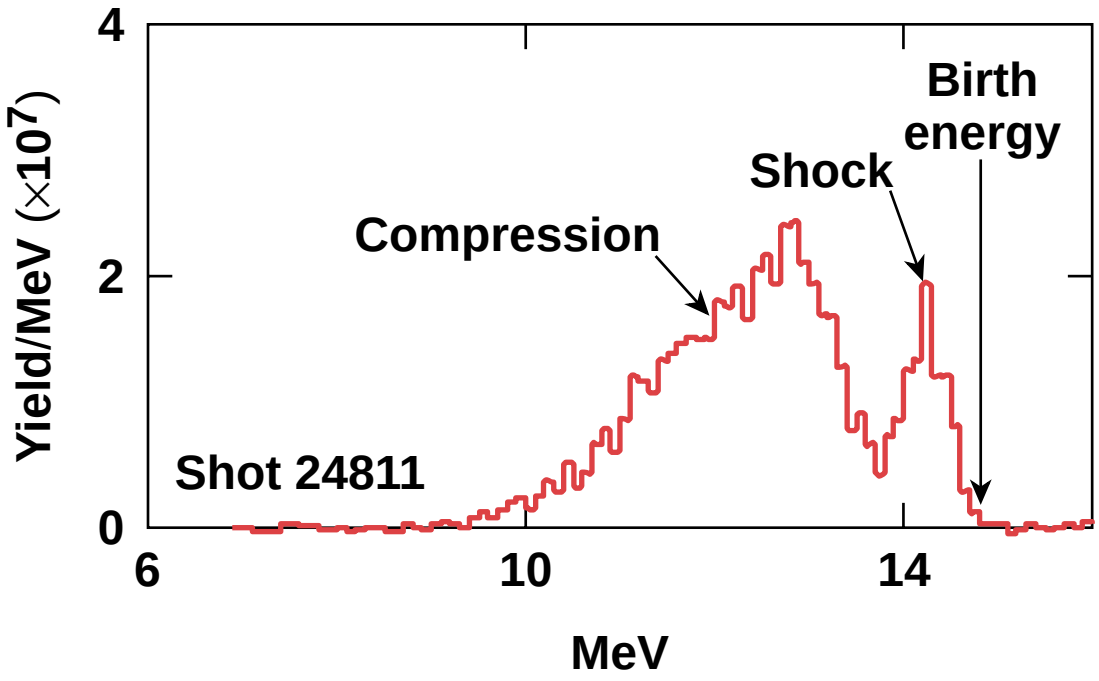
Shock and Compression ρR as Deduced from 14.7 MeV D^3He Proton Line Structure



R. D. Petrasso
Plasma Science and Fusion Center
Massachusetts Institute of Technology
Visiting Senior Scientist, LLE

43rd Annual Meeting of the
American Physical Society
Division of Plasma Physics
Long Beach, CA
29 October–2 November 2001

Collaborators

C. K. Li, F. H. Séguin, J. A. Frenje, and S. Kurebayashi

Plasma Science and Fusion Center
Massachusetts Institute of Technology

P. B. Radha, C. Stoeckl, J. A. Delettrez, D. D. Meyerhofer,
J. M. Soures, S. Roberts, C. Chiritescu, V. Yu. Glebov, S. P. Regan,
W. Seka, S. Skupsky, V. A. Smalyuk, and T. C. Sangster

