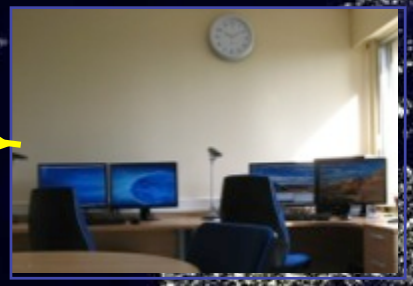
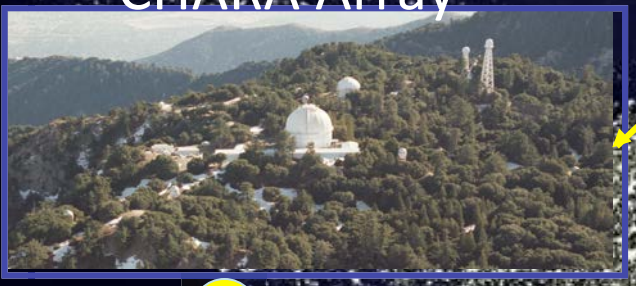
VEGA: status and science overview

N. Nardetto, D. Mourard, contribution from the VEGA group

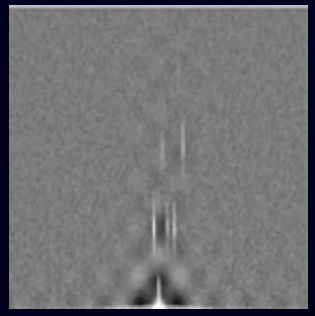
Remote control



CHARA Array



Mode 3T



Mode 4T

http://www-n.oca.eu/vega/en/publications/index.htm
Mourard+ 2009, 2011 ; Ligi et al. 2013

Already 8 years of VEGA/CHARA ! First light in 2007, September...

VEGA in few words:

- spectro-interferometer in visible band with R=(1700), 5000, 30000
- multi-program strategy: ~30 publications to date, ~30 on-going programs, ~30 active collaborators
- on site: 4TVEGA+ 6TMIRC
- routinely and remotely from Nice or Calern: 3TVEGA +3TCLIMB (as fringe tracking)
- limiting magnitude: mv=8 (r0=5cm; 21/09/12)
- ~50-60 nights per year with about 13 VEGA observers
- Open access to the french community through VEGA team
- interesting VO tools: pivot (management of the multi-program strategy), VEGA database
- 2015: first observations from Calern observatory

Track to the new observing remote station at 'Plateau de Calern'

We are here !

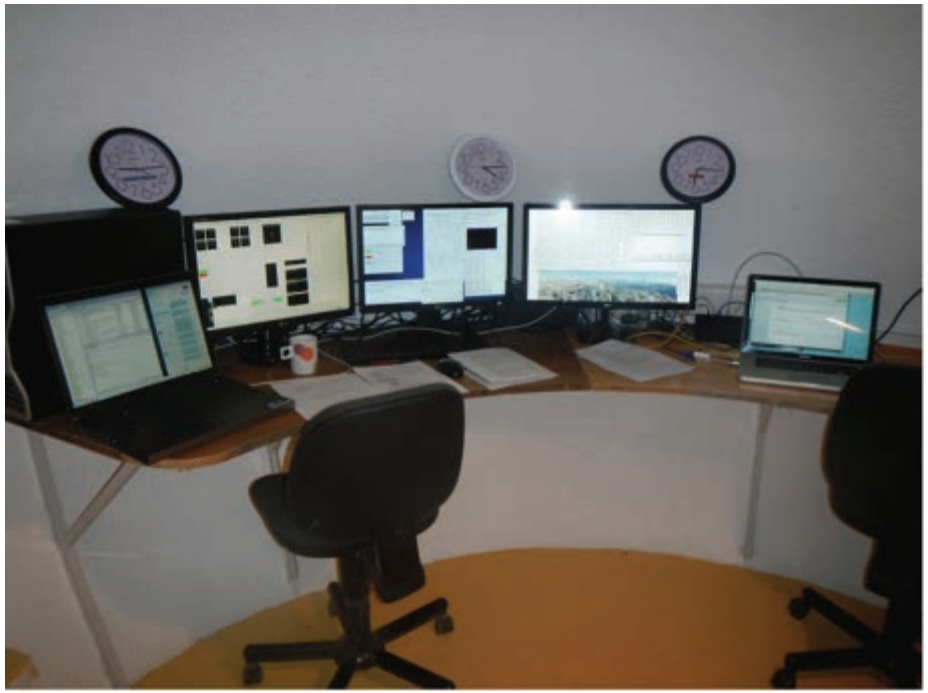
GI2T: Grand Interféromètre à 2 télescopes

GI2T: remote observing station of VEGA/CHARA at Calern Observatory ! Back to origin !

CHARA is inside !

