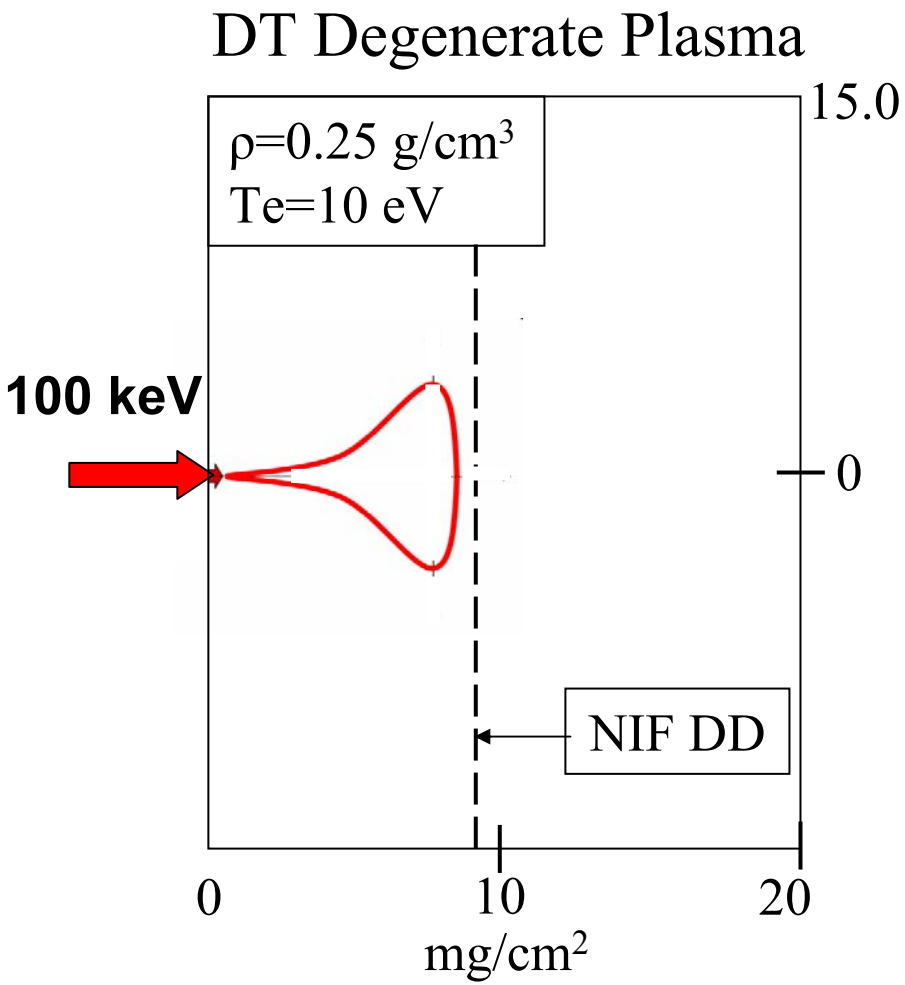
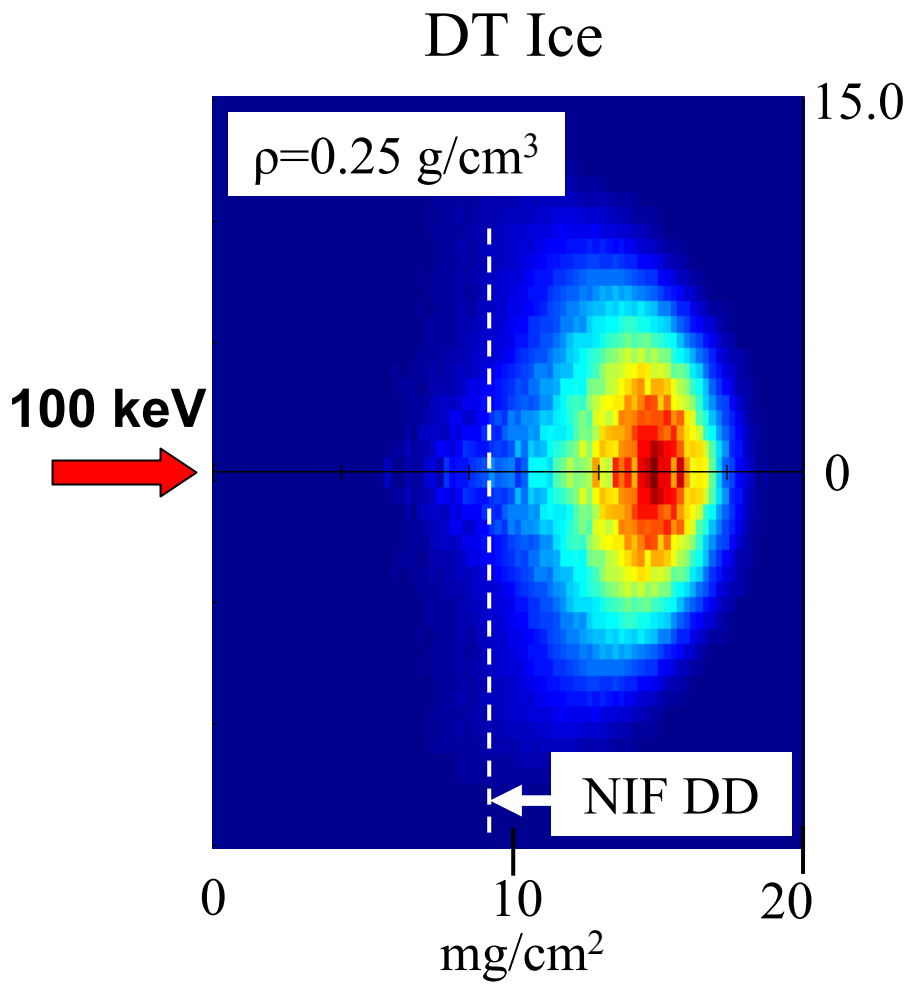
Penetration, Blooming and Energy Deposition of Energetic Electrons in Preheat Scenarios