Laboratory for Laser Energetics
University of Rochester

T. Phillips and G. Schmid

Lawrence Livermore National Laboratory

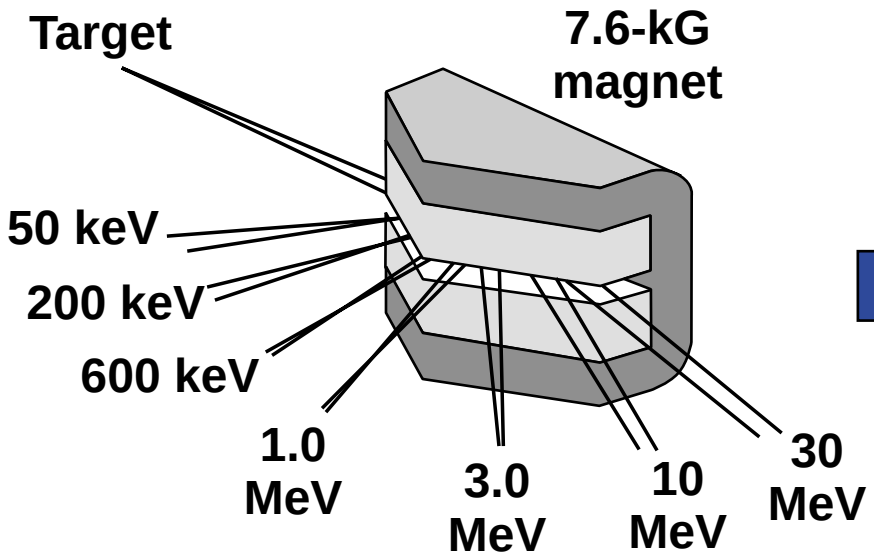
Summary

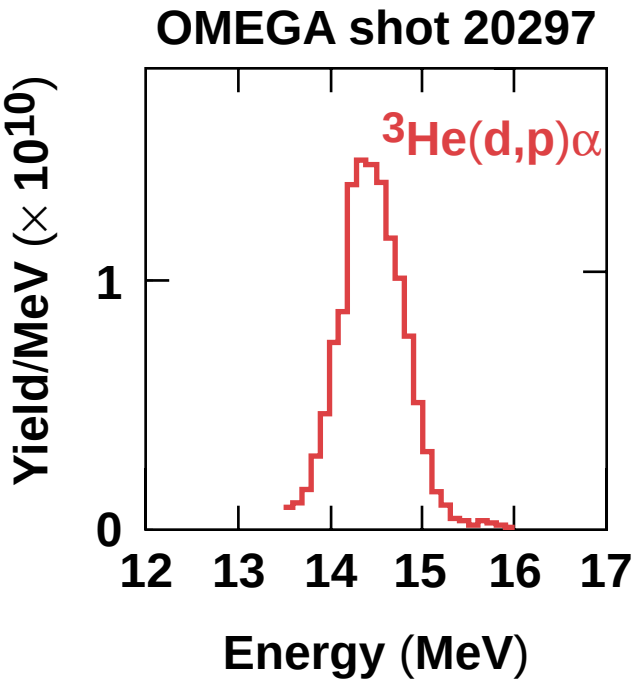
- ρR evolution between shock and compression yield
- A 14.7-MeV D^3He proton line structure is used in this analysis.
- ρR (at shock time) ~ 8 mg/cm^2; T_i ~ 7 keV
- ρR (at compression time) ~ 70 mg/cm^2

Outline

- **14.7-MeV proton diagnostic line**
- **Two distinct lines are evident in the proton profile.**
- **Evidence that the 14.7-MeV line structure is composed of compression and shock components**
- **ρR (at shock time) ~ (1/9)ρR (at compression time) ~ 8 mg/cm^2**

Magnet-based charged-particle spectrometers (CPS's)

