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Transport Phenomena in Neutron Star Cores

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Multi-messenger observations of neutron stars are likely to usher in a golden age of nuclear astrophysics and promote neutron stars to one of the most interesting "laboratories" in the universe. Transport in the outer core of neutron stars determines a number of observable phenomena, including the damping of hydrodynamic modes, r-modes and the spin evolution of neutron stars. In the core of a neutron star we expect to find a dense plasma comprised of electrons, muons, protons and neutrons interacting via electromagnetic and strong forces. The complicated interplay of these interactions lead to screening and damping effects which have a profound impact on the spectra of photons within the plasma. The photon spectrum in turn strongly modifies the scattering rate of fermions in the plasma and therefore the transport.
I will provide a detailed study of the photon spectrum and scattering rates based on the relativistic Random Phase Approximation (RPA), placing a particular focus on dynamical screening effects and collective modes. Potential repercussions on the interpretation of future observations of neutron stars will be discussed.

Primary author(s) : Mr STETINA, Stephan (TU Vienna)

Presenter(s) : Mr STETINA, Stephan (TU Vienna)

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