Electron Captures and Neutron Emissions in Magnetic White Dwarfs and Magnetars

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It has been recently proposed that very massive super-Chandrasekhar white dwarfs endowed with strongly quantizing magnetic fields could be the progenitors of overluminous type Ia supernovae like SN 2006gz and SN 2009dc [1]. On the other hand, we have shown that the onset of electron captures by nuclei and pycnonuclear reactions in these putative stars may severely limit their stability [2, 3]. We have recently reexamined the threshold density and pressure in both magnetic and nonmagnetic white dwarfs, generalizing the instability condition originally formulated in the context of the simple Chandrasekhar model [4]. We have also studied the role of a strong magnetic field on the neutron-drip transition in the crust of a magnetar [5, 6]. We have shown that the neutron drip density and pressure increase almost linearly with the magnetic field strength in the strongly quantizing regime for which electrons lie in the lowest Landau level. For weaker magnetic fields, the neutron drip density can be either increased or decreased. These results may have important implications for the physical interpretation of timing irregularities and quasiperiodic oscillations detected in soft gamma-ray repeaters and anomalous X-ray pulsars, as well as for the cooling of strongly magnetized neutron stars.

References

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