VEGA: Status and Future Plans

Denis Mourard and Philippe Bério, Daniel Bonneau, Jean-Michel Clausse, Olivier Chesneau, Omar Delaa (PhD), Roxanne Ligi (PhD), Florentin Millour, Nicolas Nardetto, Karine Perraut, Philippe Stee, Alain Spang, Isabelle Tallon-Bosc

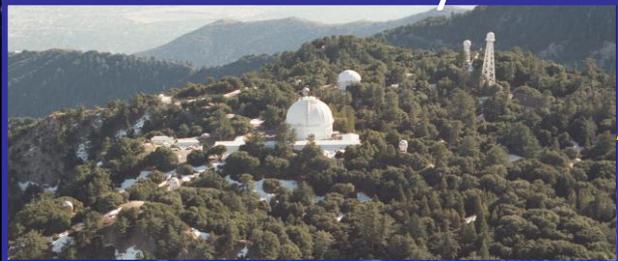FIZEAU-Nice, LAOG-Grenoble, CRAL-Lyon

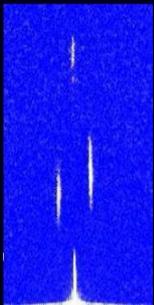# High Angular (0.3mas) and up to 30000 spectral resolution
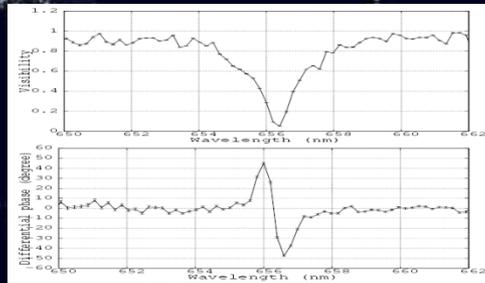
Old GI2T Facility

CHARA Array

09-2007: Integration
07-2008: First observations
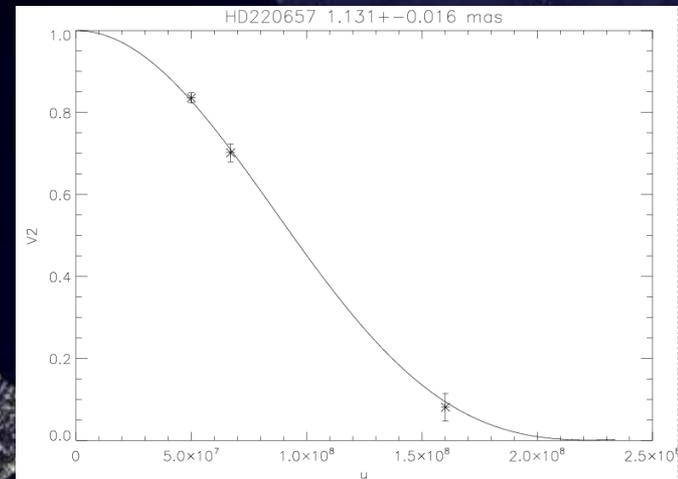07-2009: Remote operation
06-2010: First science papers

Mode 3T
HD3360- 10-08
June 27th 2010

Differential measurements

VEGA SPIE San Diego

HD220657 1.131+−0.016 mas

Fundamental parameters

VEGA 2010: main points (1)

- 5 Science papers + 2 in submission:
  - AB Aur, Deneb&Rigel, β Cep, γ Equ, Be stars published in 2010/2011
  - β Lyr and υ Sgr submitted last week.
  - δ Sco (+ VLTI/AMBER data) submitted this morning!

- Three papers in good progress (see later)
  - 3T/4T mode of VEGA + spatio-spectral encoding
  - HD49933 (main CoRoT target)
  - Chromospheric activity in K giant stars

- More than 10 others programs in analysis. + MIRC and CLIMB data…

- 3T operation (almost) fully validated. 4T fringes!
- VEGA + IR group delay tracking (CLIMB and MIRC)

VEGA 2010: main points (2)

- 52 nights (25 remote and 3 observing runs)
- Automatic simple processing at end of night
- Observation data base

- Periodic upgrades of the DRS pipeline
  - 3T for V² and closure phase measurements
  - 3T for differential quantities (still in progress)

- Progress on a scheduler for observing strategy definition
- Prototype of an electronic proposal management

