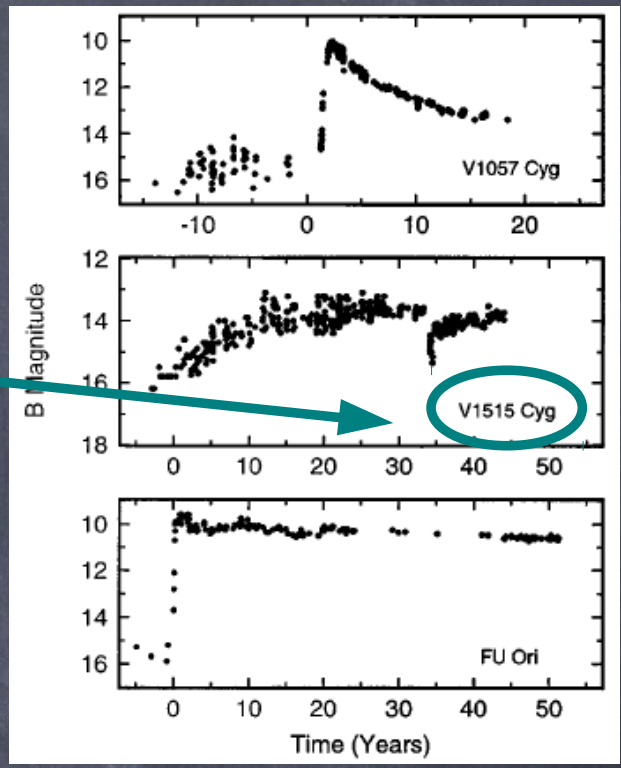
Optical analysis of the FU Ori star V1515Cyg

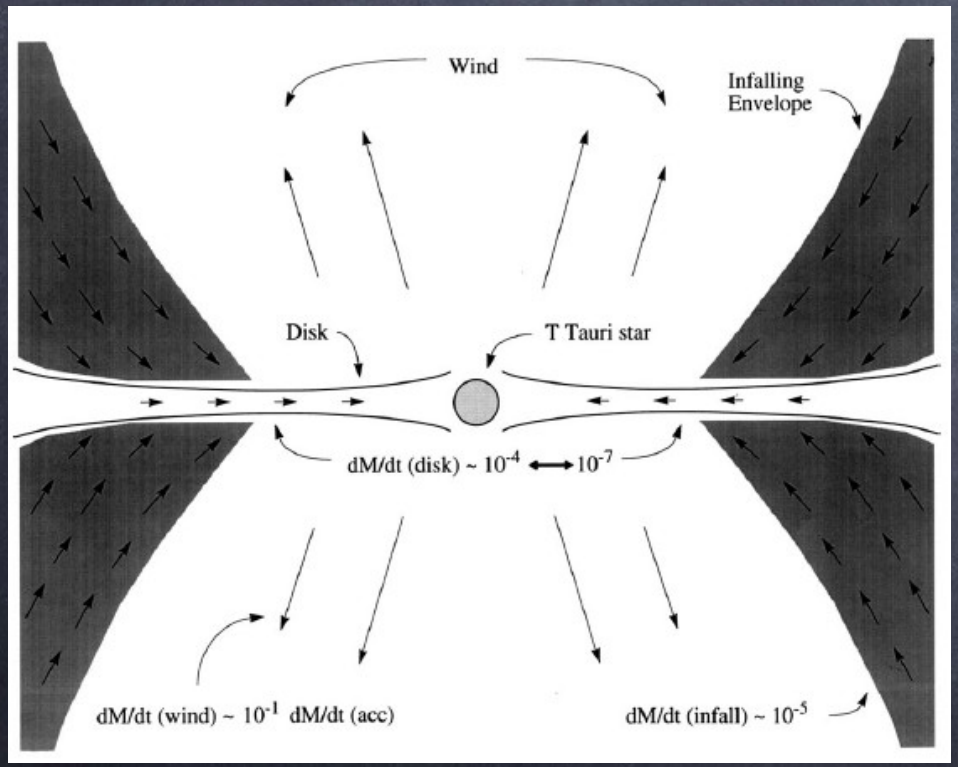
Vanessa Agra-Amboage

Faculdade de Engenharia da Universidade do Porto (FEUP) – SIM
Unidade FCT
Postdoctoral FCT Fellowship

Collaborators:
Paulo J. V. Garcia (FEUP - SIM)
Catherine Dougados (Institut de Planetologie et d'Astrophysique de Grenoble)
Sylvie Cabrit (Observatoire de Paris)

- Important outburst increasing in luminosity about 5 mags and changing their spectral type in short time-scales