New Calern Control Room ...

... with a new observer, Frédéric Morand: first run on CHARA in July 2015 and then observing support for all the remote runs of VEGA.



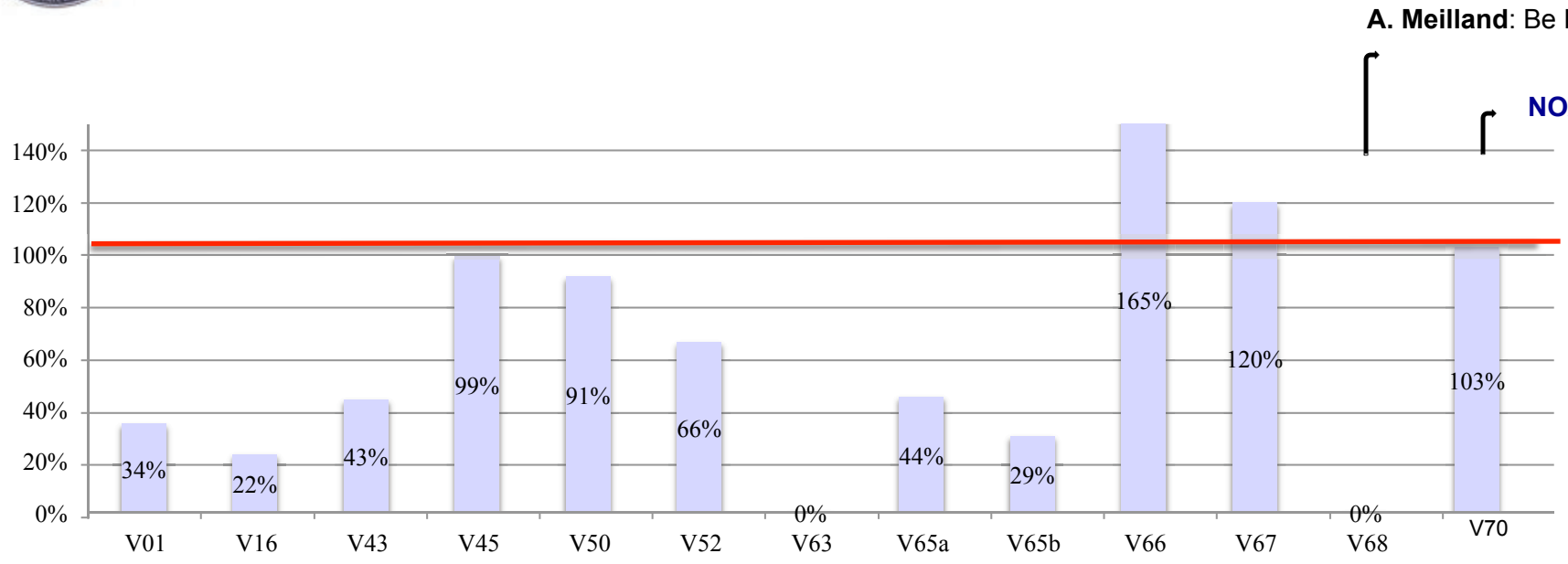
2015 observations

- 62 nights (including FRIEND prototype observations)
- 7 runs (two on site)
- 13 programs

	2013	2014	2015
# of Nights	59	48	62
# of Bad Nights (non-observing report)	17	13	16
# of Poor Nights (bad or average seeing)	7	10	24
# of Good Nights (data all the night)	35	25	22
% of Good Nights	0,59	0,52	0,35
# of measurements over the year	272	286	304
# of different observers over the year	13	13	14

As said by Chris: 30.6%
of lost nights. And about 35% of very good nights.

13 VEGA/CHARA proposals in 2015



R. Ligi: exoplanet host stars

K. Perraut: RoAp stars

O. Creevey: asteroseismic targets

F. Millour: Pleiades stars (rotators)

O. Creevey: metal poor targets

N. Nardetto: Cepheids

P. Stee: Flattening of a Bn star

D. Mourard: Hierarchical binaries

F. Millour: Be star Kappa Dra

A. Meilland: survey of Be stars

D. Huber: Oscillating Red giants

I. Measuring angular diameters (2015/2016)

Fundamental parameters

Measurement of very small angular diameters (about 0.35 mas)

- Perraut et *al.,* 2015, 579, 85 (78 Vir)
- Perraut *et al.*, 2016, A&A, sub. (HD24712)
- Creevey *et al.*, 2015, A&A, 575, 26

(metal poor targets)

Exoplanet host stars

Determination of the radius and density of a planet in transit 55 Cnc e

- Ligi et *al.,* 2016, A&A, 586, 94

Distances

The impact of rotation on the surface-brightness relation (used for eclipsing binaries distance indicators):

- Challouf, Nardetto et al. 2015, A&A, 579, 107 (theory)

