

Section 5: Collisions

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4 Electron-Electron and Ion-Ion Collisions

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4.1 Elastic

Electron-Electron collisions in electric propulsion plasmas are kinda important but we never really analyze. These types of collisions lead to thermalization (equilibrium).

- Same physics as electron-ion Coulomb collisions, but with repelling forces. Same cross-section shape.
- Masses are equal so energy transfer is much more efficient.
- This is the most important process for thermalization within a species

When we say thermalization, we mean reaching equilibrium, a thermalized state. The mechanism by which they thermalize is via collisions.

In typical electric propulsion plasma, ν_e the electron electron collision frequency is much larger than the ion ion collision frequency.

$$\nu_{e-e} \gg \nu_{i-i}$$

This is because electrons weigh a lot less and move a lot faster. In general, electrons will be thermalized and will have lots more collisions while the ions may not ever reach a thermalized state since they are heavier and slower.

4.2 Inelastic

Would require lots of energy for two like charges to get that close together. Particles would have to get really close to get to second-ionization state.

4.3 Radiation

Masses are equal so no net acceleration, and thus no Bremsstrahlung

Overall, elastic electron-electron collisions are most dominate in electric propulsion systems.