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Transport coefficients in superfluid neutron stars

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We study the shear and bulk viscosity coefficients as well as the thermal conductivity as arising from the collisions among phonons in superfluid neutron stars. We use effective field theory techniques to extract the allowed phonon collisional processes, written as a function of the equation of state of the system.

We analyze the shear viscosity taking into account the contribution of superfluid phonons to the viscosity, both in their hydrodynamical and ballistic regime. We compare to recent calculations of the shear viscosity from electron collisions and comment on the possible consequences for r-mode damping in superfluid neutron stars. Moreover, we find that phonon collisions give the leading contribution to the bulk viscosities in the core of the neutron stars, except for n ~ 2n0 when the opening of the URCA processes takes place. We finally obtain the thermal conductivity from phonon collisions and compare it with the electron thermal conductivity in superfluid neutron stars.

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