Dust to Dust: Grain Formation & Evolution in Classical Novae

Jillian Bornak, Thomas E. Harrison (NMSU),
Karl D. Gordon (STScI)

NM Symposium 2010 - Socorro, NM

Why Dust?

- From early universe (z>6) to our galaxy

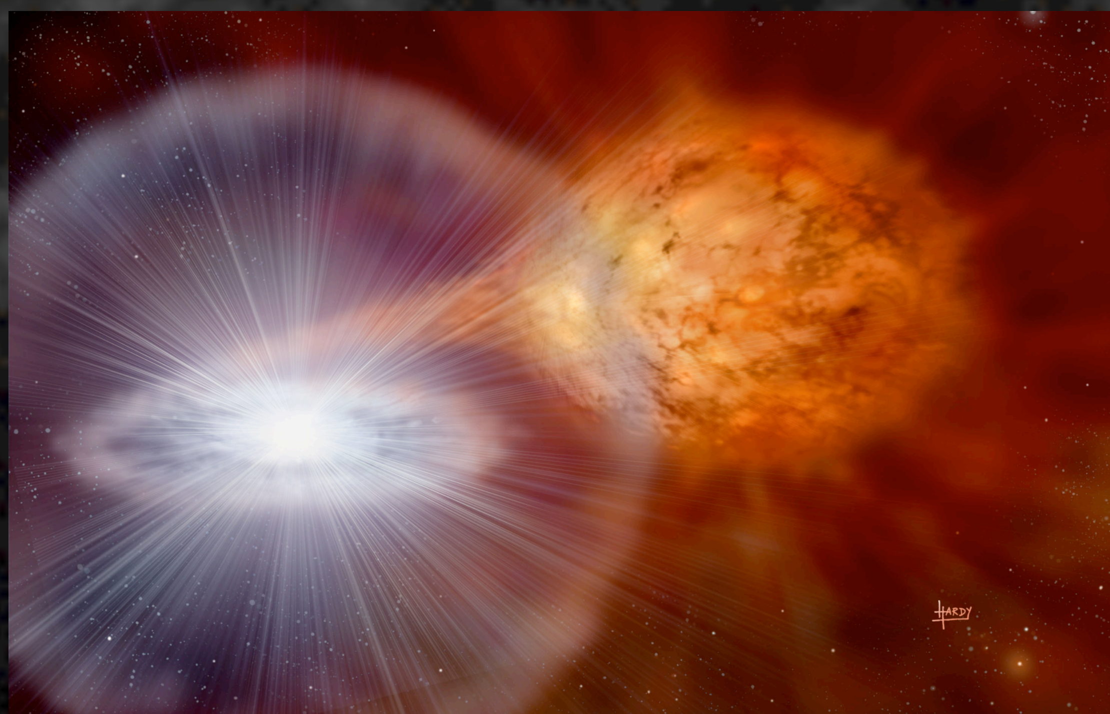
  … to rocky planets and people

- Even if you don’t study it, you look through it

- Novae: formation, evolution, destruction on human time scales

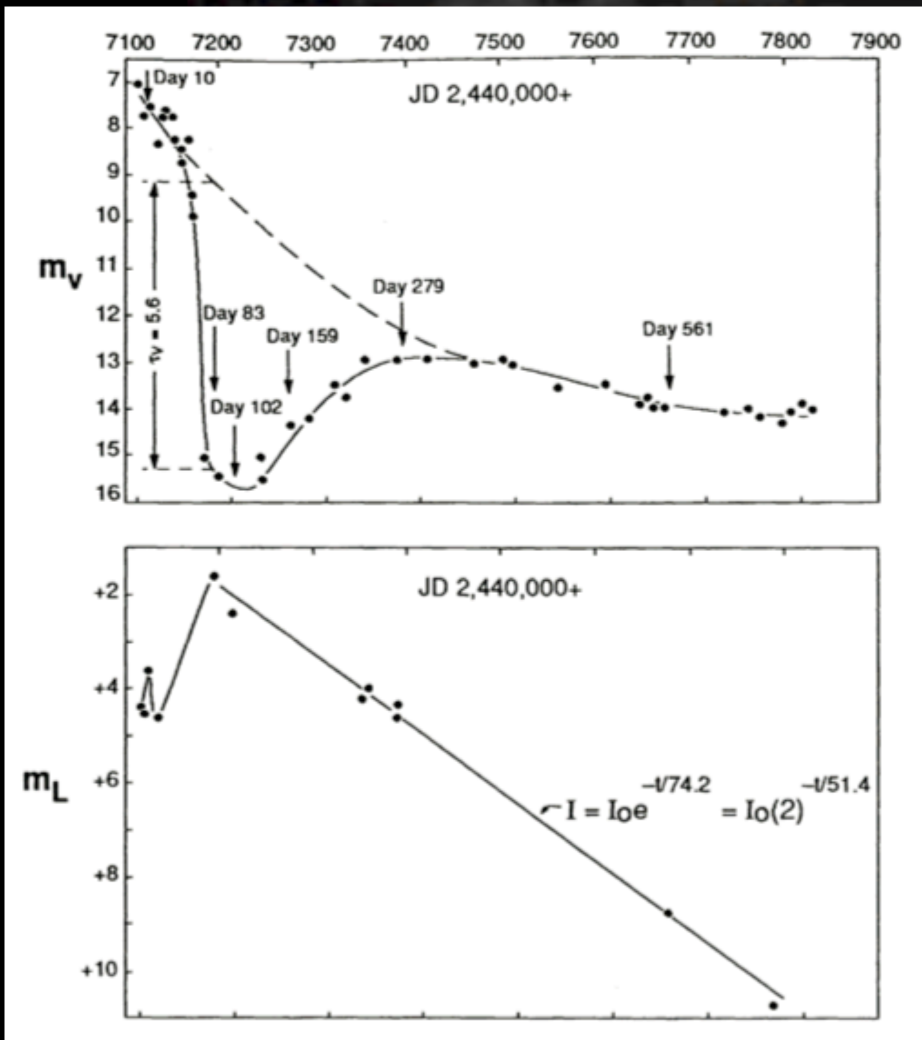
Novae Basics

- Cataclysmic variables
- Classical and recurrent novae
  - t_3 speed class: fast, medium, and slow

