VEGA, D. Mourard et al.
Observatoire de la Côte d’Azur, march 15th

Brief presentation of VEGA
Current status
Expected performances
Organizational aspects
  Schedule, budget, manpower
  Integration and first light
VEGA main characteristics

Access to the visible: 0.45 to 0.9 µm. Slit height: 4” (2” in SPIN mode)
2 photons counting detectors: ALGOL with about 200 spectral channels

Spectral resolution (dispersed fringes mode):
- 1500 with 1 camera: $\Delta \lambda = 140\text{nm}$
- 6000 with 2 cameras: $\Delta \lambda_{1-2} = 35\text{nm}$, $\lambda_1-\lambda_2 = 150\text{nm}$
- 30000 with 2 cameras: $\Delta \lambda_{1-2} = 8\text{nm}$, $\lambda_1-\lambda_2 = 30\text{nm}$

Polarimetric capabilities: SPIN
- Combination of 4 telescopes in the dispersed fringes mode
- Automatic control, data reduction pipeline 2T (4T) mode.
M6 and M2 are motorized for pupil and image planes adjustment.
Periscopic optic (PGO)

- CHARA subsystem installed just after the tip/tilt subsystem.
- Design by Laszlo
- Building in progress (end of March)
- The 4 M1s are removable
- Each M2 is motorized for tip/tilt adjustment
Interface layout
Beam compression and configuration (BCP & BCF)

Mechanical design is finished
Building of BCPs in Atlanta (april/may?)
Building of BCF in Nice (in progress)
Motorization of M6s by Mt Wilson
Calibration and Alignment Unit (CAU)

- Four functions are permitted:
  - Laser diode for alignment
  - Spectral lamp for calibrations
  - Wide field white light source for flat field
  - Unresolved white light sources for dispersed fringes optical simulator
- New mechanical design in progress
Chara/Source Selector (CSS)

- Allow to rapidly switch from the CHARA beams to the calibrating beams
- Already tested (5s)
- Integration in Grasse in progress.
Image Pupil System (IPS)

- Internal structure (stainless) finished. Optical integration in progress
- Mechanism in fabrication
- Same motorization as CSS
- 4 beams for Image and Pupil plane control
VEGA Spectrograph

New Ag coating
New slit
Calibration in progress in lab
Control of Vega

PC-Cam1

PC-Cam2

PC-Tracking

PC-ICS

Standard Network For Command Purpose

Local Network For Data Transfer Purpose & VNC if necessary

Switch

Switch

Switch

Switch

PC-CtrlVega

PC-DataRedVega

world

Optical lab

Control room
vega_plan: preparation of observations

Adaptation of chara_plan: visible, pupils, link to VEGA control
Expected performances

Hypothesis
For a m_V=0 star, N_{ph}=1000 ph/s/cm^2/A
Visible transmission
- Q_{CHARA} = 0.01 (→ 0.15)
- Q_{VEGA} = 0.15 (13 mirrors @ 0.98 + 1 grating 0.6 + slit 0.3)
- Q_{ALGOL} = 0.3
Exposure time t_0=20ms
Instrumental visibility 0.8
r_0 estimations @ 650 nm:
  - Median conditions: r_0 = 11.0 cm = 8.0*(650/500)^6/5 : seeing=1.25"
  - Excellent conditions: r_0 = 20.6 cm = 15.0*(650/500)^6/5 : seeing 0.7"

Estimations of limiting magnitude: 4 cases
1. Q=0.01, without external fringe stabilization
2. Q=0.01, with external fringe stabilization
3. Q=0.15, with external fringe stabilization
4. Q=0.15, AO (S=0.50), with external fringe stabilization