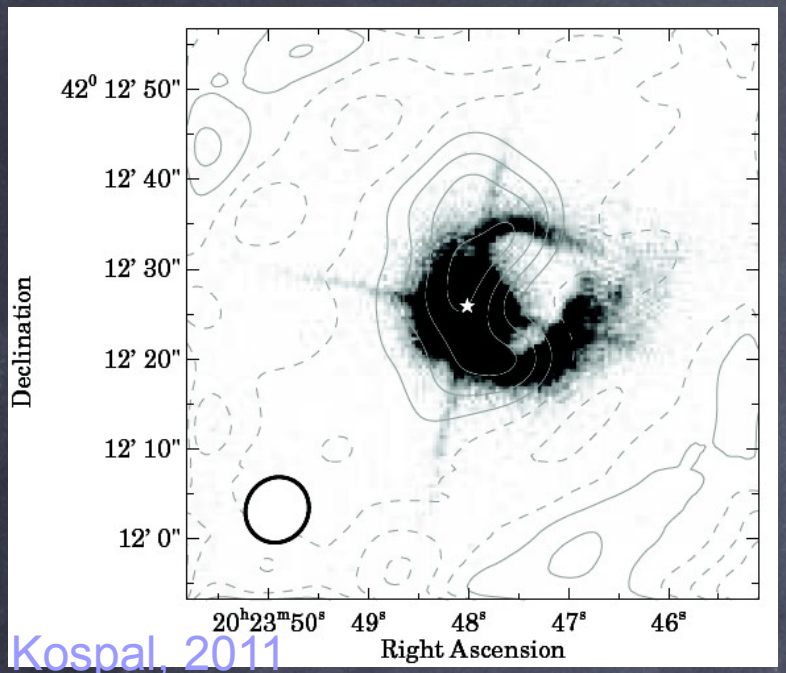




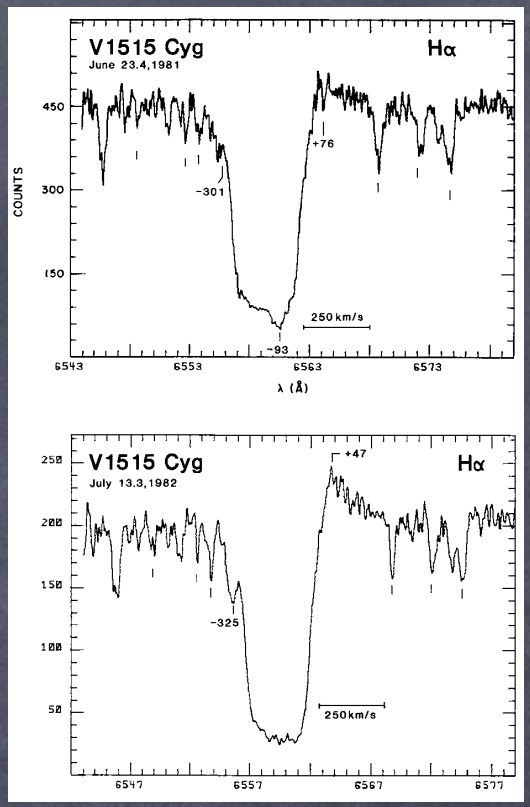
(Hartmann & Kenyon 1985, 1996)

- Current models associates the FU Ori flares to abrupt mass transfer (from 10^{-7} $M_{\odot}yr^{-1}$ (low Ttauri state) to 10^{-4} $M_{\odot}yr^{-1}$ (high Fuori state)) from an accretion disc onto a young, low mass T Tauri star.

