Cepheids and Gaia's second data release

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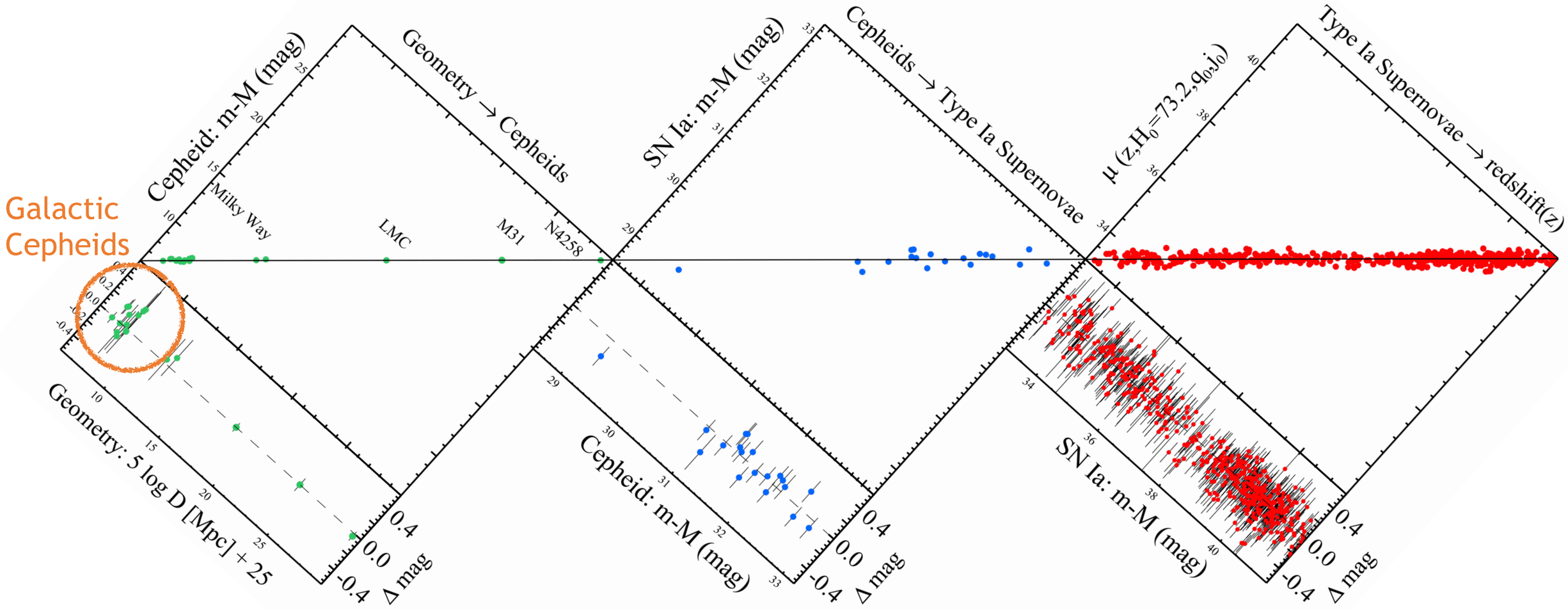
PROJET FINANCÉ PAR L'ANR - PROJECT FUNDED BY THE ANR