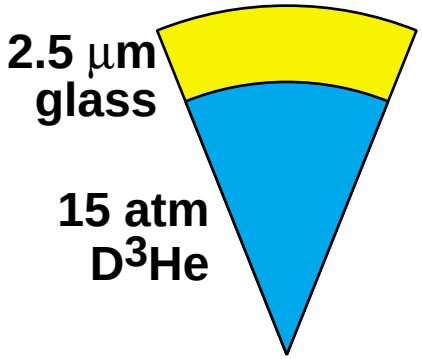




$D + {}^3He \rightarrow P(14.7\ MeV) + \alpha(3.6\ MeV)$

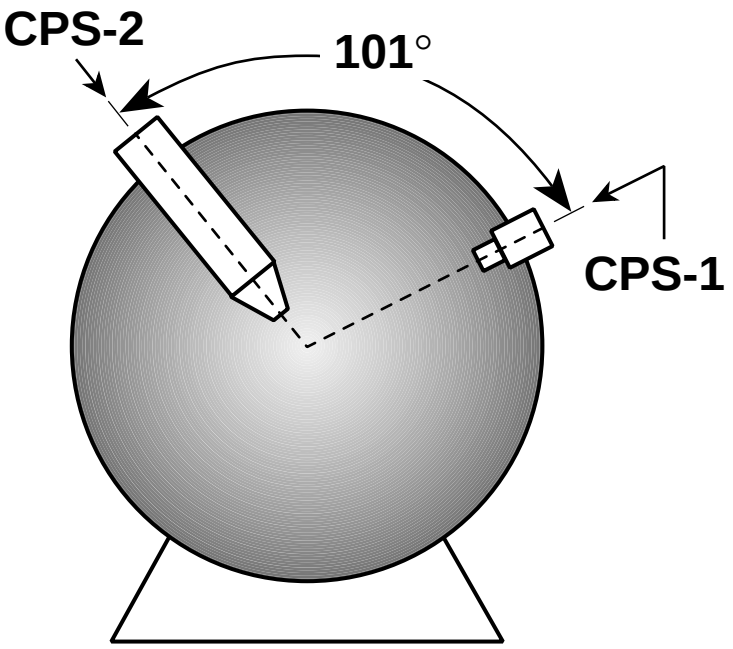
Precision ~ 0.05 MeV

Absolute accuracy ~ 0.10 MeV

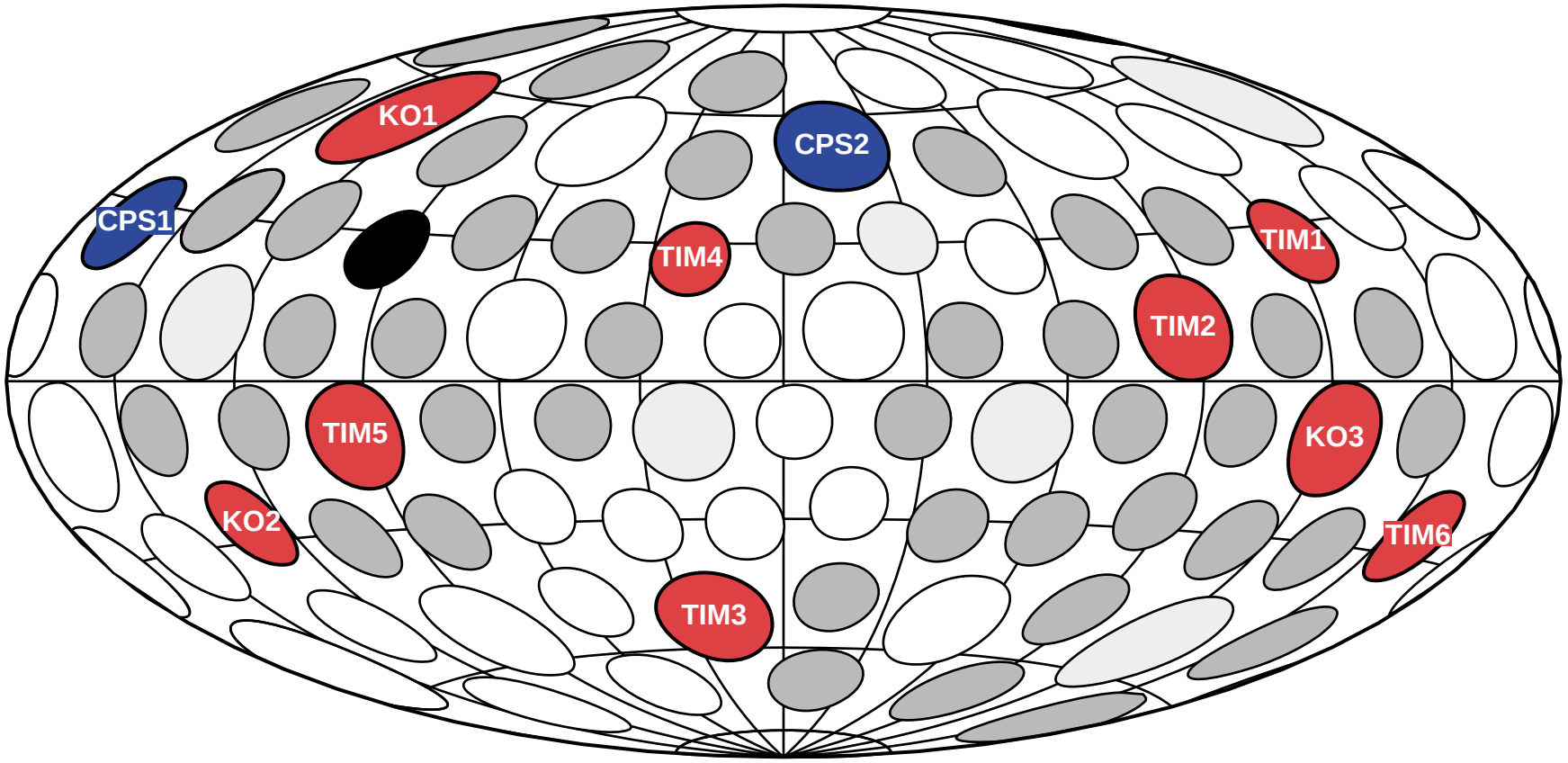


E11219

Installation of CPS-2 on OMEGA



Up to 11 ports can be used for charged-particle spectrometry on the OMEGA target chamber