R. D. Petrasso, C.K. Li, C.D. Chen

Summary and Conclusions

- A new plasma stopping model that couples energy loss and scattering has been applied to electron preheat scenarios

- There are factors of 2 differences between plasma and cold matter stopping at ~100 keV.

- Aspects of this model will be illustrated by showing the strong Z dependence of penetration and blooming

- The model is being applied to NIF direct and indirect drive electron preheat scenarios for both DT and Be

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Companion Presentations :

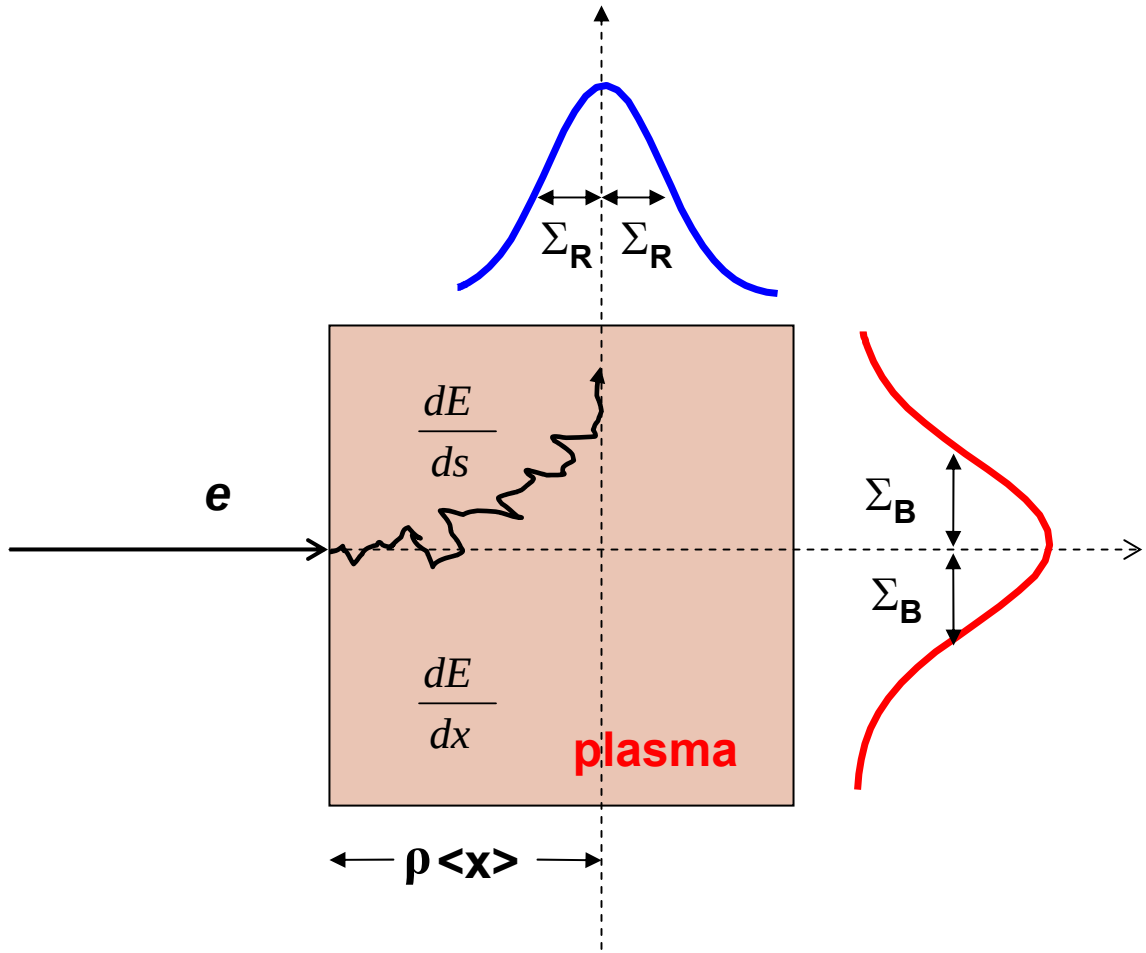
C. K. Li, Theory and Fast Ignition; Invited talk, Thur 11:30, QI2
C. D. Chen, Plasma/Cold Matter Comparisons; Poster, Thur AM , QP1

