VLTI update

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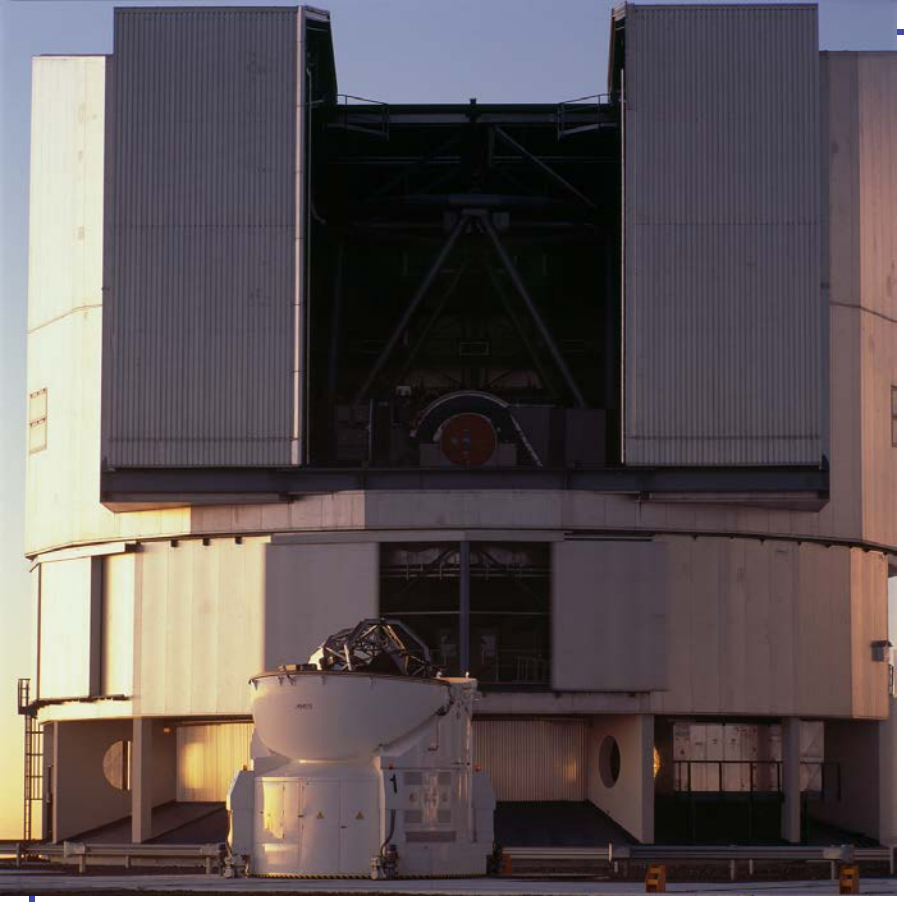
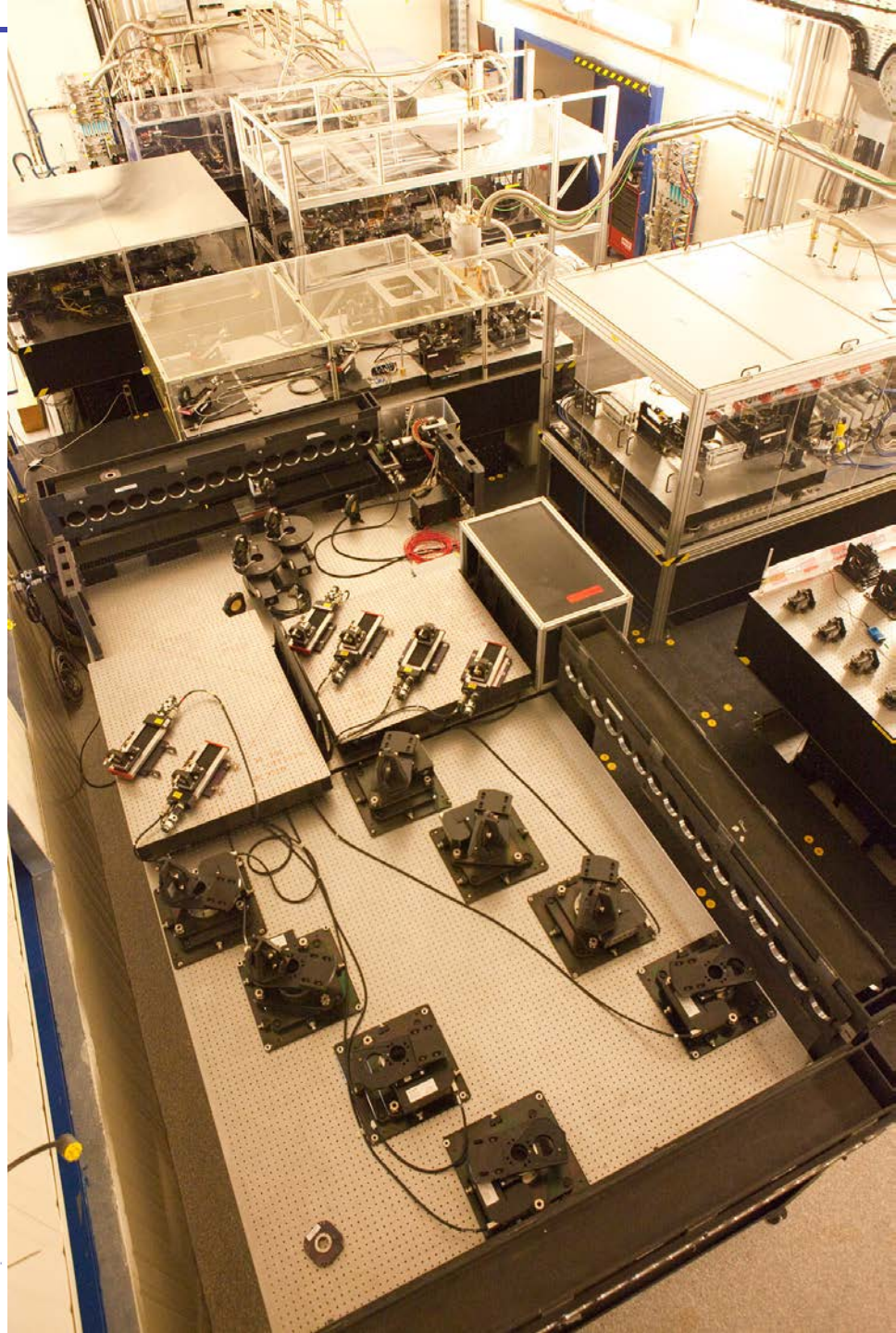
Summary