First detection of a visible CSE around a Cepheid

- Nardetto et *al.*, 2016, submitted

II spectro-interferometry (specificity of VEGA in visible using spectral resolution)

51 Oph (Be star) Photosphere and geo-kinematical structure of the disk (using model)

Jamialahmadi+2015

Imaging capabilities of VEGA

Mourard+ 2015

Summary of VEGA contribution to CHARA meeting

Talks in this conference

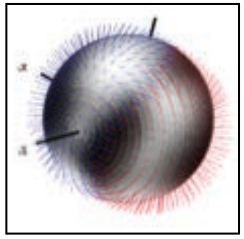
- Millour et al.: The Be star Kappa Dra and Be stars in Pleiades
- Creevey *et al.*, 2015, A&A, 575, 26 (Metal poor targets)
- Ligi et *al.,* 2016, A&A, 586, 94 (Exoplanet Host stars)

Quick overview in this talk

- Perraut *et al.*, 2016, A&A, submitted (roAp: HD24712)
- Perraut et *al.,* 2015, 579, 85 (roAp: 78 Vir)
- Nardetto et *al.*, 2016, submitted (The environment of Del Cep)
- Meilland et al.: The survey of Be star
- Jamialahmadi+2015 (flattening of a Bn star)
- Mourard+ 2015: The Be star Phi Per

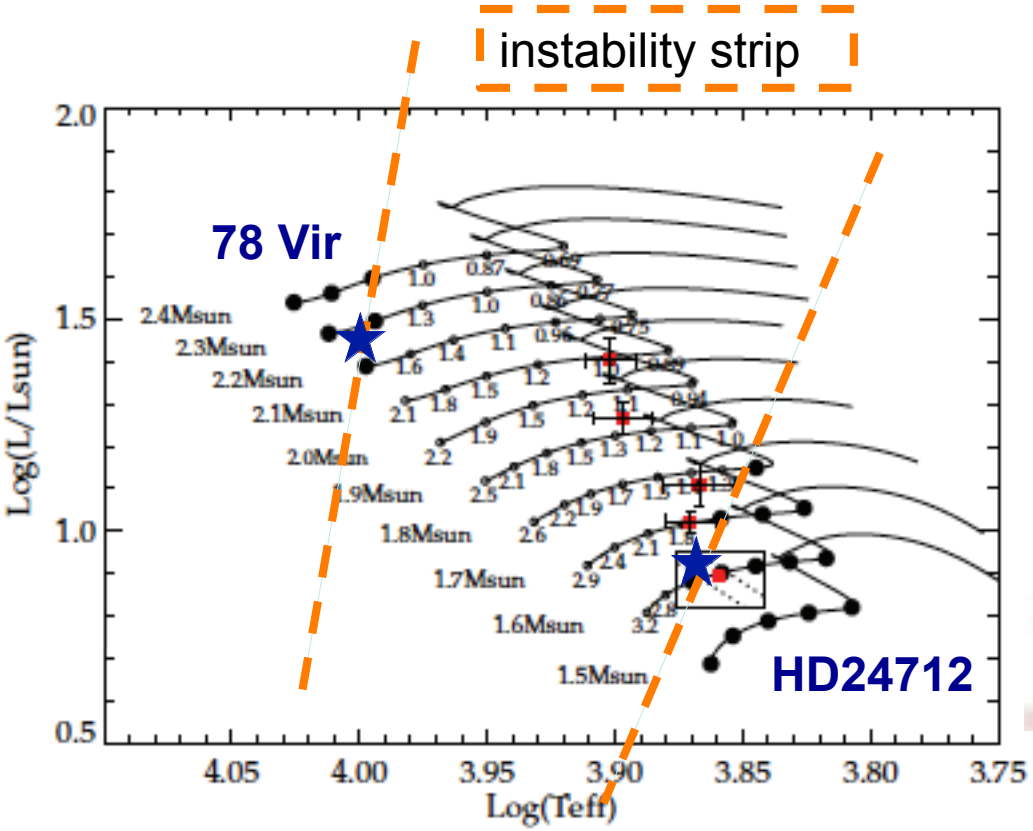
2015/2016 science highlights

Perraut et *al.*, 2015, 579, 85 (The roAp 78 Vir)
Perraut *et al.*, 2016, A&A, submitted (The roAp HD24712)



