The Stony Brook/SMARTS Atlas of (mostly) Southern Novae

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ABSTRACT. We introduce the Stony Brook/SMARTS Atlas of (mostly) Southern Novae. This atlas contains both spectra and photometry obtained since 2003. The data archived in this atlas will facilitate systematic studies of the nova phenomenon and correlative studies with other comprehensive data sets. It will also enable detailed investigations of individual objects. In making the data public we hope to engender more interest on the part of the community in the physics of novae. The atlas is online at http://www.astro.sunysb.edu/fwalter/SMARTS/NovaAtlas/.

Online material: color figures

1. INTRODUCTION

Exploding stars have been noted for millennia, and observed (in a scientific sense) for somewhat over a century. It wasn’t until the middle of the twentieth century that a distinction could be made between the supernovae, the novae, and the eruptive phenomena seen in cataclysmic variables (the dwarf novae). Kraft (1963) was the first to suggest that the novae were the consequence of explosive hydrogen burning on the surface of a degenerate dwarf. It is now well accepted that the novae are manifestations of runaway thermonuclear reactions on the surface of a white dwarf (WD) accreting hydrogen in a close binary system (e.g., Starrfield 1971). The novae are highly dynamic phenomena, with timescales ranging from seconds to millennia, occurring in complex systems involving two stars and mass transfer.

The primary driver of the evolution of the observational characteristics of a nova is the temporal decrease of the optical depth in an expanding atmosphere. The novae are marked by an extraordinary spectral evolution (Williams et al. 1991, Williams 1992). In the initial phases one often sees an optically thick, expanding pseudo-photosphere. In some cases one sees the growth and then disappearance of inverse P Cygni absorption lines from the cool, high-velocity ejecta. As the pseudo-photosphere becomes optically thin, emission lines of the Hydrogen Balmer series strengthen, accompanied by a spectrum either dominated by permitted lines of Fe II, or of helium and nitrogen. The emission line profiles and line ratios evolve as the optical depth of the ejecta decreases, and the nova transitions from the permitted to the nebular phase (Williams et al. 1991).

Beyond this template, in detail the novae exhibit a panoply of individual behaviors. Payne-Gaposchkin (1957) and McLaughlin (1960) described the evolution of novae as they were known at the time. Williams (1992) discussed the formation of the lines, and divided novae into the Fe2 and He-N classes, based on which emission lines dominated (aside from the ubiquitous Balmer lines of hydrogen). Novae are also categorized as recurrent and classical novae, with the former having more than one recorded outburst. Over a long enough baseline, it is likely that all novae are recurrent (e.g., Ford 1978).

Bode & Evans (2008) present a recent set of reviews of the nova phenomenon.

There exist well-sampled photometric records for many novae, such as those presented by Strope et al. (2010). They classify the photometric light curves, from plates amassed over the past century, into 7 distinct photometric classes. On the other hand, spectroscopic observations of novae have rarely been pursued far past maximum because most novae fade rapidly, and

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time on the large telescopes required for spectroscopy is precious. The most comprehensive past work was the Tololo Nova atlas (Williams et al. 1994) of 13 novae followed spectroscopically over a 5 year interval. The availability of the SMARTS\(^4\) telescope facilities (Subasavage et al. 2010) makes possible routine synoptic monitoring programs, both photometric and spectroscopic, of time-variable sources. It is timely, therefore, to undertake a comprehensive, systematic, high-cadence study of the spectrophotometric evolution of the galactic novae.

This atlas collects photometry and spectra of the novae we have observed with SMARTS. Most of the novae in the atlas are recent novae, discovered since 2003. Most are in the southern hemisphere. The observing cadences are irregular; we have concentrated on He-N and recurrent novae, novae in the Large Magellanic Cloud (LMC), and novae that otherwise show unusual characteristics.

Our purpose here is to introduce this atlas. Our scientific aim is to facilitate a detailed comparison of the various characteristics of the novae. These data can be used by and of themselves to study individual objects, for systematic studies to further define the phenomenon, and for correlative studies with other comprehensive data sets, such as the Swift Nova Working Group’s survey of X-ray and UV observations of recent novae (Schwarz et al. 2011). Our aim in making the atlas public is to make the data accessible to the community. We are focusing on certain novae, and on particular aspects of the nova phenomenon (§ 5), but simply cannot do justice to the full dataset.

**2. OBSERVATIONS AND DATA ANALYSIS**

### 2.1. Low Dispersion Spectroscopy

The spectra reported here have been obtained with the venerable RC spectrograph\(^5\) on the SMARTS/CTIO 1.5 m telescope. Observations are queue-scheduled, and are taken by dedicated service observers.

The detector is a Loral 1K CCD. We use a variety of spectroscopic modes, with most of the spectra having been obtained with one of the standard modes shown in Table 1.

We use slit widths of 1 and 0.8\(^8\) in the low and the higher resolution 47/II modes, respectively. The slit is oriented east-west and is not rotated during the night.

We routinely obtain three spectra of each target in order to filter for cosmic rays. We combine the three images and extract the spectrum by fitting a Gaussian in the spatial direction at each pixel. Wavelength calibration is accomplished by fitting a third to sixth order polynomial to the Th-Ar or Ne calibration lamp line positions. We observe a spectrophotometric standard star, generally LTT 4364 (Hamuy et al. 1992, 1994) or Feige 110 (Oke 1990; Hamuy et al. 1992, 1994), on most nights to determine the counts-to-flux conversion. Because of slit losses, possible changes in transparency and seeing during the night, and parallactic losses due to the fixed slit orientation, the flux calibration is imprecise. We generally recover the correct spectral shape, except at the shortest wavelengths (<3800 Å) where apparent changes in the slope of the continuum are likely attributable to airmass-dependent parallactic slit losses. We have the capability to use simultaneous or contemporaneous photometry to recalculate the spectra.

There are some quality control issues that have not been fully dealt with, especially when we are near the sensitivity limits of the telescope. These include observations of an incorrect star, obviously incorrect flux calibrations, or spectra indistinguishable from noise. We are going through the data as time permits to address these issues.

### 2.2. High Dispersion Spectroscopy

We have a small number of high resolution spectra of some of the brighter novae near maximum. These were obtained with the Bench-Mounted Echelle,\(^6\) and currently with the CHIRON echelle spectrograph.\(^7\) These data will be incorporated into the atlas at a later time.

### 2.3. Photometry

Most of the photometry was obtained using the ANDICAM\(^8\) dual-channel imager on the 1.3 m telescope. Observations are queue-scheduled, with dedicated service observers.

