AMBER-VLTI high spectral resolution observations of Herbig AeBe stars

R. García López[1]

A. Caratti o Garatti[1], L.V. Tambovtseva[2,3], D. Schertl[2], V.P. Grinin[2,3,4], K.-H Hofmann[2], G. Weigelt[2], S. Kraus[5]

[1] Dublin – Institute for– Advanced – Studies
[2] Max–Planck– Institut für Radioastronomie
[3] Pulkovo Astronomical Observatory of the Russian Academy of Sciences
[4] The V.V. Sobolev Astronomical Institute of the St. Petersburg University
[5] University of Exeter

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La Laguna, Tenerife, Jun 25, 2015

Outline

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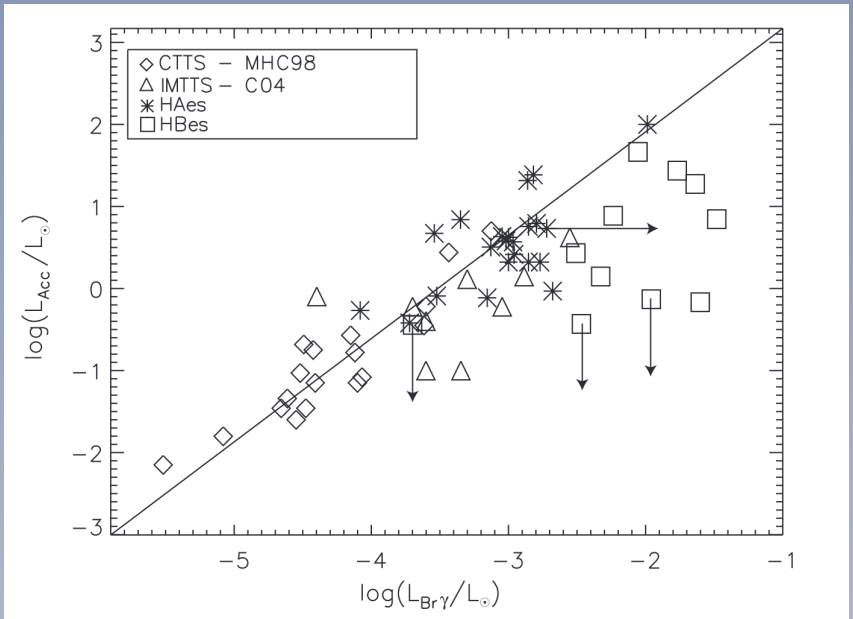
The Brγ line

- Used to measure **accretion rates** in BDs, CTTSs, IMTTSs and Herbig AeBe.



Donehew et al. (2011)

$$\log(L_{acc}/L_{\odot}) = (0.9 \pm 0.2)\log(L_{Br\gamma}/L_{\odot}) + (3.3 \pm 0.7)$$

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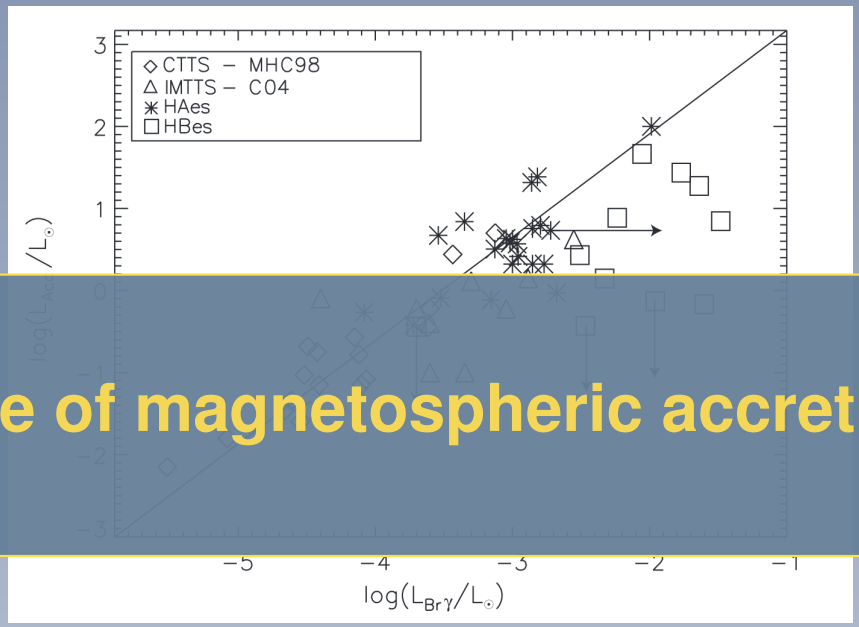

Trace of magnetospheric accretion?

