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# Interacting Binaries

An Electronic Newsletter

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## 1 Editorial

Dear IB friends,

Welcome to this edition of the Interacting Binaries Newsletter. This time it's only 3 months since the last issue, so we have a rather slimmer edition than usual. There are still plenty of good papers for you to catch up with, but it won't take you as long to do so! As always, we're on the look out for as many articles as possible in each issue, so if any of your colleagues are *not* in the habit of sending in abstracts, please encourage them to do so for the next edition, which will be in another 3 months or so.

As always: happy reading,

*Boris Gänsicke & Andy Norton*

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## 2 Abstracts of refereed papers

### DE CVn: A bright, eclipsing red dwarf - white dwarf binary

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*Astronomy & Astrophysics, in press (astro-ph/0701560)*

*Context:* Close white dwarf - red dwarf binaries must have gone through a common-envelope phase during their evolution. DE CVn is a detached white dwarf - red dwarf binary with a relatively short ( $\sim 8.7$  hours) orbital period. Its brightness and the presence of eclipses makes this system ideal for a more detailed study.

*Aims:* From a study of photometric and spectroscopic observations of DE CVn we derive the system parameters which we discuss in the frame work of common-envelope evolution.

*Methods:* Photometric observations of the eclipses are used to determine an accurate ephemeris. From a model fit to an average low-resolution spectrum of DE CVn we constrain the temperature of the white dwarf and the spectral type of the red dwarf. The eclipse light curve is analysed and combined with the radial velocity curve of the red dwarf determined from time-resolved spectroscopy to derive constraints on the inclination and the masses of the components in the system.

*Results:* The derived ephemeris is  $HJD_{\min} = 2452784.5533(1) + 0.3641394(2) \times E$ . The red dwarf in DE CVn has a spectral type of M3V and the white dwarf has an effective temperature of 8000 K. The inclination of the system is  $86_{-2}^{+3^\circ}$  and the mass and radius of the red dwarf are  $0.41 \pm 0.06 M_{\odot}$  and  $0.37_{-0.007}^{+0.06} R_{\odot}$ , respectively, and the mass and radius of the white dwarf are  $0.51_{-0.02}^{+0.06} M_{\odot}$  and  $0.0136_{-0.0002}^{+0.0008} R_{\odot}$ , respectively.

*Conclusions:* We found that the white dwarf has a hydrogen-rich atmosphere (DA-type). Given that DE CVn has experienced a common-envelope phase, we can reconstruct its evolution and we find that the progenitor of the white dwarf was a relatively low-mass star ( $M \leq 1.6 M_{\odot}$ ). The current age of this system is  $3.3 - 7.3 \times 10^9$  years, while it will take longer than the Hubble time for DE CVn to evolve into a semi-detached system.

*Download/Website:* <http://arxiv.org/abs/astro-ph/0701560>

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### CCD photometry and visual observations of V1663 Aquilae (Nova Aquilae 2005)

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*Journal of the British Astronomical Association, 116 (2006) 320-323, in press (astro-ph/0605650)*

We present CCD V and I band photometry and visual observations of V1663 Aquilae (Nova Aquilae 2005). This was a classical fast nova, probably of type Ba, observed for the first time on 2005 June 9. Maximum light occurred at  $HJD = 2453531.2 \pm 0.2$ , when the apparent V magnitude was  $10.7 \pm 0.1$  and the V-I colour index 3.1. Decline times were  $t_{2,V} = 17d$ ,  $t_{2,I} = 18d$ ,  $t_{3,V} = 32d$  and  $t_{3,I} = 35d$ . We derived a maximum absolute V magnitude of  $-7.8 \pm 0.2$ , colour excess  $E(B-V) = 2$ , extinction  $AV = 6$  magnitudes and distance  $d = 2.9 \pm 0.4$  kpc. After maximum

the V-I colour index remained between 3.1 and 3.4 for 50 days, then gradually reduced as the nova became bluer with increasing age. We saw no direct evidence of dust emission although this could have contributed to the high extinction in the direction of the nova.

*Download/Website:* <http://arxiv.org/abs/astro-ph/0605650>

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### The INTEGRAL Galactic bulge monitoring program: the first 1.5 years

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*Astronomy & Astrophysics, in press (astro-ph/0701244)*

