Atmospheres and Spectra of Magnetic Neutron Stars

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We construct atmosphere models for strongly magnetized neutron stars with surface fields $B \sim 10^{12} - 10^{15}$ G and effective temperatures $T_{\rm eff} \sim 10^6 - 10^7$ K. The atmospheres directly determine the characteristics of thermal emission from isolated neutron stars, including radio pulsars, soft gamma-ray repeaters, and anomalous X-ray pulsars. In our models, the atmosphere is composed of pure hydrogen or helium and is assumed to be fully ionized. The radiative opacities include free-free absorption and scattering by both electrons and ions computed for the two photon polarization modes in the magnetized electron-ion plasma. We describe a modified (due to the two photons modes) Unsöld-Lucy temperature correction method to establish radiative equilibrium and the resulting temperature profile. We also discuss the density-dependent, vacuum polarization resonance feature that is important at these strong magnetic field strengths.