VLTI Operations today

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VLTI Operations

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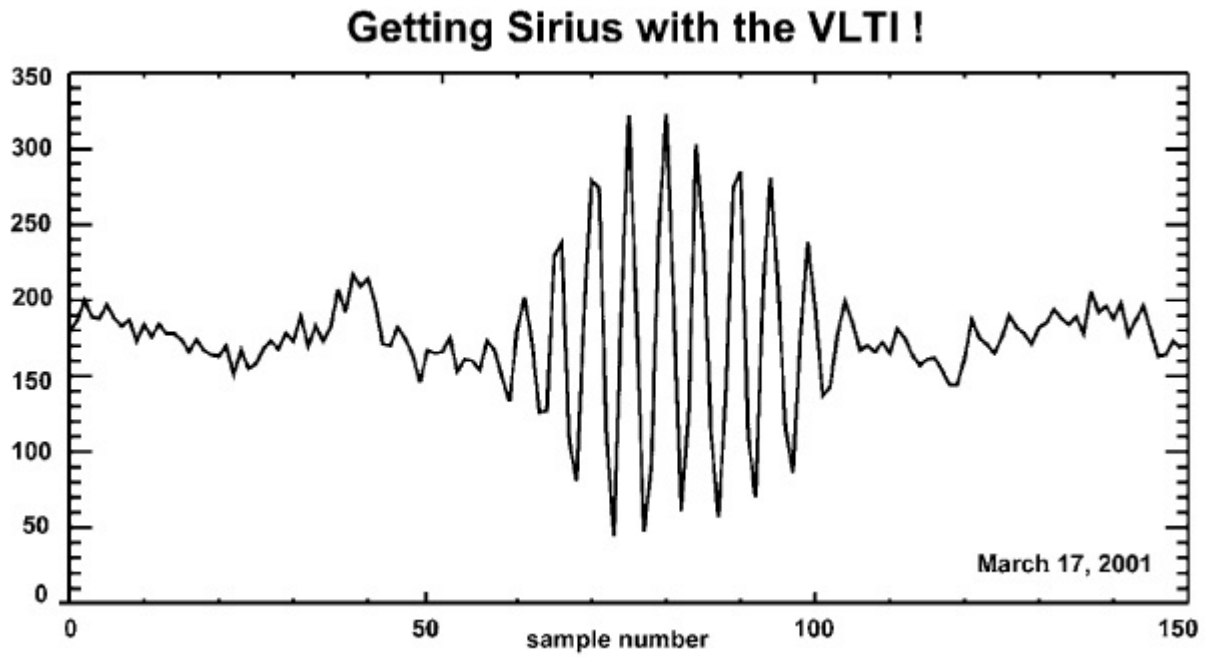
VLTI Operations: How It All Began



VLTI Operations: Where are we now

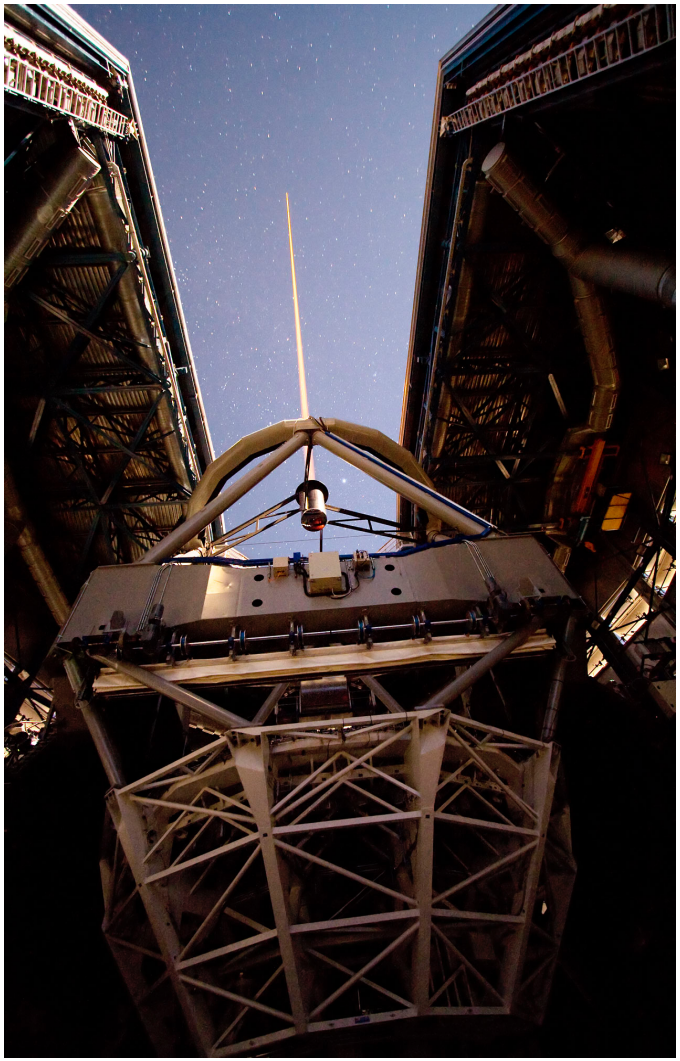
- 16 years later we have 3 fully operational instruments **AMBER – PIONIER – GRAVITY**
- Two main **Operating Modes**, one using the 8.2-m Unit Telescopes and the other using the 1.8-m Auxiliary Telescopes