- Collaboration with JMMC for ASPRO2 + VEGA Interfaces
- Nice features of VMT, really useful

VEGA 2010: main difficulties

- Run managements:
  - scheduling of multiple programs
  - Attempts to optimize the nights

- Proposals management:
  - Difficult mainly because VEGA is organized in runs rather than in a collection of independent proposals

- Growing interest for VEGA/CHARA and additional requests
  - Inside Observatoire de la Côte d'Azur
  - Outside through our long-term collaborators
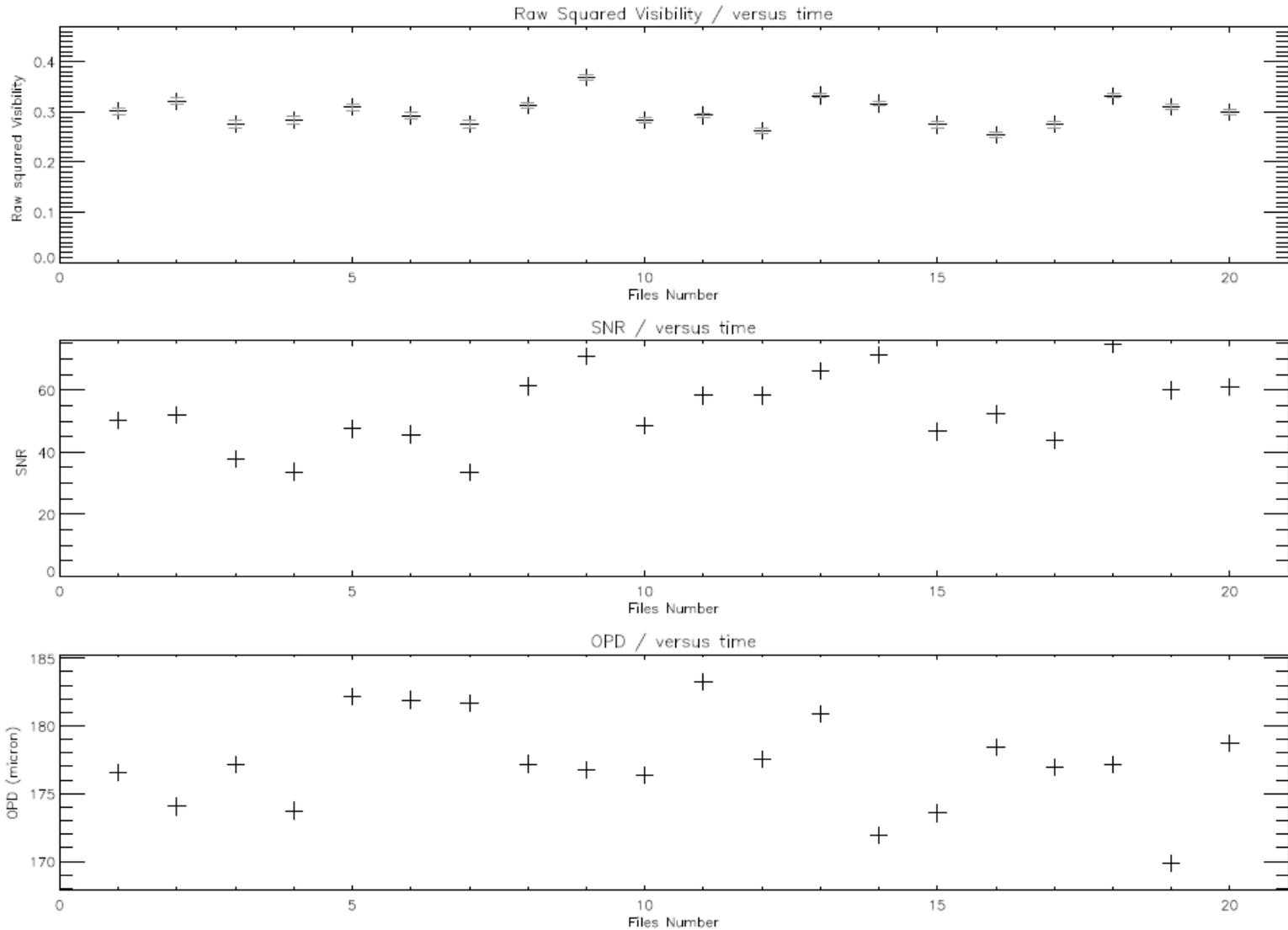
More details on some aspects