- Infrastructure
- Current instruments: MIDI, AMBER, PIONIER
- Under test & commissioning: PRIMA
- 2nd generation instruments
- Long Range Plan

Infrastructure





Infrastructure

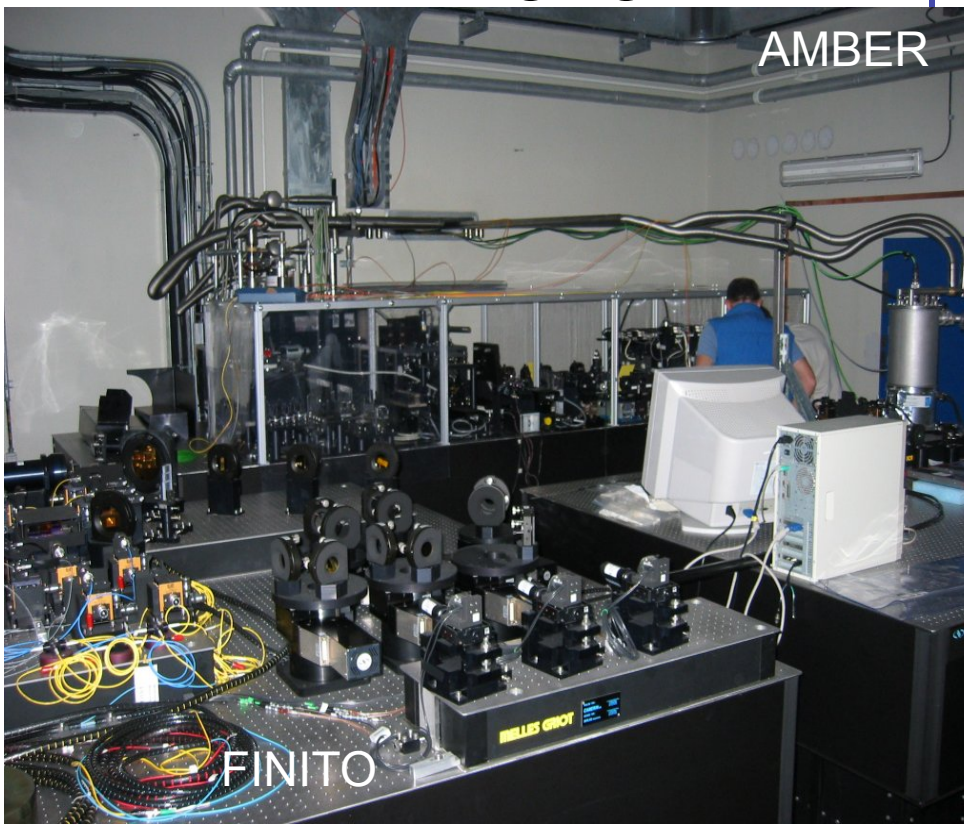
- 4 Unit Telescopes (8m ø)
  - with Adaptive Optics (60 element curvature systems)
  - used on average 3-4 nights per month (bright time)
  - baselines: 47m to 130m
- 4 Auxiliary Telescopes (1.8m ø)
  - with tip-tilt field stabilisation at telescope
  - movable (max. 2 movements per day, daytime) on many stations (9 offered or 4 different quadruplets)
  - baselines: from 8m to 128m
  - used 50% of the time (rest = UT nights and technical time / commissioning of new systems)

Infrastructure

- 6 Delay Lines
  - range: OPD from 0 to 120m, resolution: 5nm
  - pupil relay (continuous) through Variable Curvature Mirror
  - compatible wit dual-feed
- Infra-red tip-tilt sensor IRIS
  - J, H or K-band, up to 4 beams
  - fast tip-tilt guiding
- 3 telescope fringe tracker FINITO
  - H-band, used with AMBER
- Alignment tools (pupil viewer, calibration source…)

Current Instruments: AMBER

- Bands: (J) H and K (1.5 to 2.5μm)
- Spectral resolution: up to 12000 – Spatial res.: 3mas
- 3 telescopes => phase closure => some imaging
- Limiting magnitudes:
  - low resolution => H_{corr}, K_{corr} = 7.5 (UT) and 5.5 (AT)
  - high resolution => H_{corr}, K_{corr} = 6 (UT) and 5 (AT) with fringe tracking