The ANDICAM optical channel is a 2048\(^2\) pixel Fairchild 447 CCD. It is read out with 2 × 2 binning, which yields a 0.369 arcsec/pixel plate scale. The field of view is roughly 6 × 6', but until recently there has been significant unusable area

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\(^4\) The Small and Medium Aperture Telescope System, directed by Charles Bailyn, is an ever-evolving partnership that has overseen operations of four small telescopes at Cerro Tololo Interamerican Observatory since 2003.

\(^5\) For more information see http://www.ctio.noao.edu/spectrographs/60spec/60spec.html.

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### Table 1: Spectrograph Setups

| Mode | Resolution (Å) | Filter (Å) | Wavelength Range |
|------|----------------|------------|------------------|
| Standard Modes |
| 13/I | 17.2           | clear      | 3146-9374        |
| 26/Ia| 4.1            | clear      | 3660-5440        |
| 47/IIb| 1.6           | BG39       | 4070-4744        |
| 47/Ib | 3.1            | GG495      | 5650-6970        |
| Other Modes |
| 9/I | 8.6            | clear      | 3500-6950        |
| 47/II | 1.6          | CuSO\(_4\)_ | 3878-4552        |
| 58/I | 6.5            | GG495      | 6000-9000        |

\(^6\) For more information see http://www.ctio.noao.edu/noao/content/fiber-echelle-spectrograph.

\(^7\) For more information see http://www.ctio.noao.edu/noao/content/chiron.

\(^8\) For more information see http://www.astronomy.ohio-state.edu/ANDICAM/detectors.html.
on the east and south sides on the chip. The finding charts in the atlas show examples of ANDICAM images. We normally obtain single images, since the fraction of pixels marred by cosmic rays and other events is small. Exposure times range from 1 s to about 2 minute. We use the standard Johnson-Kron-Cousins B, V, R, and I filters (the U filter has been unavailable since 2005, but we have extensive U band for some of the earlier novae, particularly V475 Sct and V5114 Sgr).

The ANDICAM IR channel is a Rockwell 1024×1024 HgCdTe “Hawaii” Array. It is read out in 4 quadrants with 2×2 binning, which yields a 0.274 arcsec/pixel plate scale and a 2.4′ field of view. The observations are dithered using an internal mirror. In most cases we use 3 dither positions, with integration times from 4 s (the minimum integration time) to about 45 s. We use the CIT/CTIO techniques in these crowded regions.

The optical and IR channels are observed simultaneously using a dichroic beam splitter. The observing cadence varies from nightly for new novae to ∼annual monitoring for the oldest novae in our list.

We perform aperture photometry on the target and between 1 and 25 comparison stars in the field. The aperture radius R is either 5 or 7 pixels, depending on field crowding and sky brightness. The background is the median value in an annulus of inner radius 2R and outer radius 2R + 20 pixels centered on the extraction aperture. Instrumental magnitudes are recorded for each star. There are cases where the fading remnant becomes blended with nearby stars (within ∼1.5″). To date we have not accounted for such blending. Eventually we plan to employ PSF-fitting techniques in these crowded regions.

On most photometric nights an observation of a Landolt (1992) standard field is taken. On those nights we determine the zero-point correction and determine the magnitudes of the comparison stars. We adopt the mean magnitudes for each comparison star. These are generally reproducible to better than 0.02 mag; variable stars are identified through their scatter around the mean, and are not used in the differential photometry. With only a single observation of a standard star field each night, we assume the nominal atmospheric extinction law and zero color correction. Using differential photometry, we can recover the apparent magnitude of a target with a typical uncertainty of <0.03 mag at twentieth magnitude. While we could do the same with the IR channel images, we find it simpler to use the catalogued Two Micron All Sky Survey (2MASS) magnitudes of the standard stars. We implicitly assume that the 2MASS comparison stars are non-variable, and that the color terms in the photometric solution are negligible.

In addition, some higher cadence data have been obtained with the SMARTS 0.9 m and 1.0 m telescopes. The 0.9 m detector is a 2048×2046 CCD with a 0.401 arcsec/pixel plate scale. On the 1.0 m, we used the 512×512 Apogee camera that was employed prior to installation of the 4 K camera. We perform the differential photometry in a manner identical to that for the ANDICAM, and merge the data sets. These data are not yet fully incorporated into the atlas.

3. SETUP OF THE ATLAS

The atlas is online at http://www.astro.sunysb.edu/fwalter/SMARTS/NovaAtlas/.

The atlas consists of a main page for each nova, providing finding charts (in both V and K bands), coordinates, and links to the spectra and photometry. The spectra are available as images, and may be downloaded in ascii (text) format. The photometry page shows plots of the light curve and colors, and permits one to download the data in ascii format. Note that the plots on the photometry page only show data with formal uncertainties <0.5 mag, while all measured magnitudes and uncertainties are included in the ascii listings. There is a link to a page of references for other observations of the novae.

4. THE NOVAE

As of 2012 July 1 the atlas includes data on 64 novae. Of these, 29 are still bright enough (V < 18) to reach spectroscopically with the 1.5 m/RC spectrograph. Most are still detectable photometrically with the 1.3 m/ANDICAM imager. Only 5 are no longer on our photometric target list because they are too faint or too confused with brighter companions.

The spatial distribution of these novae is shown in Figure 1 in both celestial and galactic coordinates.

Lists of our targets and particulars on the number and observing date distribution of the observations are in Table 2 (novae from before 2012), Table 3 (novae discovered in 2012), and

![Figure 1](image_url)

**Figure 1.**—The spatial distribution of the novae currently in the atlas. The lower plot shows the distribution in celestial coordinates, centered at R.A. = 0.0; the upper plot shows the distribution in galactic coordinates, centered at $l^\text{II}, b^\text{II} = 0.0$. 

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Table 4 (novae in the LMC). The reference time is ideally the time of peak brightness, but this is often not well known. In general, \( T_0 \) is the time of discovery. In the case of \( T_{\text{Pyx}} \), which rises very slowly, \( T_0 \) is the time of peak brightness as estimated from our photometry. For novae that were discovered well past peak, including N Sgr 2012b and XMMU J115113.3–623730, \( T_0 \) is a guess. All the dates in the Tables are referenced to \( T_0 \). The tabulated \( V \) is the last observed \( V \) magnitude; in most cases
4.1. Observing Statistics

As of 2012 July 1 the full atlas contains 64 novae. We have between 1 and 368 spectra for the novae, with a mean of 45 and a median of 28 spectra per nova. The number of photometric points varies between 1 and 265, with a mean of 49 and a median of 35, for 53 novae. Since some of the observations were taken through thick clouds, not all observations have the best possible signal-to-noise ratio (S/N).