**Aims.** The Galactic bulge region is a rich host of variable high-energy point sources. Since 2005, February 17 we are monitoring the source activity in the Galactic bulge region regularly and frequently, i.e., about every three days, with the instruments onboard *INTEGRAL*. Thanks to the large field of view, the imaging capabilities and the sensitivity at hard X-rays, we are able to present for the first time a detailed homogeneous (hard) X-ray view of a sample of 76 sources in the Galactic bulge region. **Methods.** We describe the successful monitoring program and show the first results from the start of the monitoring up to 2006, April 21, i.e., for a period of about one and a half year, during three visibility seasons. We focus on the short (hour), medium (month) and long-term (year) variability in the hard X-ray bands, i.e., 20–60 keV and 60–150 keV. When available, we discuss the simultaneous observations in the soft X-ray, 3–10 keV and 10–25 keV, bands. **Results.** Almost all the sources in the Galactic bulge region we detect in the 20–60 keV and 60–150 keV bands are variable. During the last two and a half weeks of the third visibility season most of the known persistent (hard) X-ray sources in the Galactic Center region were not detected. Of our sample of sources, per visibility season we detect 32/33 sources in the 20–60 keV band and 8/9 sources in the 60–150 keV band above a signal to noise of 7. On average, we find per visibility season one active bright ( $\geq 100$  mCrab, 20–60 keV) black-hole candidate X-ray transient and three active weaker ( $\leq 25$  mCrab, 20–60 keV) neutron star X-ray transients. Most of the time a clear anti-correlation can be seen between the soft and hard X-ray emission in some of the X-ray bursters. Hard X-ray flares or outbursts in X-ray bursters, which have a duration of the order of weeks are accompanied by soft X-ray drops. On the other hand, hard X-ray drops can be accompanied by soft X-ray flares/outbursts. During the course of our program we found a number of new sources, IGR J17354–3255, IGR 17453–2853, IGR J17454–2703, IGR J17456–2901b, IGR J17536–2339, and IGR J17541–2252. We report here on some of the high-energy properties of these sources. **Conclusions.** The high-energy light curves of all the sources in the field of view, and the high-energy images of the region, are made available through the WWW, as soon as possible after the observations have been performed, at <http://isdc.unige.ch/Science/BULGE/>.

*Download/Website:* <http://xxx.lanl.gov/abs/astro-ph/0701244>

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## Physics of accretion flows around compact objects

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*C. R. Physique (2007), in press (astro-ph/0607453)*

Several physical and astrophysical problems related to accretion onto black holes and neutron stars are shortly reviewed. I discuss the observed differences between these two types of compact objects in quiescent Soft X-ray Transients. Then I review the status of various non-standard objects suggested as an alternative to black-holes. Finally I present new results and suggestion about the nature of the jet activity in Active Galactic Nuclei.

## An Illustration of Modeling Cataclysmic Variables: HST, FUSE, SDSS Spectra of SDSSJ080908.39+381406.2

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*Astrophysical Journal, published (2007ApJ...654,1036)*

FUSE, HST and SDSS spectra of the cataclysmic variable SDSSJ080908.39 +381406.2 provide a spectral flux distribution from 900–9200Å. This data set is used to illustrate procedures for calculating and testing system models. The spectra are not contemporaneous; it is necessary to assume that the combined spectra are representative of the system. The illustrations are based on a system with a  $1.0M_{\odot}$  white dwarf, a  $0.30M_{\odot}$ , 3500K, Roche lobe-filling secondary star, and an accretion disk extending to the tidal cutoff radius. Assuming a similar accretion state for the non-simultaneous spectra, the best standard model fit is with a mass transfer rate of  $3.0 \times 10^{-9} M_{\odot} \text{yr}^{-1}$ . Extensive simulations demonstrate that the accretion disk must be truncated at its inner edge if the temperature profile follows the standard model, but truncated models face severe objections, which we address. Following additional simulation tests, we obtain a model accretion disk with a temperature profile comparable to the profile for SW Sex as determined from tomographic image reconstruction. This model fits the discovery SDSS spectrum well but has a flux deficit in the UV and FUV. Emission from a white dwarf is a plausible source of additional flux. Adding this source to the disk synthetic spectrum produces FUV flux that can explain the observed flux.

An additional (archival) SDSS spectrum is fainter by about 0.3 magnitude in the optical. Additional analysis showed that UV residuals from a model fitting the archival optical wavelength spectrum are unacceptably large. Contemporaneous spectra from all wavelength regions would be necessary for a reliable system model. Our discussion illustrates how this conclusion follows from the system models.

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### A Brown Dwarf Mass Donor in an Accreting Binary

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*Science, published (2006Sci...314.1578L)*

A long-standing and unverified prediction of binary star evolution theory is the existence of a population of white dwarfs accreting from substellar donor stars. Such systems ought to be common, but the difficulty of finding them, combined with the challenge of detecting the donor against the light from accretion, means that no donor star to date has a measured mass below the hydrogen burning limit. We applied a technique that allowed us to reliably measure the mass of the unseen donor star in eclipsing systems. We were able to identify a brown dwarf donor star, with a mass of  $0.052 \pm 0.002$  solar mass. The relatively high mass of the donor star for its orbital period suggests that current evolutionary models may underestimate the radii of brown dwarfs.

