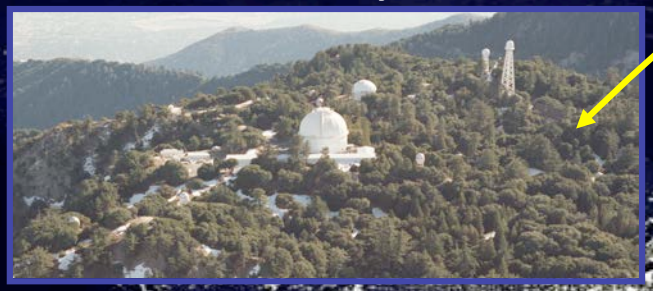
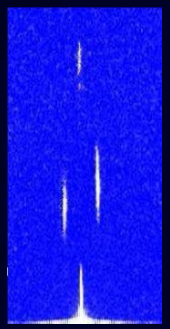
VEGA : Status, Science Overview and Future Plans

http://www-n.oca.eu/vega/en/publications/index.htm
VEGA : Mourard et al. (2009)

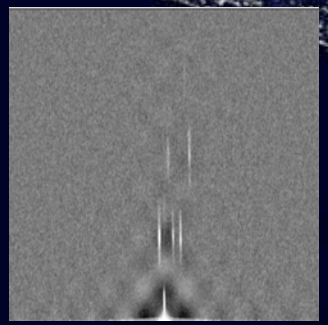
CHARA Array



Remote control



Mode 3T



Mode 4T

N. Nardetto, D. Mourard, K. Perraut, P. Berio
and all the VEGA team

VEGA: people and tools

Since D. Mourard accepted his new position at INSU (Astronomy in France) last June, the VEGA team has a new organisation.

PI : N. Nardetto

Technical aspects
D. Mourard
with Jean-Michel Clausse.
Technical support to observations

Preparation of runs/obs.:
CDS
JMMC Tools : SearchCal, Aspro2
VMT

PIVOT

vegaobs@oca.eu

Observations : K. Perraut

- people preparing VEGA runs : ~6
- people involved in observations: ~15 (+visitors)

vegadrs@oca.eu

Soft and data reduction:
P. Berio and I. Tallon-Bosc
- support to users
- analysis of uncertainties and bias

Scientific programs : N.Nardetto (with VEGA TAC)

~10 programs with data under processing and/or analysis/ modelling
~15 on-going programs
- 8 new programs for 2013

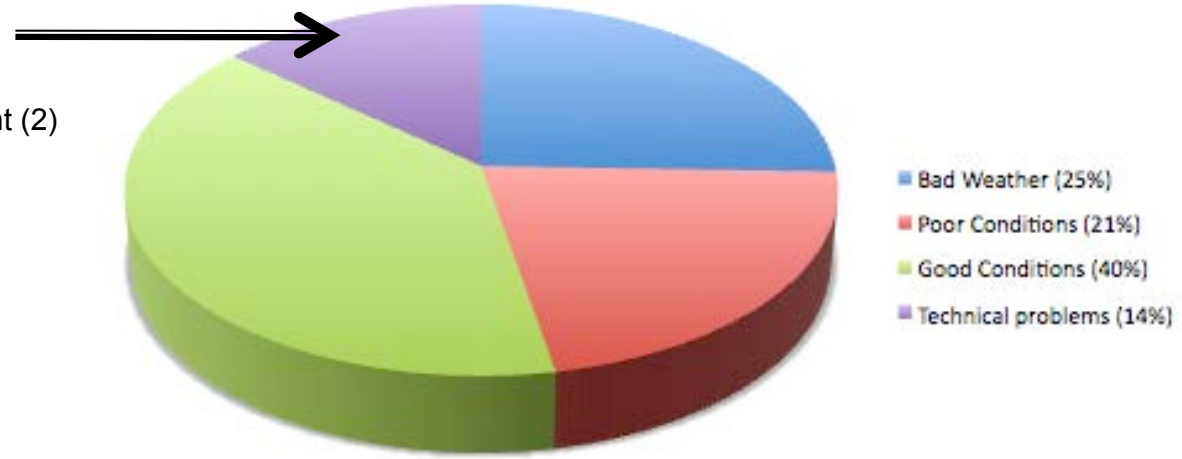
VEGA database
VEGA Twiki pages
JMMC Tools (LITpro)

Publications

Status of observations 2012

- Number of Runs: **9** (8 in remote control and 1 technical from April to Dec)
- Multi-programs runs
- Number of Nights : **51** + **4** technical

