Charged-Particle Spectra Using Particle Tracking on a Two-Dimensional Grid

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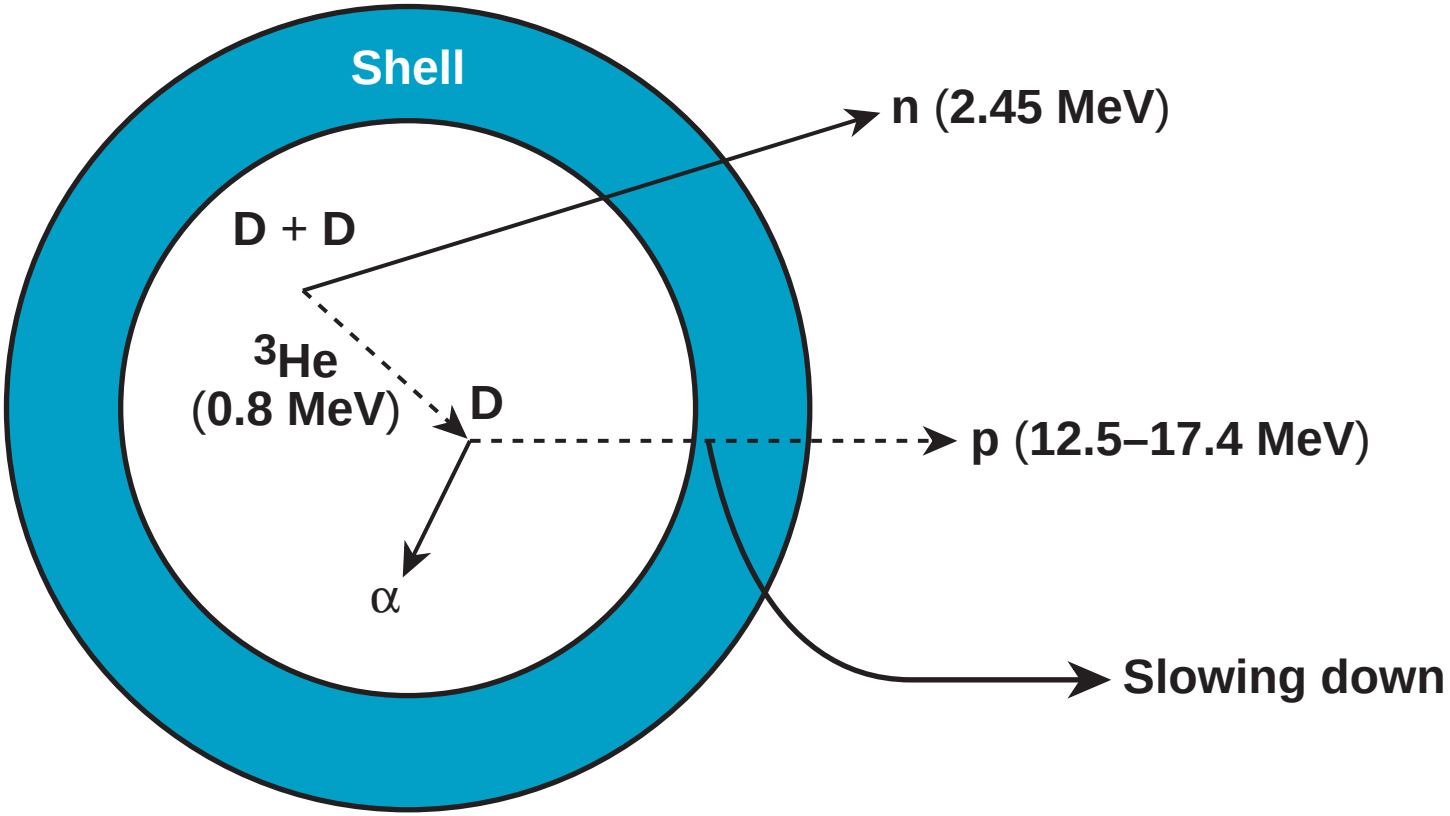
IRIS-2D is an extension of the spherically symmetric Monte Carlo particle-tracking code *IRIS*. It tracks particles on a two-dimensional Lagrangian grid and will be used as a post-processor to 2-D hydrocodes to simulate experimental neutron and charged-particle spectra. In this talk, we use *IRIS-2D* to study the effect of asymmetry and instability-induced mix on the knock-on deuteron (deuterons elastically scattered off the 14-MeV DT neutron) spectrum and its angular distribution. We will present time-integrated knock-on deuteron spectra obtained by post-processing implosion calculations using the 2-D hydrocode *ORCHID*. Preliminary comparisons of these spectra with experiment will be presented. This work was supported by the U.S. Department of Energy Office of Inertial Confinement Fusion under Cooperative Agreement No. DE-FC03-92SF19460, the University of Rochester, and the New York State Energy Research and Development Authority.

