The Extraordinary X-ray Light Curve of the Classical Nova V1494 Aql in Outburst: The Discovery of Pulsations and a "Burst"

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[Contributed talk, 15min.]

Abstract

V1494 Aql (Nova Aql 1999 No. 2) was discovered on 2 December 1999. It reached $V_{max} \sim 4$ making it the brightest northern hemisphere nova since V1500 Cyg erupted in 1975. Our early optical spectra showed that it was an "Fe II" class nova (Williams, R.E. AJ, 104, 725, 1992). We activated our CHANDRA Target of Opportunity proposal for bright novae in outburst and obtained ACIS-I spectra on 15 April and 7 June 2000 which showed only emission lines. Our third observation, on 6 August, showed that its spectrum had evolved into that characteristic of a Super Soft X-ray Source (at low resolution it resembled an "emission" line with a peak $\sim$ 0.5 keV). We obtained HRC-S+LETG spectra on 28 September (8 ksec) and 1 October 2000 (17 ksec). These spectra qualitatively resembled those of CAL 83 obtained with XMM (Paerels, F., et al. 2001, A&A, 365, L308) and demonstrated that we were observing the atmosphere of a hot white dwarf which was probably still undergoing nuclear burning near the surface. An abundance analysis of the X-ray spectrum is in progress using new Non-LTE stellar atmospheres.

We then analyzed the X-ray light curve of our grating observations and, to our surprise, found that we had discovered both a short time scale "burst" and that the nova was oscillating. Neither of these phenomena have ever been seen in the light curve of a nova in outburst. The "burst" was a factor of 6 rise in X-ray counts near the middle of the second observation which lasted about 1000 sec and exhibited at least two peaks plus other structure. Currently, we have no explanation for the cause of this burst.

Our time series analysis of the combined 25 ksec observation showed a peak at 2500 sec which was present in independent analyses of both the zeroth order image and the dispersed spectrum. We also analyzed the light curves of the HRC-S+LETG observations of HZ 43, Sirius B, and V382 Vel (Nova Vel 1999) and found no sign of any periodic behavior in the data which implied that the oscillation in V1494 Aql was real and not instrumental. Further analysis found that other periods were present in the data for V1494 Aql (in both the zeroth order image and the dispersed spectrum) which suggested strongly that we had discovered that the rekindled white dwarf was pulsating in non-radial g modes. If the white dwarf atmosphere still has sufficient hydrogen present to poison $\kappa - \gamma$ pulsation driving, then these pulsations could be caused by ongoing nuclear burning in the remnant envelope (the ϵ-effect). If this interpretation is correct, then the nova had not returned to quiescence at the time of our observations and the pulsations could then last as long as there was nuclear burning in the envelope of the white dwarf.

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