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High momentum nucleons and the direct Urca process in neutron stars HENRY FLEMING, WILLIAM NEWTON, Texas AM University - Commerce, ISAAC VIDANA, Universidade de Coimbra, BAO-AN LI, Texas AM University - Commerce — A neutron star, the post supernova remnant of a star which starts its life, between 8 and 25 solar masses, is a very exotic neutron-rich environment with densities on the order of the nuclei of atoms. This is not an environment that we can duplicate here in laboratories here on earth but by studying the phenomena observed in these massive objects that are thousands of lightyears away, we can gather data that complements and extends that which we get from terrestrial nuclear experiment. Conversely, experimental data informs our understanding of the structure and evolution of neutron stars. Recent experimental results suggest that the momentum distribution of nucleons in nuclei and nuclear matter has a significant high-momentum component, which could impact the dynamics of neutron star cores. We present an exploration of the effect of this high momentum tail on the most efficient neutron star cooling process, the emission of neutrinos via the direct Urca reactions in the neutron star core. We find that the presence of high momentum nucleons allows the direct Urca process to occur at much lower core proton fractions than in the standard picture, and demonstrate that it could have a significant effect on the cooling of neutron stars during the first million years of their lives.

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