CFHT UM
Nice, France
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Multi-wavelength studies of hot-star magnetospheres

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What are massive stars?

$$M \geq 8 \ \mathrm{M}_{\odot}$$

$$T \geq 15000 \ \mathrm{K}$$

Rosette Nebula © Juan Ignacio Jimenez

Credit: NASA, ESA/Hubble and the Hubble Heritage Team

$$L = 10^4 - 10^6 \ \mathrm{L}_{\odot}$$

RADIATELY-DRIVEN STELLAR WIND

$$\dot{M} = 10^6 - 10^8 \ \dot{\mathrm{M}}_{\odot}$$

What if we add a magnetic field?

Massive-star magnetism

0.3 - 20 kG

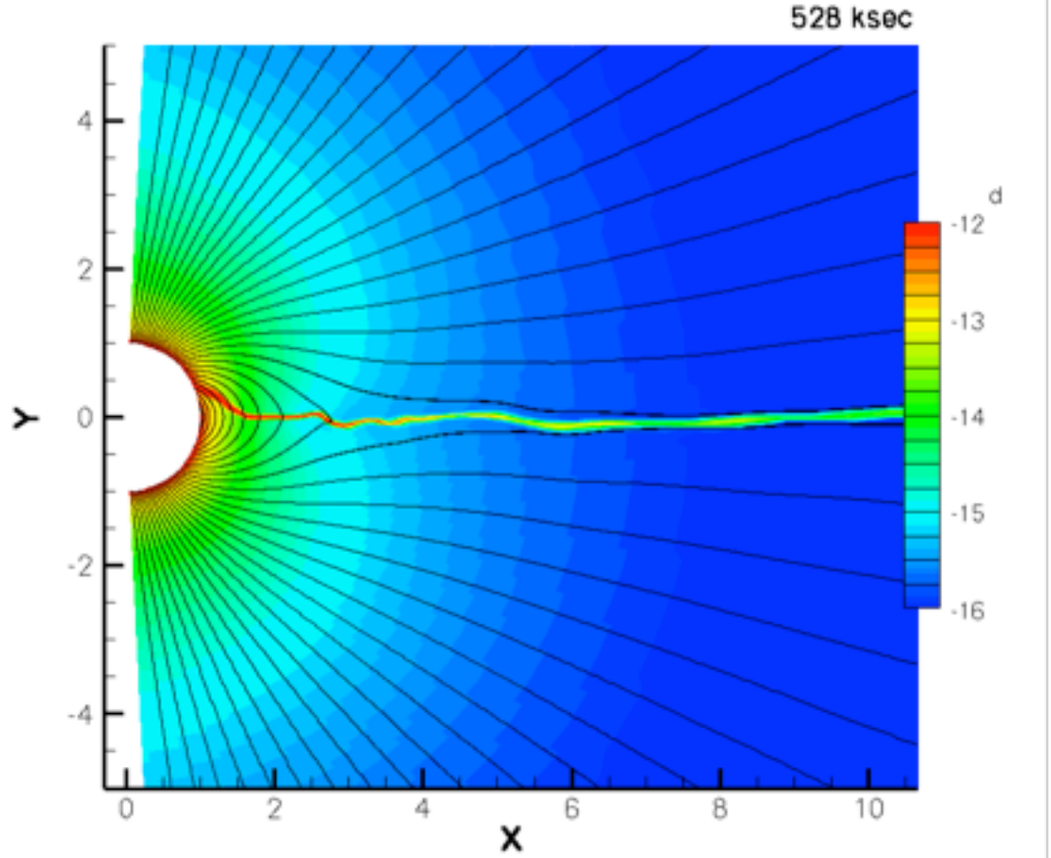
Simple, Stable, Global

+

Strong stellar wind

Mass loss

© A. ud-Doula



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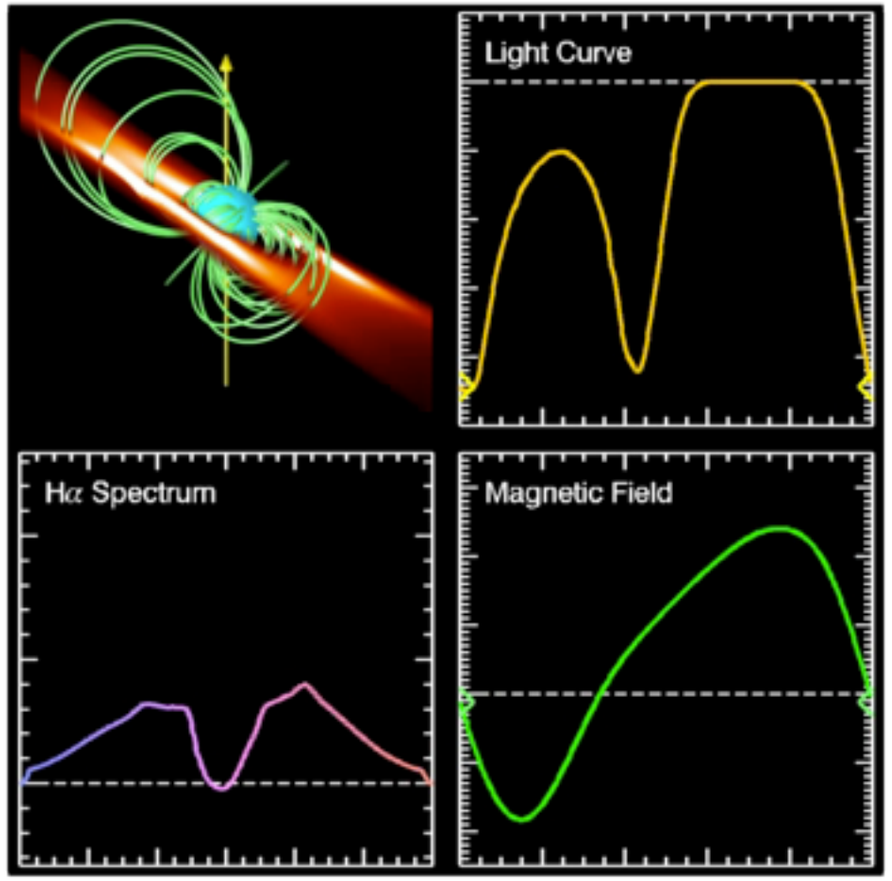
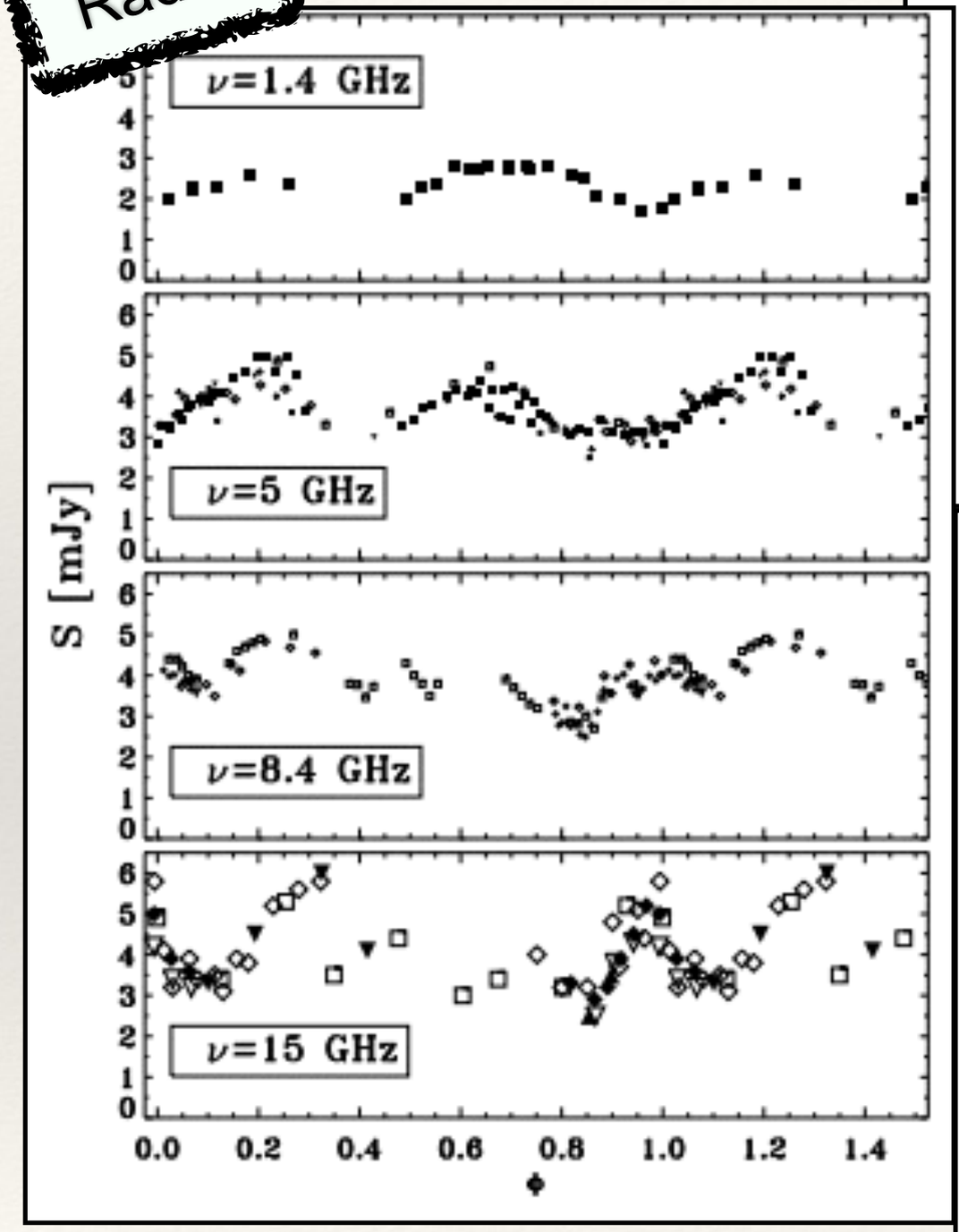


