

# V458 VUL – A CLASSICAL NOVA INSIDE A PLANETARY NEBULA

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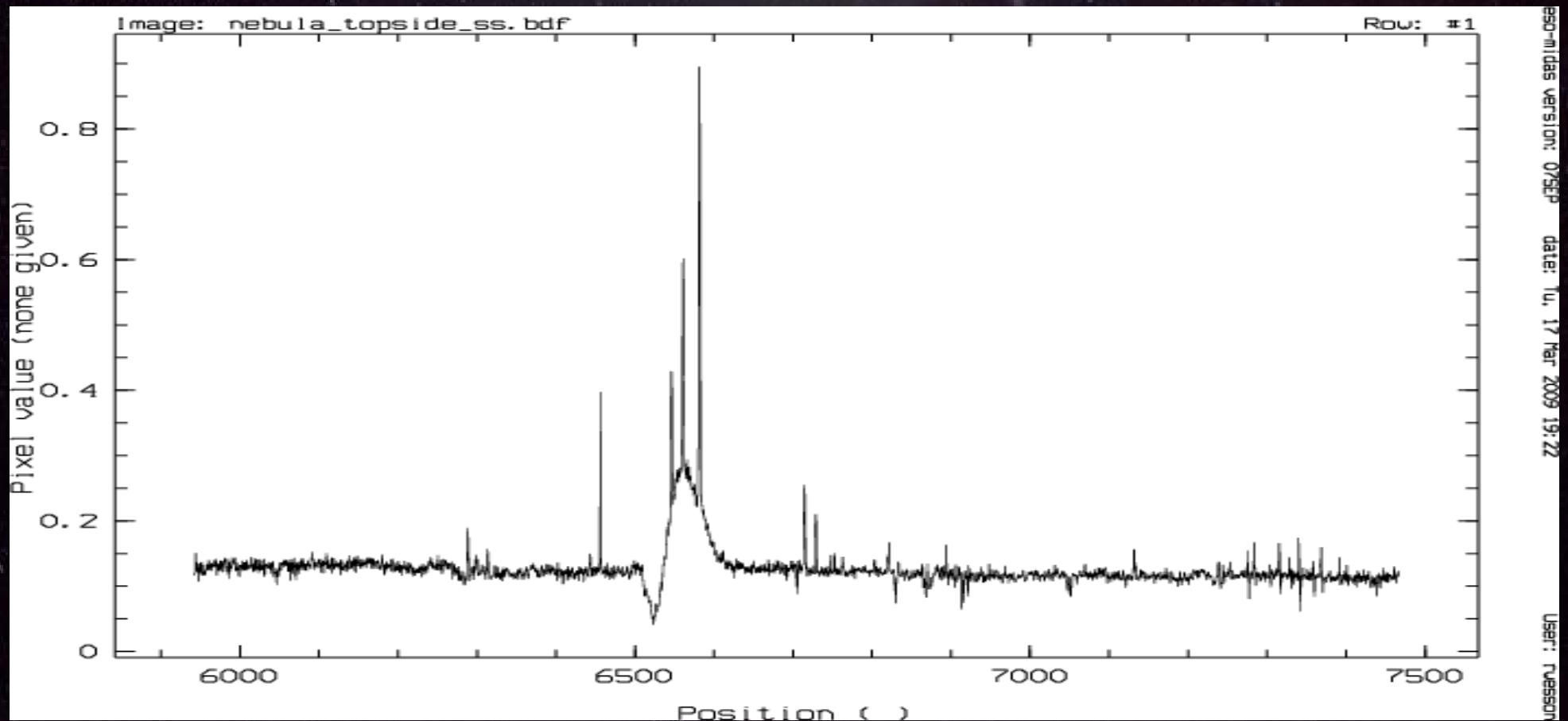
- Nova discovered in Vulpecula, August 2007
- Lay in the footprint of IPHAS (INT Photometric H $\alpha$  Survey - [www.iphas.org](http://www.iphas.org))
- Had been imaged six weeks before the outburst
- Images revealed an 18<sup>th</sup> mag. progenitor, and...

