Abstract Submitted
for the DPP20 Meeting of
The American Physical Society

New Thermal Conductivities for Warm Dense Matter and the Age of the Galaxy NATHANIEL SHAFFER, SIMON BLOUIN, DIDIER SAUMON, CHARLES STARRETT, Los Alamos National Laboratory — In white dwarfs that undergo convective coupling, the degenerate conductive core and outer convective plasma are separated by a layer of warm dense matter. This layer acts as a bottleneck for the transport of energy from the core to the convection zone, and the cooling rate and inferred age of the white dwarf are sensitive to the thermal conductivity of this warm dense plasma. However, the thermal conduction models used in most stellar evolution codes do not treat these conditions accurately, due to a combination of ion Coulomb correlations, partially degenerate electrons, and e-e scattering. The recently developed mean-force quantum Landau-Fokker-Planck kinetic theory tackles all these challenges and provides an accurate and predictive theory of thermal conduction at conditions relevant to convective coupling in H- and He-dominated white dwarf atmospheres. It is found that the bottom of the convection zone of these white dwarfs can be 2-3 times more conductive than predicted by the widely used model of Cassisi et al. (2007). This leads to more rapid cooling and dimming of the star, on the order of 1 Gyr for massive white dwarfs. Taken in isolation, this result would dramatically impact the use of white dwarfs as cosmological clocks.

Nathaniel Shaffer
Los Alamos National Laboratory

Date submitted: 29 Jun 2020 Electronic form version 1.4