

# Dust production in a binary merger

*The case of V1309 Sco*

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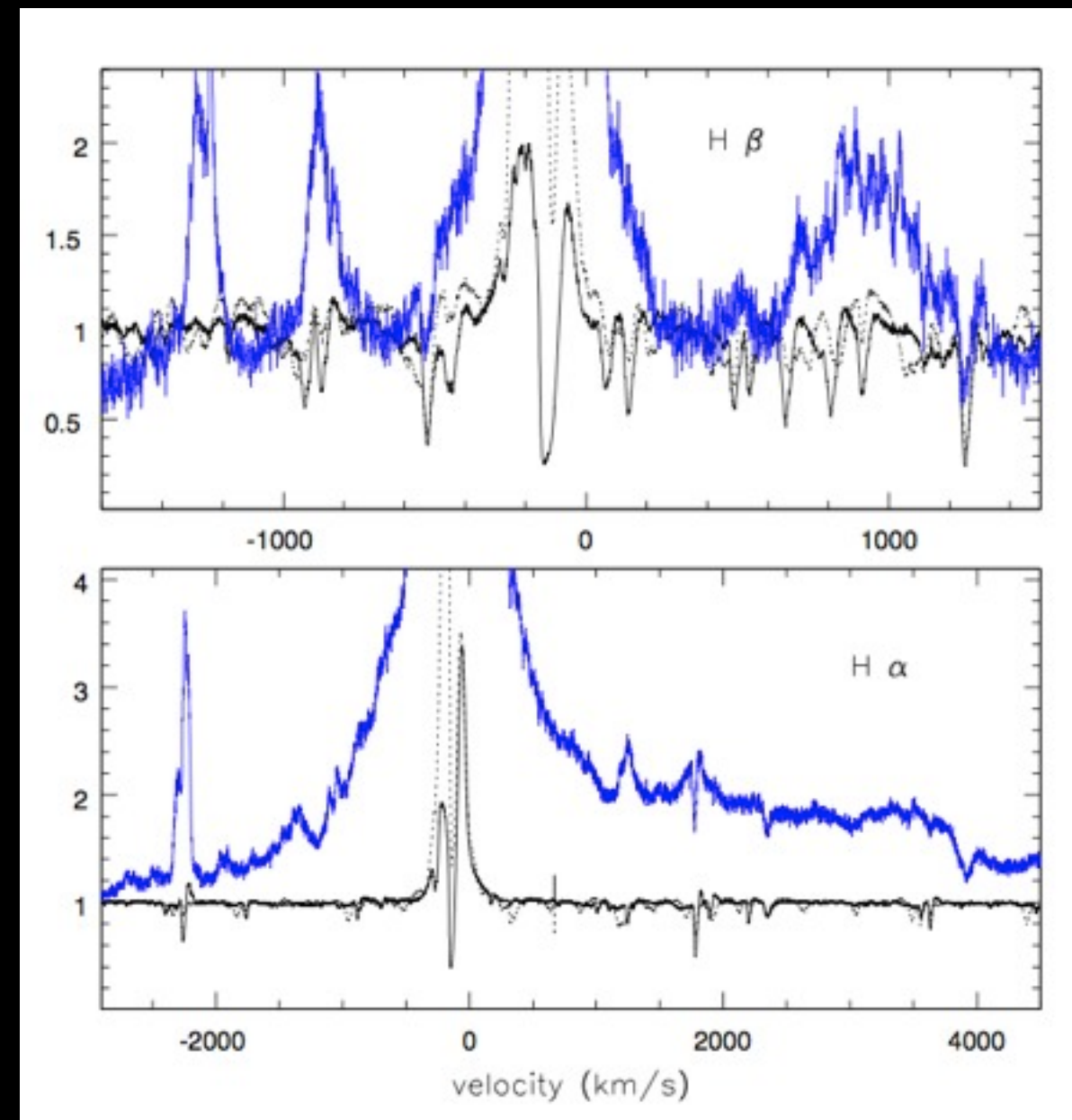
with Carl Melis (UCSD)  
and the OGLE collaboration