Basic Elements of the Plasma Stopping Model

- For hydrogenic plasmas, binary $e \rightarrow e$ and $e \rightarrow i$ scattering are comparable
- Energy loss, penetration and scattering are inextricably coupled
- Blooming and straggling effects, a consequence of scattering, lead to a non-uniform, extended region of energy deposition

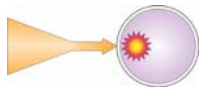
C. K. Li, Theory and FI; Invited talk, Thur 11:30, QI2; *PRE* ***70:*** *2004*

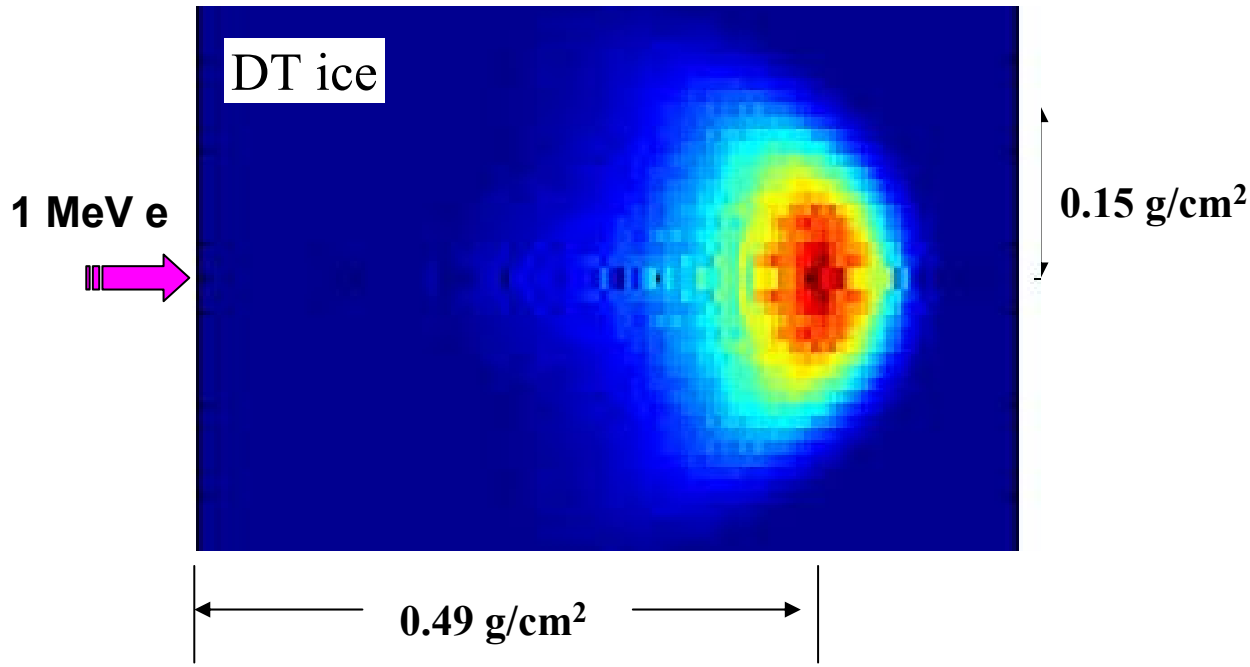
Scattering reduces the electron linear penetration, and it results in longitudinal straggling and beam blooming



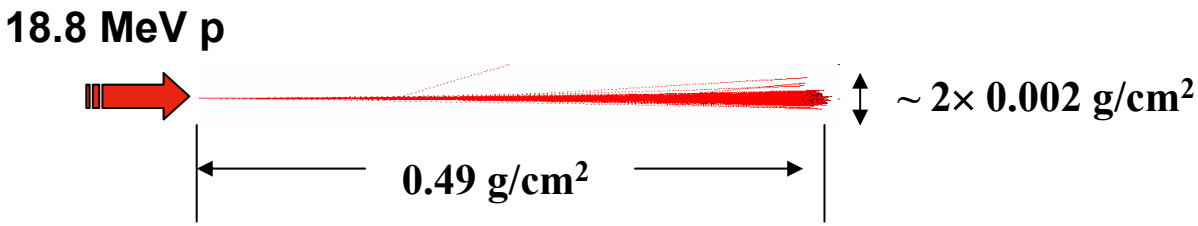
Scattering strongly modifies the energy deposition profile

For any Material, Electron Blooming and Straggling are ~100x that of Protons with the Same Penetration