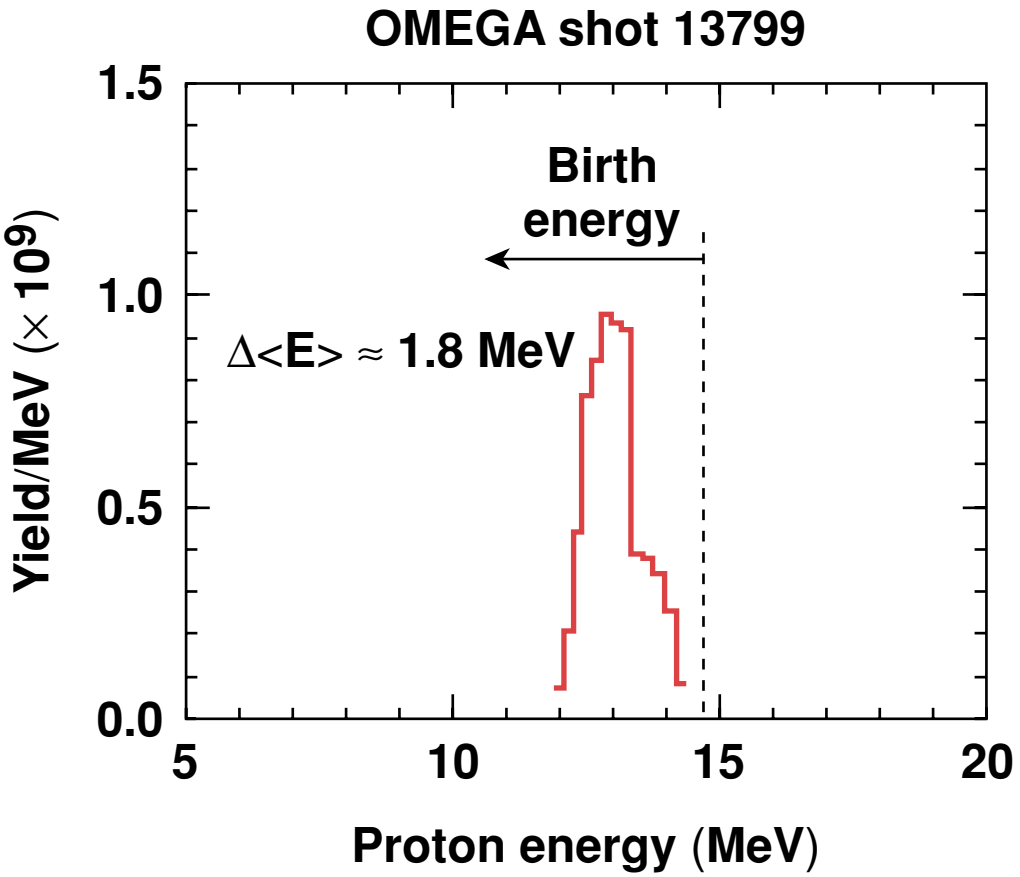


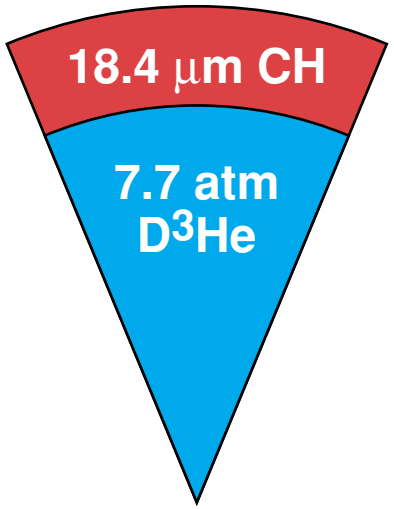
= Magnet-based CPS's

= WRF spectrometers

E11220

Shell ρR from energy loss of primaries





