Observatoire de la cote d'Azur

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YSOs

- A mini review of Young Stellar Objects observed with VEGA
- Study of the 51 Oph

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D. Mourard; C. Dougados; G. Lima;

Scientific rationale

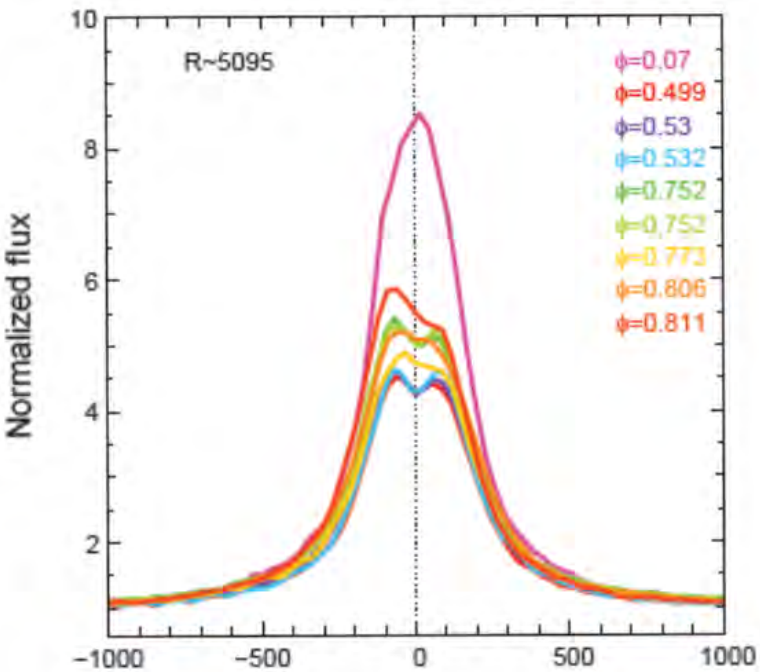
- *Understand the physical mechanism involved around YSOs...*
- *Spatially and spectrally resolved observations of such targets across the Halpha line with VEGA is crucial as it will enable the relative contributions of the accretion and ejection processes to the line formation to be disentangled.*
- *Bring direct spatial constraints on the geometry of the winds, and on the accretion/ejection scenario at scales as small as 0.1 AU.*

Target	Sp. type	L ($L_\odot$)	R_{sub} (AU)	d (pc)	R_{sub} (mas)	Ha line
MWC 361	B2Ve	3000 – 15000	3.7 – 8.4	360	10 - 23	Single- or double-peaked Benisty, Perraut et al. 2013, A&A, 555, A113
AB Aur	A0Ve	~ 50	0.5	144	3.4	(variable) P Cygni profile Perraut et al. 2010, A&A, 516, L1 Lima, Perraut et al. in prep
MWC 275	A1Ve	~ 30000	11.9	122	97	(variable) P Cygni profile
MWC 158	B6V[e]	~ 10000	6.9	500	14	Double-peaked Ellerbroek, Benisty et al. in prep.
MWC 480	A3Ve	~ 10	0.2	170	1.3	(variable) P Cygni profile
51 Oph	B9.5IIIe	~ 260	0.54	131	4	Double-peaked Dunkin et al. 1999

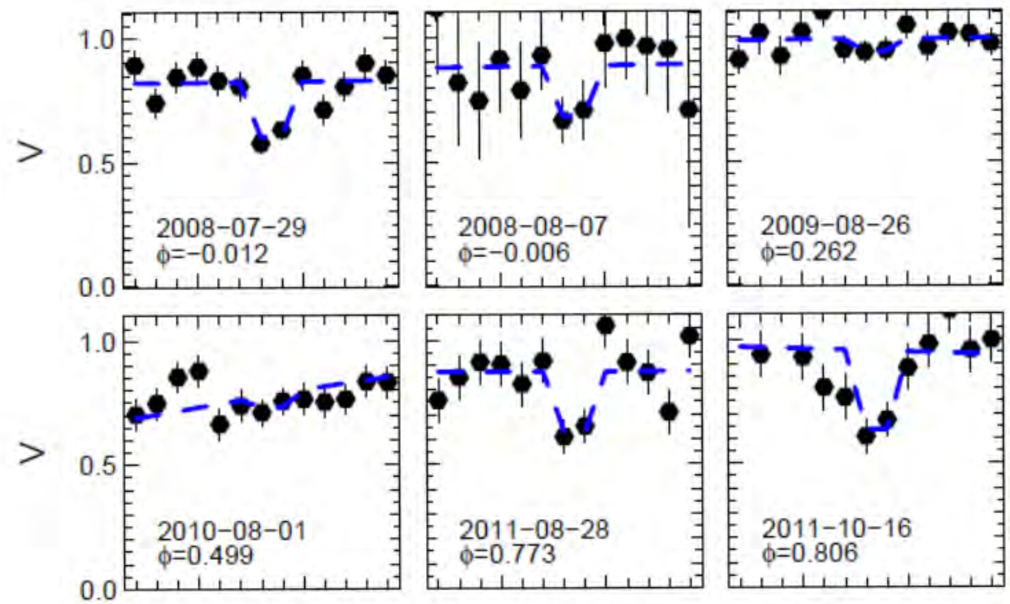
MWC361: enhanced Ha activity at periastron