Donehew et al. (2011)

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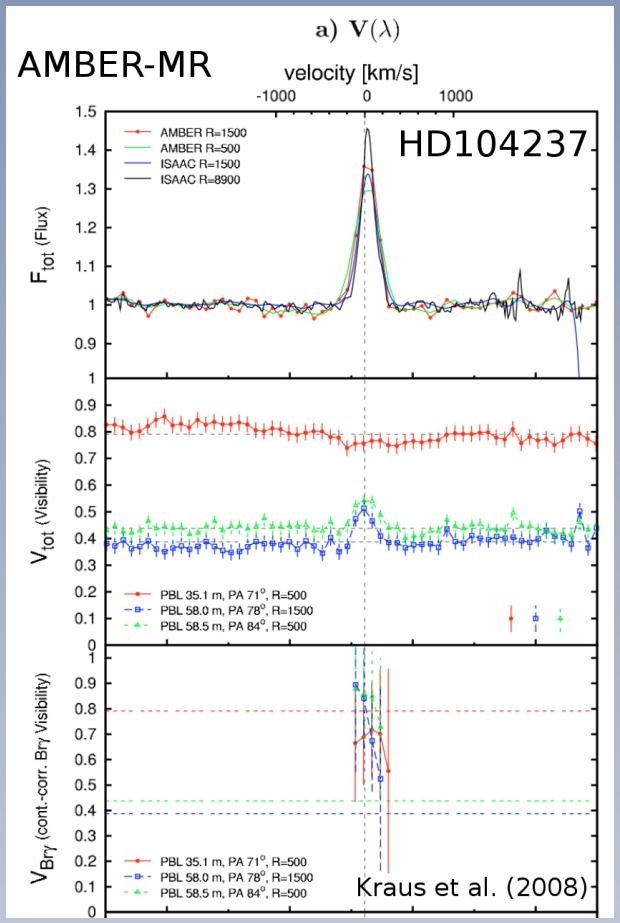
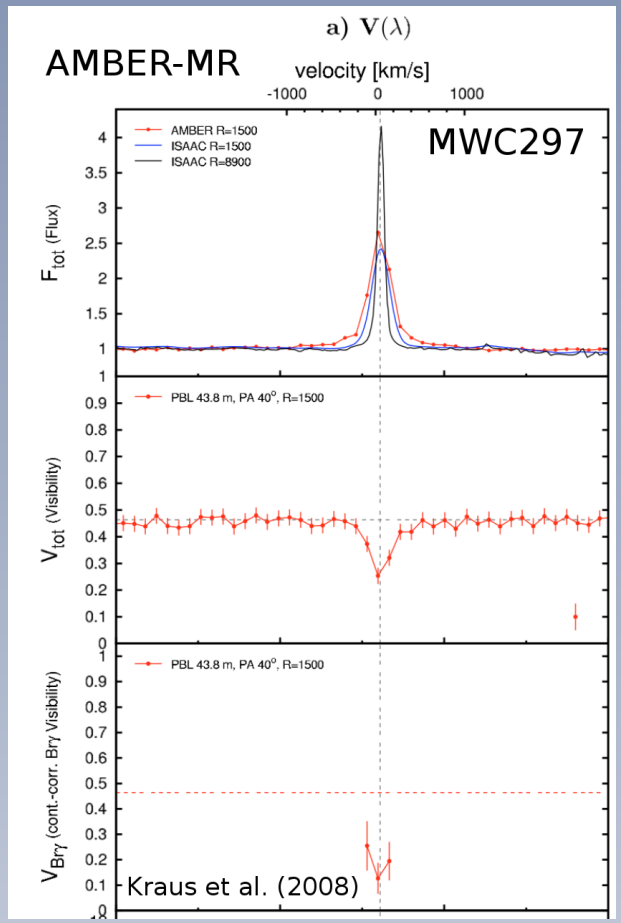
Brγ spectro-interferometric observations

- Different sizes of the Brγ line emitting region



visibility = size

lower visibility
⇓
more resolved



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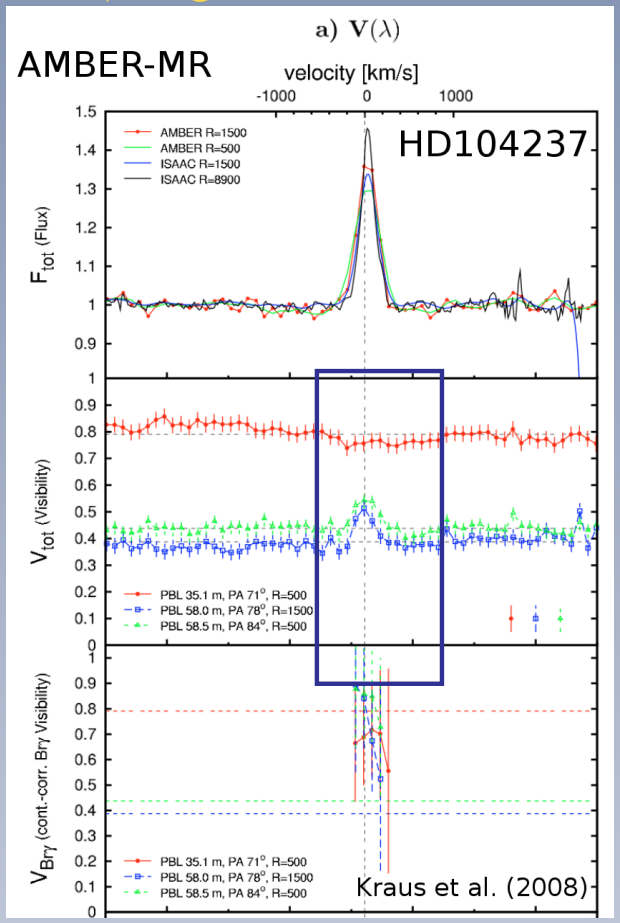
Brγ spectro-interferometric observations