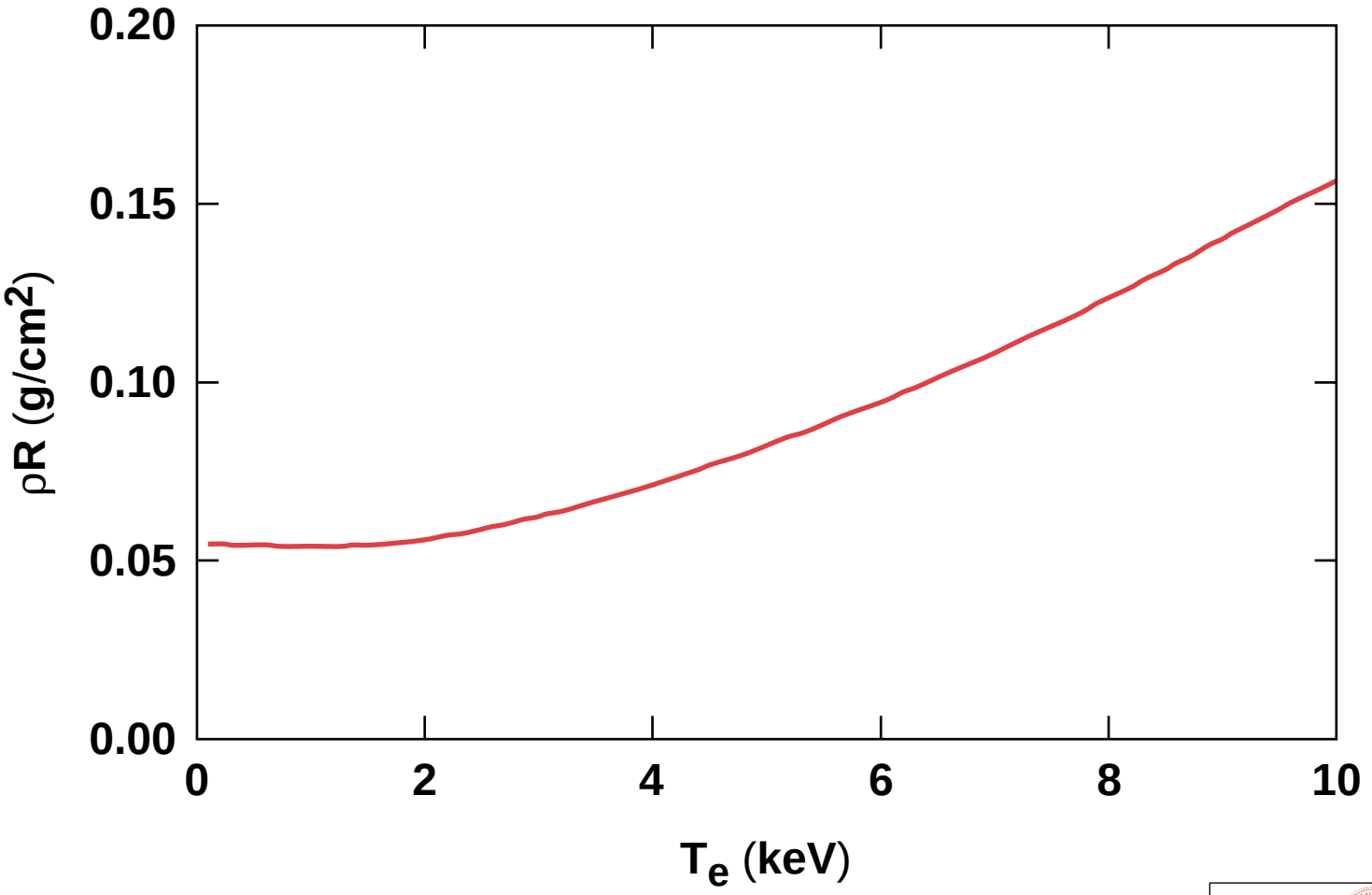
$\Delta\langle E\rangle \approx$ 1.8 MeV

$\Rightarrow \rho R \approx 57$ mg/cm^2

(insensitive to shell temperature, density, and composition as shown on the next slides)

