

Spectra and Ionization Efficiencies of Charged Decay Particles in Kilonova Ejecta

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Ionization by radioactive decay products plays a central role in determining the nebular spectra of kilonovae. We calculate the ionization efficiencies of α -particles and fission fragments in expanding kilonova ejecta using self-consistent models for particle transport, thermalization, and degradation spectra. Despite large differences in mass, charge, and injection energy between β -electrons, α -particles, and fission fragments, we find that the work per ion pair is remarkably similar across all decay channels and target species considered. This similarity arises because ionization and energy loss are governed by the same underlying collision physics, causing their ratio to remain nearly constant over the relevant energy range. These results suggest that the ionization state of late-time kilonova ejecta depends only weakly on the dominant radioactive decay channel.