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Constraints on Baryon Number Violation from Neutron Stars to the Lab

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In this work, we explore baryon number violating interactions (BNV) within a specific model framework involving a charged iso-singlet, color-triplet scalar and a Majorana fermion with interactions in the quark sector. This model has been useful for explaining baryogenesis, neutron-antineutron oscillations, and other puzzles such as the DM-baryon coincidence puzzle. We revisit this model, with chiral perturbation theory as a guide, at the level of baryons and mesons in the dense environments of neutron stars. BNV neutron decays become accessible in this environment where in vacuum they would be kinematically forbidden. By considering several equations of state in binary pulsar candidates, we establish strong constraints on the model parameter space from these decays, and the subsequent scattering of the Majorana fermions, in total amounting to a $\Delta B = 2$ loss in the star. These limits are highly complementary to laboratory bounds from rare dinucleon decay searches and collider probes.

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