*Download/Website:* <http://arxiv.org/abs/astro-ph/0612220>

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### X-ray broad-band study of the symbiotic X-ray binary 4U 1954+31

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*Astronomy & Astrophysics, in press (astro-ph/0611477)*

We present results of several pointed X-ray broad band observations of the ‘symbiotic X-ray binary’ 4U 1954+31 performed with the satellites *BeppoSAX*, *EXOSAT*, *ROSAT*, *RXTE* and *Swift* between October 1983 and April 2006. We also studied the *RXTE* ASM data over a period of more than 10 years, from January 1996 to October 2006. Light curves of all pointed observations show an erratic behaviour with sudden increases in the source emission on timescales variable from hundreds to thousands of seconds. There are no indications of changes in the source spectral hardness, with the possible exception of the *RXTE* pointed observation. Timing analysis does not reveal the presence of coherent pulsations or periodicities either in the pointed observations in the range from 2 ms to 2000 s or in the long-term *RXTE* ASM light curve on timescales from days to years. The 0.2–150 keV spectrum, obtained with *BeppoSAX*, is the widest for this source available to date in terms of spectral coverage and is well described by a model consisting of a lower-energy thermal component (hot diffuse gas) plus a higher-energy (Comptonization) emission, with the latter modified by a partially-covering cold absorber plus a warm (ionized) absorber. A blackbody modelization of our *BeppoSAX* low-energy data is ruled out. The presence of a complex absorber local to the source is also supported by the 0.1–2 keV *ROSAT* spectrum. *RXTE*, *EXOSAT* and *Swift* X-ray spectroscopy is consistent with the above results, but indicates variations in the density and the ionization of the local absorber. A 6.5 keV iron emission line is possibly detected in the *BeppoSAX* and *RXTE* spectra. All this information suggests that the scenario that better describes 4U 1954+31 consists of a binary system in which a neutron star orbits in a highly inhomogeneous medium, accreting matter from a stellar wind coming from its optical companion, an M-type giant star.

*Download/Website:* <http://arxiv.org/abs/astro-ph/0611477>

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## AR Ursae Majoris Discovered to be a Persistent Radio Polar: Results from a VLA Survey of Magnetic Cataclysmic Variables

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*The Astrophysical Journal, in press, May 10, 2007*

We conducted a VLA survey of 9 magnetic cataclysmic variable stars (MCVs) at 8.436 GHz in October 2003, to constrain models of radio emission. A follow up study was conducted in September, 2004. We obtained the first radio detection of AR UMa, the MCV with the highest known magnetic field (230 MG), at a flux density of 0.422–0.060 mJy (16 October 2003) and 0.734–0.095 mJy (4 September 2004). We completed the sample of radio observations of MCVs out to 100 pc. Surprisingly, the only radio selected CV, FIRST J1023+0038, was not detected. An upper-limit of 0.20 mJy (4s) was obtained. The original radio MCV, AM Her, was detected with a flux density of 0.586–0.074 mJy (17 October 2003), consistent with previous observations. Typical (4s) upper-limits of 0.12 mJy were obtained for other targets. The lack of radio emission from isolated magnetic white dwarfs as well as from non-magnetic CVs (outside of outburst) place constraints on radio emission mechanisms of CVs. We suggest that accretion disks may preclude radio emission. Also, since we detect radio emission from AM Her in a low state and the pre-CV V471 Tau is a persistent radio source, accretion is not a necessary condition. A secondary with a kG magnetic field might be necessary. We argue that the emission from AR UMa originates near the secondary. AR UMa joins AM Her and AE Aqr as the only confirmed persistent radio MCVs, and we suggest avenues of further study.

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## Propeller activated resonances and the fate of short period cataclysmic variables

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*Monthly Notices of the Royal Astronomical Society, in press (astro-ph/0608458)*

We show that the combination of a weak magnetic propeller and accretion disc resonances can effectively halt accretion in short period cataclysmic variables for large fractions of their lifetimes. This may help to explain the discrepancy between the observed and predicted orbital period distributions of cataclysmic variables at short periods. Orbital resonances cause the disc to become eccentric, allowing material to fall back onto the donor star or out of the system. A weak magnetic field on a rapidly spinning primary star propels disc material outwards, allowing it to access these resonances. Numerical and analytic calculations show that this state can be long lived ( $\sim 10^{11}$  yr). This is because the magnetic propeller is required only to maintain access to the resonance, and not to push matter out of the Roche lobe, so that the spin down time-scale is much longer than for a classical propeller model.

Download/Website: <http://uk.arXiv.org/abs/astro-ph/0608458>

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### Mass transfer during low-mass X-ray transient decays

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*MNRAS, published (2007MNRAS.374..466P/astro-ph/0610108)*

The outbursts of low-mass X-ray binaries are prolonged relative to those of dwarf nova cataclysmic variables as a consequence of X-ray irradiation of the disc. We show that the time-scale of the decay light curve and its luminosity at a characteristic time are linked to the radius of the accretion disc. Hence, a good X-ray light curve permits two independent estimates of the disc radius. We apply this to a number of sources: 4U 1543-475, SAX J1808.4-3658, XTE J1751-305, XTE J0929-314, XTE J1807-294, GRO J1744-28, GX339-4, XTE J1550-564, GRO J1655-40 and 4U 1705-44. In the case of the millisecond pulsars SAX J1808.4-3658 and XTE J0929-314, the agreement between these estimates is very strong. Our analysis allows new determinations of distances and accretion disc radii. Our analysis will allow determination of accretion disc radii for sources in external galaxies, and hence constrain system parameters where other observational techniques are not possible. We also use the X-ray light curves to estimate the mass transfer rate. The broken exponential decay observed in the 2002 outburst of SAX J1808.4-3658 may be caused by the changing self-shadowing of the disc.