- Automatic End of Night processing

- Prototype of scheduler

- Prototype of Interferometric VO Tool

- Some technical issues with VEGA

- 3T mode and spatio-spectral encoding

- 2011 programs

- Conclusion

Example of End of Night processing output

Scheduler presentation

Proposals management

Four phases

- – Proposal submission:
  - • targets and baselines by users
- – Planning of semester
  - • Optimization of the configurations and definition of a small number of configurations (Tel+Pop+Beam)
  - • Users download their "starlist" and "strategy" files
- – Planning of run
- – Planning of an individual night

Direct links foreseen with ASPRO2, SearchCal etc…

Few technical issues on VEGA

- Upgrade of ICCD detectors for Image and Pupil controls….€€€…

- Improved pre-processing of data:
  - Spectral resolution in high resolution mode
  - Fine rotation of images in the different modes

- New procedure or new spectral lamp for a better and more reliable calibration in high resolution mode

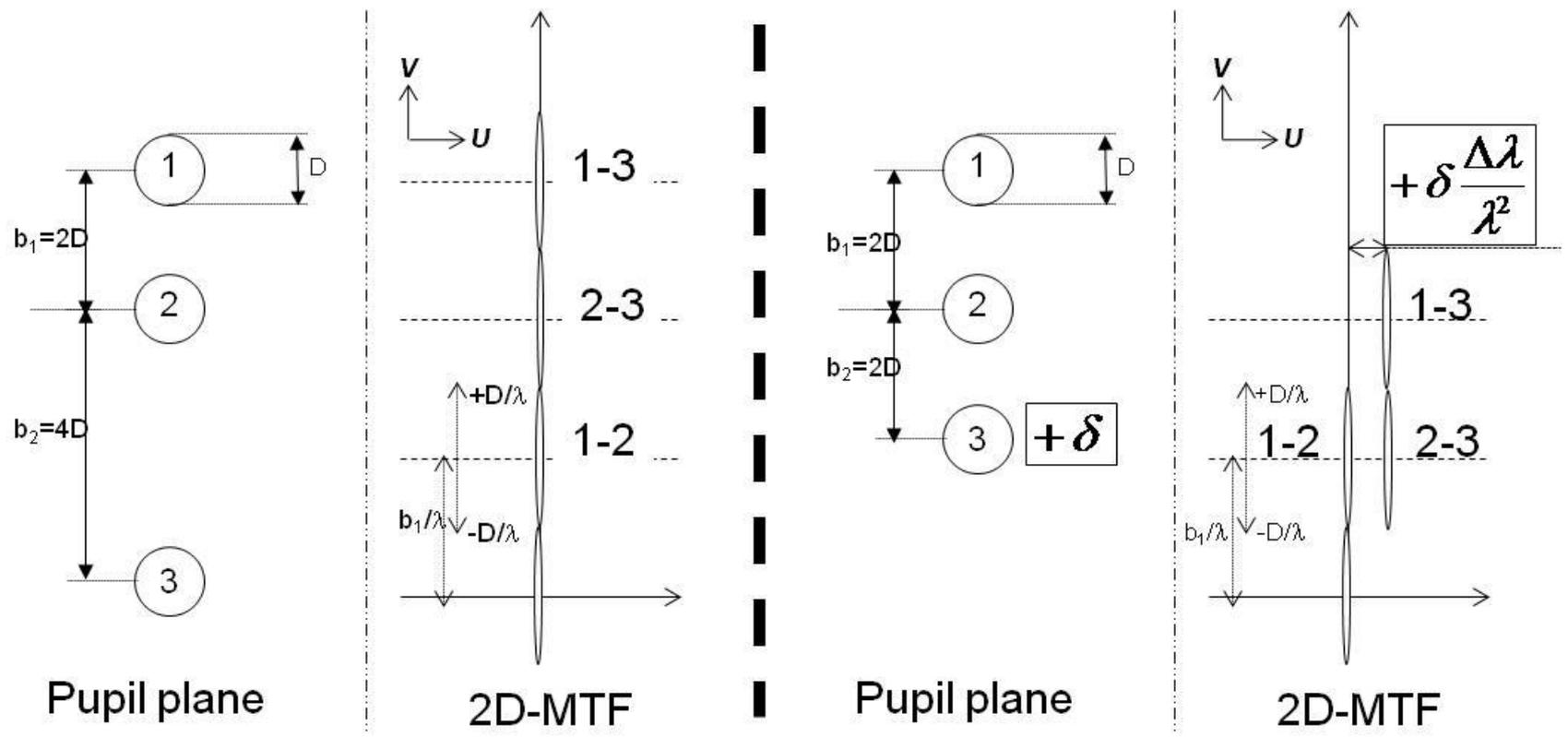- Attempts to use faster read modes to avoid saturation effects in photon counting regime.