The two edges of the instability strip

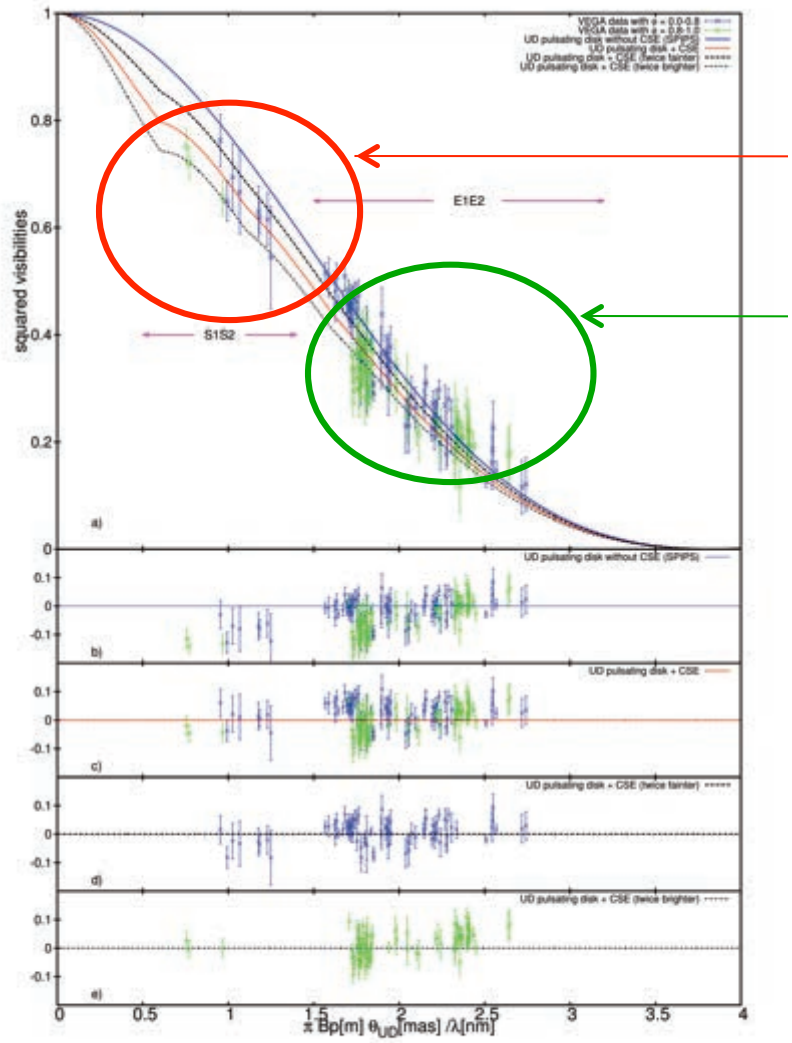
Could 78 Vir be a hot roAp star ?



Which excitation mechanism for the coldest roAp stars ?

2015/2016 science highlights

The environment of Del Cep: Nardetto et *al.*, 2016, accepted with revisions

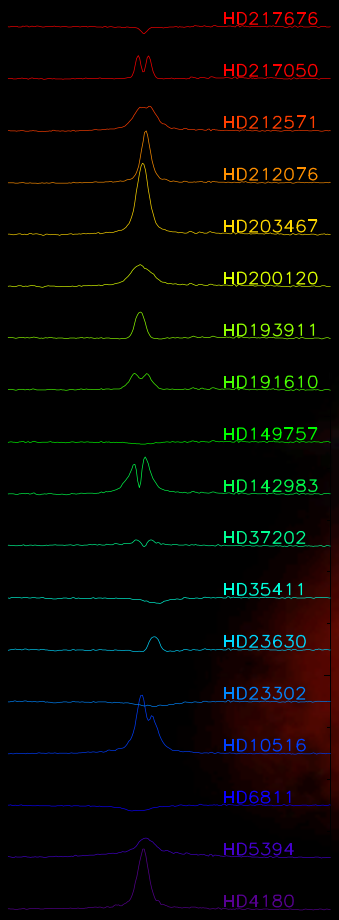


- S1S2: a resolved structure around δ *Cep* in the visible band (contribution of 7% in flux !). The same on η Aql.
- E1E2: at minimum radius (green dots), departure from the standard LD pulsating disk (reference SPIPS: Merand+ 2015)

- ANR UnlockCepheids (Kervella et al.): Unbias the PL relation of Cepheids from CSEs
- Good proposal for NPOI...

2015/2016 science highlights

Meilland et al.: the survey of Be stars with VEGA/CHARA (+AMBER/GRAVITY/MATISSE)