The photometric and spectral coverage is generally nonuniform in time. In addition to annual gaps due to the Sun, there is spotty coverage during the austral winter when the weather becomes worse. We do not have unlimited observing time, so we concentrate on those novae that tickle our astronomical fancy—the He-N novae, and those showing unusual characteristics. We do not attempt spectroscopy of targets fainter than $V \sim 18$, because the 1.5 m telescope has limited grasp.

We generally do not make great efforts to obtain photometry from day 0, because amateur astronomers do such a good job. In many cases data available from the AAVSO can fill in the first few weeks, while the nova is bright (we do have bright limits near $V = 8$ and $K = 6$). Our forte is the ability to (1) follow the evolution to quiescence, and (2) to do so in the 7 photometric bands from $B$ through $K_s$. In one case we were on the nova 1.1 days after discovery, but the median delay is 15 days.

We try to start the spectroscopic monitoring sooner, because this is a unique capability of SMARTS. The first spectrum is obtained with a median delay of 8.0 days from discovery, but we have observed 1 nova within 0.6 days, 9 within 2 days, and 14 within 3 days.

We have multi-epoch photometry of 52 novae over timespans of up to 3173 days (8.7 years), and multi-epoch spectroscopy of 63 novae over timespans of up to 3156 days (8.6 years). These durations will increase with time so long as SMARTS continues operating, and the targets are sufficiently bright. The median observation durations of 1317 and 362 days, respectively, for the photometry and spectroscopy, are limited mostly by target brightness. The median time between observations is skewed by the growing number of old, faint targets that are now observed with a cadence of 1–2 observations per year, so that the median time between spectra is 8.4 days, and is 27 days for photometric observations.

4.2. The Example of V574 Pup

We illustrate possible uses of the atlas with the example of V574 Pup, an Fe II nova for which we have good coverage. Aside from near-IR observations (Naik et al. 2010) and analysis...
of the super-soft (SSS) X-ray source (Schwarz et al. 2011), there has been little discussion of this bright nova.

The main atlas page (Fig. 2) presents finding charts in $V$ and $K$, along with the coordinates, time of discovery, and links to the spectral and photometric data and references.

The photometry consists of observations taken on 100 days with the 1.3 m ANDICAM imager, starting on day 33 and running through day 2723 (2012 May 5). Most of these sets include all 7 ANDICAM bands, $BVRIJHK_s$. This light curve is shown in Figure 3. It is possible to fill in the first 30 days with data from other sources, such as Silviero et al. (2005), or by using data from the AAVSO (http://www.aavso.org).

We supplemented these with data taken on 20 days using a temporary small CCD on the SMARTS 1.0 m telescope. These were opportunistic observations enabled by the unavailability of the wide-field 4 k camera. We use the $\sim$2 hr long sequences to search for short periodicities (similar data exist for very few of the novae in the atlas.) Three long sequences in the $B$ band, on days 87, 195, and 196, showed sinusoidal-like modulations. Removing a linear trend from the data on day 87 and normalizing to the mean magnitudes, we find a likely period of 0.0472 days (68 minute; see Fig. 4) from a shortest-string analysis (Dworetsky 1983). However, we cannot exclude some aliases. This is shorter than the minimum orbital period for CVs, and may be half an orbital period (ellipsoidal variability is a possible explanation). The amplitude of the best-fit sinusoid decreased from 0.02 to 0.007 mag from day 87 to days 195–196.

We obtained 107 spectra before the target became too faint for the 1.5 m telescope. We illustrate two types of investigations that can be supported by high cadence spectral observations.

1. Figure 5 shows the evolution of the P Cygni line profiles as the wind evolves against the backdrop of the optically-thick pseudo-photosphere. With daily spectra, it is clear that...
the absorption velocities are not constant, but rather are accelerating. Through day 14 the velocities can be described as a quadratic function of time. Hence the acceleration is linear in time. It is hard to see how this can result from decreasing optical depth effects in an envelope with a monotonic velocity law increasing outwards. Shore et al. (2011) show how similar structures seen in $T$ Pyx can be explained as an outward-moving recombination front in an envelope with a linear velocity law.

2. Figure 6 shows the time-evolution of a series of lines of differing temperatures as the nova evolves through the nebular and coronal phases. The [Fe X] $\lambda 6375$ Å line requires high excitation, and its presence correlates well with the super-soft X-ray emitting phase (Schwarz et al. 2011). V574 Pup was in its SSS phase from before day 180 through day 1118; it ended before day 1312. We can use data such as these to explore how well optical lines are diagnostic of the SSS phase.

4.3. Notes on the Novae

Notes here are not meant to be complete or definitive in any sense. They are meant to highlight past or ongoing work on select novae, or to note some particularly interesting cases. We have made no attempt to provide complete references here; they are in the on-line atlas. For the convenience of the reader, we have collected in Table 5 various basic measurements. These are:

1. Spectroscopic class. This is a phenomenological classification based on the appearance of the spectrum in the first few spectra after the emission lines appear. Physically, this is likely an indicator of the optical depth of the envelope. Of the 63 classifiable targets, most (47/63, or 75%) are Fe II type; 15 (24%) are or may be He-N, and one is a possible symbiotic nova. In one case we cannot tell because our first spectrum was obtained nearly 2 years after peak.

We append a “w” in those cases where there is a clear P Cygni absorption in the Balmer lines (and sometimes in Fe II) indicative of an optically-thick wind. Half (32 of the 64 novae) show such P Cyg absorption. We caution that the absence of P Cyg absorption may be caused by the cadence of the observations.

