

# V2487 Oph: A Test of Recurrent Nova Identification Criteria

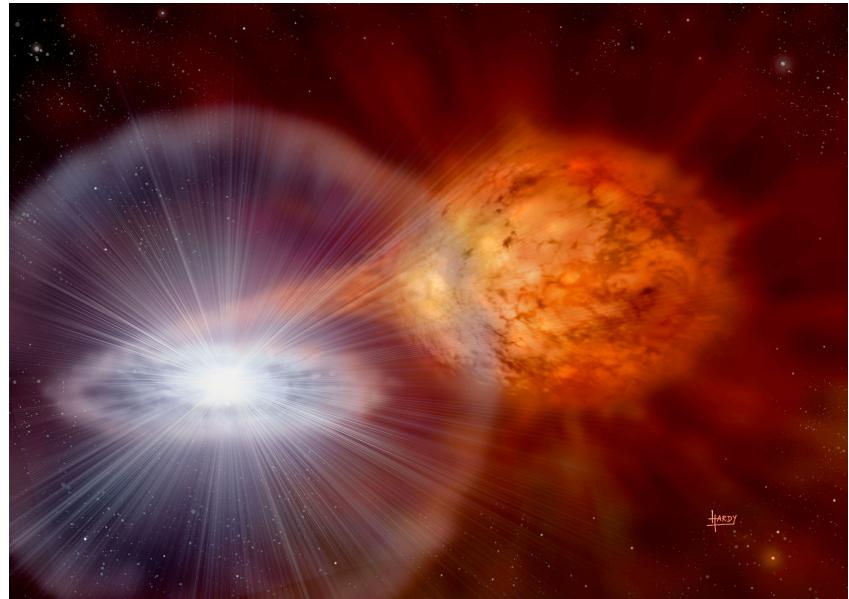


**ASHLEY PAGNOTTA**  
**LOUISIANA STATE UNIVERSITY**

**WILD STARS IN THE OLD WEST II**  
**19 MARCH 2009**

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**THANKS TO: HARVARD COLLEGE OBSERVATORY, STERNWARTE SONNEBERG, AAVSO**

# Identifying Recurrent Novae (RNe)



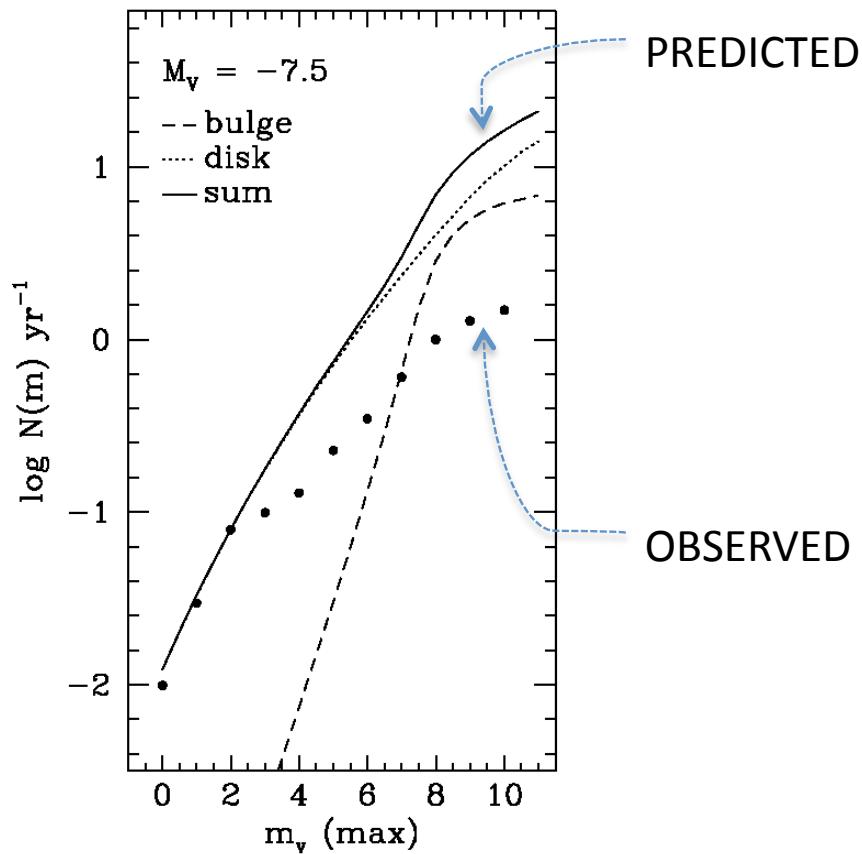
- White dwarf (WD) accretor, non-degenerate donor star
- Thermonuclear runaway on the WD surface
- Multiple outbursts within a given century
- High mass WD

$$M_{WD} \gtrsim 1.3 M_{\odot}$$

- Fast accretion rate

$$\dot{M} \gtrsim 10^{-7} M_{\odot} \text{ yr}^{-1}$$

## Motivation: Hidden RNe



Only 10% of nova eruptions are observed!