Fringe stabilization: OPD less than ~1% of l_c, i.e. 150µm (resp. 30, 10) in HR (resp. MR, LR)
10s of integration. $\lambda=650\text{nm}$. Without fringe tracking
SNR for $|V_{\lambda_1} - V_{\lambda_2}|$ with $\Delta\lambda_1 = 50\text{ nm} (40, 6.7)$ and $\Delta\lambda_2 = 0.4\text{ nm} (0.13, 0.02)$
30mn of integration. $\lambda=650\text{nm}$. With fringe tracking
SNR for $|V_{\lambda_1} \cdot V_{\lambda_2}|$ with $\Delta\lambda_1 = 50 \text{ nm (40, 6.7)}$ and $\Delta\lambda_2 = 0.4 \text{ nm (0.13, 0.02)}$
30mn of integration. $\lambda=650\text{nm}$. With fringe tracking. $Q_{\text{chara}}=15\%$

SNR for $|V_{\lambda_1} \cdot V_{\lambda_2}|$ with $\Delta \lambda_1 = 50$ nm (40, 6.7) and $\Delta \lambda_2 = 0.4$ nm (0.13, 0.02)
30 mn of integration. $\lambda=650$ nm. With fringe tracking, $Q_{\text{chara}}=15\%$, AO ($S=50\%)$ SNR for $|V_{\lambda_1} - V_{\lambda_2}|$ with $\Delta\lambda_1 = 50$ nm (40, 6.7) and $\Delta\lambda_2 = 0.4$ nm (0.13, 0.02)
Schedule

- Spectro+CSS+CAU: end of March
- IPM+IPS: mid-April. *End of ICS*
- BCF: mid-April
- Prototype of BCP in Grasse: end of April
- Tests in Grasse: April+May. *End of DCS, OS, DRS*

- End of PGO building: end of March
- Building of BCP in Atlanta: April+May

- Transportation in June
- Integration end of June (travel before 21th)
  - Spectro+CAU+CSS+IPS+IPM
  - BCF+BCP+PGO
  - First light
Status of the 4T mode

All subsystems are 4T compatible.

Two special aspects:

- Narrower fringes
  - Change the spectrograph’s magnification:
    - Optical study already done
    - Easy implementation if necessary but reduced spectral band
  - Better photon centroiding algorithms:
    - from 1 pixel to ¼ pixel
    - Work in progress

- 6 fringe systems
  - Definition of estimators: closure phase, $V^2_1$ to $V^2_6$
  - Data reduction pipeline: online and offline

The internal simulator allows recording 4T dispersed fringes
Funding aspects

VEGA 2006: 60 k€

VEGA 2007: 70 k€
   Already obtained: 52.5 k€
   Wait for 10 k€ more from OCA
   Wait for 8 k€/year from CNRS/USA collaboration

   Already engaged: ~25 k€
   Need to be engaged: ~45 k€

Do not account for ‘old’ REGAIN expenses as well as CHARA expenses

Estimation for coming years: about 20 to 25 k€/year (travels, VEGA)
People involved

Core Team OCA:
- Astronomers: Alain Blazit, Daniel Bonneau, Denis Mourard, Philippe Stee
- Engineers: Jean-Michel Clausse, Aurélie Marcotto, Alain Roussel, Yves Hugues, Guy Merlin, François Hénault

Extended scientific group at OCA, Lyon, Grenoble and Paris (~10p)

Integration team:
Jean-Michel Clausse, Yves Hugues, Aurélie Marcotto, Denis Mourard

First run:
Daniel Bonneau, Jean-Michel Clausse, Denis Mourard
Conclusions

End of June: integration and first light
Science and data reduction preparation

VEGA+IR really fundamental
- Unique science, complementary approaches (see Philippe’s talk)
- Fringe stabilization
- Dual operation of CHARA is really a great chance for VEGA

Current strategy: 3 phases for VEGA
- Phase 0: a ‘small team’ instrument for qualification and performances
- Phase 1: a collaborative instrument with involvement of a VEGA core team member
- Phase 2: if possible, a general user instrument. Remote observing.

Prospects for 4T operation, SPIN (polarisation); AO or Courtés mode (increased sensitivity)