Near Contact Binaries as an Evidence af the Binary Star Evolution I. Magnetic Activities

Young Woon Kang[1], Hoil Kim[2], Woo Baik Lee[2], and Kyu Dong Oh[3]
[1]Dept. of Earth Sciences, Sejong University, Seoul,143-747, Korea
[2]Korea Astronomy Observatory, Whaam-dong Yusong-gu, Taejon, 305-348, Korea
[3]Dept. of Earth Sciences, Chonnam National University, Kwangju, Korea

The research of the near-contact binaries (NCBs) is one of the long term projects among Korea Astronomy Observatory, Sejong University Observatory and Chonnam National University. The research includes observations, period variations, light curve analyses, UV and X-ray data analyses, and theoretical works for the NCBs. In this paper we present the magnetic activities of 19 NCBs whose X-ray luminosities are greater than those of normal late type main-sequence stars. First we have analyzed the light curves by the method of Wilson and Devinney Differential Corrections. Then the IUE spectra and X-ray luminosities have been investigated for the selected NCBs. The light curve of the NCBs belongs to the typical beta Lyr type. The light curves of the most NCBs show a high degree of asymmetry, namely an O'Connell effect is presented. It is generally accepted that a cool star with convective envelope and with rapid rotation has magnetic activity. The magnetic activity causes photospheric spot, chromospheric activity, coronal X-ray, and flare activity. If a star with a significant convective atmosphere is a member of a close binary system, tidal forces can cause the star to spin rapidly (equal to the binary's orbital period) and maintain a high level of magnetic activity through out most of its life time. RS CVn, BY Dra, Algol, and W UMa type binaries are known as chromospherically active binaries that emit large amounts of X-ray radiation from their hot, magnetically heated corona. This is why close binaries with cool, synchronously rotating components are so active and fairly numerous. The majority of the near-contact binaries is one of such binaries. We tested two possible spot models, a cool spot and a hot spot on the cooler star. The cool spot model is better fitted to the most NCBs light curves as shown in the above figures. 15 of 19 binary systems required the spot model to fit to their observed light curves. 14 systems have a cool spot while one system has a hot spot on the secondary system. More than half of the systems have X-ray luminosity greater than that of normal late type main-sequence stars. We confirmed the UV excess for only two systems using the chromospheric emission lines in the IUE spectra because most NCBs are too faint to get the IUE spectra. But we can infer the NCBs have quite strong magnetic activity using the asymmetrical light curves and X-ray luminosity.