The VLTI Lab

- Beam Switchyard for injecting the light into the instruments
- Beam compressor
  - 3 mirror design (compress 80 – 18mm)
    - High optical quality off axis parabolas
- Reference sources
  - Laser and white light sources
  - Provide reference axis for each beam and reference OPD between beams
- FINITO, co-phases (3 beams) to allow long exposures (mH <12 for UTs)
- IRIS is the infrared field-stabilizer of the VLTI. It consists of a fast infrared (K-band) camera onto which the images from each beam are projected

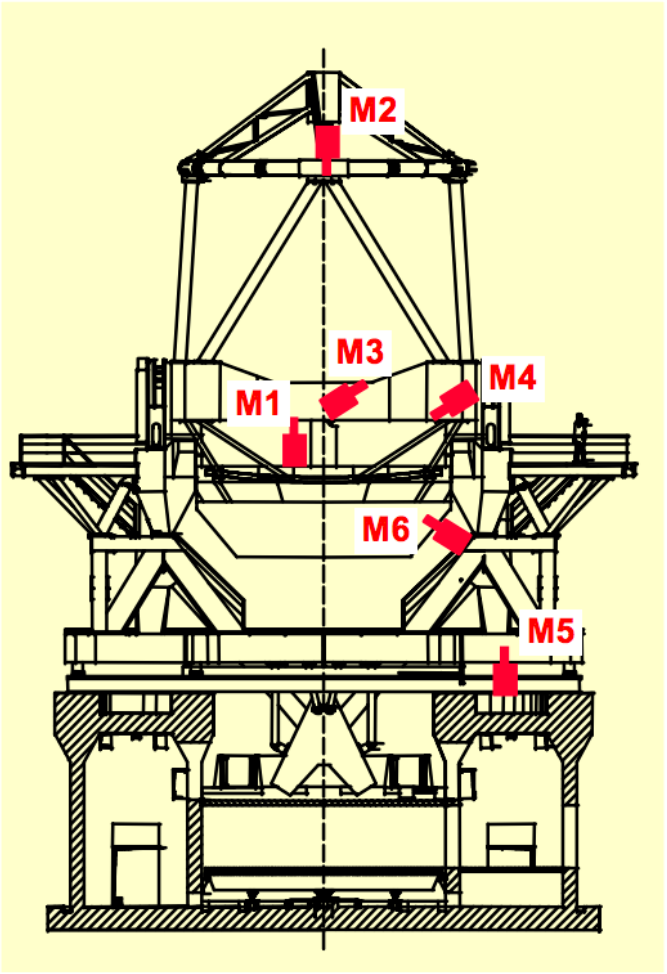
The Unit Telescopes

- The 8.2m diameter telescopes are housed in compact, thermally controlled buildings, which rotate synchronously with the telescopes.
- This design minimizes any adverse effects on the observing conditions, for instance from air turbulence in the telescope tube, which might otherwise occur due to variations in the temperature and wind flow.
- The first of the Unit Telescopes, 'Antu', went into routine scientific operations on 1 April 1999.



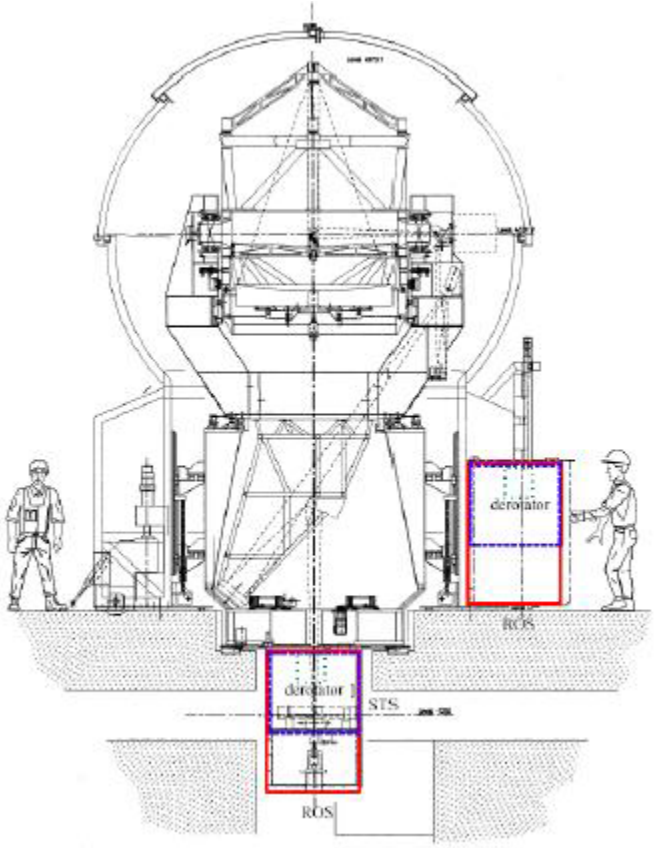
The Unit Telescopes

- 1.8m diameter main mirror
- Alt-Az mount
- Optical Layout: Ritchey-Chretien type
- Uses Active Optics to achieve the best optical quality by controlling the shape of flexible M1 and to M2 unit which controls the position of the mirror along 5 deg of freedom (focusing and centering)



