CYCLOTRON LINE EMISSION FROM ACCRETION ONTO A MAGNETIZED NEUTRON STAR

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For material accreting along the magnetic field axis of a neutron star, electrons are quantized into Landau orbits. Collisional excitation of the first excited Landau level, followed by radiative decay, leads to the emission of a cyclotron line. The expected line is broad, because the optical depth is large, and its shape is difficult to calculate. Redshifts due to the recoil of a scattering electron and blueshifts due to scattering from the infalling accretion column are being calculated by I. Wasserman, as well as the proton stopping length in the presence of a magnetic field.

When the magnetic field is very strong, the intensity of the cyclotron line is small. When the magnetic field is of moderate strength, the line is broad (and may overlap with the next harmonic) but should still be observable from its affect on angular distribution ("phase" for an X-ray pulsar) and polarization. In principle, the gravitational potential ϕ at the neutron star surface can be obtained from detailed observations and analysis: The line intensity depends critically on $\phi\ m_e/E_{cyc}$, where m_e and E_{cyc} are the mass and the Landau excitation energy of an electron.

D. Sugimoto, D. Q. Lamb, and D. N. Schramm (eds.), Fundamental Problems in the Theory of Stellar Evolution, 233.