Transport Properties in the Crust of Highly Magnetised Neutron Stars

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With surface magnetic fields up to $\sim 10^{15}$ G, neutron stars - the stellar remnants of gravitational core-collapse supernovae explosions - are unique cosmic laboratories for probing the properties of matter under extreme conditions. The outermost layer of a neutron star is thought to consist of a solid crust, whose atoms are fully ionised by the huge pressure. Electrons are expected to be highly degenerate and form an essentially ideal relativistic Fermi gas. With increasing depth, nuclei become progressively more neutron rich by capturing electrons until at some point, neutrons start to drip out of nuclei. At about half the density found in heavy atomic nuclei, the crust dissolves into a neutron liquid with a small admixture of protons and electrons. The transport properties of highly magnetised neutron- star crusts are shown to be significantly affected by Landau quantisation of electron motion.