Equilibrium Thickness

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Why is low energy is hard?

Strong projectile–electron interaction:

- At low velocities, the projectile moves slowly enough that it's Coulomb field strongly distorts the target's electrons.

Adiabatic collisions & electron capture competition:

- The encounter lasts longer, allowing the electron to adapt to both nuclei instead of being knocked out. Instead of ionization, it often transfers to the projectile (capture). PWBA and CDW don't include this competing channel, so they overpredict ionization.

Multiple interactions and correlation:

- At low energy, electrons can interact with both centers several times during the same collision.

Ionization Cross Section – PWBA vs CDW

- *PWBA*→Simple, perturbative (valid only for small Kp); Overestimates ionization at low energies.
- *CDW-EIS*→ Includes field distortion and strong coupling; Relatively more reliable deeper into low energies (Kp<2).

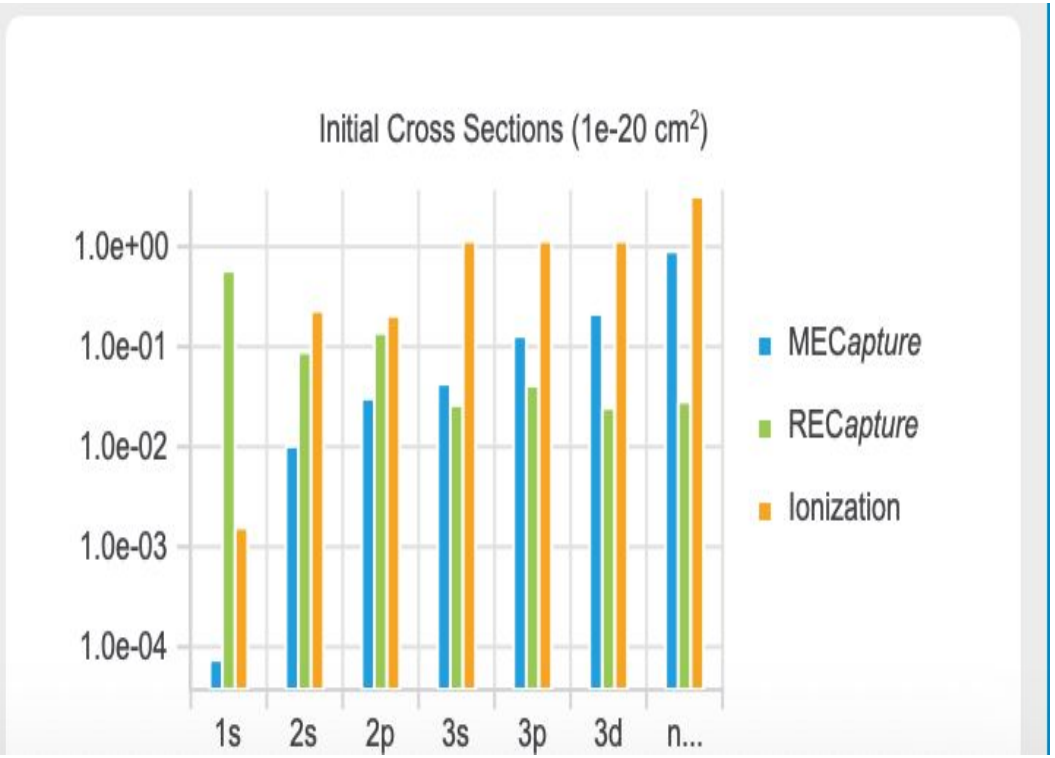
Effective lower limit: 0.1 MeV/u.

When Kp(n=1)>1, perturbative approach becomes unreliable.

