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Enhanced Collision Rates in Correlated Plasmas[1] C.F. DRISCOLL, F. ANDEREGG, D.H.E. DUBIN, T.M. O'NEIL, UCSD — Experiments on cryogenic pure ion plasmas corroborate the Salpeter collisional enhancement[2] factor $g(\Gamma)$ when the correlation parameter $\Gamma \equiv e^2/aT$ is large. This factor enhances the perp-to-parallel collision rate in the magnetized plasmas described here,[3] and also enhances the nuclear reaction rates in dense stellar interiors. The enhancement is caused by plasma screening of the repulsive Coulomb potential, enabling closer collisions for a given particle energy. The Salpeter theory assumes thermal equilibrium screening, whereas various dynamical theories suggest other factors. Prior experiments[4] corroborate the predicted $g \sim \exp(\Gamma)$ enhancement with enhancements as large as $g \sim 10^{11}$. Current theory is considering the effects of parallel collisions in multi-species ion plasmas, and cyclotron modes and energy exchange. Current experiments with improved laser cooling and plasma stability will provide more accurate tests of equilibrium theory in the sensitive regime of $\Gamma \leq 1$, and may also approach the (classical) pycnonuclear regime.

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[2]E.E. Salpeter & H.M. VanHorn, Astrophys. J. 155, 183 (1969)
[3]D.H.E. Dubin, Phys. Plas. 15, 055705 (2008)
[4]F. Anderegg et al., PRL 102, 185001 (2009)

C.F. Driscoll
UCSD

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