- Inside a large scale nebula



Kospal, 2011

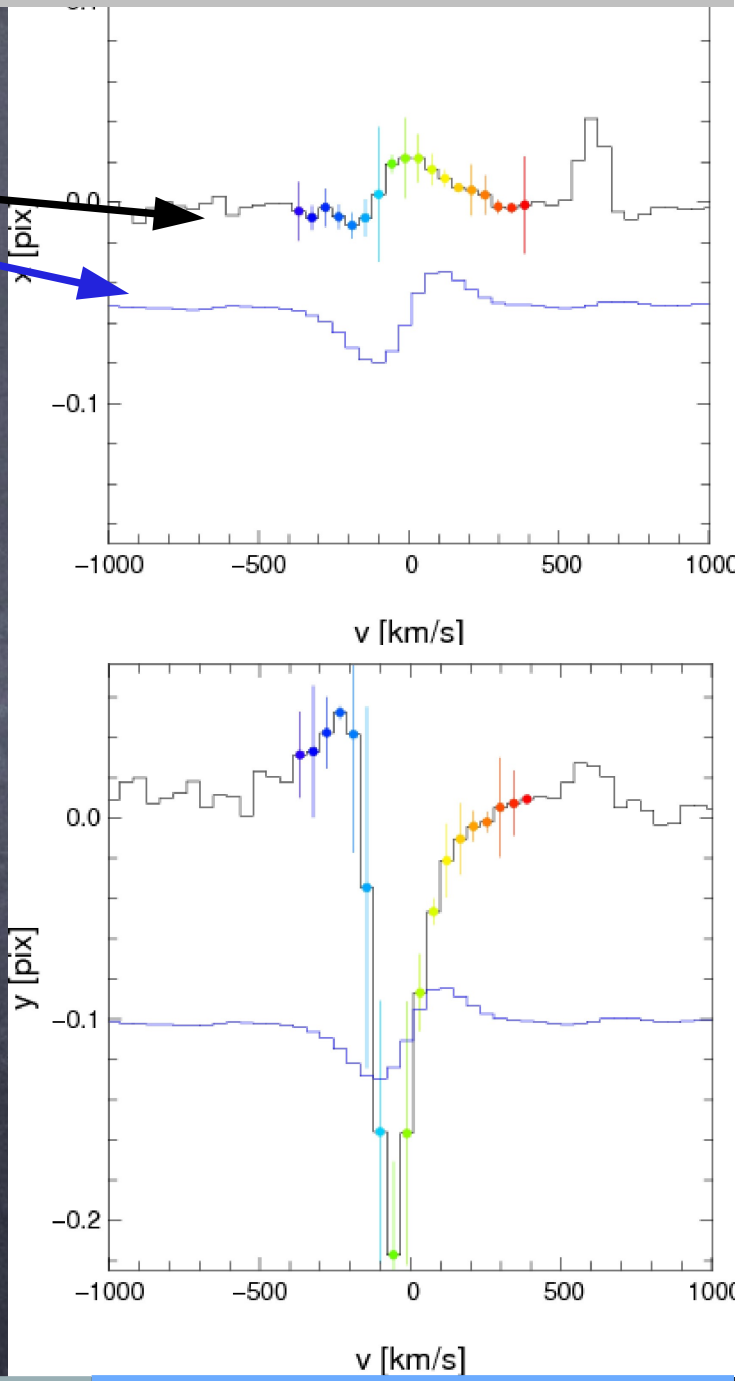


Bastian & Mundt (1985)

- Sings of accretion and outflows in early works:
  - P Cygni profiles in Hα
  - M_{dot} ~10^{-5} M_{sun}/yr

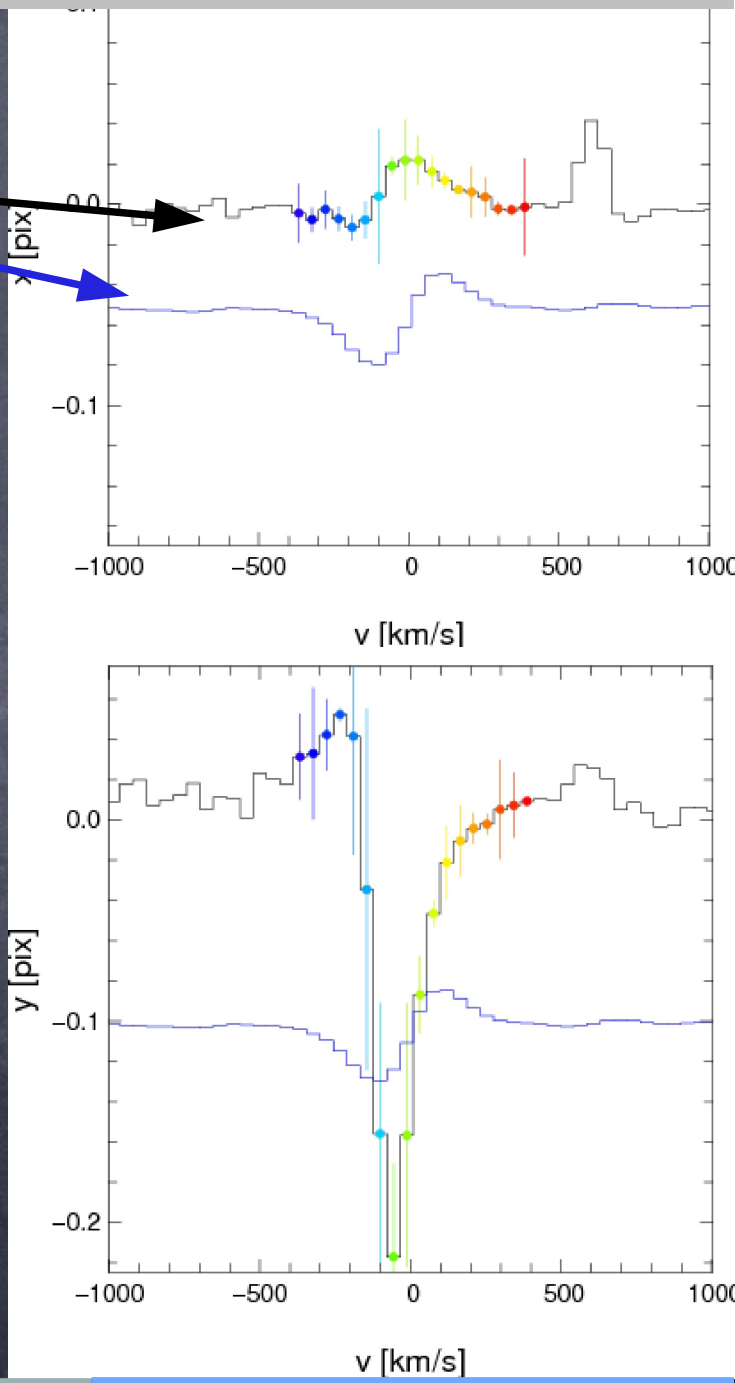
(Croswell et al. (1987); Kenyon et al. (1991))