2. Photometric class. We examined the $V$ band light curves for the first 500 days and categorized them by eye into one or
| Nova                      | Spec Type | FWHM (Hα) Å | Day | Phot Type |
|---------------------------|-----------|-------------|-----|-----------|
| N Aql 2005                | V1663 Aql | Fe II       | 39  | 49.0      | —         |
| N Car 2008                | V679 Car  | Fe II       | 44  | 4.1       | —         |
| N Car 2012                | V834 Car  | Fe IIw      | 41  | 76.5      | S         |
| N Cen 2005                | V1047 Cen | Fe II       | 28  | 6.9       | —         |
| N Cen 2007                | V1065 Cen | Fe IIw      | 45  | 13.9      | —         |
| N Cen 2009                | V1213 Cen | Fe II       | 39  | 125.8     | —         |
| PNV J13410800-5815470     | N Cen 2012 | Fe IIw      | 31  | 28.9      | S, P, D   |
| PNV J14250600-5845360     | N Cen 2012b | Fe II     | 36  | 12.5      | S         |
| N Cir 2003                | DE Cir    | He-N        | 133 | 12.0      | —         |
| N Cru 2003                | DZ Cru    | Fe IIw      | 28  | 20.6      | —         |
| N Dor 1937                | YY Dor    | He-N        | 145 | 5.1       | S         |
| N Eri 2009                | KT Eri    | He-N        | 98  | 23.6      | P         |
| N Lup 2011                | PR Lup    | Fe IIw      | 31  | 19.5      | F         |
| N Mus 2008                | QY Mus    | Fe IIw      | 34  | 185.9     | D?        |
| N Nor 2005                | V382 Nor  | Fe II       | 34  | 56.9      | —         |
| N Nor 2007                | V390 Nor  | Fe IIw      | 28  | 13.4      | —         |
| N Oph 1898                | RS Oph    | He-N        | 22  | 25.6      | P         |
| N Oph 2003                | V2573 Oph | Fe IIw      | 29  | 822.4     | —         |
| N Oph 2004                | V2574 Oph | Fe IIw      | 36  | 30.3      | —         |
| N Oph 2006                | V2575 Oph | Fe IIw      | 29  | 94.0      | —         |
| N Oph 2006b               | V2576 Oph | Fe IIw      | 55  | 45.7      | S         |
| N Oph 2007                | V2615 Oph | Fe IIw      | 28  | 26.3      | —         |
| N Oph 2008                | V2670 Oph | Fe II       | 28  | 20.7      | —         |
| N Oph 2008b               | V2671 Oph | Fe IIw      | 79  | 31.1      | —         |
| N Oph 2009                | V2672 Oph | He-N        | 190 | 3.6       | S         |
| PNV J17260708-2551454     | N Oph 2012 | Fe IIw      | 20  | 36.6      | D         |
| PNV J17395600-2447420     | N Oph 2012b | Fe II     | 66  | 3.9       | S         |
| N Pup 2004                | V574 Pup  | Fe IIw      | 51  | 9.6       | S         |
| N Pup 2007                | V597 Pup  | He-N?       | 79  | 31.1      | —         |
| N Pup 2007b               | V598 Pup  | Fe II       | 50  | 68.3      | —         |
| N Pyx 1890                | T Pyx    | Fe IIw      | 73  | 194.8     | S         |
| N Sco 1863                | U Sco     | He-N        | 148 | 3.4       | —         |
| N Sco 2004b               | V1187 Sco | Fe IIw      | 64  | 18.6      | S         |
| N Sco 2005                | V1188 Sco | Fe II       | 35  | 43.8      | —         |
| N Sco 2007a               | V1280 Sco | Fe IIw      | 23  | 55.5      | —         |
| N Sco 2008                | V1309 Sco | Sy?         | 4   | 7.6       | —         |
| N Sco 2010 No. 2          | V1311 Sco | He-N?       | 79  | 46.5      | S         |
| N Sco 2011                | V1312 Sco | Fe IIw      | 39  | 2.2       | O         |
| N Sco 2011 No. 2          | V1313 Sco | He-Nw       | 94  | 6.1       | S         |
| N Sco 2012                | Fe II     | 45  | 15.8      | D         |
| N Sct 2003                | V475 Sct  | Fe IIw      | 30  | 53.4      | F         |
| N Sct 2005                | V476 Sct  | Fe II       | 26  | 33.6      | —         |
| N Sct 2005b               | V477 Sct  | Fe II       | 56  | 23.0      | —         |
| N Sct 2009                | V496 Sct  | Fe IIw      | 26  | 215.0     | —         |
| N Sgr 2002c               | V4743 Sgr | Fe II       | 43  | 221.9     | P         |
| N Sgr 2003                | V4745 Sgr | Fe IIw      | 38  | 102.5     | —         |
| N Sgr 2004                | V5114 Sgr | Fe IIw      | 42  | 28.4      | S         |
| N Sgr 2006                | V5117 Sgr | Fe IIw      | 35  | 49.9      | S         |
| N Sgr 2007                | V5558 Sgr | Fe IIw      | 20  | 141.2     | F         |
| N Sgr 2008                | V5579 Sgr | Fe IIw      | 45  | 1123.5    | —         |
| N Sgr 2009 No. 3          | V5583 Sgr | Fe II       | 66  | 4.7       | S         |
| N Sgr 2009 No. 4          | V5584 Sgr | Fe IIw      | 26  | 11.6      | —         |
| N Sgr 2010 No. 2          | V5586 Sgr | He-N?       | 84  | 5.4       | —         |
| N Sgr 2011 No. 2          | V5588 Sgr | Fe II       | 16  | 44.6      | J         |
| PNV J17452791-2305213     | N Sgr 2012 | He-N      | 132 | 10.4      | S         |
| PNV J18110375-2717276     | N Sgr 2012b | Fe II     | 8   | 101.6     | —         |
| PNV J17522579-2126215     | N Sgr 2012c | He-N     | 92  | 4.5       | S         |
| N TrA 2008                | NR TrA    | Fe IIw      | 19  | 29.5      | —         |
| CSS081007:030559+054715   | HV Cet    | He-N        | 79  | —         | —         |
more of the 7 classes defined by Strope et al. (2010). In many cases we have very little data during the first 3 months, and do not attempt to categorize these. In some cases we had a hard time shoehorning the lightcurve into one class, and have given multiple classes. For example, N LMC 2005 maintained a fairly flat light curve for about 50 days (class F), then exhibited a cusp (class C). It also formed dust (class D), though the dip is not particularly pronounced. The presence of dust is indicated by the increase in the \( H \) and \( K \) fluxes as the optical fades.

In many cases a significant brightening in \( K \), suggestive of dust formation, is not accompanied by an optical dip, suggesting an asphericity in the dust.

In some cases there is significant color evolution between the optical and near-IR. We will quantify this later.

3. The FWHM of the H\( \alpha \) emission line. We measure the first grating 47 spectrum (3.1 Å resolution) that does not show P Cyg wind absorption, and report the day on which that spectrum was obtained. Uncertainties are of order 2%. Note that the FWHM can change significantly with time in the Fe II novae. For the He-N novae we measure the FWHM of the broad base, ignoring the narrow central emission component. In some cases there is a faint but broader component visible early on. The measurement of the FWZI of this component would be more representative of the maximum expansion velocity. We do not tabulate this because of incompleteness, and because of the difficulty defining the continuum level in some cases.

We have not estimated the times for the light to decay by 2 and 3 magnitudes at \( V \) (\( t_2 \) and \( t_3 \), respectively) in any systematic manner, because it is only in rare cases that we have sufficiently dense photometric sampling early enough to make a good estimate. We discuss these in the notes on individual novae.

We note that the estimates of \( t_2 \) and \( t_3 \) can be highly uncertain, especially for fast novae. The reported discovery times are often past the peak. The discovery magnitudes are often visual estimates, or unfiltered CCD magnitudes, necessitating a color correction to \( V \). A full analysis of the light curves, incorporating other published literature, AAVSO data (which are much denser near peak), and data from other sources, is beyond the scope of this article.