- Different sizes of the Brγ line emitting region

Brγ region $<$ continuum



visibility = size

lower visibility
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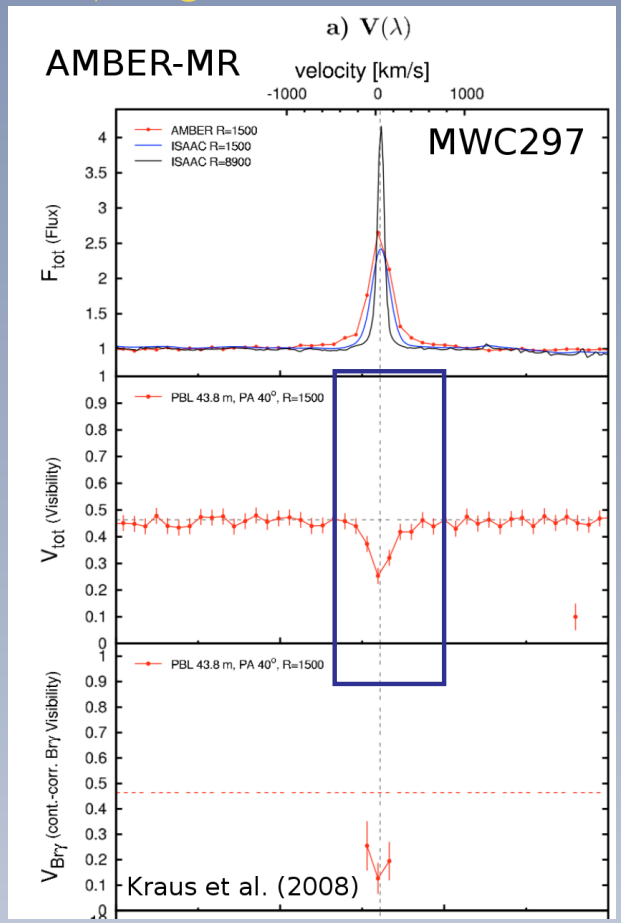
Brγ region $>$ continuum



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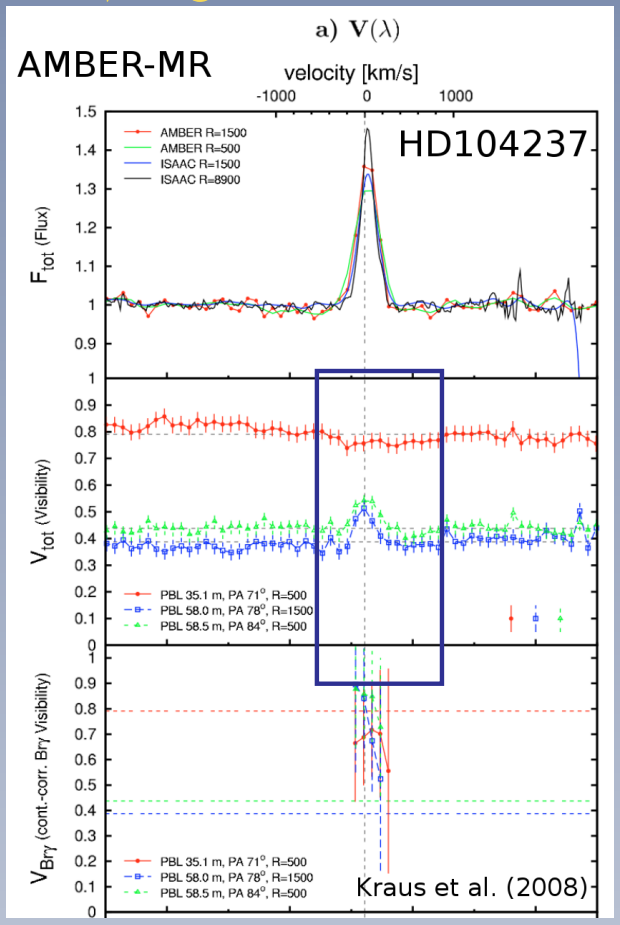
Brγ spectro-interferometric observations