[Benisty, Perraut et al. A113] 2013, A&A, 555

3-year follow-up of the young binary system MWC361



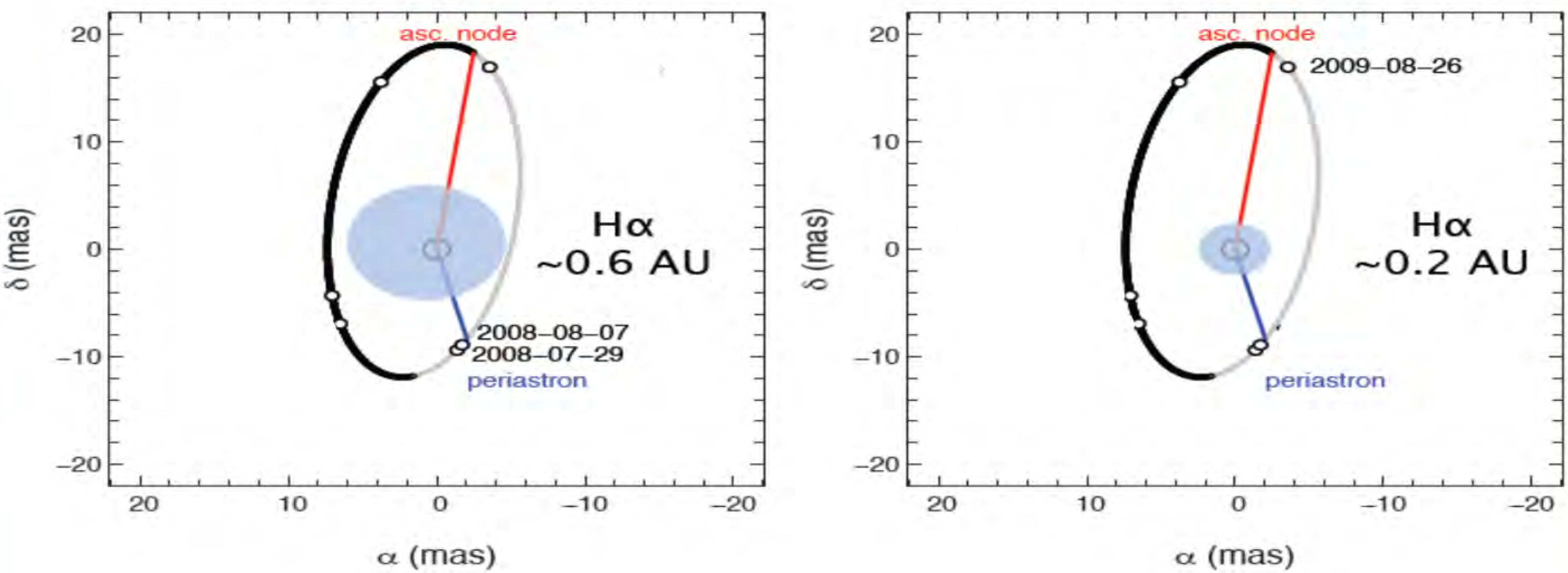
VEGA Ha line over the orbital period



VEGA differential visibilities (S1S2) across the Ha line (observations and best model)

MWC361: an enhanced mass-loss event

[Benisty, Perraut et al. 2013, A&A, 555, A113]

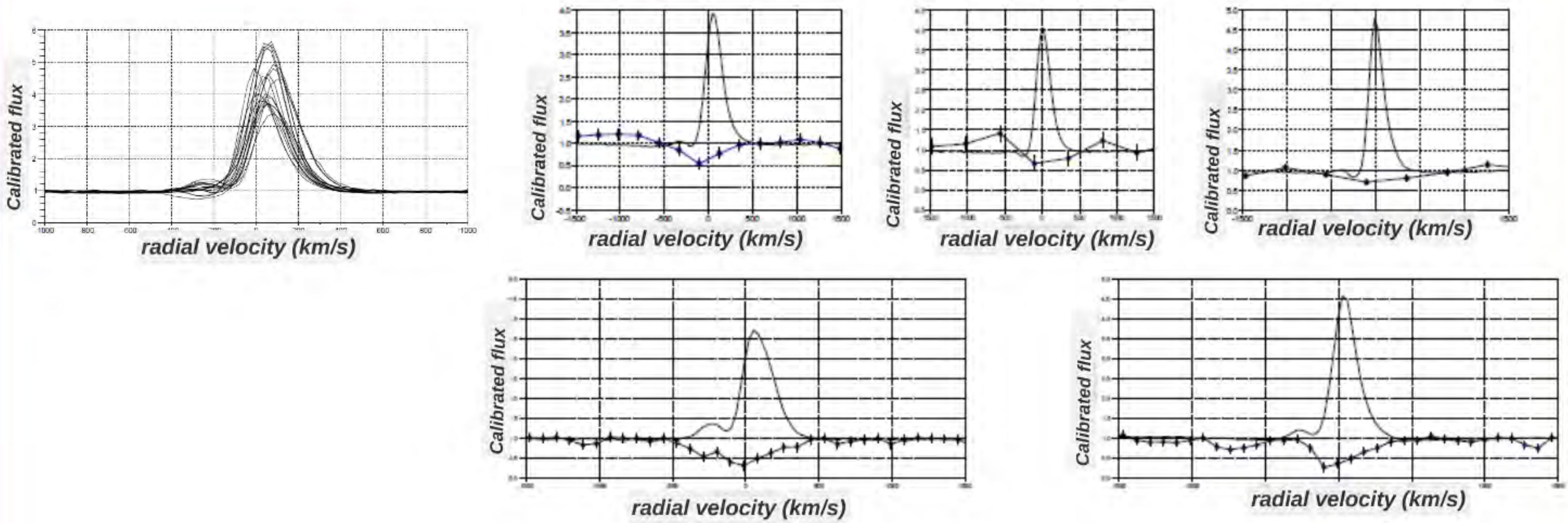


outburst of accretion, followed by a massive ejection, at the periastron

AB Aur: temporal variability

[Lima, Perraut et al, A&A, in prep.]