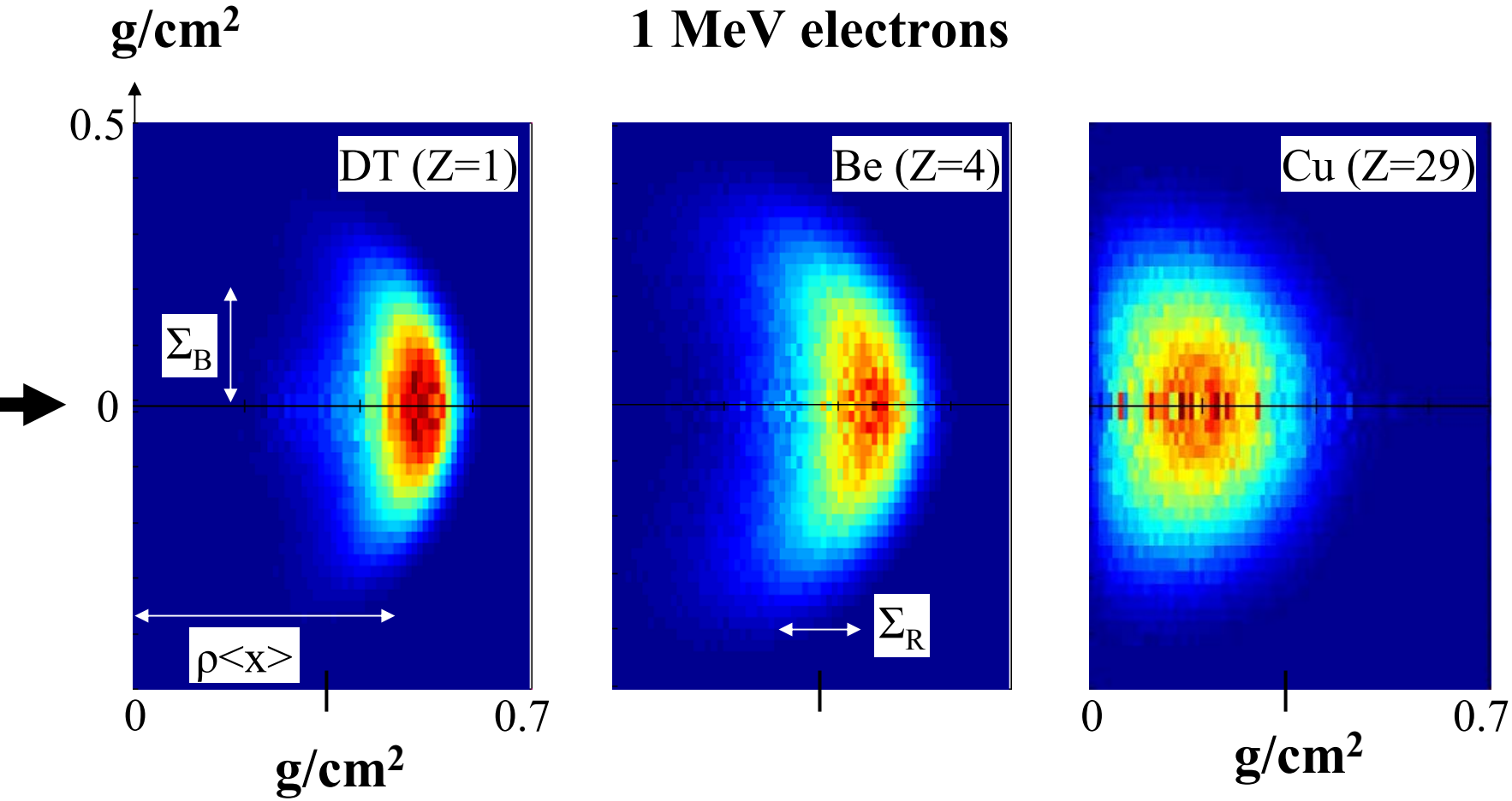


$$\frac{\Sigma_B}{\rho\langle x\rangle} \sim 30\%$$

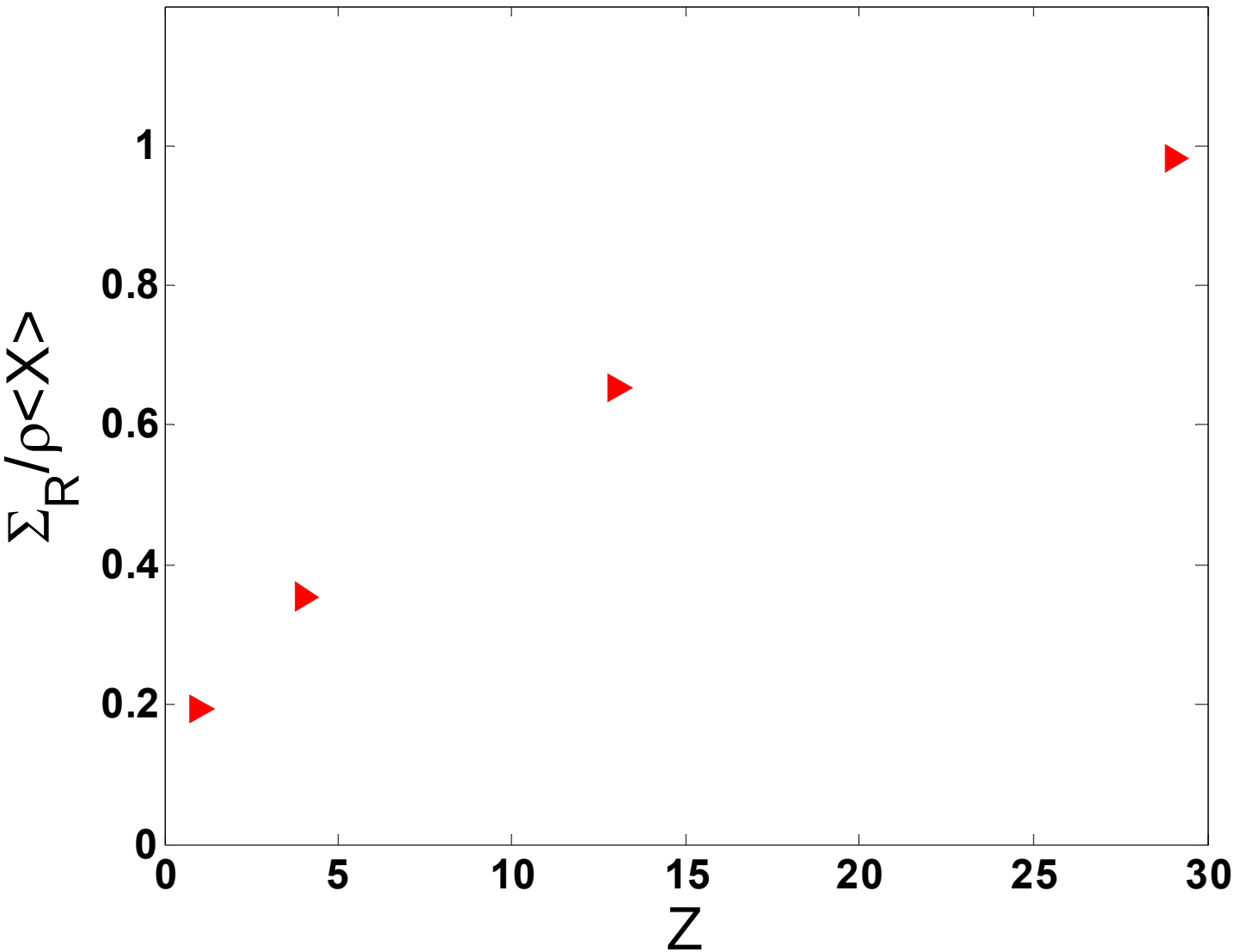


$$\frac{\Sigma_B}{\rho\langle x\rangle} \sim 0.5\%$$

Strong Z dependence of penetration, blooming and straggling is reflected in cold matter