SPATIO-SPECTRAL ENCODING
&
VEGA 3T/4T MODE

What is spatio-spectral encoding?

Formalism in the general case. Global interest
Example of the VEGA 3T/4T mode
Definition of the 3T estimators (V², Closure phase and differential visibilities)
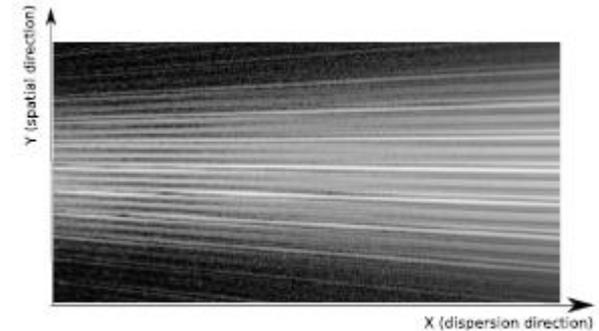Science case permitted by VEGA-3T/4T

Principle of spatio-spectral encoding

$$I(x, y) = ni(x, y) \left(1 + \frac{2}{n} \sum_{i=1}^{n} \gamma_i \cos \left[2\pi\sigma\chi_i + \phi_i \right] \right)$$

$$\left(U_{pi}, V_{pi} \right) \approx \left(\frac{\chi_i^0 \Delta\lambda}{\lambda_0^2}, -\frac{b_i \Delta y}{\lambda_0} \right)$$

$$\chi_i^0 = \frac{U_{pi}}{N_{ch}} * l_c$$
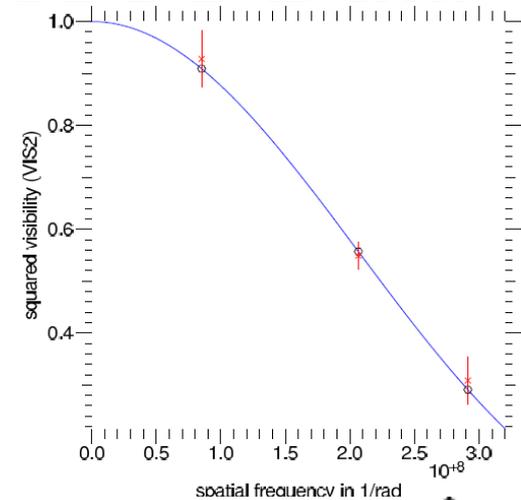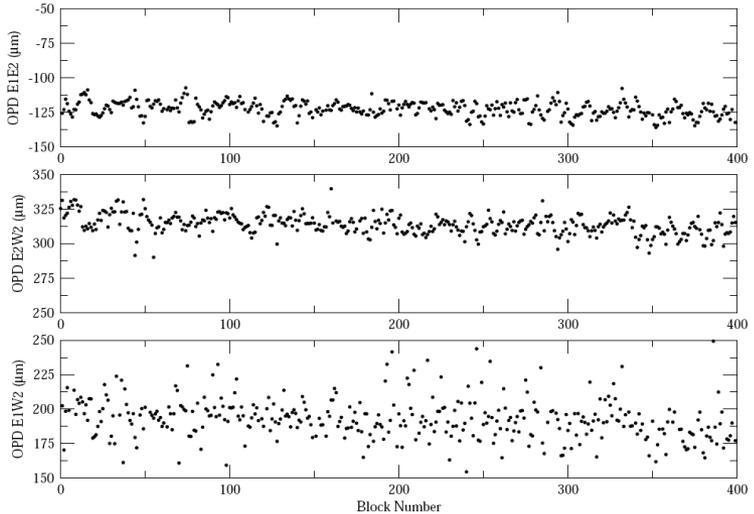
$$N_{ch} \geq \sim 2 * N.$$

$$FT(I_{\Delta\lambda} \otimes I_{\delta\lambda})(u, v) = FT(I_{\Delta\lambda})^2(u, v) \otimes FT(\Pi_{\delta\lambda}))(u, v).$$