Diagnostics

Radio

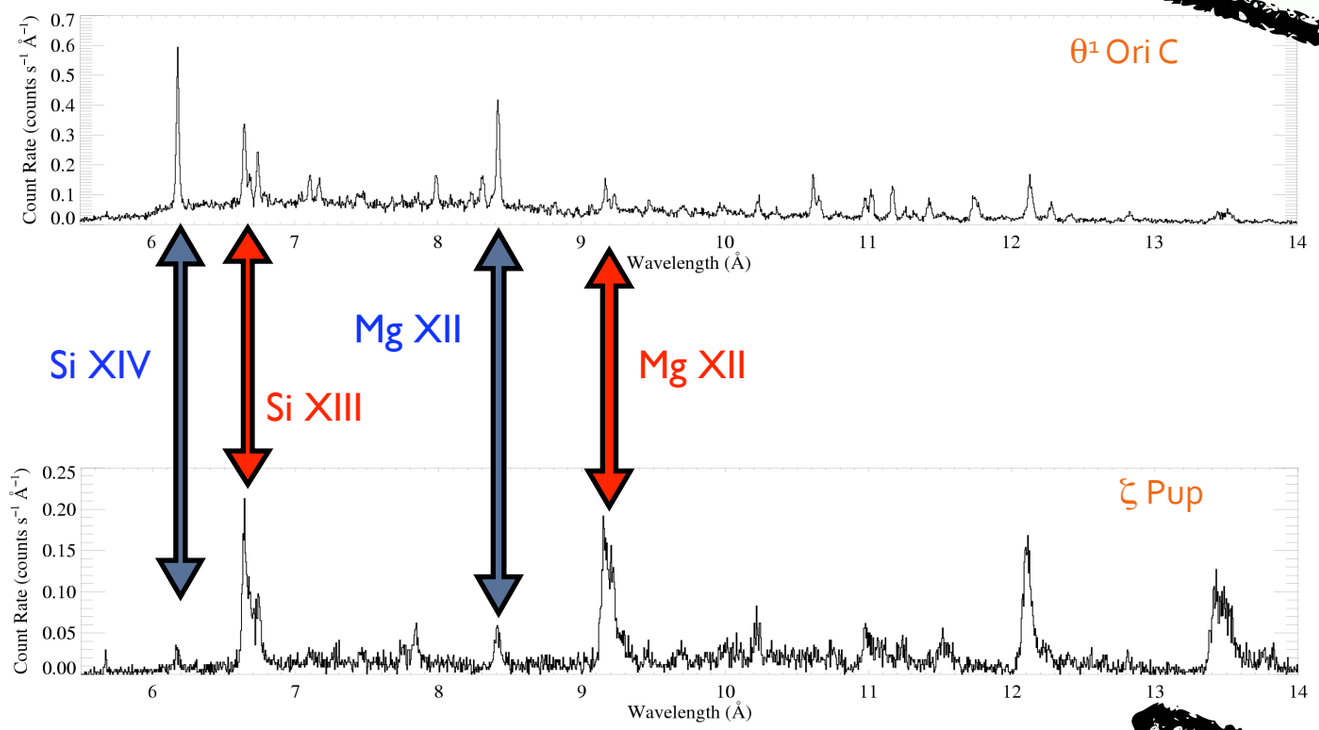
σ Ori E



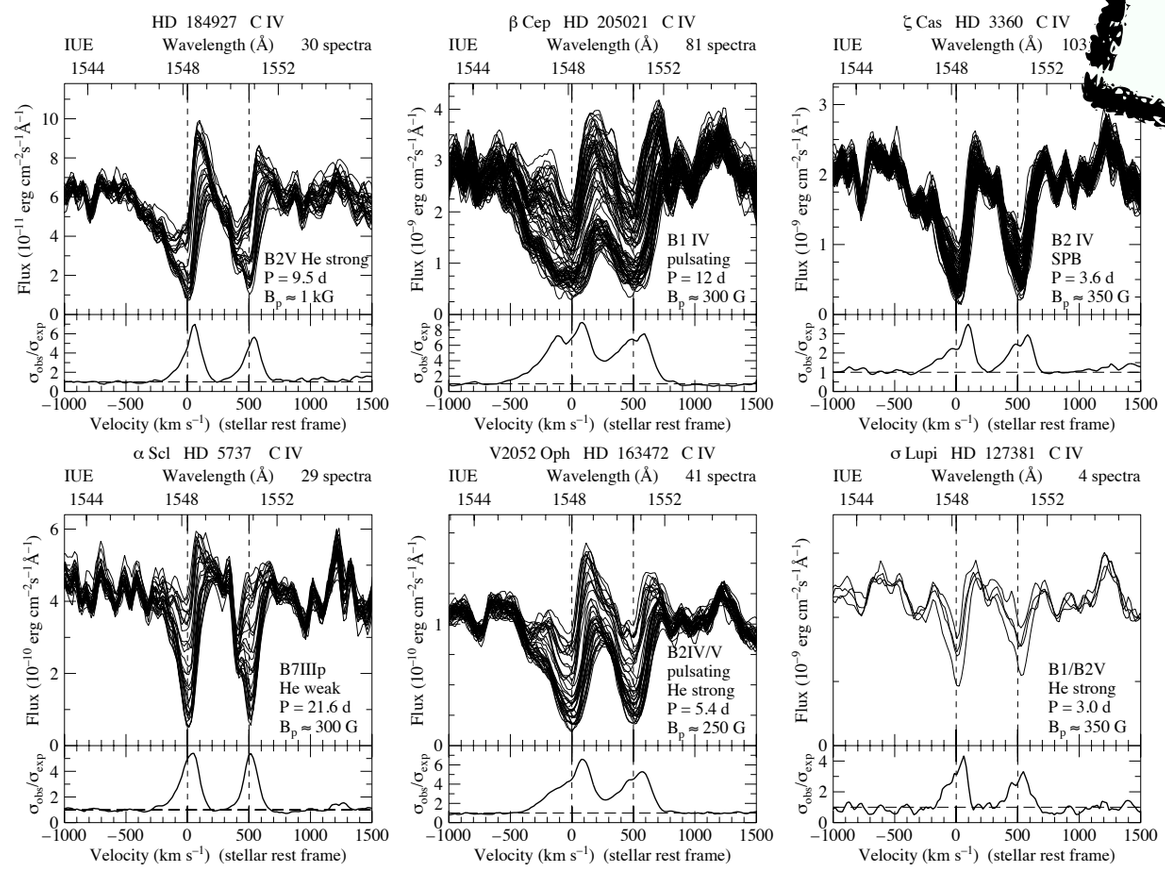
Leto et al. 2012

X-ray

Gagné et al. 2005



UV

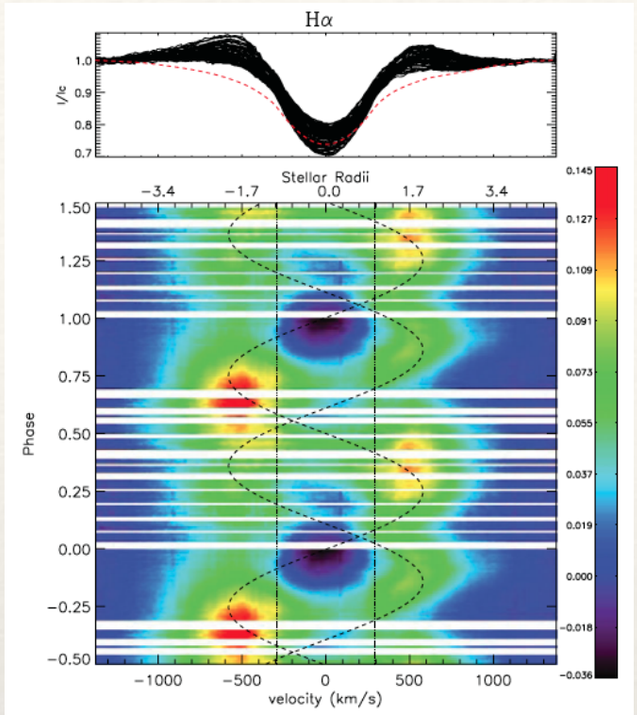


Courtesy of H. Henrichs

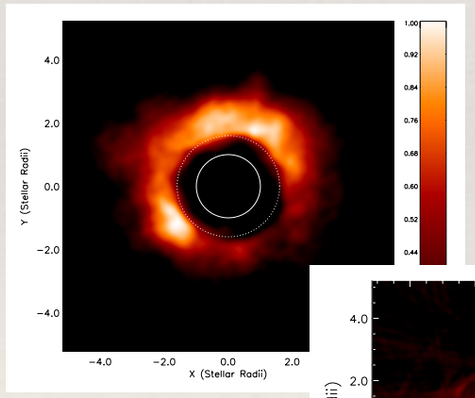
Optical+IR diagnostics