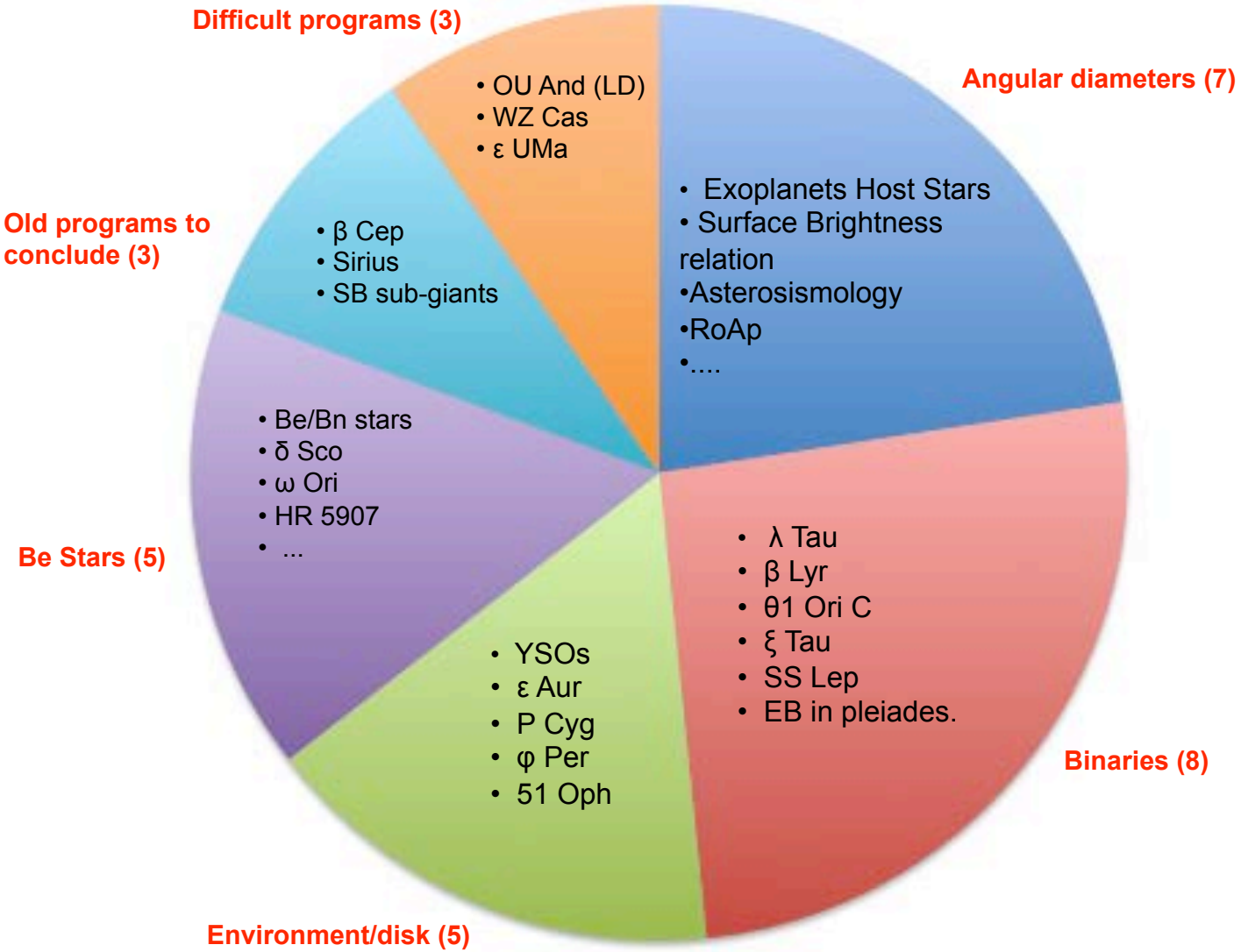
• chara (1n)
• chiller (4n)
• VEGA alignment (2)



- Number of calibrated measurements : ~**150** (about **7** measurements per night and **10** measurements for best nights)

To the Chara team : "many thanks for your help for quick magic intervention to repair the VEGA chiller and also for installing the new one..." It allows to save many VEGA nights at the end of 2012.

VEGA programs (~30 including 8 new for 2013)



Observations of 2013

2013 :

- Number of programs: **20** (including **8** news programs)
- The VEGA group can support no more than **50** nights per year (+ few technical nights).

⇒ Priorities will be put among these VEGA programs
⇒ New strategy: few objects per night, quick sequence C-T-C

- Several programs VEGA+MIRC (β Lyrae, , θ1 Ori C, ε UMa) or VEGA+FLUOR (surface brightness relation of late-type stars for LMC distance of eclipsing binaries)
- All VEGA programs need CLIMB as a fringe tracker (and for recording in some cases)

⇒ The CHARA array is unique in the world to provide such complementary data !

Status of publications

http://www-n.oca.eu/vega/en/news/index.htm (VEGA website)

2012

P12: "The relationship between gamma Cassiopeaie's X-ary emission and its circumstellar environment", Smith, Lopes, Motch et al., A&A 540, A53 (2012) (pdf)

P13: "A high angular and spectral resolution view into the hidden companion of eps Aurigae", Mourard, Harmanec, Stencel et al., A&A 544, A91 (2012) (pdf)

P14: "A new interferometric study of four exoplanet host stars: theta Cygni,14 Andromedae, ups Andromedae and 42 Draconis", Ligi, Mourard, Lagrange et al., A&A 545, A5 (2012) (pdf) → See Talk by Roxanne Ligi on Wenesday

P15: "The relationship between gam Cassiopeiae's X-ray emission and its circumstellar environment", Stee, Delaa, Monnier et al., A&A 545, A59 (2012) (pdf)

2013

P16: "Spectrally resolved interferometric observations of a cep and physical modeling of fast rotating stars", Delaa, O., Zorec, J., Domiciano de Souza, A. et al., accepted for publication in A&A (2013)

P17: "Enhanced Halpha activity at periastron in the young and massive spectroscopic binary HD 200775", Benisty, Perraut, Mourard et al., in revision for A&A

+ in preparation:

- 10 Aql (Perraut et al.)
- φ Per imaging (Mourard et. al.)
- Metal poor stars (Creevey et al.)
- SB relations for EBs (PhD Challouf et al.)
- CoRoT Target HR7349 (Creevey et al.)
- Eclipsing Binary λ Tau (Nardetto et al.)

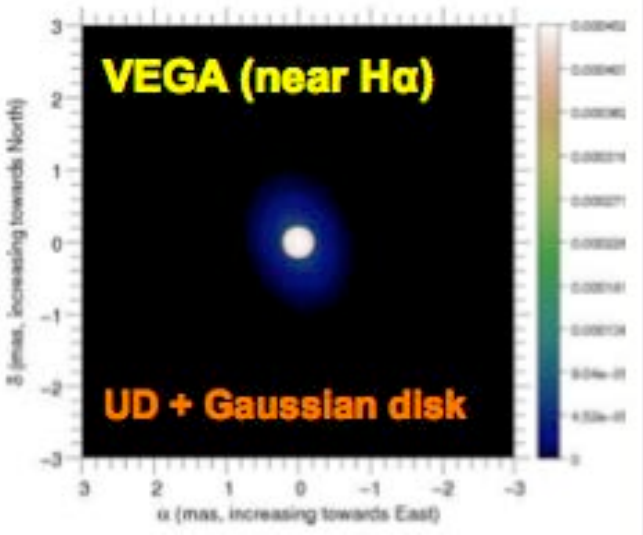
Two VEGA niches :

- high spatial frequencies for diameters and fundamental parameters
- high spectral resolution (kinematic)