THE DISTANCE SCALE



Riess et al. 2016, ApJ, 826, 56

PARALLAX OF PULSATION

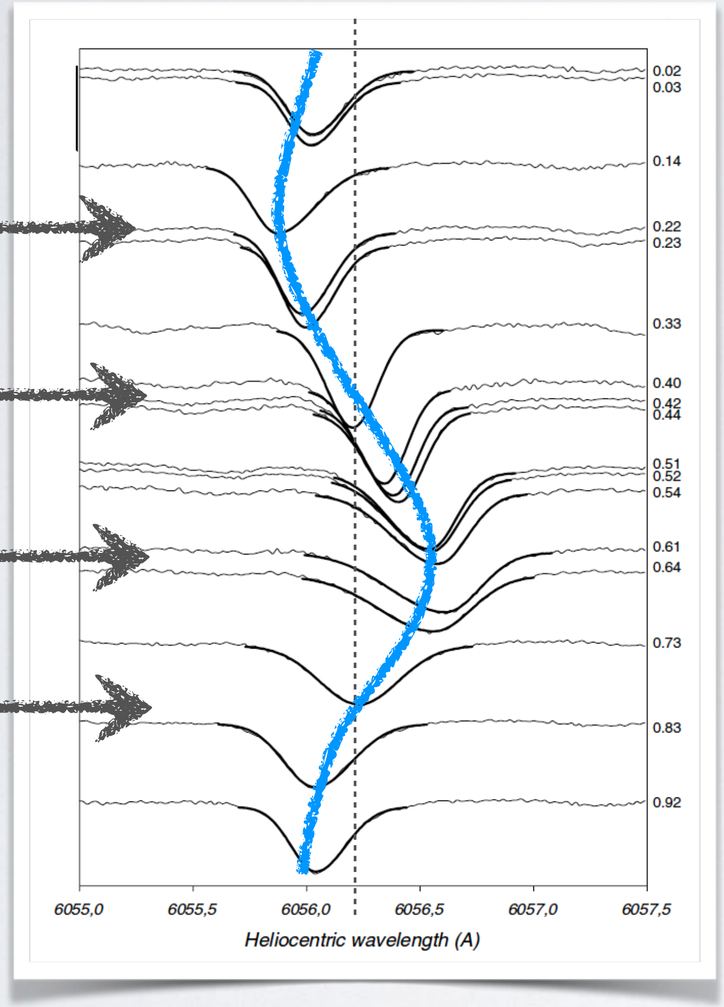
Radial velocity

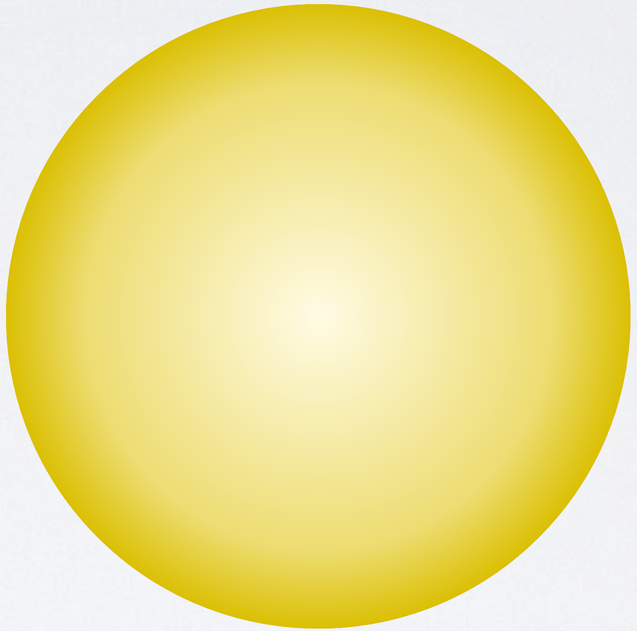
Expansion

Max radius

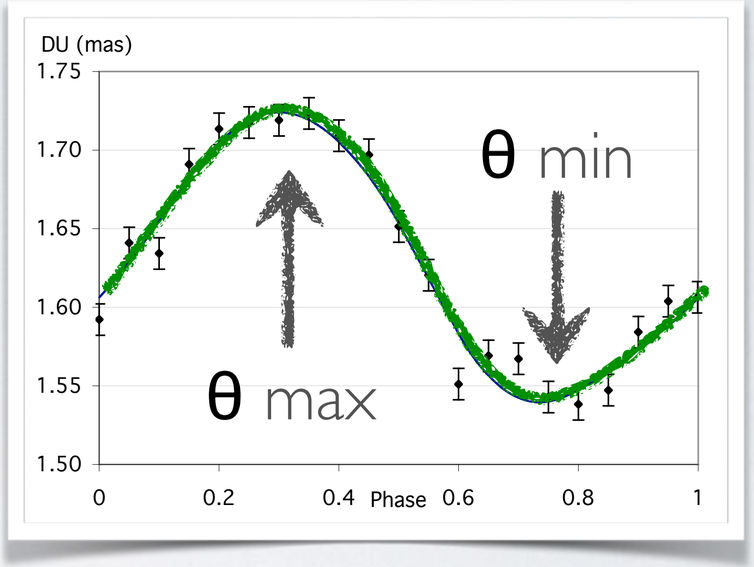
Contraction

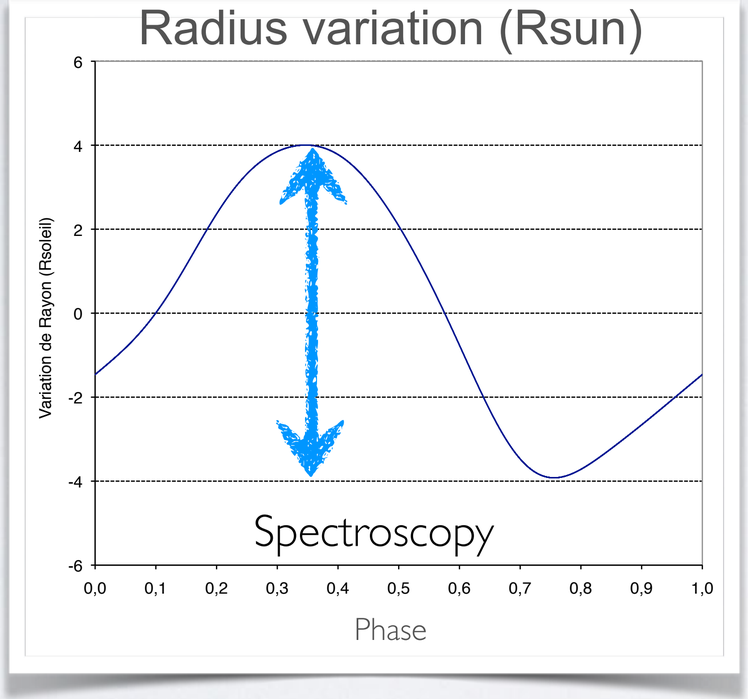
Min radius

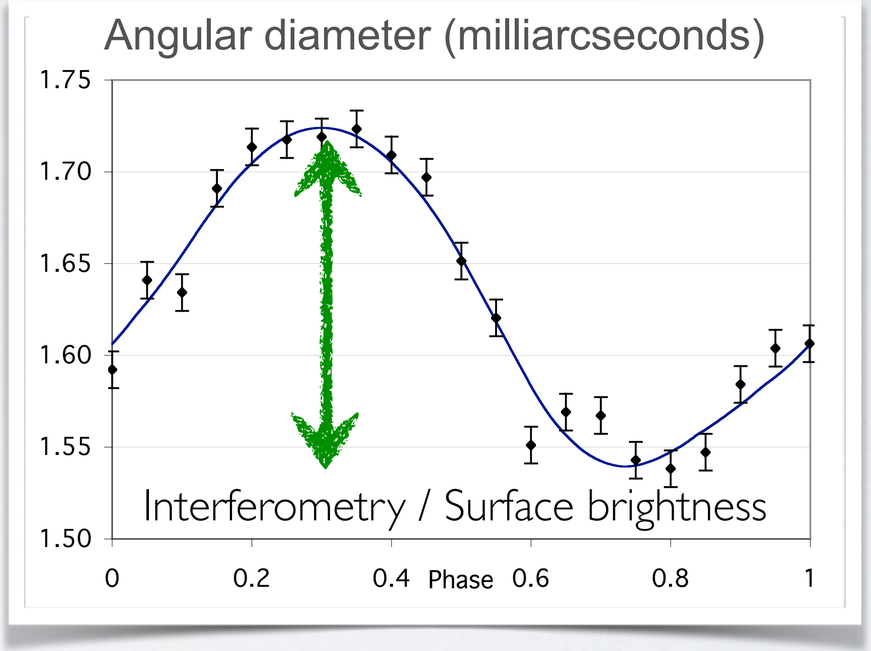




Angular diameter







The distance d is given by the relation:

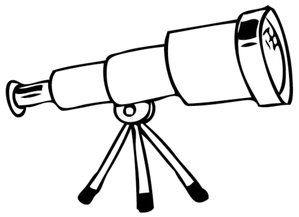
$$d = \frac{2\delta R(T)}{\delta\theta(T)} = \frac{-2\,k\,p\int_0^T v_{\mathrm{rad}}(t)\,dt}{\theta_{\mathrm{UD}}(T) - \theta_{\mathrm{UD}}(0)}$$

