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Numerical studies of the dynamical bar-mode instability in rapidly rotating relativistic stars

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We present numerical results on the dynamical bar-mode (m=2) instability in differentially rotating relativistic star models with a polytropic EoS, obtained by means of full 3D ideal magneto-hydrodynamics simulations in full General Relativity. We focus our attention on two different ingredients that may affect the onset and the dynamics of the instability, i.e., the magnetization and the stiffness of the EoS. The first study is carried out by superimposing to initial (matter) equilibrium configurations purely poloidal magnetic fields of different strength (in the range 10^{12}-10^{16} Gauss). We find that magnetic fields of order 10^{15} Gauss or less have negligible effects on bar-mode unstable models, while stronger magnetic fields are able to completely suppress the hydrodynamic instability which is present in the unmagnetized case. The second study is carried out by changing the adiabatic index of the polytropic EoS from 2 to 2.75, in order to mimic the behavior of a realistic EoS. We determine the change on the threshold for the emergence of the instability. We also extend the analysis to low values of the instability parameter \beta to check for the presence of low-\beta or shear instabilities.

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