ESPaDOnS@ CFHT

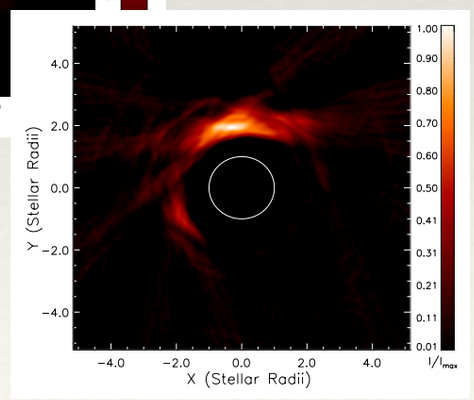
Narval@TBL



Grunhut et al. 2012



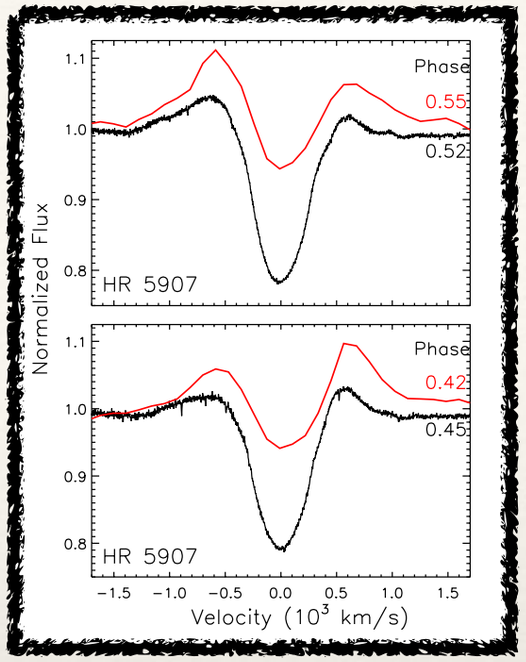
Hα



Pa13

Courtesy of J. Grunhut

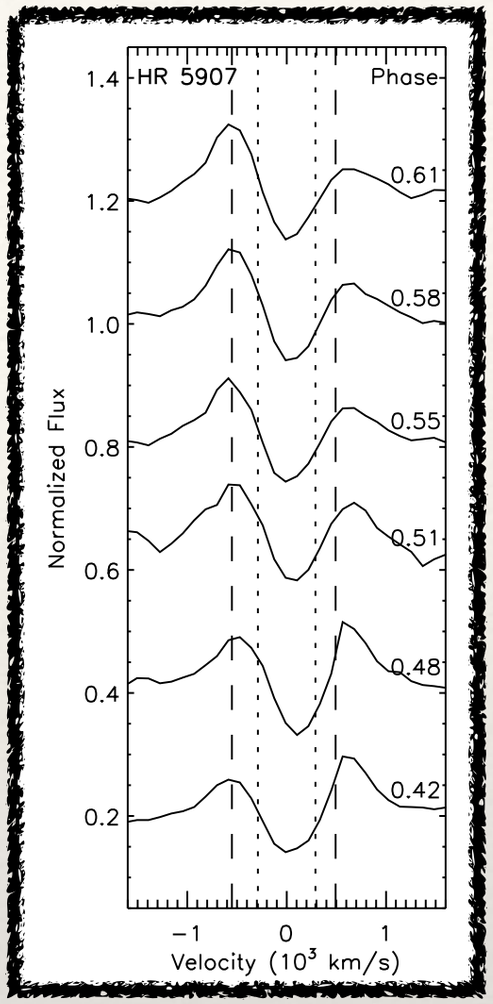
Oksala et al. 2015

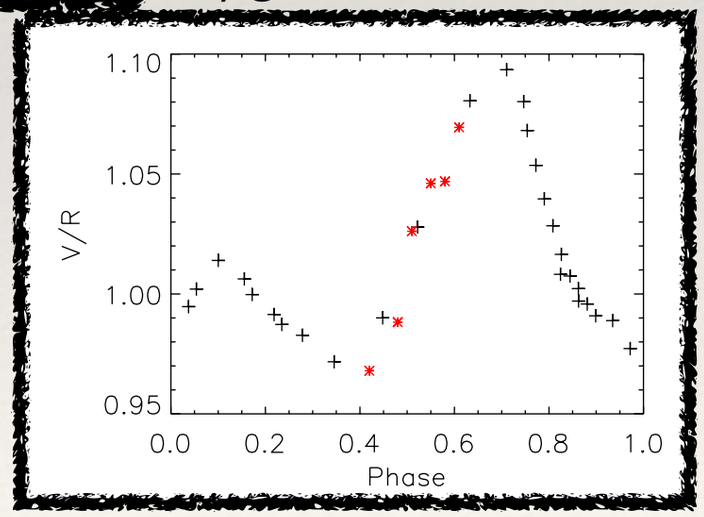


*** INFRARED + OPTICAL**

HR 5907

