DRACO is computed using either multi-group flux-limited diffusion theory or continuous energy Monte Carlo particle tracking. Both of these transport models incorporate the same basic slowing down model of Li and Petrasso. Detailed comparisons of particle transport and energy loss predicted by the two models will be presented. Results of 2D triangular lattice burn simulations will be compared for the two models. Comparison of energy deposition and its partition to electrons and ions for 3.5 Mev alpha particles in a 50 keV DT plasma.

Outline

I. Charged Particle Stopping Power
II. Multi-group Charged Particle Diffusion Model
III. Monte Carlo Particle Tracking
A. Algorithm
IV. Comparison of Fusion Burn Simulation
A. Heating rate by alpha particle source from origin
B. Effect of two dimensional transport
V. Future Work

Stopping Power

Energy loss rate interacting with electrons (non-thermal electrons): $e^{-\lambda} N (N_e/N)$

Alpha particle density in group $g$: $N_g = \sum N_i (\lambda_g/\lambda_i) N_i$

Relaxation time from upper group $g+1$ to lower group $g$: $\tau_{g,g+1} = 4 \sum N_i (\lambda_{g+1}/\lambda_i) N_i$

Monte Carlo Particle Tracking

Diffusion theory is valid for short mean-free-path transport. For energetic alpha particles in the Monte Carlo technique provide more accurate results, however, require more computing time and storage.

Flux Limiter and Energy Deposition

The Monte Carlo particle transport algorithm has to fulfill the basic tasks:
1. To generate particles randomly in the source cells, (2) to determine the intersection with a quadrilateral and get the particle information updated, and (3) other tasks, such as the treatment of boundary conditions and tally, are also required.

Results of Stopping Power

Using this graph, we can estimate the alpha particle range.

Monte Carlo model

Comparison of Energy Deposition for Diffusion Model and Monte Carlo Tracking Model

• Mesh size: 100 by 100
• The number of Monte Carlo particle is about one million
• Alpha source rate of $10^{20}$ at the origin of radius $R_c < 4 \times 10^6$ cm

Two cases:
1. DT plasma temperature at 5 keV and plasma density of 10^16 cm^-3
2. DT plasma temperature at 50 keV and plasma density of 10^15 cm^-3

• Alpha source rate of $10^{20}$ as two non-symmetric sources shown on mesh