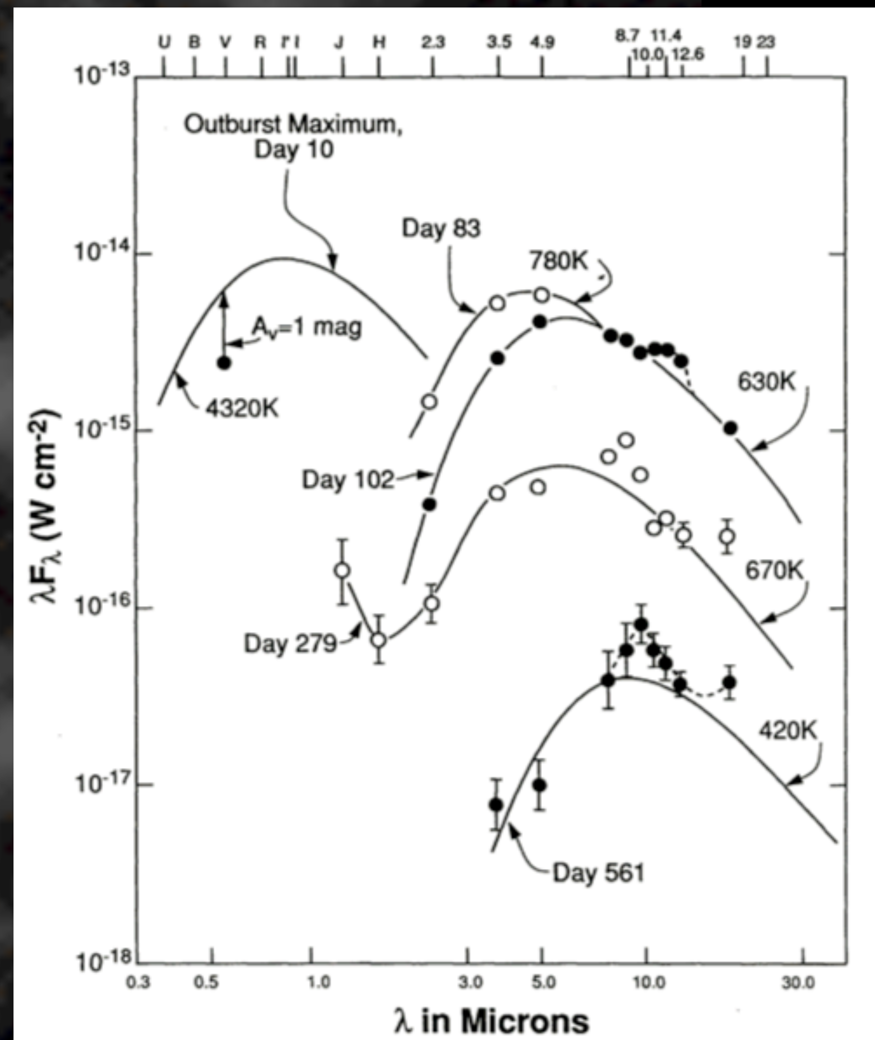


Typical Dusty Nova

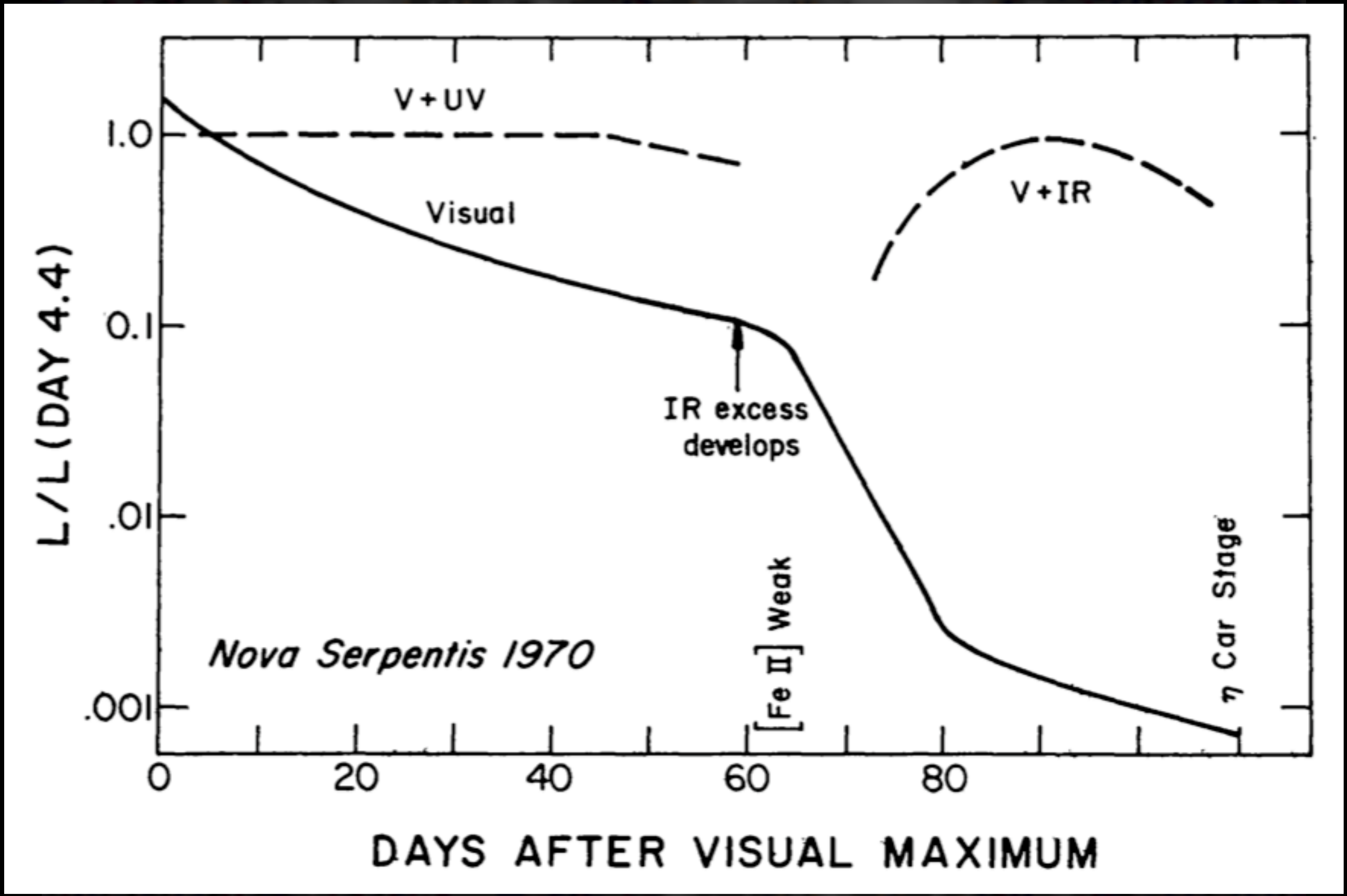
Light curve



SED

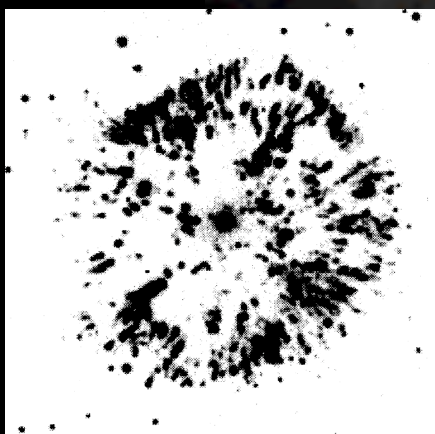
