# Target threat ion spectra – fluid or kinetic model?

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# We are following a three path approach to understanding and modeling target threat spectra

**Following burn, a strong shock propagates radially outward through the target, accelerating debris into the low density target chamber gas.**

**Self-similar analytic model of shock propagation down density gradient – Zel'dovich and Raizer, Ch XII.**

**Simple Lagrangian fluid simulation of shock propagation to compare to Z&R.**

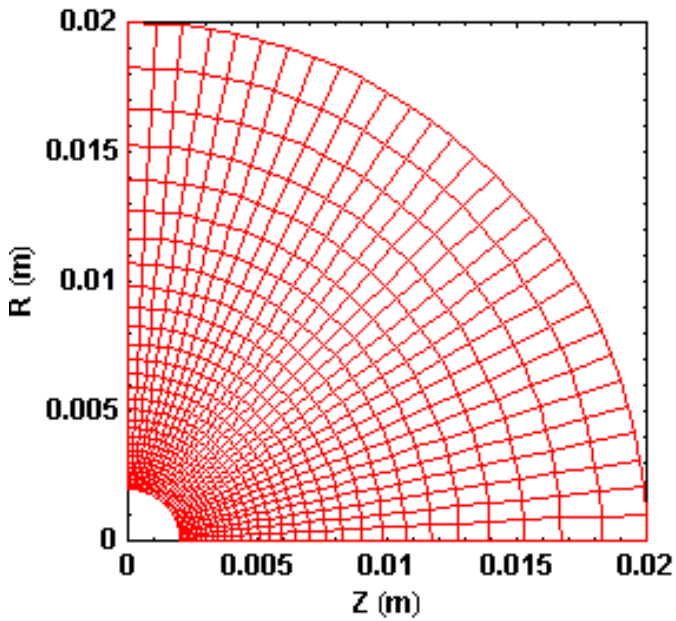
- $\partial u/\partial t + \partial p/\partial m = 0$
- $\partial e/\partial t + p(\partial V/\partial t) = 0$

**Simple Monte Carlo kinetic simulation (Icarus) of shock propagation in transition between collisional and collisionless regime.**

**Hybrid fluid-kinetic multi-physics simulation BUCKY**

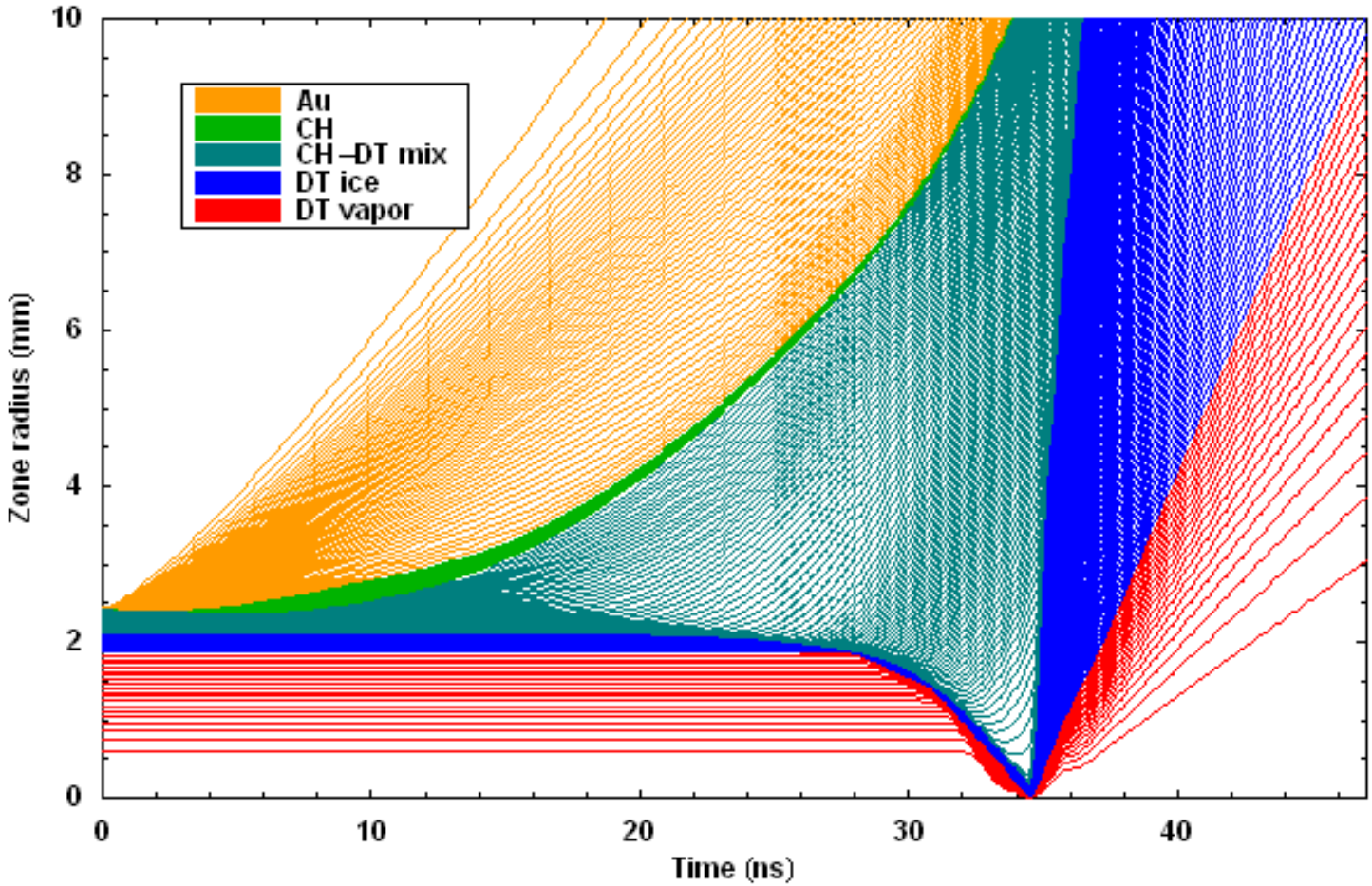
# UW is Simulating Target Burn Dynamics Using the *Icarus* Direct Simulation Monte Carlo (DSMC) Code

