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

Shell

D + D

3He (0.8 MeV)

D

α

n (2.45 MeV)

p (12.5–17.4 MeV)

Slowing down

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

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

- About secondary D-\(^3\)He protons
- Preliminary experimental proton spectra
- \textit{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.

*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.

\[
\rho R = 100 \text{ mg/cm}^2
\]

See Séguin, this conference, paper KO2.07

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

- 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 $^3\text{He}$.

- The location of the spectrometers will determine the observed difference of the mean energies for any mode.

- Guidance 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.