

GI Trigger Target: We are invoking our GI CY9 target of opportunity program entitled, "SWIFT X-Ray/UV ToO Monitoring of a Bright Nova in Outburst," (proposal number 912005) to obtain simultaneous X-ray and ultraviolet (UV) observations of the new high galactic latitude nova PNV20233073+2046041 (= Nova Delphini 2013) when the system reaches  $[V] \sim 9$  as it declines from outburst maximum ( $V_{\max} \sim 4.3$  on 2013 Aug 16.25UT; ATEL#5304). The current ~~TV~~ (JD=2456525.96) ~~the~~ visual magnitude is  $[V] \sim 5.5$ , with an approximate rate of decline of  $\sim 0.22$  mag/day (AAVSO light-curve dataset). Nova Del 2013 satisfies the trigger criteria outlined in the original proposal including: detection by Fermi/LAT (ATEL#5302), high expansion velocity FWHM  $> 1800$  km/s (ATEL#5304, #5295), and low extinction  $E(B-V) < 0.5$  (measured  $E(B-V) = 0.182$ ; ATEL#5297).

Science Objective: We seek to determine the characteristics of the three major X-ray phases of Nova Del 2013. The X-ray phases are: 1) the early  $\gamma$ -ray and hard X-ray phase; 2) a rapid and highly variable transition phase; and 3) the later and brighter SSS phase. Early hard X-ray emission has been detected in all novae observed by Swift and which have high expansion velocities  $> 5000$  km/s (e.g., Schwarz et al. 2011 [ApJ 197, 31]), or are recurrent novae with red giant secondaries (e.g., RS Oph). These hard X-rays are consistent with shocks either within the ejected material or with the ambient medium and decline rapidly as the shock dissipates. Some slower novae, including Nova Mon 2012 (Nelson et al. 2012 [ATEL#4321]), also show persistent hard X-ray emission many months to years after the outburst that is difficult to reconcile with the shock model. The transition to the SSS phase is not smooth. Novae with high cadence Swift monitoring reveal extreme variability on very rapid timescales (Schwarz et al. 2011). Hourly changes in count rate of  $\sim 100$  ct/s are common (cf., Page et al. 2013 [ApJ 768, L26]). These variations eventually damp out, but do not go away completely, as the nova enters the SSS phase. In some cases the variability can be attributed to rapid X-ray opacity changes as the clumpy ejecta clear but the progression of the hardness ratio is not always consistent with this explanation. The onset and duration of the SSS phase provides critical information for each outburst. Using the derived expansion velocities of the ejecta and amount of time until the SSS emission is detected, the "turn-on" time, we can obtain an estimate of the amount of mass ejected. The end of the SSS phase, or the "turn-off" time, is a direct measure of the duration of nuclear burning on the WD and provides an estimate of the amount of material remaining on the WD after the initial explosion. These times depend on many factors including the WD mass, the composition of both the accreted material and WD, the luminosity of the WD prior to accretion, the mass accretion rate, and possibly the system separation.

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The number of observations in our GI ToO is insufficient to fully explore all three of the expected phases outlined above. Our goal is to execute an observational study with a modest cadence that will allow us to determine the start, durations, and general properties of each phase and more importantly rapidly exploit any new and unexpected behavior such as a Fermi/LAT  $\gamma$ -ray detection. If the situation warrants we will request additional ToO time via the non-GI website to fully explore known phenomena such as the variable phase or a SSS duration beyond our 60 ks GI-

awarded time. It also is entirely possible that a triggered source may not show all three phases, e.g., no early  $\gamma$ -ray or hard X-ray emission. However, null detections are still very useful as they allow us to determine how specific properties differ relative to the benchmark sample that do show these properties.

Execution Request: Assuming the current decline rate is monotonic (i.e., no dust formation event ensuing), SWIFT observations could safely (i.e., on-saturating UV observations and UV grism spectra) commence near 05 Sept 2013. Interpretation of early Swift ToO (outside our GI request) data is complex, as saturation is problematic (cf., ATEL#5283). Our campaign will consist of one 2 ks observation (GRB observations permitting) every 3 days for 90 days (60 ks total). Our prior Swift experience demonstrates that sufficiently bright novae should have X-ray count rates between 0.01 - 0.5 ct/s during the early hard phase and 1 - 100 ct/s as a SSS. We will also utilize Swift's unique multi-wavelength capabilities. We will search the BAT data for high-energy photons during the early outburst while the UVOT will obtain uvm2 band exposures (even in the co-incidence loss regime as Osborne et al. 2011 [ATEL#3549] have developed a method to recover data near saturation). and UV grism exposures. With the UV filter data we can compare the X-ray and UV light curves to determine the source of the emitting regions.

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