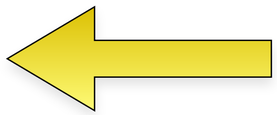
p = projection factor

k = limb darkening correction

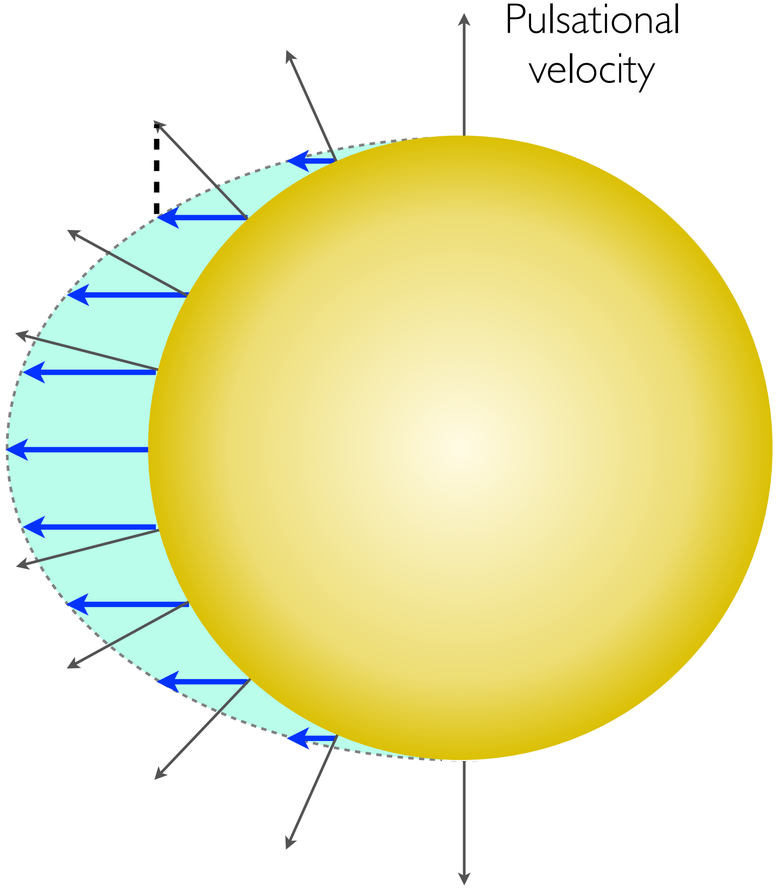
THE P-FACTOR

Disk-integrated
radial
velocity





Radial
velocity



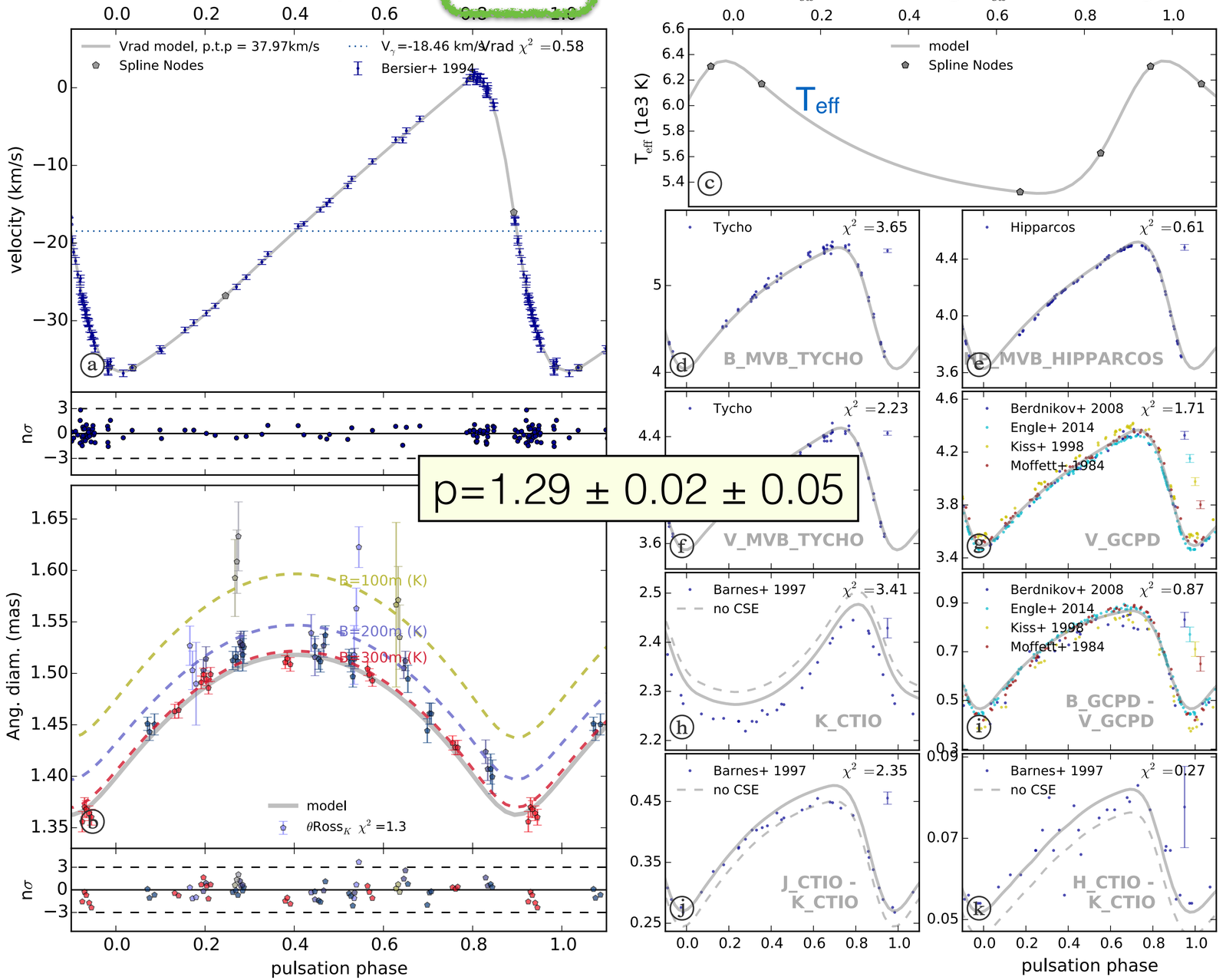
- Pure geometry = 1.5
- Limb darkening component < 1
- Atmosphere dynamics = ?

Nardetto et al. (2009, A&A, 502, 951)

Main limitation for PoP
Cepheid distances

Radial velocity (spectroscopy)

Angular size (interferometry)