- Blue: H_α profile
- Black: Spectro-astrometric signal
- P Cygni profile traces ejection activity
- Spectral-analysis in both spatial directions
- Significant signal observed in the vertical direction
- No detection in the horizontal direction
- No detection in PV diagrams nor channel maps



- Blue: H_α profile
- Black: Spectro-astrometric signal
- P Cygni profile traces ejection activity
- Spectral-analysis in both spatial directions
- Significant signal observed in the vertical direction
- No detection in the horizontal direction
- No detection in PV diagrams nor channel maps

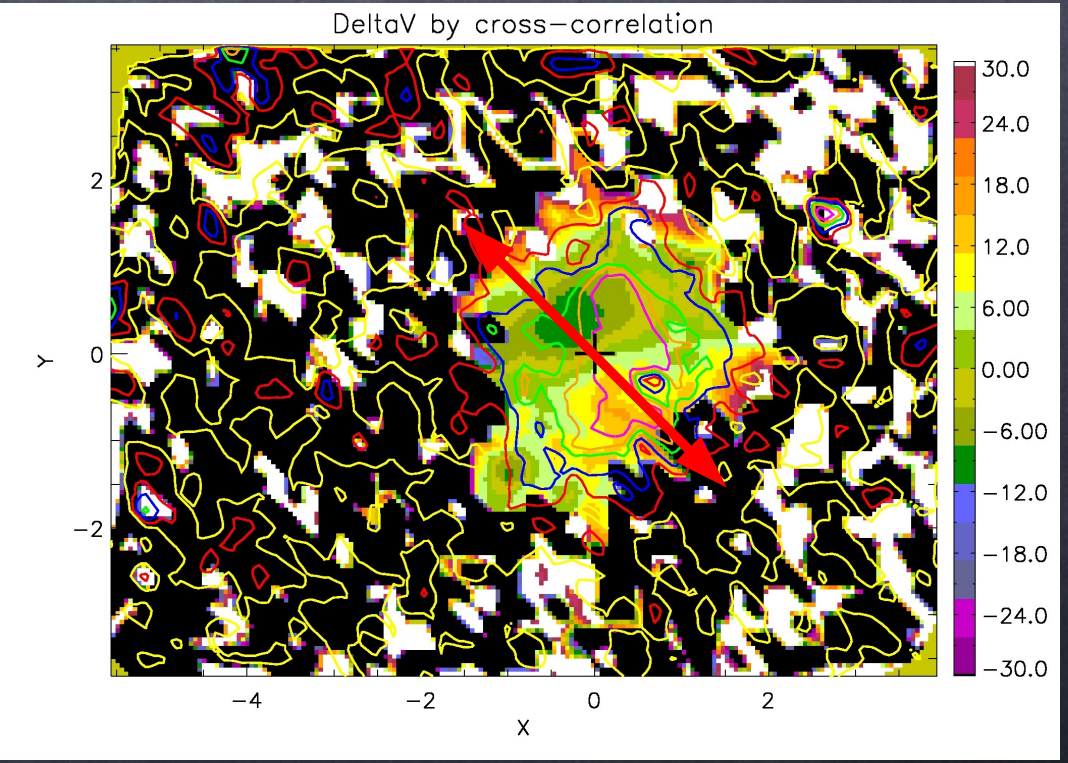
➔ Is this signal real?



