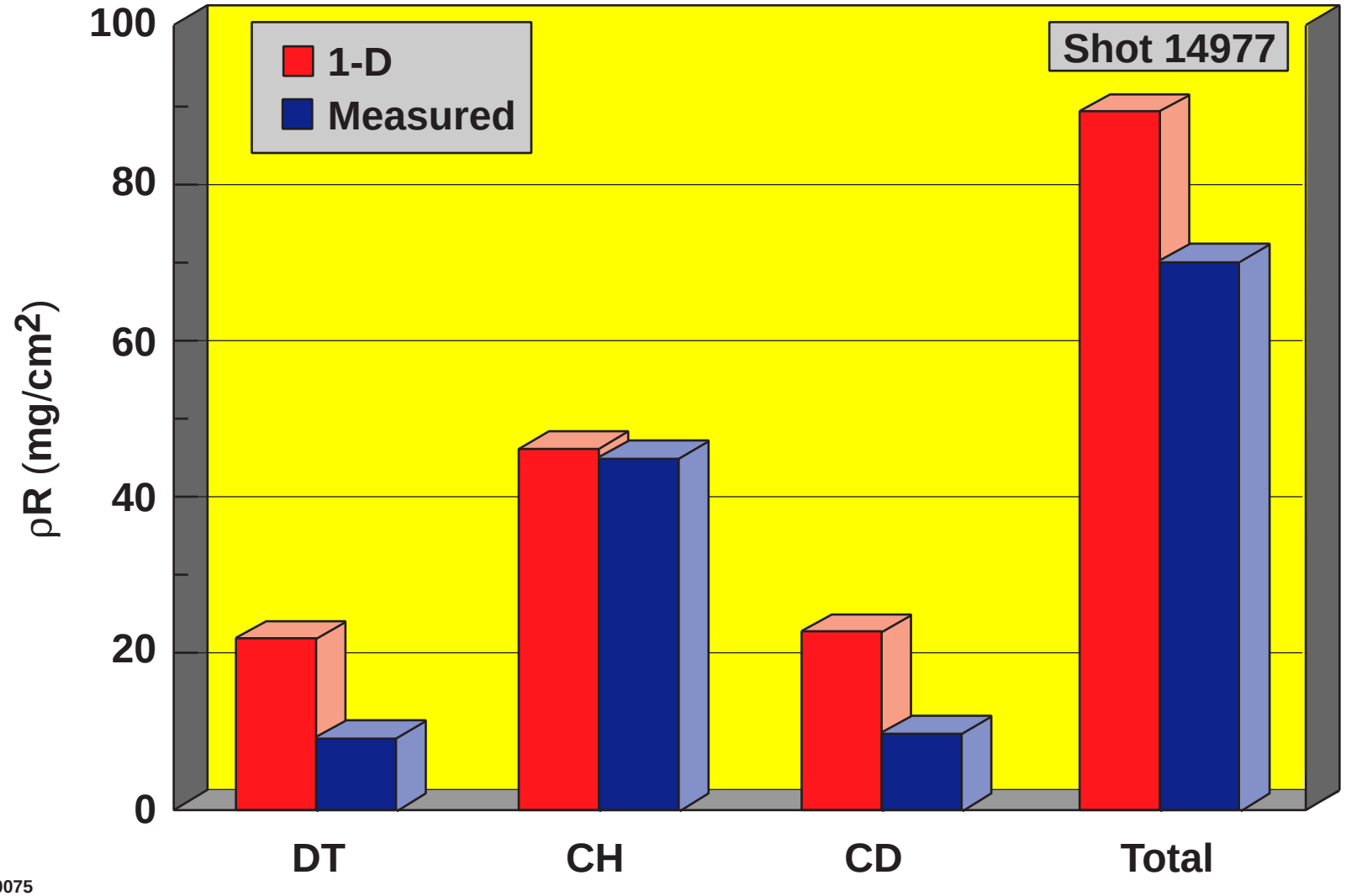
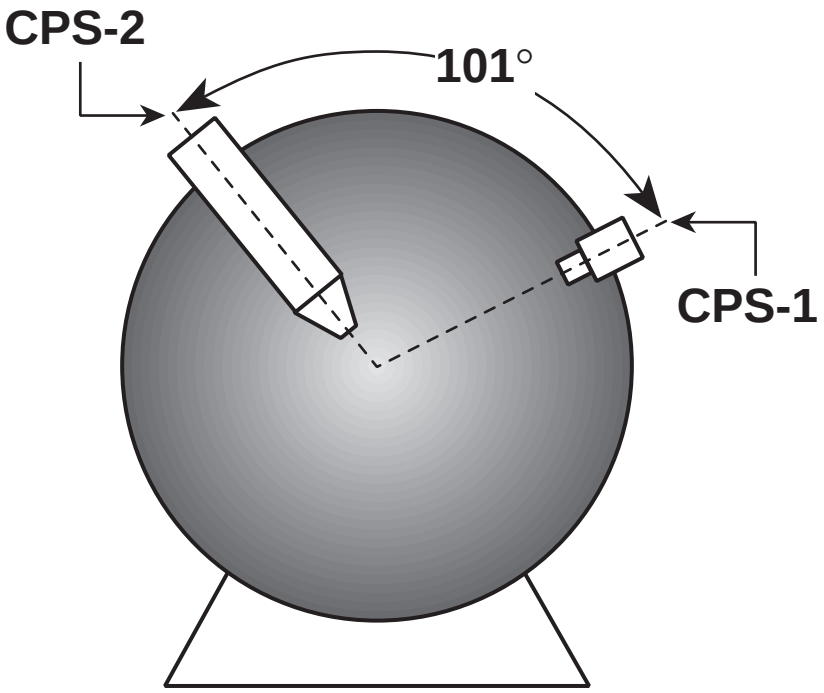