Secondary Protons and Two-Dimensional Particle Tracking



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Summary

Secondary protons can be used to deduce areal densities in compressed ICF targets

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- Energetic secondary D-^{3}He protons can be used as an areal density diagnostic for cryogenic DD targets.
- Recent measurements of the proton spectrum using the charged-particle spectrometer show qualitative agreement with 1-D calculations. However, quantitative agreements require at least 2-D simulations of the proton spectra.
- Calculations with *IRIS2D* suggest that the secondary proton spectrum may be useful in deducing the existence of low-order modes in DD targets.
- Guidance from 2-D simulations on the modal structure is required to further investigate the use of secondary protons to detect low-order modes.

Outline

Secondary protons can be used to deduce areal densities in compressed ICF targets

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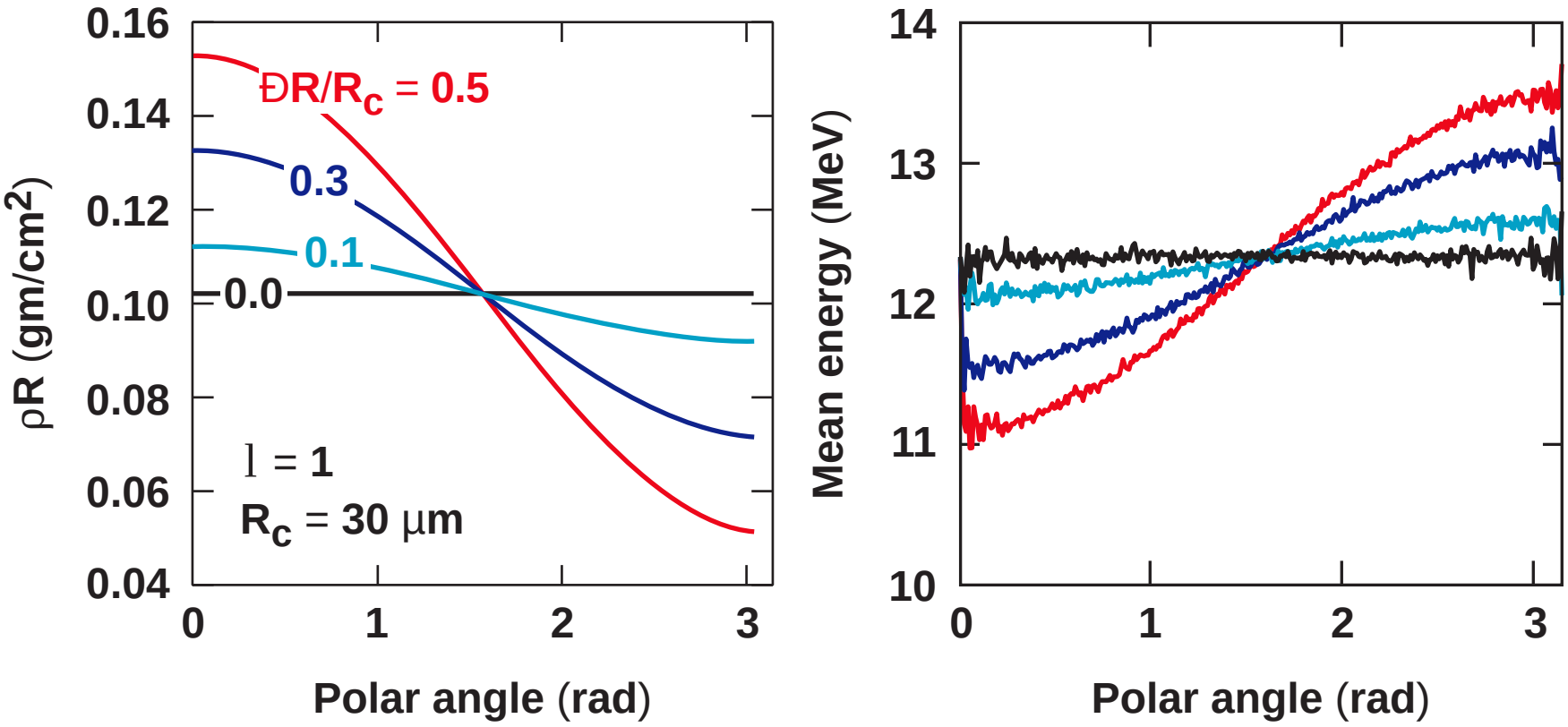
- About secondary D-^{3}He protons
- Preliminary experimental proton spectra
- *IRIS2D* and two-dimensional particle tracking
- Low-order modes and the proton diagnostic
- Conclusions

