



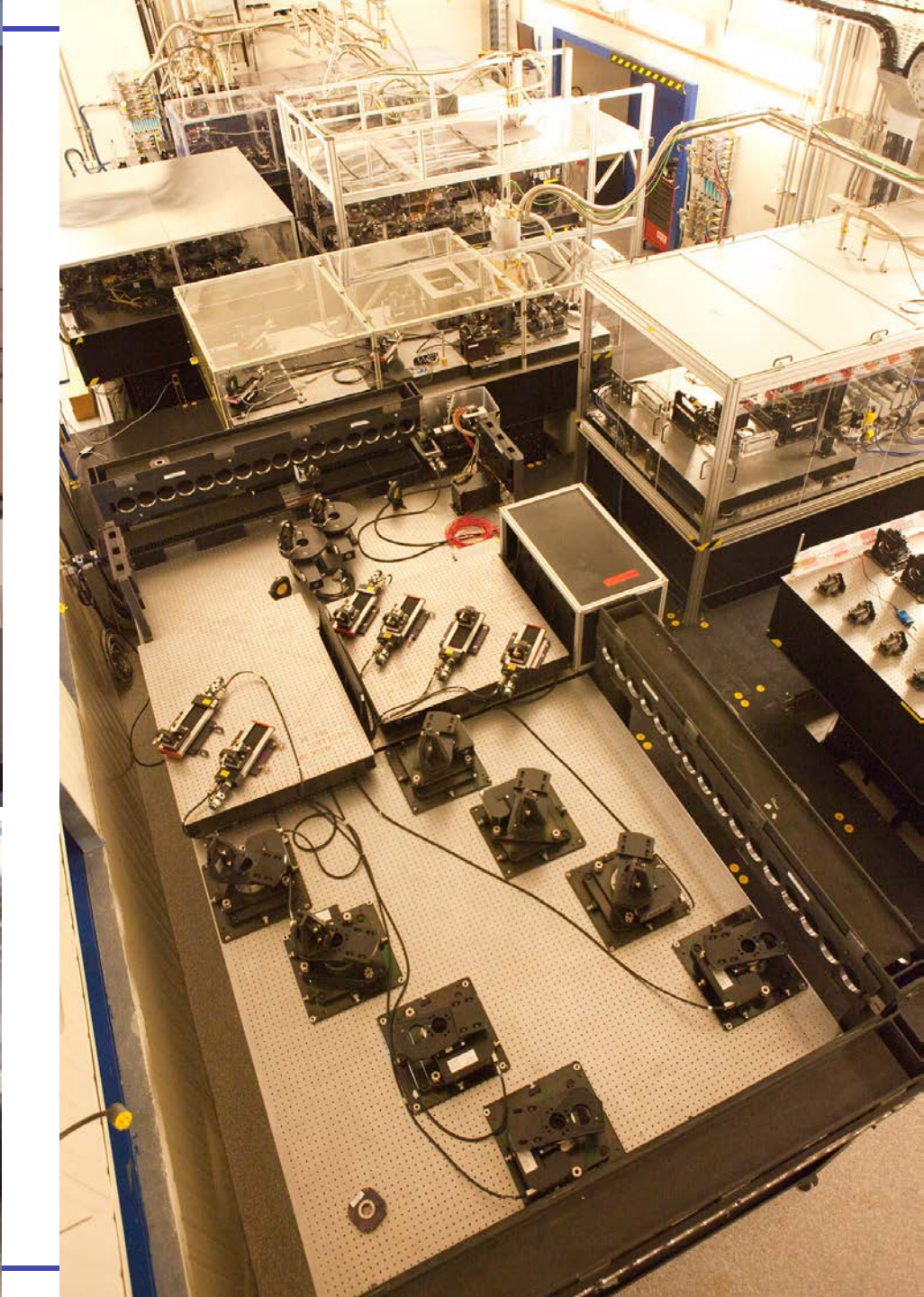
# Summary

- Infrastructure reminder
- Current instruments: MIDI, AMBER, PIONIER
- Under test & commissioning: PRIMA
- 2<sup>nd</sup> generation instruments/infrastructure
- Prospective