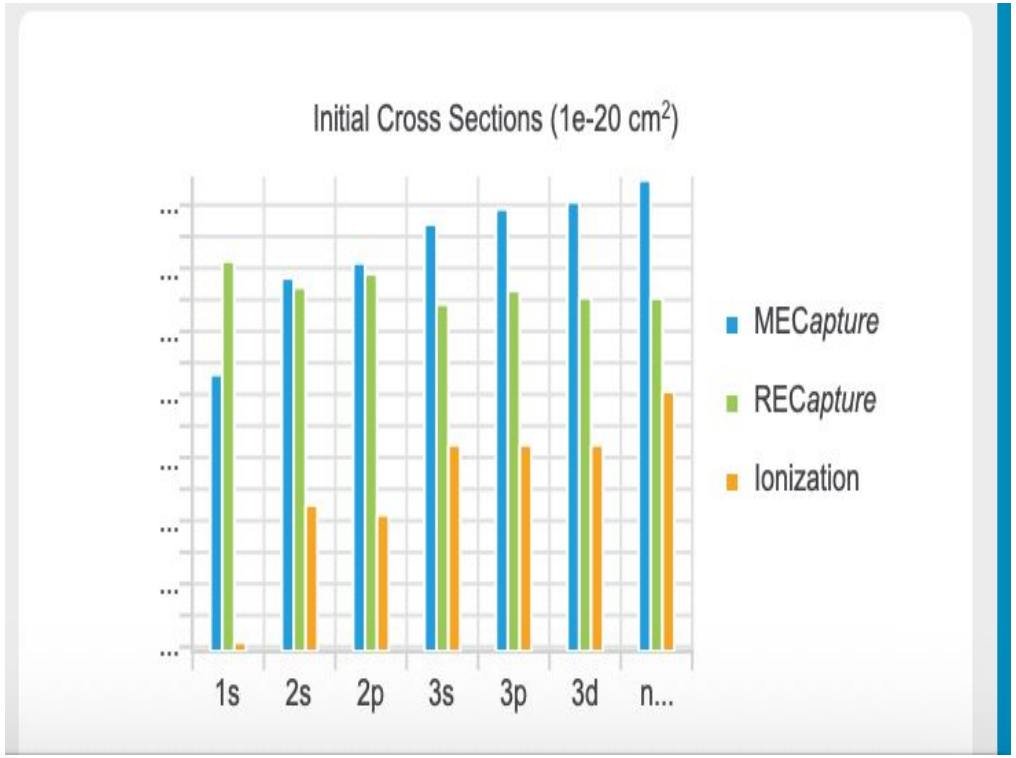
How to Push Lower

- Include high-n states (n>4) to capture low-E excitations.
- Lighter projectiles → smaller Kp.

True accuracy below 0.1 MeV/u needs non-perturbative (eikonal or close-coupling) physics.



Normal functioning plot



Capture bars explode; ionization bars collapse(especially 1s) .
Thus, the plot reads MECapture ≫ RECapture ≫ Ionization, with the biggest capture in high-n states.

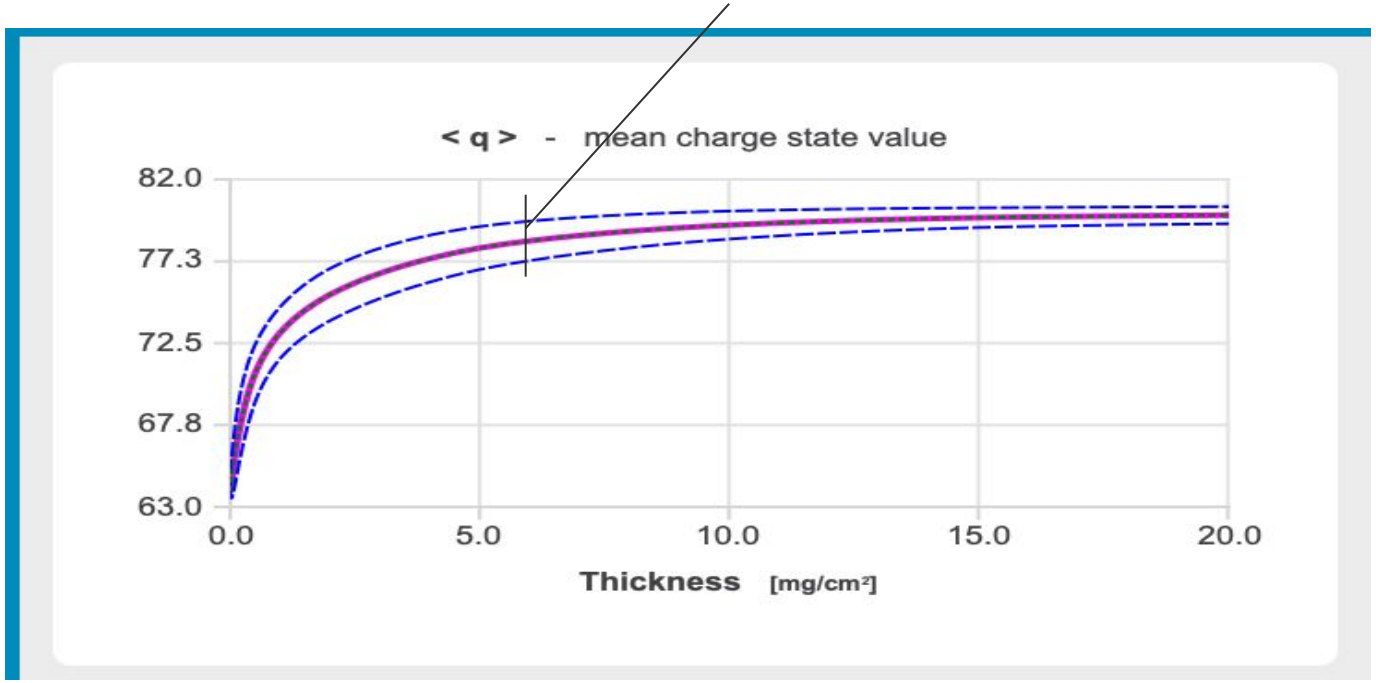
– Added two new methods to find Eq.Thickness