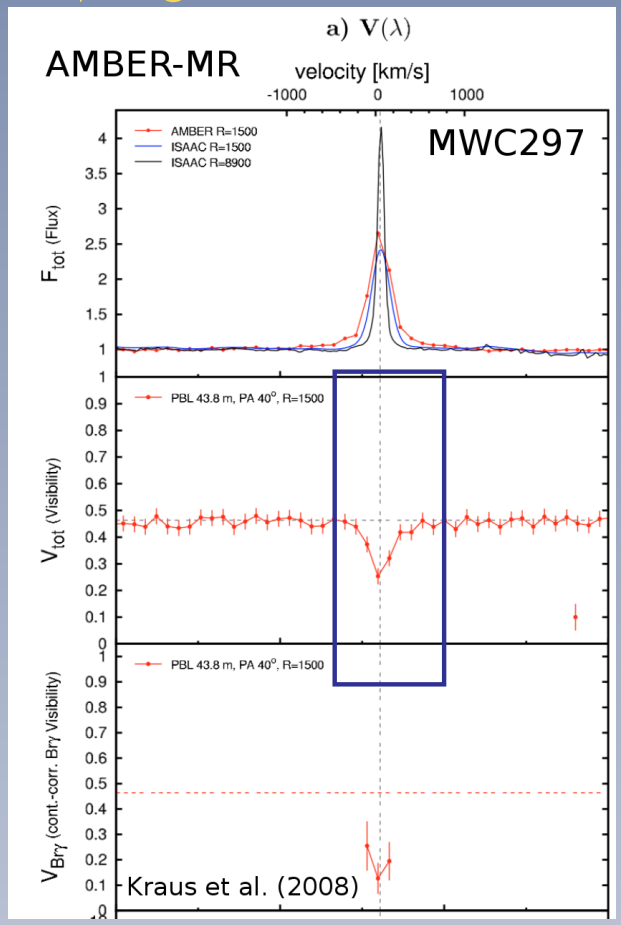
Brγ region < continuum



← compact emission:
inner disc emission,
magnetospheric accretion?

extended emission: →
disc-, X-, stellar-wind?

Brγ region > continuum



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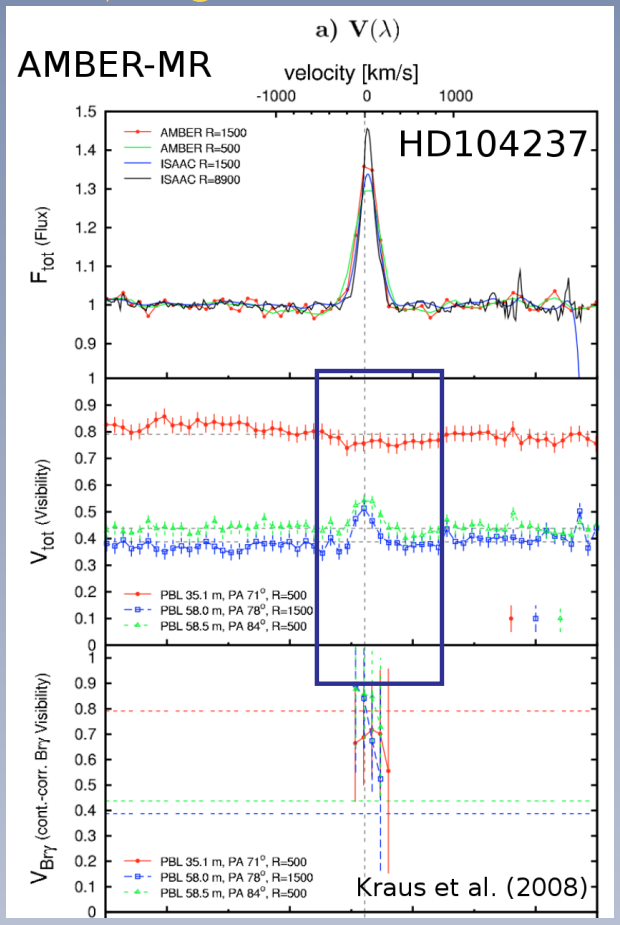
Brγ spectro-interferometric observations

Brγ region < continuum



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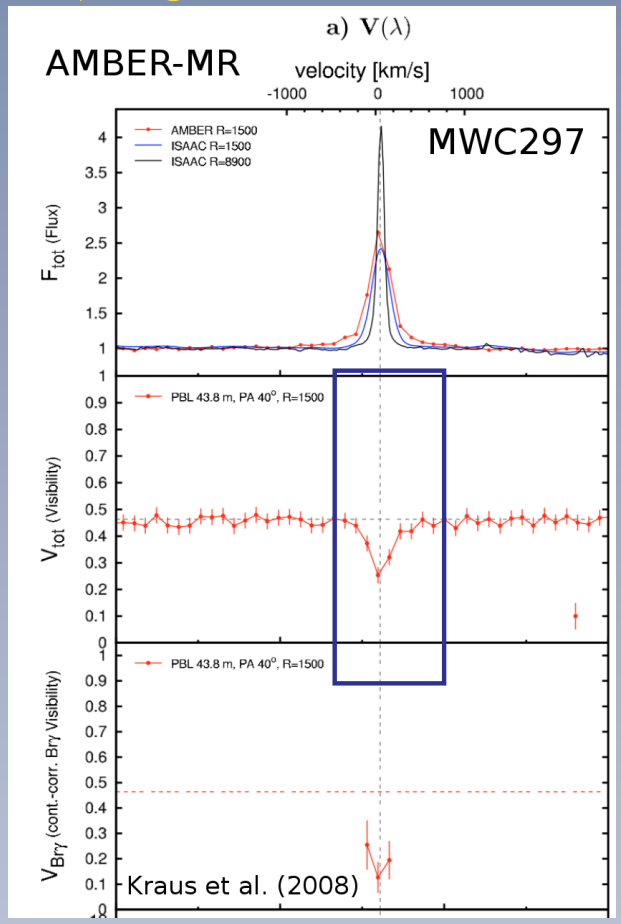
Physical mechanism?:

- Good modelling
- AMBER-HR

Brγ region > continuum



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The Herbig AeBe stars HD163297 and HD98922

Table : stellar parameters

Source	SpT	d (pc)	R_* ($R_\odot$)	M_* ($M_\odot$)	$\dot{M}_{acc}$ ($10^{-7} M_\odot/yr$)	$\dot{M}_{out}$ ($M_\odot/yr$)
HD163296	A1V	119	2.3	2.2	0.8 – 4.5*	5×10^{-10}–2×10^{-7}
HD98922	B9V	440	7.6	5.2	9±3	

* Range of $\dot{M}_{acc}$ values reported in the literature (see references in table) derived from the luminosity of the Brγ line.
** The first and second values correspond to the atomic ([SII], [OI]) and molecular (CO) jet/outflow components.

References: Garcia Lopez et al. 2015; Caratti o Garatti et al. 2015.

- AMBER Brγ spectro-interferometric observations at R$\sim$12 000:

  $\sim$30 spectral channels accross the Brγ line

- **Configuration:** UT2-UT3-UT4.

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The Herbig AeBe stars HD163297 and HD98922

Sou

HD16
HD98

*

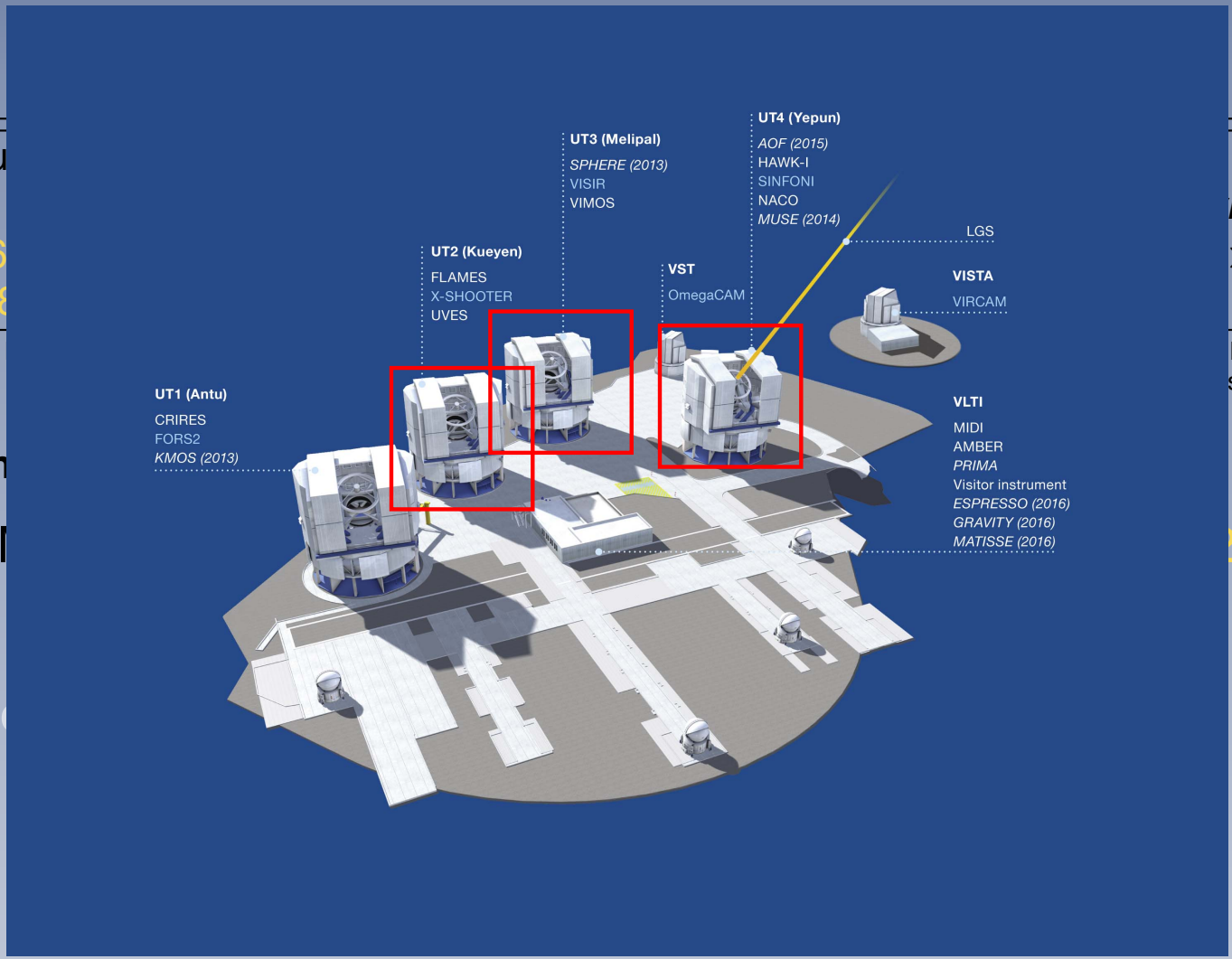
r)
$\times 10^{-7}$

line.
s.