# Infrastructure







# Infrastructure

- 4 Unit Telescopes (8m  $\emptyset$ )
  - 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  $\emptyset$ )
  - 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)

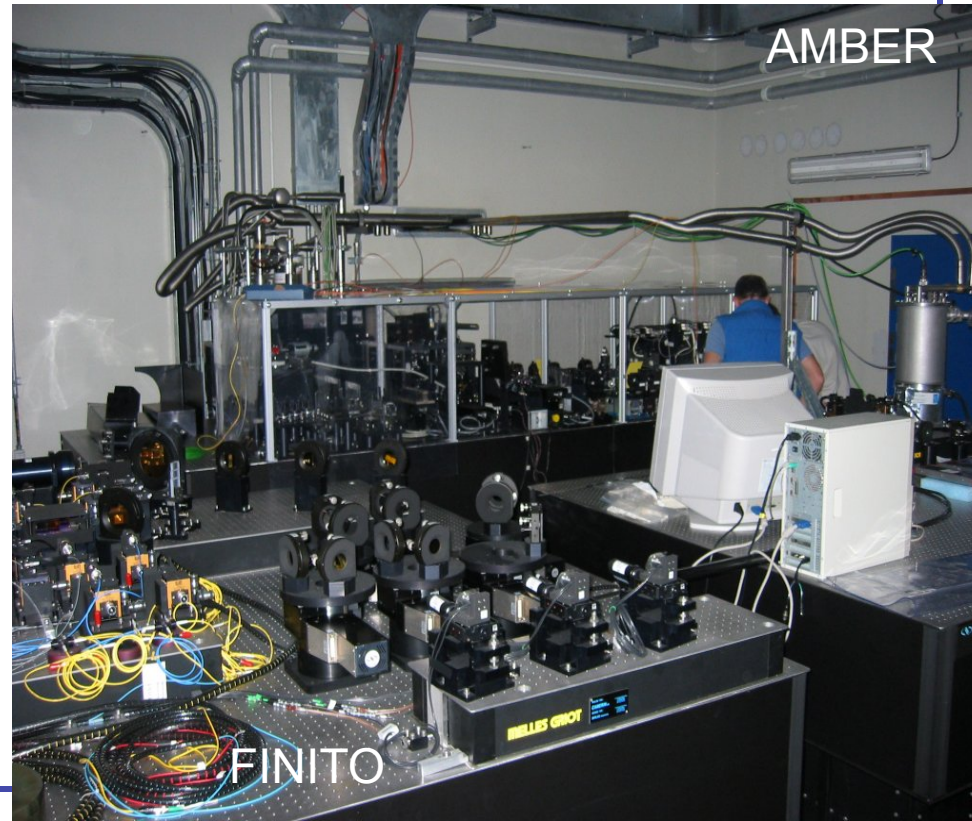


# Infrastructure

- 6 Delay Lines
  - range: OPD from 0 to 120m, resolution: 5nm
  - pupil relay (continuous) through Variable Curvature Mirror
  - compatible with 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  $2.5\mu\text{m}$ )
- Spectral resolution: up to 12000 – Spatial res.: 3mas
- 3 telescopes  $\Rightarrow$  phase closure  $\Rightarrow$  some imaging
- Limiting magnitudes:
  - low resolution  $\Rightarrow$   
 $H_{\text{corr}}, K_{\text{corr}} = 8.0$  (UT)  
and 5.5 (AT)
  - high resolution  $\Rightarrow$   
 $K_{\text{corr}} = 6.5$  (UT)  
and 5 (AT) with fringe tracking