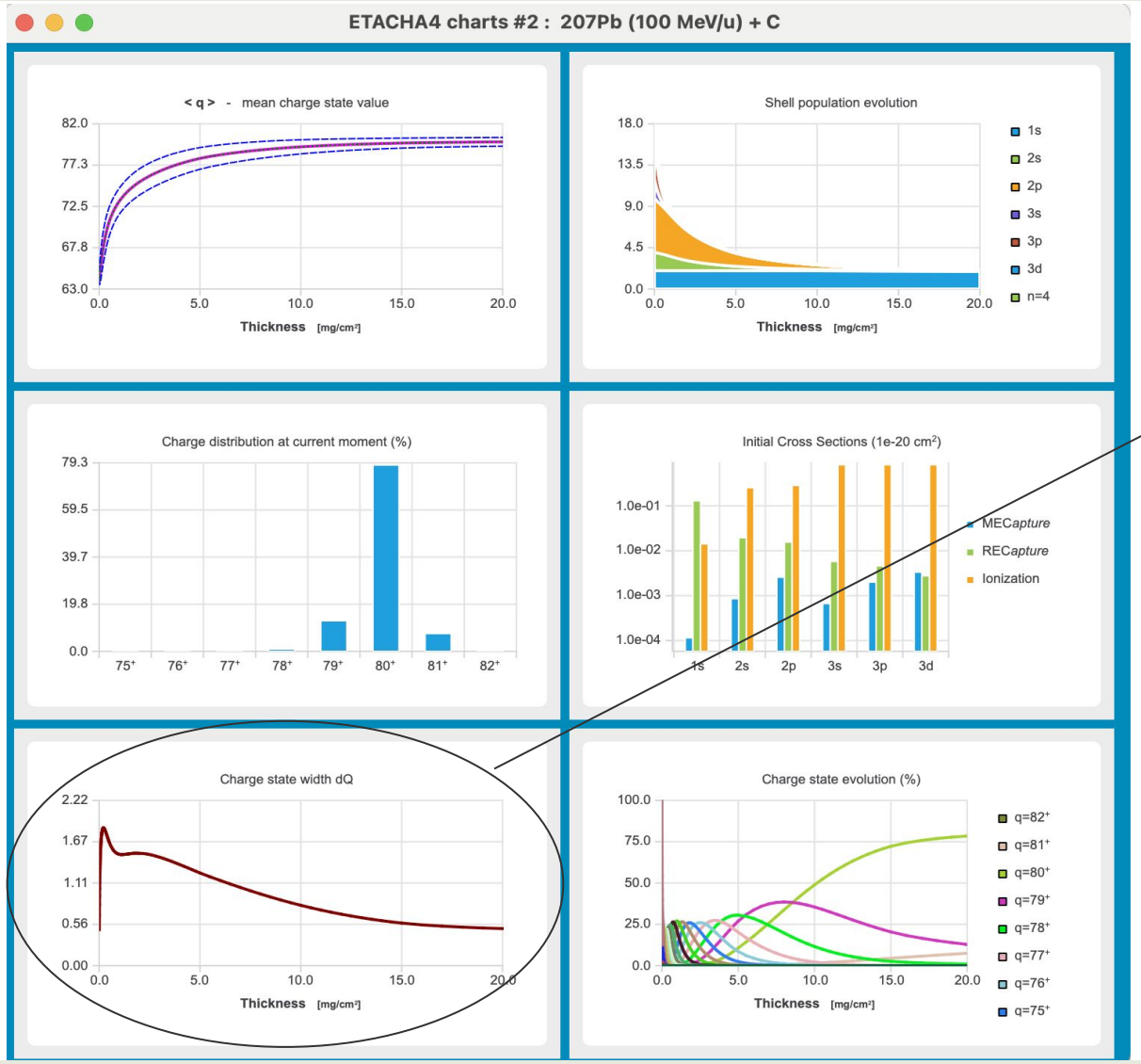
–Slope method tracks how the mean charge changes with thickness and declares equilibrium when the slope is small enough.

–The cross-section method finds the equilibrium thickness by evolving charge-state populations using capture and ionization cross-sections until the distribution stops changing with depth.

Equilibrium thickness:
Slope method ≈ 8.250 mg/cm^2
Cross-section method ≈ 8.283 mg/cm^2

Starts flattening around here





–Introduced a new graph of dQ vs Thickness

–All graphs combined into a singular grid

–New method of finding Equilibrium Thickness using charge-state distribution width.

–Works by detecting equilibrium thickness by sliding a small window over the data and declaring equilibrium when the dQ curve becomes flat and stable for several consecutive steps.

FINAL achieved >> T=100.000 mg/cm^2 **<Q>=80.898** **dQ=0.722** E=289.687 dSum=-2.000

Equilibrium thickness:
Slope method ≈ 14.438 mg/cm^2
dQ tracker ≈ 25.125 mg/cm^2
Cross-section method ≈ 18.198 mg/cm^2