Not only are we missing classical nova eruptions, but we are missing a significant number of second eruptions of RNe.

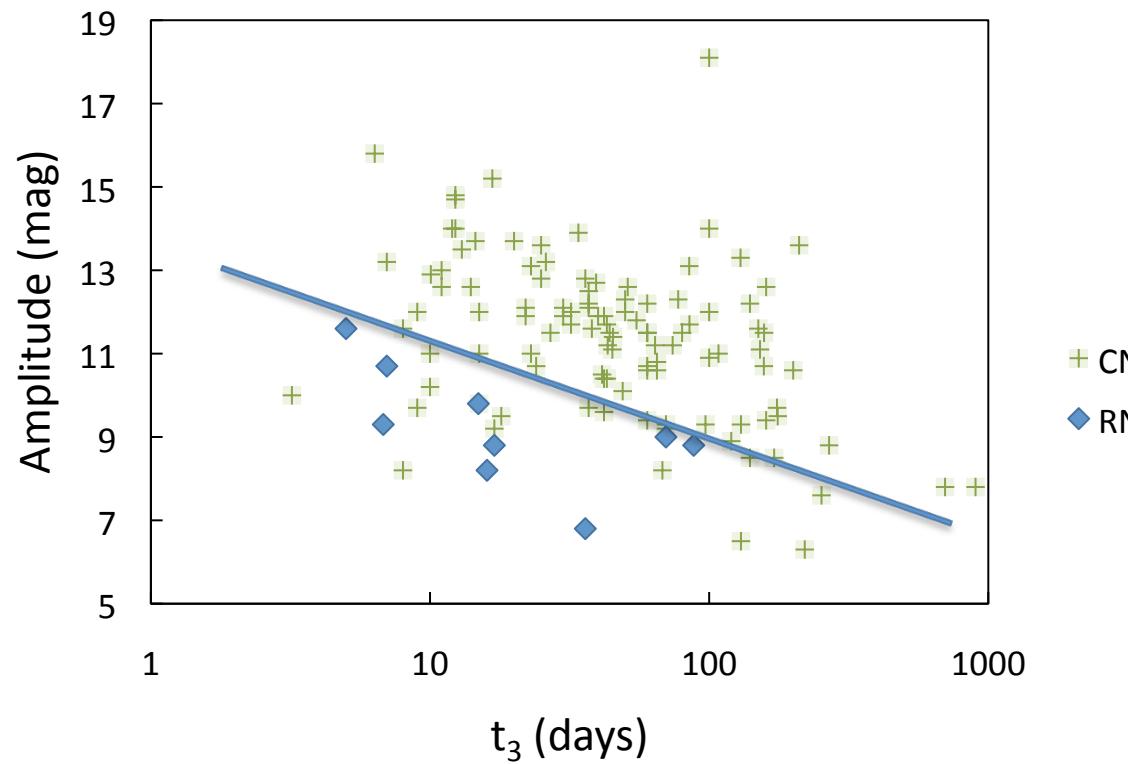
# Small Nova Outbursts

Low-amplitude eruptions

Location on Duerbeck  
Amplitude/ $t_3$  plot

## RN Candidates

- HR Lyr
- V1330 Cyg
- V2487 Oph
- V697 Sco
- V723 Sco
- V838 Her
- V868 Cen



## Evolved Donor Stars

Long orbital period

Infrared excess in quiescence

### RN Candidates (IR Colors)

CK Vul

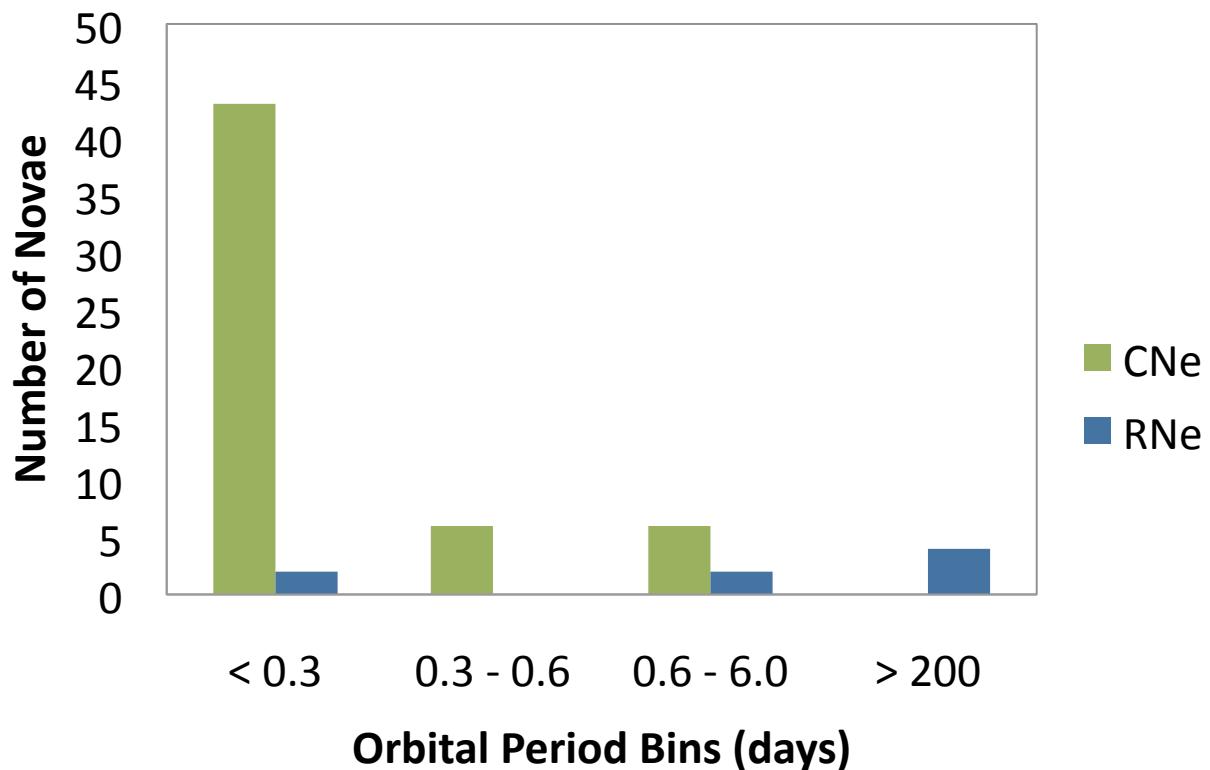
DN Gem

GR Sgr

V1172 Sgr

V723 Sco

V732 Sgr



78% of RNe have  $P_{\text{orb}} > 0.6$  days

but only

22% of CNe have  $P_{\text{orb}} > 0.3$  days