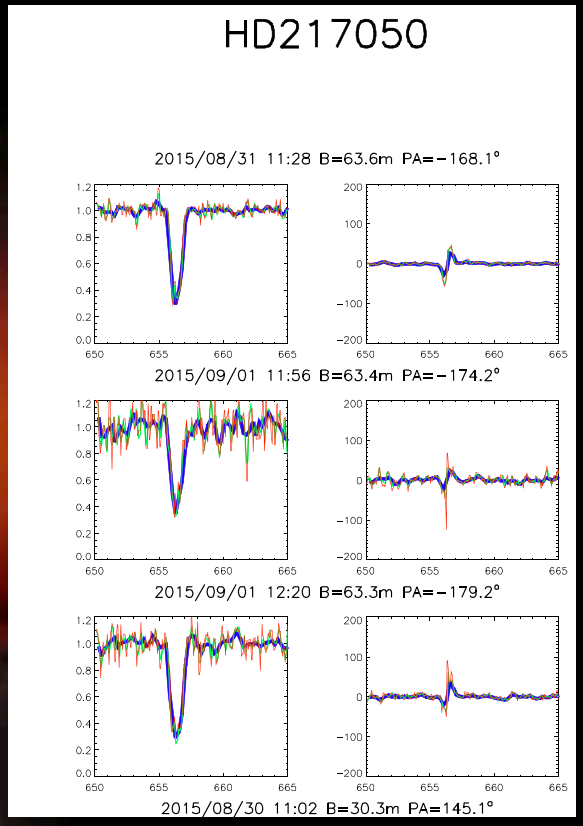


8 Stars observed before survey start last year

17 Stars observed in 2015
(+ 30 observed with AMBER)
77% of good data

Minimum of 40 stars needed
Programme should be
Finished by 2017

Statistics on photosphere
flattening and disk parameters
Image reconstruction



Example of differential visiblity & phase

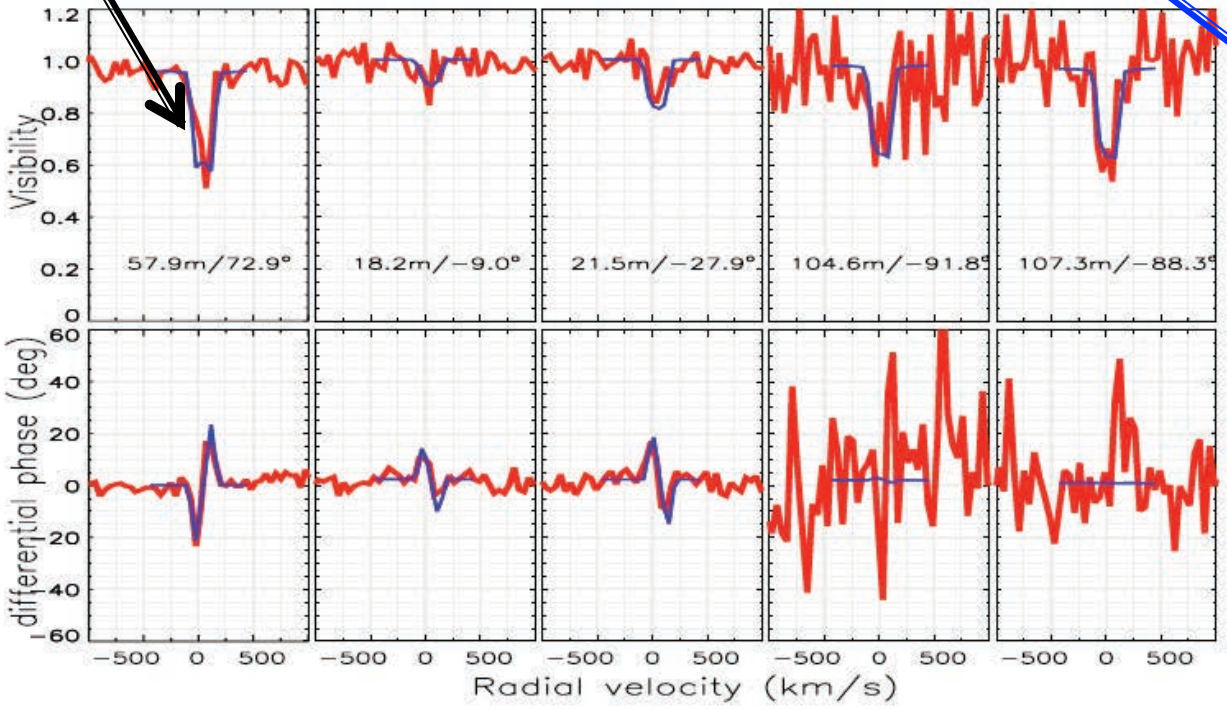
2015/2016 science highlights

Jamialahmadi+2015

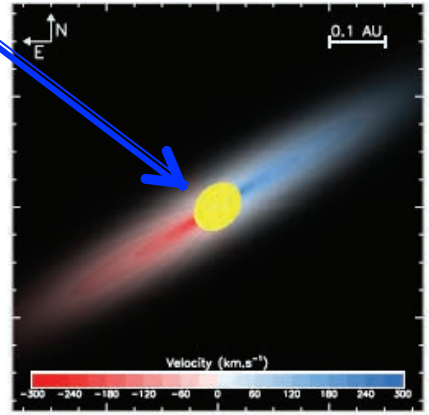
Parameter	Value
Major axis of θ_{eq}	0.6±0.05 mas
Minor axis of θ_{pol}	0.42±0.01 mas
Elongated ratio (θ_{eq}/θ_{pol})	1.45 ± 0.12
Position angle (PA)	138 ± 3.9°
χ^2_r	1.52