Final formalism for cross-spectrum analysis in progress

Example of the VEGA 3T Data

$$\phi_{HD55185} = 0.474 \pm 0.014 mas$$
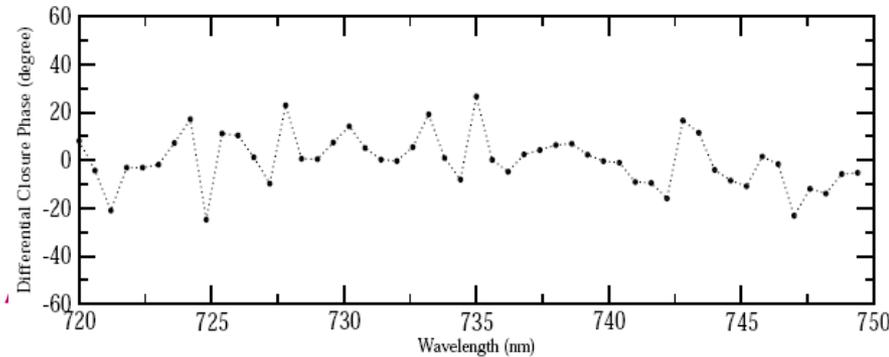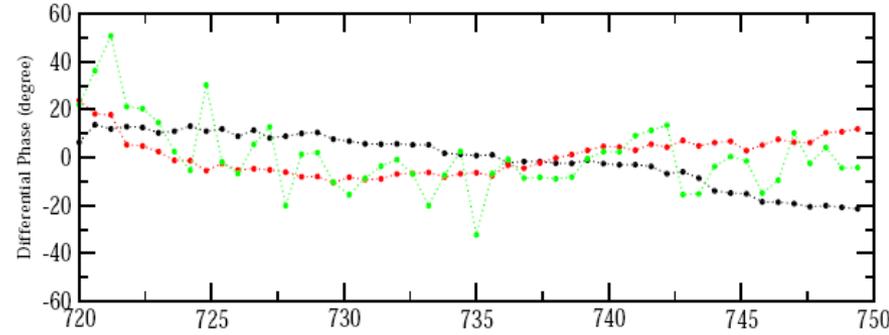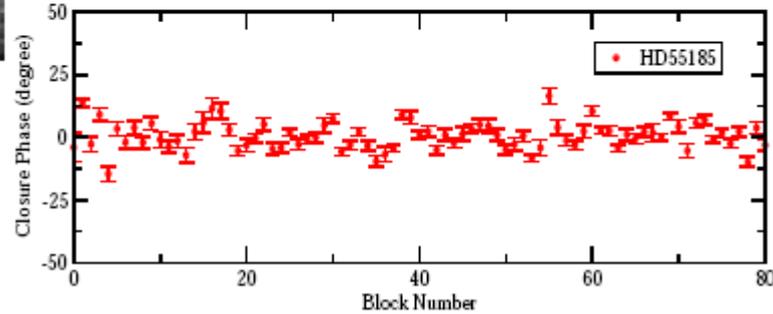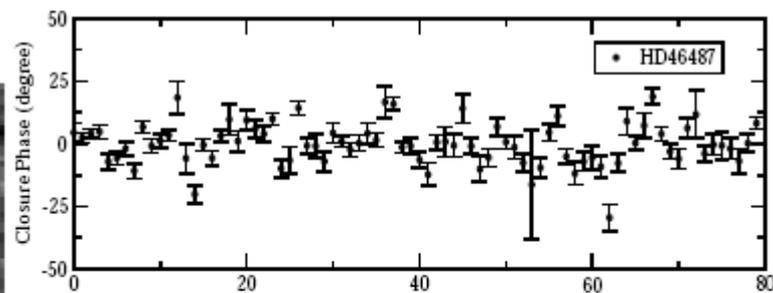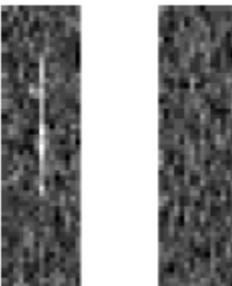
Science cases of VEGA-3T/4T

