



HD 109962 - The Most Massive Dwarf Nova?

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Abstract

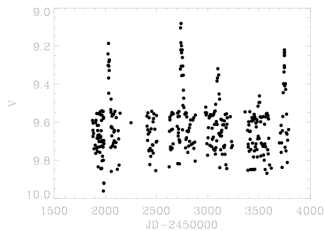
We report observations of HD 109962, an F2V star. This star undergoes quasi-periodic outbursts about every 350 days. During the most recent outburst He II 4686 was in emission above the F star continuum with an equivalent width of 2.5 Å. While no other emission was detected above the continuum, a difference spectrum revealed a typical accretion disk emission spectrum. *SWIFT* and *Chandra* observations about a month after the start of the outburst revealed a weak X-ray source. The previously-reported photometric light curve is that of an ellipsoidal variable with a 0.893 day period. The radial velocity of the F2V primary, however, suggests a slightly non-circular orbit. We will discuss orbital fits to the light curve and the radial velocities. We suggest that this is a dwarf nova system with a $1.3 M_{\text{solar}}$ primary and an approximately $1 M_{\text{solar}}$ white dwarf, perhaps the most massive dwarf nova system currently known.

Dwarf Novae

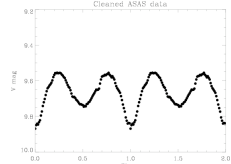
- Subset of CVs
- Outbursts result from thermal-viscous disk instability
- WD + K-M donor, 2-5 mag outbursts
- Example: U Gem

HD 109962

- Variable star in ASAS database
- Ellipsoidal variable, $P=0.893$ days
- $V=9.3$; $d \sim 250$ pc
- 0.5 mag outbursts every 350 +/- 38 days
- Outbursts like those of GK Per



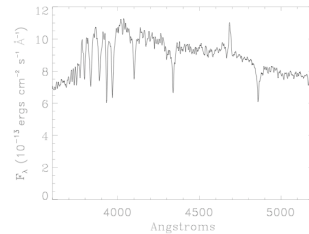
The ASAS V band photometry. The five outbursts are superposed on the ellipsoidal variations.



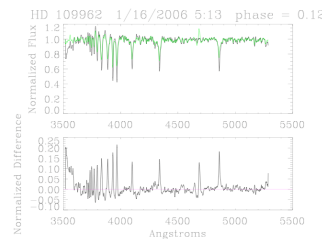
The ASAS V band photometry from 2002-2006 folded on the 0.893 day period. The outbursts have been removed and the data smoothed.

The Dec 2005 Outburst

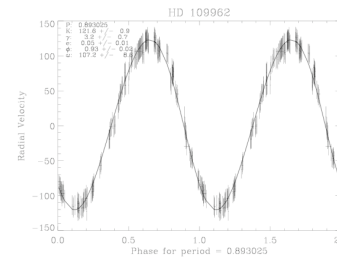
- Spectrum shows He II 4686 in emission
- Difference spectrum shows accretion disk
- Quiescent disk/WD masked by F2V



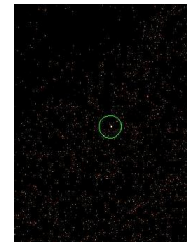
The low-dispersion spectrum in outburst, showing the strong He II 4686A emission and the 4640A blend superposed on an early F star spectrum.



The outburst spectrum and a post-outburst spectrum (upper panel), with the difference (lower panel) showing the residual accretion disk spectrum consisting of the Balmer lines, HeII 4686, the 4640A Bowen-fluorescent N III blend, and Ca II K&H lines.

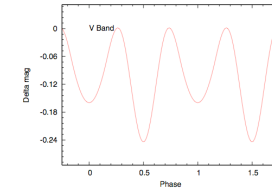


The radial velocity curve from the SMARTS spectrograph between Jan and May 2006. The ephemeris is that of the optical light curve. Two periods are plotted. The best fit orbit (overplotted) has a significant eccentricity of 0.05. The zero crossings occur about phases 0.4 and 0.9, about 0.15 cycles following photometric quadrature.



A 1 ksec Chandra ACIS image of HD 109962 on 2 Feb 2006, at the end of the January 2006 outburst. The 50 source counts are circled.

SMARTS



The light curve of an F2+WD ellipsoidal variable with $q=0.77$, from Nightfall

Facts

- mass function $f(m) = 0.17 M_{\text{solar}}$
- F2V $\sim 1.3 M_{\text{solar}}$
- for $i=90$, WD mass $\sim 1 M_{\text{solar}}$
- $e = 0.05 \pm 0.01$

Challenges

- Non-circular orbit?
- Shadowing by asymmetric disk?
- Quiescent $L_X \sim 10^{30}$ erg/sec
 - about 0.01 of GK Per
 - too bright for F2V

Opportunities

- Outburst due mid-February
- Proposed *SWIFT* observations
- Proposed *XMM* quiescent observation
- What is source of X-rays?
- Is WD/disk eclipsed?
- Optical light curve modeling may yield disk structure