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### Spectroscopic search for new SW Sextantis stars in the 3–4 hour orbital period range – I.

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*Monthly Notices of the Royal Astronomical Society, in press (astro-ph/0611829)*

We report on time-resolved optical spectroscopy of ten non-eclipsing nova-like cataclysmic variables in the orbital period range between 3 and 4 hours. The main objective of this long-term programme is to search for the characteristic SW Sextantis behaviour and to eventually quantify the impact of the SW Sex phenomenon on nova-likes at the upper boundary of the orbital period gap.

Of the ten systems so far observed, HL Aqr, BO Cet, AH Men, V380 Oph, AH Pic, and LN UMa are identified as new members of the SW Sex class. We present improved orbital period measurements for HL Aqr ( $P_{\text{orb}} = 3.254 \pm 0.001$  h) and V380 Oph ( $P_{\text{orb}} = 3.69857 \pm 0.00002$  h). BO Cet and V380 Oph exhibit emission-line flaring with periodicities of 20 min and 47 min, respectively. The H $\alpha$  line of HL Aqr shows significant blueshifted absorption modulated at the orbital period. Similarly to the emission S-wave of the high-inclination SW Sex stars, this *absorption* S-wave has its maximum blue velocity at orbital phase  $\sim 0.5$ . We estimate an orbital inclination for HL Aqr in the range  $19^\circ < i < 27^\circ$ , which is much lower than that of the emission-dominated, non-eclipsing SW Sex stars ( $i \sim 60^\circ - 70^\circ$ ). This gives rise to the interesting possibility of many low-inclination nova-likes actually being SW Sex stars, but with a very different spectroscopic appearance as they show significant absorption. The increasing blueshifted absorption with decreasing inclination points to the existence of a mass outflow with significant vertical motion.

This six new additions to the SW Sex class increase the presence of non-eclipsing systems to about one third of the whole SW Sex population, which therefore makes the requirement of eclipses as a defining criterion for SW Sex membership no longer valid. The statistics of the cataclysmic variable population in the vicinity of the upper period gap is also discussed.

Download/Website: <http://arxiv.org/abs/astro-ph/0611829>

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## The statistical significance of the superhump signal in U Gem

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*Astronomy & Astrophysics, in press (astro-ph/0701572)*

Although its well determined mass ratio of  $q = M_{\text{sec}}/M_{\text{wd}} = 0.357 \pm 0.007$  should avoid superoutbursts according to the thermal tidal instability model, the prototypical dwarf nova U Gem experienced in 1985 an extraordinary long outburst resembling very much superoutbursts observed in SU UMa systems. Recently, the situation for the model became even worse as superhump detections have been reported for the 1985 outburst of U Gem. The superhump signal is noisy and the evidence provided by simple periodograms seems to be weak. Therefore and because of the importance for our understanding of superoutbursts and superhumps, we determine the statistical significance of the recently published detection of superhumps in the AAVSO light curve of the famous long 1985 outburst of U Gem. Using Lomb-Scargle periodograms, analysis of variance (AoV), and Monte-Carlo methods we analyse the 160 visual magnitudes obtained by the AAVSO during the outburst and relate our analyse to previous superhump detections. The 160 data points of the outburst alone do not contain a statistically significant period. However, using additionally the characteristics of superhumps detected previously in other SU UMa systems and searching only for signals that are consistent with these, we derive a  $2\sigma$  significance for the superhump signal. The alleged appearance of an additional superhump at the end of the outbursts appears to be statistically insignificant. Although of weak statistical significance, the superhump signal of the long 1985 outburst of U Gem can be interpreted as further indication for the SU UMa nature of this outburst. This further contradicts the tidal instability model as the explanation for the superhump phenomenon.

*Download/Website:* <http://arxiv.org/abs/astro-ph/0701572>

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## HR Lyrae (Nova Lyr 1919): from outburst to active quiescence

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*Journal of the British Astronomical Association, in press (astro-ph/0701719)*

Nova Lyrae was discovered at the Harvard College Observatory on 1919 December 6 at magnitude 6.5. We present a lightcurve for this nova based on published and archival observations. This was a classical fast nova, probably of type B. Decline times were  $t_2 = 31$  or 47d, depending on the method used, and  $t_3 = 97$ d. The amplitude was at least 9.5 magnitudes. Based on our  $t_2$  values, we estimate that the absolute magnitude at maximum was -6.9 or -7.2 (+ or -1.1) and at minimum is +2.3 or +2.6 (+ or - 1.1). The star shows an active quiescence with brightness variations on a variety of timescales. Visual observations over a period of ten years also reveal long periods when the star was around 15.4v and others when it was close to 15.7v. Finally, we point out that some characteristics of the star are similar to those of recurrent novae and propose further monitoring of future activity.

