Measurement of Correlation-Enhanced Collision Rates in the Mildly Correlated Regime \((\Gamma \sim 1)^1\) F. ANDEREGG, D.H.E. DUBIN, M. AFFOLTER, C.F. DRISCOLL, UCSD — We have recently measured correlation-enhanced perpendicular-to-parallel collision rates \(\nu_{\perp//}\) in cryogenic, strongly magnetized ion plasmas in the mildly correlated regime. The enhancement of \(\nu_{\perp//}\) is directly analogous \([1]\) to the correlation-enhancement of fusion collisions in hot dense stellar plasma, as first analyzed by Salpeter \([2]\). The enhancement occurs because plasma screening reduces the repulsive Coulomb potential between charges, allowing closer collisions for a given relative energy. The correlations are parameterized by \(\Gamma = e^2/aT\) which is the ratio of the nearest neighbor potential energy to the ion thermal energy. Our prior measurements \([3]\) over the range \(0 < \Gamma < 15\) observed enhancement up to \(10^7x\), in broad agreement with Salpeter “equilibrium screening” theory. However recent “dynamical screening” theories \([4]\) predict negligible enhancement for \(\Gamma \sim 1\). In our magnesium ion plasmas, we obtain \(\Gamma \sim 1\) at densities \(n = 2 \times 10^7\text{cm}^{-3}\) and temperatures \(T \approx 5 \times 10^{-5}\text{eV}\). Recent improvements in our cooling and diagnostic lasers provide better long-term stability in \(T\), enabling more accurate measurements of the enhancements. Our new results rule out the dynamical screening theories. \([1]\) D.H.E. Dubin, Phys. Plasmas \textbf{15}, 055705, (2008) \([2]\) E.E. Salpeter, Austr. J. Phys., 7, 373, (1954) \([3]\) F. Anderegg et.al., Phys. Rev. Lett. \textbf{102}, 185001, (2009) \([4]\) W. Däppen and K. Mussack Contrib. Plasma Phys. 52, 149, (2012).

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