4.3.1. N Aql 2005=V1663 Aql

This is a standard Fe II nova. On day 50 there was prominent \( \lambda 4640 \) Å Bowen blend emission. The auroral [O III] lines were strong by day 85. Our last spectrum, on day 414, is dominated by H\( \alpha \), [O III] 4959/5007, [N II] 5755, [Fe VII] 6087, [O I] 6300, and [Ar III] 7136.

4.3.2. N Car 2008=V679 Car

This Fe II nova never seemed to develop a coronal phase. We have limited photometric coverage.

4.3.3. N Car 2012=V834 Car

This recent Fe II nova exhibited a strong wind through day 36. Evolution of the light curve has been uneventful. There was some jitter of ±0.5 mag from a smooth trend from days 12–40. We estimate \( t_2 \) and \( t_3 \) to be 20 and 38 days, respectively, with uncertainties of order 3 days for \( t_2 \) and ±1 day for \( t_3 \).

4.3.4. N Cen 2005=V1047 Cen

We have no photometry, and only two spectra, of this Fe II nova.

4.3.5. N Cen 2007=V1065 Cen

This dusty Fe II nova was analyzed by Helton et al. (2010), using SMARTS spectra through day 719. The atlas includes additional photometry, from days 944 though 1850.

4.3.6. N Cen 2009=V1213 Cen

This Fe II nova became a bright super-soft X-ray source. The coronal phase extended from about days 300 to 1000, roughly coinciding with the SSS phase (Schwarz et al. 2011), with strong lines of [Fe X], [Fe XI], and [Fe XIV]. In quiescence the remnant is blended with two other objects of comparable brightness.
4.3.7. PNV J13410800-5815470=N Cen 2012

This recent Fe II nova exhibited wind absorption through day 25. \( t_2 \) is about 16 ±1 days; \( t_3 \) occurs about day 34. The 2 mag brightening in \( K \) starting about day 35, with a contemporaneous drop in the \( B \) and \( V \) band brightness, suggests dust formation. The strong emission in the Ca II near-IR triplet on day 11 had disappeared by day 74.

4.3.8. PNV J14250600-5845360=N Cen 2012b

The \( K \) band brightness increased by 2 magnitudes between days 18 and 32, suggesting dust formation, but no drop is seen at optical magnitudes. The smooth \( V \) light curve yields \( t_2 \) and \( t_3 \) of 12.3 and 19.8 days, with uncertainties <1 day. The spectral development is similar to N Cen 2012. The strong emission in the Ca II near-IR triplet on day 11 had disappeared by day 61.

4.3.9. N Cir 2003=DE Cir

This fast nova was discovered by Liller (2003) in the glare of the setting Sun. Spectra obtained on days 11 and 12, at high air mass, show this was a He-N nova. We did not obtain any photometry until after it reappeared from behind the Sun. Since then it has been in quiescence at \( V \sim 17 \), with a variance of ±0.4 mag. The strongest line in the quiescent spectrum is He II \( \lambda 4686 \) Å.

4.3.10. N Cru 2003=DZ Cru

This is another nova that was discovered in the west in the dusk twilight. Despite the discussion about the “peculiar” early spectrum (Bond et al. 2003), our spectra show this was an Fe II nova discovered before maximum, as concluded by Rushton et al. (2008).

4.3.11. N Dor 1937=YY Dor

This is the second recurrent nova discovered in the LMC (Liller 2004). It is a fast \( (t_2, t_3 = 4.0, 10.9 \) days, respectively) He-N nova with the broad tripartite Balmer lines seen in many fast recurrent novae. An analysis is in preparation.

4.3.12. N Eri 2009=KT Eri

KT Eri is a fast He-N nova with a bright quiescent counterpart. Hounsell et al. (2010) reported a spectacular premaximum light curve from the SMEI instrument. The light curve shows two plateaus (Fig. 7), much like those seen in U Sco, prior to dropping to quiescence. Jurdana-Šepić et al. (2012) find a 737 day period in the quiescent source from archival plate material. Hung, Chen & Walter (2011) claim a 56.7 day period during the second plateau. In quiescence, after day 650, there are hints of a period near 55 days, and a possibly 4.2 day spectroscopic period (Walter et al. in preparation). Due to its brightness and R.A. (there is less competition for time towards the galactic anticenter), we have excellent spectral time coverage. Figure 8 shows the time-evolution of KT Eri in the blue, over 790 days, from 83 low dispersion blue spectra. KT Eri is located in a sparse field; there is only a single comparison star available in the small IR channel field of view.

4.3.13. N Lup 2011=PR Lup

The light curve of this slow Fe II nova showed a second maximum at about day 3.5. There was little appreciable decay during the first 2 months. Wind absorption was evident through day 58. As of day 300 it has not entered the coronal phase.

4.3.14. N Mus 2008=QY Mus

We picked this up fairly late, but a combination of the spectroscopy and photometry span the time that dust formed. It seems to be a standard Fe II nova that bypassed the coronal phase and is now in the nebular phase.

4.3.15. N Nor 2005=V382 Nor

This appears to be a standard Fe II nova.

4.3.16. N Nor 2007=V390 Nor

We have good spectroscopic coverage of this Fe II nova for 4 months, but no photometry. During this time it did not evolve any hot lines.
4.3.17. RS Oph

This is the prototypical long period, wind-driven recurrent nova. The emission lines are narrow. We are continuing observations to characterize it well into quiescence.

4.3.18. N Oph 2003=V2573 Oph

Based on two spectra, this appears to be a standard Fe II nova.

4.3.19. N Oph 2004=V2574 Oph

Our photometric coverage consists of two observations, 4 and 8 years after the eruption. Neither was obtained on a photometric night, so the data are not yet photometrically calibrated. We have good spectroscopic coverage showing the transition from an optically thick pseudophotosphere to the permitted line spectrum in this Fe II nova.

4.3.20. N Oph 2006=V2575 Oph

This is a standard Fe II nova.

4.3.21. N Oph 2006b=V2576 Oph

Most photometric observations are in $R$ only. It is a standard Fe II nova.

4.3.22. N Oph 2007=V2615 Oph

This is a normal Fe II nova. Photometric coverage begins after 1.5 years.

4.3.23. N Oph 2008=V2670 Oph

This is an Fe II nova.

4.3.24. N Oph 2008b=V2671 Oph

This Fe II nova faded rapidly, and was undetectable, except at $R$, after 1 year.