Two-dimensional calculations suggest that the presence of an $l = 1$ mode may be deduced using secondary protons

- Calculation uses an ice-block model with an imposed $l = 1$ Legendre mode.
- Primary particles (^{3}He) are centrally produced and tracked; secondary protons are produced along ^{3}He trajectories.



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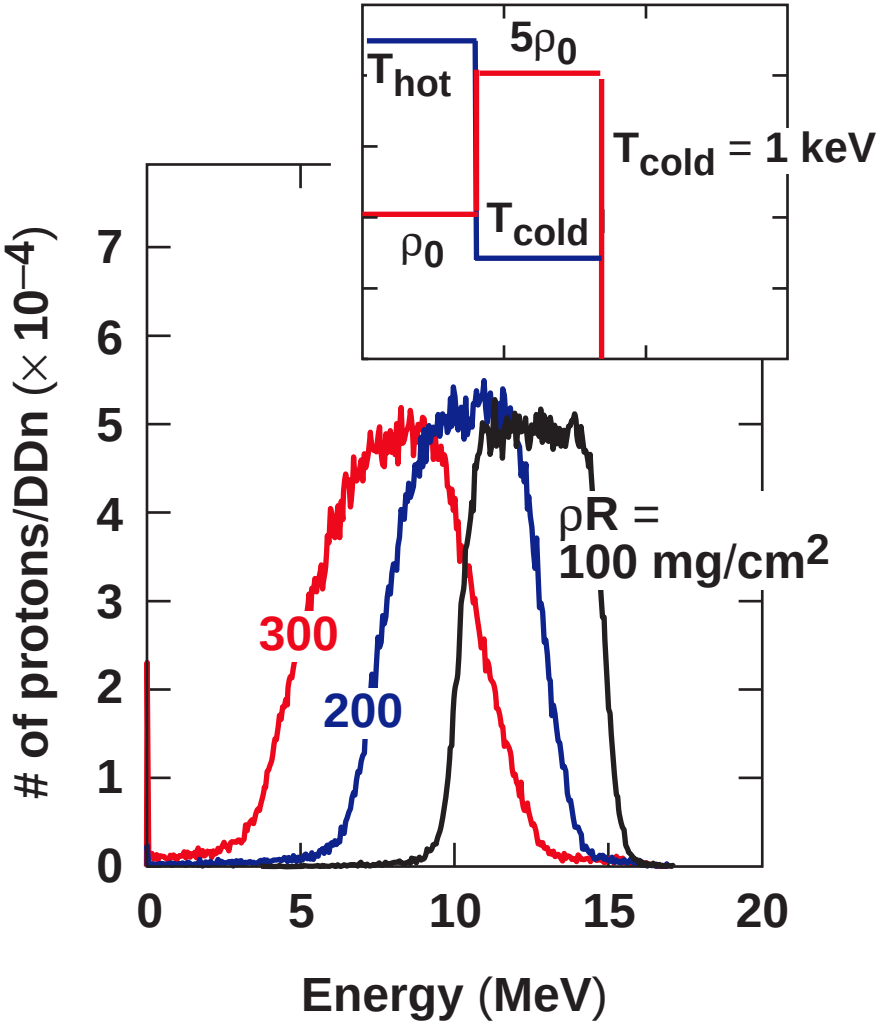