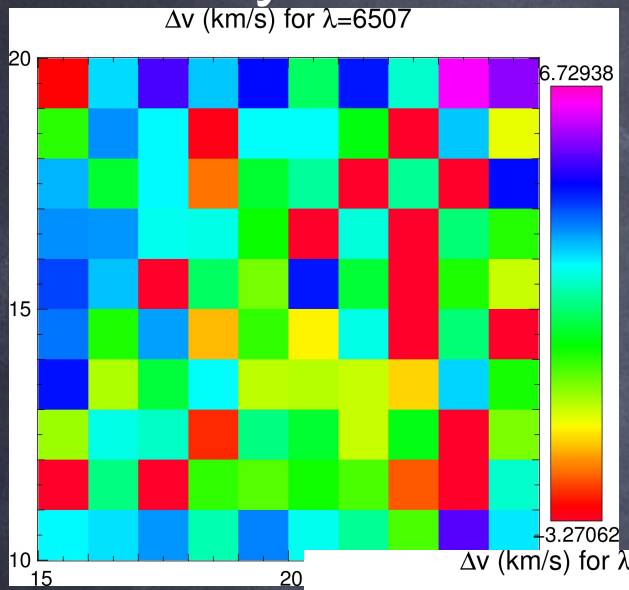
- Test 1: Signal due to neighbouring lenses?
  - New data reduction restricting the spectra subtraction
    - No difference in the results

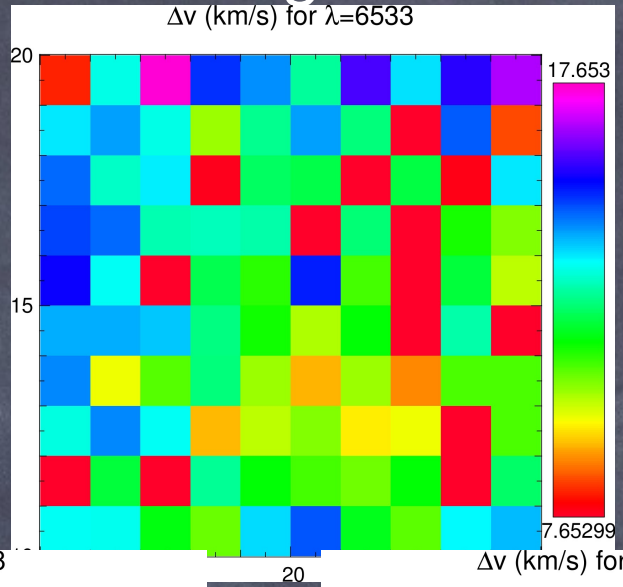
- Test 1: Signal due to neighbouring lenses?
  - New data reduction restricting the spectra subtraction
    - No difference in the results

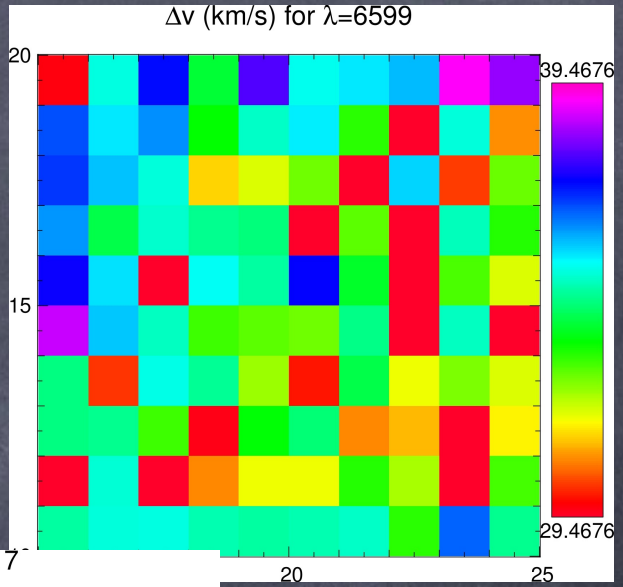
- Test 2: Signal due to an error in wavelength calibration?
  - Cross-correlation between each spectrum of the field and that at the central star position
    - Unexpected structure