4.3.25. N Oph 2009=V2672 Oph

Munari et al. (2011) reported on this very fast nova. $t_2$ and $t_3$ passed before our first photometry; they quote values of 2.3 and 4.2 days, respectively. The spectra and spectral evolution are similar to those of U Sco. We followed this nova spectroscopically through day 31.6, and did not see the deceleration reported by Munari et al. (2011). This has the broadest H$\alpha$ line, at $\text{FWZI} \sim 11,000$ km/s, of all the novae in the atlas, exceeding that of U Sco by about 20%.

4.3.26. PNV J17260708-2551454=N Oph 2012

This recent slow Fe II nova showed no significant decline in brightness from days 10 through 90. Then dust formed, with a drop in the $B$ and $V$ brightness by over 5 magnitudes. The lines are narrow: FWHM(H$\alpha$) $\sim 950$ km/s. There is little spectral evolution through day 90, with persistent P Cygni line profiles.

4.3.27. PNV J17395600-2447420=N Oph 2012b

This is an Fe II nova with an H$\alpha$ FWHM about 3000 km/s. Through the first 45 days the brightness drops monotonically in $B$ through $K$. 

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4.3.28. N Pup 2004=V574 Pup

See § 4.2. Our first photometry was on day 30, suggesting \( t_3 < 27 \) days. Schwarz et al. (2011) quote \( t_2 = 13 \) days.

4.3.29. N Pup 2007=V597 Pup

This slowly developing, broad-lined nova developed a coronal phase after 3–4 months.

4.3.30. N Pup 2007b=V598 Pup

This X-ray-discovered nova was in its nebular phase when reported by Read et al. (2007). The quiescent counterpart appears fairly bright.

4.3.31. T Pyx

This well-known recurrent nova is, as has been pointed out by many authors, very different from the fast He-N recurrent novae. Its light curve and spectral development mimic those of slow classical novae. The rate of the photometric decay remained unchanged by the turn-on/turn-off of the SSS X-ray emission (Fig. 9). The slope of the photometric decay decreased at about day 300. The Hα line width shown in Table 5 refers to the width of the broad base after the line profile stabilized; it was about half that during the first 40 days post-peak.

Evans et al. (2012) include some of our near-IR photometry in an analysis of the heating of the dust already present in the system.

As T Pyx remains bright, we are continuing our monitoring.

4.3.32. U Sco

This is the prototypical short orbital period recurrent nova. Some spectral analysis is included in Maxwell et al. (2012).

4.3.33. N Sco 2004b=V1187 Sco

This well-observed Fe II nova became a super-soft X-ray source.

4.3.34. N Sco 2005=V1188 Sco

We have only limited coverage of this Fe II nova.

4.3.35. N Sco 2007a=V1280 Sco

This extraordinarily slow nova has remained bright (\( V \) generally between 10 and 11) for nearly 2000 days. Naito et al. (2012) present a lot of data for this nova; our monitoring provides finer temporal coverage, which show absorption events with durations <60 days that may be due to dust formation in small mass ejection events. The latest spectra, at an age of 5.3 years, still show evidence for wind absorption.

4.3.36. N Sco 2008=V1309 Sco

This is a very narrow-lined system, and likely a symbiotic nova or a merger (Mason et al. 2010). The spectrum is dominated by narrow Balmer line emission.

4.3.37. N Sco 2010 No. 2=V1311 Sco

This nova faded rapidly. It is likely a He-N class nova. On day 9 possible \([\text{Ne III}] \lambda 3869\) is seen, and the \( \lambda 4640 \) Bowen blend is in emission.

4.3.38. N Sco 2011=V1312 Sco

This Fe II nova developed coronal line emission.

4.3.39. N Sco 2011 No. 2=V1313 Sco

This nova exhibited very strong He I and H-Paschen line emission. Strong He II \( \lambda 4686 \) emission appeared between days 16 and 19. The Balmer lines have a narrow central core atop a broad base, as in the He-N and recurrent novae, but there is also likely Fe II multiplet 42 emission at \( \lambda 5169 \) \( \rho \) (other multiplet 42 lines are overwhelmed by He I emission lines), and wind absorption at least through day 3. This seems to be a hybrid nova. \( t_2 \) lies between 5.8 and 8.5 days, and \( t_3 \) between 13 and 18 days, depending on whether the peak was on 2011 September 6.37 or 2011 September 7.51 (Seach et al. 2011). The continuum is red. This may be a symbiotic nova.

4.3.40. N Sct 2003=V475 Sct

This was the first nova that we concentrated on. Results appear in Stringfellow & Walter (2006). This fairly narrow-lined Fe II nova may have formed dust; no coronal phase was seen. We have \( U \)-band photometry for the first 100 days.

4.3.41. N Sct 2005=V476 Sct

We have very limited observations of this Fe II nova.

4.3.42. N Sct 2005b=V477 Sct

This is probably an Fe II nova; we have very poor coverage.

4.3.43. N Sct 2009=V496 Sct

This Fe II nova likely formed dust. As it is fairly bright, we have good spectral coverage for nearly 2 years.

4.3.44. N Sgr 2002c=V4743 Sgr

This is the first nova we started observing. We picked it up about 200 days after discovery. There is currently no photometry in the atlas.
4.3.45. N Sgr 2003=V4745 Sgr

This was the first nova to explode during the SMARTS era. There are two prominent P Cygni absorption line systems, initially at $-780$ km/s and $-1740$ km/s, visible from days 12 through 66; they disappear by day 71. There is currently no photometry in the atlas.

4.3.46. N Sgr 2004=V5114 Sgr

Data for this Fe II nova have been analyzed and published by Ederoclite et al. (2006). They quote $t_2$ and $t_3$ values of 11 and 21 days; for a peak $V = 8.38$ we find a marginally slower nova, with $t_2$ and $t_3$ of 14 and 25 days, respectively. We have $U$ band photometry for the first 180 days.

4.3.47. N Sgr 2006=V5117 Sgr

This is a standard Fe II nova. We estimate $t_2$ and $t_3$ are about 16 $\pm$ 1 and 42 days, respectively, with uncertainties of perhaps a week in $t_3$.

4.3.48. N Sgr 2007=V5558 Sgr

This very slow nova resembles V723 Cas. We started the photometry at about day 100; the nova remained at $V < 9$ through day 200, with the exception of one short dip to $V = 10$ seen in all 7 bands. Since then there has been an uneventful decay to $V \sim 14$. It is a narrow-lined Fe II nova that exhibits P Cygni absorption through day 208. He II 4686 exceeded H$\gamma$ in strength by day 480, and rivaled H$\beta$ by day 1100. The [Ne V] doublet was visible by day 432, and became the strongest line, aside from H$\alpha$, by day 1150. There is very strong [Fe VII] emission, but little coronal [Fe X].