*Download/Website:* <http://uk.arxiv.org/abs/astro-ph/0701719>

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## Cataclysmic Variables

*Robert Connon Smith*

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*Contemporary Physics, in press*

Cataclysmic variables are binary stars in which a relatively normal star is transferring mass to its compact companion. This interaction gives rise to a rich range of behaviour, of which the most noticeable are the outbursts that give the class its name. Novae belong to the class, as do the less well known dwarf novae and magnetic systems. Novae draw their energy from nuclear reactions, while dwarf novae rely on gravity to power their smaller eruptions. All the different classes of cataclysmic variable can be accommodated within a single framework and this article will describe the framework, review the properties of the main types of system and discuss models of the outbursts and of the long-term evolution.

*Download/Website:* <http://astronomy.sussex.ac.uk/rcs/cpreview.pdf>

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### HST and Optical Observations of Three Pulsating Accreting White Dwarfs in Cataclysmic Variables

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*Astrophysical Journal, in press (astro-ph/0612529)*

Ultraviolet observations using the Solar Blind Channel on the Hubble Space Telescope provide light curves and low resolution spectra of three pulsating white dwarfs in the cataclysmic variables SDSS013132.39-090122.3, SDSSJ161033.64-010223.3 and SDSSJ220553.98+115553.7. The UV light curves show enhanced pulsation amplitudes over those from simultaneous and previous optical photometry, while the UV-optical spectra are fit with white dwarf temperatures near 15,000K. These temperatures place the accreting white dwarfs outside the instability zone for non-interacting DAV white dwarfs and show that the instability strip is complex for accreting white dwarfs.

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### Spectroscopy of the candidate pre-CV LTT 560

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*Astrophysics and Space Science, published (2006Ap&SS.304..299T, astro-ph/0601046)*

We present preliminary results on spectroscopic data of the candidate pre-cataclysmic variable LTT 560. A fit to the flux-calibrated spectrum reveals the temperature of the white-dwarf primary to be  $T_{\text{eff}} = 7000 - 7500$  K, and confirms the result of previous studies on the detection of an M5V secondary star. The analysis of radial velocity data from spectral features attributed to the primary and the secondary star show evidence for low-level accretion.

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## The Unusual Cataclysmic Binary Star RBS 0490 and the Space Density of Cataclysmics

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*Publications of the Astronomical Society of the Pacific, published (2006PASP..118.1238T)*

RBS (Rosat Bright Source) 0490 is a cataclysmic variable star (CV) with unusually strong emission lines. The strength of the emission lines led to a suggestion that the object is intrinsically faint and correspondingly nearby ( $\sim 33$  pc), which, if true, would strongly affect estimates of the CV space density. Here we report astrometry, filter photometry, and time-series spectroscopy of this object. The astrometry gives an absolute parallax  $\pi_{\text{abs}} = 4.5 \pm 1.5$  mas and a relative proper motion of  $102 \text{ mas yr}^{-1}$ . A Bayesian procedure gives a very uncertain distance estimate of  $d \sim 300$  pc, and the small parallax alone implies  $d > 133$  pc (at two standard deviations). The mean  $V$  magnitude is 17.4, which implies  $M_V = 10.9 - 5 \log(d/200 \text{ pc})$ , neglecting extinction. At 200 pc, the space velocity would be over  $90 \text{ km s}^{-1}$  with respect to the LSR. The time-series spectroscopy shows a possible emission-line radial-velocity period near 46 min. This would be unusually short for an orbital period and it may represent some other clock in the system.

*Download/Website:* astro-ph/0608111

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## An in-depth study of the pre-polar candidate WX LMi

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*Astronomy & Astrophysics, in press (astro-ph/0611758)*

Optical photometry, spectroscopy and XMM-Newton ultraviolet and X-ray observations with full phase coverage are used for an in-depth study of WXLMi, a system formerly termed as a low-accretion rate polar. We find a constant low mass accretion rate,  $\dot{M} \simeq 1.5 \times 10^{-13} M_{\odot}/\text{yr}$ , a peculiar accretion geometry with one spot not being accessible via Roche-lobe overflow, a low temperature of the white dwarf,  $T_{\text{eff}} < 8000 \text{ K}$  and the secondary likely being Roche-lobe underfilling. All this lends further support to the changed view on WXLMi and related systems as detached binaries, i.e. magnetic post-common envelope binaries without significant Roche-lobe overflow in the past. The transfer rate determined here is compatible with accretion from a stellar wind. We use cyclotron spectroscopy to determine the accretion geometry and to constrain the plasma temperatures. Both, cyclotron spectroscopy and X-ray plasma diagnostics reveal low plasma temperatures below 3 keV on both accretion spots. For the low  $\dot{m}$ , high B plasma at the accretion spots in WX LMi, cyclotron cooling is dominating thermal plasma radiation in the optical. Optical spectroscopy and X-ray timing reveal atmospheric, chromospheric and coronal activity at the saturation level on the dM4.5 secondary star.