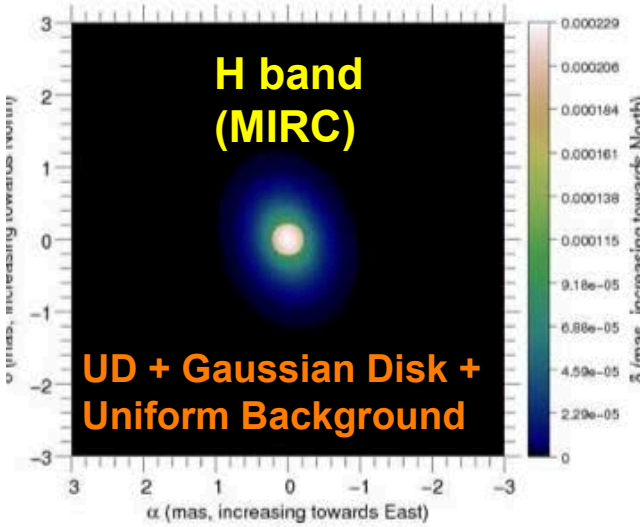
The relationship between γ Cassiopeiae's X-ray emission and its circumstellar environment

II. Geometry and kinematics of the disk from MIRC and VEGA instruments on the CHARA Array

Ph. Stee[1], O. Delaa[1], J. D. Monnier[3], A. Meilland[1], K. Perraut[2], D. Mourard[1], X. Che[3], G. H. Schaefer[8], E. Pedretti[14], M. A. Smith[4], R. Lopes de Oliveira[5], C. Motch[6], G. W. Henry[7], N. D. Richardson[8], K. S. Bjorkman[9], R. Bücke[10], E. Pollmann[11], J. Zorec[13], D. R. Gies[8], T. ten Brummelaar[8], H. A. McAlister[8], N. H. Turner[8], J. Sturmann[8], L. Sturmann[8], and S. T. Ridgway[12]



Parameters	Gaussian model	
	Visible band	near-IR band
θ_{disk} (mas)	0.76 ± 0.05	0.82 ± 0.08
$\delta\theta_{disk}$ (mas)	–	–
f	1.36 ± 0.08	1.33 ± 0.08
PA (deg)	19 ± 5	12 ± 9
F_{disk} (%)	45 ± 9	53 ± 2
F_{bg} (%)	–	12 ± 1
χ^2_r	3.03	3.96



Conclusion : (1) the disk is increasing in size (V_{exp}=0.2km/s), (2) the disk is in contact with the star, (3) in Keplerian rotation and (4) without 1-arm feature (and without any secondary star), (5) the star is in critical rotation

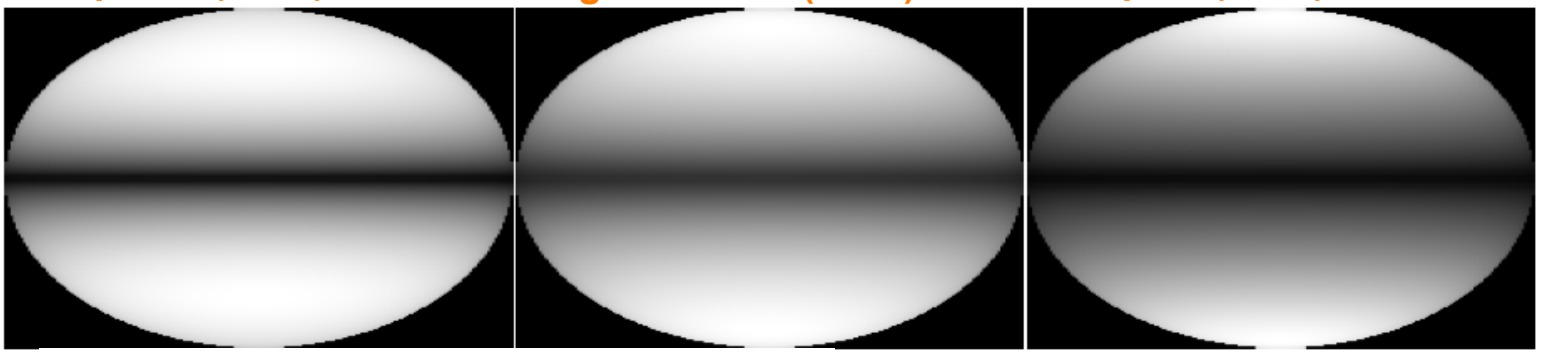
Spectrally resolved interferometric observations of α Cep and physical modeling of fast rotating stars

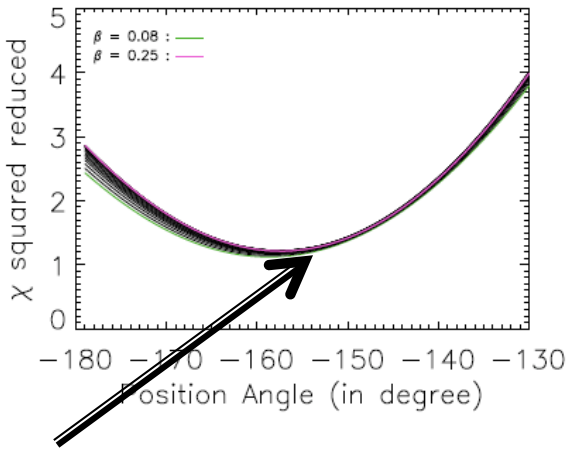
O. Delaa[1,2], J. Zorec[2], A. Domiciano de Souza[1], D. Mourard[1], K. Perraut[3], Ph. Stee[1], Y. Frémat[4], J. Monnier[7], S. Kraus[7], X. Che[7], Ph. Bério[1], D. Bonneau[1], J.M. Clausse[1], M. Challouf[1], R. Ligi[1], A. Meilland[1], N. Nardetto[1], A. Spang[1], H. McAlister[5,6], T. ten Brummelaar[6], J. Sturmann[6], L. Sturmann[6], N. Turner[6], C. Farrington[6] and P.J. Goldfinger[6]