Nicholls et al. 2013 MNRASL

# Nova Sco 2008: not your average nova



Nakano et al. 2008

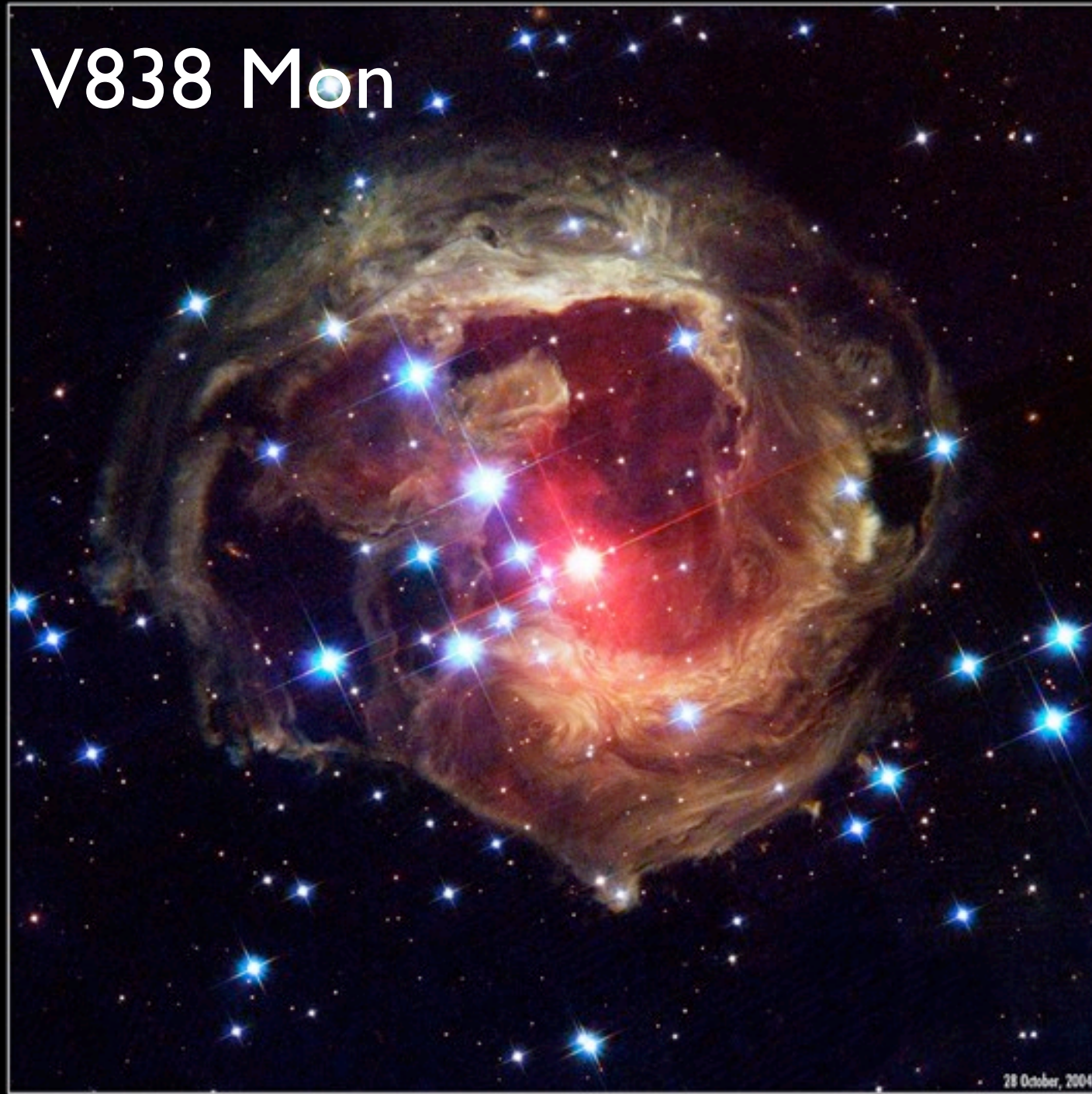


Mason et al. 2010



# V1309 Sco: a red nova?

V838 Mon