3-year follow-up VEGA observations:



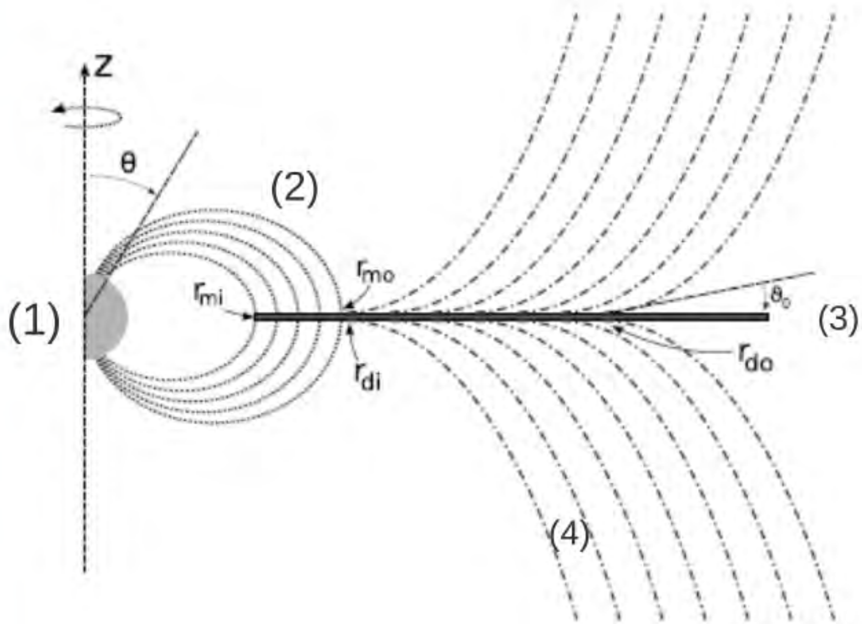
20 Ha VEGA spectra exhibiting a P-Cygni profile and a fast variability mainly in the blue wing

AB Aur: constraining the wind

[Lima et al. 2010, A&A, 522, 104]

Simultaneous fit of (variable) spectra and interferometric data allow to:

- constrain the disk wind
- study of magnetospheric accretion



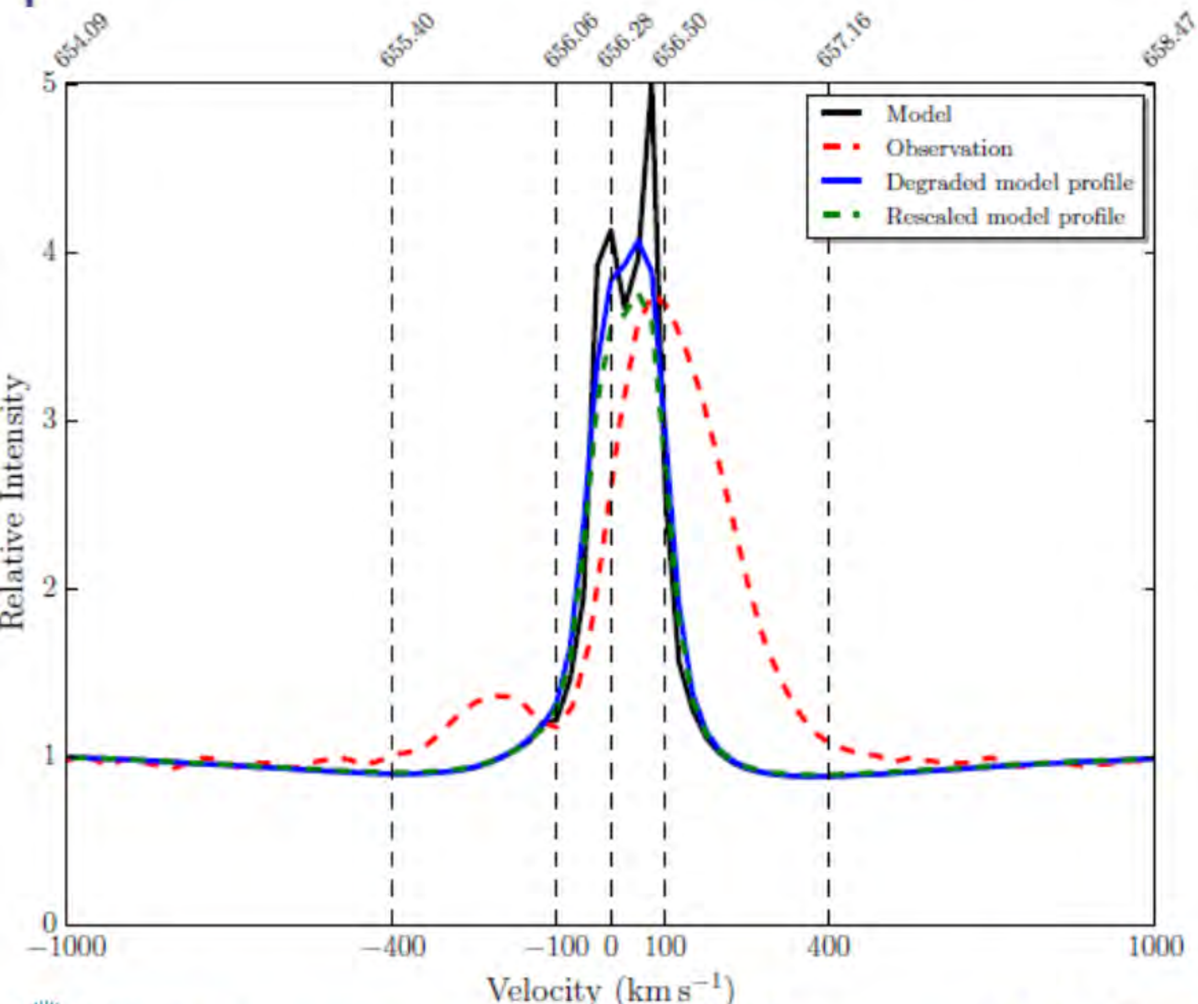
Four components:

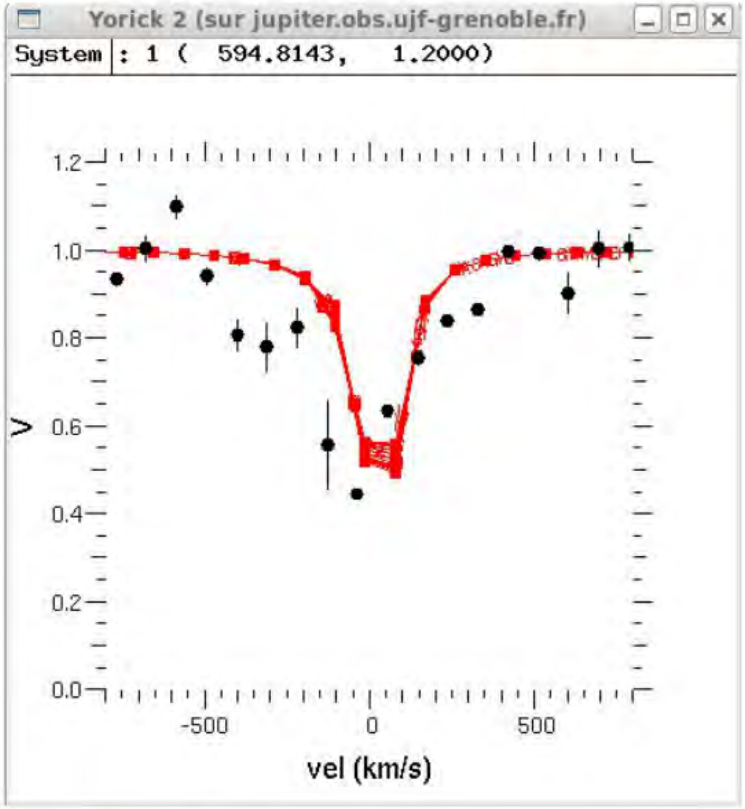
- the star (1)
- the magnetosphere (2)
- the accretion disk (3)
- the disk wind (4)

AB Aur: constraining the wind

i = 30°
Disk wind: Rin = 5 R*, Rout = 25 R*, launching angle = 44°, Teff = 7500 K
Mass loss rate =1.7e-08 Msun/yr without magneto

[Lima, Perraut et al, A&A, in prep.]

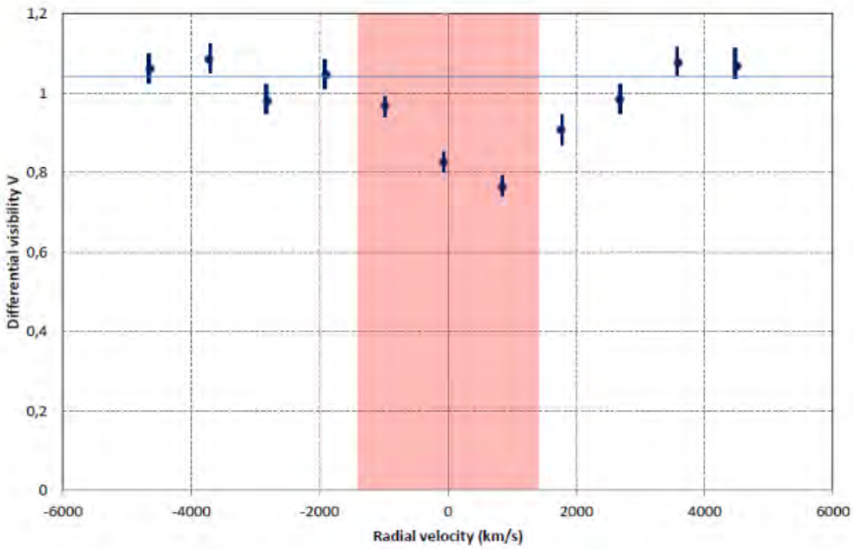




HD50138: resolving the gas disk

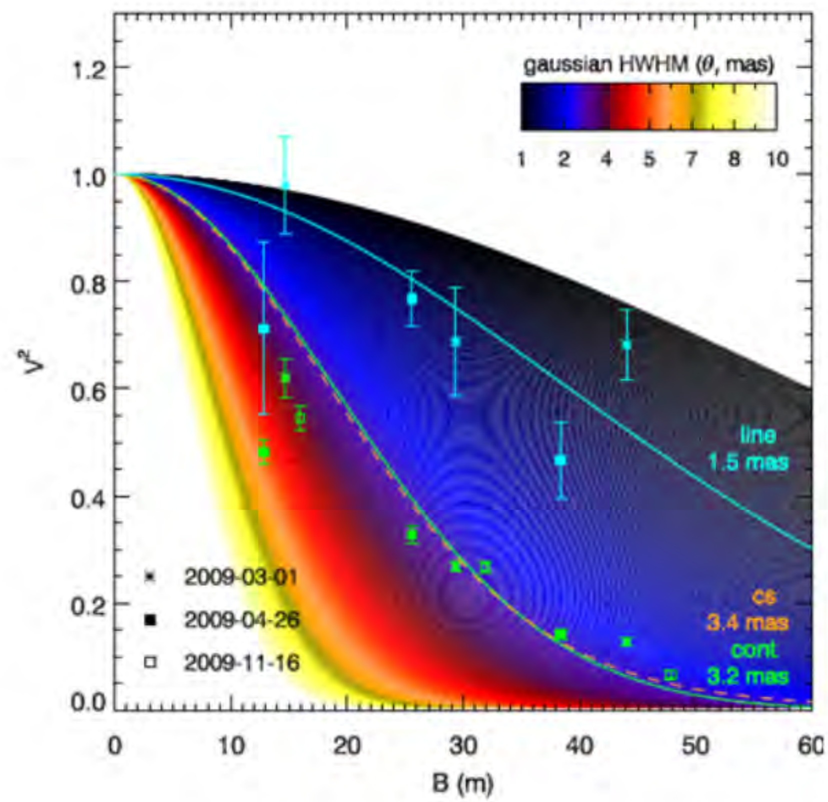
Pre- or post-main sequence B[e] star HD50138