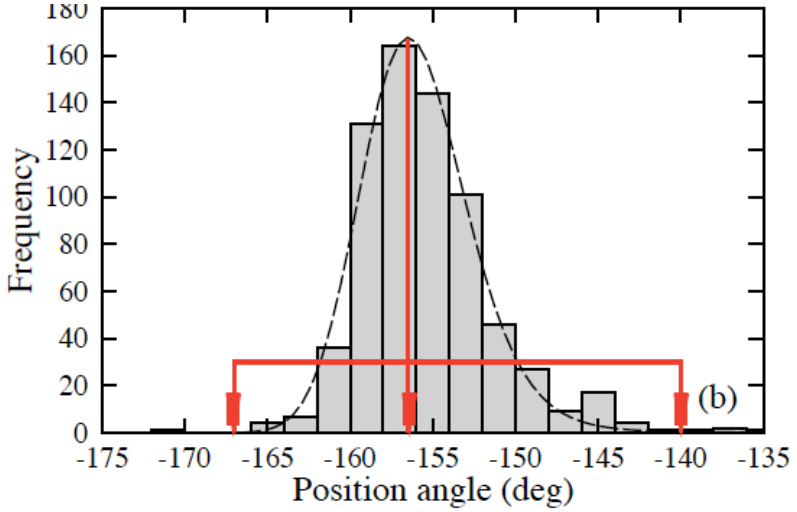
The pole turn faster the equator (α > 0)

Rigid rotation (α = 0)

The Equator turn faster the pole (α < 0)





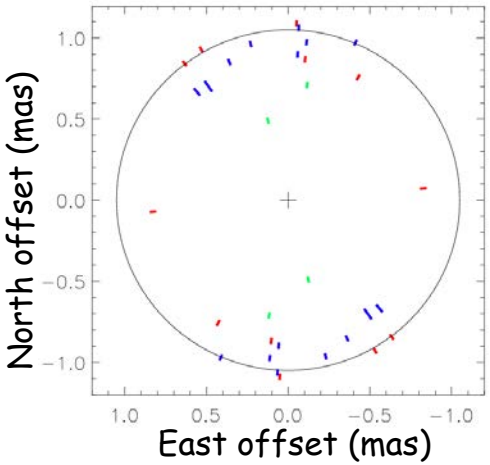


PA=-158°+-17°

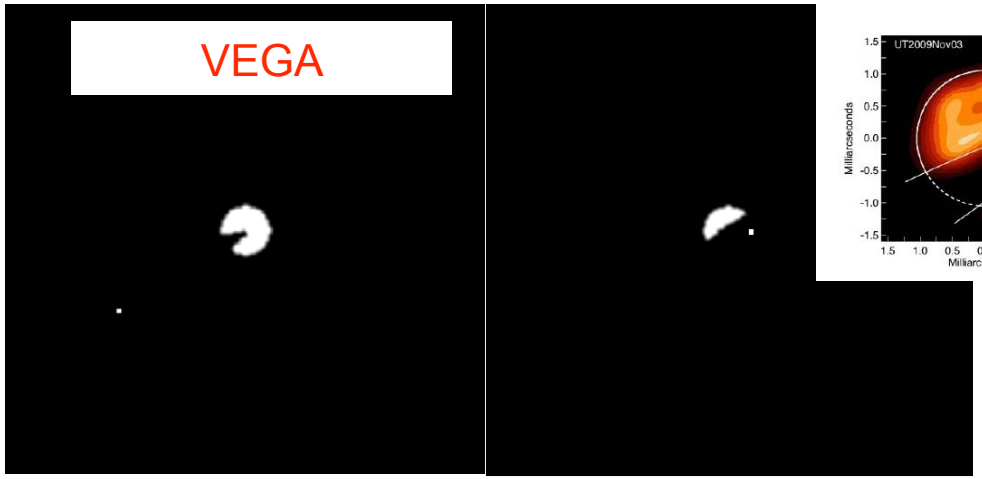
Conclusions :
1/ Theoretical result : stellar brightness distribution (β) modified by the differential rotation (α)...
2/ in-depth analysis of VEGA data to determine PA.

A high angular and spectral resolution view into the hidden companion of ε Aurigae⋆,⋆⋆,⋆⋆⋆

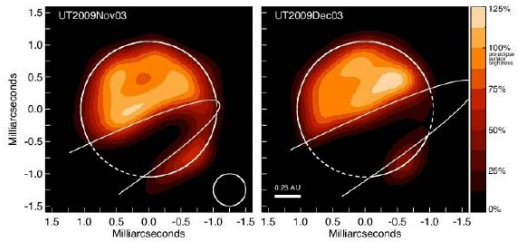
D. Mourard[1], P. Harmanec[2], R. Stencel[3], Ph. Bério[1], O. Chesneau[1], J. M. Clausse[1], R. Ligi[1], N. Nardetto[1], K. Perraut[4], Ph. Stee[1], I. Tallon-Bosc[5], H. McAlister[6,7], T. ten Brummelaar[7], S. Ridgway[8], J. Sturmann[7], L. Sturmann[7], N. Turner[7], C. Farrington[7], and P. J. Goldfinger[7]