Referen

- Al
- C

2 000:



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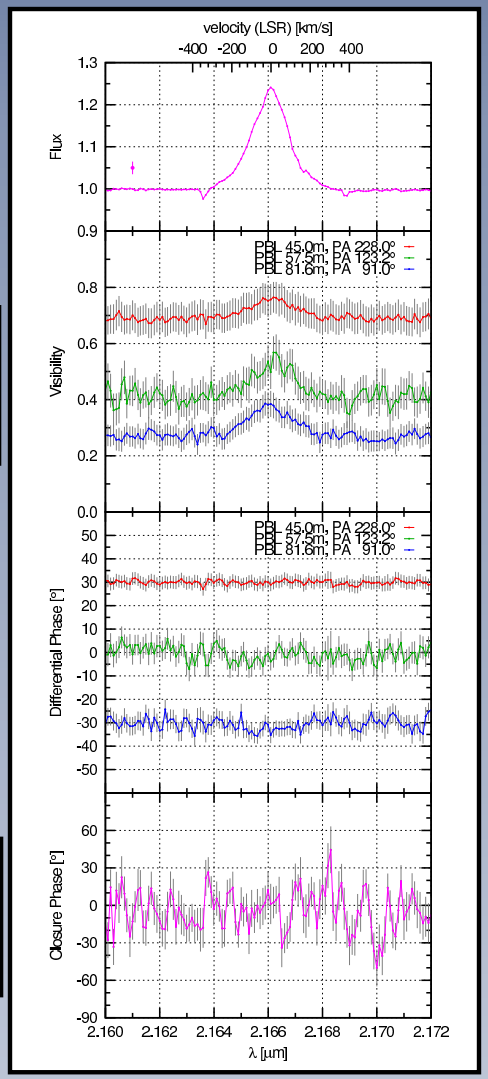
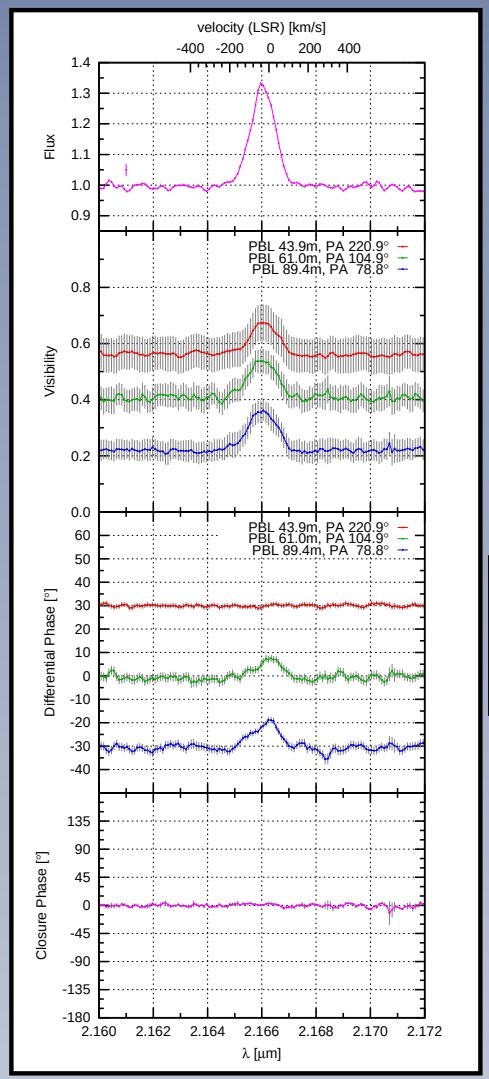
- - HD163297 -and- HD98922 - -

line > continuum

diff. phase < 5^o

closure ph. $\sim 0^o$





line > continuum

diff. phase $\sim 10^o$

closure ph. $\sim 0^o$

Garcia Lopez et al. (2015); Caratti o Garatti et al. (2015)