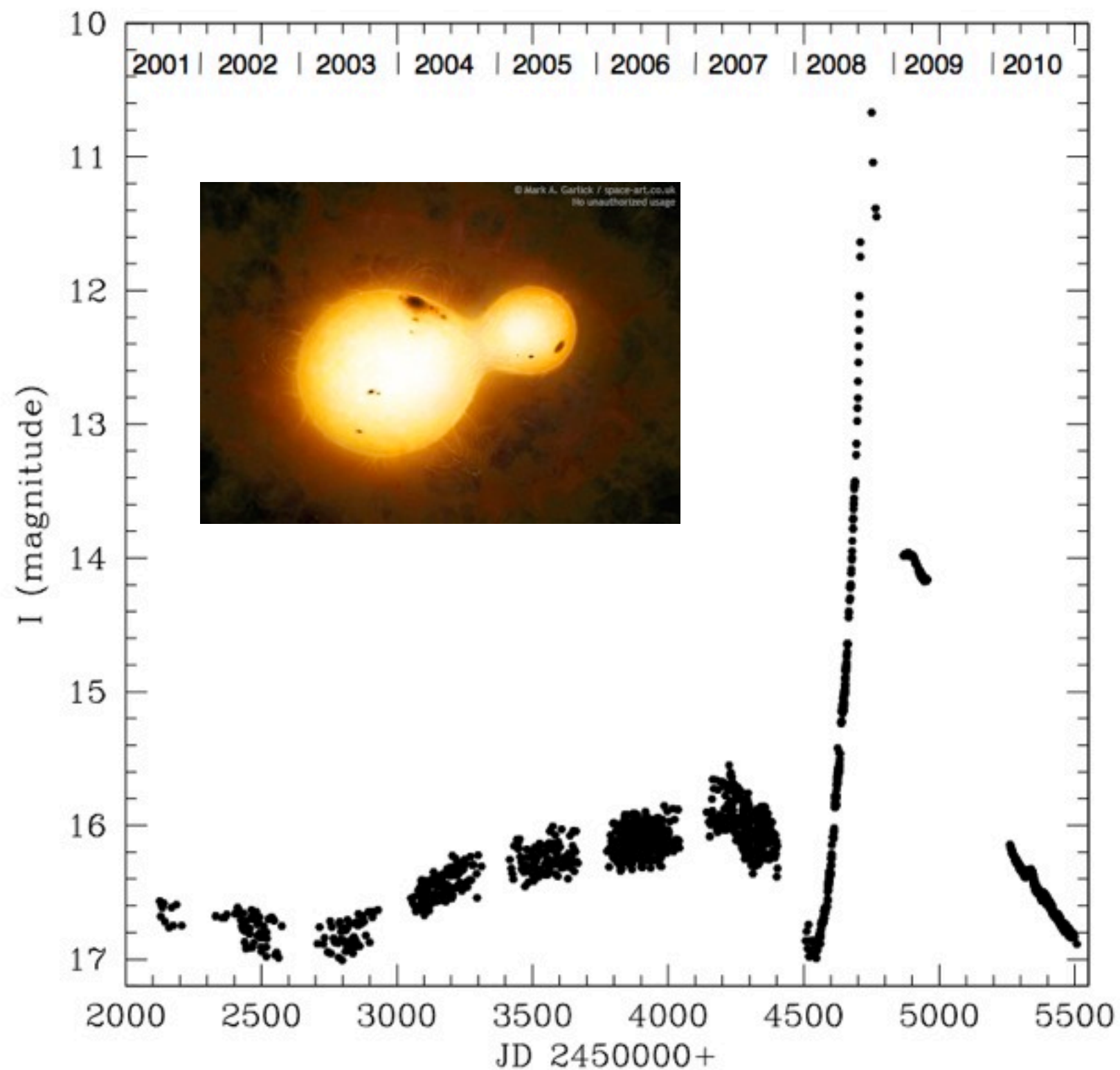


Soker & Tylenda 03:  
red novae are binary  
mergers

NASA/ESA

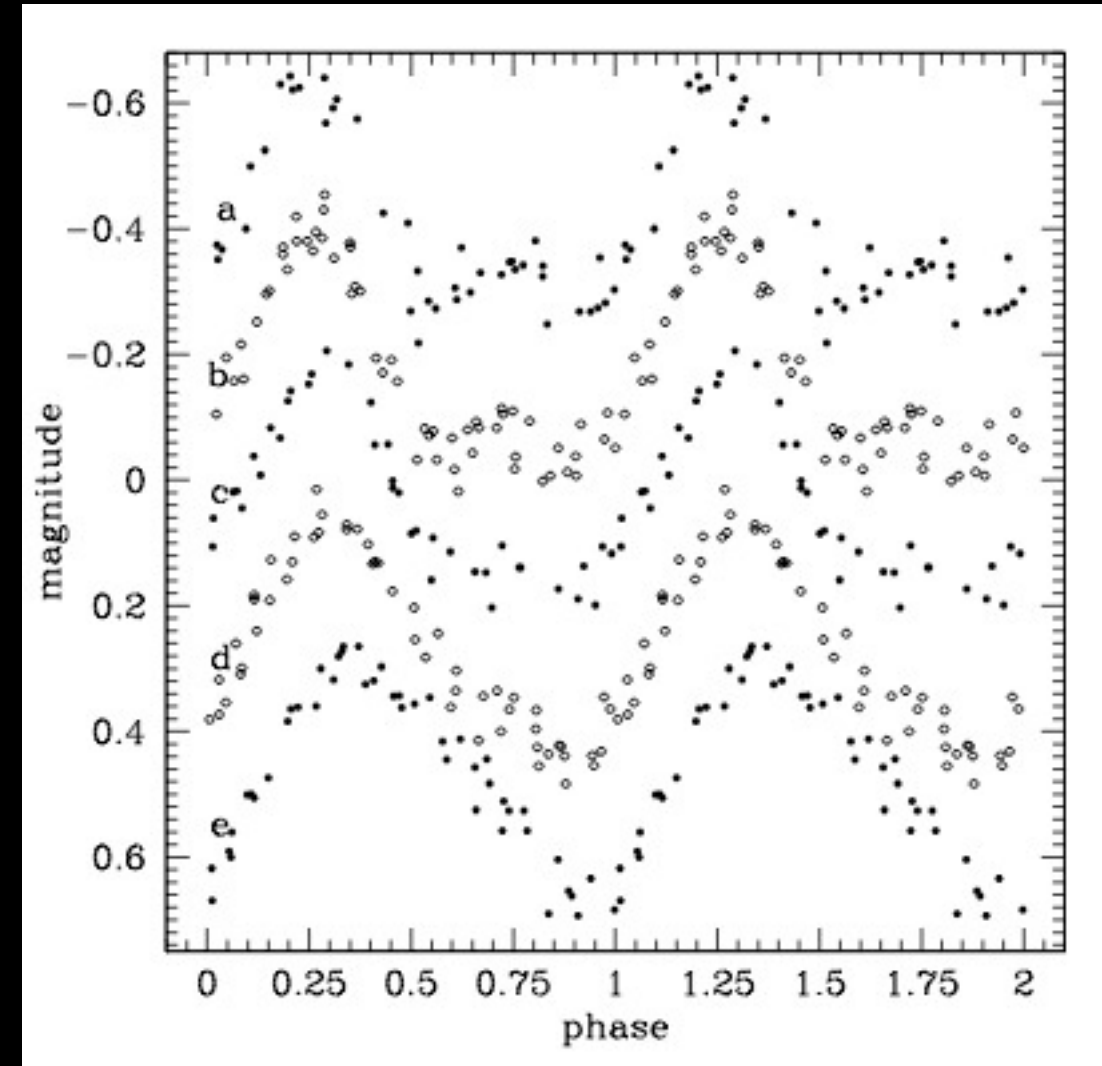
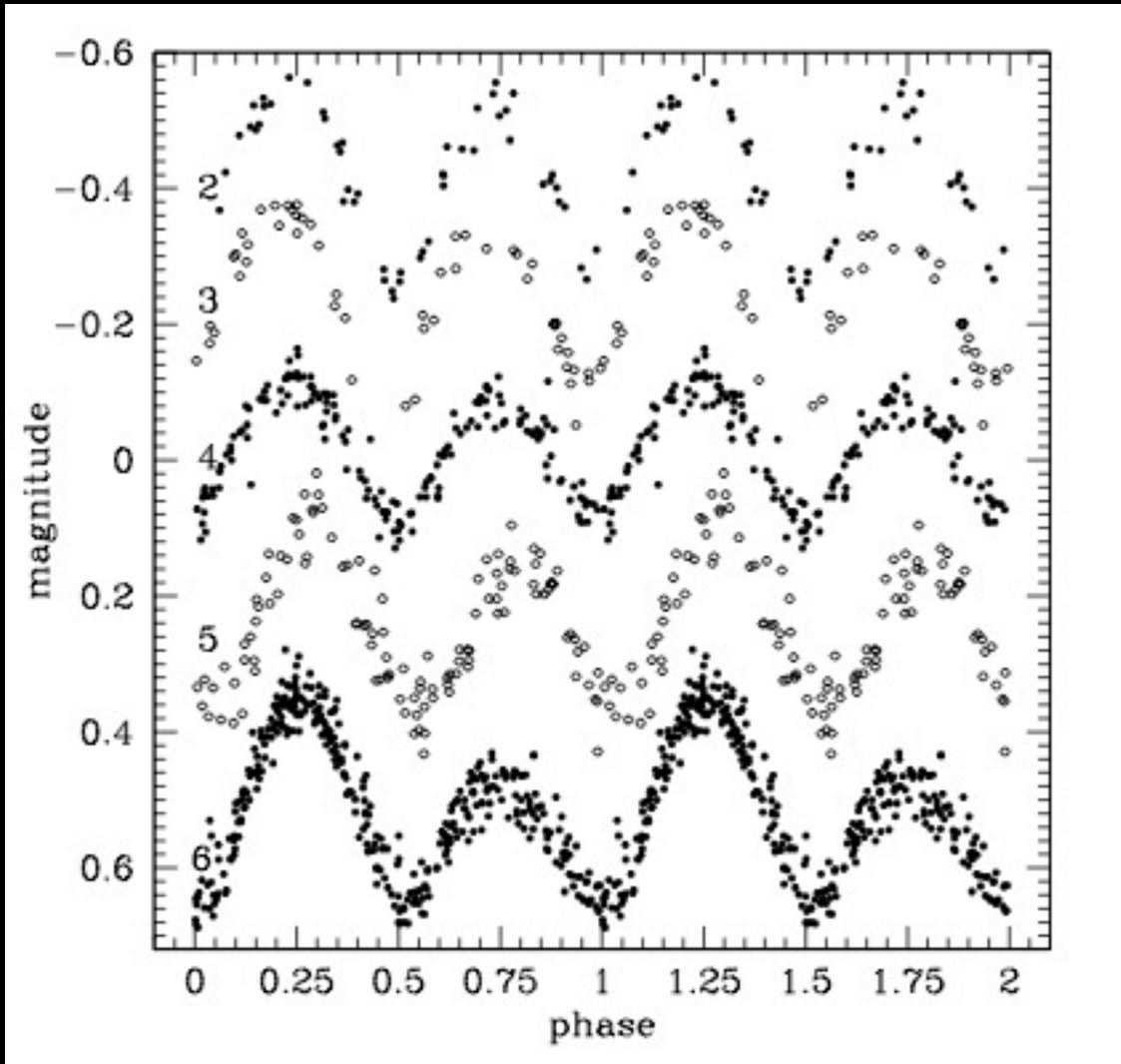
# first direct evidence of a binary merger