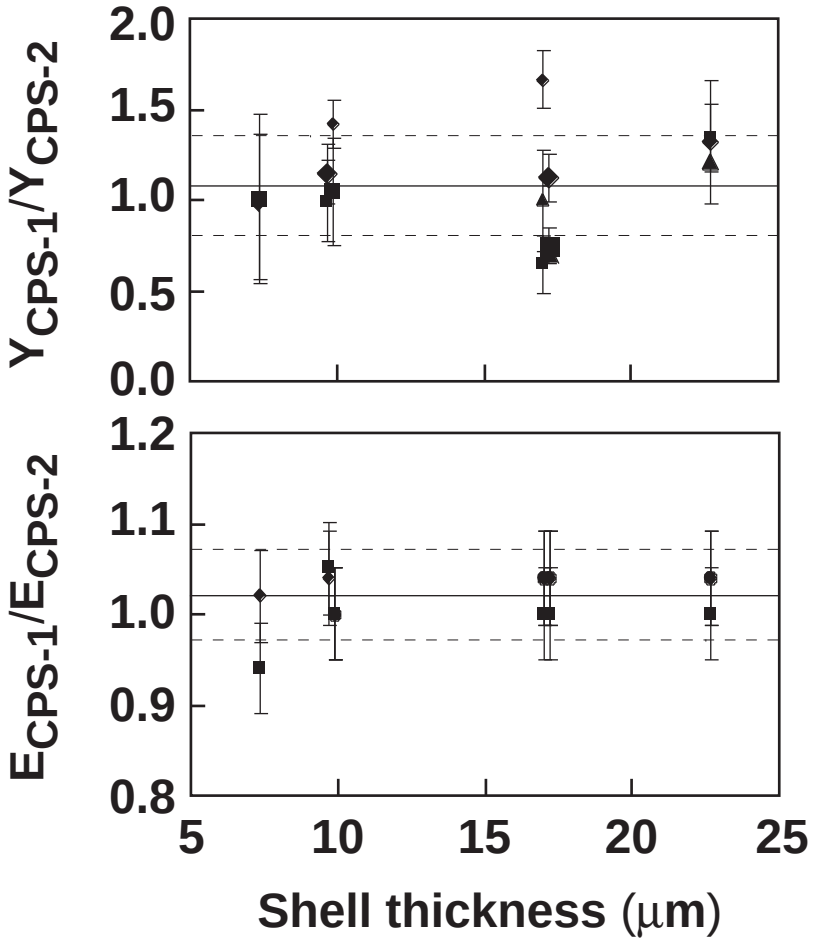
A comparison of the inferred ρR with predictions of the 1-D simulation