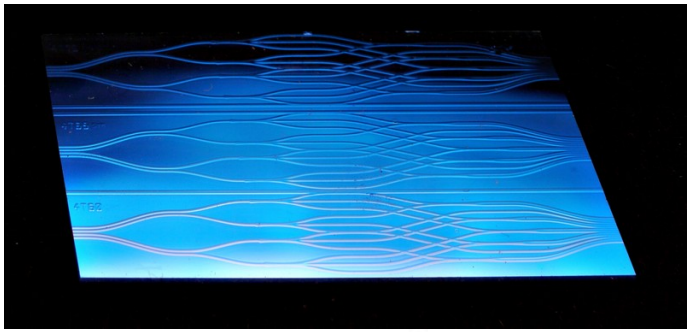


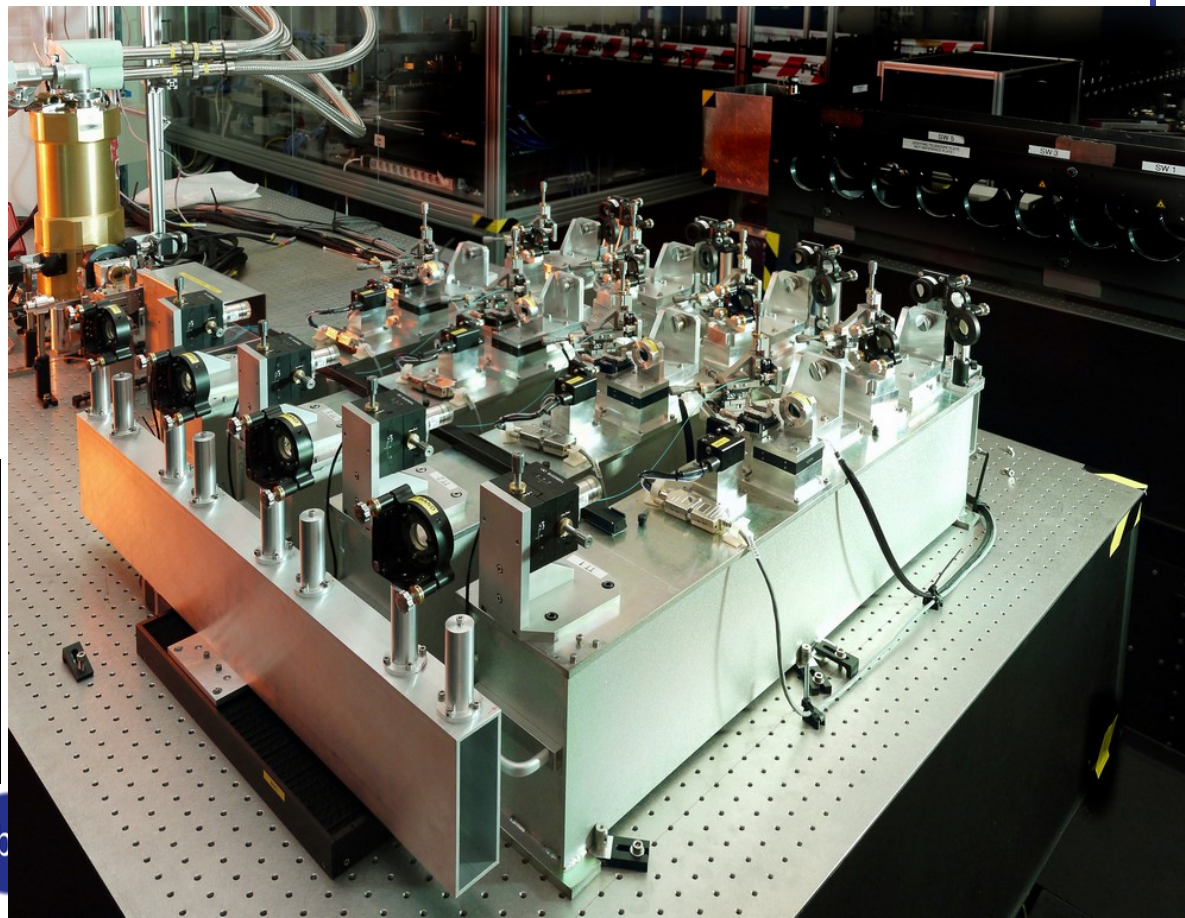
Current instruments: MIDI

- Band: N (8-13μm)
- Spectral resolution: 30 or 230 – Spatial res.= 15mas
- 2 telescopes => squared visibilities + differential phase (as a function of the wavelength)
- Limiting magnitudes:
  - high-sensitivity mode (prism) => N=4 =1Jy (UT) and N=0.74 =20Jy (AT)
  - new correlated flux mode => N=5.7 =0.2Jy (UT)

