

Evolution of V339 Del (Nova Del 2013) since 0.37 – 75 days after discovery

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We study the evolution of V339 Del (Nova Del 2013) during 0.37-75 days after discovery. Spectra from the Liverpool Telescope were collected and analysed to find the velocity of ejecta (v_{ej}), relative radiation with respect to continuum level (R^*_λ), and FWHM of the radiation. The evolution of light curve was explained by adopting an ideal nova light curve as criteria. We found that the evolution of V339 Del during $t = 0.37 - 75$ days can be explained in 7 phases: 1) Initial rise ($t = 0 - 0.6$ days); nova is suddenly brighter from $V \sim 11$ to ~ 6.4 . A maximum v_{ej} is ~ 2400 km/s. R^*_λ and FWHM first increases and then decreases where this joint ($t = 0.35$ days) turns out to be the first detection of X-ray. 2) Pre-maximum halt (0.6–1.2 days); There is a halt of brightness around $V \sim 5.1 - 5.9$, decreasing v_{ej} , increasing R^*_λ with decreasing FWHM. 3) Final rise ($t = 1.2 - 1.5$ days); Nova is brighter again to maximum. The variation of v_{ej} and radiation have similar trend to the halt phase. 4) Maximum ($t = 1.5 - 2.5$ days); Nova has maximum brightness of $V = 4.45 \pm 0.01$ ($t = 1.67$ days) decreasing v_{ej} and increasing R^*_λ until maximum value and the decreasing afterward, while FWHM decreases from the final rise. 5) Early decline ($t = 2.5 - 35$ days); Nova has a drop in brightness and v_{ej} . The last measurement of v_{ej} is $\sim 1100 - 1200$ km/s at $t = 35.5$ days. The radiation seems to have 2 distinct phases in this early decline including: First stage ($t = 2.2 - 12$ days) where R^*_λ and FWHM increase and nebular spectra begins around $t \sim 10$ days. In this stage the nova shell expands optical depth reduces, marking pseudo-photosphere shrink. Second stage ($t = 12 - 35$ days) where R^*_λ and FWHM decrease and SED shift to near-IR until not visible in optical ($t = 28$ days). Iron curtain ($t \sim +25$ days) was found near the time of first soft X-ray detection ($t = 35.6$ days). 6) Transition ($t = 35 - 60$ days); Brightness decreases where R^*_λ and FWHM gradually increase meaning it reveals deeper pseudo-photosphere. 7) Final decline ($t = 60 - 75$ days); Nova is fainter than 6 magnitude from maximum, R^*_λ and FWHM decrease, Nova is now in nebular phase permanently allowing us to see the surface of white dwarf for the first time.

Primary authors: Mr MUEANGKON, Yothin (Chiang Rai Rajabhat Univeristy); KHAMRAT, Sutharut (Chiang Rai Rajabhat University); Ms AINTAWIPHAK, Sutthida (Chiang Rai Rajabhat University); Ms JAIBOE, Anothai (Chiang Rai Rajabhat University); Mr SUEKONG, Dawee (Chiang Rai Rajabhat University); Dr SURINA, Farung (Chiang Rai Rajabhat University); Dr DARNLEY, Matt J. (Liverpool John Moores University); Prof. BODE, Mike F. (Liverpool John Moores University)

Presenters: Mr MUEANGKON, Yothin (Chiang Rai Rajabhat Univeristy); KHAMRAT, Sutharut (Chiang Rai Rajabhat University)

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