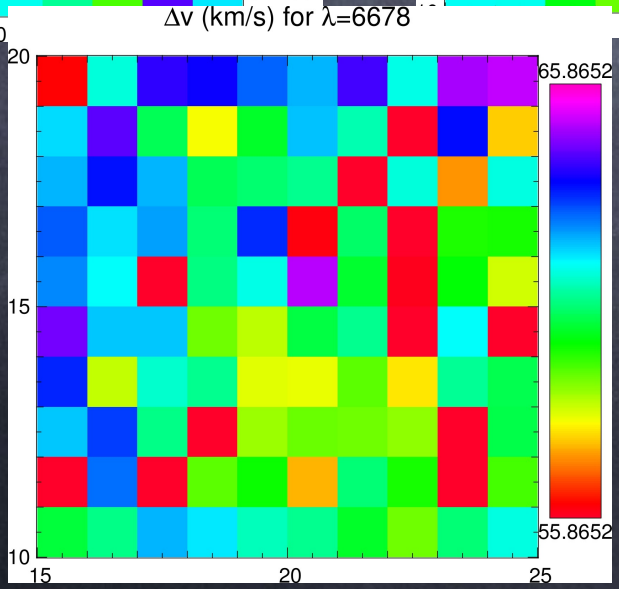


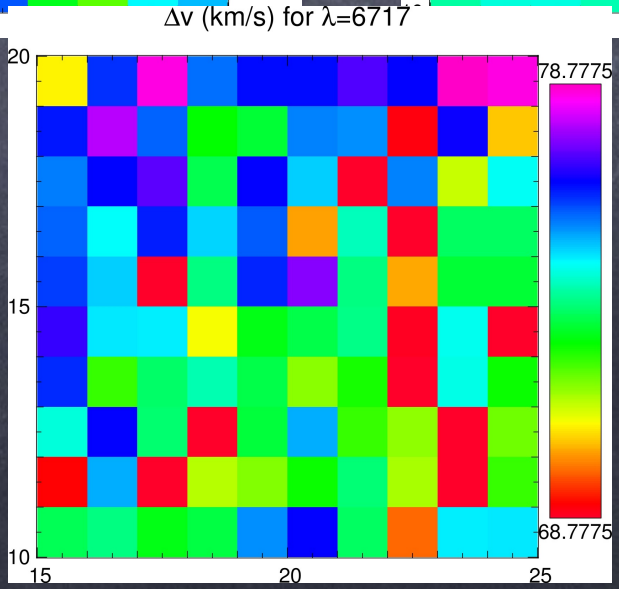
- Test 2: Tests on the Ne arc used for wavelength calibration
  - Polynomial fit to second degree