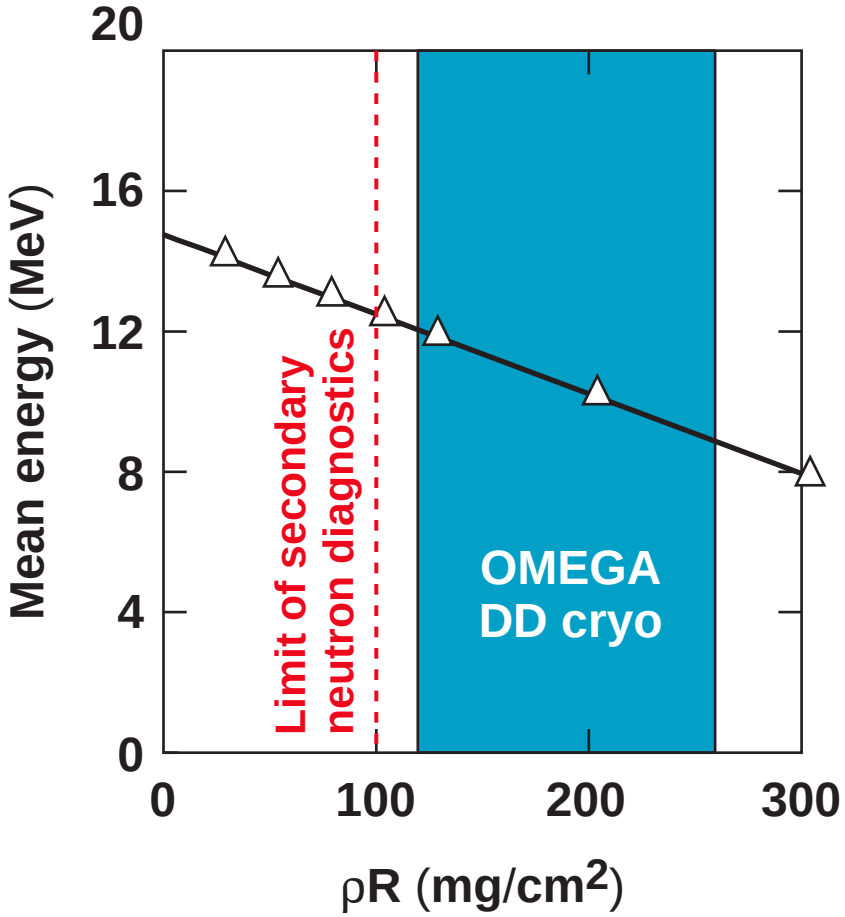
**IRIS2D*—A 2-D Monte Carlo particle-tracking code.

The mean energy of the D-^{3}He proton* spectrum can be used to deduce the target areal density





See Séguin, this conference, paper KO2.07

*H. Azechi, M. D. Cable, and R. O. Stapf, Laser and Particle Beams 9, 119 (1991).