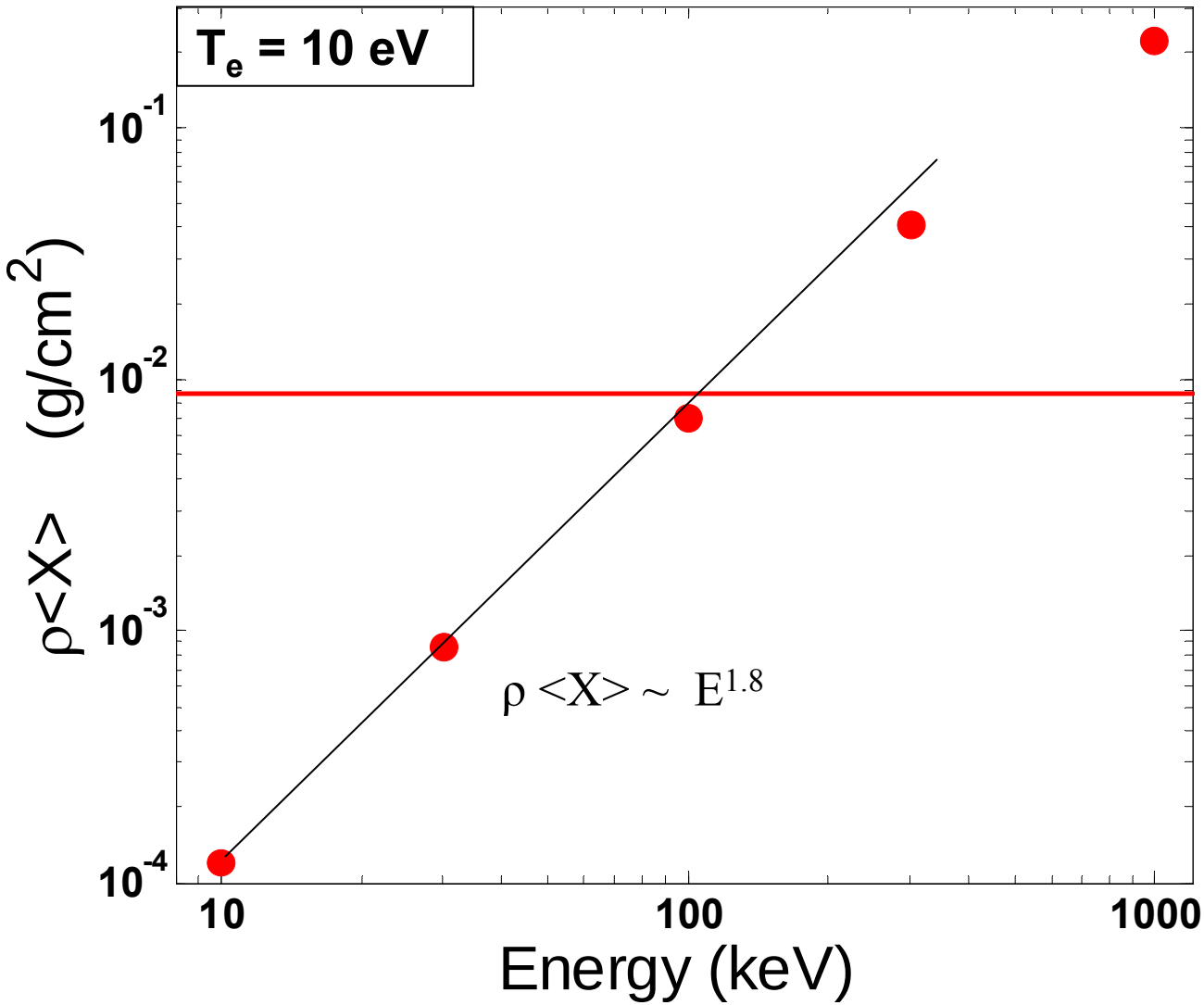


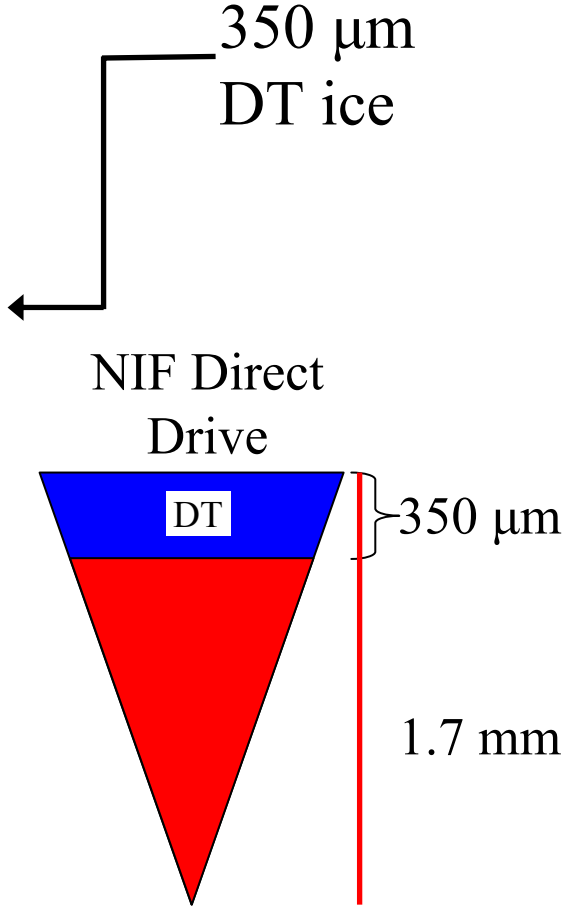
Plasma penetration and straggling also show a strong Z dependence