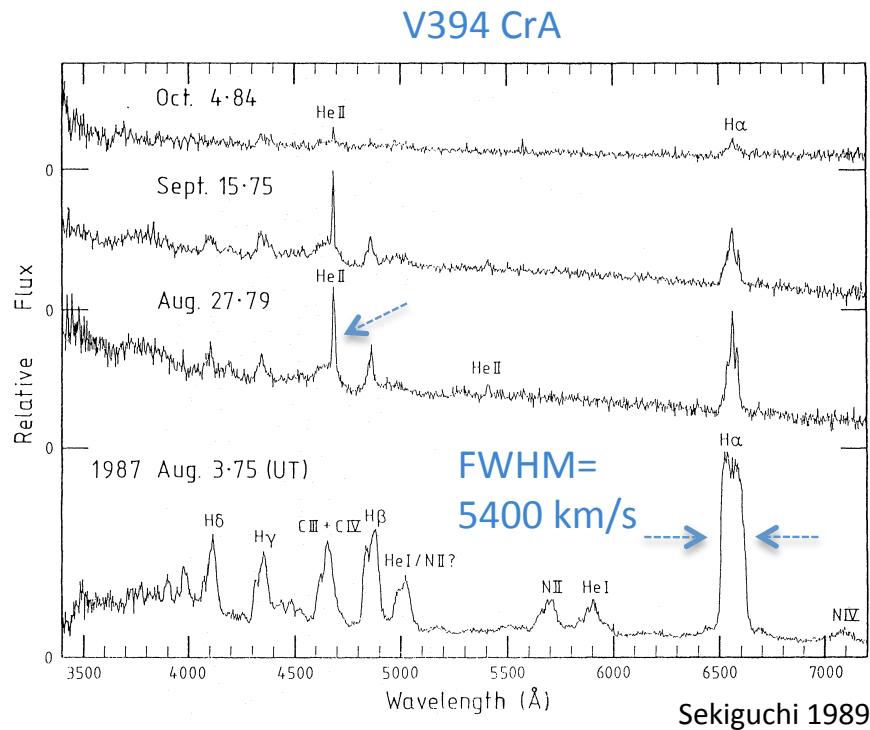
## Spectral Characteristics

High expansion velocities

High excitation lines in outburst

### RN Candidates

- DE Cir
- V1142 Sco
- V1819 Cyg
- V2275 Cyg
- V2487 Oph
- V2573 Oph
- V4739 Sgr



100% of RNe have  $\text{FWHM H}\alpha > 2000 \text{ km/s}$   
45% of CNe do

100% of RNe have high excitation lines  
14% of CNe do

# Candidate Summary



Name	Amp. (mag)	P <sub>orb</sub> (days)	t <sub>3</sub>	Amp./t <sub>3</sub>	FWHM H $\alpha$	He II	Fe ??	Other Lines	IR	Other	Total
V2487 Oph	8.2	-	8.0	yes	10000	Yes	-	-	Mass, t <sub>3</sub> , pl	5	
V838 Her	10	0.30	3.2	yes	5000	Yes		Ne V	Mass	5	
BT Mon	7.6	0.33	252.6	yes	2100	Yes				4	
