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Tests of the nuclear equation of state and superfluid and superconducting gaps using the Cassiopeia A neutron star

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The observed rapid cooling of the Cassiopeia A neutron star can be interpreted as being caused by neutron and proton transitions from normal to superfluid/superconducting states in the stellar core. Here we present measurements of the neutron star mass and radius found from consistent fitting of both the Chandra X-ray spectra and cooling behavior; this comparison is only possible for individual nuclear equations of state. We also test phenomenological superfluid and superconducting gap models, that mimic most of the known theoretical models, against the cooling behavior and obtain constraints on the gaps.

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