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Formation of Balmer lines in the spectra of X-ray Novae

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Abstract

The profiles and equivalent widths of the absorption and emission components of Balmer lines and the continuum optical spectra of X-ray novae during outbursts are calculated. A stationary self-illuminated accretion a disk around a Schwarzschild black hole is used as an instantaneous model for the X-ray nova. Each annulus of the disk is assumed to emit as a stellar atmosphere that is illuminated by the same X-ray flux. The irradiated stellar model atmospheres are calculated in the LTE approximation. The equivalent widths of the emission components of the Balmer lines are shown to depend on the X-ray flux that is intercepted by the disk (i.e., on the geometric sizes of the disk), on the optical depth of the chromospheric-like layer along the line of sight (i.e., on the inclination of the disk to the line of sight), and on the relative fraction of the soft component with E ~ 0.1 keV in the X-ray spectrum (because it is this component that heats the upper atmosphere of the disk). A comparison of the theoretical spectra with the observed spectra of the X-ray nova V518 Per (GRO J0422+32) reveals an additional emission in the observed spectrum, which is most probably the bremsstrahlung of an optically thin, hot (T ~ 106 K) shell.