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- WHT/ISIS spectroscopic observations obtained the night after discovery



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- Key spectroscopic points:

the lines are **narrow**:  $<1\text{\AA}$

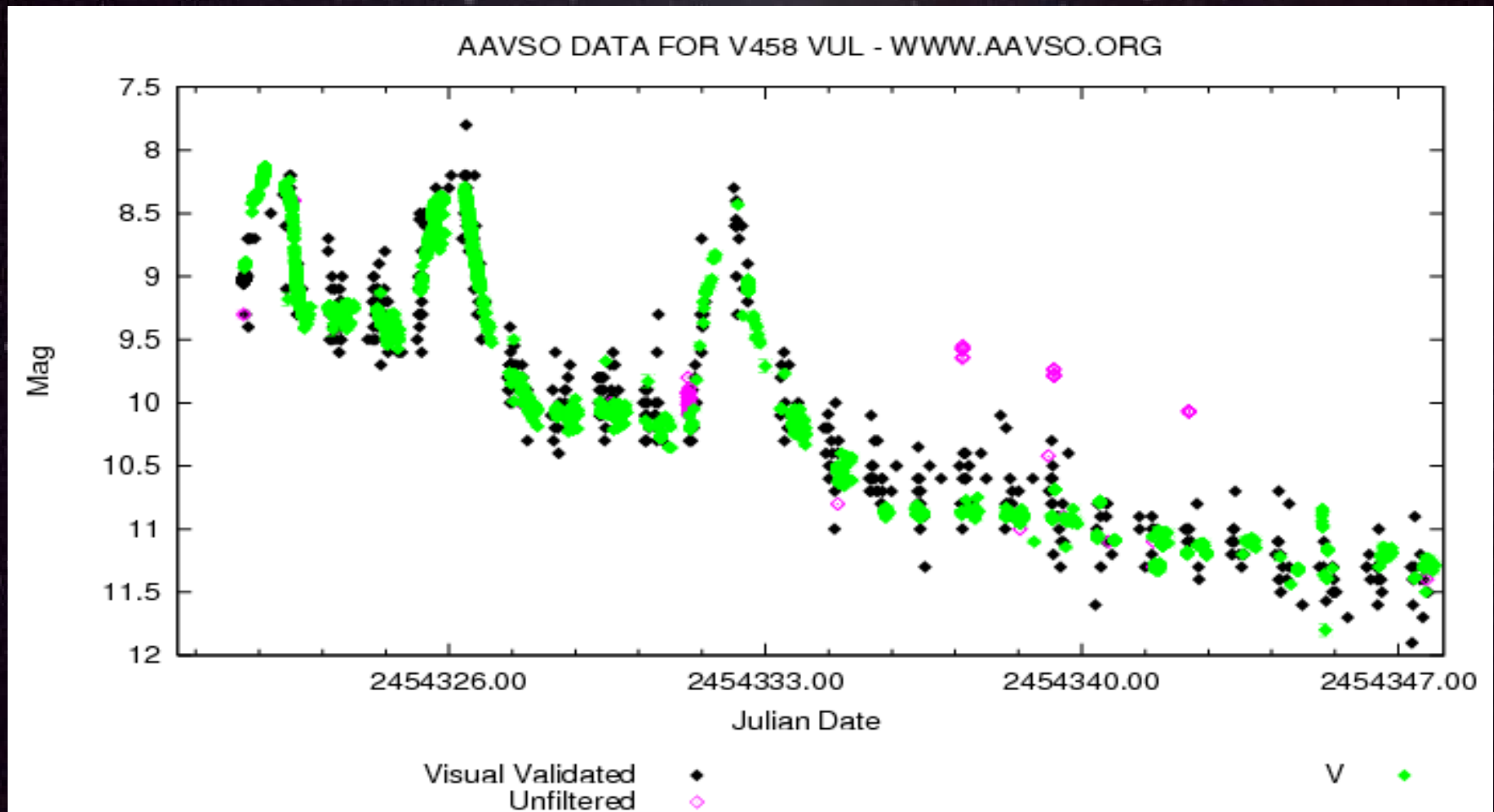
RVs vary by  $<10\text{kms}$  across nebula

Therefore, this nebula is expanding slowly



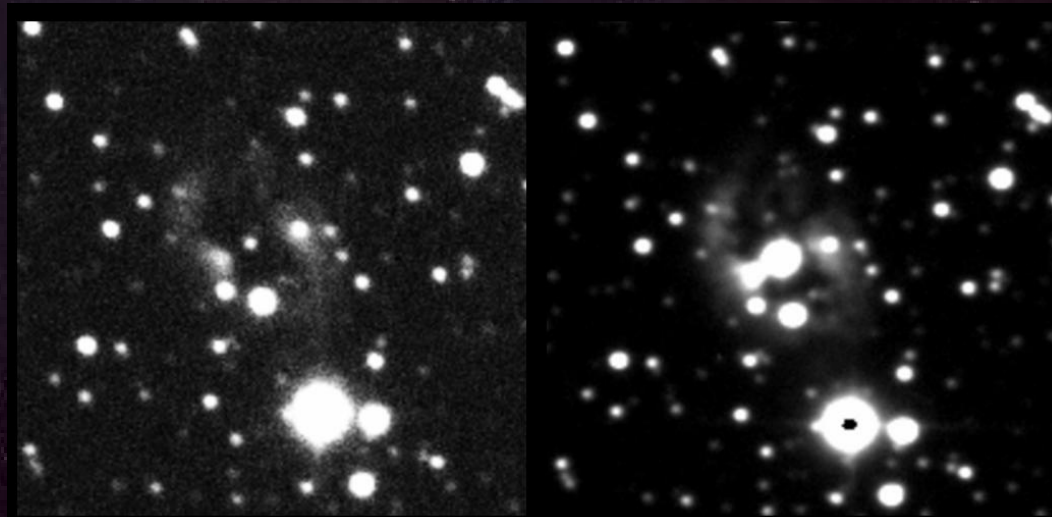
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- Light curve: unusual early re-brightenings