regular  
photometric  
variability



Tylenda et al. 2011

# VI 309 Sco's progenitor

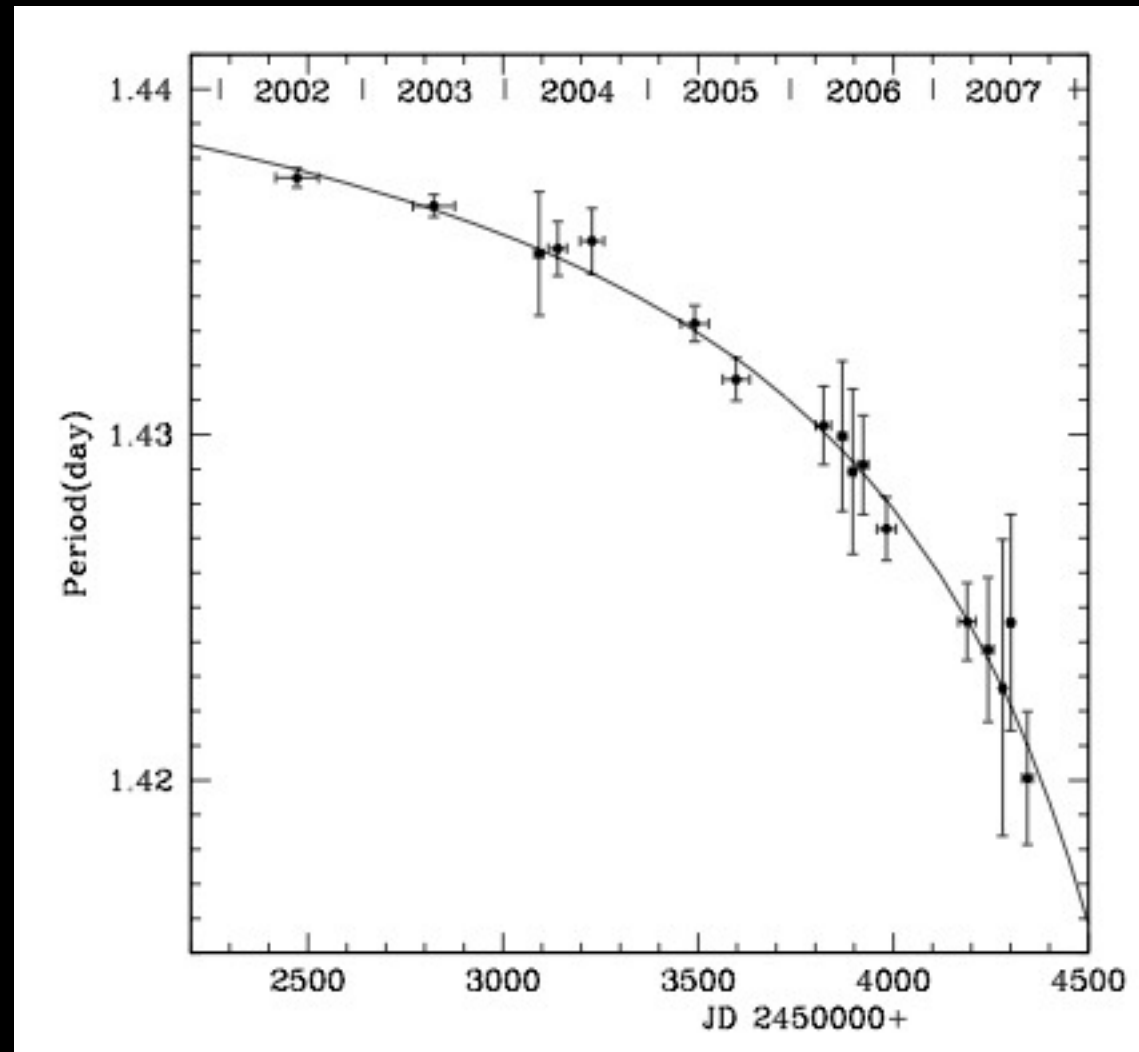


Tylenda et al. 2011

- lightcurve => contact binary,  $P \sim 1.4d$
- $V - I$  colour => K giant



# VI 309 Sco's progenitor

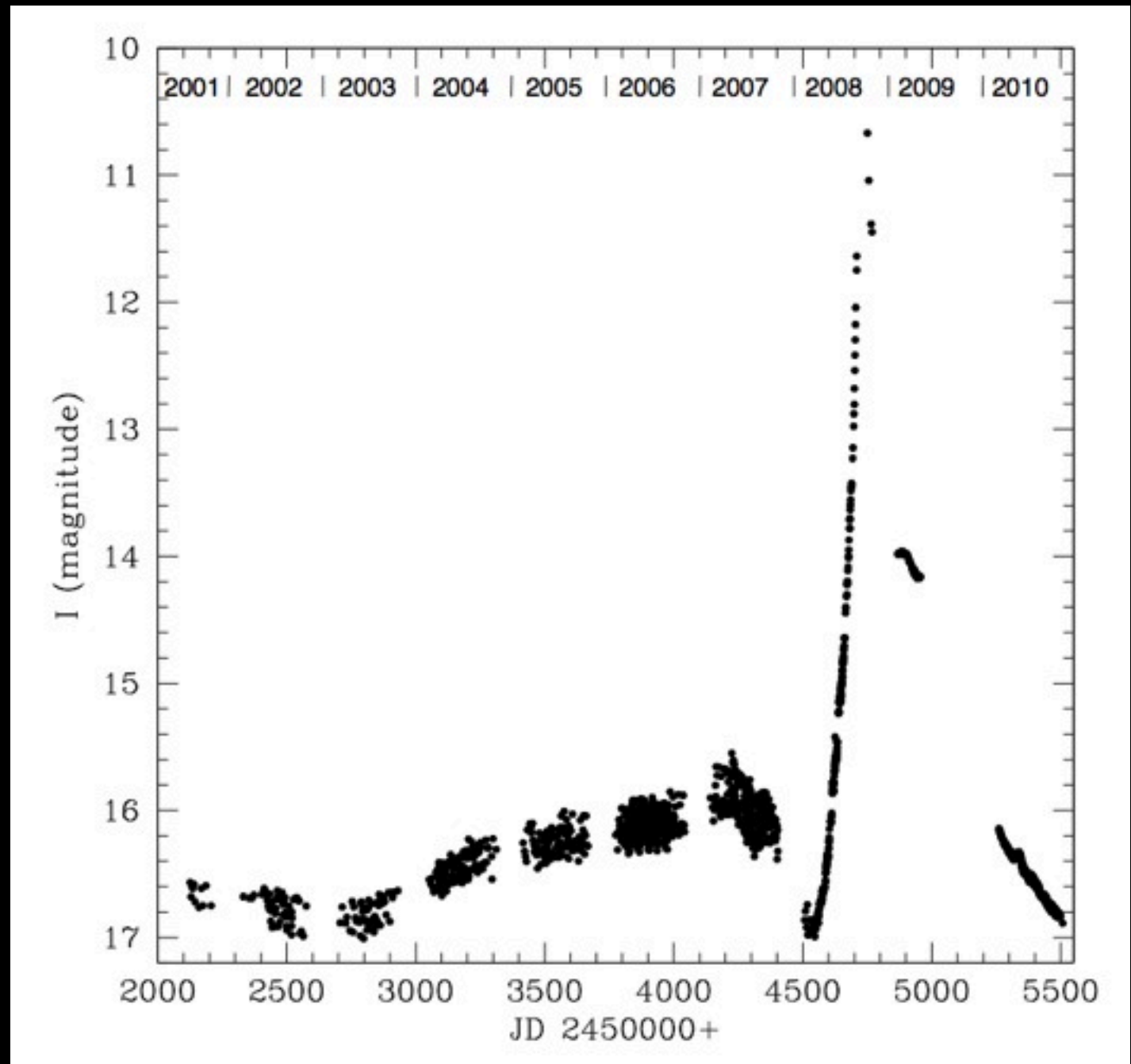


