Abstract Submitted
for the APR13 Meeting of
The American Physical Society

Generic conditions for stable hybrid stars[1] SOPHIA HAN, MARK ALFORD, Physics Department, Washington University in St. Louis, MADAPPA PRAKASH, Department of Physics and Astronomy, Ohio University — We study the stability and maximum mass of hybrid stars, assuming a generic quark matter equation of state with a first-order phase transition between nuclear and quark matter, and a sharp interface between the quark matter core and nuclear matter mantle in a neutron star. For standard nuclear matter equations of state, we find that the mass-radius relation contains a stable hybrid branch, connected to the nuclear matter star branch, if the energy density discontinuity at the nuclear-quark transition is less than a critical value, which is typically between 60% and 80% of the nuclear matter energy density at the transition. Extending the quark matter EoS to higher densities by assuming it has an ideal gas form, we find that, as has been noticed before, there can be a second disconnected branch of hybrid stars. For typical nuclear matter equations of state, this branch exists if the nuclear matter density at the transition is less than a critical value which is about two to four times nuclear saturation density. We calculate the maximum hybrid star mass as a function of the nuclear matter density and the parameters of the quark matter EoS, and find that hybrid stars with mass above $2\,M_\odot$ can exist.

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Date submitted: 08 Jan 2013 Electronic form version 1.4