4.3.49. N Sgr 2008=V5579 Sgr

This standard Fe II nova apparently formed dust, because it was bright in the near-IR ($K = 6.6$) and fainter than twenty-third magnitude at $BVRI$ on day 68. When we next looked at it, on day 1120, $V \sim 16.1$ mag with $V - K \sim 1.6$.

4.3.50. N Sgr 2009 No. 3=V5583 Sgr

This appears to be a standard Fe II nova. Linear interpolation between our first 2 observations yields $t_2$ and $t_3 = 6.7$ and 12.6 days, respectively; Schwarz et al. (2011) quotes $t_2 \sim 5$ days.

4.3.51. N Sgr 2009 No. 4=V5584 Sgr

This appears to be a standard Fe II nova.

4.3.52. N Sgr 2010 No. 2=V5586 Sgr

We have only a single red spectrum of this nova. The broad H$\alpha$ emission line, the presence of strong broad He I lines, and the rapid decay are all consistent with a He-N classification. The nova is located about 2.5$''$ east of a highly extincted near-IR source, 2MASS J17530316-2812183. This can contaminate the photometry, particularly on nights with less than ideal seeing.

4.3.53. N Sgr 2011 No. 2=V5588 Sgr

This Fe II nova exhibited at least 6 outbursts of up to 2 mag during the first 200 days. The spectrum shows an Fe II nova with very strong and time-variable He II 4686 and [Fe VII] and [Fe X] emission lines.

4.3.54. PNV J17452791-2305213=N Sgr 2012

This fast hybrid nova showed Fe II emission on day 3, but by day 8 resembled a He-N nova. By day 65 it was in its coronal phase, with emission from [Fe X], [Fe XI], and [Fe XIV]. The FWHM of H$\alpha$ is about 5700 km. $t_2$ passed prior to our first photometric observation, and was likely 4.5 $\pm$ 1.5 days; $t_3$ is about 7 days.

4.3.55. N TrA 2008=NR TrA

This is the only nova in our collection that has shown eclipses. The 5.25 hr period has a broad primary minimum covering half the period (Fig. 10) and a likely smaller secondary minimum.

The early spectra are those of an Fe II nova with narrow lines. The cool permitted lines (N II, He I, Fe II) faded out between days 570 and 1220, and were replaced with a composite of a nebular spectrum with a WN-like spectrum. After the nebular lines of [O III], [Ne V], and [Fe VII], the strongest lines are the Balmer series and He II $\lambda$4686. Other prominent high

![FIG. 9.](image_url)

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excitation lines include He II (4200, 5411, 7592, 8236) N III (4515 and the 4640 blend), N IV and/or N V (4606/4608), C IV (5803), O VI (3811, 5292, 6200), and a strong line that may be a blend of N IV (7703), C IV (7708), and O IV (7713). A recent optical spectrum is shown in Figure 11.

Aside from the nebular lines, the system bears a striking resemblance to the V Sge stars (Steiner & Diaz 1998). Steiner & Diaz (1998) argue that the presence of O VI, and the absence of strong hard X-ray emission, implies the presence of a source of super-soft X-rays, with kT between 30 and 50 eV. This in turn suggests steady nuclear burning in the atmosphere of a massive WD, as in the persistent SSS sources like Cal 83 or RX J0513-69. However, models containing other types of compact objects, or even WC stars, remain viable, and Smak et al. (2001) argue that V Sge is a contact binary following common envelope evolution. However, Hachisu & Kato (2003) conclude that V Sge is the product of accretion wind-driven evolution of a massive WD, similar to the persistent SSS sources.

Since NR TrA, as a classical nova, must contain a WD, if further investigation confirms its resemblance to the V Sge stars then we may be able to clarify the nature of those systems.

4.3.56. PNV18110375-2717276=N Sgr 2012b

This apparently very slow nova was reported in 2012 April (Nakano et al. 2012), and then found to have been bright at least as early as 2011 April 12.

4.3.57. PNV17522579-2126215=N Sgr 2012c

This nova was reported on 2012 June 26. The single spectrum we have shows a broad Hα line, with FWHM 4200 km/s. Both t2 and t3 passed prior to our first photometric observations, with t3 < 7.5 days.

4.3.58. N LMC 2005

This is a slow Fe II nova. The light curve was flat for about 2 months, developed a cusp, and then formed dust after about 100 days.

4.3.59. N LMC 2009

This is a recurrence of N LMC 1971b, and becomes the third known recurrent nova seen in the LMC. It developed into a strong super-soft X-ray source. A full analysis is in preparation (Bode et al. in preparation).

4.3.60. N LMC 2009b

This Fe II nova formed dust; there is a very deep trough in the optical light curve between about days 80 and 120, following a 4 mag increase in brightness at K.

4.3.61. N LMC 2012

This is a very fast (t2 = 1.1 ± 0.5 days; t3 = 2.1 ± 0.5 days) recent He-N nova.

4.3.62. CSS081007:050559+054715

This peculiar high-galactic latitude object showed triple peaked, velocity-variable Hα emission. After [Ne V], the strongest emission line is He II λ4686 Å.

4.3.63. XMMU J115113.3–623730

The spectra nearly 2 years after peak shows strong emission in He II, C IV, N IV, and O VI (see Hughes et al. 2010). We
confirm the 8.6 hr period (Patterson et al. 2010). The system bears some resemblance to high excitation systems like V Sge. The nebular [O III] emission, absent on day 604, appeared about day 800 and now dominates the spectrum (day 1281).

5. DISCUSSION

The nature of our interest in novae has evolved over time, as we have gained experience with these systems. What seemed at first to be a largely understood class of objects has become more and more puzzling as the full scope of the population has become evident.

We are exploiting this database to investigate a number of areas, including:

1. The origin and evolution of the tripartite Balmer line profiles in the fast He-N novae. Such novae eject very little mass, hence their envelopes are thin, and afford the opportunity to view the innermost environs of the nova at early times. Walter & Battisti (2011) note the similarity of the tripartite Balmer line profiles to those of optically-thin accretion disks, and suggest that we are seeing either a disk that survives the outburst, or one that reconstitutes itself within a few days of the outburst.

2. The relation of the spectral and photometric evolution to the super-soft X-ray emission. The X-rays probe the innermost, hottest regions near the surface of the white dwarf. While the envelope is optically thick to soft X-rays, one can probe hotter regions using the Bowen fluorescence mechanism (McClintock et al. 1975; Kallman & McCray 1980) and the optical He II lines. We are examining how these lines vary with the emergent soft X-ray flux.

3. Novae in the LMC. These have the advantage over novae in the Milky Way in that they are at a known distance, and suffer fairly small reddening. They are a small but statistically complete sample that can be used for population studies. A catalog of all known novae in the LMC is maintained at MPE.9 While a much larger sample of novae at a uniform distance and low reddening exists in M31 (e.g., Pietsch et al. 2007, Shafter et al. 2011), those novae are fainter and the field is more crowded. The novae in the LMC can generally be followed for longer and in more detail than can those in M31.