*Download/Website:* <http://arxiv.org/abs/astro-ph/0611758>

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## Theoretical orbital period distributions of cataclysmic variables above the period gap: effects of circumbinary disks

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*Astrophysical Journal, in press (astro-ph/0611569)*

Population synthesis tools are used to investigate the population of non magnetic cataclysmic variable binary systems with unevolved main sequence-like donors for systems above the upper edge of the period gap at orbital periods greater than 2.75 hr. In addition to the angular momentum losses associated with gravitational radiation, magnetic braking, and mass loss from the system, we also include the effect of a circumbinary disk on the evolution of the binary system. To calculate the orbital period distribution, a grid of detailed binary evolutionary sequences has been included in the simulations. For a fractional mass input rate into the disk, corresponding to  $3 \times 10^{-4}$  of the mass transfer rate, the model systems exhibit a bounce at orbital periods greater than 2.75 hr. The simulations reveal that (1) some systems can exist as dwarf nova type systems throughout their lifetime, (2) dwarf nova type systems can evolve into nova-like systems as their mass transfer rate increases with increasing circumbinary disk mass, and (3) nova-like systems can evolve back into dwarf nova systems during their postbounce evolution to longer orbital periods. Among these subclasses, nova-like cataclysmic variables would be the best candidates to search for circumbinary disks at wavelengths  $\gtrsim 10\mu\text{m}$ . The theoretical orbital period distribution of our population synthesis model is in reasonable accord with the combined population of dwarf novae and nova-like systems above the period gap, suggesting the possibility that systems with unevolved donors need not detach and evolve below the period gap as in the disrupted magnetic braking model. The resulting population furthermore reveals the possible presence of systems with small mass ratios (a property of systems exhibiting superhump phenomena at long orbital periods) and a preference of O/Ne/Mg white dwarfs in dwarf nova systems in comparison to nova-like systems. The nova-like population furthermore shows a lack of systems with high-mass white dwarfs. The importance of observational bias in accounting for the differing populations is examined, and it is shown that an understanding of these effects is necessary in order to confront the theoretical distributions with the observed ones in a meaningful manner.

*Download/Website:* <http://arxiv.org/abs/astro-ph/0611569>

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### 3 Abstracts of theses

#### SPH Simulations of X-ray Binary Systems

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*PhD Thesis, published*

In low mass X-ray binaries a neutron star or a black hole accretes from a low mass companion star via an accretion disc. The physics of accretion discs in these systems is currently an area of vigorous international research activity. In particular the advent of supercomputing has allowed quantitative numerical work on the dynamics of such systems. The numerical simulations are becoming increasingly able to reproduce observed phenomena, and the interplay between simulation and observation is refining the picture derived from analytical work on these systems. Consequently this PhD exploits the synergy between observation and simulation.

We present two/three-dimensional smoothed particle hydrodynamics (SPH) simulations of a number of binary systems, such as XTE J1118+480, and reveal complex accretion discs that are continuously varying in shape, kinematics and dissipation. The stream-disc impact region and disc spiral density waves are prominent sources of energy dissipation. For extreme mass ratios the dissipated energy is modulated on the superhump period. We generate synthetic trailed spectrograms that reveal two distinct ‘S-wave’ features, produced by the stream gas and the disc gas at the stream-disc impact shock. These S-waves are non-sinusoidal, and evolve with disc precession phase.

We also describe three-dimensional SPH calculations of warped accretion discs in X-ray binary systems. Geometrically thin, optically thick accretion discs are illuminated by a central radiation source. This illumination exerts a non-axisymmetric radiation pressure on the surface of the disc resulting in a torque that acts on the disc to induce a twist or warp. Initially planar discs are shown to be unstable to warping driven by the radiation torque and in general the warps also precess in a retrograde direction relative to the orbital flow. We simulate a number of X-ray binary systems which have different mass ratios using a number of different luminosities for each. Models for X-ray binary systems such as Her X-1 and SS 433 are able to reproduce their observed long period photometric modulations.

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### 4 Other abstracts

#### JSkyCalc: A Convenient, Portable Observing Aid

*J. R. Thorstensen*

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*IB News announcement,*

The venerable `skycalc` program performs “time-and-the-sky” calculations needed by observational astronomers, computing quantities such as airmass, moon and twilight interference, time and velocity corrections to the solar system barycenter, and so on. The purpose of this note is to announce the availability of a radically different (and hopefully much more usable) version, `JSkyCalc`. This version is written entirely in Java, and hence can run on any computer that has the Java Runtime Environment version 1.5 or higher. There is a modern graphical user interface, and a very useful planetarium-style visualization tool. The page below gives more detail, including links for downloading the executable and running the program through Java WebStart.

