Modelling the Old Nova Shell and Jet of the Bright Nova, GK Persei

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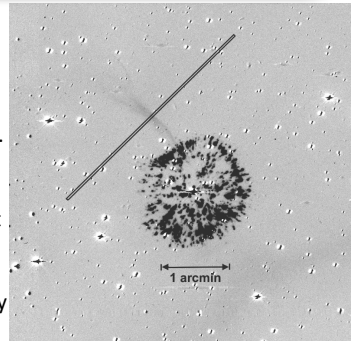
Abstract

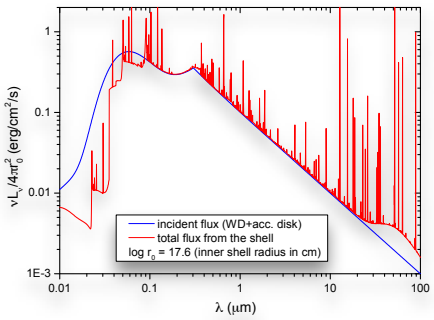
GK Persei (1901) consists of an evolved K I type star & white dwarf accreting binary system, an expanding fragmented old nova shell, as well as a collimated apparently one-side jet feature.

Based on the literature a photoionization model was developed using the Cloudy code in an attempt to gain an understanding of the underlying physics at play in this curious object.

A deep image of GK Per, the jet and shell are clearly visible. The overlayed slit depicts that of the spectrograph. The 2D spectra of the 6 bright knots that are located in the north-east quadrant of the shell. Adapted from Shara et al. 2012 , hereby referred to as (S12)

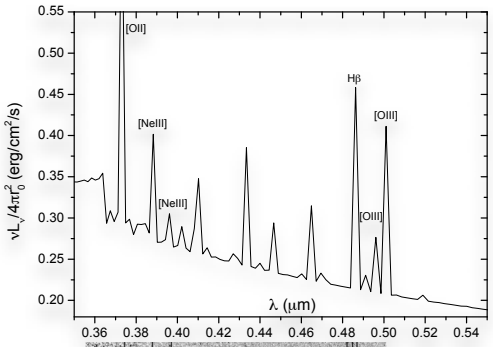


Shell Model

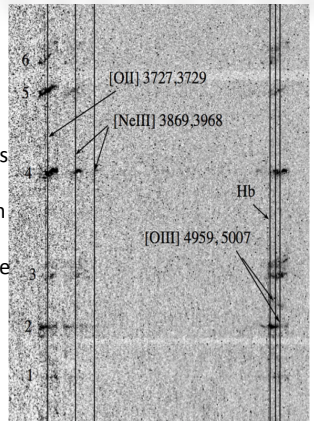


Parameters:
Illuminated by WD
L_{bol}= 10^{36} erg/s
T = 65 000 K
with a log
Hden = 3.3 cm^-3
R= 26,000 AU
Thickness = 670 AU
Filling factor = 10%
and modified nova abundances:
4x He & 10x O

The synthetic spectrum generated depicted over the observational wavelength range.



Longslit spectra of 6 bright knots (S12). The line ratios derived in the paper are compared to the model spectra above.

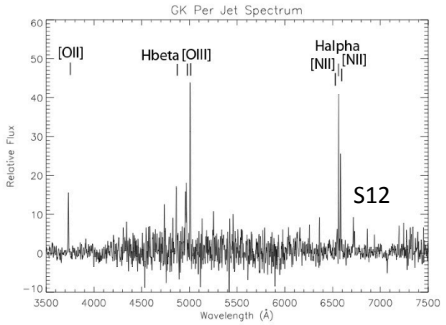


Average emission line ratios for the GK-Per knots (S12) compared with model. It should be noted that there is a significant change in abundances from knot to knot.

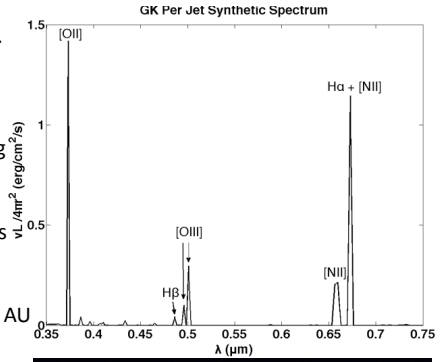
	Measured	Model
[O II]3727/ [O III]	3.14	3.70
He I 3889/ [O III]	1.32	0.48
[Ne III] 3969/ H-Beta	5.71	0.16
[O III]/ H-Beta	6.64	1.10
[N II]2 - H-Alpha/ [O III]	5.648	10.20
[O II] 7320,30/ [O II] 3727,29	0.1	0.07

Jet Model

Observed spectrum (S12)



Model spectrum of the jet feature. Illuminated by Shell and WD
+ Coronal Heating = 4500 K
Modified Nova Abundances
Hden = $10^{1.5}$ cm^{-3}
R = 26,000 AU
Thickness 17,000 AU
Age: 1.2e10s



Jet emission line strengths relative to [O III] (S12)

	Measured	Model
[O II]	0.58	3.30
H-Beta	0.60	0.075
[O III]	1.00	1.00
[N II]	0.17	0.11
H-Alpha	0.99	0.23
[N II]	0.54	0.33
[S II]	0.73	0.67
[S II]	0.52	0.57

Conclusion:

Despite significant overproduction of OII from our models we see a better fit with the shell than the jet. This leads us to the conclusion that they originate from differing physical processes in the same system.

Special thanks to Prof. Gary Ferland, Prof. Francis Keenan and Ted!!!