The Balmer Wavelength Range of BP Tauri

David R. Ardila1, Gibor Basri1 1Astronomy Dept., Univ. of California, Berkeley, CA 94720. e-mail: ardila@garavito.berkeley.edu, basri@soleil.berkeley.edu

abstract We have analyzed all the observations of BP Tauri taken by the International Ultraviolet Explorer in the low resolution (\( \Delta \lambda \sim 6\alpha \)), long wavelength (from \( \lambda = 1850\alpha \) to \( \lambda = 3350\alpha \)) range. This dataset contains 61 spectra. We observe variability in the ultraviolet continuum of \( \Delta m_{\text{cont.}} \sim 1 \) magnitude and variability in the Mg2 line flux of \( \Delta m_{\text{MgII}} \sim 0.8 \) magnitudes. Moreover, these spectra do not show any correlation between the continuum flux and the Mg2 line flux, thus resolving a standing controversy in the literature concerning the origin of the Mg2 line flux. There is no correlation between the color temperature of the UV continuum and the average value of its flux. Using models of the accretion process developed by Calvet & Gullbring (1998), we obtain energy fluxes, accretion spot sizes, and accretion rates from the IUE observations of BP Tauri. We find average energy fluxes of \( 5.0 \times 10^{11} \text{ergs cm}^{-2} \text{s}^{-1} \), average spot sizes of \( 4.4 \times 10^{-3} \) times the stellar surface, and average accretion rates of \( 1.6 \times 10^{-8} \text{yr}^{-1} \). Our analysis shows that the particle energy flux and the UV flux in the stellar surface are proportional to each other. Most strikingly, we observe a correlation between accretion rate and spot size, with the spot size increasing as the square of the accretion rate. Based on the results of a simulation, we conclude that geometrical effects (i.e. the varying inclination of the spot with respect to the observer) are not enough to account for this effect. Current models of the accretion process fail to reproduce such an effect, suggesting the need of using more realistic descriptions of the stellar field when treating magnetospheric accretion. There may also be an unmodelled efficiency factor that determines how matter is loaded into the field lines. Non-dipole fields, geometry, oblique shocks and the possibility of “limb brightening” should be taken into account when creating models and explaining the results of observations of T-Tauri stars.