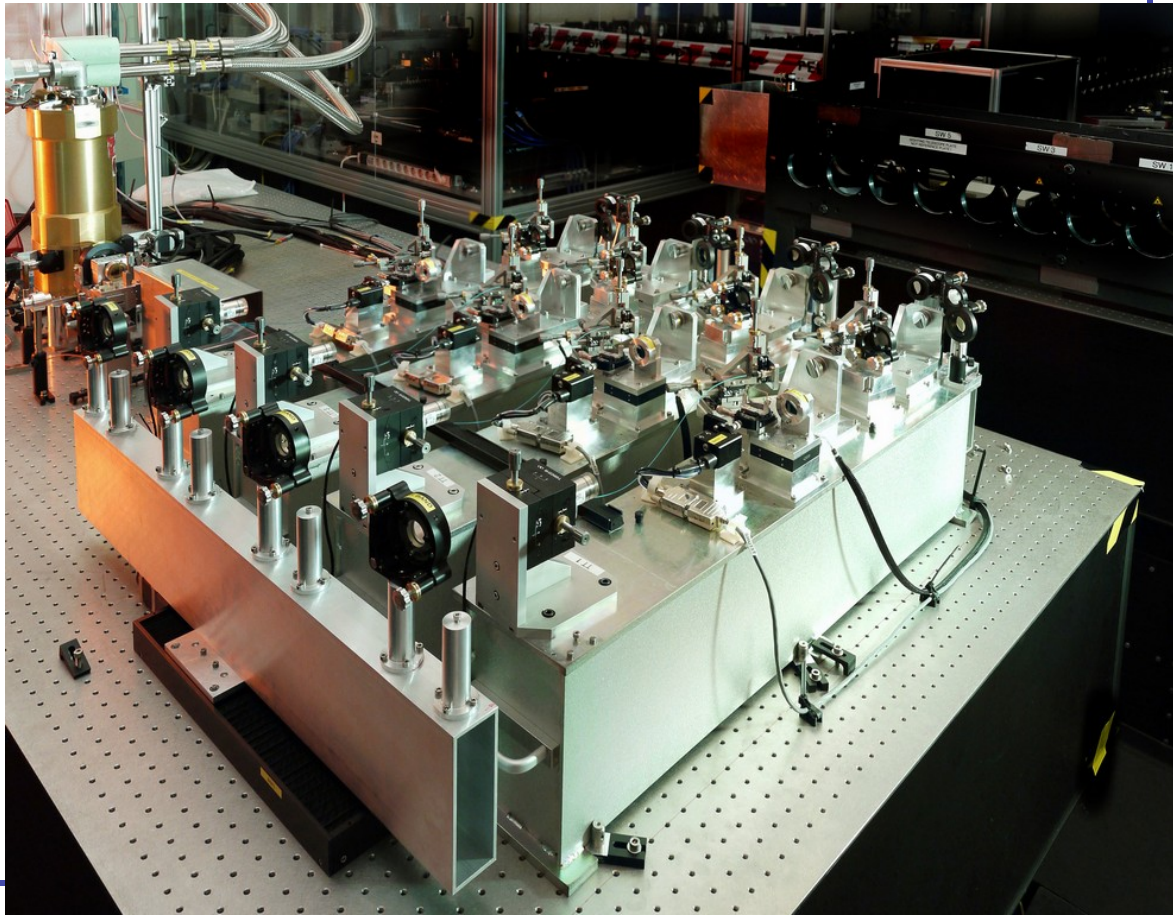
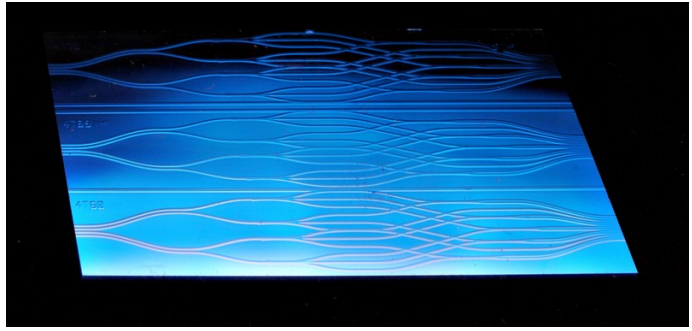
# Current instruments: MIDI

- Band: N (8-13 $\mu$ m)
- 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)
  - correlated flux mode => N=5.7 =0.2Jy (UT)
  - with FSU fringe tracker => UT sensitivity on AT