Tylenda et al. 2011

- period decay in years prior to eruption
- no periodicity after outburst

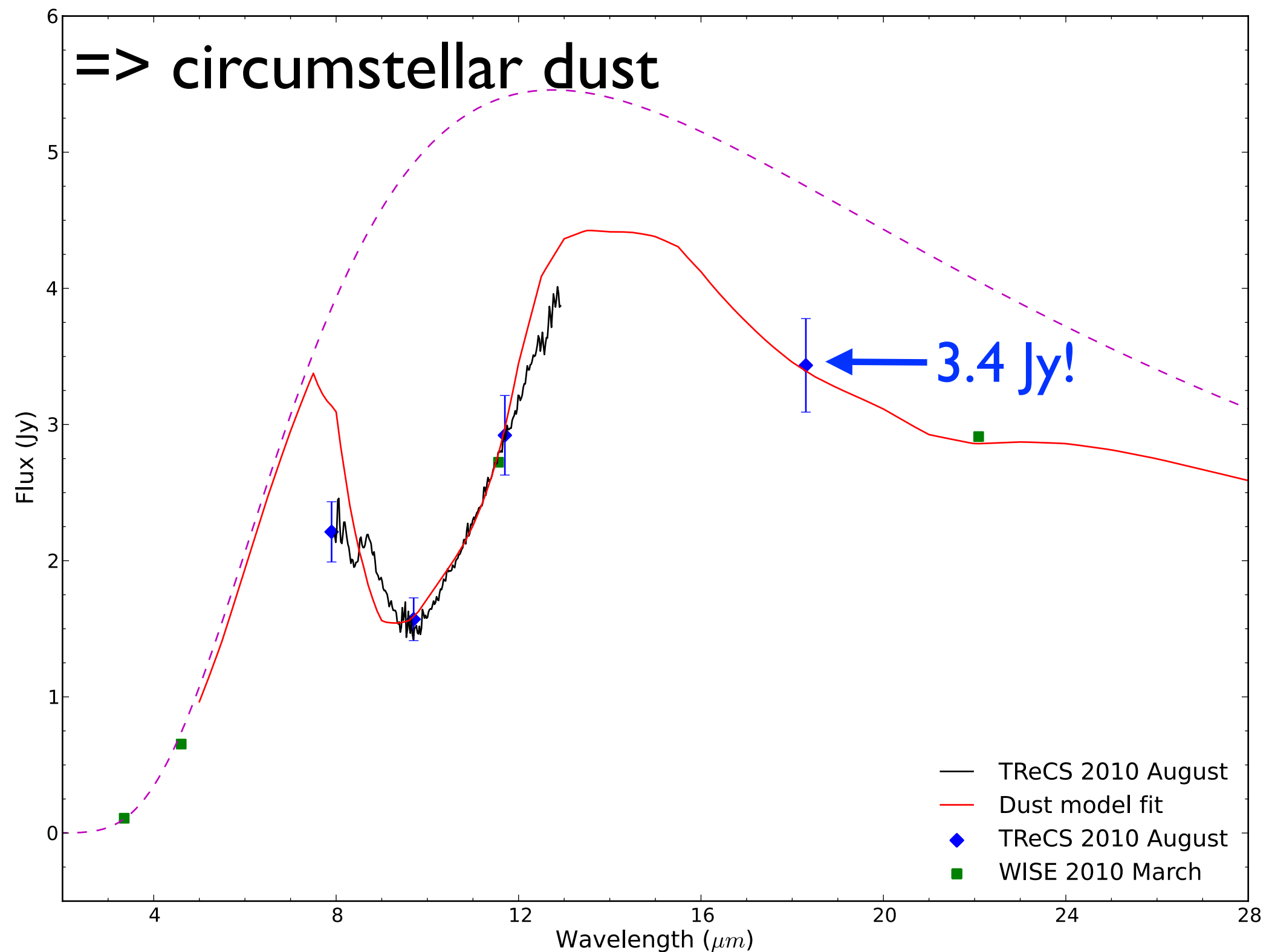
# V1309 Sco: a binary merger

- was a contact binary
- huge outburst as stars merged
- so what is it now?