- Fundamental parameters of star

  ESSOHR program (submitted at the french ANR agency)

  Exoplanets and Stars Study by Optical High Resolution

- Chromatic imaging of stellar surfaces and complex environments

VEGA-3T/4T + IR tracking
The calibrator issue
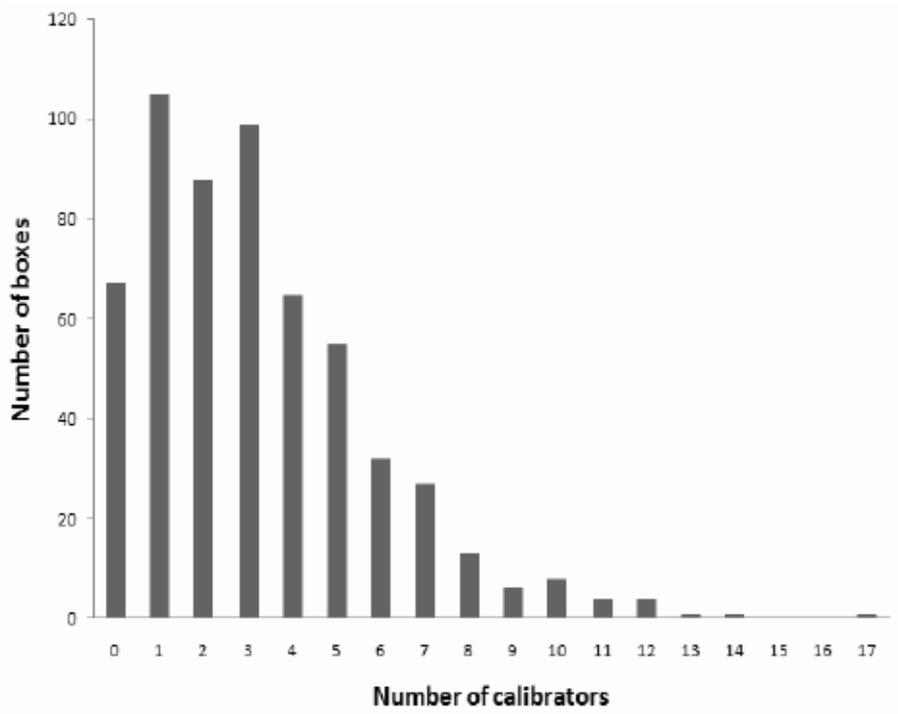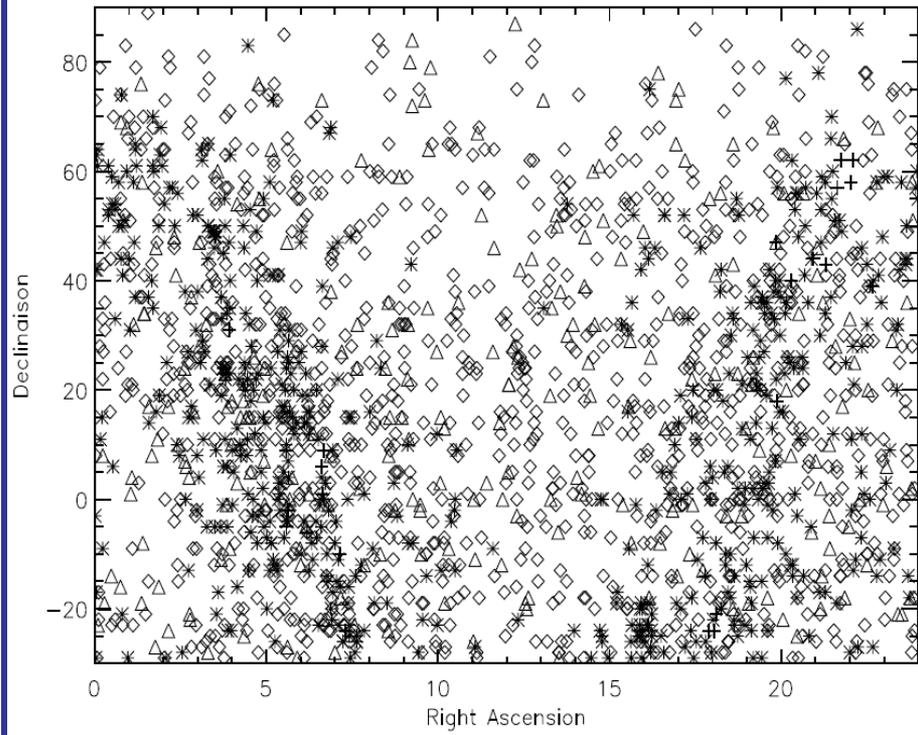
2011 programs

- 17 proposals received.
- ~480hours = ~60nights...
- Almost a factor 2 so decisions are necessary.