# Current instrument: PIONIER

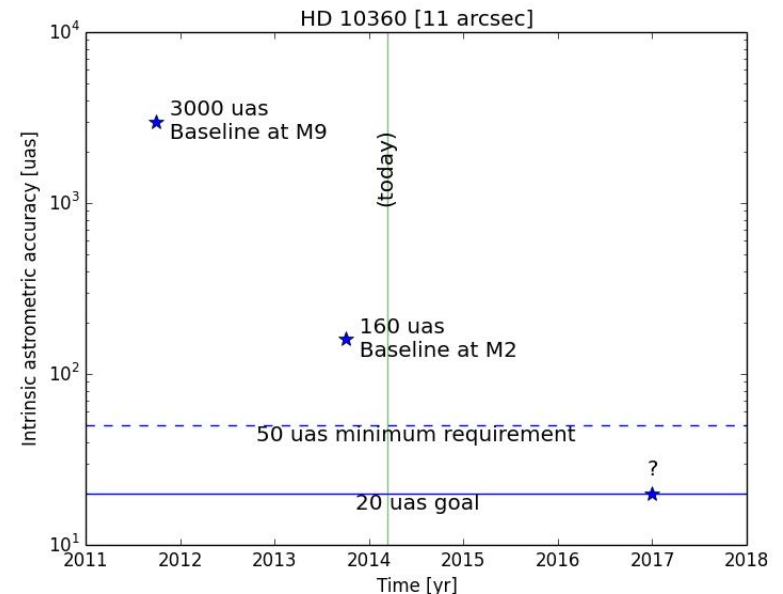
- Band: H (1.5-1.8  $\mu\text{m}$ )
- Low spectral resolution (up to  $R \sim 40$ )
- 4 telescopes – 6 baselines
- lim. mag.  $H > 7$
- Visitor instrument





# PRIMA (1/2)

- Three components projects:
  - Narrow-angle astrometry (ExoP)
  - Off-axis fringe tracking for MIDI and AMBER
  - Phase-referencing for MIDI and AMBER
- Narrow-angle astrometry achieved 160 uas in Oct. 2013
  - x20 improvement over fall 2011 (improved baseline configuration)
  - Short of the 20 uas goal
- PRIMA project review held in January 2014
  - Reaching 20 uas should be possible, but with risk, significant resources, and delays (+3 yrs).
  - ExoP science case threatened by GAIA: transformational to niche.
- ESO management proposal to governing bodies: cancellation, focus on GRAVITY and MATISSE





# PRIMA (2/2)

- Instrumental operation legacy
  - Distributed and real-time data recording infrastructure
  - Dual interferometry
- Instrumental performance legacy
  - Baseline stability for narrow angle astrometry
    - Benefits GRAVITY-Astrometry
  - Impact of polarization on stellar/metrology (2012/2013)
    - Wollaston on PIONIER/AMBER, STS derotator, AT/UT hybrid
  - Strehl fluctuations and fringe tracking
    - New views on UT performance



# 2<sup>nd</sup> generation instruments

- GRAVITY (2015) in testing phase
  - 2 to 2.5  $\mu\text{m}$  (K-band),  $R= 22$  to 4000
  - IR WFS at UT coudé
  - 4 telescopes simultaneously
  - high-accuracy astrometry (30 $\mu\text{as}$ ) and faint imaging ( $K>15$ )
  - Galactic Center, AGNs, stellar environment & dynamics...
- MATISSE (2016) under manufacturing
  - 3 to 13  $\mu\text{m}$  (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 ...



# Infrastructure for 2<sup>nd</sup> generation

- Installation of Star Separators on ATs and UTs
  - AT3 and AT4 are complete (PRIMA astrometry)
  - AT1 and AT2: take apart, modify, re-assemble.
  - UT1, UT3 partially, UT2/UT4 to be done
- Laboratory reorganization
  - Out: MIDI, PRIMA FSU
  - Move: PIONIER
  - In: GRAVITY, MATISSE



# Performance for 2<sup>nd</sup> generation

- AT: NAOMI adaptive optics
  - Post PDR, 4x4 SH WFS with off-the-shelf DM
  - Scheduled for operation in 2017
- UT: MACAO, Vibrations
  - Project under formulation
  - Expected to deploy on-axis end-to-M2 laser metrology
- VLTI: FT for MATISSE
  - Current option: GRAVITY as FT for MATISSE
  - Starting system analysis of the option



# Prospective

- Started by VLTI program scientist with community at VLTI Community days
  - Upgrade of PIONIER (detector and high resolution)
  - High dynamic range visitor instrument
  - Visible instrument with high spectral resolution
  - Extension to 6-8 telescopes