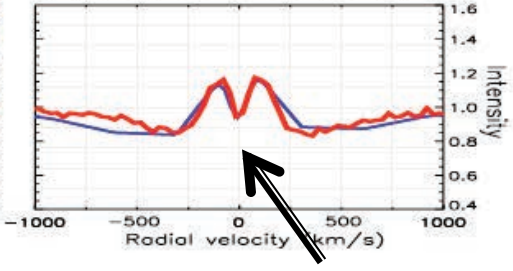
The flattening of 51 Oph is measured (stellar photosphere) !

red: observations
blue: modle



model



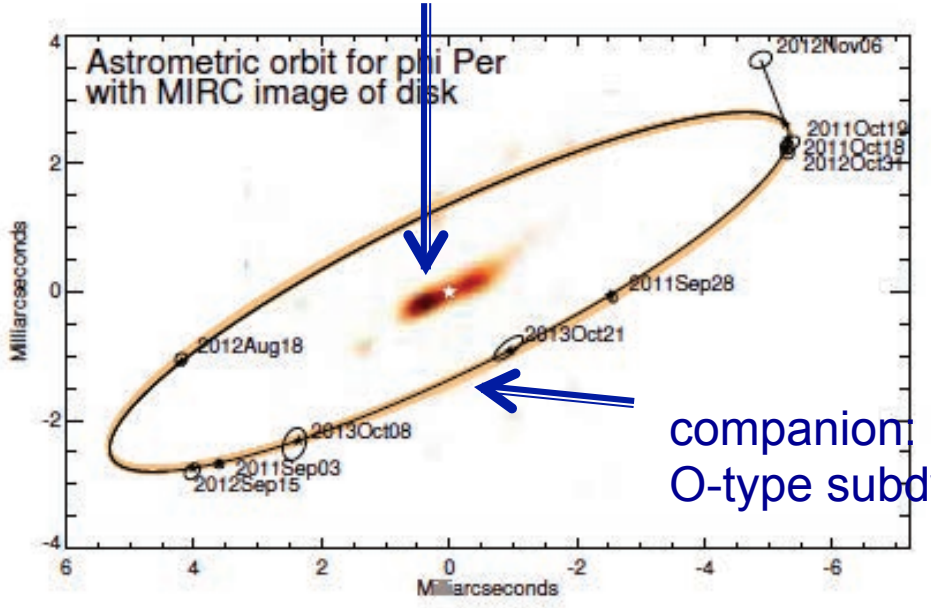


Hα emission line

The first step is to use models, the second is to make images !

2015 science highlights

φ Per Be star + rotating disk

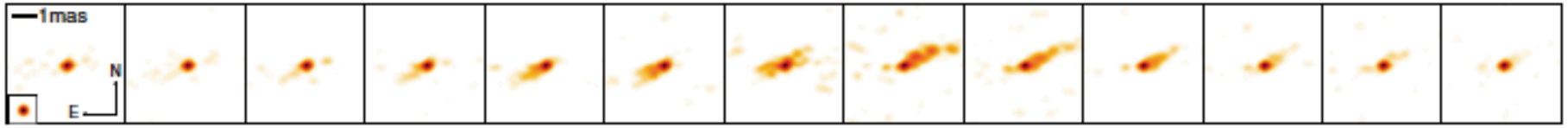


companion:
O-type subdwarf

Mourard+ 2015

Briefly: talk at CHARA meeting in Atlanta last year.