- Almost all proposals are including CLIMB so CHARA will be for us only (no parallel operation)…

- 3 "survey" like programs
- 2 programs from OCA non VEGA-core members
- 2 programs from externals with close VEGA-coIs collaborators
- 1 proposal from CHARA(-VEGA) members

Status of proposals

#	Titre	Target	PI	Instruments	Base	Nb H	04	05	06	07	08	
1	Constraining Numerical Models of Stellar Differential Rotation	tau Boo	Baines	VEGA	S1S2/E1E2/W1W2/W2S2/W2E2	36						3h*2b*3m
2	Calibration of the surface-brightness relation of BA early type stars: Toward a very accurate distance determination of LMC eclipsing binaries	many	Nardetto	VEGA (+CLIMB?)	E1E2W2	70						7*x3T*5m
3	Understanding the eps Aur environment	eps Aur	Mourard	VEGA	S1S2	12						3lambda*2n*2fois
4	Fundamental parameters of (rapidly oscillating) Ap stars	many	Perraut	VEGA+CLIMB	E1E2W2, S2W1W2, E2W1W2	12						2*x3T*3m
5	Constraint on the Teff of the very metal poor star HD140283	HD140283	Thévenin	VEGA+CLIMB	S1E1/S2E2…3T	9						3T*3m*1.5
6	Determination of accurate basic properties of astrophysically important binary and multiple stars	many	Chesneau	VEGA+CLIMB	S2W2W1, S2E2W1	36						2*x3T*3m*6dates
7	Ha line forming region of HAEBE spatially resolved at sub-AU scales	MWC361 and MWC275	Perraut	VEGA+CLIMB	S1S2/E1E2/W1W2	54						2*x3b*3m*1.5
8	mu cep	mu cep	Chiavassa	VEGA+CLIMB	S1S2	6						1b*3m
9	Study of the photosphere/wind connection of OBA supergiants: Deneb	Deneb	Chesneau	VEGA+CLIMB	S1S2/S1S2W2	30						4datesS1S2*3m+3T*3m
10	The gaseous environment of the post-AGB binary 89 Her	89 Her	Chesneau	VEGA+CLIMB	S1S2/S1S2W2	12						S1S2*3m+3T*3m
11	Study of the chromosphere of the red giant star beta Ceti	bet cet	Berio	VEGA	S1S2/E1E2	20						2b*5lambda+MR 2*
12	LD measurements demonstration: exoplanets host stars characterization	many	Ligi	VEGA+CLIMB	E2W1W2-E1W1W2	60						5*x2*3T*3m
13	A possible breakthrough in the Be phenomenon: long-term follow up of the δ Scorpii disk formation	delta sco, chi Oph	Stee	VEGA	S1S2/E1E2/W1W2/Any Triplet	24						
14	Global Fast Rotation and Surface Differential Rotation of Fast rotating stars	alpha cep	Delaa	VEGA/MIRC	E1E2/E2W1W2	18						3m*3b
15	Imaging the possibly warped disk of the Be star Kappa Draconis	kappa Dra	Millour	VEGA+CLIMB	All	60						6T*5m
16	Attempt to detect disk around Weak Lined T Tauri stars	many	Lopez	VEGA+CLIMB	?	12						1Tx2*3m
17	The complex system of P Cyg	P Cyg	Tallon	VEGA	S1S2/E1E2/W1W2	18						3h*3bases

Conclusion

- VEGA has now clearly demonstrated its potential
  - → Growing interest in the stellar physics community
  - → Development of key programs for stellar physics and exo planets related works

- Increased technical support inside the VEGA group
  - Runs and proposals management
  - Data analysis

- VEGADRS almost ready for distribution but still work on error's bars and correlations and on 3T differential analysis.

Thanks a lot to the whole CHARA team
Special thanks for Chris and PJ for remote and run assistance
And for CLIMB and MIRC // operation