

Luminosity Dependent Changes of Cyclotron Resonance Energies in Binary X-ray Pulsars

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Pulsars are highly-magnetized neutron stars. Its surface magnetic field can be estimated by measuring the resonance energy of the electron cyclotron structure. So far, the cyclotron resonance have been considered to be occurred near the surface of the neutron star, and the observed resonance energy is unchangeable. However, the exception was found from the recurrent transient source 4U 0115+63 by the Ginga observation (Mihara et al. 2004). When the source flux was faint, the different resonance energy at ~ 16 keV was observed, instead of the typical energy at ~ 11 keV. In order to reveal how the resonance energy change together with the luminosity, we analyzed the X-ray data of 4U 0115+63 and X0331+53, which were taken continuously with RXTE. We have found that the resonance energies depend on the source X-ray luminosity. The luminosity dependence of the resonance energy may be understood as a result of a decrease in the height where the cyclotron structure is produced, in response to a decrease in the mass accretion rate. Thus the observed change of the magnetic field is just appearant, not the real change of the surface field strength. Furthermore, we can infer that the observed magnetic field, when the source flux is faint, is the real field strength of the surface of the neutron star.