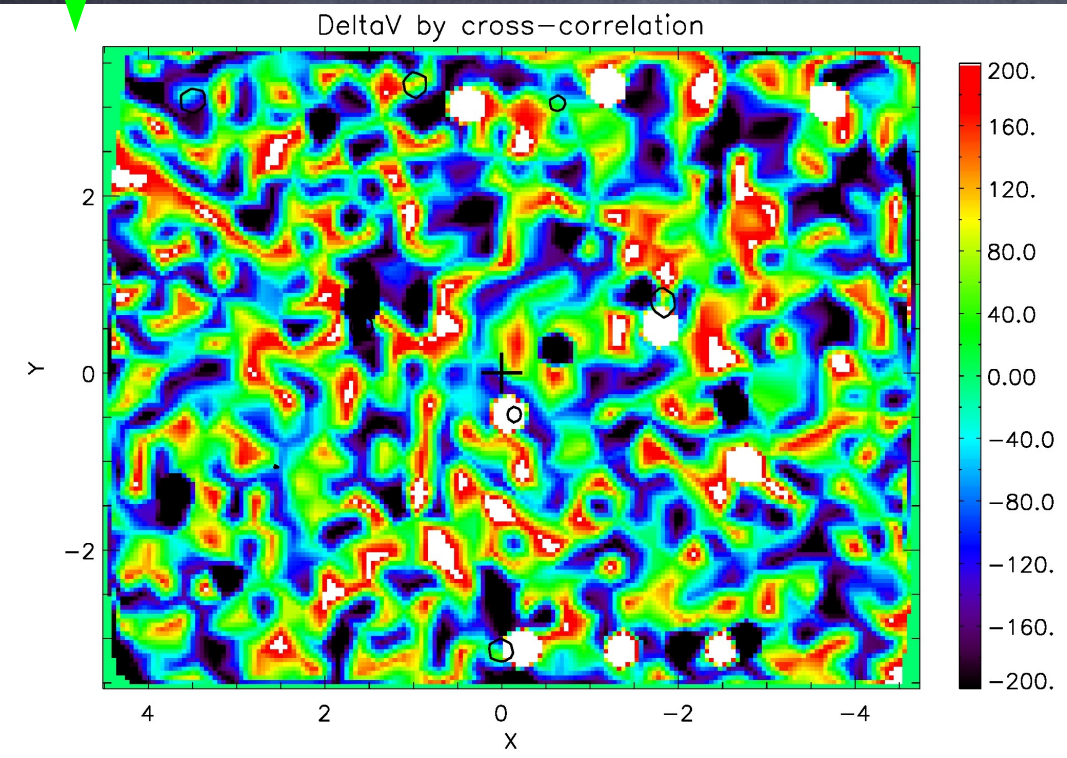


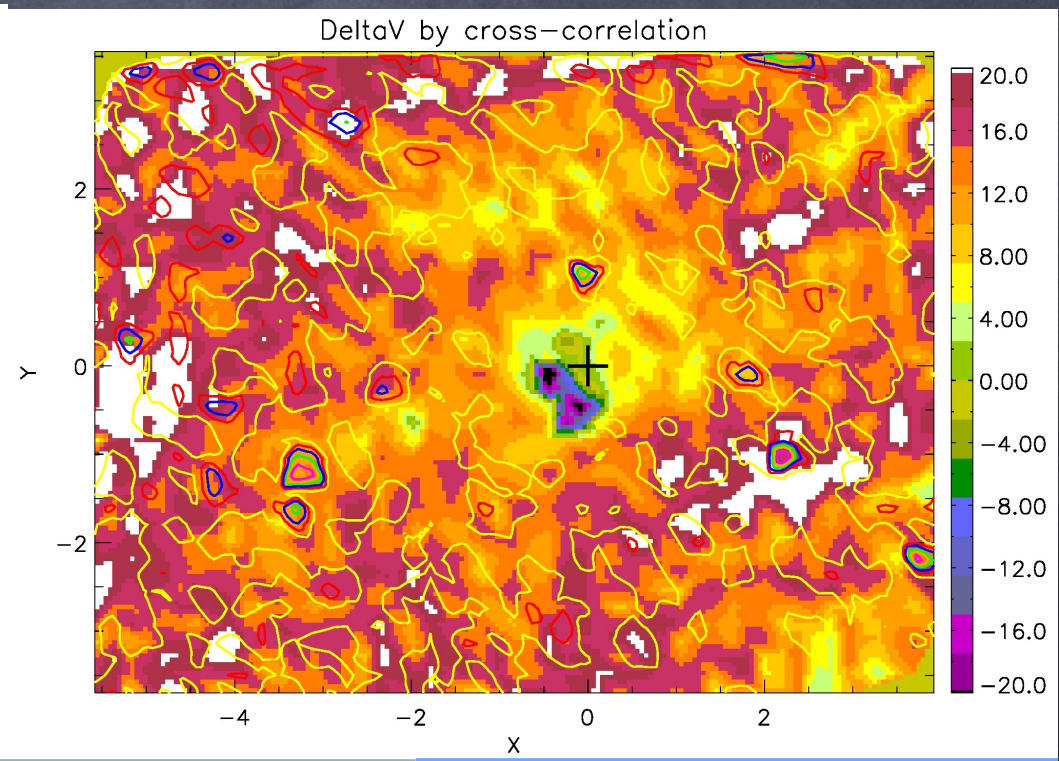


- Test 2: Same study in other images of the same set of data:

standard star and [OI]λ6300Å of V1515Cyg

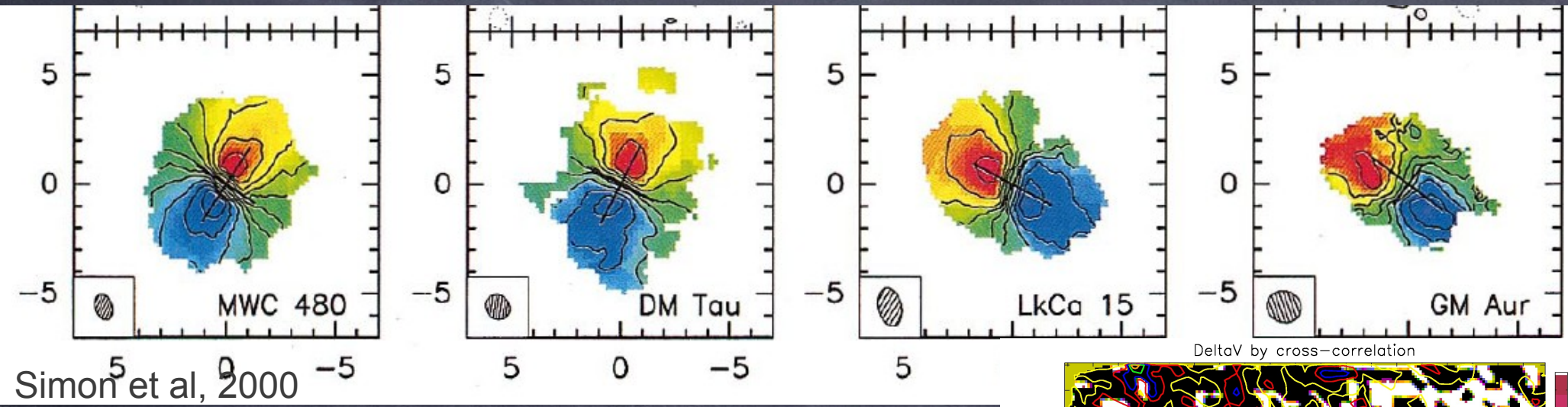
  - No structure for the standard star
  - Small structure in [OI] but at a noise level