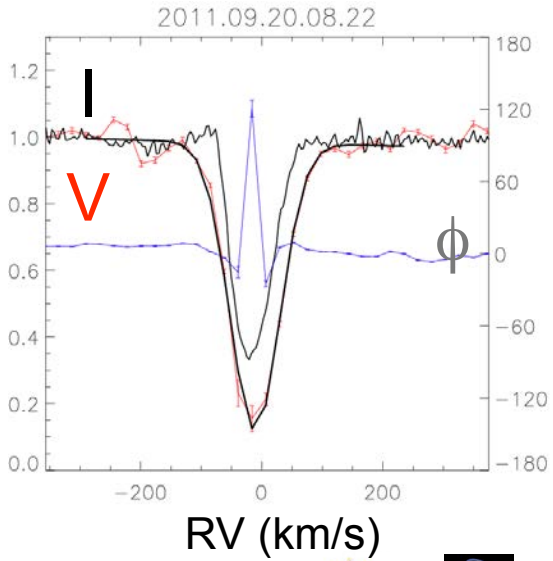


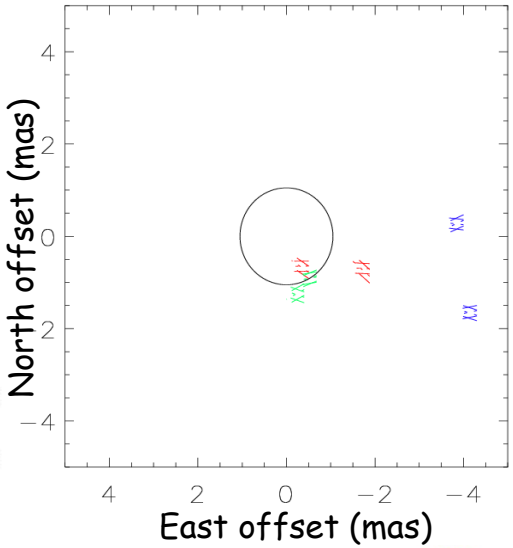
VEGA



MIRC



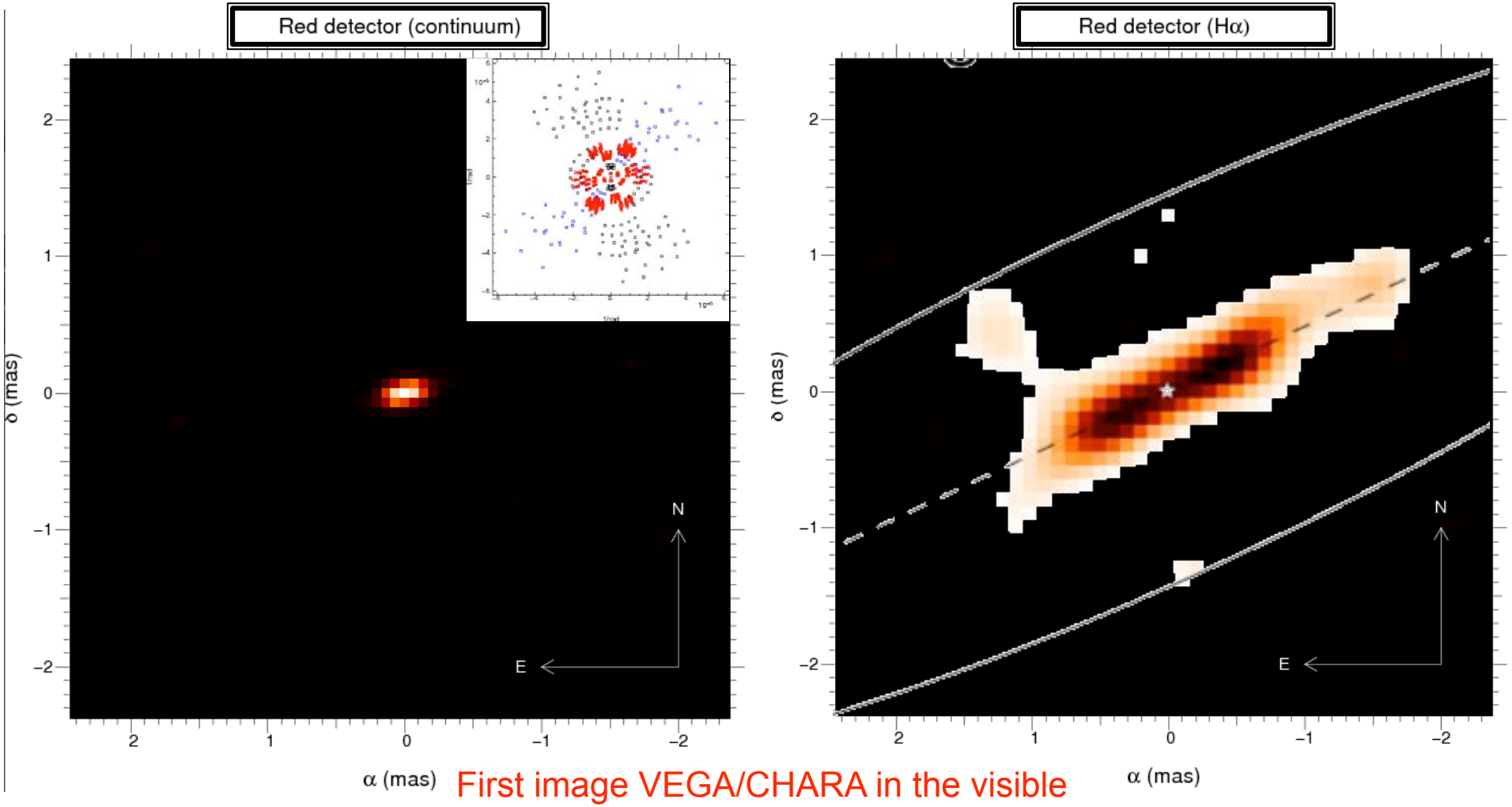




- Confirmation of dark disk and of its orbital motion
- Hα very close to the F star
- Existence of a wind and of a possible filling Roche lobe on the F atmosphere

ϕ Persei (Mourard et al.)