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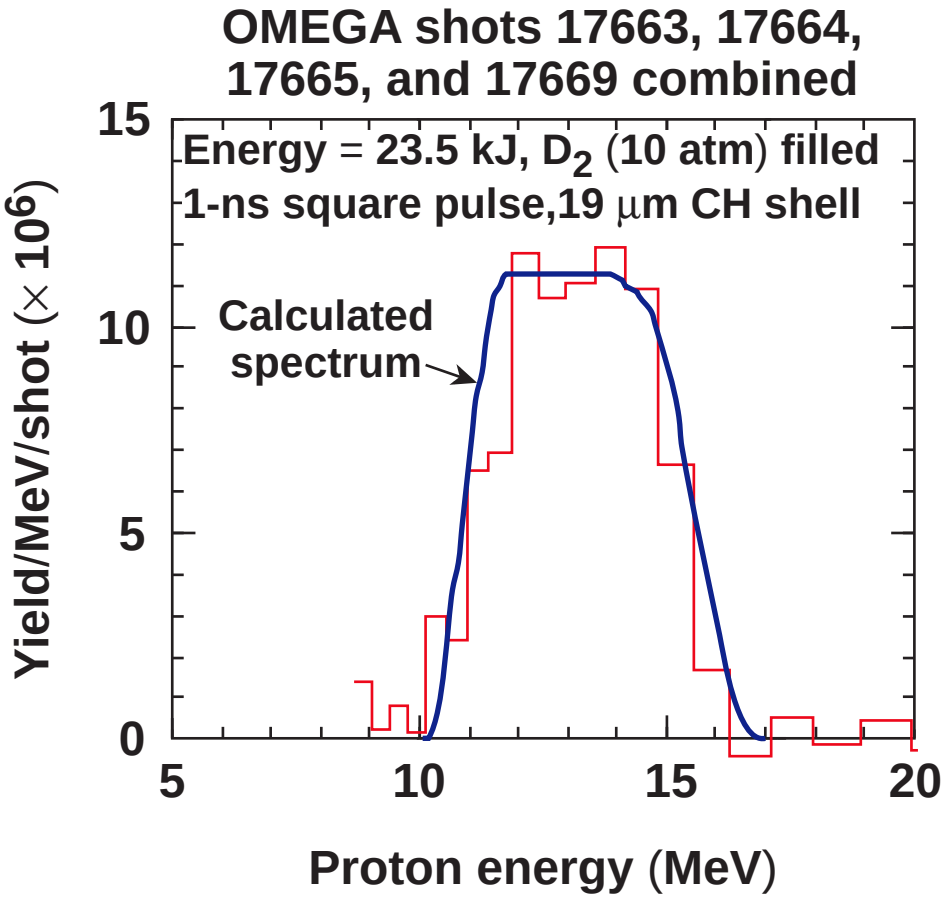
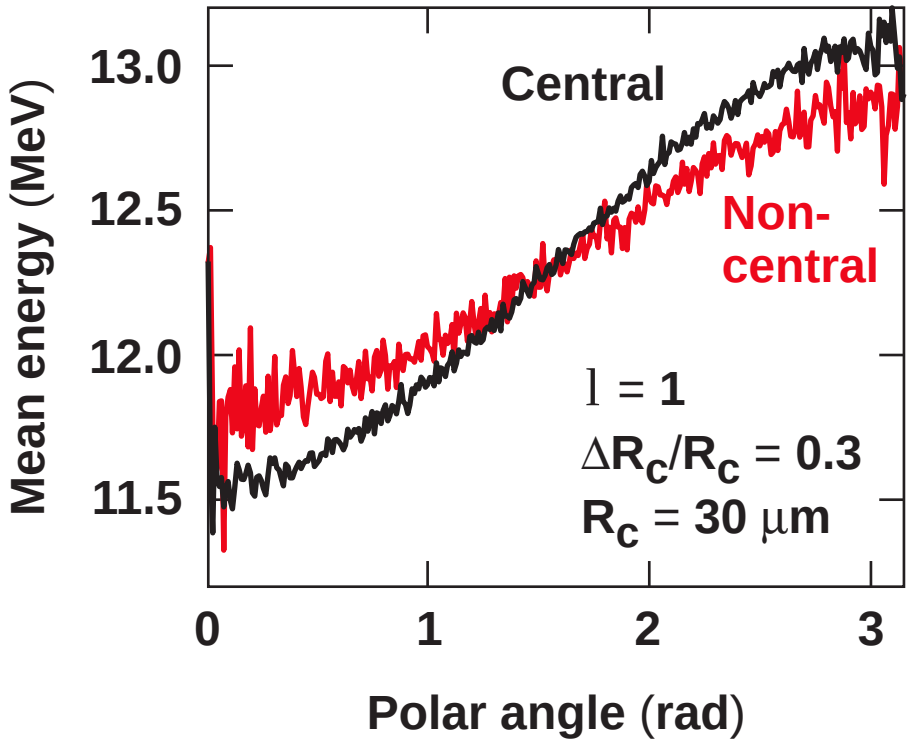
Preliminary measurement of the secondary proton spectrum shows good agreement with calculations