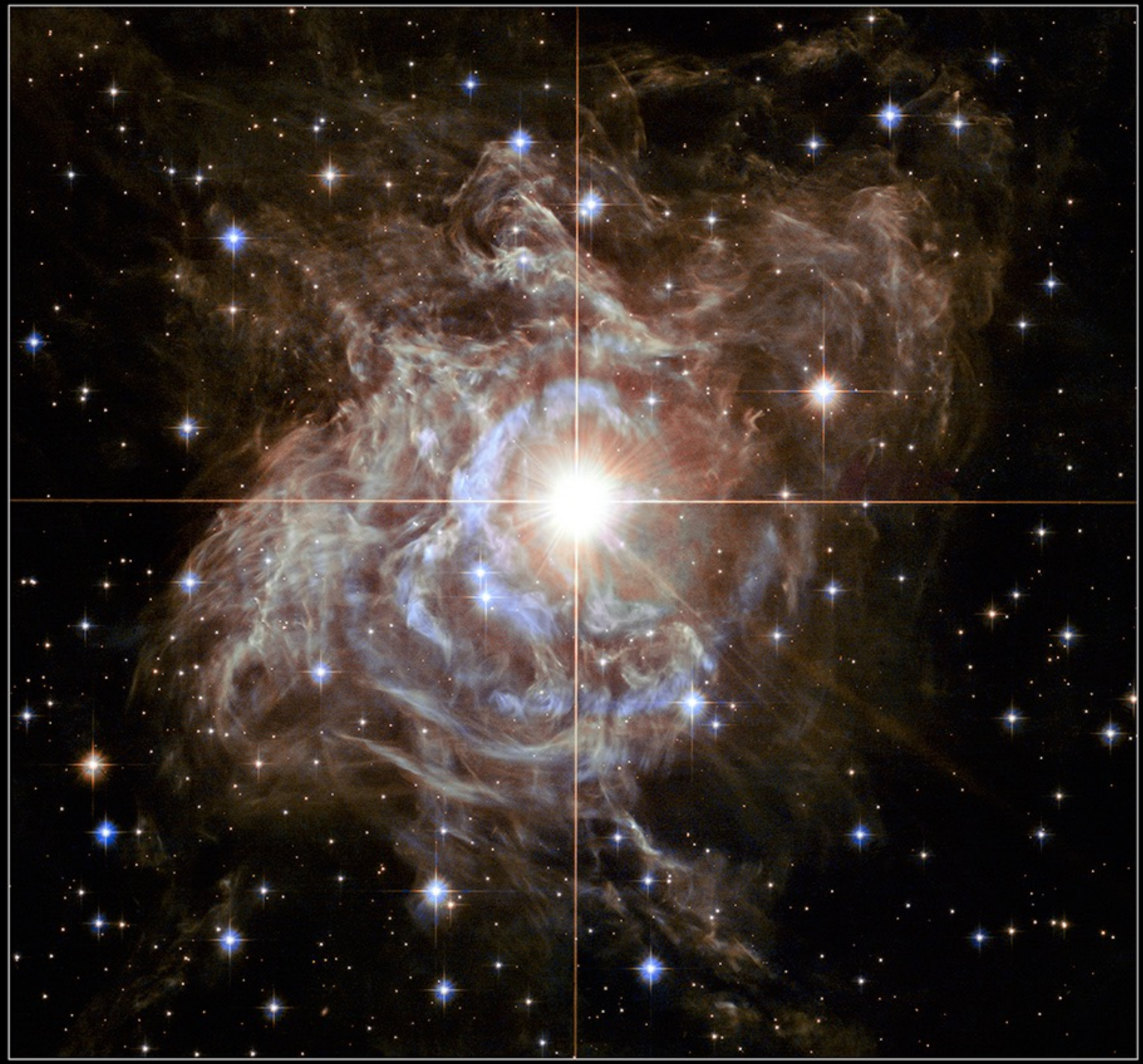


Photometry

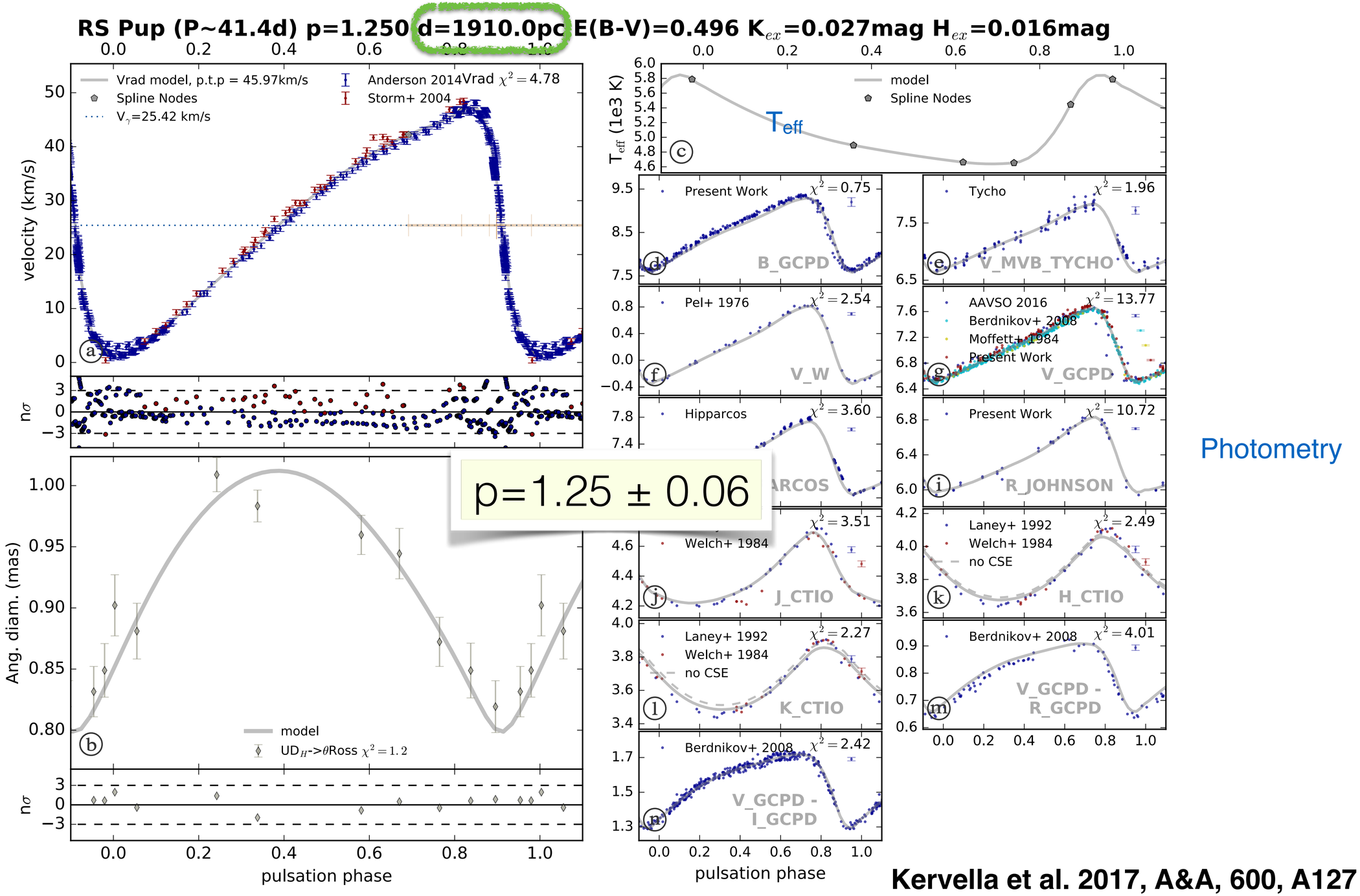
Mérand et al. 2015, *A&A*, 584, A80

RS Puppis

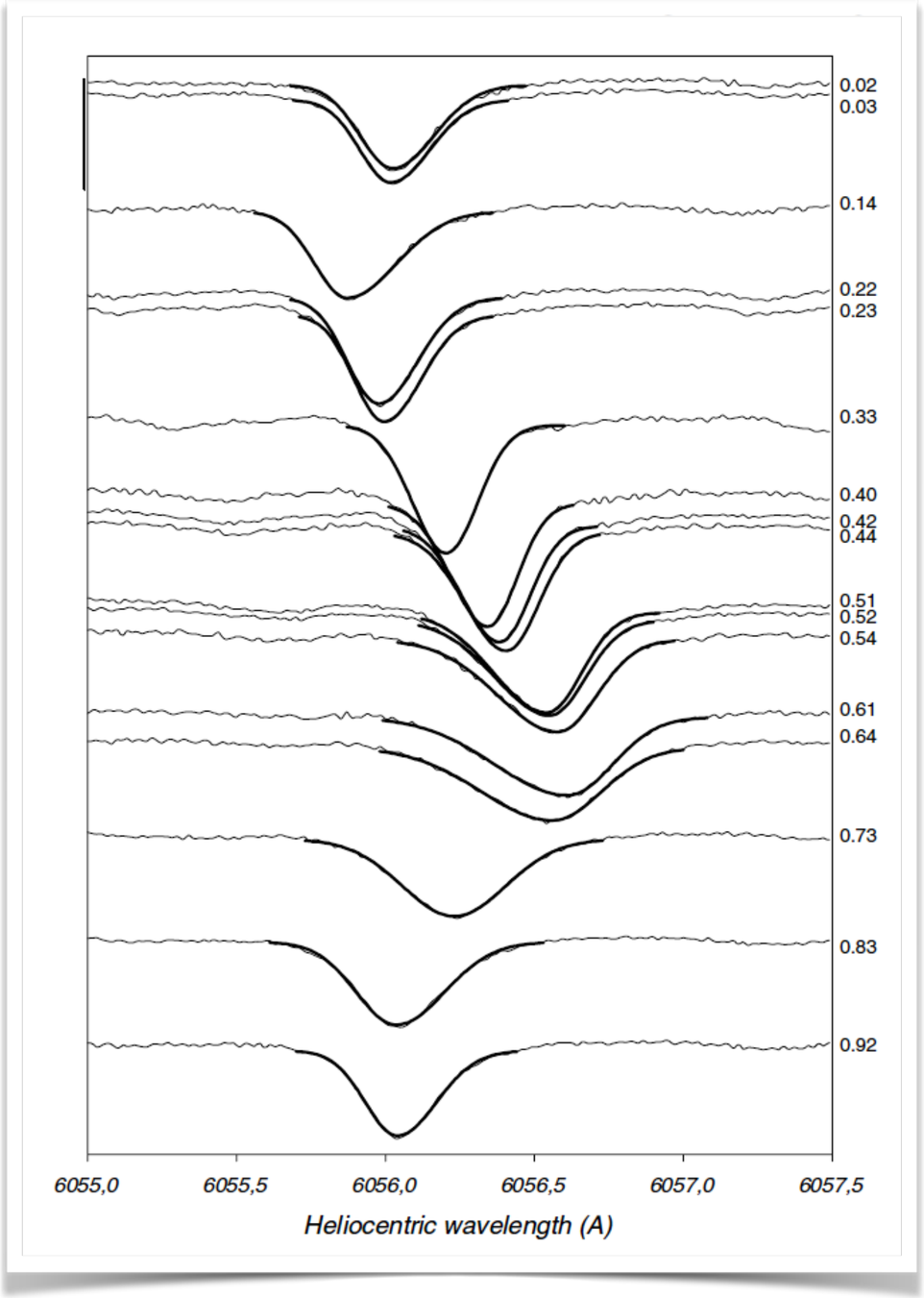
