RELATIVISTIC ELECTRON-POSITRON PLASMA SCREENING IN ASTROPHYSICAL ENVIRONMENTS

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If an astrophysical environment is hot enough (greater than approximately 0.5 MeV or so), screening in the associated nuclear reactions can be modifed by the presence of a relativistic electron-positron plasma. For non-zero electron chemical potentials, the effect is compounded as the Debye length in a plasma can drop significantly. The effect of screening is to shift the reaction energy in the cross-section. This can result in an enhancement of nuclear reaction rates, and the reaction rate enhancement factor is studied in several relevant scenarios. For sub- or near-threshold resonances, this could potentially change the reaction rates by a significant amount as the reaction energy effectively shifts the resonance above or below threshold. Possible sites where relativistic plasma screening could have a significant effect on observed results include Big Bang Nucleosynthesis, α-rich freezout in the r-process, x-ray bursts, and type Ia supernovae in white dwarfs. Most recently, the effects of the screening due to the relativistic electron-positron plasma during the Big Bang Nucleosynthesis have been explored. While the effects of relativistic screening was found to be relatively small in the standard Early Universe models, further work is being done to explore the same effects in the above-mentioned astrophysical sites. Additional work is currently focussed on possible effects on the production of ^{56}Ni in type Ia supernovae, effects on light curves (both frequency and duration) in X-ray bursts, and effects on the electron fraction in the astrophysical r-process following α-rich freezeout.