Bolometric study of classical novae in the LMC

Spectrophotometry from 1200-8000Å

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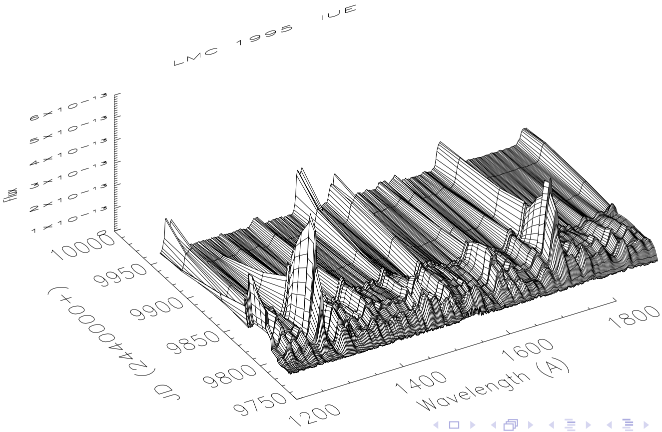
Subtypes: classical novae

- Two principal subtypes based on spectral diagnostics: CNO, ONe - these are distinguished based on the post-trabsitional spectra that show strongest emission from N III-V, C II-IV, O I-VI (this includes the FUV resonance lines); [Ne III]-[Ne V] (UV, also higher ionization states in optical)
- An optical spectroscopic distinction (cf. Williams 1992) is based on the presence of strong Fe II, [Fe II] or the early appearance of He I-II without the strong fluorescent emission.
- Recurrents: these come in two varieties, compact systems ($P_{\rm orb} \leq 1^d$) or with giant companions, analogous to symbiotics ($P_{\rm orb} > 200^d$)
- Aside from the symbiotic-like recurrents, all three have been observed in the LMC between 1988 and 2000, with coverage from 0.1 to 1μ

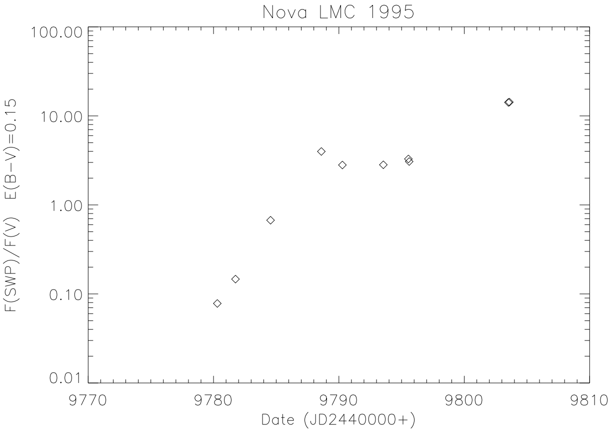
Basic spectroscopic stages

- Fireball stage: the first optically thick phase during the initiation of the outburst when the UV continuum shows a characteristic temperature of $> 3 \times 10^4$K, within the first two days of outburst and before optical maximum. (This was originally distinguished based on IR photometry, the (optically thick) continuum phase before the appearance of low ionization emission lines.
- "Fall of the Iron Curtain": so named for the rapid development of recombination-induced absorption lines, mainly from the Fe-group (Fe I-III, etc) that blanket the spectrum from 0.1-0.2μ and redistribute flux to the optical and near IR; followed by the "lifting of the curtain", when the topical declines. In the optical phenomenology t_2 and t_3, the decline times of 2 or 3 mags from optical peak, correspond to this phase.
- Transition phase: intercombination emission lines of intermediately ionized species (e.g. C III], N III], N IV])
- Nebular phase: disappearance of the continuum (e.g. pseudo-photosphere) and dominance of recombination lines of increasing ionization.
- Coronal line phase

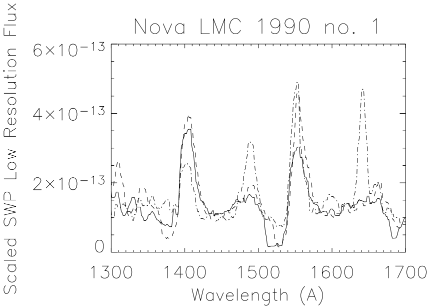
Basic spectroscopic stages: sample UV surface (1200-2000Å), LMC 1995



Flux redistribution: LMC 1995

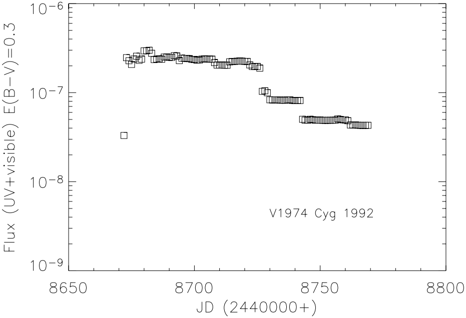


ONe novae have displayed a transient (a few days) P Cyg stage when the resonance lines (particularly Si IV 1400, C IV 1550) show strong P Cyg components with velocities comparable to the ejection velocity 3000 - 12000 km s^{-1}, at the same stage when the Fe-curtain lifts and a pseudo-photosphere remains (with a radiation temperature $> 2 \times 10^4$K). LMC 1988#1 also showed P Cyg Mg II profiles



Constant Bolometric Luminosity (CBL) phase

With a duration of days to weeks, this phase (calibrated on Galactic novae in multiwavelength campaigns) can be used to independently determine E(B-V) and energetics. First established in V1974 Cyg 1992, the technique has also been applied to LBVs in outburst (e.g. Shore, Altner, Waxin 1996) by minimizing the dispersion in the CBL as a function of extinction, in this case using the LMC standard extinction

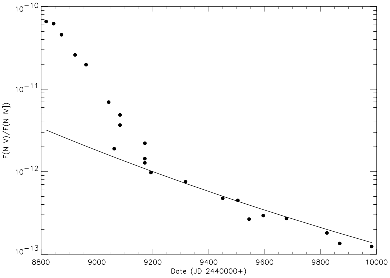


Turnoff Timescales

The turnoff time for the central source can be estimated , for example, using He II 1640 (in the hope of the STIS repair but also from archival IUE, GHRS, and STIS data; also He II 4686) :

$$\ln \frac{n(HeII)}{n(HeI)} = \frac{1}{2}\alpha_{\rm HeII}(T)n_e(t_0)t_0[\frac{t_0}{t})^2 - 1]$$

assuming no further radiative input from the WD during free expansion of the constant mass ejecta (Shore et al. 1996, Vanlandingham et al. 2001). This has also been applied to the N III-V UV sequence:



Bolometric luminosities and turnoff times

Nova	E(B-V)	L_V	L_{bol}	t_{CBL}(d)	t_{to}(d)	ratio	$V_{exp}(km\ s^{-1})$
88#1	0.12	1.0	4.5	8	143	0.23	4000
88#2	0.24	3.0	17.0	–	51	0.18	4000
90#1	0.15	3.3	9.0	5	45	0.4	9000
90#2	0.15	1.2	10.0	$\sim$3	12	0.12	10000
91	0.1:	9.1	37.0	5	182	0.25	3000
92	0.2	2.4	7.0	$\sim$10	83	0.36	3000
95	0.15	1.2	6.4	$\sim$60	72	0.19	4000