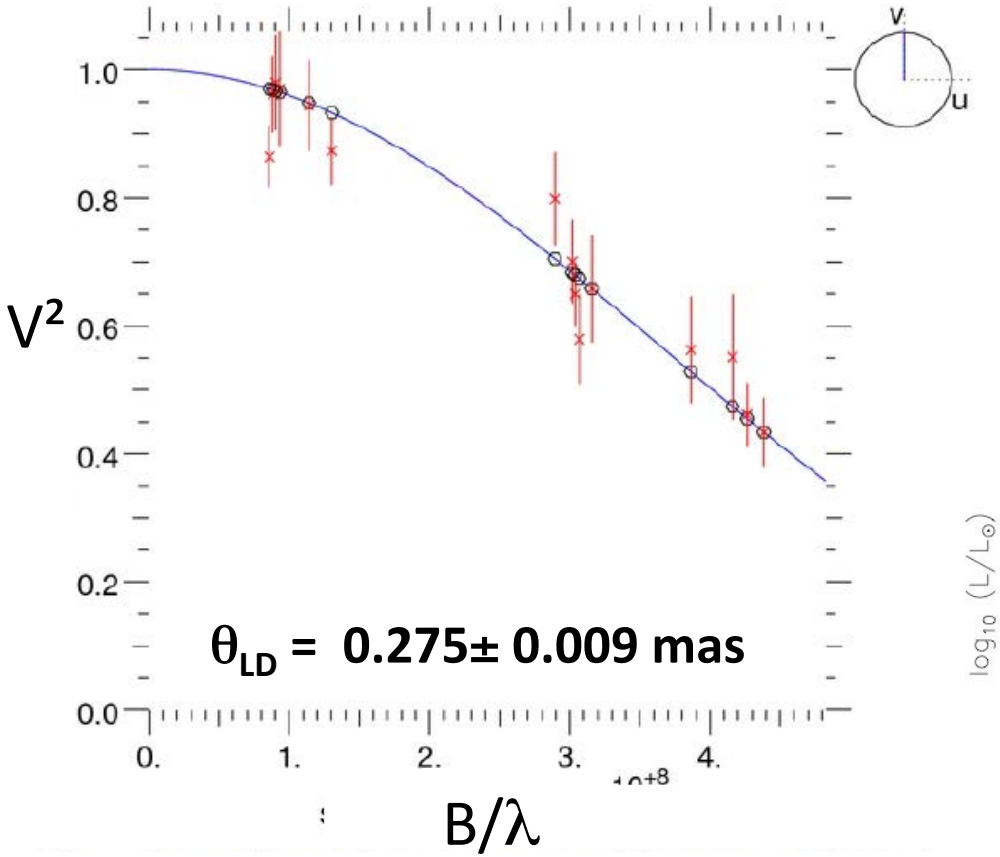
VEGA Image reconstruction done by Millour et MIRC image reconstruction done by Monnier/Che



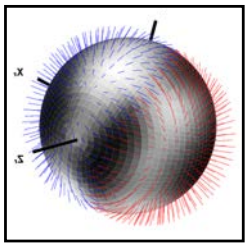
First image VEGA/CHARA in the visible
Disk orientation consistent with MIRC
Quantitative analysis in progress...

10 Aql (RoAp) : Perraut et al. (in prep)

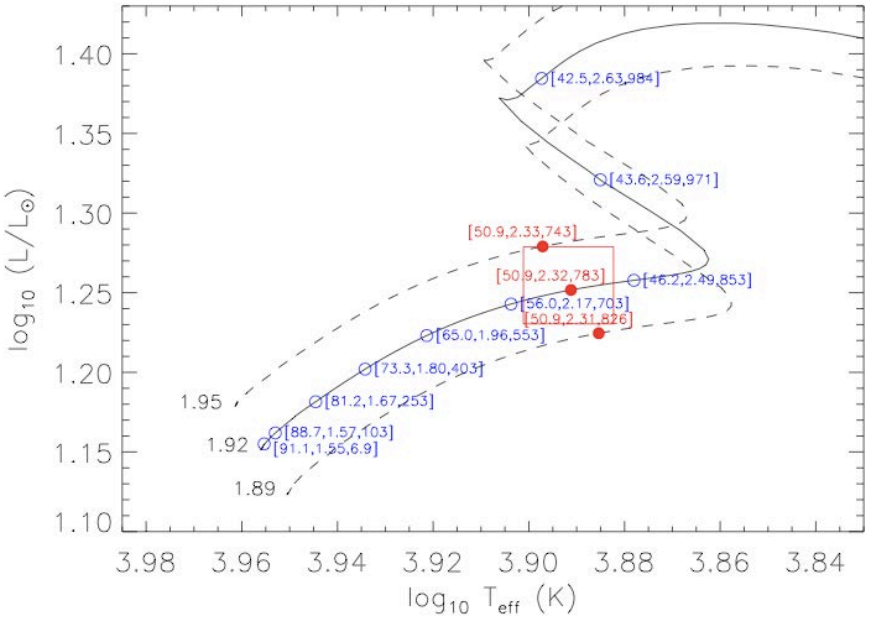
Determining the position of 10 Aql in the HR diagram to constrain Teff law (biased by spots) and also to better understand the pulsating mechanisms.



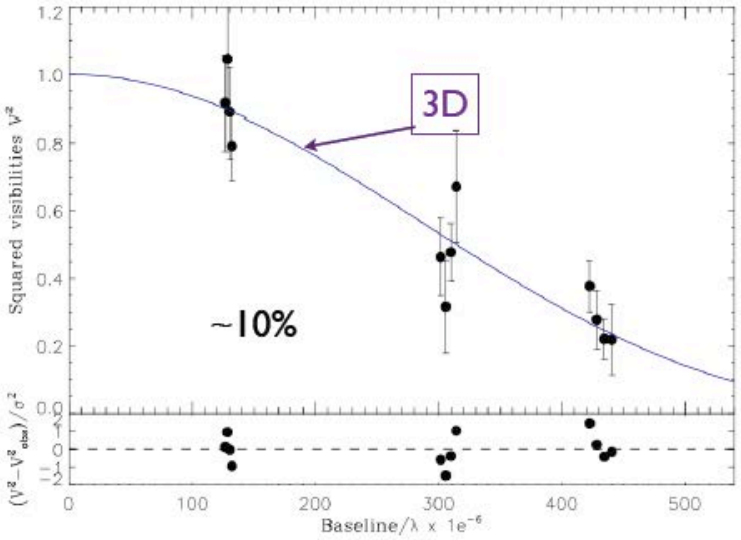
θ_{LD} = 0.275± 0.009 mas



R = 2.318 ± 0.090 $R_\odot$



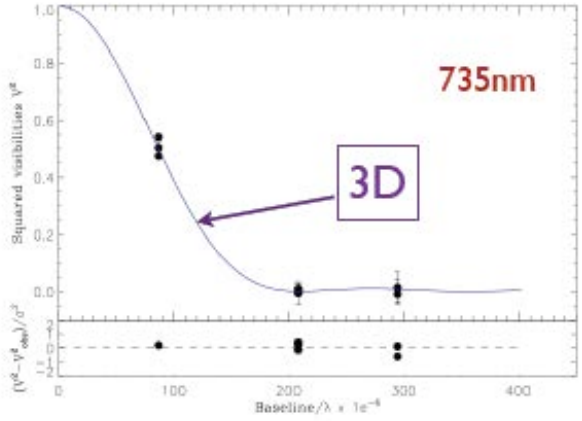
Benchmark metal-poor stars HD140283 (Creevey et al. in prep.)



