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Penning ion trap experiments at NIST J.J. BOLLINGER, M.J. JENSEN, T. HASEGAWA[1], NIST, Boulder, CO 80305, D.H.E. DUBIN, Phys. Dept., UCSD, La Jolla, CA 92093 — We summarize recent work and discuss future plans for experiments with laser-cooled, strongly correlated Be^+ ions stored in a Penning-Malmberg trap. We measured the equilibration rate of ion cyclotron energy with ion energy parallel to the magnetic field and find that it is enhanced by more than 10^{10} over that predicted for uncorrelated plasmas[2]. The enhancement is due to screening of the Coulomb repulsion between colliding ion pairs by the surrounding (correlated) plasma and is closely related to the enhancement of nuclear reactions in dense stellar interiors[3]. This is the first observation of this enhancement in the strongly correlated regime and it can provide, along with future work, a method to advance our understanding of nuclear reactions in high energy density plasmas. We also describe plans for a different type of experiment where we propose to entangle the internal states of ions in small planar plasmas. The proposed method uses quantum gates developed for a few ions in an rf trap on up to ~ 1000 ions in a Penning trap. The resulting "spin-squeezed" states can be used to improve the precision of a spectroscopic measurement.

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[2]Jensen et al., PRL **94**, 025001 (2005); Dubin, PRL **94**, 025002 (2005)
[3]Salpeter, Australian J. Phys. **7**, 353 (1954); adjacent poster by Dubin

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