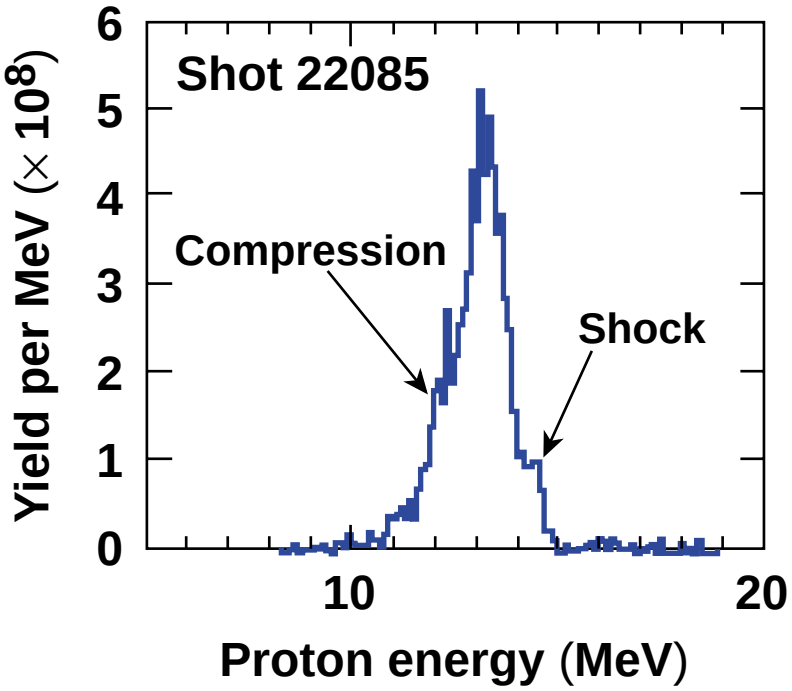
E11221

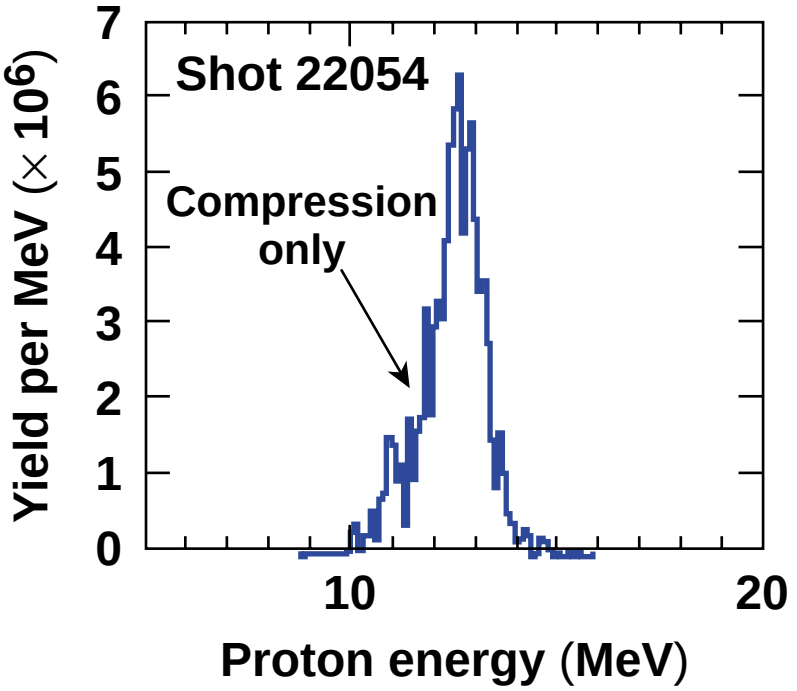
Range of D^3He protons in slowing down from 14.7 MeV to 12.9 MeV