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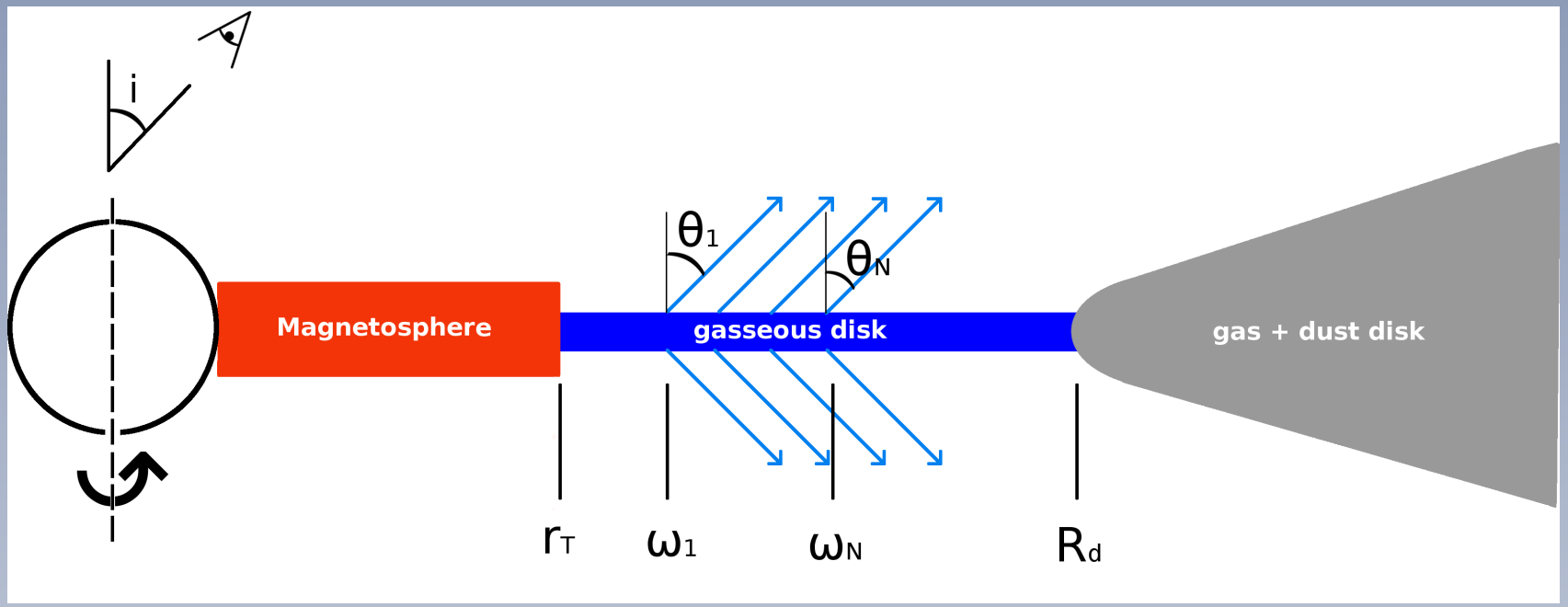
Our model

Contributions:

- continuum emission: star + disc
- line emission: disc wind + (magnetosphere)



More details in: Weigelt et al. (2011); Tambovtseva et al. (2014); Garcia Lopez et al. (2015)

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Modelling results: disc wind emission

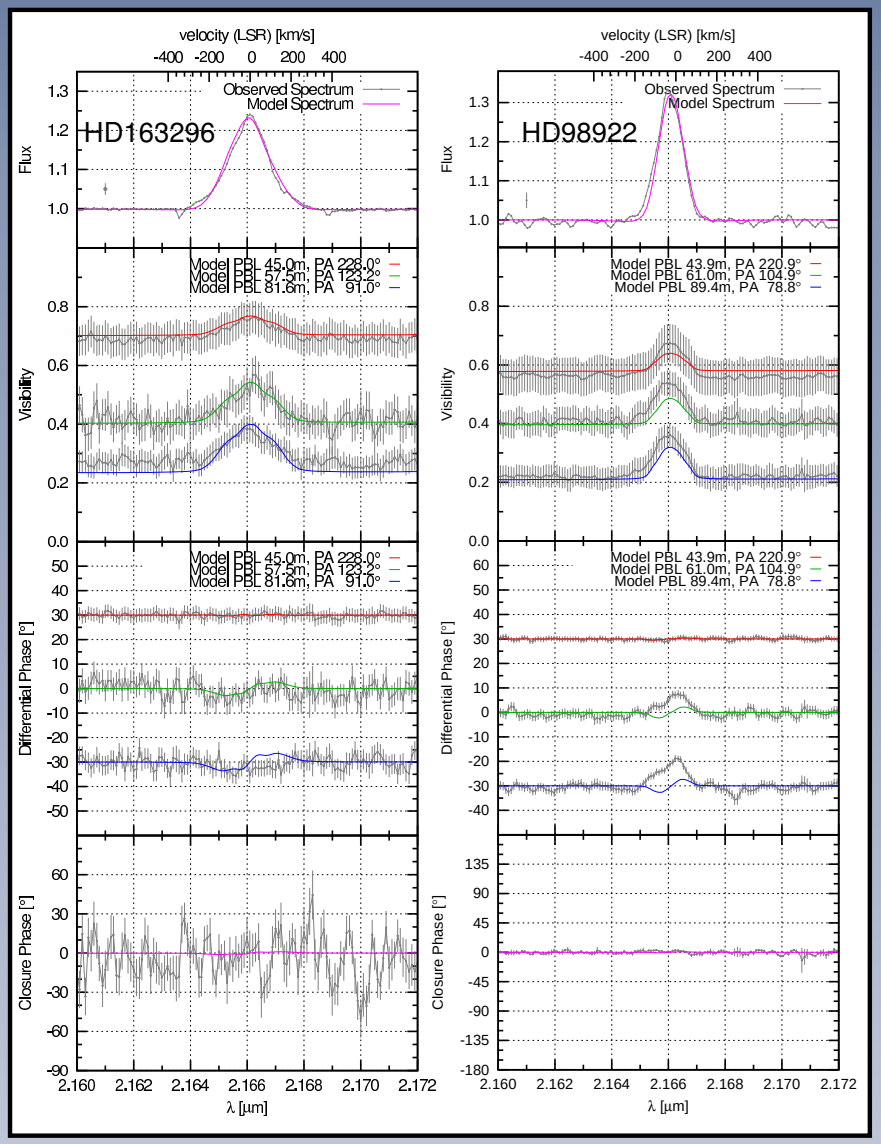

Table : Disc wind model parameters

	HD163296	HD98922
Temperature (K)	10 000	10 000
Half opening angle (θ)	45°	30°
Inner radius (ω_1 (R$_*$))	2.0 (0.02 AU)	3.0 (0.1 AU)
Outer radius (ω_N (R$_*$))	4.0 (0.04 AU)	30.0 (1 AU)
Acceleration parameter (β)	5	5
Mass load parameter (γ)	3	3
Mass loss rate ($\dot{M}_W$ (M$_\odot$/yr))	5×10^{-8}	2×10^{-7}