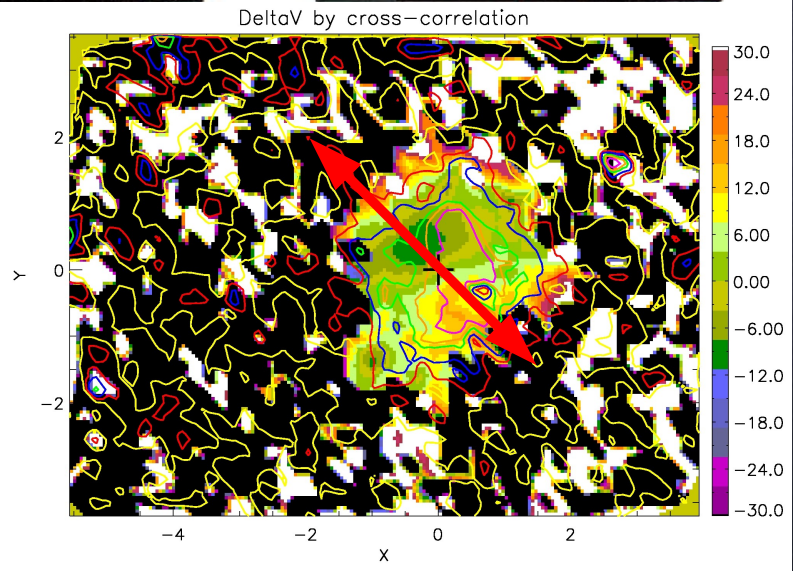


What are we observing?

- Very similar to observed velocity gradients in ^{12}CO images of protoplanetary disks in several T Tauri stars showing keplerian rotation

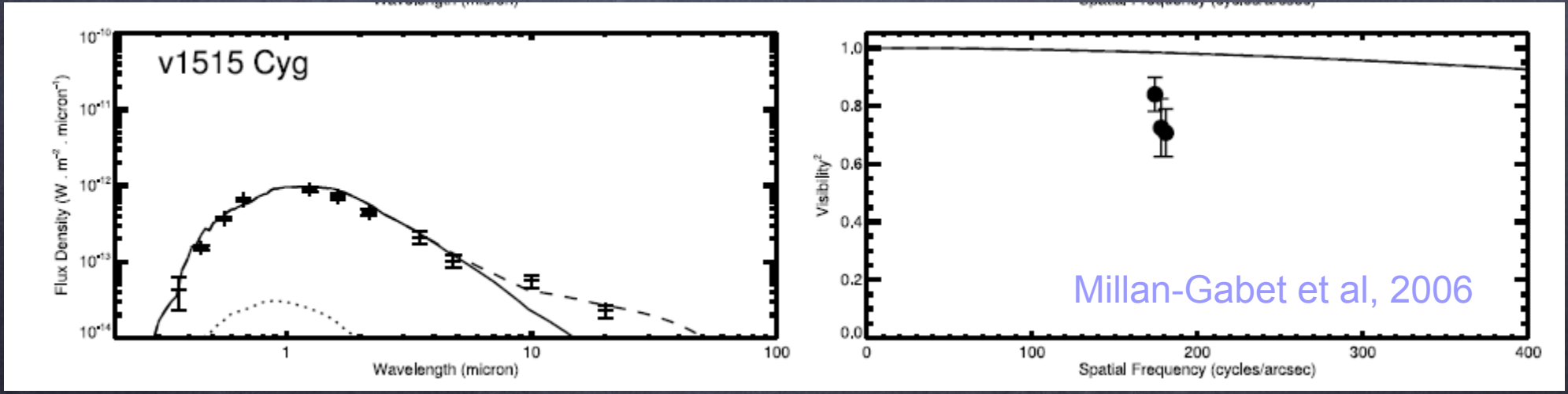


Simon et al, 2000



What are we observing?

- Scattering by an envelope:
  - Several previous works concluded about the need of an in-falling envelope in order to fit the observed SED (excesses at 10 μm) and explain the low-K-Band visibilities observed. (Millan-Gabet et al, 2006, Green et al, 2006, Zhu et al, 2008)



  - Models by Zhu et al and Green et al, also require the existence of an outflow cavity in the envelope

What are we observing? - Some ideas

- The observed ΔV is due to scattering by the disk with a keplerian rotation
  - For the 1kpc distance of V1515 Cyg, the expected V_k at 1" is ~1km/s << than observed

What are we observing? - Some ideas

- The observed ΔV is due to scattering by the disk with a keplerian rotation
  - For the 1kpc distance of V1515 Cyg, the expected V_k at 1" is ~1km/s << than observed
- The observed ΔV is a projection of the velocity in an inner wind (rotating?) at higher velocities
  - Points at different sides of the jet with different velocities would be scattered by the disk adding this ΔV to the ΔV due to the disk rotation. This second V would be much more important.

What are we observing? - Some ideas

- The observed ΔV is due to scattering by the disk with a keplerian rotation
  - For the 1kpc distance of V1515 Cyg, the expected V_k at 1" is ~1km/s << than observed
- The observed ΔV is a projection of the velocity in an inner wind (rotating?) at higher velocities
  - Points at different sides of the jet with different velocities would be scattered by the disk adding this ΔV to the ΔV due to the disk rotation. This second V would be much more important.
- Others?

Thank you!