VEGA observations within Hα



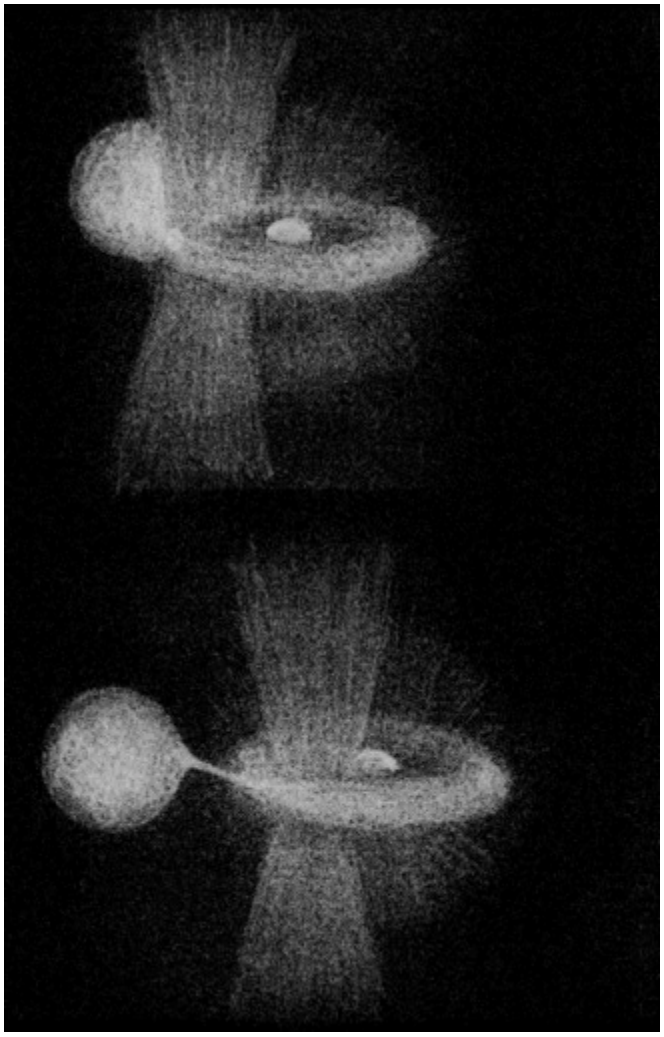
654.9nm

657.3nm

steps of 0.2 nm

Advanced drafts of paper

ξ Tau hierarchical system (Nemravová et al.)
β Lyrae (Nemravová et al.)
HR 7349 (Bigot et al.)
Nova Del (Mourard/Tallon-Bosc et al.)
Eclipsing binary in pleiades (Valls-Gabaud et al.)
Eclipsing binary λ Tau (Nardetto et al.)



Artist view by D. Bonneau of β Lyrae

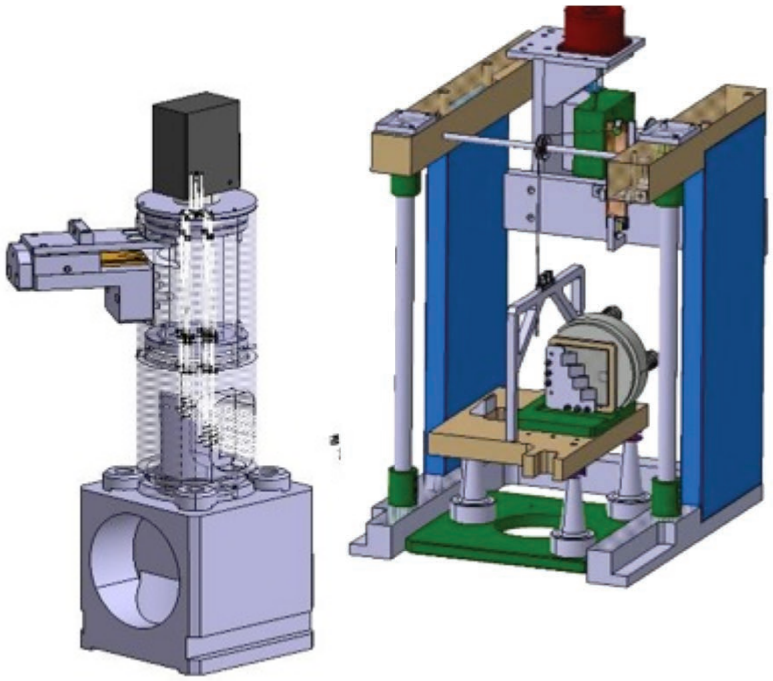
Technical news in 2015

• New Calern control room

Good things:
• robust baseline solution, stability of carts (much less vibrations), operations were smooth...

Difficulties:
• ~30% of night lost, ~30% of nights with bad or average seeing
• data PI => CHARA logs and VEGA database
• new system for imaging the pupils (problems and possibilities with OA -> next slide)

Imaging the CHARA pupils



Current situation but pupil from the OPLE-cat's eye + the BRT + the VEGA beam compressor.

Very different with LABAO

Important for:
- lateral control (loss of contrast, loss of injection)
- Longitudinal control (fresnel diffraction and loss of contrast + hard to control the lateral position)

Solutions:
- Changes the M2 of VEGA compressor…
- Add a Field Lens close to the M2 of VEGA compressor?
- Control of lateral position through the LABAO and M10?

PhD Students

1. Omar Delaa (*P. Stee*) => **defended in 2012**
2. Roxanne Ligi (*D. Mourard*) => **defended in 2013**
3. Mounir Challouf (*N. Nardetto & D. Mourard*) **=> defended in 2015**
4. Narges Jamialahmadi (*P. Berio et B. Lopez*) => **defended in 2015**
5. Simon Borgniet (*A.-M. Lagrange & N. Meunier*) => **defended in 2015**
6. Jana Nemravová (*Petr Harmanec & D. Mourard*) => end of 2016
7. Marc Antoine Martinod (*D. Mourard & K. Perraut*) => 2015-2018

8. Soon (start end of 2016 or end of 2017): PhD Thesis granted by the ANR UnlockCepheids of Pierre Kervella (*N. Nardetto & E. Lagadec*)

Note: no post-doc yet, in particular on CHARA !