Tylenda et al. 2011

# very bright in mid-IR

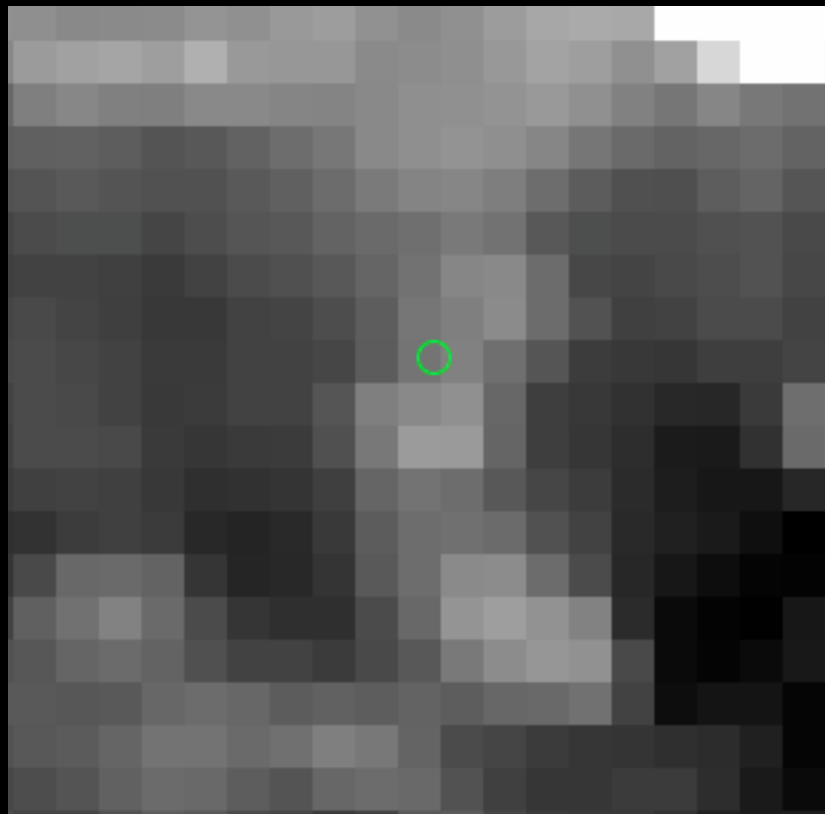


Nicholls et al. 2013

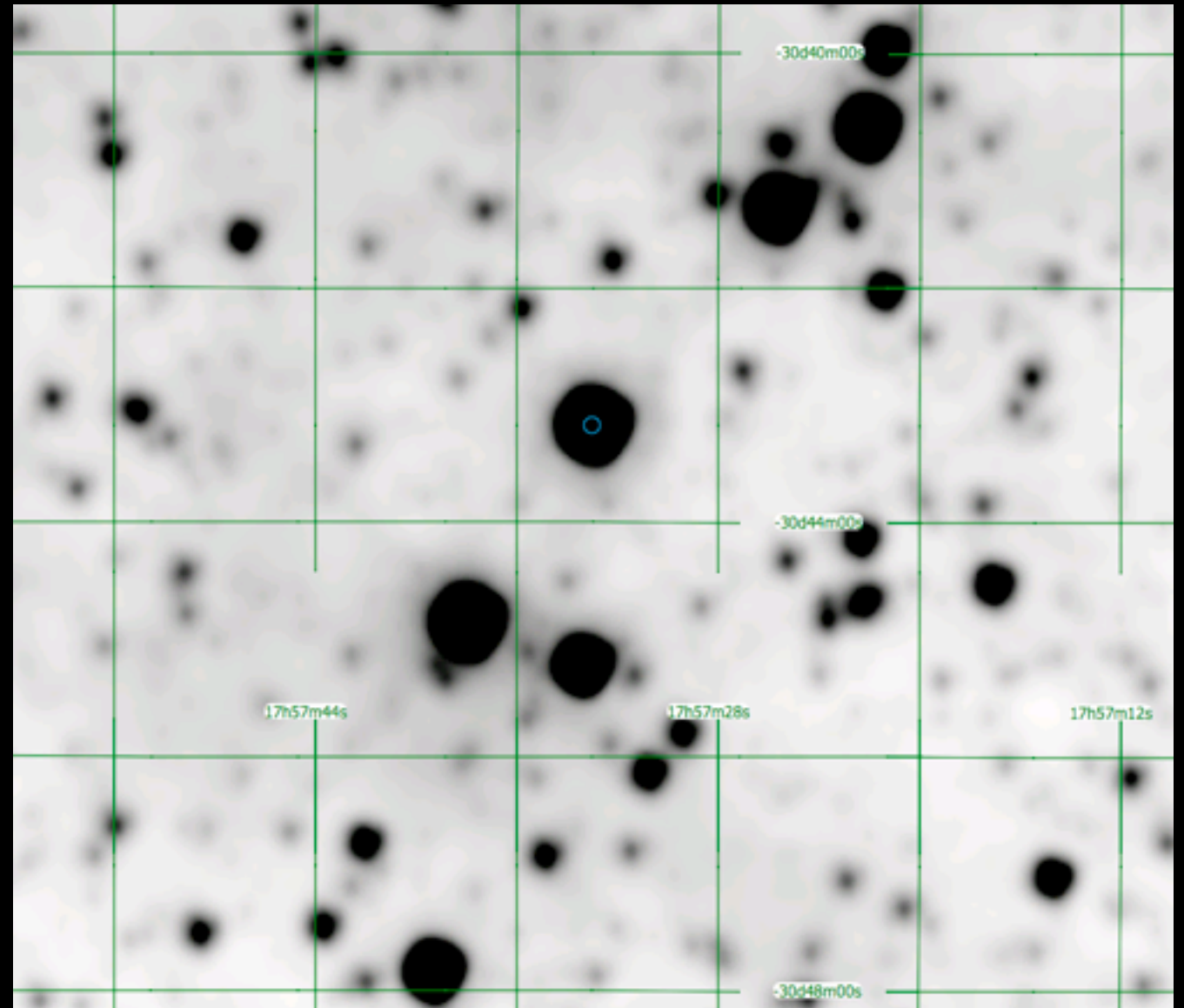


# no previous

=> dust produced in  
merger

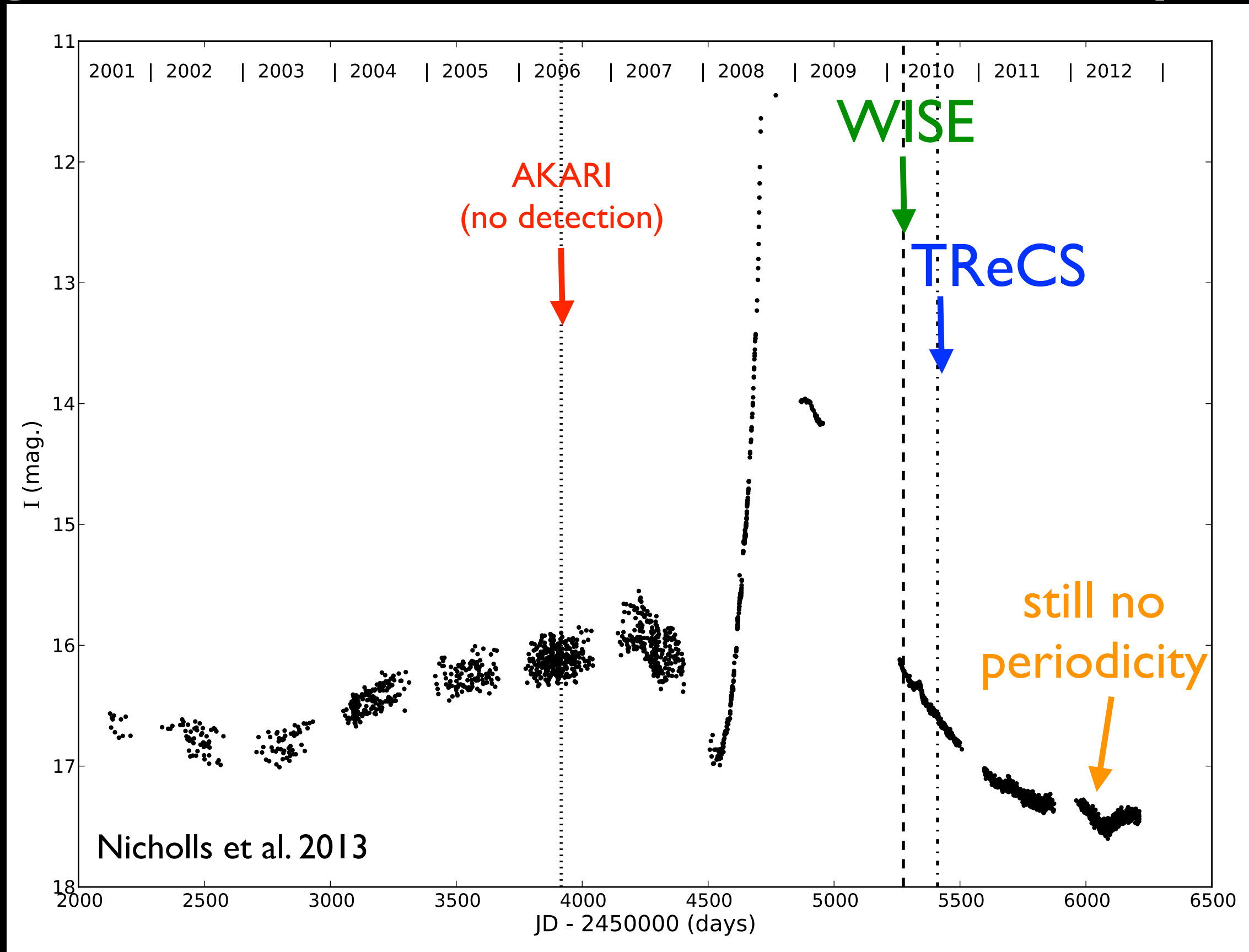


IRAS 12 $\mu$ m

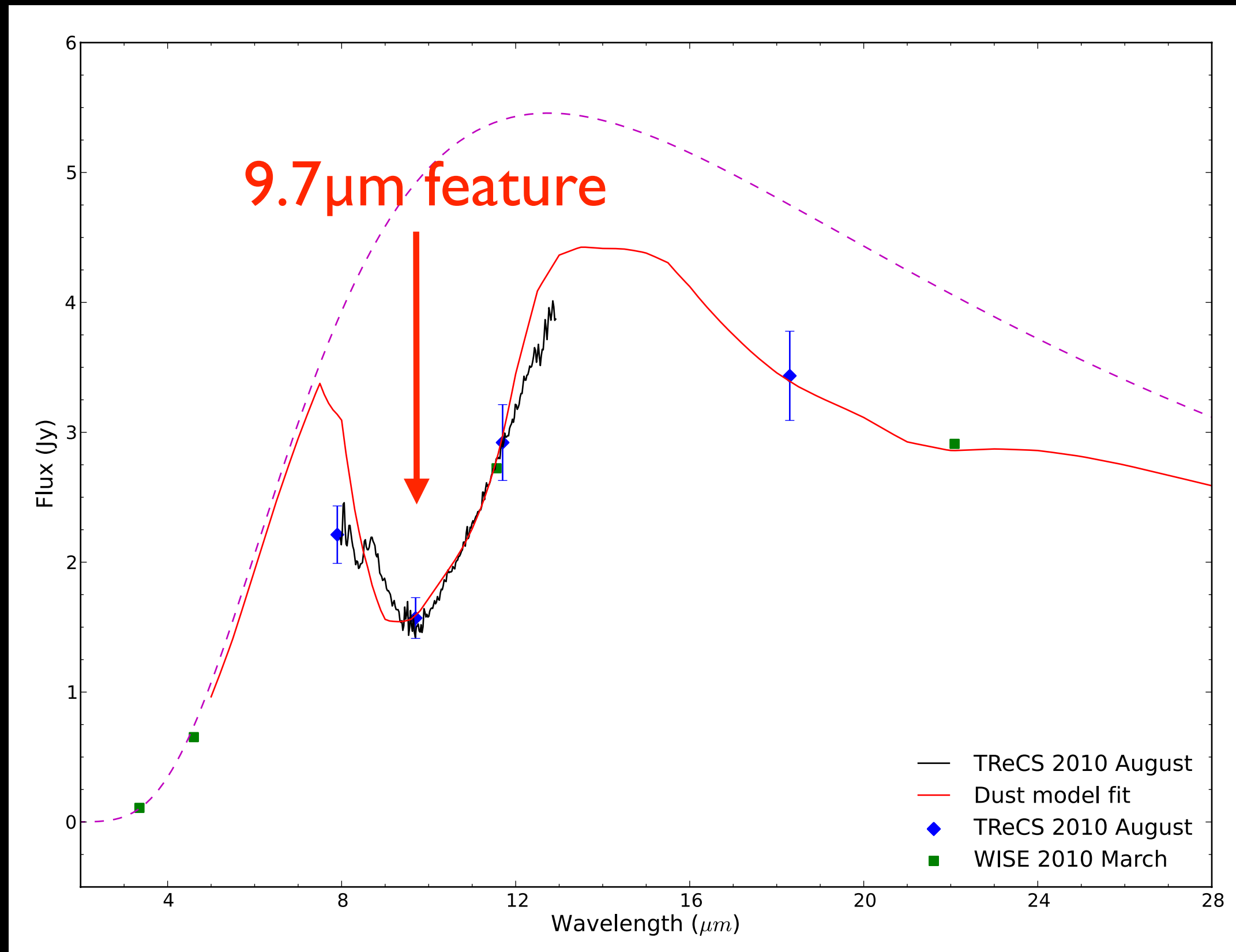


WISE W3

# bright in mid-IR but declined in optical



# bright in mid-IR + absorption feature



what is the nature of  
the dust?



# a simple model for V1309 Sco's dust

$$D = f \left[ B_{\nu, cont} - \sum_{i=1}^n (a_i A_i B_{\nu, i}) \right]$$

- dust temperature
- amount of dust present
- dust species