[Ellerbroek, Benisty et al, A&A, in prep.]



VEGA differential visibilities (S1S2) across the Ha line

VEGA data included in a multi-technique, multi-lambda study (X-shooter spectra, AMBER K-band and Brgamma data, PIONIER H-band



IR interferometric data

- ***emission size of ~1-3 mas more consistent with an outflow than accretion***

51 Oph presentation

Altemate name	Spectral type	Distance (pc)	Velocity (v sini) (km/s)	Magnitude (V)	Age (Myr)	Mass (x stellar mass)
HD 158643	*B9.5IIIe*	*131*	*267 ± 5*	*4.83*	*0.3*	*4*

Dunkin et al. 1997

Dunkin et al. 1997

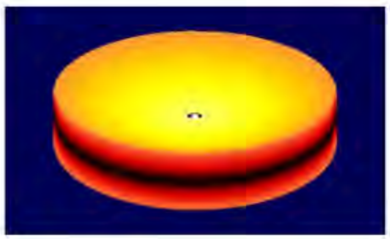
Van den Ancker et al.1998

Mendigutia et al. 2012

Perryman et al. 1997

Evolutionary status of 51 Oph ???

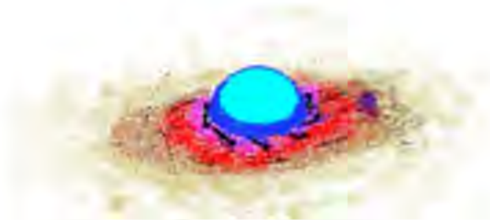
Herbig Ae/Be star???



1) Emission lines
2) Infrared excess
10 micron silicate feature
Presence of circumstellar dust

1) Hot CO emission
2) Lack of near infrared excess

Be star???



1) Fast-rotating
2) Hot molecoular lines emission
3) The compact gaseous disk

IR emission interpreted as due to free-free emission from an ionized high-density envelope around star

Beta Pictoris???

1) Edge-on disk with both gas and dust
2) Variable absorption features suggesting infalling gas and materials
3) Rare nearby example of a young debris disk with gas just entering the late stages of formation

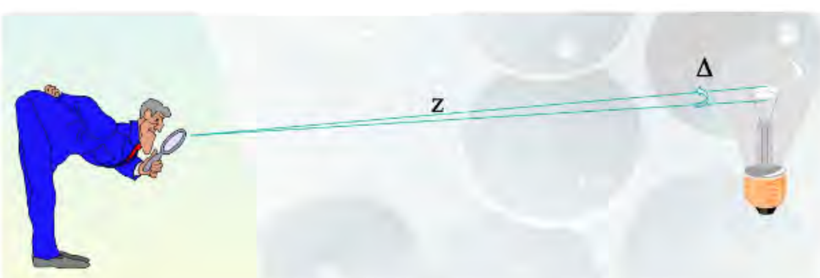
1) Lacking the far infrared-excess bump (No dust detection at 18 μm)
2) Absence of H alpha emission in Beta Pic
3) Beta Pic star age of 8-12 ×10 Myr and mass of 1.75 stellar mass

VEGA Observations:

May (2013) → **E1E2W2; Run: VEGA MR: In continuum**

July (2013) → ***S1S2; Run : VEGA MR : H alpha (two points)***

July (2013) → **W1W2; Run : VEGA MR: poor quality**

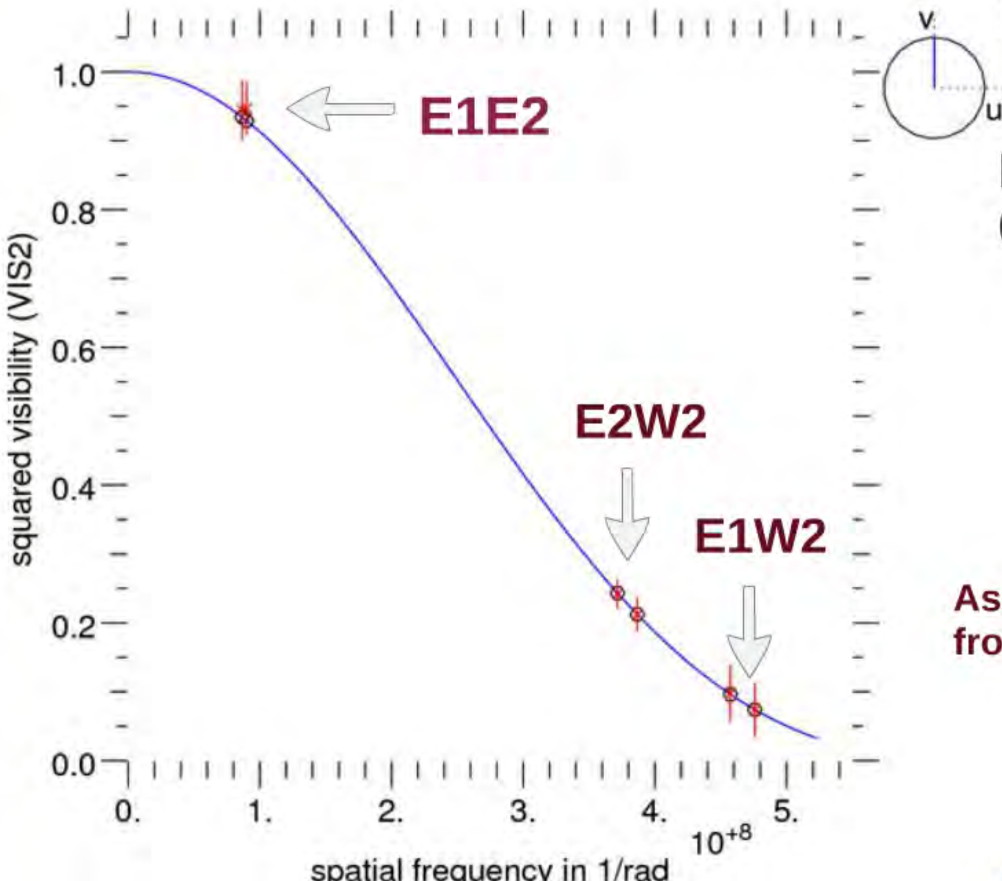


→ **Fundamental parameters of thes star**

→ **Study of the gaseous disk**

Data process in continuum neighbored Halpha

Results of first processing:



From data obtained in May 2013,

Estimated angular diameter: 0.39 +/- 0.01 mas

Assuming all flux in the continuum comes from the central star

Calculating the effective temperature:

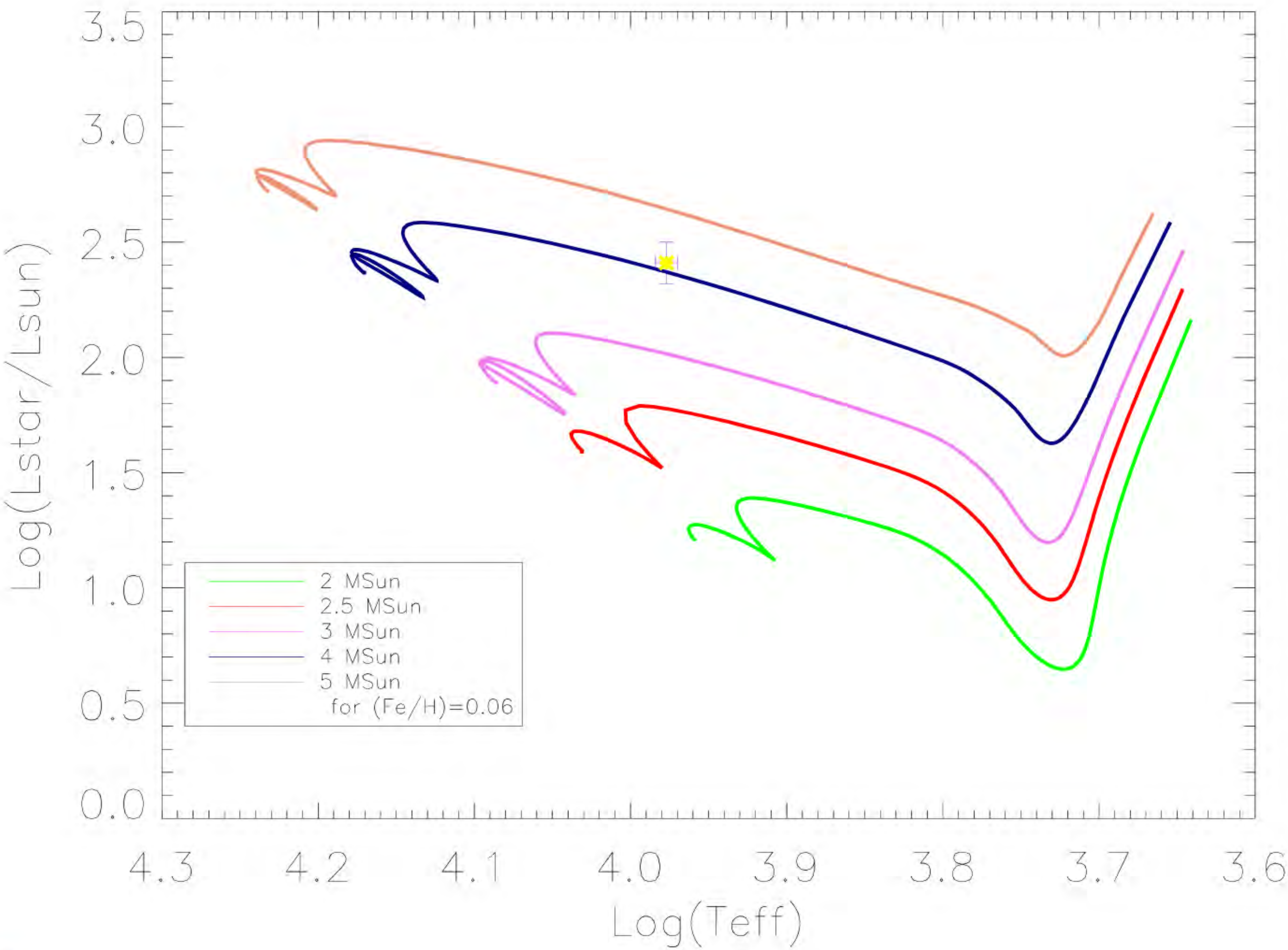
First estimation

$$T_{eff} \sim \left(\frac{L_\star}{4\pi{\theta_{LD}}^2 d^2 {R_\odot}^2 \sigma}\right)^{1/4}$$

T_eff= 9500 +62/-53 K

Estemated with angular diameter in one direction...