- Long-period Cepheid
  P = 41.5 days
- $\pi = 0.524 \pm 0.022$ mas
  (4.2%) from its light echoes



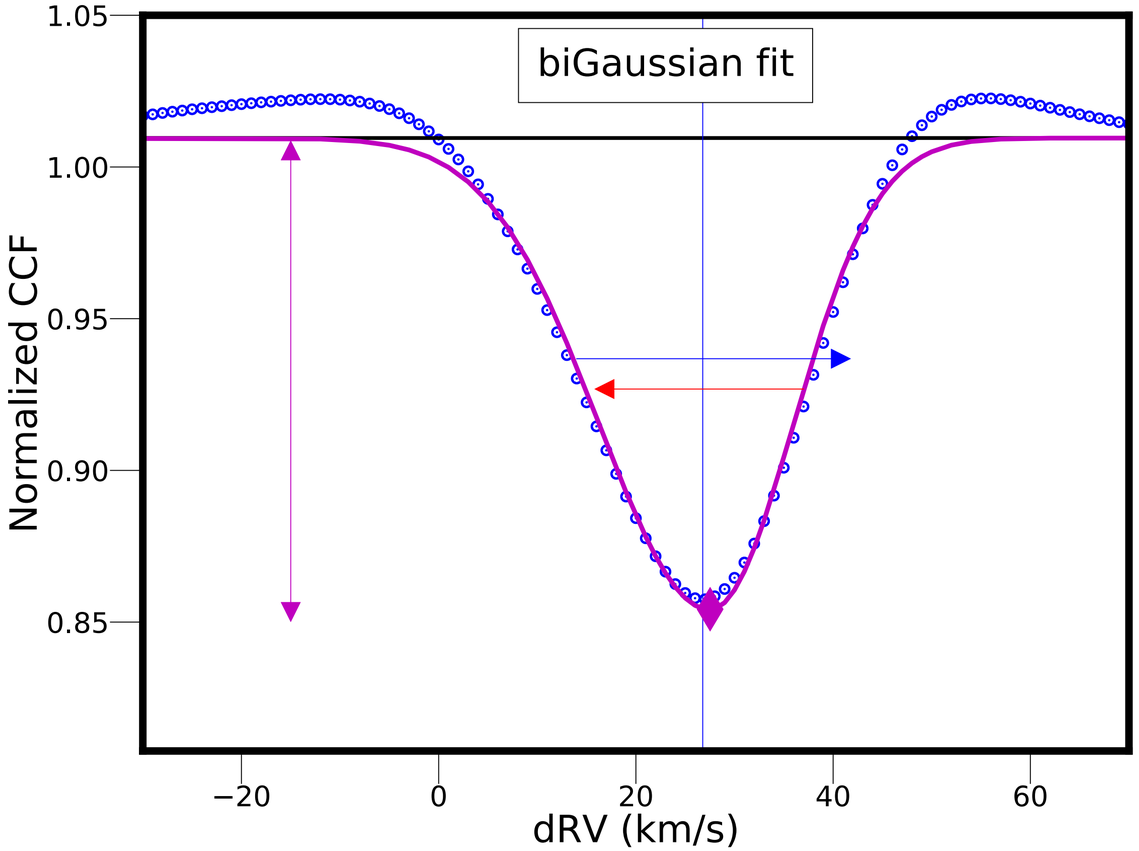
Kervella et al. (2014, A&A, 572, A7)