Novae are complex systems that likely lack spherical symmetry, hence examination of the evolution of a large sample will provide insights into the behaviors that may be masked by geometric effects in particular cases. Our investigations focus on the ensemble for this reason, but there are many other types of investigations that these data can help one address.

9 For more information see http://www.mpe.mpg.de/~m31novae/opt/lmc/index.php.

6. ACCESS TO THE DATA

We are making the data freely available to the community at http://www.astro.sunysb.edu/fwalter/SMARTS/NovaAtlas/ with the following caveats:

1. There may be faulty data in the atlas. This includes some early low dispersion spectra (grating 13 setup) that are clearly miscalibrated. We will correct this as time permits.
2. There are some spectra that are clearly not of the correct star. We have tried to catch these, but some certainly have escaped notice.
3. There are miscalibrated or poorly calibrated spectra for the reasons alluded to in § 2.1.
4. Magnitudes of very faint novae, or novae in crowded regions, should be used with caution. At a later time we may employ point-spread function-fitting photometry.
5. Magnitudes are differential, but corrected for zero point, and may differ systematically from the truth.
6. Some data are not posted, simply because we are currently working on those objects.

If you choose to use any of the data in your research, please reference this article. Any questions about the data may be directed to the lead author.

The compilation of this atlas would not have been possible had it not been for the vision of Charles Bailyn, who formed the SMARTS partnership in 2003 in order to keep the small telescopes at CTIO, and the science enabled by them, open and accessible to the community.

The reason that SMARTS is a success is due in large part to its cadre of service observers, including Claudio Aguilera, Sergio Fernandez, Rodrigo Hernandez, Manual Hernandez, Alberto Miranda, Alberto Pasten, Jacqueline Seron, and Jose Velasquez. They have taken the vast majority of the observations available in the atlas. Their professionalism ensures the uniformly excellent quality of the data. Eduardo Cosgrove and Arturo Gomez have been invaluable in keeping the telescopes and instruments running. We are thankful for the efforts of the 1.3 m telescope schedulers at Yale, including M. Buxton, R. Chatterjee, and J. Nelan, to accommodate our many requests for prompt scheduling of new novae.

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**REFERENCES**

Bode, M. F., & Evans, A. eds. 2008, Classical Novae (Cambridge: Cambridge University Press)

Bond, H. E., et al. 2003, IAU Circ., 8185, 1

Dworetsky, M. M. 1983, MNRAS, 203, 917

Ederoclite, A., et al. 2006, A&A, 459, 875

Evans, A., et al. 2012, MNRAS, 424, L69

Ford, H. C. 1978, ApJ, 219, 595

Hachisu, I., & Kato, M. 2003, ApJ, 598, 527

Hamuy, M., Walker, A. R., Suntzeff, N. B., Gigoux, P., Heathcote, S. R., & Phillips, M. M. 1992, PASP, 104, 533

Hamuy, M., Suntzeff, N. B., Heathcote, S. R., Walker, A. R., Gigoux, P., & Phillips, M. M. 1994, PASP, 106, 566

Helton, L. A., et al. 2010, AJ, 140, 1347

Hounsell, R., et al. 2010, ApJ, 724, 480

Hung, L. W., Chen, W. P., & Walter, F. M. 2011, ASPC, 451, 271

Hughes, J. P., et al. 2010, ATel, 2771

Jurdana-Sepić, R., Ribeiro, V. A. R. M., Darnley, M. J., Munari, U., & Bode, M. F. 2012, A&A, 537, A 34

Kallman, T., & McCray, R. 1980, ApJ, 242, 615

Kraft, R. F. 1963, in Adv. Astr. Ap., ed. V. Kopal 2, 43

Landolt, A. U. 1992, AJ, 104, 340

Liller, W. 2003, IAUC, 219

Liller, W. 2004, IAUC, 8422

Mason, E., Diaz, M., Williams, R. E., Preston, G., & Bensby, T. 2010, A&A, 516, 108

Maxwell, M. P., et al. 2012, MNRAS, 416, 1465

McClintock, J. E., Canizares, C. R., & Tarter, C. B. 1975, ApJ, 198, 641

McLaughlin, D. B. 1960, in “Stellar Atmospheres”, ed. J. L. Greenstein, 585

Munari, U., Ribeiro, V. A. R. M., Bode, M. F., & Saguner, T. 2011, MNRAS, 410, 525

Naik, S., Bannerjee, D. P. K., Ashok, N. M., & Das, R. K. 2010, MNRAS, 404, 367

Naito, H., et al. 2012, A&A, 543, 86

Nakano, S., et al. 2012, CBET, 3140

Oke, J. B. 1990, AJ, 99, 1621

Patterson, J., et al. 2010, ATel, 2777

Payne-Gaposchkin, C. 1957, The Galactic Novae (New York: Dover)

Pietsch, W., et al. 2007, A&A, 465, 375

Read, A. M., Saxton, R. D., & Esquej, P. 2007, ATel, 1282

Rushton, M. T., Evans, A., Eyres, S. P. S., Van Loon, J. T., & Smalley, B. 2008, MNRAS, 386, 289

Schwarz, G. J., et al. 2011, ApJS, 197, 31

Seach, J., et al. 2011, IAUC, 9233

Shafter, A. W., Darnley, M. J., Hornoch, K., Filippenko, A. V., Bode, M. F., Ciardullo, R., Misselt, K. A., & Hounsell, R. A., et al. 2011, ApJ, 734, 12

Shore, S. N., Augusteijn, T., Ederoclite, A., & Uthas, H. 2011, A&A, 533, 8

Silviero, A., Munari, U., & Jones, A. F. 2005, IBVS, 5638

Smak, J. I., Belczyński, K., & Zola, S. 2001, Acta Astron., 51, 117

Starrfield, S. 1971, MNRAS, 152, 307

Steiner, J. E., & Díaz, M. P. 1998, PASP, 110, 276

Stringfellow, G. S., & Walter, F. M. 2006, Ap&SS, 304, 401

Strope, R. J., Schaefer, B. E., & Henden, A. A. 2010, AJ, 140, 34

Subasavage, J. P., et al. 2010, SPIE, 7737, 77371C

Walter, F. M., & Battisti, A. 2011, BAAS, 217, 338.11

Williams, R. E. 1992, AJ, 104, 725

Williams, R. E., Hamuy, M., Phillips, M. M., Heathcote, S. R., Wells, L., & Navarette, M. 1991, ApJ, 376, 721

Williams, R. E., Phillips, M. M., & Hamuy, M. 1994, ApJS, 90, 297