$\theta_{UD} \pm \sigma$ (mas)	$\theta_{1D} \pm \sigma$ (mas)	$\theta_{3D} \pm \sigma$ (mas)
0.337 ± 0.029	0.352 ± 0.029	0.351 ± 0.029

$$\chi^2 = 0.77$$

CoRoT target HR7349 (Creevey et al. in prep.)

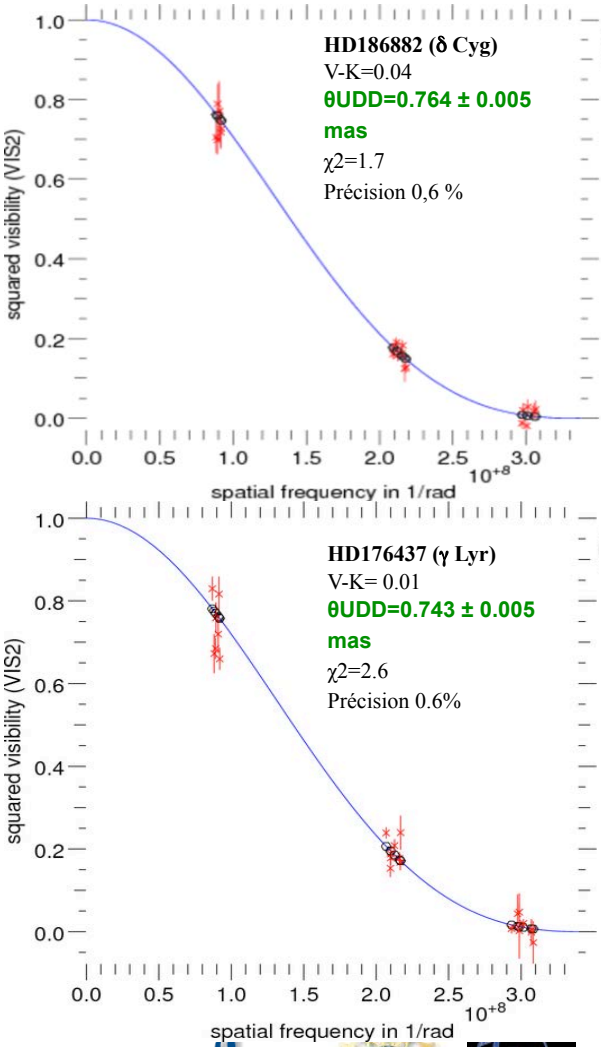


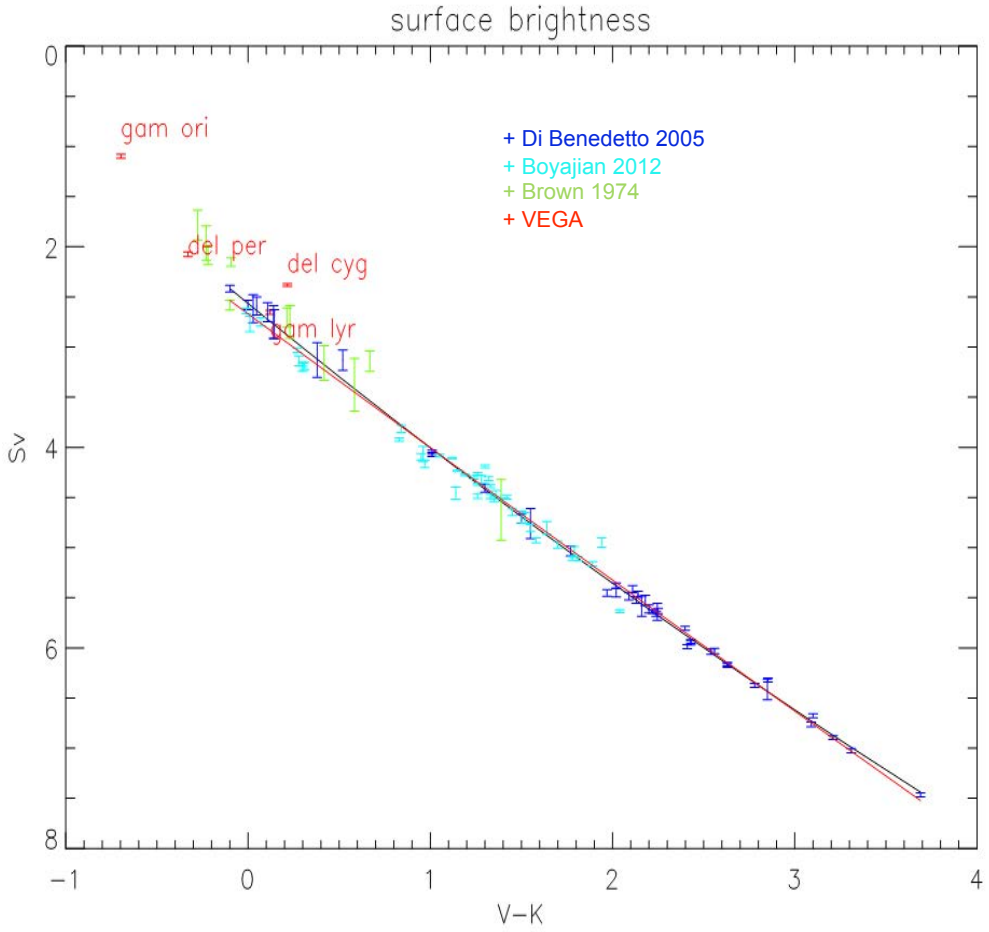
In both cases :
position in HR diagram

constraints on evolutionary and interior models

Surface brightness of early (and late-type) stars for the distance of Eclipsing Binaries in LMC (PhD Challouf et al. in prep)

Pietrzynski et al. 2013, Nature, 495, 76 (LMC distance at 2%)



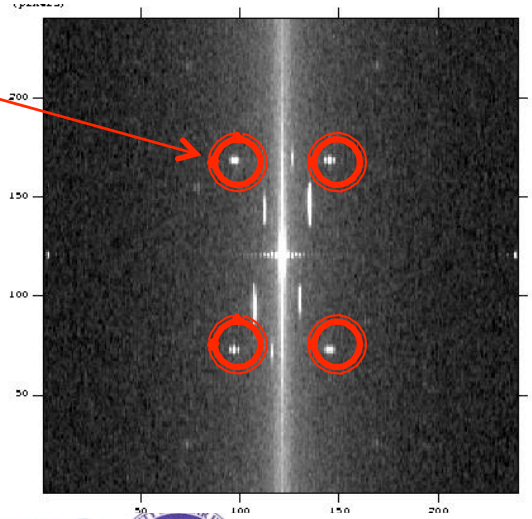


Technical run to test the OCAM camera (Berio et al.)

