Scientific Report on the STSM

COST-STSM-MP1304-24260

Quasi-radial pulsations in rotating Neutron Stars

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I report on the STSM I made at the Goethe University in Frankfurt from 16 to 20 March, 2015.

The main purpose of my STSM was to start a collaboration with Prof. Sedrakian, on the calculation of the frequencies of quasi-radial modes both in static and rigidly-rotating neutron stars.

In this initial stage our goal was to create a framework for further collaboration. During the STSM we selected and identified the equations of state (EOS) that will be studied. In the hadronic regime we chose a set of realistic EOS derived in the framework of the Brueckner-Hartree-Fock many-body theory and phenomenological density functional theories (relativistic mean field models). The description of the quark phase is based on the Nambu–Jona-Lasinio and the Field Correlator Method models.

We have further discussed the framework of perturbative, general-relativistic computation of fundamental modes of slowly rotating stars using the formalism developed in the 1970s. This will serve as a basis for creating a code for computation. Furthermore, we have set up the key ideas that are behind the computation of the modes: (a) comparison of results based on the relativistc EOS and polytropes; (b) effects of the first order phase transition on the oscillations modes.

We further studied the literature related to the possibility of detecting the signals emitted at the frequencies of the quasi-radial modes by currently operating gravitational wave (GW) detectors. Our purpose is to understand whether a gravitational signal may give some clear information on the equation of state of the neutron or hybrid star. We have identified the relevant framework that will be used after the frequencies are computed.

In the upcoming months we will concentrate on (a) re-deriving the key equations of the theory and cross-checking this with the older literature; (b) creating a code for computation of the modes both for non-rotating and slowly-rotating configurations. (c) Performing computations for our chosen set of EOS. This will be followed by the publication of one or two papers on this subject.