The Mysterious IR Excesses in RS CVn Binaries

M. Matranga, J. J. Drake, M. Marengo, V. Kashyap
(Harvard-Smithsonian Center for Astrophysics)

MOTIVATIONS

One of the most remarkable properties sometimes attributed to RS CVn binaries is evidence of infrared excess, which is thought related to the presence of circumstellar matter. The existence of this non-stellar component in the flux distribution of such a class of object has been the subject of considerable controversy. (Mitrou et al., *A&ASS*, **115**, 61 (1996) and references therein)
Within current scenarios explaining IR excess around late type stars, RS CVn should not have any: they represent a significantly older population than the ~ 400 Myr dusty disk lifetime, with typical ages of 1 Gyr or more. Moreover, they have not undergone any evolutionary period during which substantial mass loss is expected.

Target	Sp. Type	Log(g)	T_fit	$(R2/R1)_{fit}$	Excess
AR Psc	K1IV/G7V	4.08/4.48	4500/5250	0.80	Y
CF Tuc	G0V/K4IV	4.42/3.48	6500/4750	3.07	N
II Peg	K2IV/M2V	3.65/4.58	4500/4250	0.17	Y
TY Pyx	G5IV/G5IV	4.12/4.07	5750/5750	1.06	N
UV Psc	G5V/K2V	4.37/4.52	5500/5000	0.74	N
UX Ari	G5V/K0IV	4.46/2.77	6000/5750	6.02	Y
V471 Tau	K2V	4.57	5000	-	N
WY Cnc	G5V/K0V	4.31/4.52	5500/3500	0.82	N
XY Uma	G5V/K5V	4.46/4.60	5750/4250	0.44	Y

Table 1 – Stellar parameters of the targets. Green columns contain the best fit parameters of the Kurucz models.

OBSERVATIONS

• IRAC aperture photometry has been performed on mosaics produced by custom software. For MIPS photometry we used the PBCD processed data.

• In order to check the presence of any possible excess in the IRAC and MIPS photometry, we compare them with a grid of SED derived by fitting optical and near infrared photometry data (founded in the literature) with Kurucz's stellar atmosphere models. In figure 1 we report the results for WY Cnc, for which we don't find any excess.

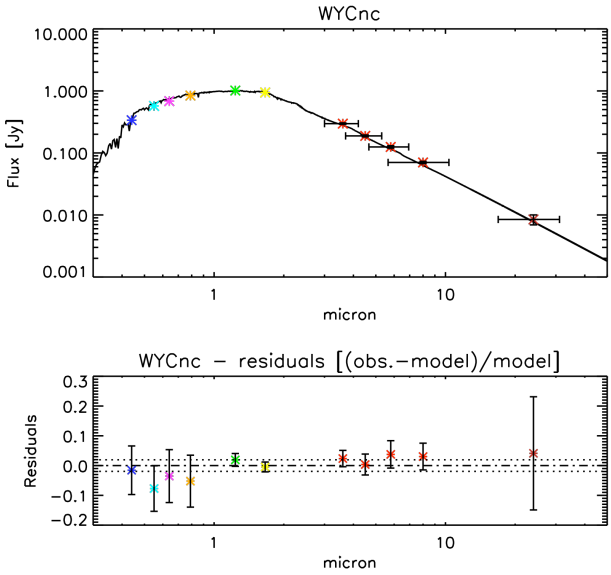

Fig.1 – In the upper panel we show the SED derived for WY Cnc as fit to the optical photometry (blue symbol – B band, cyan – V band, purple – R band, orange – I band, green – J (2MASS), yellow - H(2MASS), red – IRAC, brown – MIPS24). In the lower panel we report the normalized residuals. Dotted lines represent the RMS of the data

FINDINGS

• From the fit: fours binaries, AR Psc, II Peg, UX ARI and XY Uma, show evidence for an excess. In Fig 2 we report the residual obtained from the fit of AR Psc, which clearly shows an excess in both IRAC and MIPS bands.

• Use Montecarlo simulations in order to get the probability of having an excess 'd' given the Kurucz model that fit the optical data. In figure 3 we show such distribution. So, in his case d=1.16=/-0.06 (FWHM), i.e. a 16% flux excess.

• The nature of this excesses is not clear. Possible explanations are long-lived dusty disks, an unexpected episode of significant mass loss at the subgiant Hertzsprung gap phase, or mass loss through stellar winds and condensed coronal mass ejections at rates much higher than currently assumed. Measured IRAC fluxes imply approximate source temperatures of few hundreds degrees.

• Measured disk luminosity is in ~ 3E-2 L_{star} whereas for dusty disks it is typically ~ 1E-5 L_{star} .

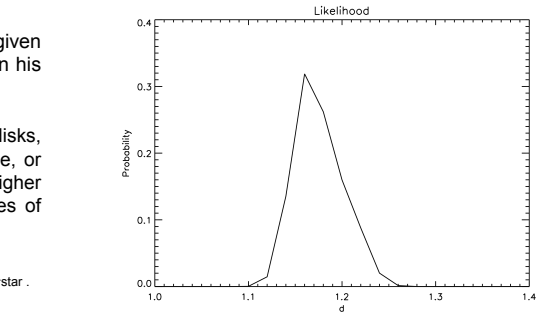

Fig.3 – Likelihood of observing an excess 'd', given Kurucz model that fit AR Psc optical data.

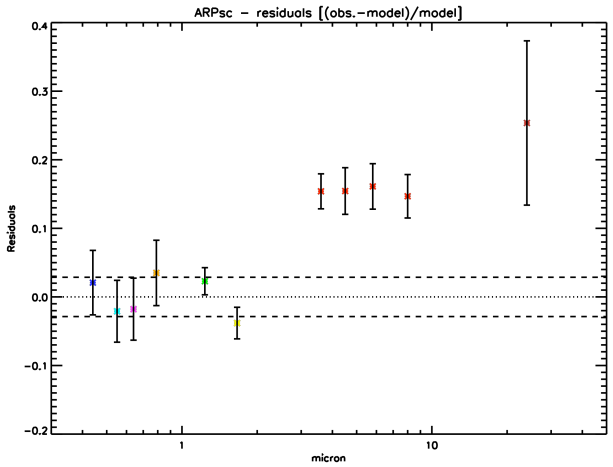

Fig.2 – Residuals obtained for fitting the optical photometry of AR Psc. Symbol as in Fig.1

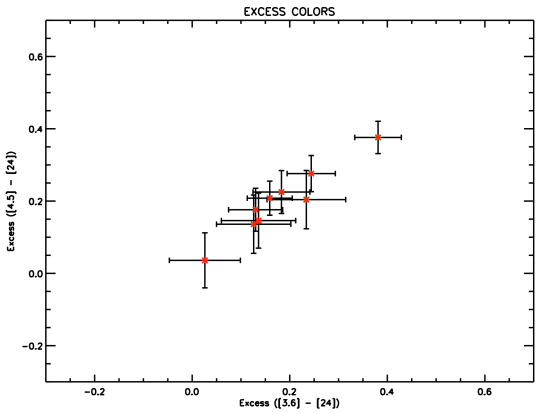

Fig.3 – Excess colors, Models-Observations.