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Numerical Models For Superfluid Neutron Stars With Realistic Equation Of State And Application To Pulsar Glitches

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We present a realistic numerical model for rotating superfluid neutron stars in a full general relativistic framework. Following the work initiated by Prix, Novak & Comer [1], we compute stationary axisymmetric configurations of neutron stars composed of two fluids, namely superfluid neutrons and charged particles (protons and electrons), which are free to rotate around a common axis with different rigid rotation rates. This system is described by a realistic equation of state derived from a relativistic mean field theory using DDH parametrization including (or not) delta mesons. Then, we apply this model to investigate pulsar glitches in a very simple way. From a series of equilibrium states of a neutron star, assuming total baryon mass and total angular momentum to be constant, we compute the evolution in time of the properties of the star during a glitch. To do so, we model a glitch as a transfer of angular momentum from one fluid to the other, through the action of mutual friction force [2]. This enables us to infer characteristic features relative to glitches, such as rise timescales, which could be compared to future accurate observations.

[1] Prix, R., Novak, J. & Comer, G. L., Relativistic numerical models for stationary superfluid neutron stars, Phys. Rev. D 71, 2005

[2] Langlois, D., Sedrakian, D. M. & Carter, B., Differential rotation of relativistic superfluid in neutron stars, MNRAS 297, 1998

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