Kervella et al. 2017, A&A, 600, A127



HR-SPIPS

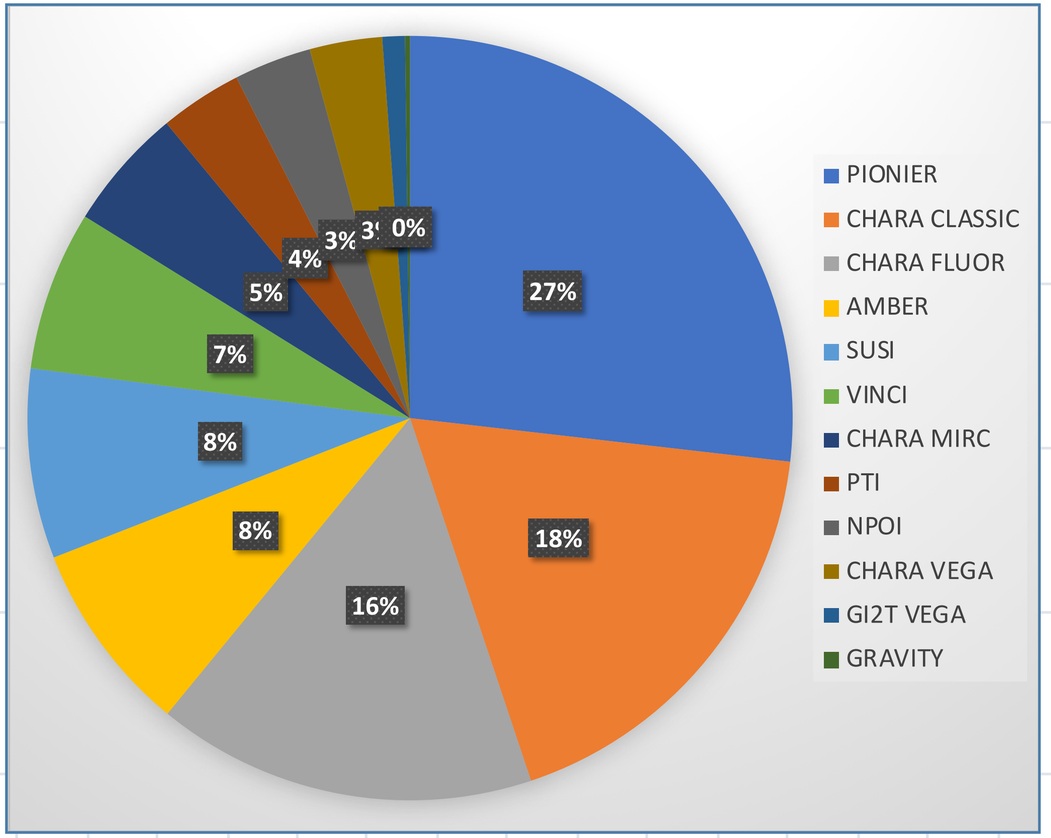


- Measurement of p-factor through comparison of observed cross-correlation functions to synthetic CCF profiles
- Post-doc of **Simon Borgniet** (LESIA)

Borgniet et al. 2018, A&A, in prep.

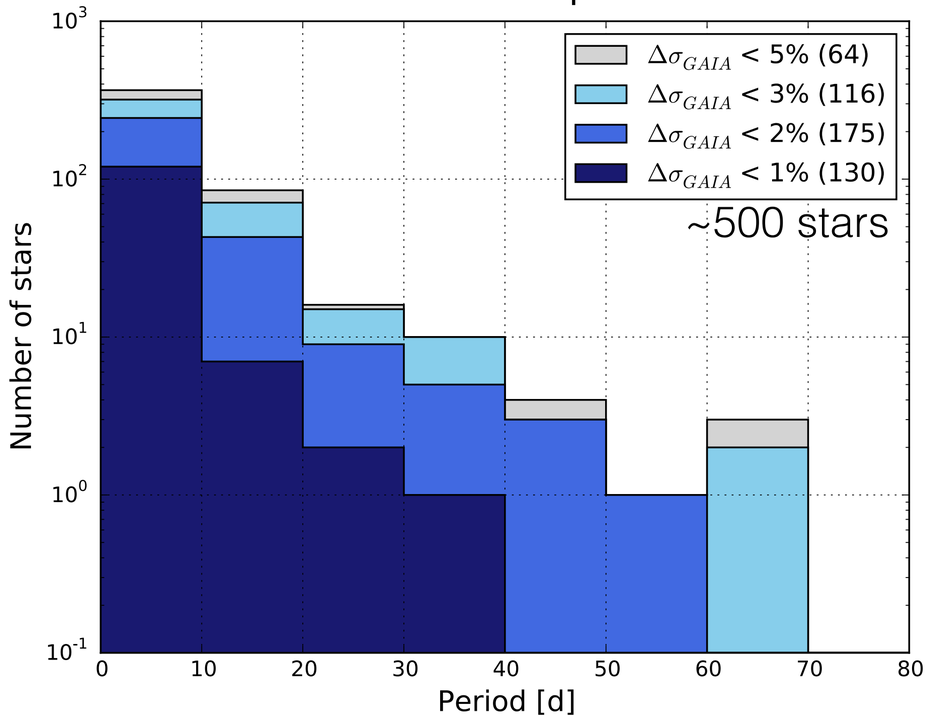
Interferometric observations of Cepheids