*Download/Website:* <http://www.dartmouth.edu/~physics/faculty/skycalc/flyer.html>

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## 5 Jobs and positions

### Research Fellowship in X-ray Astronomy

*D. de Martino*<sup>1</sup>

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*Job vacancy,*

Applications are invited for a research fellowship in X-ray astronomy at the INAF-Osservatorio Astronomico di Capodimonte (Naples, Italy). The successful candidate will work primarily on XMM-Newton observations of Cataclysmic Variables. The appointment is for one year, founded by Italian Space Agency. Extensions are possible depending on availability of funds. Applications of motivated students which have not yet completed their PhD will be also considered. The official announcement (in Italian) can be found on the INAF-Osservatorio Astronomico di Capodimonte web main page: [www.oacn.inaf.it](http://www.oacn.inaf.it) and in the job announcement page: [www.oacn.inaf.it/oacweb/oacweb\\_info\\_gen/oacweb\\_lavoro.htm](http://www.oacn.inaf.it/oacweb/oacweb_info_gen/oacweb_lavoro.htm) Applications can be sent in English. Applicants who need any help in filling, the application form or requesting further information, may contact Domitilla de Martino, email: [demartino@na.astro.it](mailto:demartino@na.astro.it)

Expiring date for applications is February, 22 2007.

Download/Website: [http://www.oacn.inaf.it/oacweb/oacweb\\_info\\_gen/oacweb\\_lavoro.htm](http://www.oacn.inaf.it/oacweb/oacweb_info_gen/oacweb_lavoro.htm)

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## 6 As seen on astro-ph

In this issue of IB News, as in the last, we have divided up the ‘as seen on astro-ph’ list into a number of categories. No guarantee is made that absolutely every paper is assigned to the correct category, but we hope you find the division useful in identifying the papers that you may wish to read. The list is as complete as we can make it from the time of IB News 24, so it includes all of March, April and May 2006.

### 6.1 Cataclysmic Variables and related systems

astro-ph/0603010: **Modeling Eclipses in the Classical Nova V Persei: The Role of the Accretion Disk Rim** by *A. W. Shafter, K. A. Misselt*

astro-ph/0603087: **A 110 MG cyclotron harmonic in the optical spectrum of RX J1554.2+2721** by *A.D. Schwope, M.R. Schreiber, P. Szkody*

astro-ph/0603155: **The effect of dust obscuration in RR Tel on optical and IR long-term photometry and Fe II emission lines** by *D. Kotnik-Karuza et al*

astro-ph/0603325: **Simultaneous photometry and echelle-spectroscopy of the dwarf nova BZ Ursae Majoris during the 2005 January Outburst** by *V. V. Neustroev, S. V. Zharikov, R. Michel*

astro-ph/0603347: **The X-ray properties of the magnetic Cataclysmic Variable UU Col** by *D. de Martino et al*

astro-ph/0603356: **HST/FOS Spectral Mapping of V2051 Ophiuchi in a Low State** by *R. K. Saito, R. Baptista*

astro-ph/0603374: **Chandra and Hubble Space Telescope Study of the Globular Cluster NGC 288** by *A.K.H. Kong et al*

astro-ph/0603429: **Supersoft X-ray Sources. Parameters of Stellar Atmospheres** by *A. Ibragimov et al*

astro-ph/0603430: **Supersoft X-ray Sources. Basic Parameters** by *V. Suleimanov, A. Ibragimov*

astro-ph/0603715: **XSS J00564+4548 and IGR J00234+6141 – new cataclysmic variables from RXTE and INTEGRAL all sky surveys** by *I. F. Bikmaev et al*