CP Cru	10.2	0.94	10.0	yes	2000	Yes				4	
V368 Aql	10.4	0.35	42.0		?	Yes	Fe X			3	
DN Gem	12.5	0.13	37.0			No	Fe X		Yes	2	
GK Per	13.7	2.00	14.5			?	Fe II	Ne V		2	
HR Lyr	9.3		97.0	yes		-	Fe II			Amp/t <sub>3</sub>	2
KT Mon			40.0			Yes		NIII			2
LS And	8.8			yes						Amp/t <sub>3</sub>	2
Q Cyg	12.6	0.42	11.0			Yes	Fe II				2
QZ Aur	11.5	0.36	27.0							Mass	2
V1017 Sgr	6.5	5.78	130.0	yes		-	-				2
V1172 Sgr	9				5000					Yes	2
V2275 Cyg	11.7	0.31			3199						2
V723 Cas			0.69			?	Fe XVII				2
V723 Sco	9.2		17.0	yes						Yes	2

# Where to Look?



## **Harvard College Observatory**

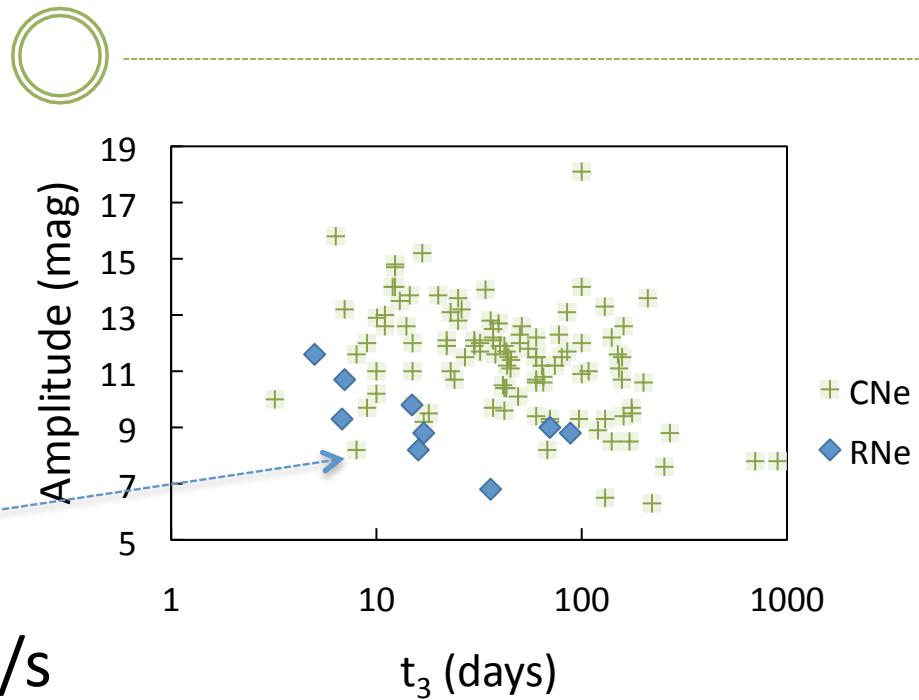
>500,000 plates  
1880s – 1953 and 1968 – 1989  
Limiting mag ≈ 18