- More than 1000 individual epochs
- 42% VLTI, 39% CHARA, 19% others

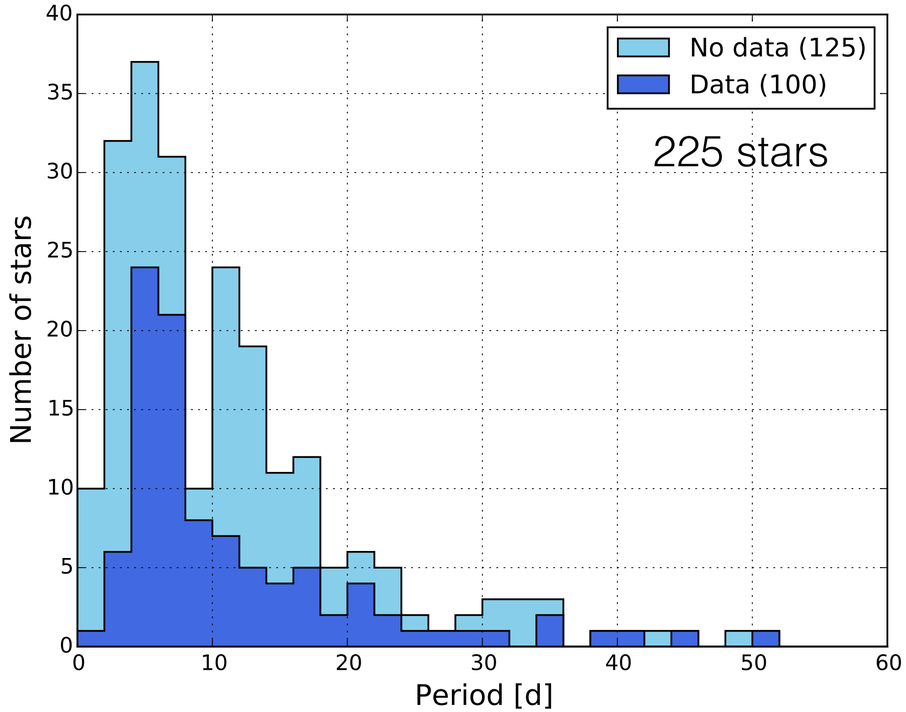


Galactic Cepheids with Gaia

Full sample

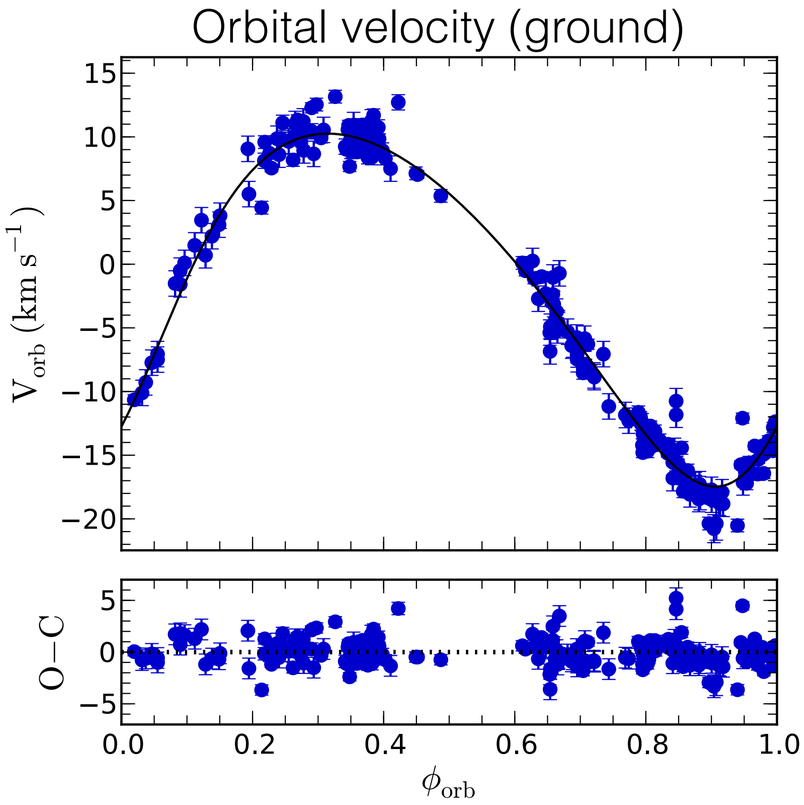


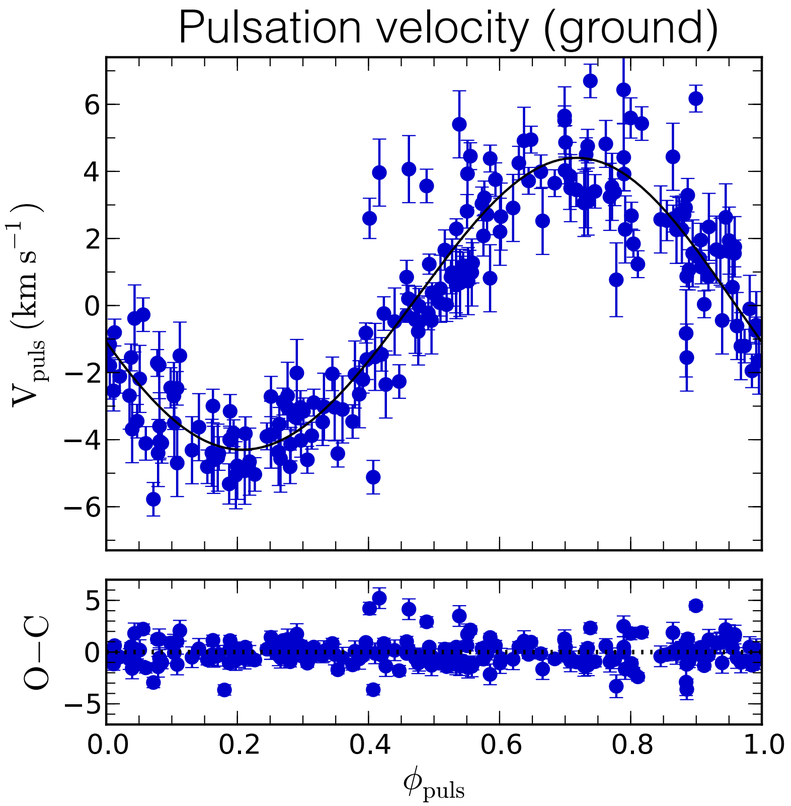
Selected sample

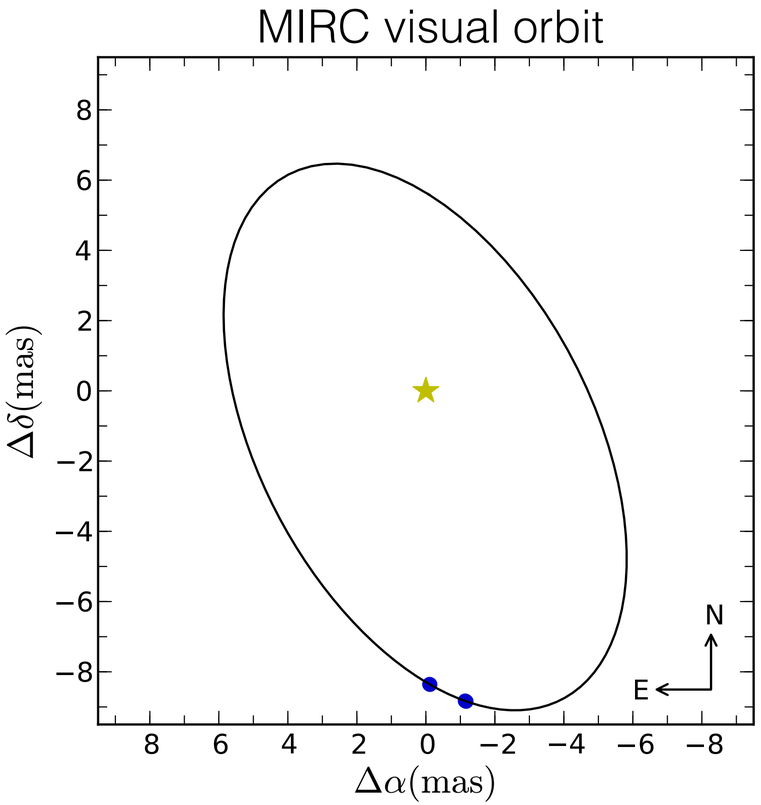


- ~35 stars with optical interferometry (full SPIPS) > **PhD thesis of Boris Trahin** (supervisors Pierre Kervella & Antoine Mérand)
- ~200 stars with radial velocities (SBC)
- ~500 stars with Gaia (+other) photometry + limited RV