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- Distance: MMRD relations give 10-13 kpc
- $V_{\text{LSR}}$  – gives  $13 \pm 3$  kpc
- Flash ionisation: SE knot brightened rapidly in May 2008 as it was ionised by the nova flash.



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- Light travel time gives distance of  $13 \pm 2$  kpc
- Large distance puts it 800pc below galactic plane – unusual for a fast nova



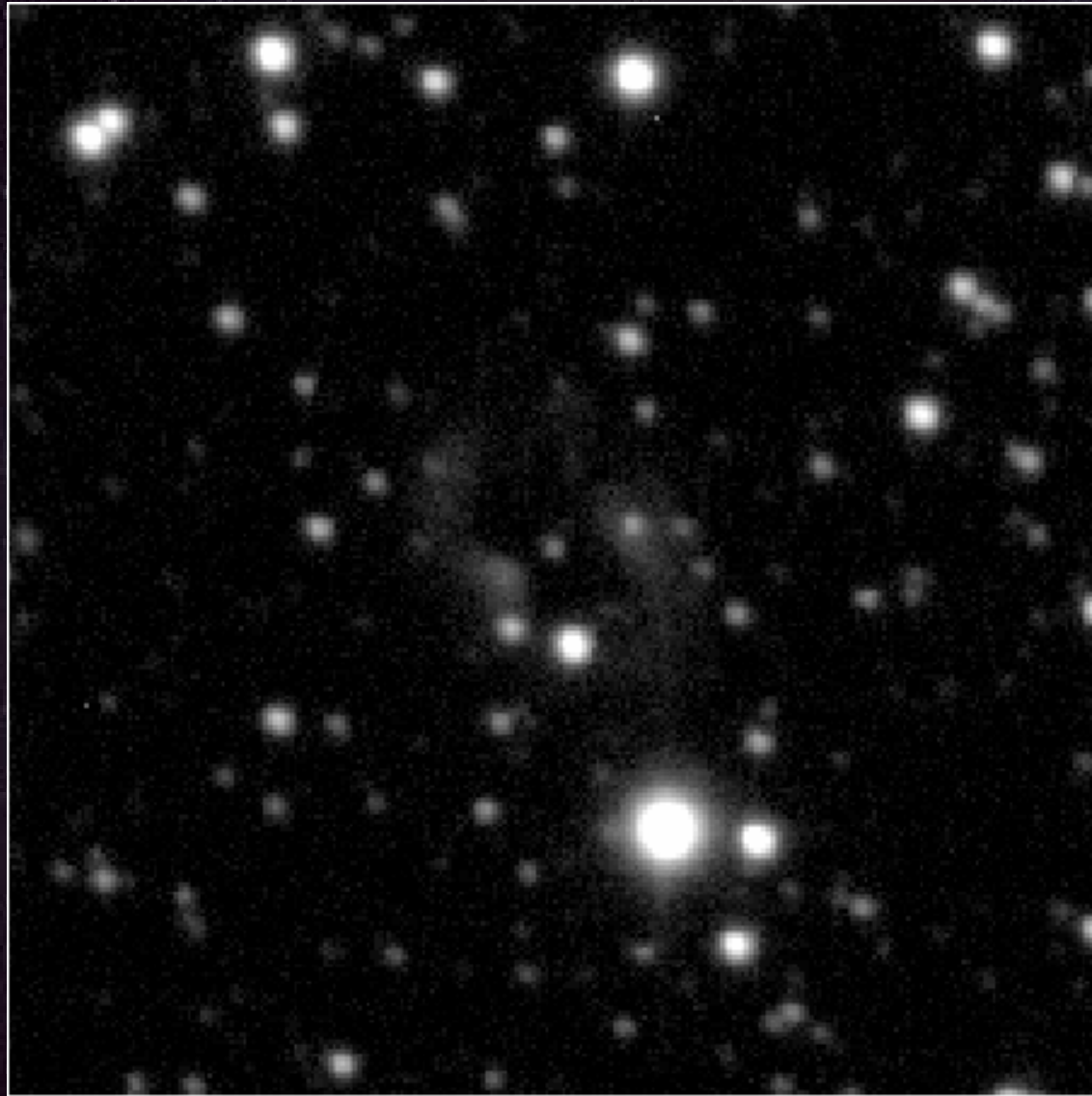
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- Density from [S II] lines is  $\sim 600\text{cm}^{-3}$
- In conjunction with  $H\alpha$  flux and distance, this gives us the mass:  $0.2 M_{\odot}$
- Low  $v_{\text{exp}}$  + high mass = **not nova ejecta**