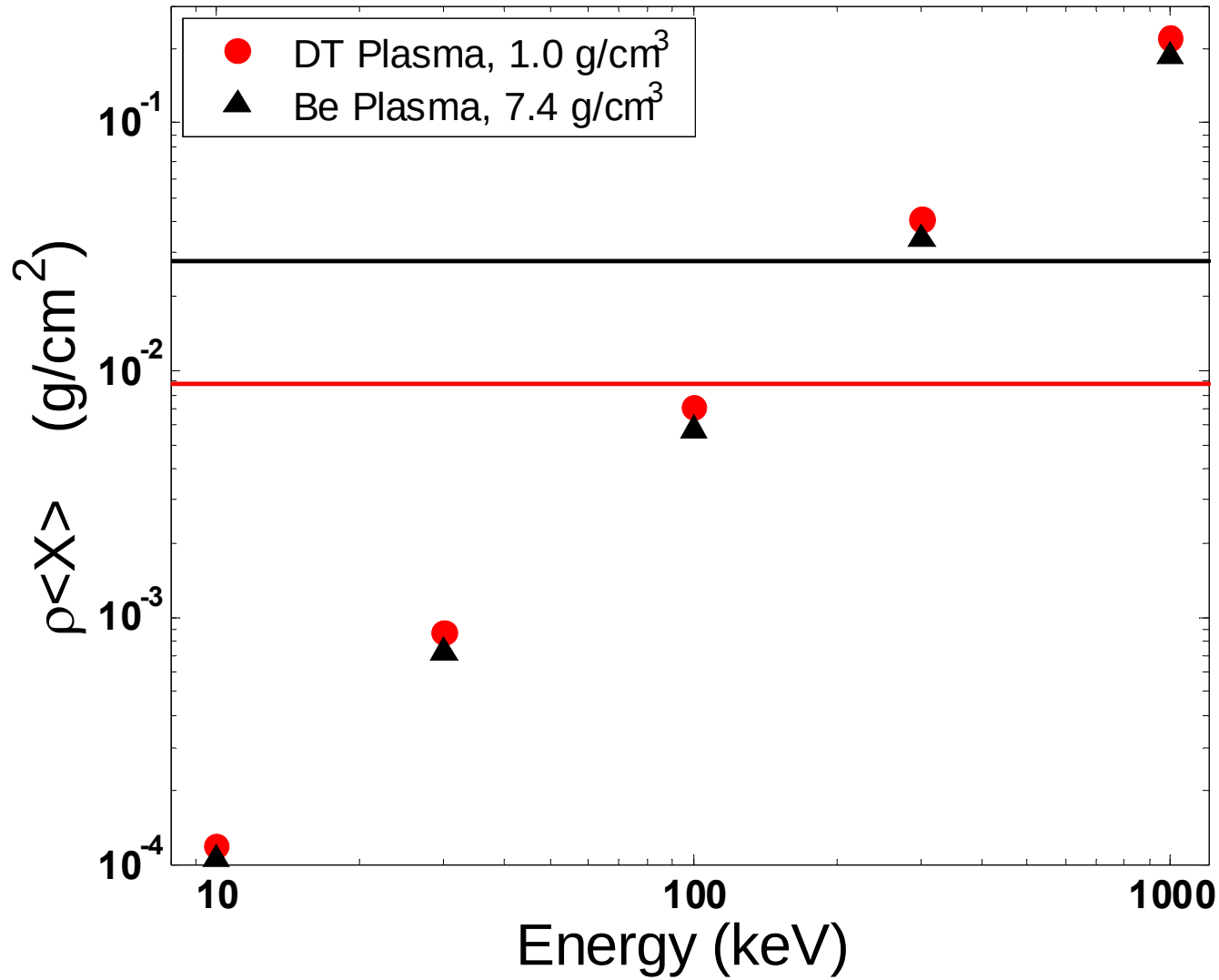
1-MeV e

100 keV electrons penetrate the NIF DT layer for degenerate plasmas of 1 g/cm^3



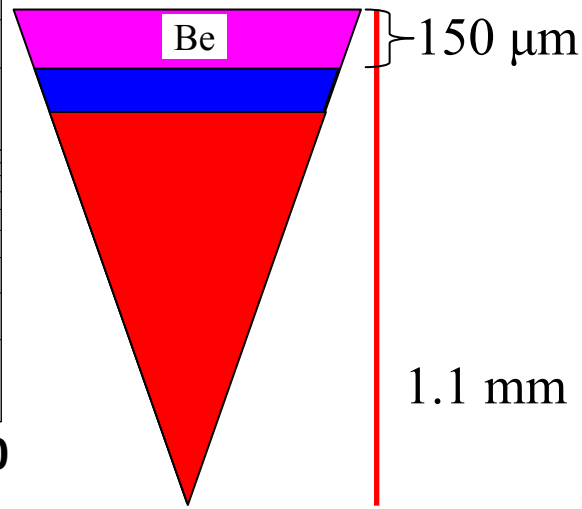


Comparison of electron penetration for 10 eV DT and Be degenerate plasmas at 4x solid density

