THE X-RAY NOVA GRO J0422+32 IN DECLINE AND QUIESCENCE

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We have followed the X-ray nova GRO J0422+32, spectroscopically and photometrically, throughout the decline to quiescence.

In the final stages of decay (days 430...880 after the outburst, see Callanan et al. (1995) for the epoch 1995), the equivalent width (EW) of the Hα emission increases monotonically and the R magnitude decreases monotonically. This suggests that the flux in the Hα line is constant, while the continuum fades. The Hα flux is the product of the R band flux ($F(R)$, arbitrarily scaled to 100 at $R = 19$ mag) and the EW, and is shown in the last column of the table below. The Hα flux varies by only $\sim 30\%$ while the continuum fades by a factor of eight (from $R = 19$ mag to $R = 21.3$ mag). So, to first order, the Hα luminosity is constant in the final stages of decay. While it is generally the case that the emission line EWs in individual dwarf novae also increase during the decay, the exact behavior seen in GRO J0422+32 is *not* what is seen for dwarf novae (on average). Using the relation between EW[Hβ] and M_v given in figure 6 of Patterson (1984), we would expect a factor of ~ 5 variation in the Hα flux during days 430...880. The stability of the Hα flux implies that somehow the emission line region is 'disconnected' from the continuum (R−band) emission region.

Day	Date	EW(Å)	R	F(R)	Flux = EW×F(R)
430	1993 Oct 9/11	30	19.0	100	300
580	1994 March 10	100	20.0	40	400
790	1994 Sept 29/30	150	20.8	19	285
880	1994 Dec 30/31	210	21.3	12	250

Many authors have noted that in CVs, the width of the Balmer emission lines is an indicator of the inclination of the system. For any thin disk model this must be the case, as the observed line width will depend on the

projected velocity (i.e. on sin i). If the disks are Keplerian and fill a constant fraction of their Roche lobe, one can easily derive the approximation that the projected velocity will also go like $(M/P)^{1/3}$ (see Frank, King & Raine 1992). In order to investigate this we correlated the Balmer line width measured by Williams (1983) versus the inclinations from Ritter (1994). A clear correlation is seen, although with a wide ($\sigma = 396\,\mathrm{km\,s^{-1}}$) scatter. If one includes the $\sim (M/P)^{1/3}$ factor, the correlation becomes more significant and the scatter drops to $284\,\mathrm{km\,s^{-1}}$. When we add GRO J0422+32 and points for other SXT in quiescence (taken from the literature) to the graph (in larger type) we find that they also seem to obey the same correlation (see figure below).

CV H-alpha FWHM vs. Orbital Inclination and Mass
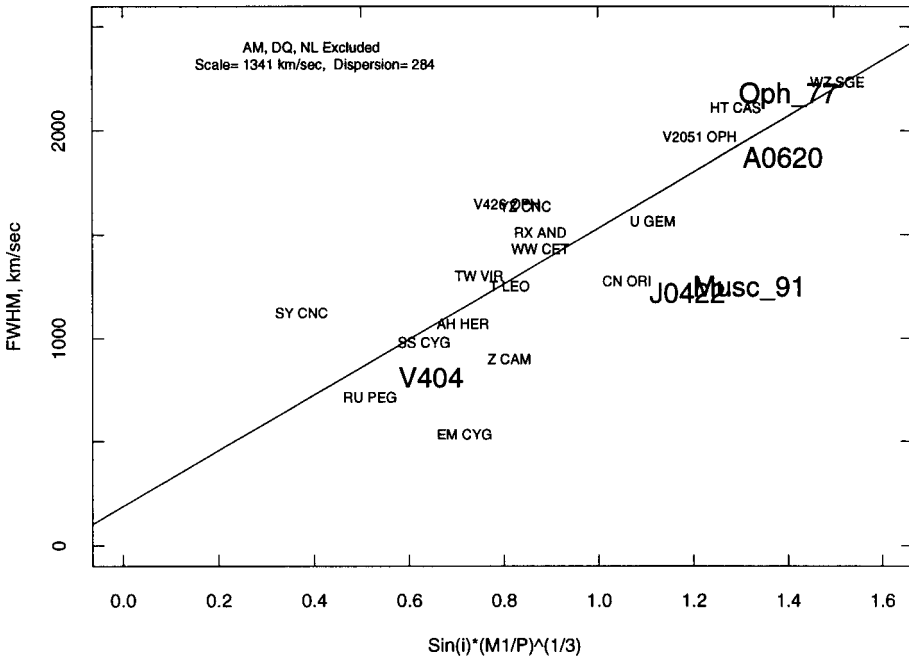
References

Callanan, P.J., Garcia, M.R., McClintock, J.E., et al., 1995, Ap. J., **441**, 786
Frank, J., King, A. R., Raine, D.J., 1992, "Accretion Power In Astrophysics", p54
Patterson, J., 1984, Ap. J. Supp., **54**, 443
Ritter, H., 1994, A&AS, **85**, 1179
Williams, G., 1983, Ap. J. Supp., **53**, 523