Br 10
1.73 microns

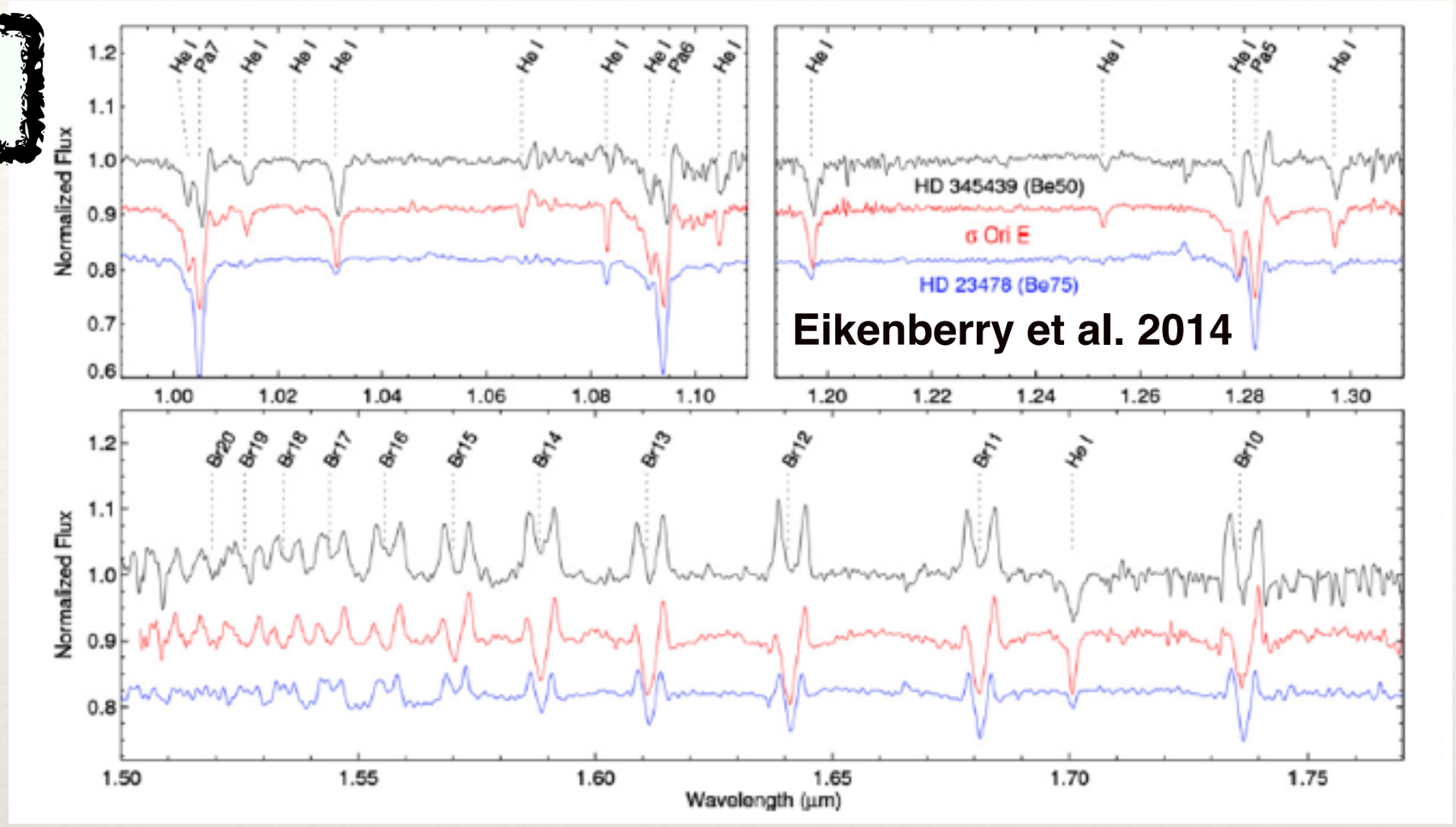




OSIRIS@SOAR

The serendipitous detection of a CM star

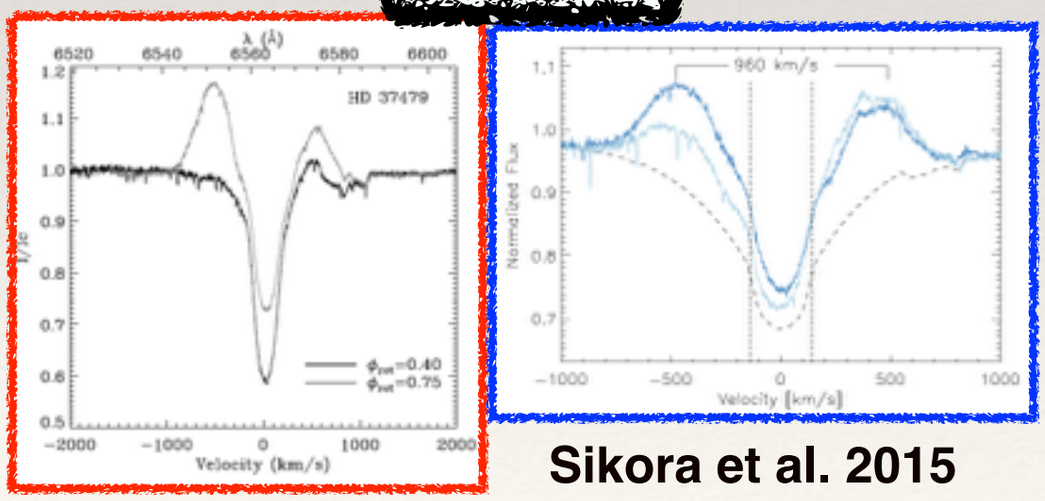
IR



σ Ori E

HD 23478

Optical

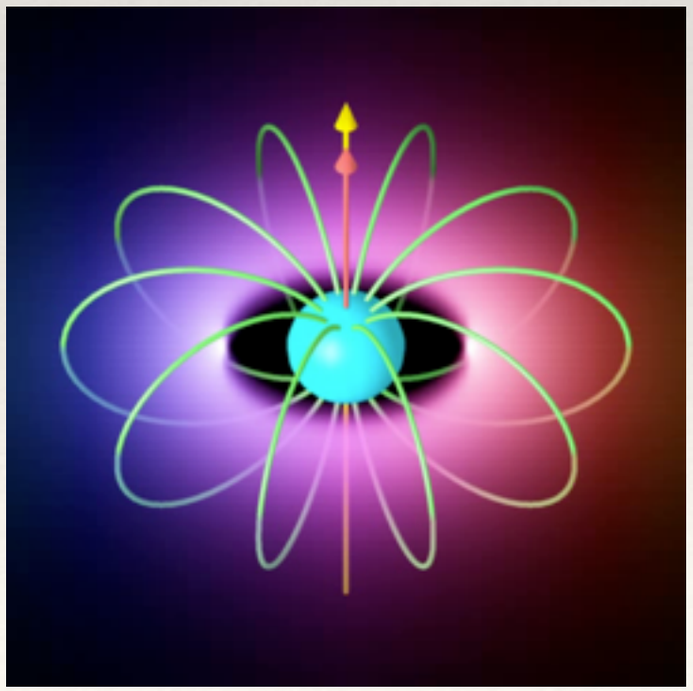


Sikora et al. 2015

Magnetic field confirmed by:

Sikora et al. 2015
ESPaDOnS@CFHT

Hubrig et al. 2015
FORS2@VLT



Optical Spectropolarimetry

HD 23478

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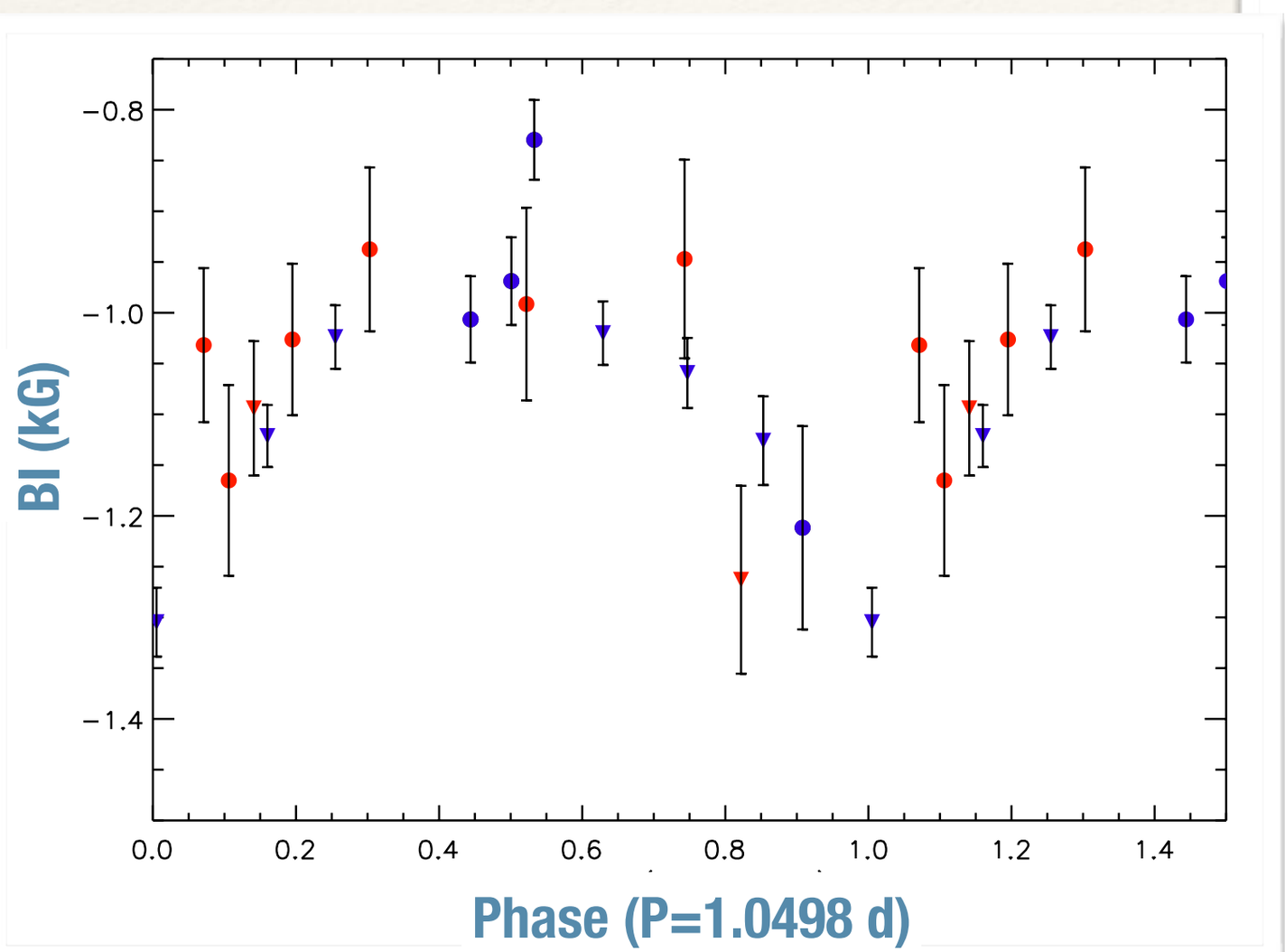
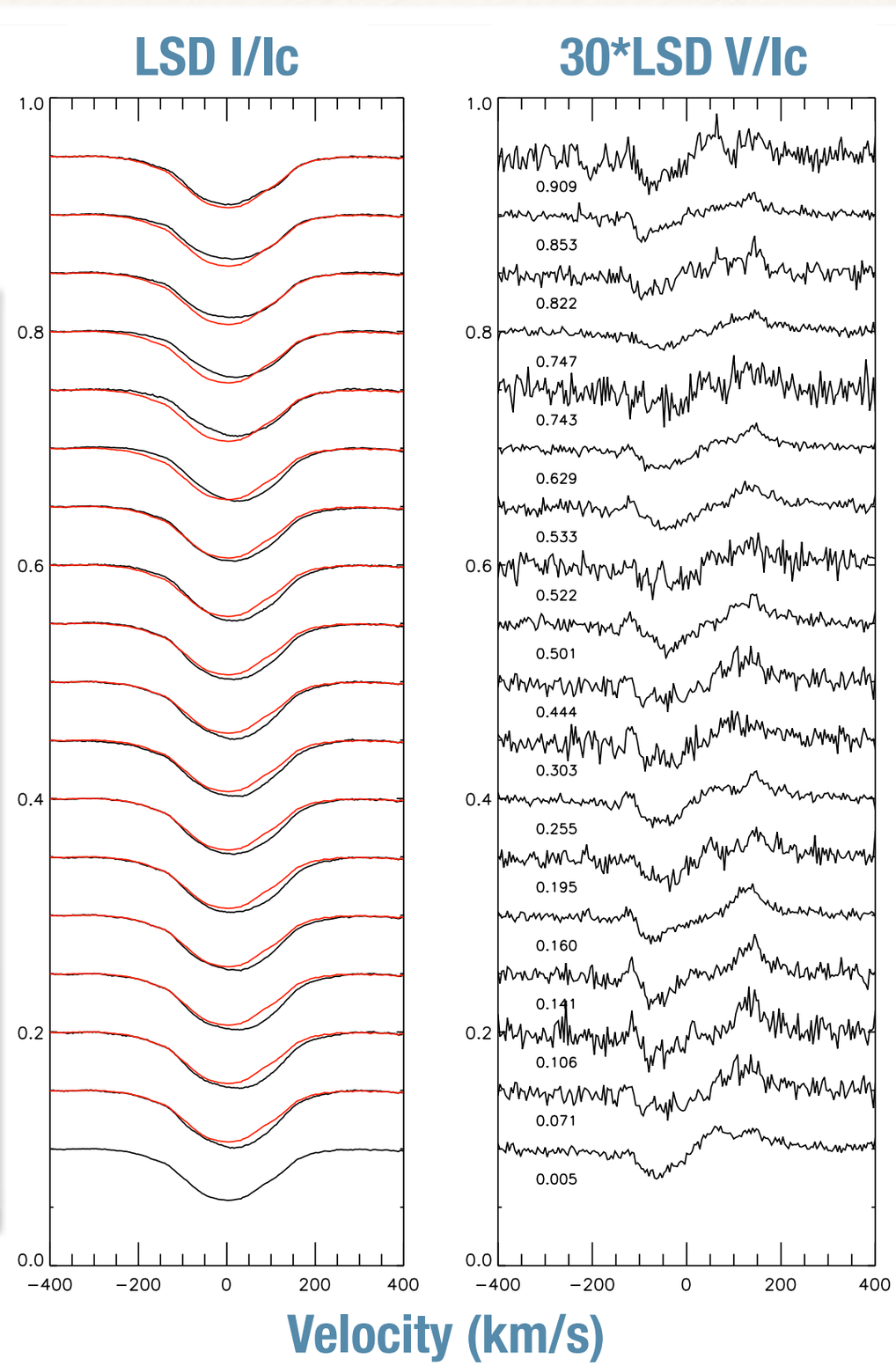
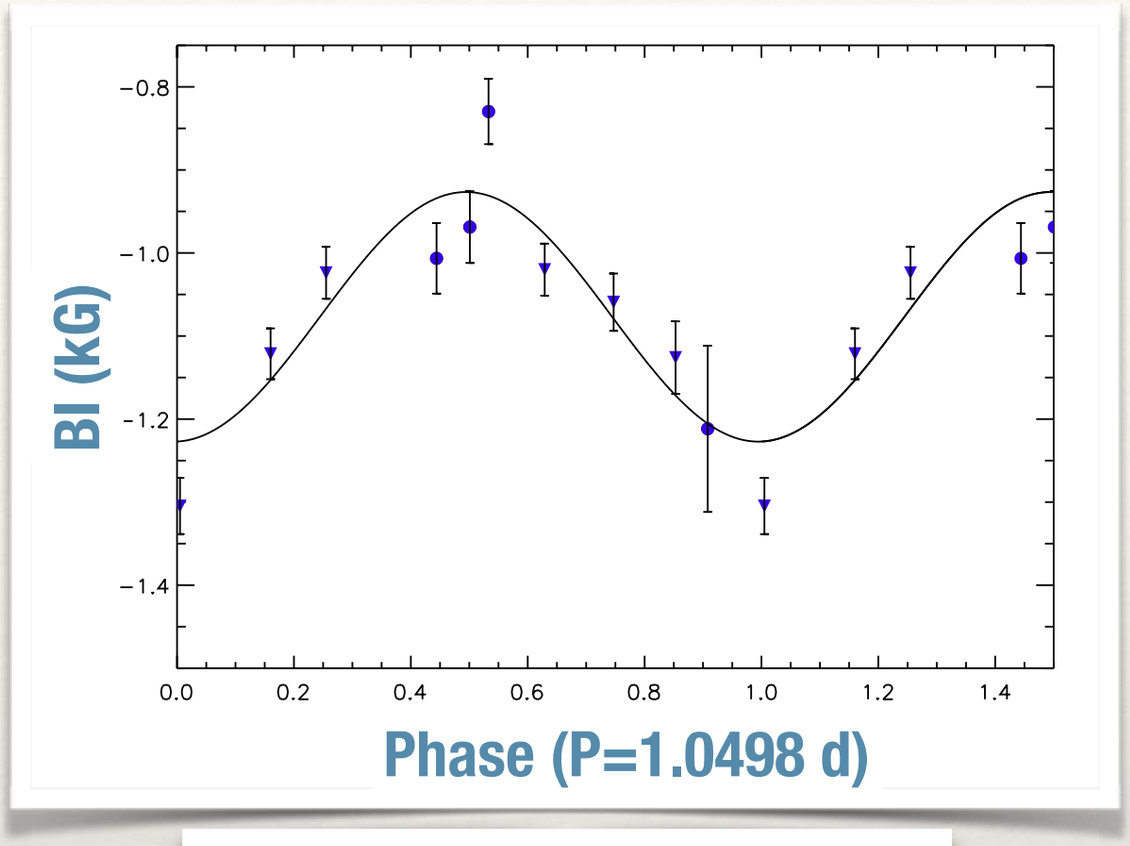