- grain size
- grain shape

# a simple model for V1309 Sco's dust

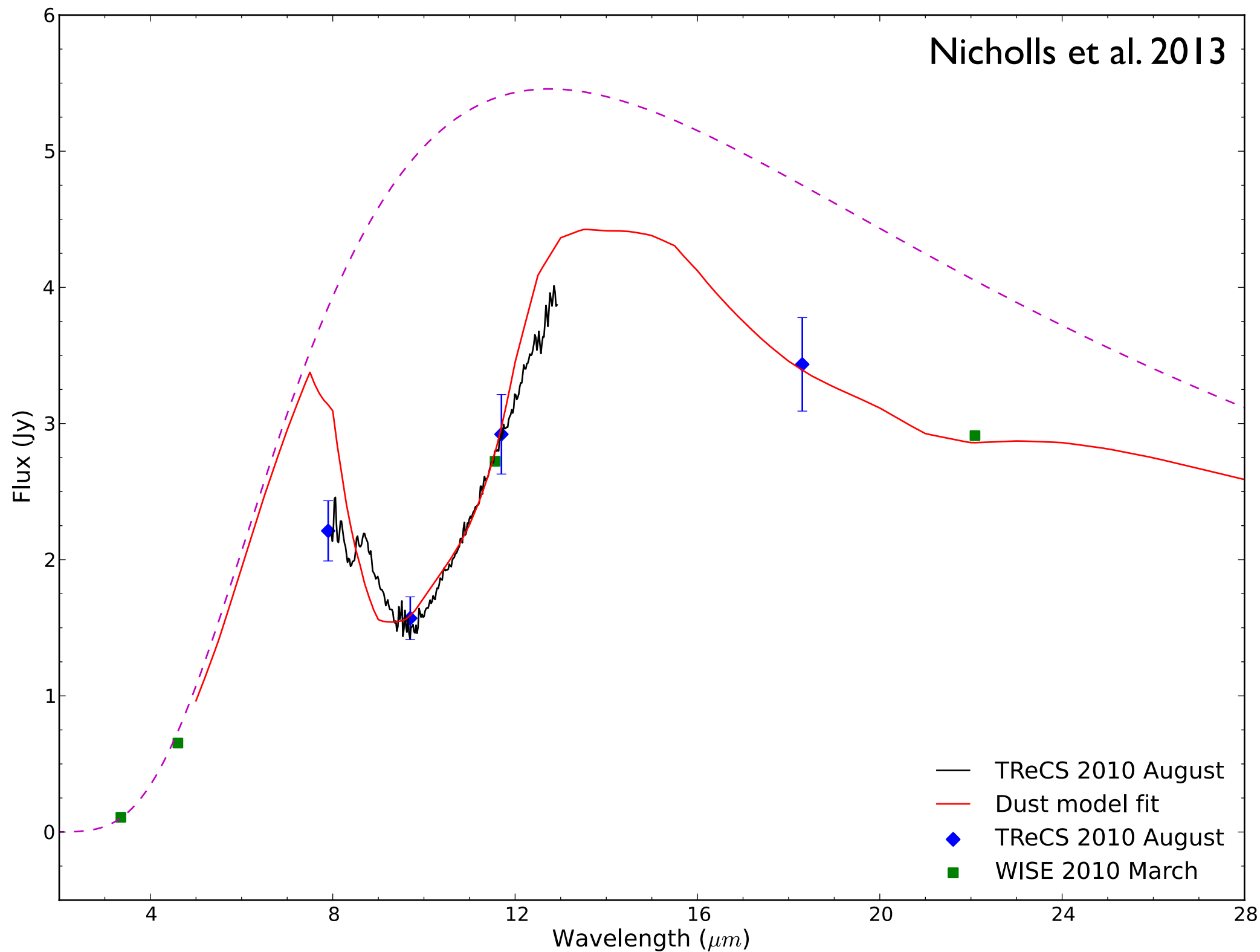
$$D = f \left[ B_{\nu, cont} - \sum_{i=1}^n (a_i A_i B_{\nu, i}) \right]$$

- dust temperature 200 - 1500K (steps 50K)
- amount of dust present
- dust species olivines + pyroxenes
- grain size various 0.1 - 4.0 $\mu$ m
- grain shape spheres and irregular

$T_{\text{cont}} = 400\text{K}$

$T_{\text{feat}} = 800\text{K}$

3 $\mu\text{m}$  spherical  
MgFeSi<sub>2</sub>O<sub>6</sub> grains



most  
sensitive to  
grain size

pyroxenes  
fit better  
than olivines

# recently-formed, processed dust?

- warm dust temperature => formed recently
- large grain sizes => processing
- timescales... very quick processing
- processing usually => disk
- disk?





# conclusions

- V1309 Sco: contact binary -> red nova as stars merged
- post-merge, high mid-IR flux and strong silicate absorption => circumstellar dust
- dust is warm, large grains
- not sure if disk or shell

# future work

- mid-IR spectra at longer wavelengths/  
greater wavelength coverage
- more complex dust modelling: radiative  
transfer?
- is dust variable? dissipating?
- optical luminosity evolution?
- nature of the central remnant