Abstract Submitted
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The Cooling of the Cassiopeia A Neutron Star as a Probe of the Nuclear Symmetry Energy and Nuclear Pasta[1] KYLEAH MURPHY, Univ of Oregon, WILLIAM NEWTON, Texas A&M University -Commerce, JOSH HOOKER, Texas A&M University, BAO-AN LI, Texas A&M University -Commerce — X-ray observations of the neutron star in the Cas A supernova remnant over the past decade suggest the star is undergoing a rapid drop in surface temperature of $\approx 2{-}5.5\%$. One explanation suggests the rapid cooling is triggered by the onset of neutron superfluidity in the core of the star, causing enhanced neutrino emission from neutron Cooper pair breaking and formation (PBF). Using consistent neutron star crust and core equations of state (EOSs) and compositions, we explore the sensitivity of this interpretation to the density dependence of the symmetry energy L of the EOS used, and to the presence of enhanced neutrino cooling in the bubble phases of crustal "nuclear pasta." Modeling cooling over a conservative range of neutron star masses and envelope compositions, we find $L \leq 70$ MeV, competitive with terrestrial experimental constraints and other astrophysical observations. For masses near the most likely mass of $M \geq 1.65 M_\odot$, the constraint becomes more restrictive $35 \leq L \leq 55$ MeV. The inclusion of the bubble cooling processes decreases the cooling rate of the star during the PBF phase, matching the observed rate only when $L \leq 45$ MeV.

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Kyleah Murphy
Univ of Oregon

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