...*at the focus of VEGA/CHARA.*

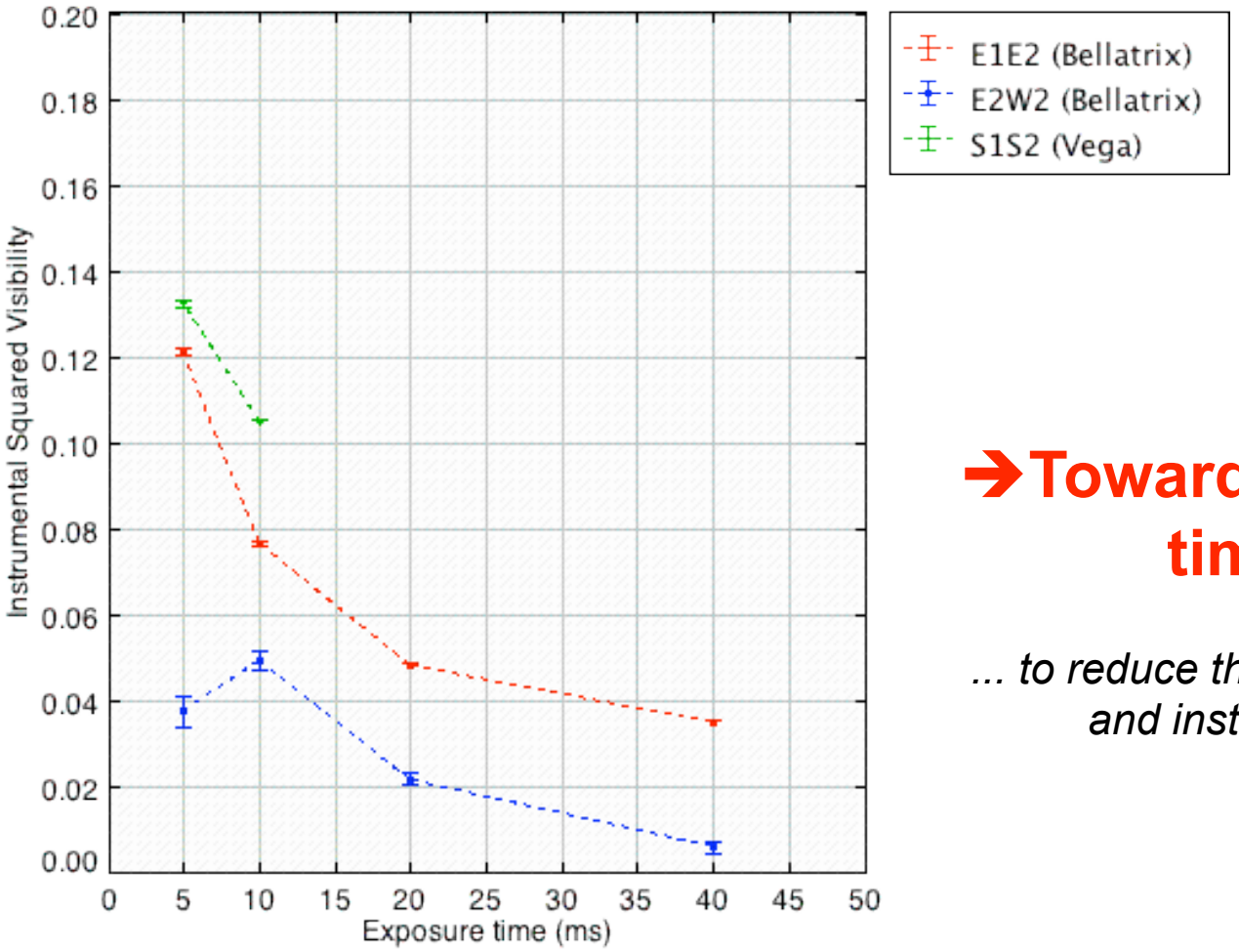
- 4 half-nights in Nov. 2012 (2 nights with good conditions)
- Setting and observations made by S.Lagarde, P.Feautrier and P.Balard.
- 10 stars observed:
  - with magnitude from m_V=0 to m_V=5.5
  - using 2T (S1S2) and 3T (E1E2W2)
  - in medium resolution (R=5000) around Hα and 800nm
  - exposure times tested : 1, 2, 5, 10, 20 and 40ms

artefacts



Conclusion : fringes obtained in each configuration (in photon counting mode)

Instrumental visibility vs. Exposure Time



➔Toward lower exposure times < 5ms

... to reduce the OPD Jitter (atmosphere and instrumental vibrations)

Conclusions concerning the OCAM camera

✗ **First successful test of OCAM camera in optical interferometry**

- ✓ Fringes detected in 3T up to 5.5 mag (with r_0~5cm and a gain lower than 1000)

even if:

- ✓ The VEGA mode is not the best for this kind of camera
- ✓ Number of pixels inadequate to image all the speckles (limitation of spectral range)
- ✓ Correction of detector's artefacts to be done

✗ **Next steps**

- ✓ Closure phase and differential visibility and phases.
- ✓ New campaign : characterization of the OPD *Jitter*

✗ **Toward a new instrument ?**

- ✓ A prototype is developed at Lagrange Laboratory (with fiber optics)
- ✓ Toward more sensitivity and/or more precision
- ✓ The Sciences cases are promising using future AO of CHARA: please visit the VEGAS website: http://www-n.oca.eu/vega/en/vegas/index.htm

Thank you for your attention

Calern meeting, february 6th, 2012