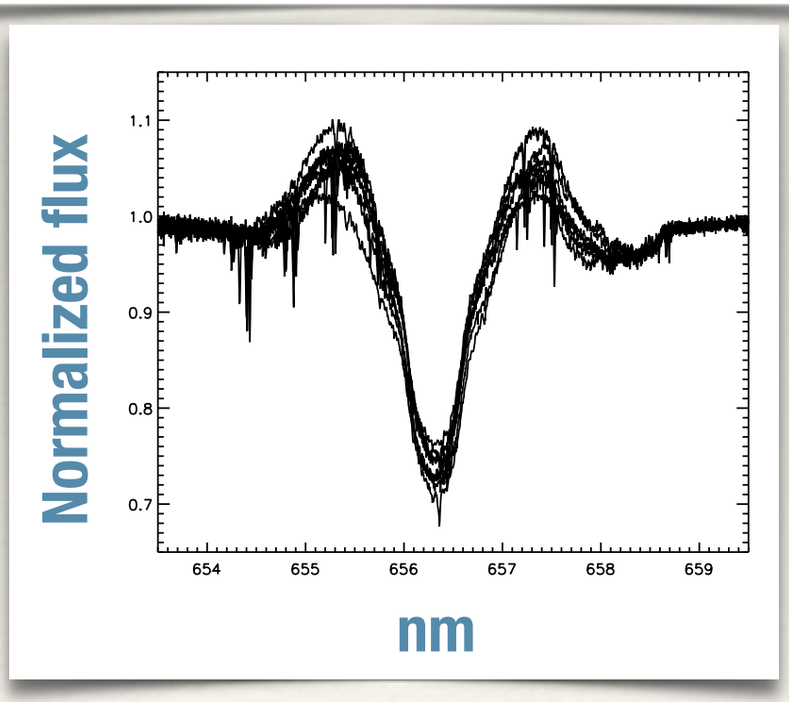


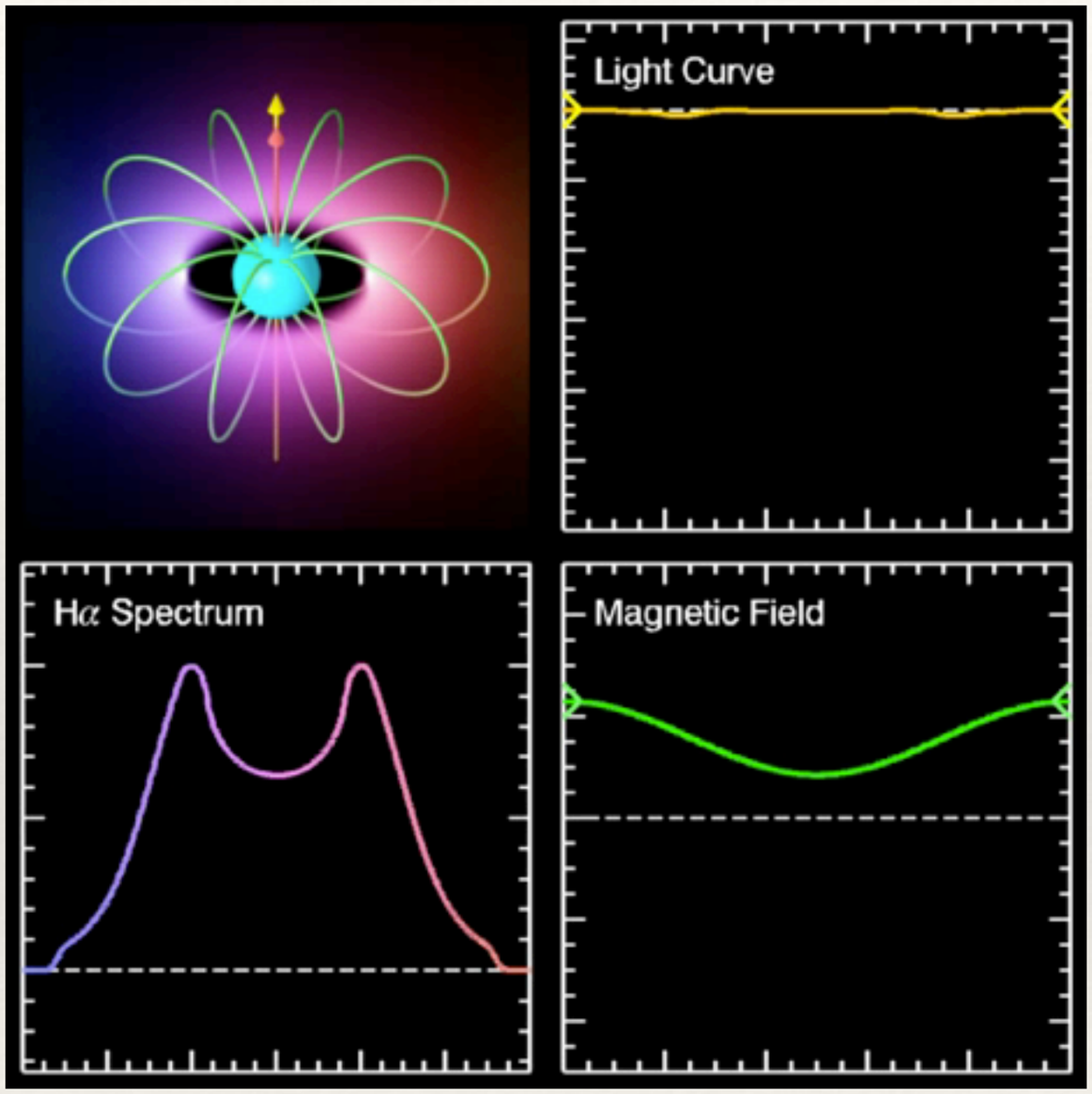
Obtained 2014-2016

Magnetosphere variations

HD 23478

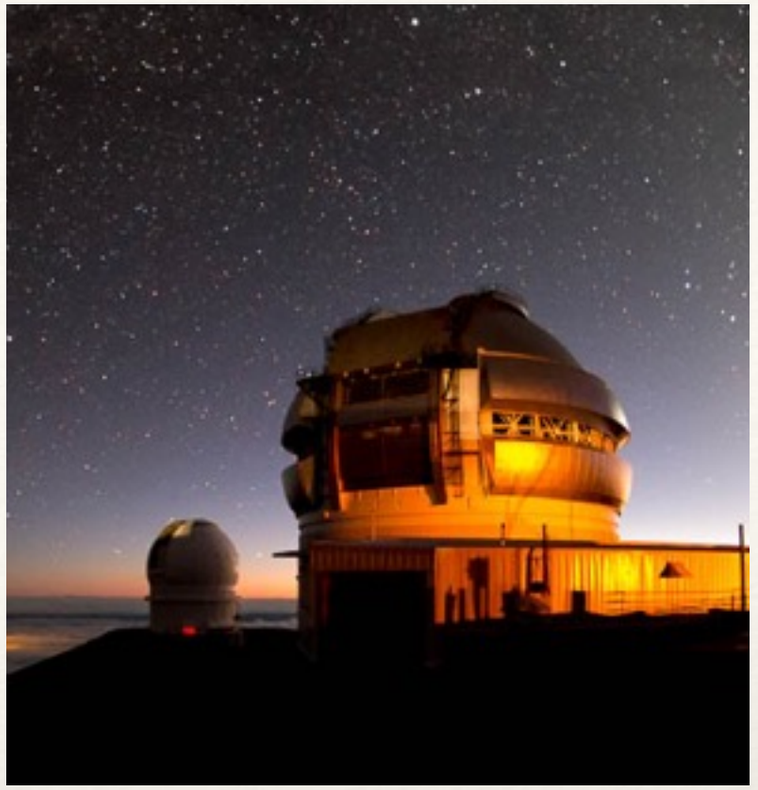




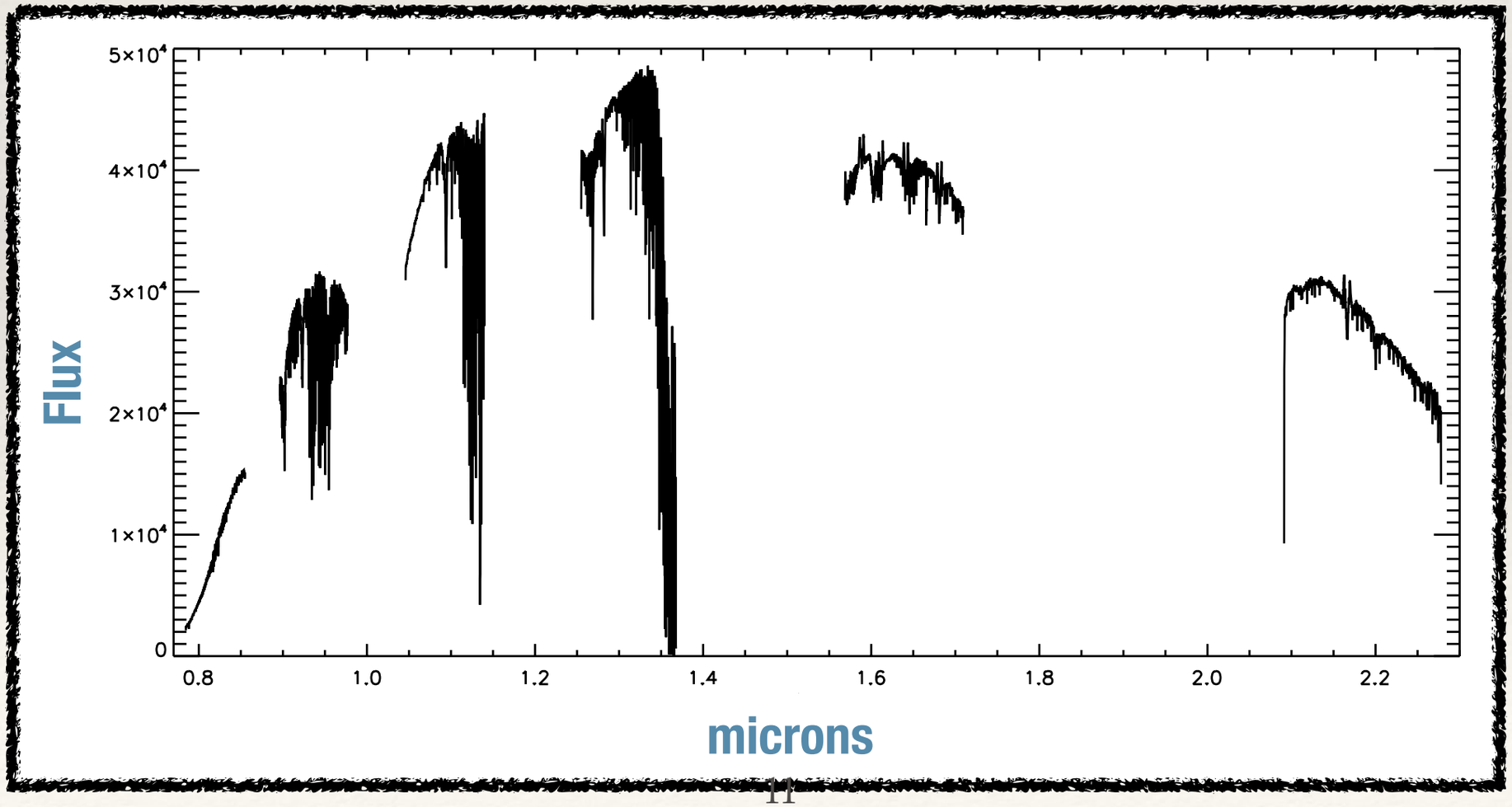


NIR spectroscopy

- **Short camera (30” slit)**
- **R ~ 6000 — intermediate**
- **Cross-dispersed — 0.78-2.3 microns**
- **Time series of 9 spectra, covering the 1.0498 d rotation period**