## **Sonneberg Observatory**

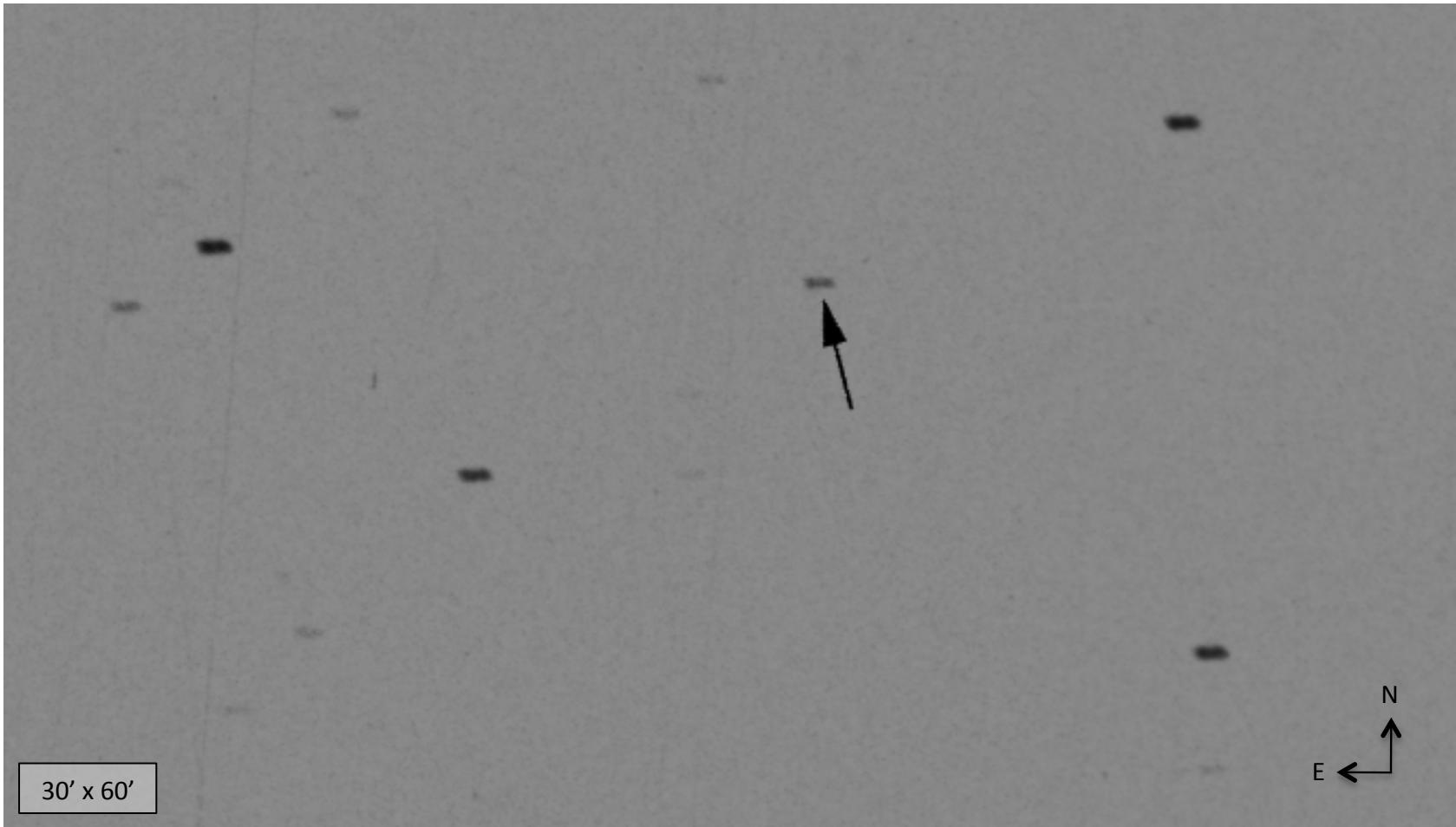
>300,000 plates  
1923 – present, mostly Northern  
Limiting mag ≈ 18