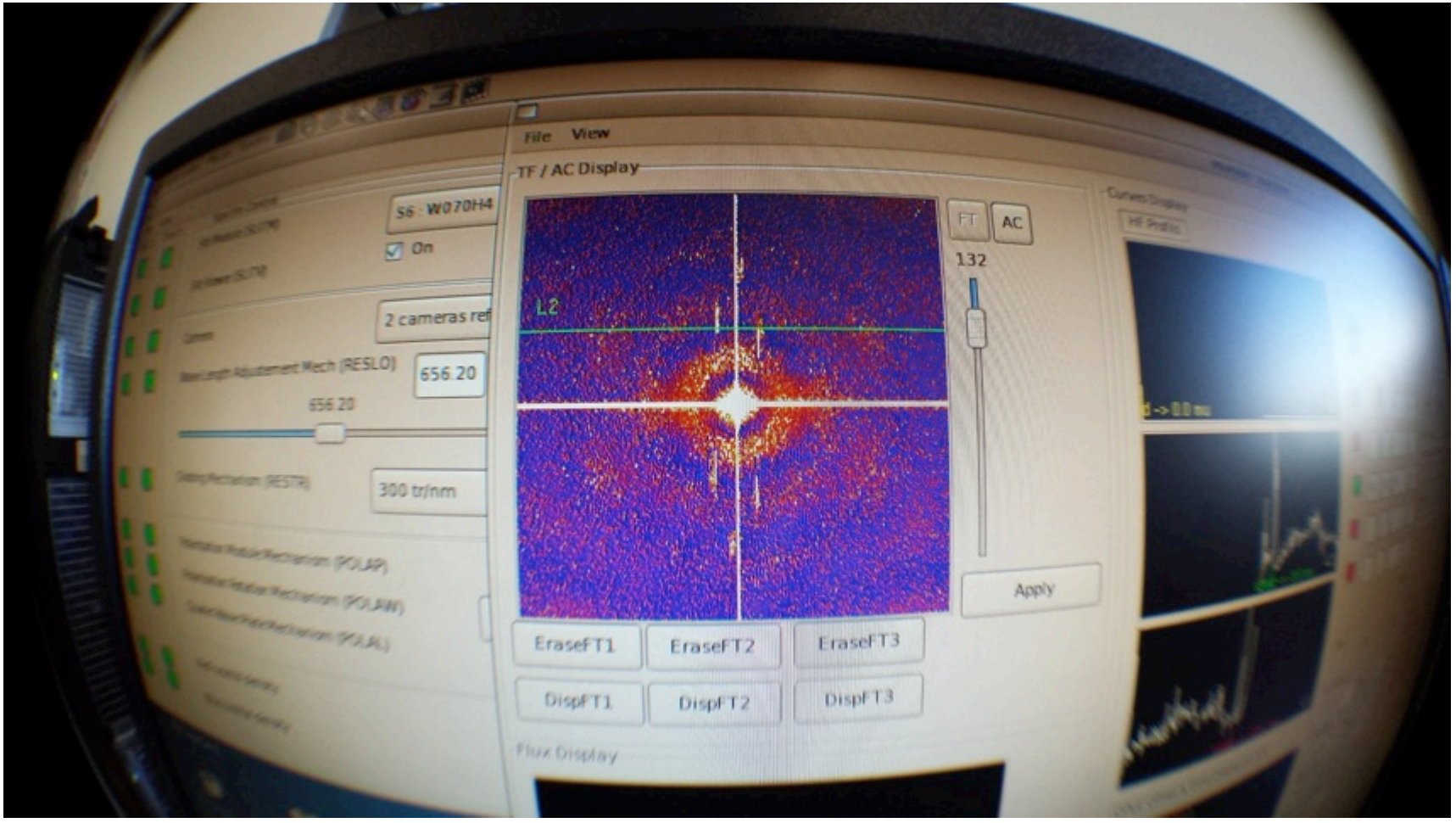
Perspectives

- After 8 years, the pressure is still high. Continue VEGA and push for the visible 6T instrument on CHARA.

- Push the exploitation of the HR mode of VEGA (VEGA 'niche') and test/use the LR mode (gain in magnitude)

- Pipeline automatisation in MR mode (gain of time for angular diameter determination)

- It would be nice to have a VEGA postdoc on CHARA...


File View
TF / AC Display
S6 : W070H4
On
2 cameras ref
656.20
656.20
300 tr/nm
L2
FT
AC
132
Apply
EraseFT1
EraseFT2
EraseFT3
DispFT1
DispFT2
DispFT3
Flux Display

Merci CHARA !