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Strange quark matter nucleation and implications for NS–QS coexistence

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The Bodmer-Witten hypothesis concerns the possibility that ordinary hadronic matter in bulk is a metastable state of strongly interacting matter, while strange quark matter (SQM) is absolutely stable (i.e., the global minimum). These two phases would be separated by a potential barrier that prevents the spontaneous decay of hadronic matter into SQM in ordinary conditions.
If this hypothesis is true, a family of hadronic neutron stars (NSs) and a family of strange quark stars (QSs) may coexist.
A fundamental question regards the conditions under which a hadronic star converts into a QS and in which astrophysical phenomena these conditions could be reached.
The conversion is triggered after the nucleation of SQM, namely, after that, a SQM droplet large enough to keep expanding is created by a local spontaneous fluctuation.

I will present the state of the art of SQM nucleation in astrophysical systems, including the roles of thermal fluctuations in the hadronic composition and color superconductivity.

Moreover, I will evaluate whether the nucleation conditions are reached during the evolution of a proton-neutron star (PNS) and discuss the implications for the possible coexistence of QSs and NSs.

- Guerrini et al, 2024, ApJ 974 45; doi:10.3847/1538-4357/ad67cc
- Guerrini et al, 2025, Universe, 11(8), 258; doi:10.3390/universe11080258
- Guerrini et al, *in preparation* (Testing the coexistence of QS and NS in the PNS evolution)

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