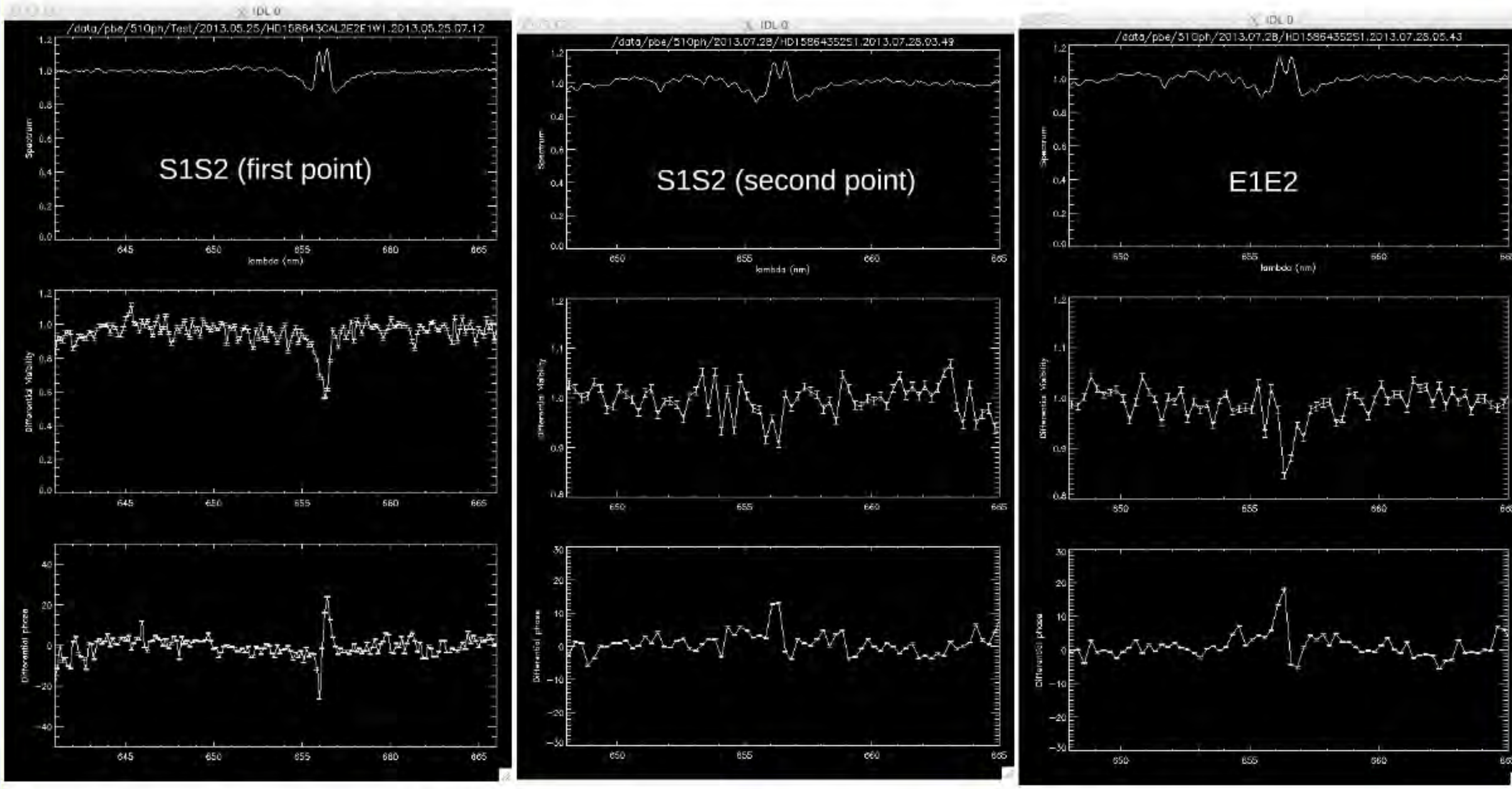
L (star)= 260 +60/-50L (sun) ; (Thi et al . 2013)
d=131 +/- 4 pc (Perryman et al. 1997)


3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Log(Lstar/Lsun)
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
Log(Teff)
2 MSun
2.5 MSun
3 MSun
4 MSun
5 MSun
for (Fe/H)=0.06

Results of second processing:

Processing for:

- data obtained in May (baseline E1E2; 1 point)
- data obtained in July (baseline S1S2; 2 points)