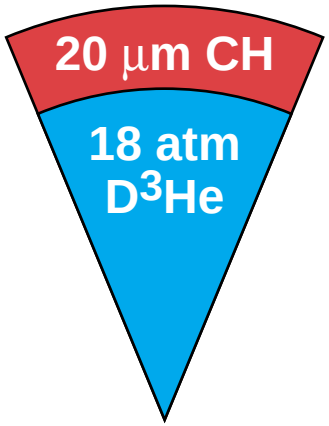


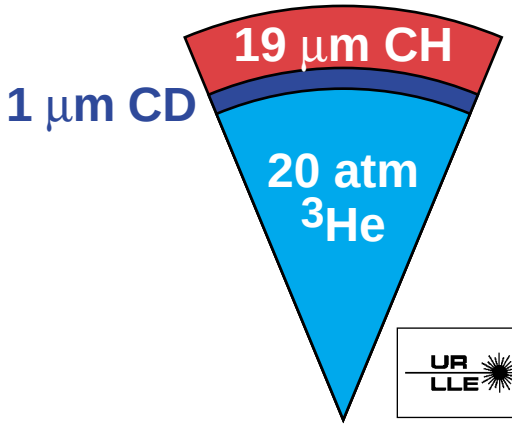
E11382

Two shots, with and without shock flash



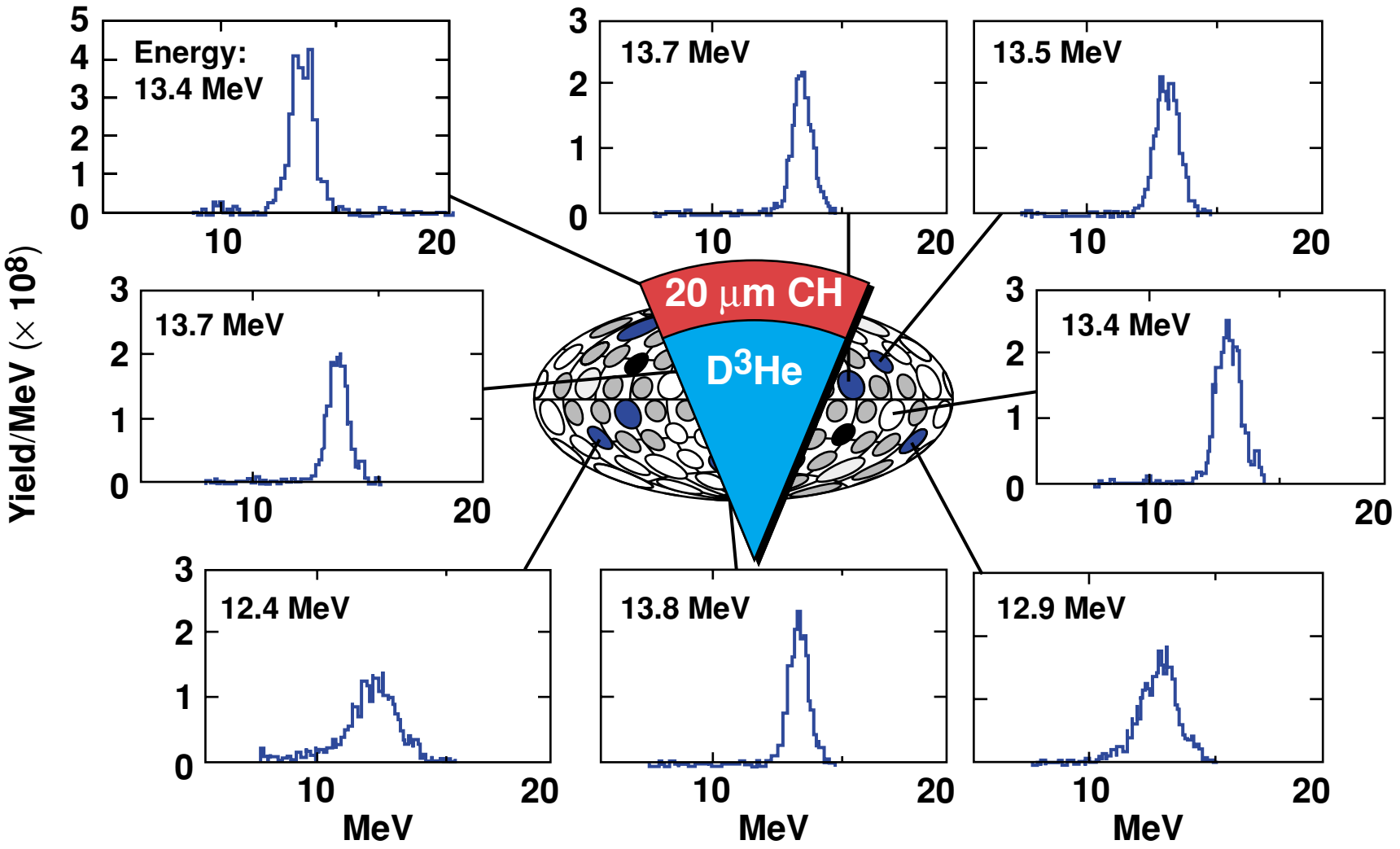






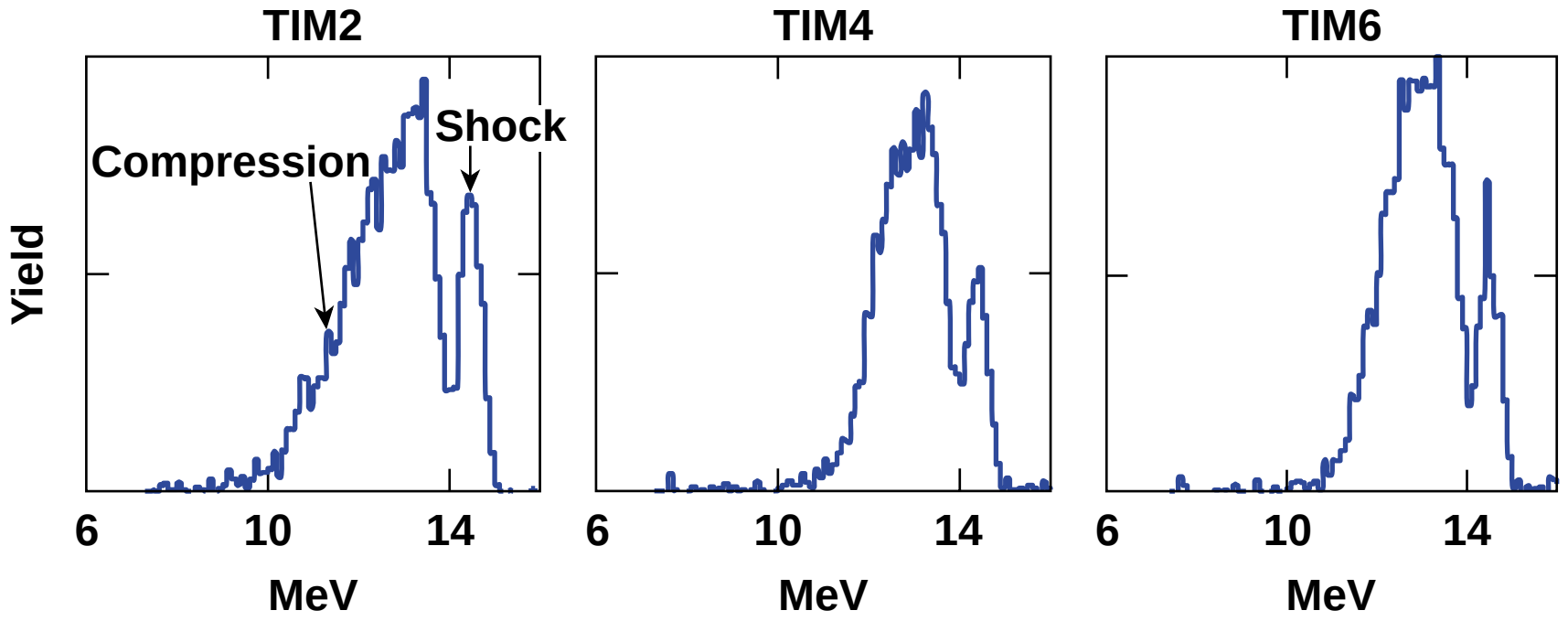
E11222

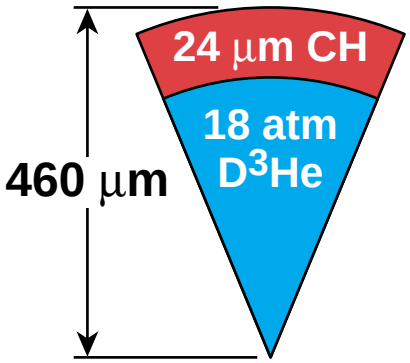
Proton spectra at different positions, shot 21240



E11206a

Shock and compression spectra for shot 24811 from three spectrometers





E11383

ρR is "gated" at shock and compression times

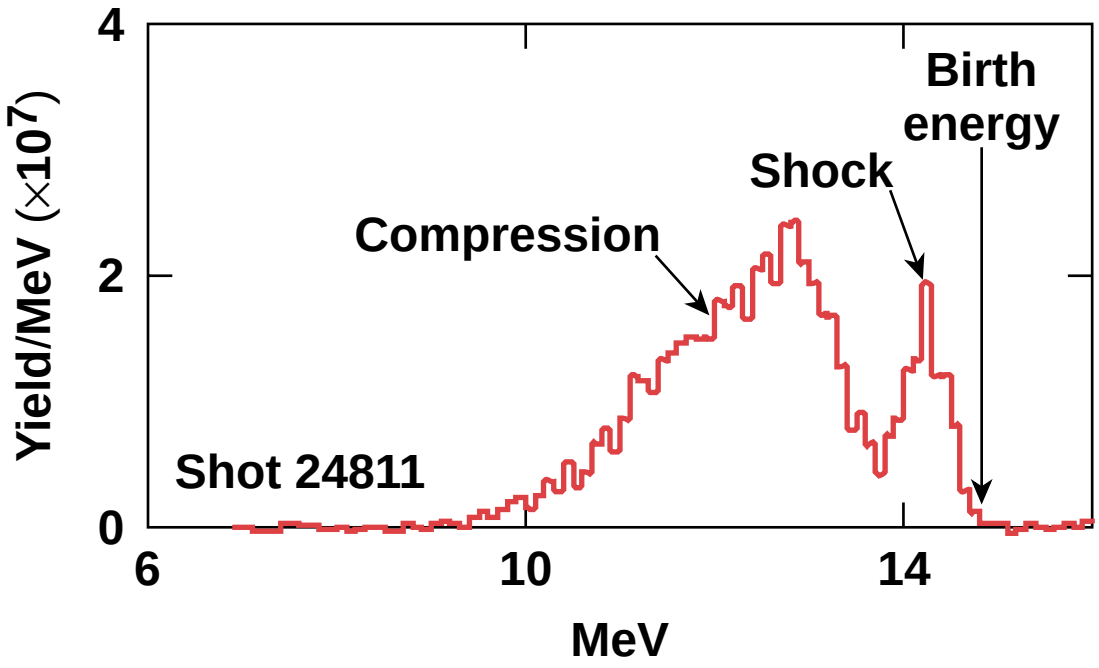
Shock yield: $\Delta E \sim 0.3$ MeV $\rightarrow \rho R \sim 8$ mg/cm^2
$T_i \sim 7$ keV

Compression yield: $\Delta E \sim 2.3$ MeV $\rightarrow \rho R \sim 70$ mg/cm^2

$\Delta t \sim 500$ ps (between shock and compression times)

Summary

- ρR evolution between shock and compression yield
- A 14.7-MeV D^3He proton line structure is used in this analysis.
- ρR (at shock time) ~ 8 mg/cm^2; T_i ~ 7 keV
- ρR (at compression time) ~ 70 mg/cm^2



Related talks

- **P. B. Radha**
- **F. H. Séguin**
- **V. A. Smalyuk**