- astro-ph/0603718: **Structure of the hot object in the symbiotic prototype Z And during its 2000-03 active phase** by *A. Skopal et al*
- astro-ph/0603733: **FH Leonis, the first dwarf nova member of a multiple star system?** by *N. Vogt*
- astro-ph/0603795: **Unipolar Inductor Model coupled to GW emission: energy budget and model application to RX J0806+15 and RX J1914+24** by *S. Dall'Osso, G.L. Israel, L. Stella*
- astro-ph/0603798: **VW Hyi: optical spectroscopy and Doppler tomography** by *Amanda J. Smith, Carole A. Haswell, Robert I. Hynes*
- astro-ph/0604085: **Formation and evolution of compact binaries in globular clusters: I. Binaries with white dwarfs** by *N. Ivanova et al*
- astro-ph/0604274: **Accretion column structure of magnetic cataclysmic variables from X-ray spectroscopy** by *R. Hoogerwerf, N.S. Brickhouse, C.W. Mauche*
- astro-ph/0604275: **AD Mensae: a dwarf nova in the period gap** by *L. Schmidtbreick, C. Tappert*
- astro-ph/0604306: **Optical polarimetry and infrared photometry of two AM Her binaries: 1RXS J161008.0+035222 and 1RXS J231603.9-052713** by *C. V. Rodrigues et al*
- astro-ph/0604314: **The White Dwarf in AE Aqr Brakes Harder** by *Christopher W. Mauche*
- astro-ph/0604319: **Pulsational Instabilities in Accreting White Dwarfs** by *Phil Arras, Dean M. Townsley, Lars Bildsten*
- astro-ph/0604338: **A Flare of AE Aquarii Observed with XMM-Newton** by *Chul-Sung Choi, Tadayasu Dotani*
- astro-ph/0604396: **Optical spectroscopy of the dwarf nova U Geminorum** by *Unda-Sanzana, E., Marsh, T.R., Morales-Rueda, L.*
- astro-ph/0604438: **Nova V4743 Sagittarii 2002: An Intermediate Polar Candidate** by *Tae W. Kang et al*
- astro-ph/0604618: **Swift observations of the 2006 outburst of the recurrent nova RS Ophiuchi: I. Early X-ray emission from the shocked ejecta and red giant wind** by *M.F. Bode et al*
- astro-ph/0605048: **Dynamical Formation of Close Binaries in Globular Clusters II: Cataclysmic Variables** by *David Pooley, Piet Hut*
- astro-ph/0605164: **Photometric study of selected cataclysmic variables** by *C. Papadaki et al*
- astro-ph/0605246: **Newly arising problems in the research of SU UMa-type dwarf novae from VSNET collaborations** by *D. Nogami*
- astro-ph/0605284: **Brief outbursts in the dwarf nova V1316 Cygni** by *Jeremy Shears, David Boyd, Gary Poyner*
- astro-ph/0605286: **Discovery of a new dwarf nova, TSS J022216.4+412259.9: WZ Sge-type dwarf novae breaking the shortest superhump period record** by *Akira Imada et al*
- astro-ph/0605291: **The Properties of Cataclysmic Variables In Photometric Halpha Surveys** by *A. R. Witham et al*
- astro-ph/0605326: **X-Ray Emitting Blast Wave from the Recurrent Nova RS Ophiuchi** by *J. L. Sokoloski et al*
- astro-ph/0605394: **Observations of the recently discovered dwarf nova 1RXS J053234.9+624755 during the 2005 March superoutburst** by *Gary Poyner, Jeremy Shears*
- astro-ph/0605554: **V4745 Sgr – a nova above the period gap and an intermediate polar candidate** by *Andrej Dobrotka, Alon Retter, Alex Liu*
- astro-ph/0605556: **New Pulsating White Dwarfs in Cataclysmic Variables** by *R. Nilsson et al*
- astro-ph/0605588: **Dwarf novae in the Hamburg Quasar Survey: Rarer than expected** by *A. Aungwerojwit et al*
- astro-ph/0605650: **CCD photometry and visual observations of V1663 Aquilae (Nova Aquilae 2005)** by *David Boyd, Gary Poyner*
- astro-ph/0605722: **Ultra-compact (X-ray) binaries** by *G. Nelemans, P.G. Jonker*
- astro-ph/0605727: **GEMINI spectroscopy of the ultra-compact binary candidate V407 Vul** by *D. Steeghs et al*

## 6.2 LMXBs and related systems

- astro-ph/0603024: **Spectral and Fourier analyses of X-ray QPO in accreting black holes** by *M.A. Sobolewska, P.T. Zycki*
- astro-ph/0603126: **Analysing the atolls: X-ray spectral transitions of accreting neutron stars** by *Jeanette Gladstone, Chris Done, Marek Gierlinski*
- astro-ph/0603207: **The XMM-Newton view of GRS1915+105 during a "plateau"** by *Andrea Martocchia et al*
- astro-ph/0603210: **High-frequency Quasi-Periodic Oscillations from GRS 1915+105 in its C state** by *T. Belloni et al*
- astro-ph/0603281: **The non-linear behavior of the black hole system GRS 1915+105** by *R. Misra et al*
- astro-ph/0603352: **What can we learn from long term monitoring of X-ray bursters?** by *Andrew Cumming*
- astro-ph/0603708: **XMM-Newton Discovery of the X-ray Transient XMMU J181227.8-181234 in the Galactic Plane** by *Edward M. Cackett, Rudy Wijnands, Ron Remillard*
- astro-ph/0604043: **Spreading of thermonuclear flames on the neutron star in SAX J1808.4-3658: an observational tool** by *Sudip Bhattacharyya, Tod E. Strohmayer*
- astro-ph/0604096: **Connection between accretion disk and superluminal radio jets and the role of radio plateau state in GRS 1915+105** by *J. S. Yadav*
- astro-ph/0604345: **Accretion-powered Millisecond Pulsar Outbursts** by *Duncan K. Galloway*
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