star has (a) the maximum mass in the non-rotating limit larger than $1.44 M_\odot$ which is the most accurately measured value for the maximum mass of a compact star [43] and (b) the maximum allowed rotation frequency is larger than the current observational limit of 716 Hz [44].

In Fig. 8 we show the correlations between the values of the $f_{\rm crit}$ for the hybrid stars and the radius $R_{1.4}$ for the neutron star with the canonical mass. We see that $f_{\rm crit}$ is large if value of $R_{1.4}$ is also large. Thus, hybrid star constructed for a given EOS for the CSQM can rotate faster if the EOS for the nuclear matter is stiffer. The existence of the correlations between the values of $f_{\rm crit}$ and $R_{1.4}$ may be due to the fact that the pressure at which the nuclear to the quark matter transition occurs is closer to the values of $P_{1.4}$ as can be seen from the lower and upper left panels of Figs. 2 and 3, respectively.

Finally, we would like to compare the present results with coresponding ones obtained within the MIT bag model [37, 45]. The present results as obtained within the NJL model are significantly different with those for the MIT bag model. Within MIT bag model the EOS for the CSQM can be obtained by adjusting the value of the CFL gap parameter and the bag constant such that the resulting hybrid stars with CFL quark matter core are gravitationally stable upto the masses $\sim 2M_\odot$ in the static limit and the the maximum allowed rotation frequency is much larger than 1 kHz. However, it can be seen from Fig. 7, stable configurations of the hybrid stars with CFL quark matter core obtained within the NJL model are having the maximum values for the mass and the rotational frequency appreciably lower than those obtained for the MIT bag model. The differences between the results for the MIT bag model and the NJL model can be attributed to the fact that the constituent quark masses, chiral condensates and the colour superconducting gaps in the later case are computed self-consistently as a function of baryon density.

IV. CONCLUSIONS

The stability of non-rotating and rotating hybrid stars, composed of the colour superconducting quark matter core surrounded by a nuclear mantle, is studied by using several EOSs. The EOSs for the nuclear matter, employed at lower densities, are based on the variational and the mean field approaches. We use a diverse set of nuclear matter EOSs such that the resulting maximum neutron star mass lie in the range of $2.2 - 2.8 M_\odot$ and the radius at the canonical neutron star mass vary between 11.3 – 14.8km. The EOSs at higher densities corresponding to the colour superconducting quark matter in the 2SC or the CFL phase, are calculated within the NJL model