Interaction of compact object with the surrounding matter in Symbiotic Stars, Be/X-ray binaries, and Quasars

Radoslav Kostadinov Zamanov
Institute of Astronomy, Bulgarian Academy of Sciences
rkz@astro.bas.bg
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Взаимодействие на компактен обект със заобикалящата го матеприя в симбиотични звезди, Be/рентгенови двойни и квазари

Радослав Костадинов Заманов

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In this dissertation (for the degree of Doctor of Sciences) are presented the results of the investigation of interacting binary stars and active galactic nuclei. The results are based on observations obtained on the following teslescopes: 2.0m RCC telescope, 60 cm, and 50/70 cm Schmidt telescope of the National Astronomical Observatory Rozhen, 60cm telescope of the Belogradchick Astronomical Observatory (Bulgaria); 2.2m and 3.6m telescopes of the European Southern Observatory (La Silla); 1.82m telescope of Asiago Observatory (Italy), 1.23 m telescope of Calar Alto, 2.0m Liverpool telescope on La Palma, 1.2m telescope of Observatory of Heute Provance (France), VLT of ESO. We also used observations from the archives of VLT/UVES, ELODIE, Hubble Space telescope, International Ultraviolet Explorer (IUE), Isaac Newton Group of telescopes (ING), Green Bank Interferometer (USA).

We have observed spectroscopically and photometrically the recurrent nova T CrB. We investigate the Hα variability on short and long term scales, UBV brightness and flickering (MNRAS, 350, 1477). On two nights we detected statistically significant variability in the central part of the $H\alpha$ emission line profile on time scale of 10-20 minutes (PASP, 117, 268).

We investigated the Hα and HeIIλ4686 emission lines of the recurrent nova RS Oph (MNRAS, 363, L26). We discovered that the flickering of RS Oph disappeared after the 2006 outburst. In 2008, when the flickering source was present again, we derived its temperature, size and luminosity. We also find that on a $(U-B)$ vs $(B-V)$ diagram the flickering of the symbiotic stars differs from that of the cataclysmic variables (MNRAS, 404, 381).

We have measured the projected rotational velocities of the mass donors in 42 S– and D'-type symbiotic stars. For the D'-type (yellow) symbiotics, 5 out of the six southern D'-type symbiotic stars are the fastest or among the fastest rotators in their spectral classes (MNRAS 365, 1215).

We demonstrated that in the S-type symbiotics the rotation of the mass donors is synchonized with the orbital motion (MNRAS 380 1053). In our sample of 17 S-type symbiotics with known orbital periods, 15 objects are synchronized within the $3-\sigma$ level.

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The symbiotic K giants included in our survey rotate on average more than twice as fast as the field K giants. The M giants in symbiotics are more rapid rotators than most of the field M giants. The rapid rotation is the (likely) reason for their larger mass loss rates. We find suggestions that in the jet-ejecting symbiotics the giants rotate faster than the orbital periods. This is the first observational investigation that clearly confirms theoretical predictions that the mass donors in symbiotics are fast rotators (MNRAS 390, 377).

We perfomed 15 years regular spectroscopic monitoring of the Be/X-ray binary LSI+61303. For the first time, the 26.5 d orbital/radio period is clearly detected in the Hα emission (A&A 351, 543). A remarkable correlation between the Hα line and the radio behaviour of LSI+$61^0$303 over its 4 yr modulation is discovered. The radio outburst peak is shifted by a quarter of the 4 yr modulation period (about 400 days) with respect to the equivalent width of the Hα emission line variability. The onset of the radio outbursts varies in phase with the changes of the Hα, at least during the increase of Hα equivalent width, which points towards the 4 yr modulation, being probably a result of variations in the mass loss rate of the Be star and/or density variability in the circumstellar disk (A&A 358, L55). This is the first clear correlation between the emission associated to the compact object and the Be circumstellar disk in a Be/X-ray binary system.

We performed a comparative study of the circumstellar disks in Be/X-ray binaries and isolated Be stars based upon the Hα emission line (A&A 367, 884). From this comparison it follows that the overall structure of the disks in the Be/X-ray binaries is similar to the disks of other Be stars, i.e. they are axisymmetric and rotationally supported. The factors for the line broadening (rotation and temperature) seem to be identical. However, we do detect some intriguing differences between the envelopes. On average, the circumstellar disks of the Be/X-ray binaries are twice as dense as the disks of the isolated Be stars. The disks in Be/X-ray binaries have on average a smaller size, probably truncated by the compact object.

We used a sample of $\sim$300 AGNs and created average spectra around Hβ line in various bins. We identified AGNs with blue shifted [OIII]λ5007 (blue outliers) and investigated their nature (ApJ 576, L9).

We showed a clear similarity between the emission line spectra of the accreting white dwarfs CH Cyg and MWC 560 and low redshift quasars (ApJ 571, L77). The position of these two white dwarfs in the Eigenvector-1 diagram confirms that the physical drivers of the Boroson & Green's Eigenvector-1 are primarily the L/M ratio and the mass of the accreting object.

The dissertation is based on 30 refereed articles and 26 non-refereed publications. I gratefully acknowledge partial support from Bulgarian NSF - HTC 01-152. The full text of the dissertation can be downloaded at

www.astro.bas.bg/$\sim$rz/dissertation/Dissertation.RZamanov.pdf