- Written by Dr. Tim Bartel, SNL.
- DSMC codes follow gas and plasma computational particles.
  - PIC-like, but particle positions arbitrary, not fixed to grid.
  - Icarus includes collisions and plasma physics for multiple species.
  - Allows electrostatic fields and arbitrary mean free paths.
- Presently implementing expansion of ICF shock wave.
  - Code benchmarked for gas/plasma combination, but not pure plasma.



# Starting Point for Icarus Simulation is Time of Maximum Compression

- Lagrangian constant-mass zones from BUCKY run of HAPL case:



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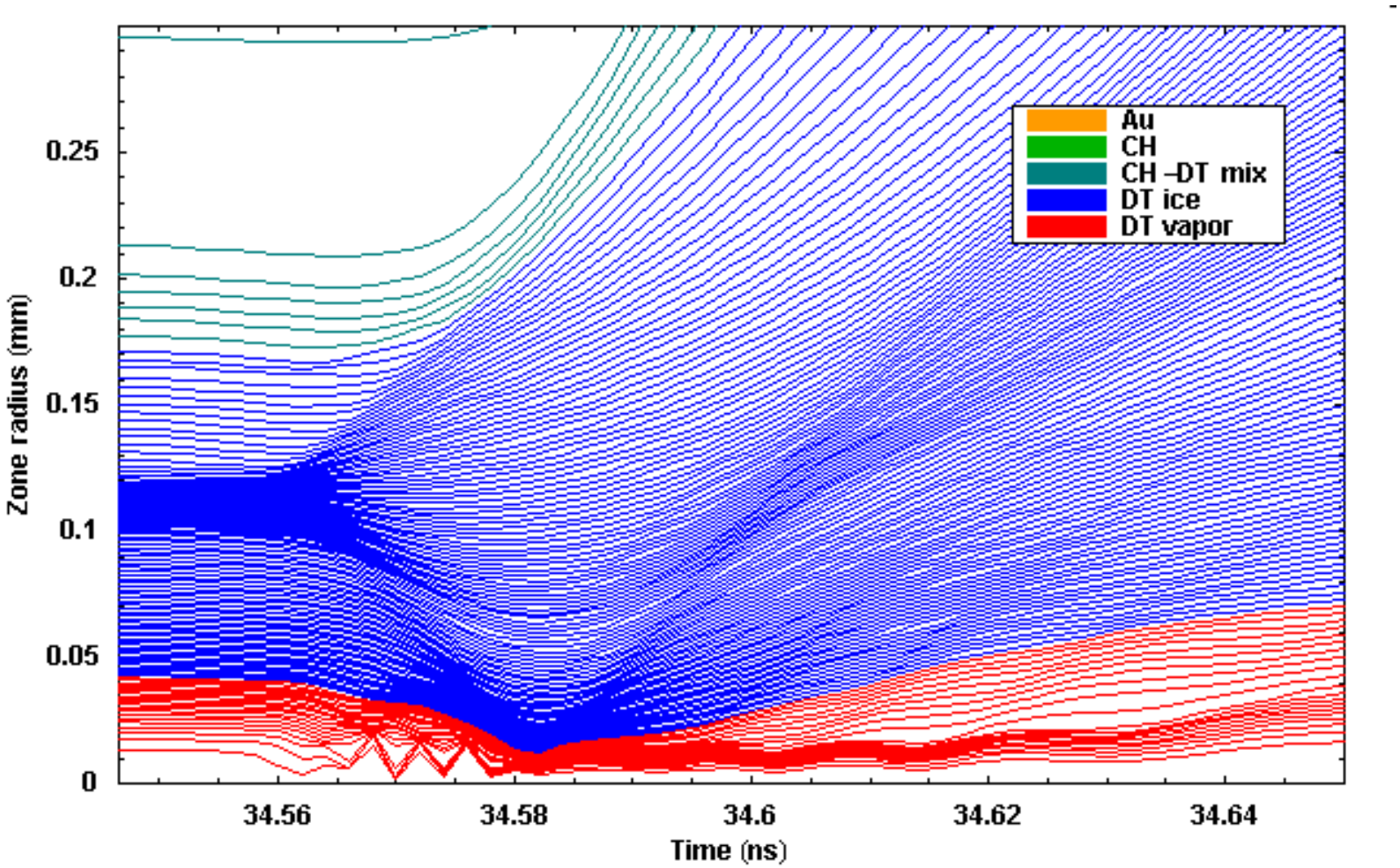
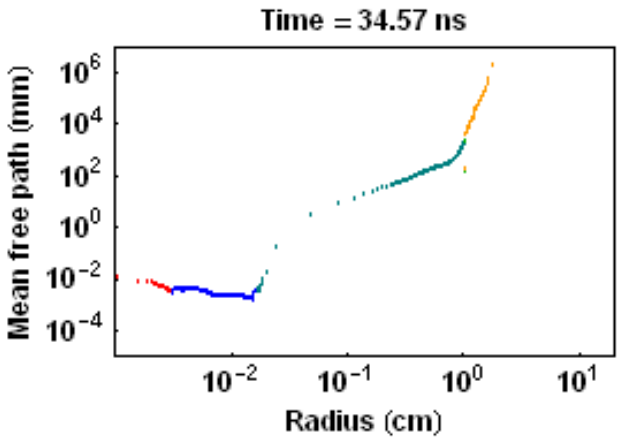