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- Instead, spectroscopically and visually this nebula looks like a **planetary nebula**
- Only the second such object known
- It has very strong [N II] and [S II] emission, characteristic of PNe from **high mass progenitors**
- Nebula is now showing dramatic changes as nova flash passes through it

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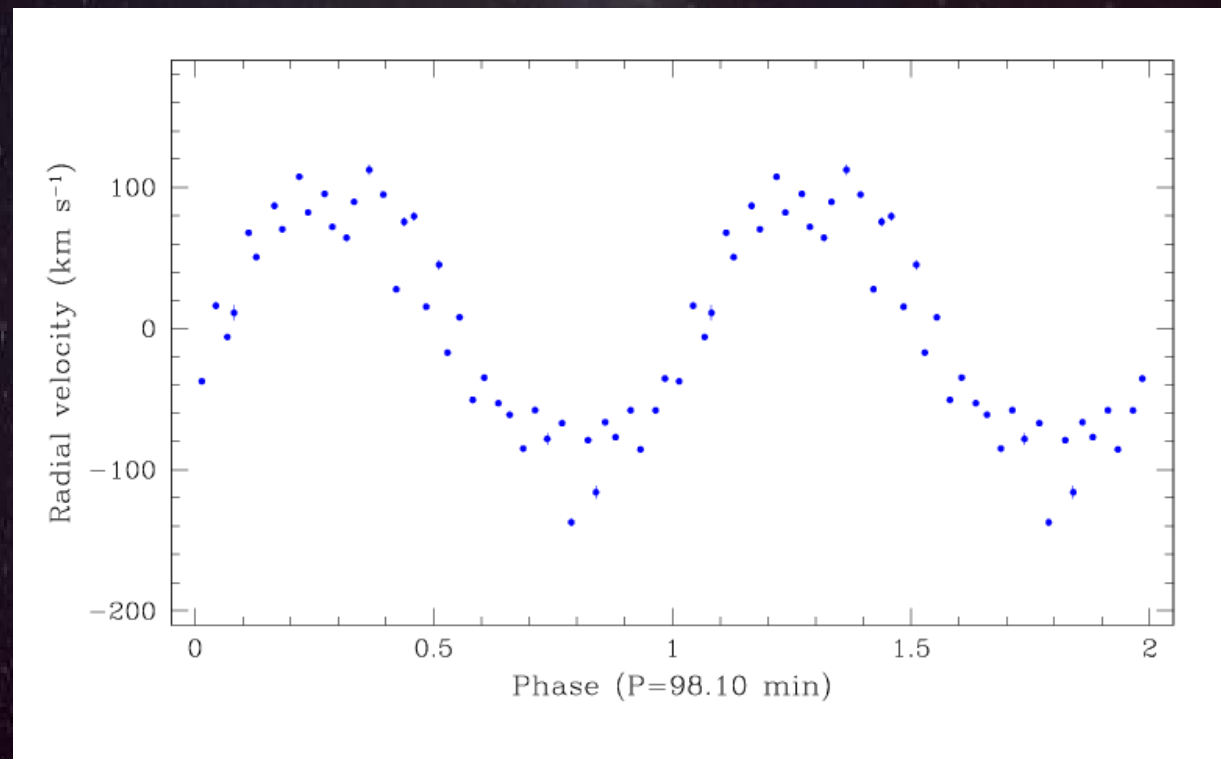


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- Absolute B magnitude at maximum corresponds to thermonuclear runaway on surface of  $1.3M_{\odot}$  WD.
- Was the erupting star the PN central star, or its companion?
- In either case, combined mass of binary system is very likely to be more than  $1.4 M_{\odot}$

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- Spectroscopic monitoring throughout 2008 reveals strong indication of orbital period of 98.1 minutes





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- However, photometric signal not entirely clear. Quiescence awaited...
- If confirmed, this is shortest period for a PN central star, and is short enough that the two white dwarfs will merge in  $\ll 100$  million years.
- Type Ia supernova progenitor?

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- V458 is returning to view after a few months behind the Sun. More imaging and spectroscopy planned.
- V458 has the potential to give us unique insights into the evolution of common envelope systems.
- Do all planetary nebulae have close binary central stars?

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