GNIRS@GEMINI

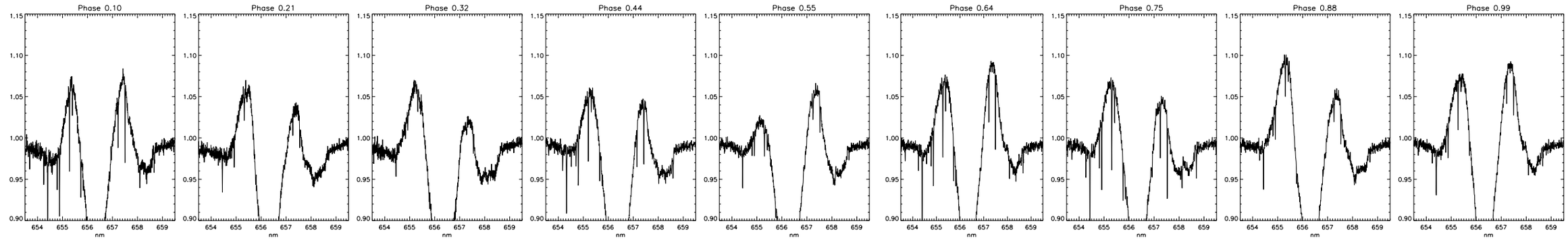


Magnetosphere diagnostics

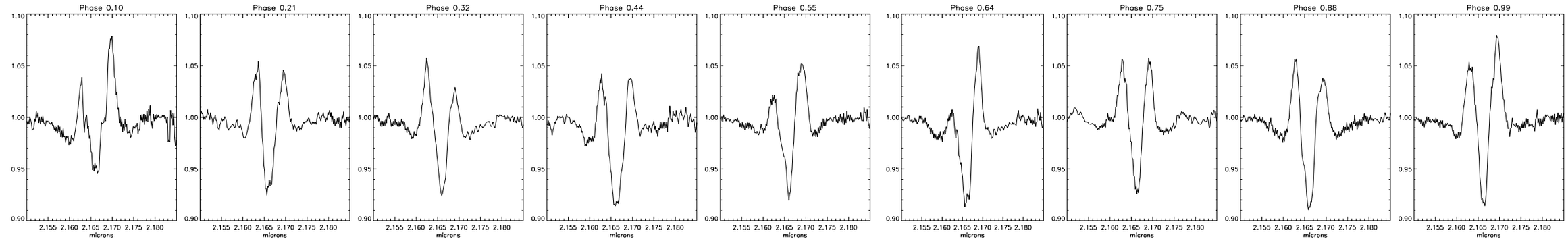
HD 23478

0.1	0.21	0.32	0.44	0.55	0.64	0.75	0.88	0.99

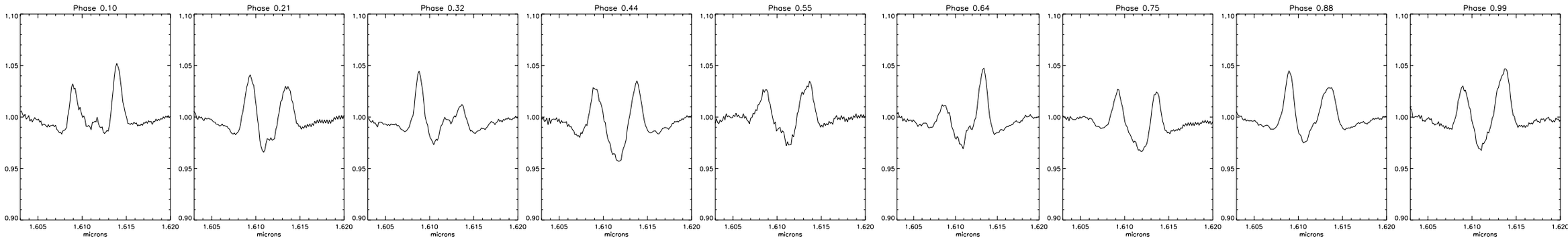
Hα



Brγ

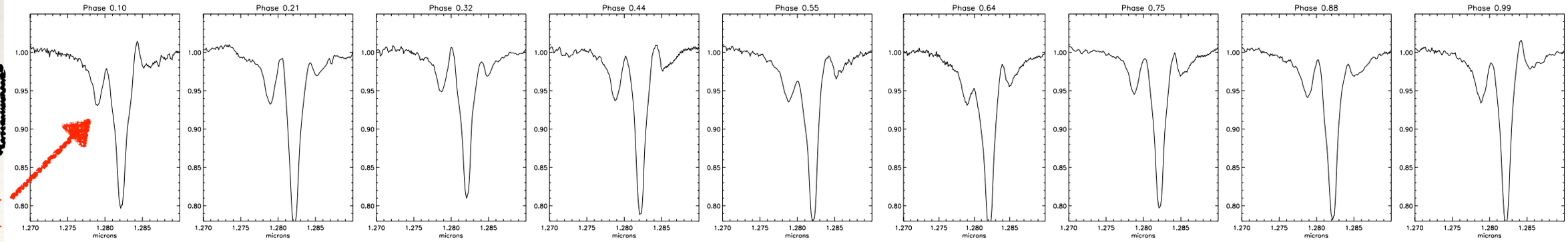


Br13



Paβ

He I



Magnetosphere diagnostics

HD 23478

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Hα

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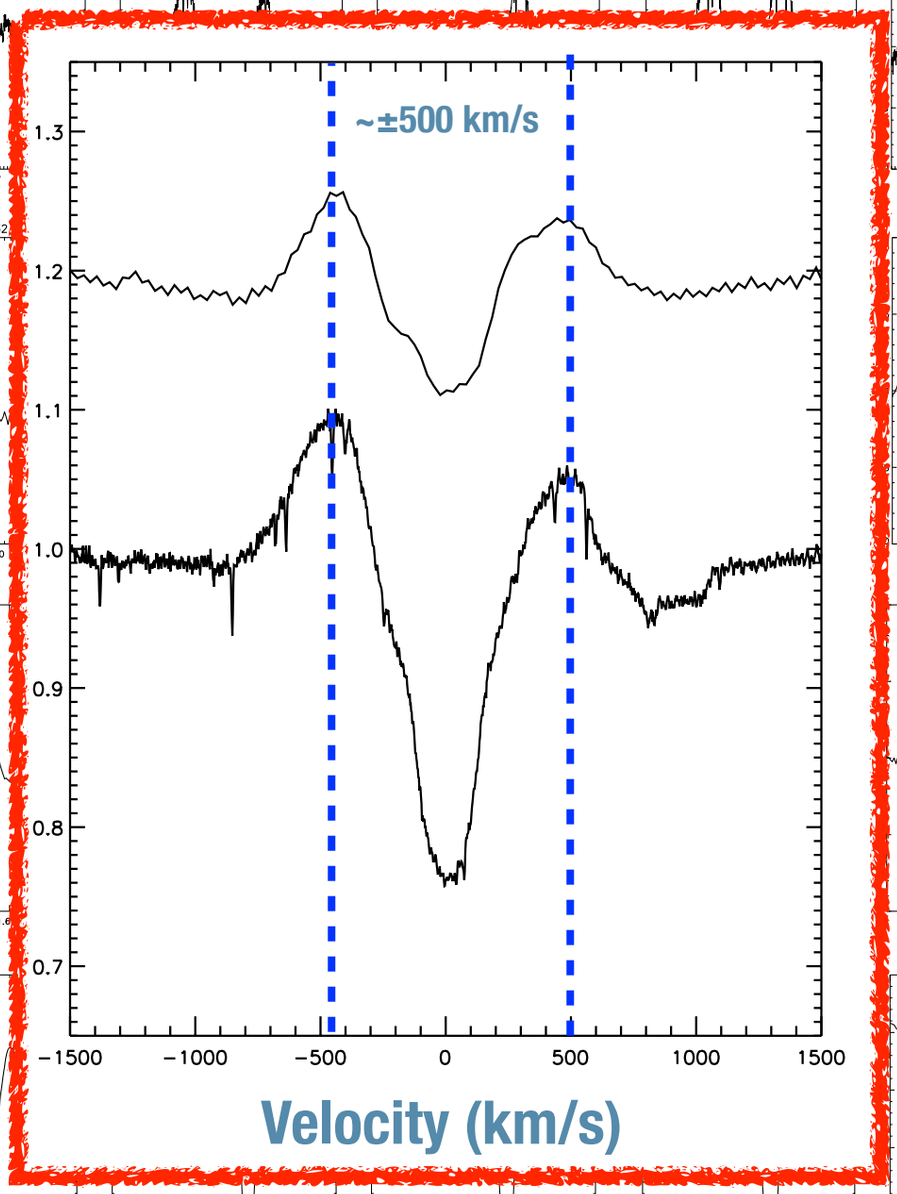

Summary

- Magnetic fields play an important role in shaping the circumstellar environment of hot, massive stars.
- Observational diagnostics give clues to the presence of magnetism across the **entire electromagnetic spectrum**
- Longer wavelength diagnostics are being developed
- IR is a viable tool to detect magnetic candidates in the Galactic center and star forming regions.
- SPIRou is coming soon:
    - **Ideal to simultaneously obtain magnetosphere and magnetic field info**
    - **Requires in-depth knowledge of the features and behavior of magnetic diagnostics in the IR**
    - **Determine physical characteristics of the magnetic field and magnetosphere of identified candidate stars.**
    - **Study very young OB stars**