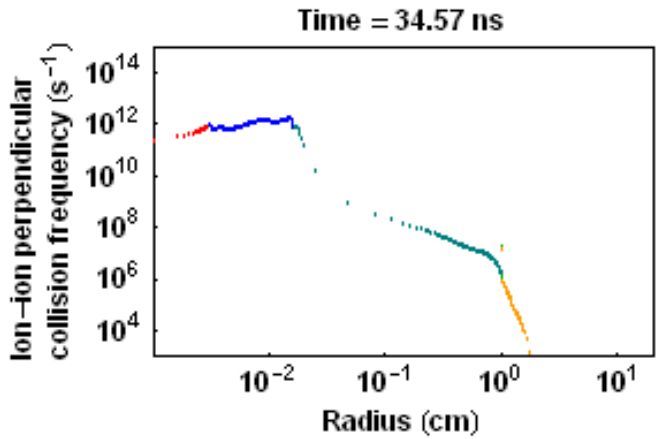
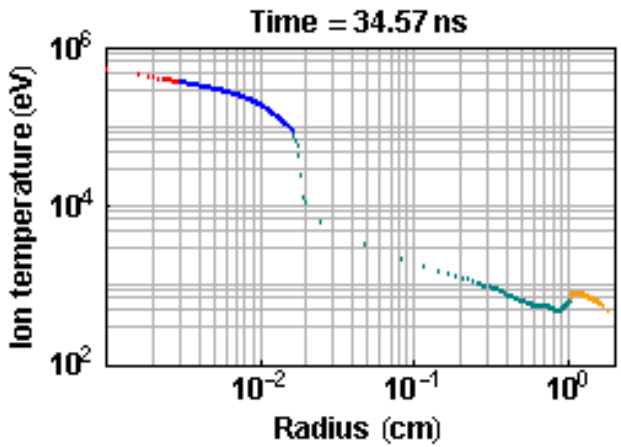


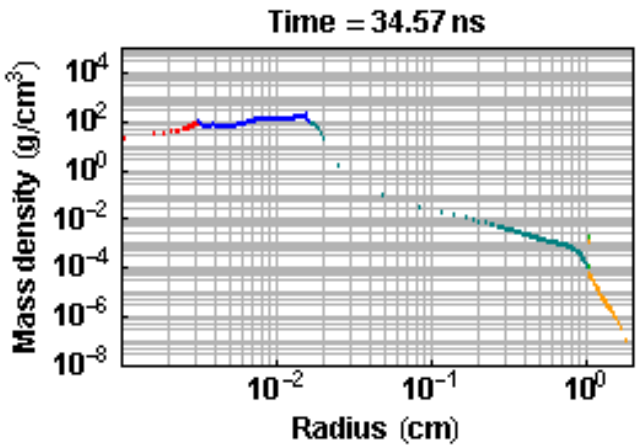
# Fast Ions Possess Mean Free Paths Larger than the Shock Thickness

- BUCKY simulation:

# Summary

- We are analyzing a HAPL implosion/explosion case and implementing a long mean free path approach.

  (to be reported at the next HAPL meeting)

- Benchmarking results with analytic solutions of shock propagation down a density gradient.
- Investigating details of fast ion interaction with spherically expanding shock wave using SNL's discrete simulation Monte Carlo (DSMC) code, Icarus.
- Modifying the UW 1-D radiation hydrodynamics code BUCKY to predict ion threat spectrum.