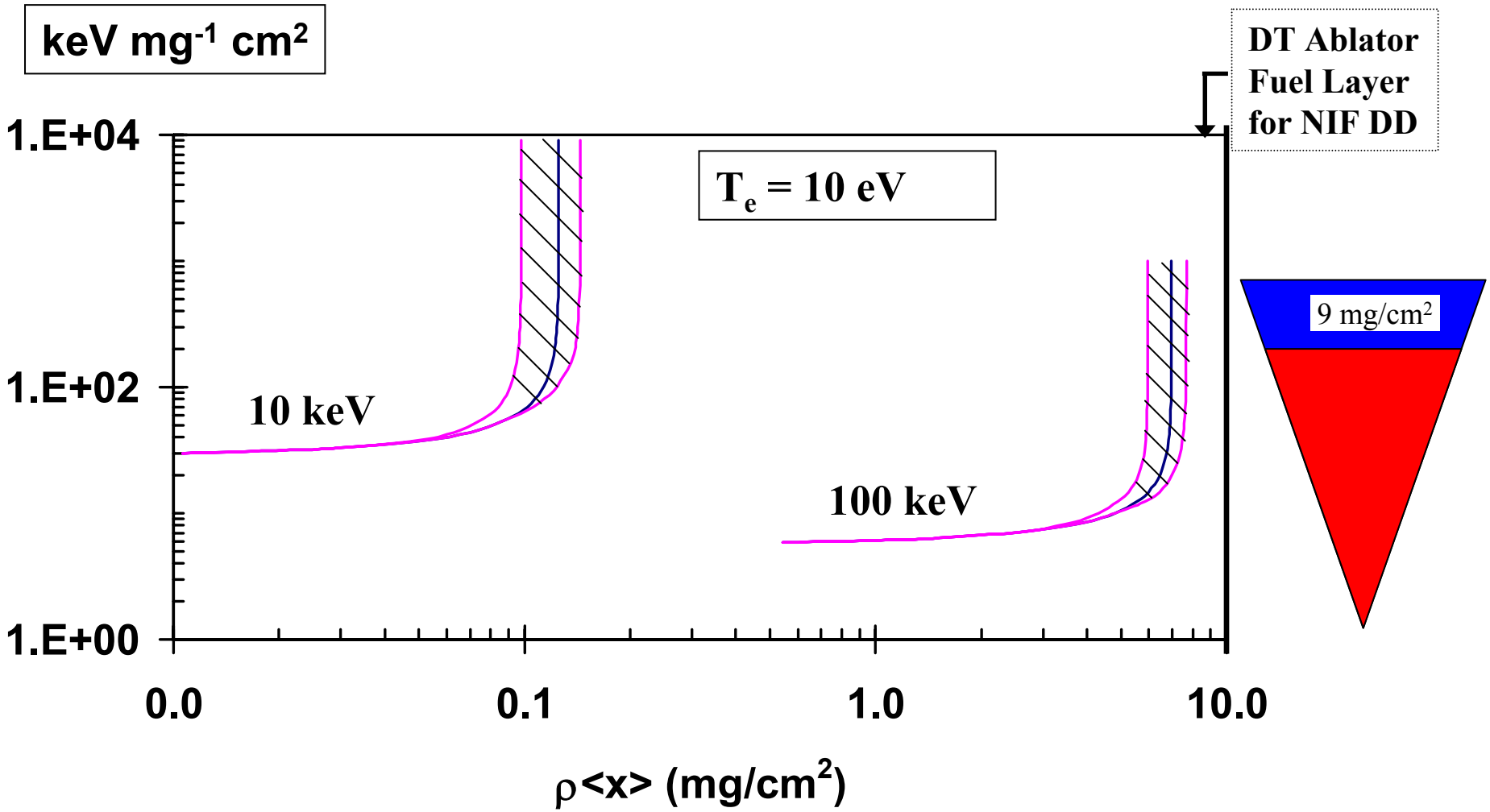


150 μm NIF ID Be ablator

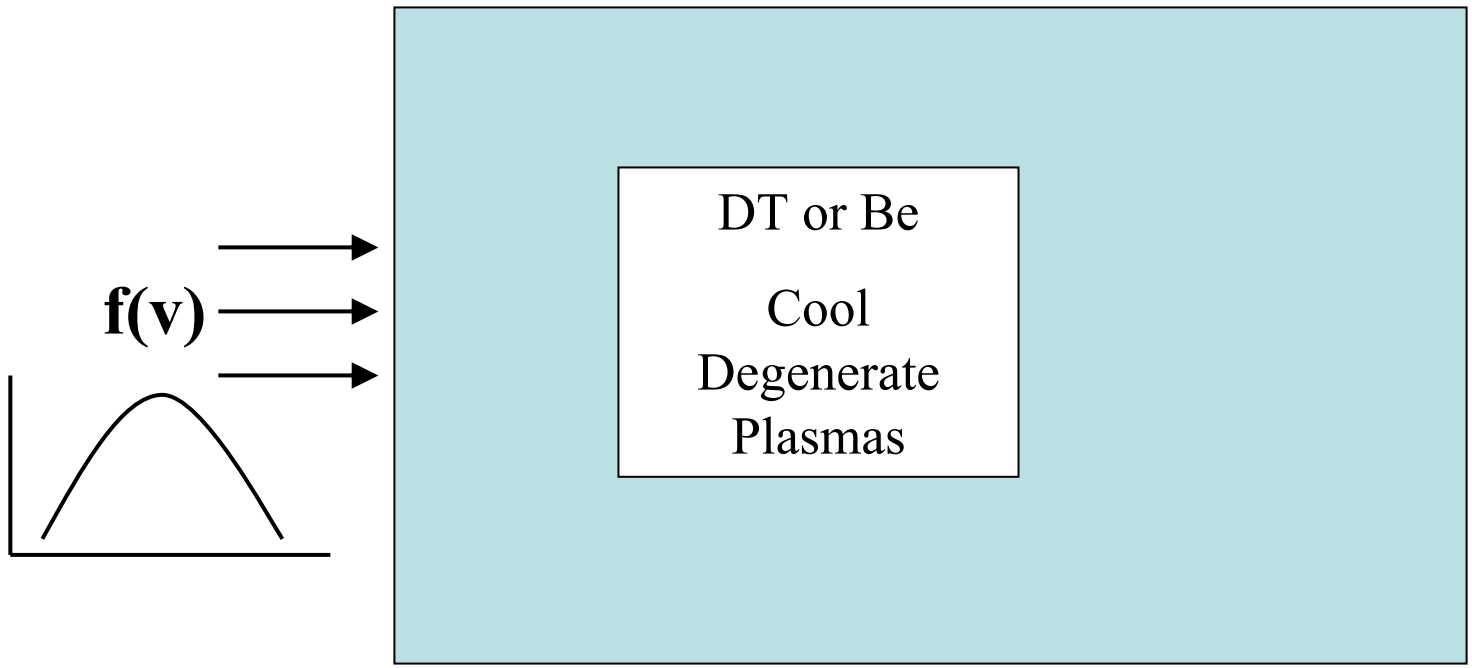
350 μm Direct Drive DT ice



Energy deposition profiles for 10 keV and 100 keV electrons into a degenerate DT plasma at 1.0 g/cm^3

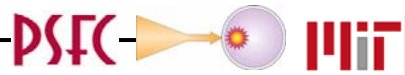


Next Steps



1. Select “realistic” electron distributions f(v,θ) for DD and ID
2. Calculate the change in adiabat for planar models

Summary and Conclusions



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