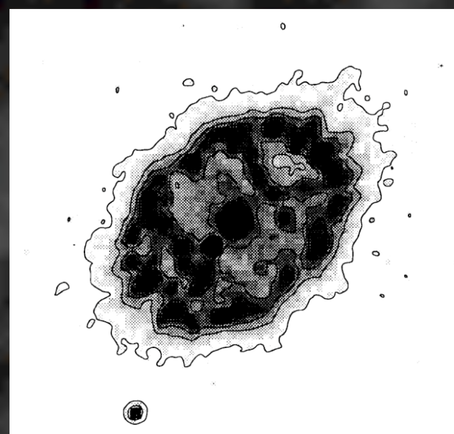
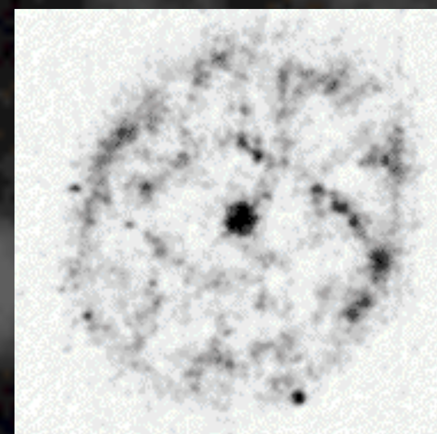
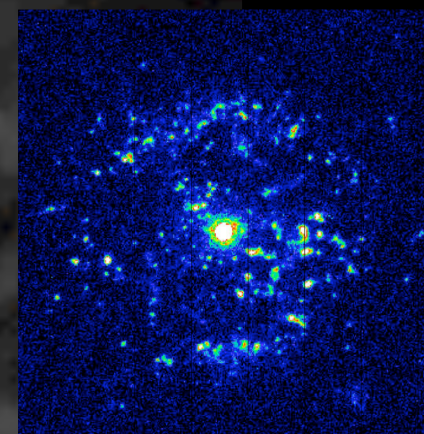