	Predicted (1-D *LILAC*)	Inferred
Shell ρR	92 mg/cm^2	40–50
Fuel ρR	20 mg/cm^2	10
n yield	5.2×10^{11}	1.2×10^{11}
p yield	1.3×10^{9}	5×10^{7}

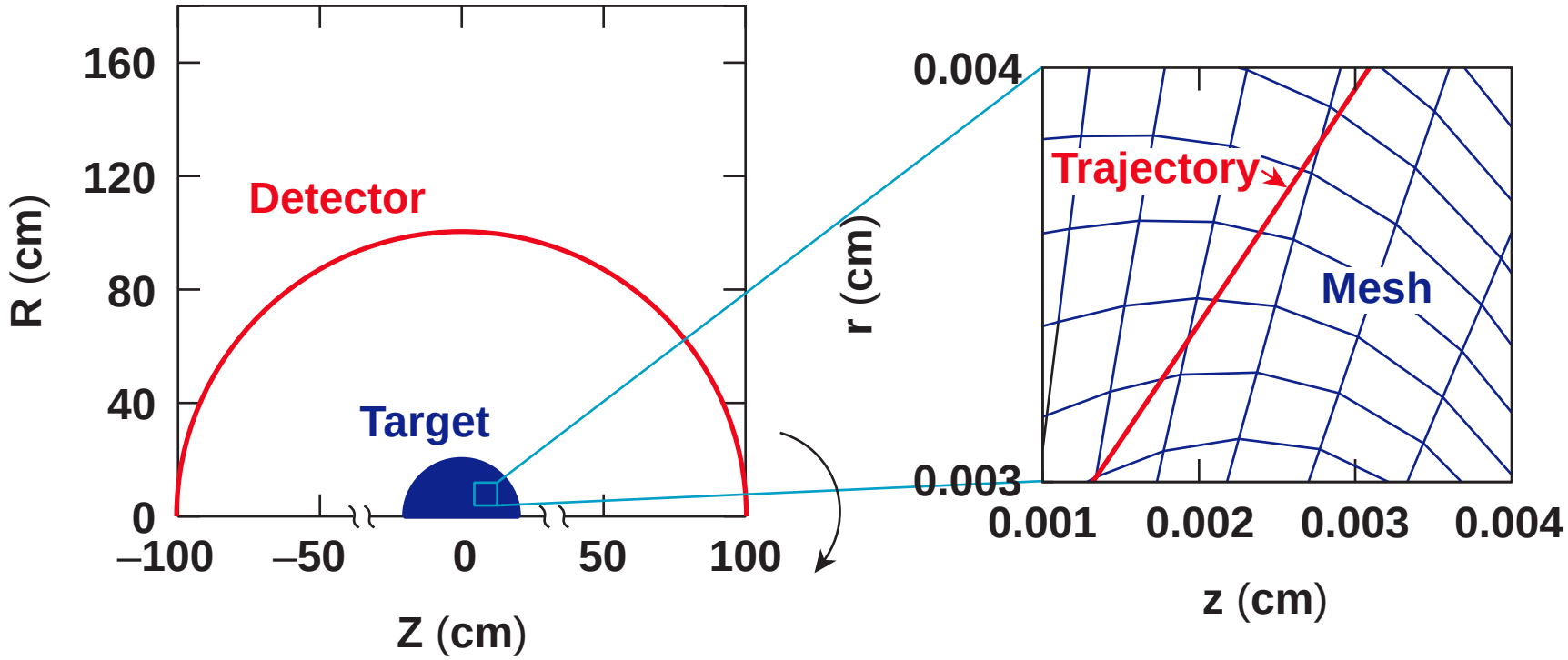
- Quantitative agreement with experiment requires at least two-dimensional simulations.

Sensitivity of the mean energy to the modal structure is decreased with a non-central source for the primary ^{3}He



- The location of the spectrometers will determine the observed difference of the mean energies for any mode.
- Guidence from 2-D simulations on the modal structure expected is required to further investigate the use of secondary protons to detect low-order modes.

IRIS2D tracks particles on a cylindrical Lagrangian mesh



- Interactions occur at discrete points along the trajectory.
- Charged particles undergo continuous energy loss.