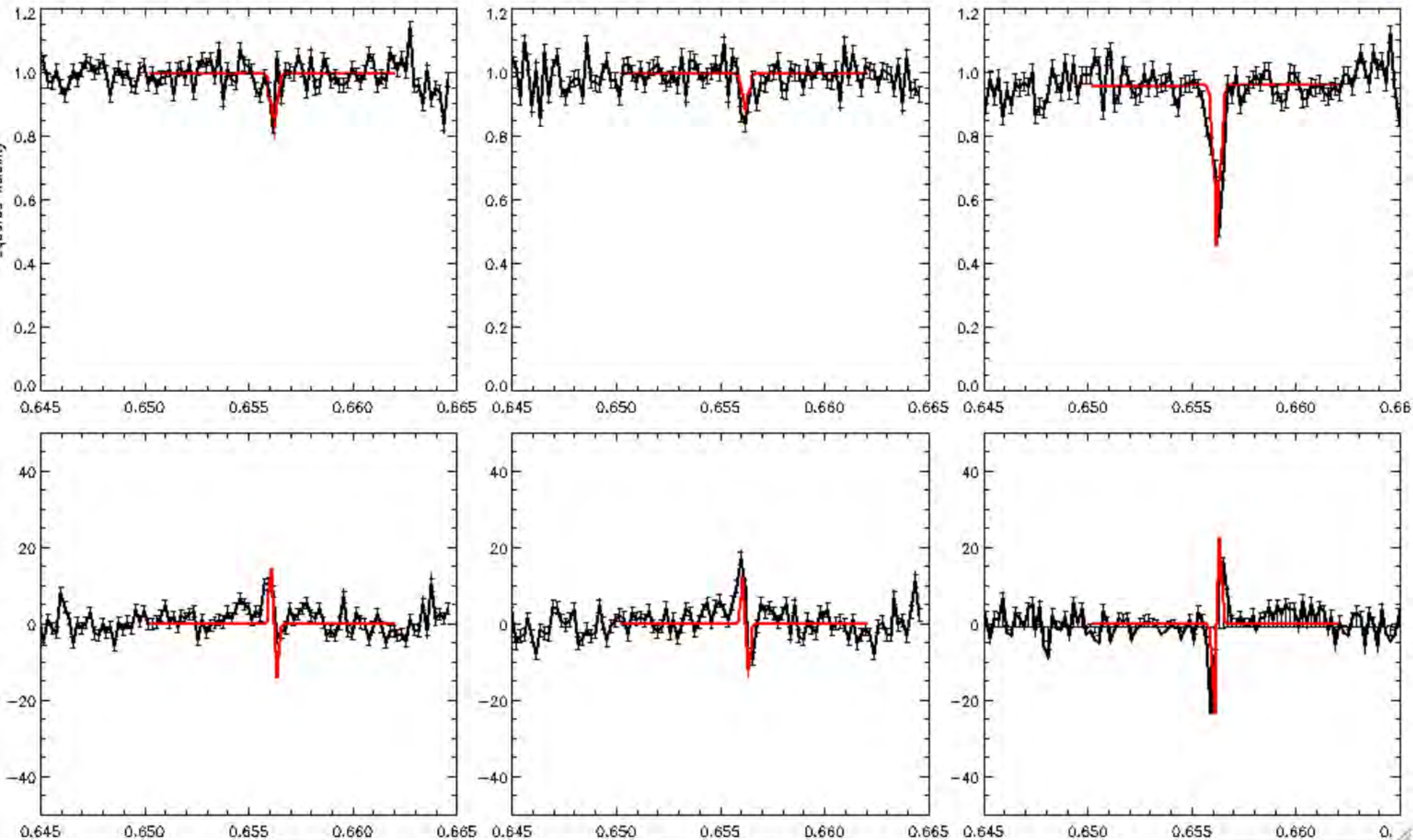


Are VEGA data consistent with a keplerian disk?

We use: **Keplerian and uniform disk model**

Free parameters:

1) Inclination
2) P.A.
3) Major-axis FWHM in the continuum
4) Major-axis FWHM in the line



Prezi

Derived information:

For star:

1) The angular diameter= 0.39 +/- 0.01 mas

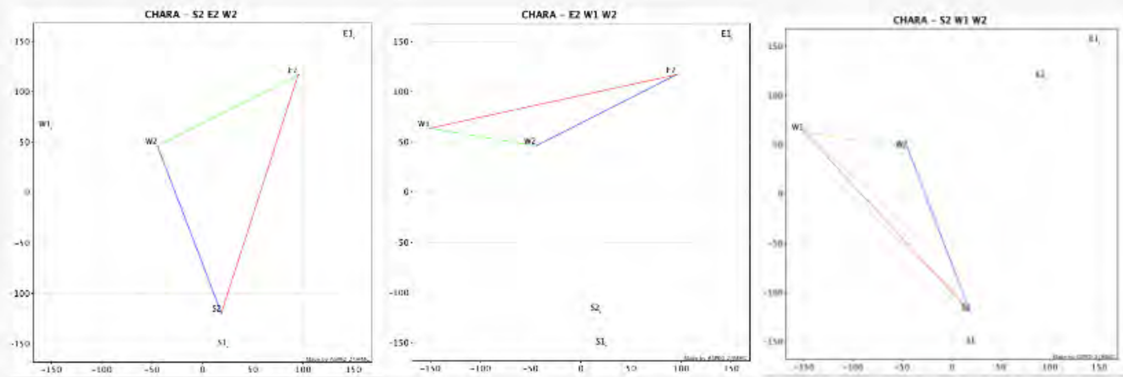
2) First estimation of the effective temperature= 9500 +62/-53 K

For gaseous disk:

1) *Gaseous disk is keplereian* → According with Thi et al. 2005
2) *i=88* → According to (Gil et al . 2006) and (Tatulli et al. 2008)

3) P.A. = 197 ✗ *In Tatulli et al 2008* → *P.A=129*
4) FWHM in the continuum= 3 stellar diameter
5) FWHM in the line= 10 stellar diameter

New observations 2014:



First run: E2S2W2 or W1W2E2 or W1W2S2;
VEGA MR : Continuum

To constrain the photosphere (extension and flattening) of this close-to-critically rotating star

Second run: VEGA MR: Halpha S1S2; E1E2; W1W2

To improve our knowledge on the gaseous disk geometry and kinematics and confirm the estimated parameters of the keplerian disk

Conclusions:

For YSOs studies:

1) Importance of adding the IR data in muliti wavelengths to visibile interferometric data

2) New constrains to modelize the physics involved (wind, accretion, magnetospheric) models.