## First Test: V2487 Oph

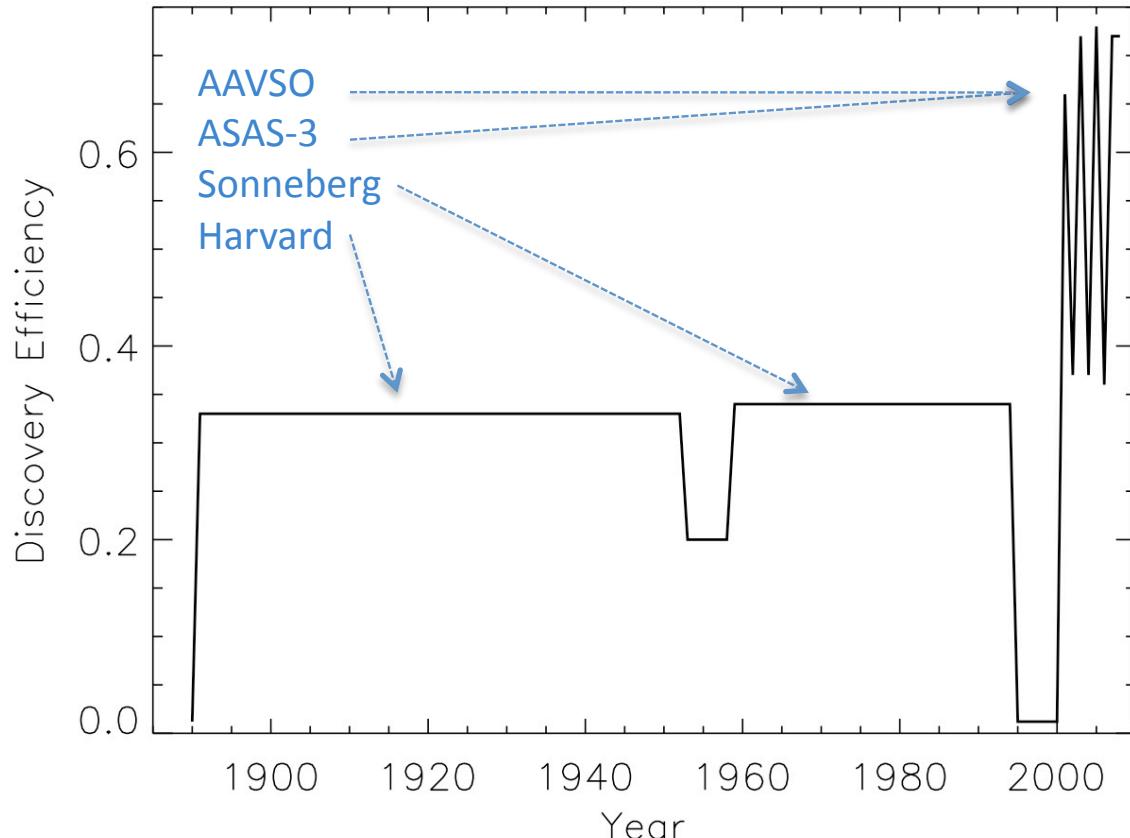
- Nova Oph 1998
- $M_{\text{wd}}$  and LC Shape  
(Hachisu & Kato 2002)
- Amplitude = 8.2 mag
- $t_3 = 8$  days
- FWHM of H $\alpha$  = 10,000 km/s  
(Lynch et al. 2000)
- He II lines observed  
(Lynch et al. 2000)



## Previous Eruption – 20 June 1900



# Discovery Efficiency



Average Discovery Efficiency = 30%

Recurrence Time as short as 18 years

Next eruption as soon as 2016!

$$\text{Efficiency} = \frac{365 - (SG - t_{vis}) - 4 \times (LG - t_{vis})}{365}$$

## Summary



- Low discovery efficiencies lead to missed eruptions
- Many RNe are likely masquerading as CNe
- We can identify strong RN candidates and search for previous eruptions
- V2487 Oph was our first test of this method, and it was successful
- The next eruption of V2487 Oph could be as soon as 2016