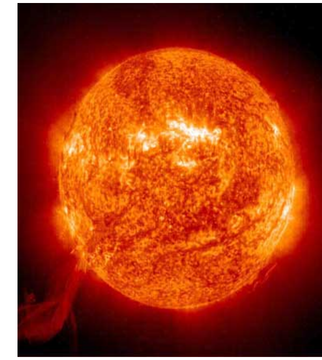
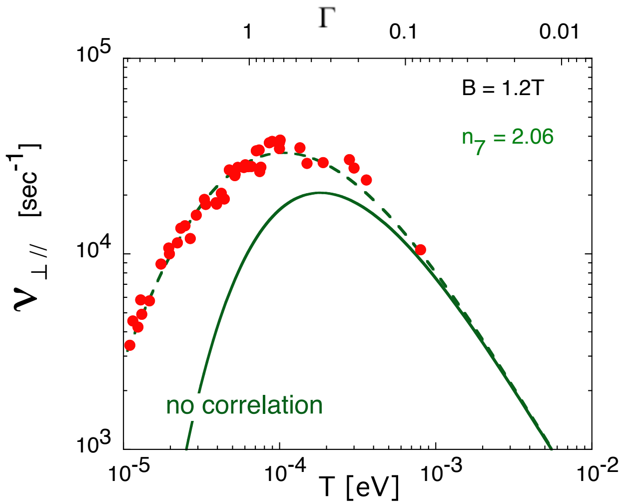
Driscoll /Dubin /O'Neil, UCSD

Correlation-Enhanced Collisions, *à la* Salpeter



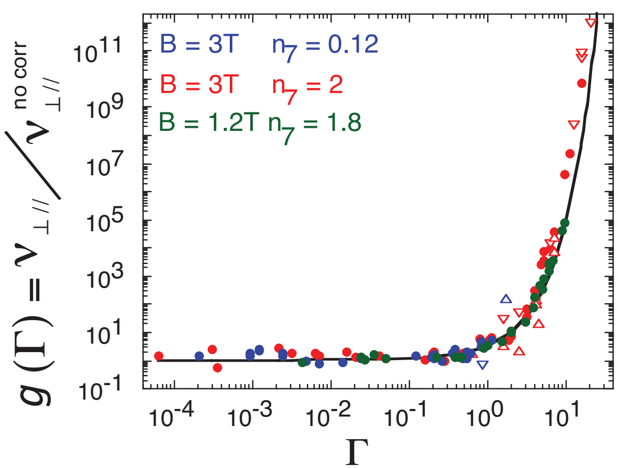
Salpeter predicted that the nuclear fusion rate in a dense, strongly correlated plasma (e.g., a white dwarf star) is enhanced by inter-particle correlations. The predicted enhancement is approximately *exp*(Γ), where Γ is the correlation parameter.



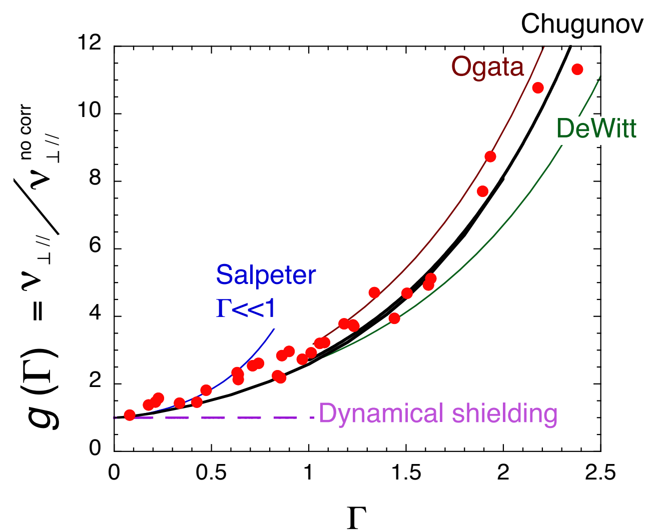
Dubin (2008) argued that the same enhancement occurs in perp-to-parallel collisions in a pure ion plasma at low temperatures. For $T < 10^{-3}$eV and strong magnetization, an adiabatic invariant suppresses collisions (solid curves), but correlation re-enhances them (dashed curves).

Our measurements (dots) clearly show the magnetization suppression, and show correlation enhancements *g*(Γ) up to 9 orders of magnitude over a wide range of densities and temperatures (Anderegg 2013).

However, recent theories of "dynamical screening" (Dappen 2012) predict *zero* enhancement near $\Gamma \sim 1$, where our initial data was least accurate.



We improved the stability of our diagnostic and control lasers, with DOE/HEDLP funding. Our new results (right) rule out dynamical screening, and are most consistent with the equilibrium screening calculations of Chugunov (2007).



D.H.E Dubin, Phys. Plasmas **15**, 055705 (2008)

F. Anderegg et al., AIP Conf. Proc. **1521**, 257 (2013)

References,
Correlation-Enhanced Collisions, *à la* Salpeter

Driscoll/ Dubin /O'Neil

Equilibrium Screening:

J.N. Bahcall, L.S. Brown, A. Gruzinov, R.F. Sawyer, Astronomy & Astrophysics **383**, 291 (2002) (theory review)

E.E. Salpeter, Aust. J. Phys. **7**, 373 (1954)

Dynamical Screening & Related:

N.J. Shaviv, & G. Shaviv, ApJ **468**, 433 (1996)

C. Carraro, A. Schafer & S.E. Koonin, ApJ **331**, 565 (1997)

A. Lavagno & P. Quarati, Nucl. Phys. B (Proc. Supl.) **87**, 209 (2000)

G. Shaviv & N.J. Shaviv, ApJ **529**, 1054 (2000)

V.N. Tsytovich, A&A **356**, L57 (2000)

V.I. Savchenko, Phys. Plasmas **8**, 82 (2001)

W. Dappen & K. Mussack, Contrib. Plasma Phys **52**, 149 (2012)

UCSD Experiments & Theory:

D.H.E. Dubin, "Measurement of Screening Enhancement to Nuclear Reaction Rates Using a Strongly-Magnetized and Strongly-Correlated Non-Neutal Plasma", Phys. Rev. Lett. **94**, 025002 (2005)

D.H.E. Dubin, "Modeling Nuclear Fusion in Dense Plasmas Using a Cryogenic Non-Neutral Plasma", Phys. Plasmas **15**, 055705, (2008)

F. Anderegg, D.H.E. Dubin, T.M.O'Neil & C.F. Driscoll, "Measurement of Correlation-Enhanced Collision Rates", Phys. Rev. Lett. **102**, 185001 ((2009)

F. Anderegg, C.F. Driscoll, D.H.E. Dubin & T.M. O'Neil, "Measurement of Correlation-Enhanced Collision Rates Using ure Ion Plasmas", Phys. Plasmas **17**, 055702 (2010)

F. Anderegg et.al., "Measurements of Correlation-Enhanced Collision Rates", AIP Conf. Proc. **1521**, 257 (2013)