Abstract Submitted
for the DPP08 Meeting of
The American Physical Society

Measurements of Correlation-Enhanced Collision Rates

F. ANDEREgg, D.H.E. DUBIN, T.M. O’NEIL, C.F. DRISCOLL, UCSD — We measure the perp-to-parallel collision rate $\nu_{\perp\parallel}$ in laser-cooled Magnesium ion plasmas in the strongly-magnetized and correlated regime; and obtain close agreement with the “Salpeter correlation enhancement” first studied for fusion in dense plasmas such as stars. The cyclotron energy, like nuclear energy, is released only through rare close-range collisions. These close collisions are suppressed by strong magnetization, because collisional impact distances are rarely as small as a cyclotron radius $r_c$. However, theory predicts that particle correlations reduce this suppression of collisionality, enhancing the rare close collisions by $e^\Gamma$, where $\Gamma \equiv e^2/aT$ is the correlation parameter. We control the plasma temperature over the range $4 \times 10^{-6} < T < 1 \text{eV}$, giving correlation parameters up to $\Gamma \sim 20$, with measured collision rates $2 < \nu_{\perp\parallel} < 2 \times 10^4 \text{sec}^{-1}$. At low temperatures, the measured $\nu_{\perp\parallel}$ are enhanced by up to $10^9$ compared to uncorrelated theory, consistent with the predicted correlation enhancement. When the plasma density is reduced from 2 to $0.12 \times 10^7 \text{cm}^{-3}$, the correlations are eliminated and the measured $\nu_{\perp\parallel}$ agree with uncorrelated theory.

1Supported by NSF/DOE PHY-0613740 and NSF PHY-0354979.

Francois Anderegg

Date submitted: 19 Jul 2008