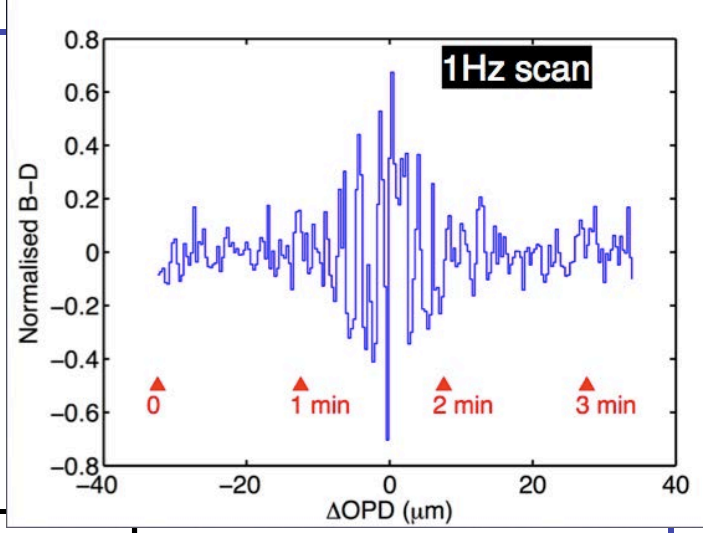
Current instrument: PIONIER

- Band: H (1.5-1.8 μm)
- Low spectral resolution (up to R~ 40)
- 4 telescopes –
  6 baselines
- lim. mag. H>7
- Visitor instrument