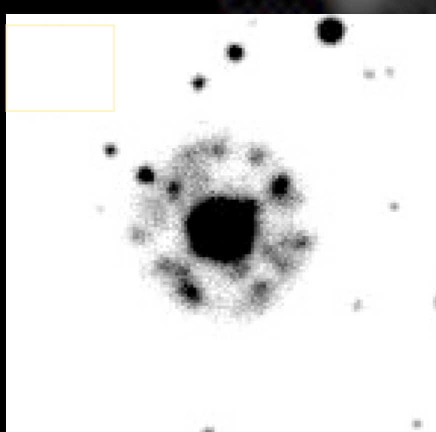
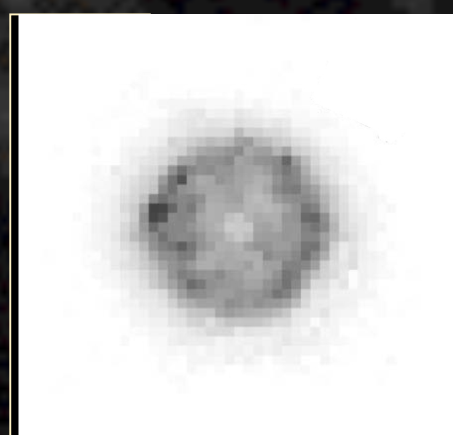
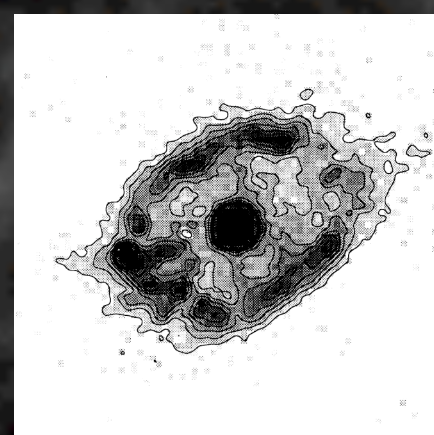
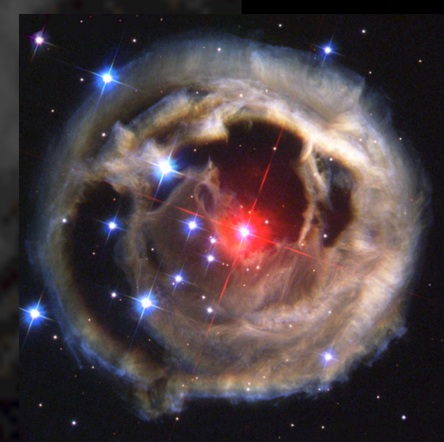