Binarity: V1334 Cyg 2013





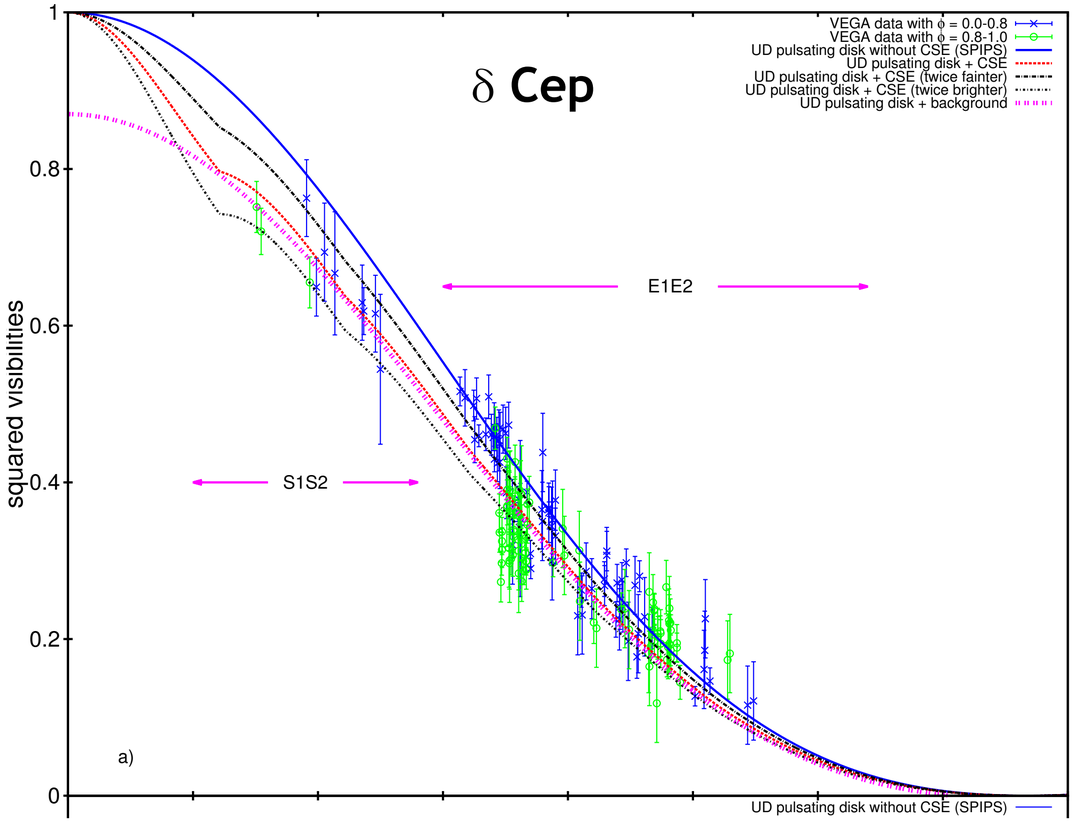


Gallenne et al. (2013, A&A, 552, A21)

Pulsation period = 3.3 days
Orbital period = 5.3 years

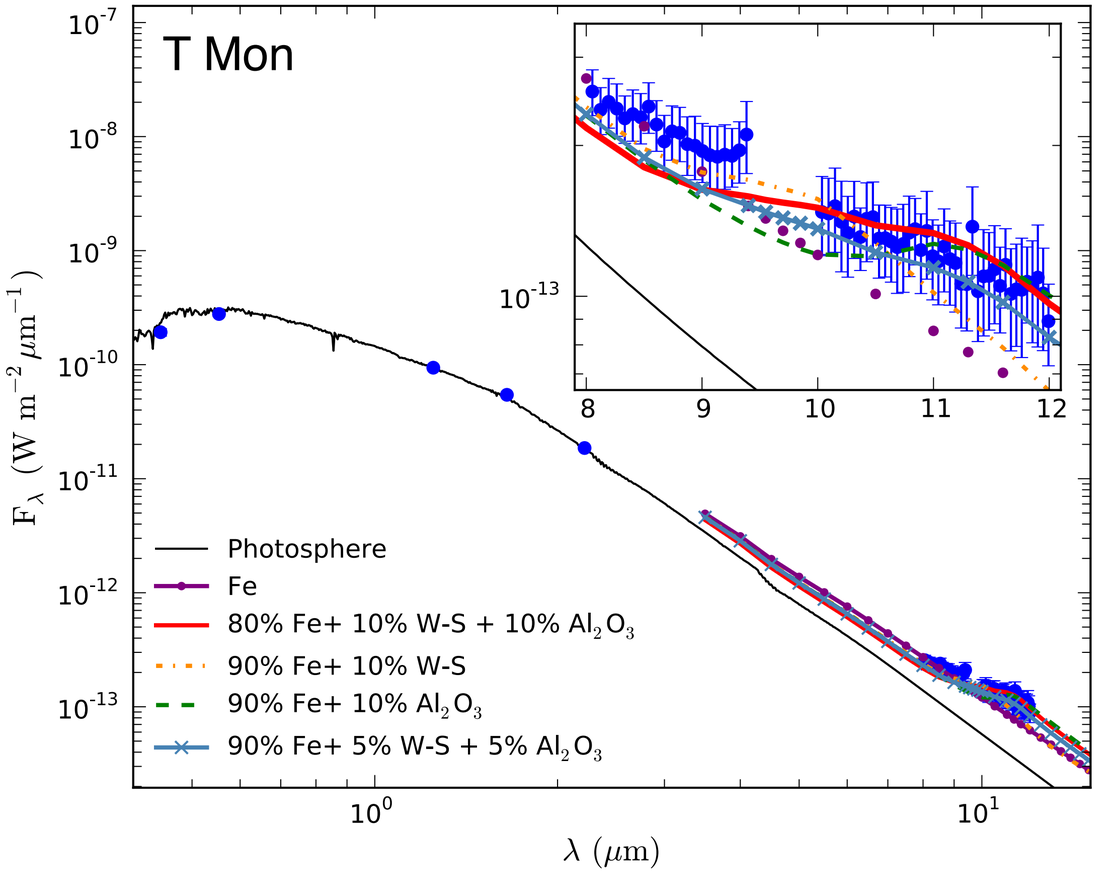
Circumstellar envelopes

- PhD student **Vincent Hocdé** (Nice) supervised by Nicolas Nardetto
- Detection of CSEs in the visible with VEGA



Nardetto et al. 2016, *A&A*, 593, A45

Gallenne et al. (2013, A&A, 558, A140)



Included in SPIPS modeling