PRIMA

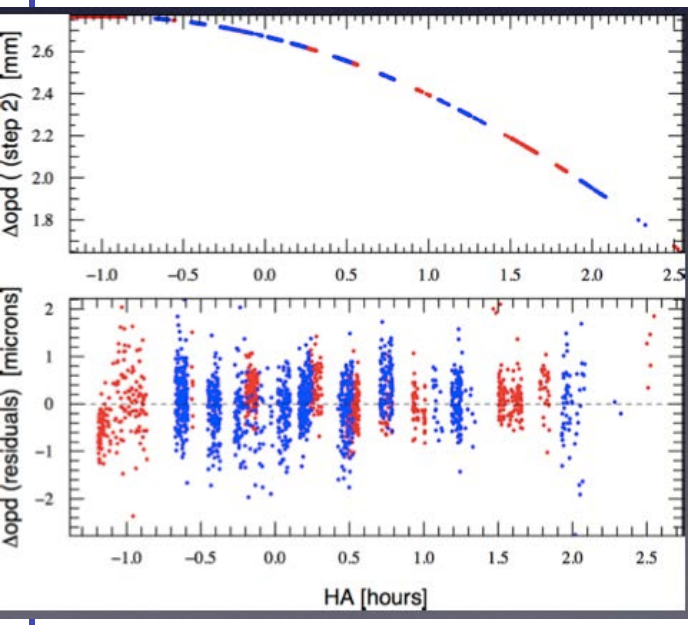


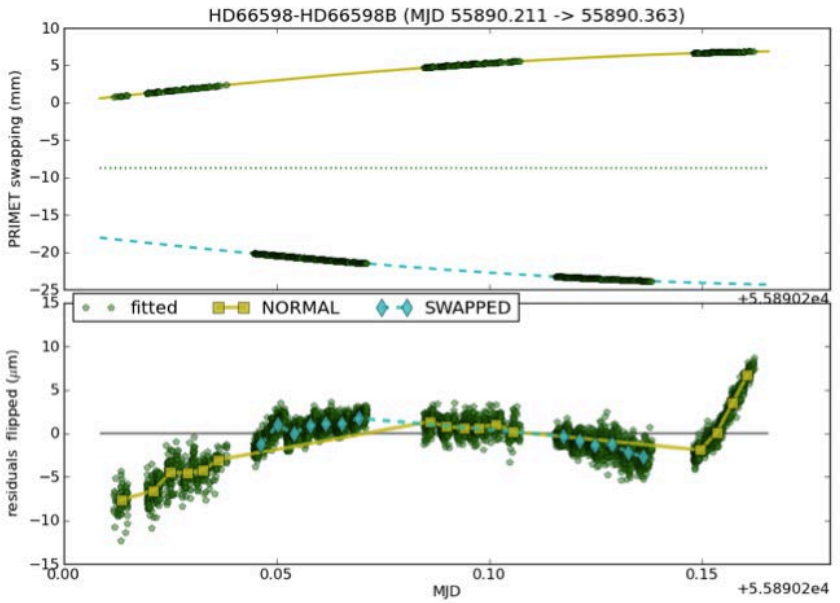
- PACMAN: Differential astrometry
  - under test / commissioning
  - goal: 50-100 μas accuracy for Jupiter-
    => gives the mass and orbit inclination
  - follow-up of radial velocity + access to more active stars
  - current problem with baseline stability / definition
- Off-axis fringe tracking to push the limiting magnitude of AMBER and MIDI (at the cost of sky coverage)
  - increase of limiting magnitude by 4-5 magnitudes
- Phase-referenced imaging with AMBER & MIDI
  - for some imaging … if implemented

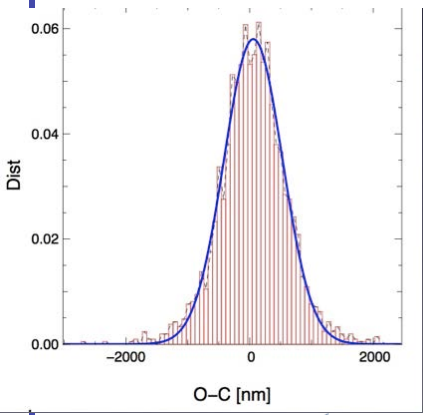
PRIMA - astrometry

July-August 2011

November 2011







K=5.42, separation = 7.2”
4 nights over 40 days
# measurements: 2106
Residuals = 500nm rms

Gaussian white noise =
28 μas expected

separation = 35”
1 night
Residuals 20μm PTV
Fast evolution at transit
(large field rotation)

PRIMA - astrometry

- January 2012 =>
  - large pupil run-out discovered (27% of pupil on AT#4!)
  - modeling of run-out as a function of Az and field rotation (thanks to F. Eisenhauer & O. Pfuhl) =>
    - blind reduction of the residuals (factor ~5)
    - + scaling of 1 parameter => further reduction (factor ~10)
- Our problem: different baselines for star light and our reference metrology, varying on uncontrolled way
- Tiger Team just created to propose solutions and evaluate potential performance => moving metrology reference point up (M2), measuring its position…

2nd generation instruments

- GRAVITY (2014) under manufacturing
  - 2 to 2.5 μm (K-band), R= 22 to 4000
  - 4 telescopes simultaneously
  - high-accuracy astrometry (30μas) and faint imaging (K>15)
  - Galactic Center, AGNs, stellar environment & dynamics…
- MATISSE (2015) at final design stage
  - 3 to 13 μm (L, M & N-bands), R= 30 to 1000
  - 4 telescopes simultaneously
  - imaging
  - star & planet formation (dust), evolved stars, AGNs, minor solar system bodies, Galactic center, extra-solar planets …

Long Range Plan

- under discussion => to be issued this year but current ESO budget (E-ELT) does not allow more than just (one) new instrument. Choice based on science.
- last October: VLTI first light 10th anniversary => first discussions with the community
- 3 directions:
  - imaging, imaging and imaging => more telescopes or hybrid mode (AT+UT) + the right software to reconstruct images
  - more resolution => going to the visible (stellar physics)
  - more sensitivity (for AGNs…) => new detectors, improvement of current infrastructure