Typical Dusty Nova



Complications

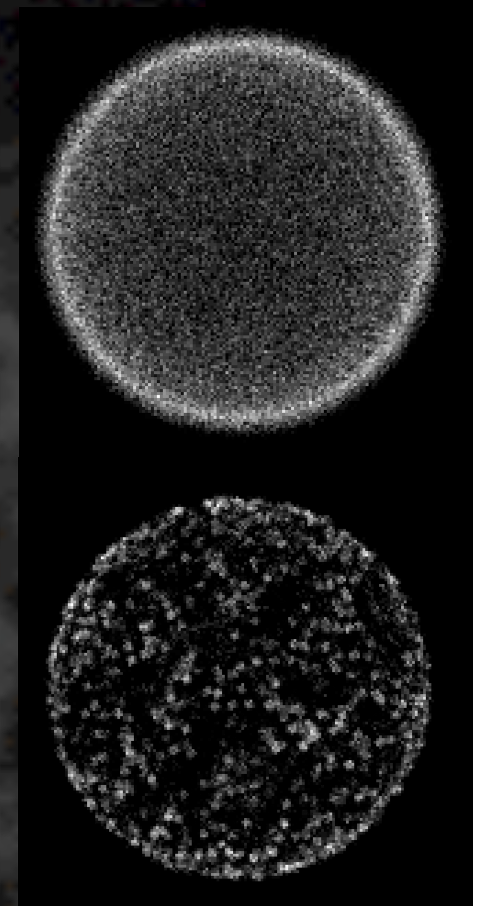
Ejecta can be clumpy!

The DIRTY Code

DustI Radiative Transfer, Yeah!

two phase medium with dust absorption, emission, scattering



Model parameters:

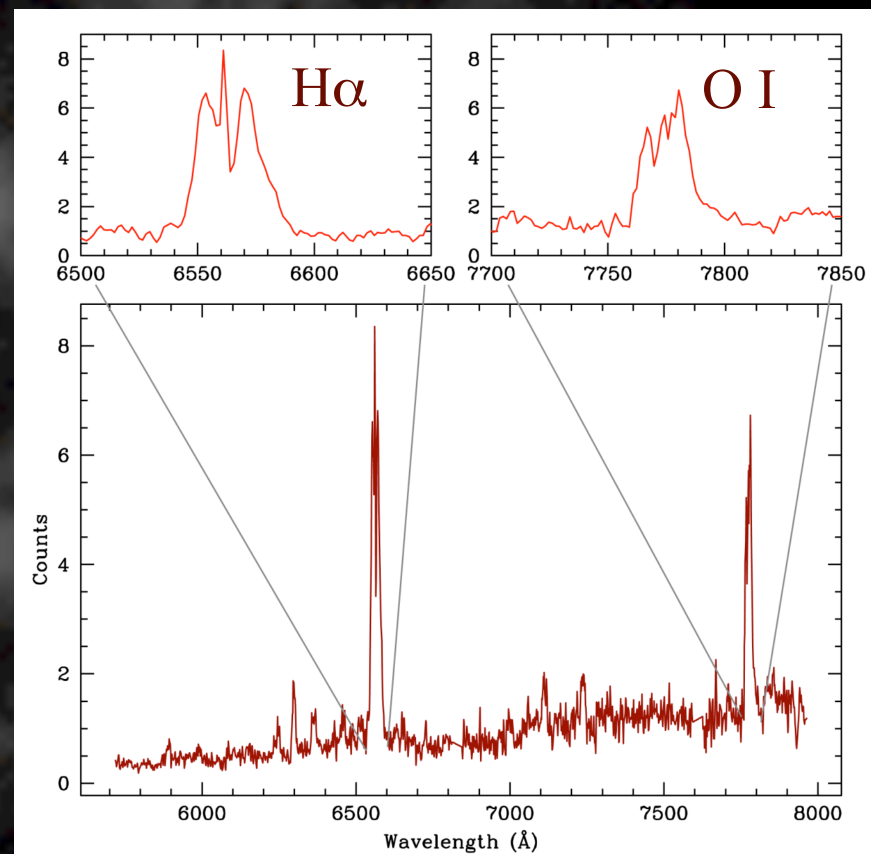
distribution geometry, optical depth, filling factor, density ratio, grain size, grain composition, central source SED

