Sci**light**

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Laser-cooled plasmas yield first measurements of enhanced collision rates for coupled plasmas found in stars

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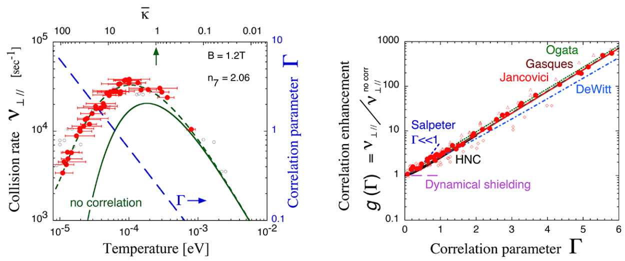
Physicists measure plasma collision rates to investigate stellar interior screening enhancement.



In 1954, astrophysicist Edwin Salpeter proposed a theory that assumed the plasma response to colliding particles could be described as static thermal equilibrium Debye screening.

Now, a team of physicists from the University of California, San Diego, reporting in *Physics of Plasmas,* have made the first accurate measurement of the Salpeter approximation in a laser-cooled, magnetized ion plasma. The results are directly analogous to the enhancement of fusion collisions in hot dense stellar plasmas and may settle an ongoing debate about the veracity of Salpeter's theory.

The experiments were conducted using a cryogenic magnesium ion plasma at temperature 0.1 K < T < 10 K confined in a Penning-Malmberg trap with a magnetic field of 1.2 T. While no fusion reactions occurred in the plasma, the researchers measured the enhancement of perpendicular-to-parallel collisions, which has been shown to be a mathematical isomorphism to the nuclear reaction enhancement.

They used the "optimal frequency" technique, which determines the compression/expansion frequency at which axial compressions give maximal heating. The resulting measurements showed enhancement in the mildly correlated regime consistent with equilibrium and not dynamical screening theory.

The traditional equilibrium screening theory starkly contrasts dynamical screening theory, which predicts that because colliding pairs move much faster than average thermal speed, surrounding particles have no time to adjust, and consequently almost no screening enhancement appears for the mildly correlated regime with a plasma coupling close to 1 ($\Gamma \sim 1$).

First author Francois Anderegg believes their results have ruled out dynamical screening and finally settled this controversy in the field. Next, they plan to simulate a propagating burn front, another phenomenon in nuclear fusion, using similar methods.

Source: "Measurements of correlations enhanced collision rates in the mildly correlated regime ($\Gamma \sim 1$)," by F. Anderegg, D. H. E. Dubin, M. Affolter, and C. F. Driscoll, *Physics of Plasmas* (2017). The article can be accessed at https://doi.org/10.1063/1.4999350.