VEGA: Status, Science Overview and Future Plans

VEGA: Mourard et al. (2009)

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

**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

**Observations:**
K. Perraut
- People preparing VEGA runs: ∼6
- People involved in observations: ∼15 (+visitors)

**VEGA database**
**VEGA Twiki pages**
**JMMC Tools (LITpro)**

**Publications**

**VEGADRS@oca.eu**
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

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.

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

- chara (1n)
- chiller (4n)
- VEGA alignment (2)
VEGA programs (~30 including 8 new for 2013)

Difficult programs (3)
- OU And (LD)
- WZ Cas
- ε UMa

Angular diameters (7)
- Exoplanets Host Stars
- Surface Brightness relation
- Asterosismology
- RoAp
- ....

Old programs to conclude (3)
- β Cep
- Sirius
- SB sub-giants

Be Stars (5)
- Be/Bn stars
- δ Sco
- ω Ori
- HR 5907
- ...

YSOs
- ε Aur
- P Cyg
- φ Per
- 51 Oph

Binaries (8)
- λ Tau
- β Lyr
- θ1 Ori C
- ξ Tau
- SS Lep
- EB in pleiades.

Environment/disk (5)

Environment/disk (5)
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


2012


See Talk by Roxanne Ligi on Wednesday

2013


P17: "Enhanced Halpa 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)
II. Geometry and kinematics of the disk from MIRC and VEGA instruments on the CHARA Array

Conclusion: (1) the disk is increasing in size ($V_{\exp}=0.2\text{km/s}$), (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
The pole turn faster the equator ($\alpha > 0$)  
Rigid rotation ($\alpha = 0$)  
The Equator turn faster the pole ($\alpha < 0$)  

Conclusions:
1/ Theoretical result: stellar brightness distribution ($\beta$) modified by the differential rotation ($\alpha$)...
2/ In-depth analysis of VEGA data to determine PA.

PA = $-158^\circ \pm 17^\circ$
A high angular and spectral resolution view into the hidden companion of ε Aurigae**,**,**,**

D. Mourard¹, P. Harmanec², R. Stencil³, Ph. Bério¹, O. Chesneau¹, J. M. Clausse¹, R. Ligi¹, N. Nardetto¹, K. Perraut⁴, Ph. Stee¹, I. Tallon-Bosc⁵, H. McAlister⁶,⁷, T. ten Brummelaar⁷, S. Ridgway⁸, J. Sturmann⁷, L. Sturmann⁷, N. Turner⁷, C. Farrington⁷, and P. J. Goldfinger⁷

- 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.

\[ \theta_{LD} = 0.275 \pm 0.009 \text{ mas} \]

\[ R = 2.318 \pm 0.090 R_\odot \]
Benchmark metal-poor stars HD140283 (Creevey et al. in prep.)

In both cases:
- position in HR diagram

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

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 $H\alpha$ and 800nm
  - exposure times tested: 1, 2, 5, 10, 20 and 40ms

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 \( r_0 \sim 5\text{cm} \) 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:
Thank you for your attention