Garcia Lopez et al. (2015); Caratti o Garatti et al. (2015)

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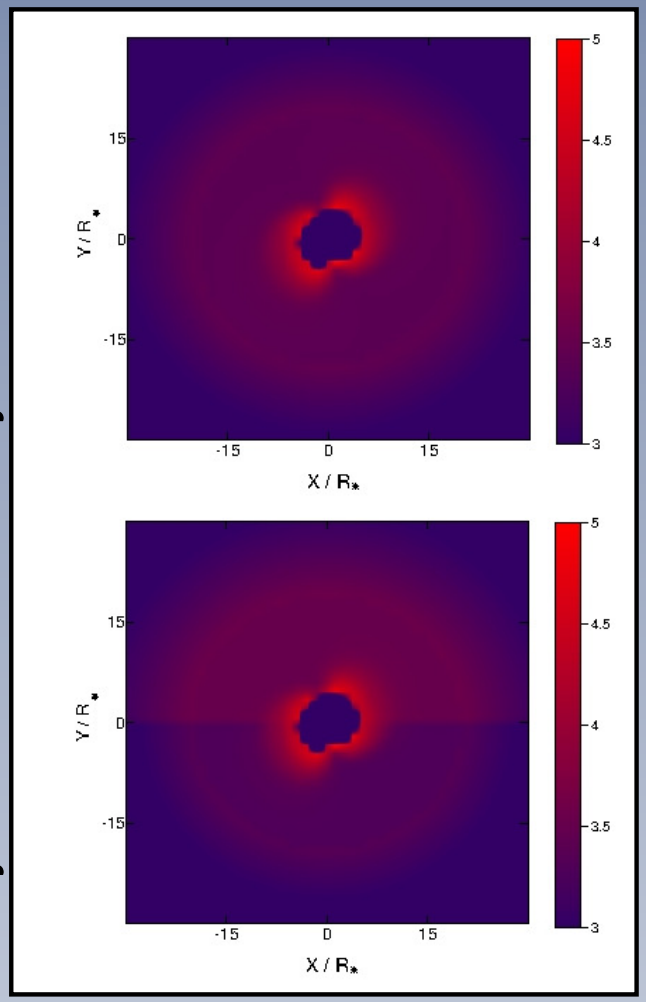
HD98922: an asymmetric disc

symmetric disc

asymmetric disc



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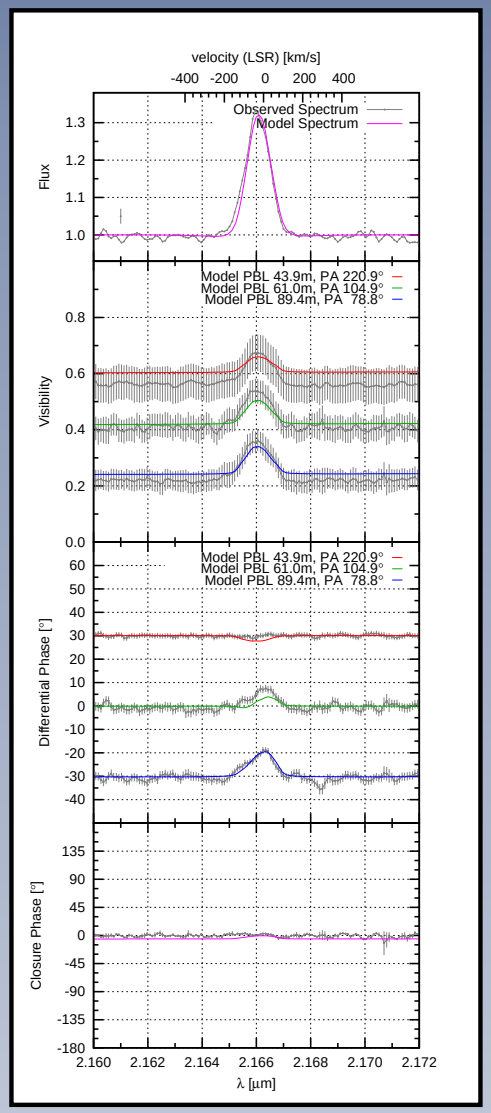

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Conclusions

- **Visibility increases across the Brγ line** in HD 163296 and HD98922.
  - Line emitting region is smaller than the continuum emission region.
- Our modelling suggest that the Brγ line mostly originates in a **Disc wind**.
  - The Brγ line profile and interferometric observables are reproduced:
    - HD 163296: Disc wind + symmetric disc continuum + stellar continuum
    - HD 98922: Disc wind + asymmetric disc continuum + stellar continuum