Nova Cen 1991

t_3 95d implies M_v = -7.0

Hα line -392 km/s and +690 km/s

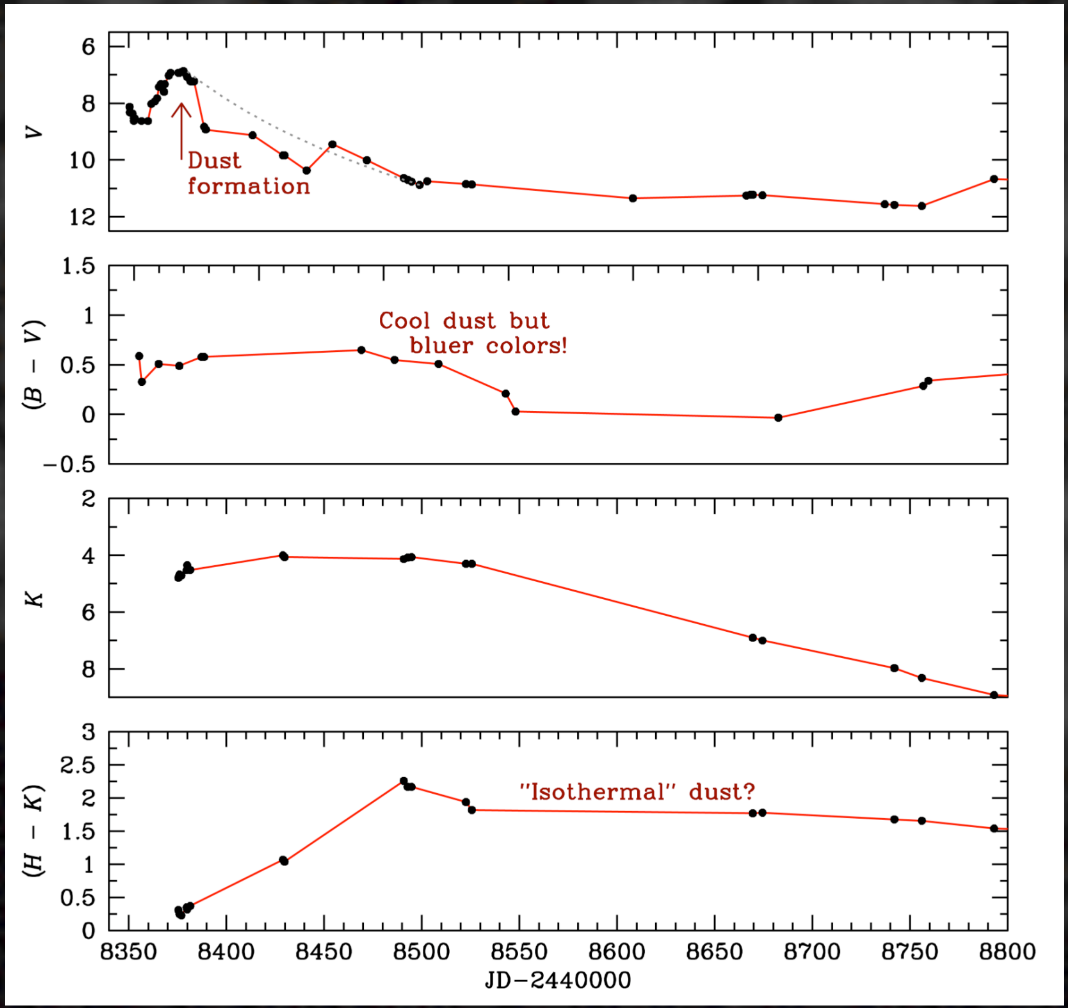
Hα/Hβ gives A_v 3.37



… A_v & M_v → 5.32 kpc

Nova Cen 1991

A dusty nova with a leaky shell!



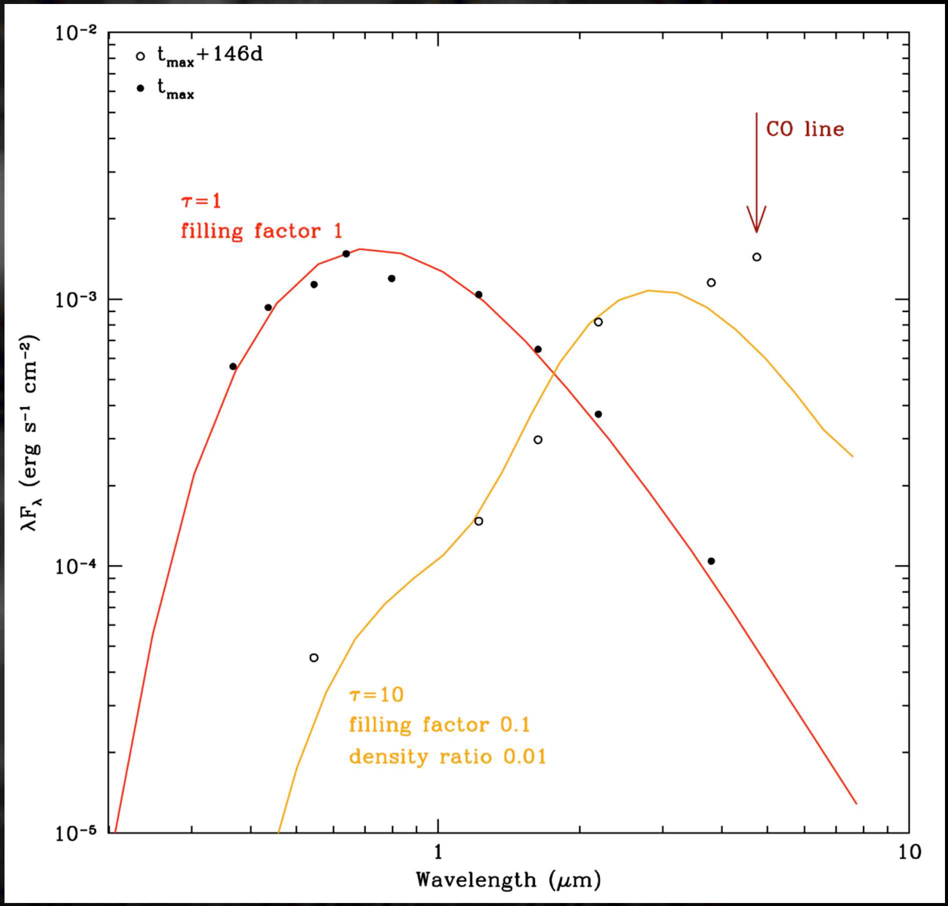
Modeling

Ejecta velocities give shell size

Central SED 5500K ~ 3000K MIII

Early stages fit well by homogeneous shell τ ~ 1

Later stages require filling factor <1 and τ ~ 10



Past, Present, and Future Work

- ✓ Implement arbitrary dust distribution in DIRTY
  spherical shells and Solf (1983) model
- ✓ Implement narrow grain size distribution in DIRTY
- → Follow change in time of dust parameters

Apply understanding of clumpy dust to other novae

observe ~30 old dusty novae in *UBVRIJHK* using SMARTS 1m in April 2010

additional data @ 3.6, 4.5, 12, and 22 μm with the WISE survey