E10075

Two identical spectrometers located at near-orthogonal directions allow the issue of implosion symmetry on OMEGA to be addressed





E10076

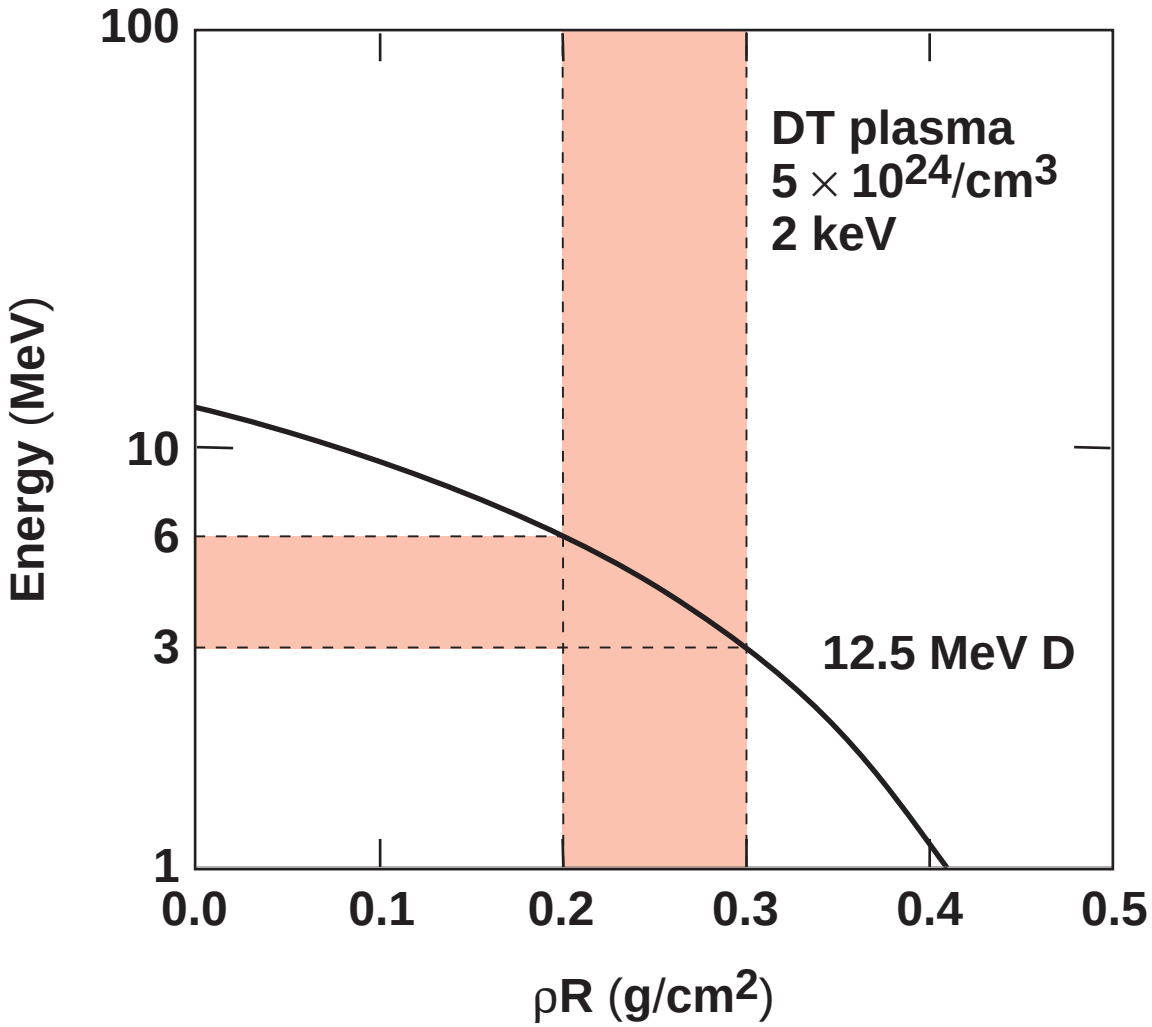
Knock-on particles will be useful for diagnosing cryogenic capsule implosions on OMEGA

DT cryogenic targets:

Knock-on yields
$\geq 2 \times 10^{11}$

$\rho R \approx$ 200 to 300 mg/cm^2

$T_i \approx$ 2 to 4 keV



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