The Auxiliary Telescopes

- They are mounted on tracks and can be relocated at 30 different observing positions on the observatory platform enabling thus to change the entire configuration of telescopes according to the observational requirements
- The Main Structure containing the mirrors is attached to the ground bearing with clamps and anchoring devices
- Underneath the telescope inside the “Station” is the Relay Optics Interface (ROS) to the coude focus and VLTI Tunnels
- The transporter provides the AC, Cooling Liquid, auxiliary power, hydraulic and pneumatic power services



The Auxiliary Telescopes (ATs)

- **M1** is passive.
- **M2** has 5 degrees of freedom but does not do the field stabilization.
- **M3** is fixed (to nasmyth)
- **ONECAL** is a focusing correction taken from previously calibrated lookup tables
- There is no **active optics** whatsoever, yet
- **M6** moves fast and does the field stabilization correction

The Auxiliary Telescopes (ATs)

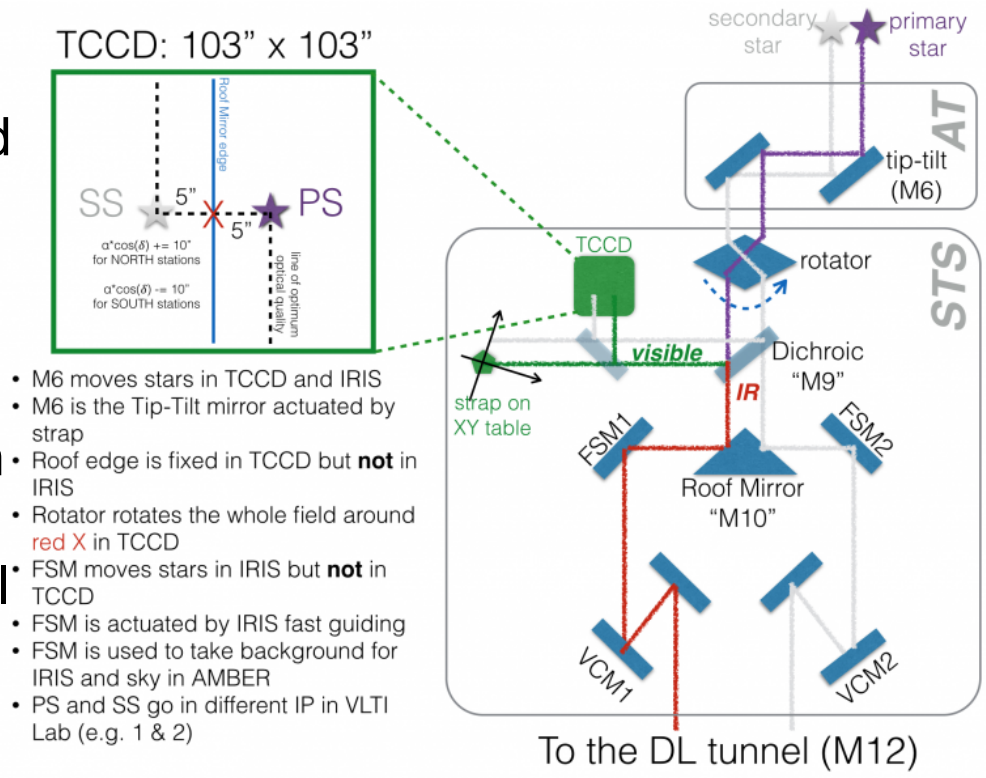
- There is no **rotator**
- There is no **adapter**, nor probe arm. There is an XY table where STRAP is mounted.. We will refer to it as the probe
- The ATs guide either using the technical CCD or STRAP
- The **CCD Reference Pixel** tracks
- Get **configured** as North or South depending to where the tunnel is looking from the pit (the ***ROS*** is then rotated according to the orientation too)

The Auxiliary Telescopes (ATs)

- **Enclosure** is either fully open or closed and does not rotate.
- ATs have a **Star Separator** enabling the VLTI to simultaneously acquire 2 stars using the same DL, that are injected into two different IPS.

The ATs Star Separator

- Single Feed ROS suffered from poor pupil steering (M10) and poor longitudinal imaging (DL VCM could not reach desired pressure)
- It was introduced so the VLTI could acquire **two stars**, using the same DL
- It is located in the *ROS*
- Each STS has its own **VCM**, which helps the DL-VCM out reimaging the pupil in the middle of the tunnel
- Larger FOV. Necessary for GRAVITY

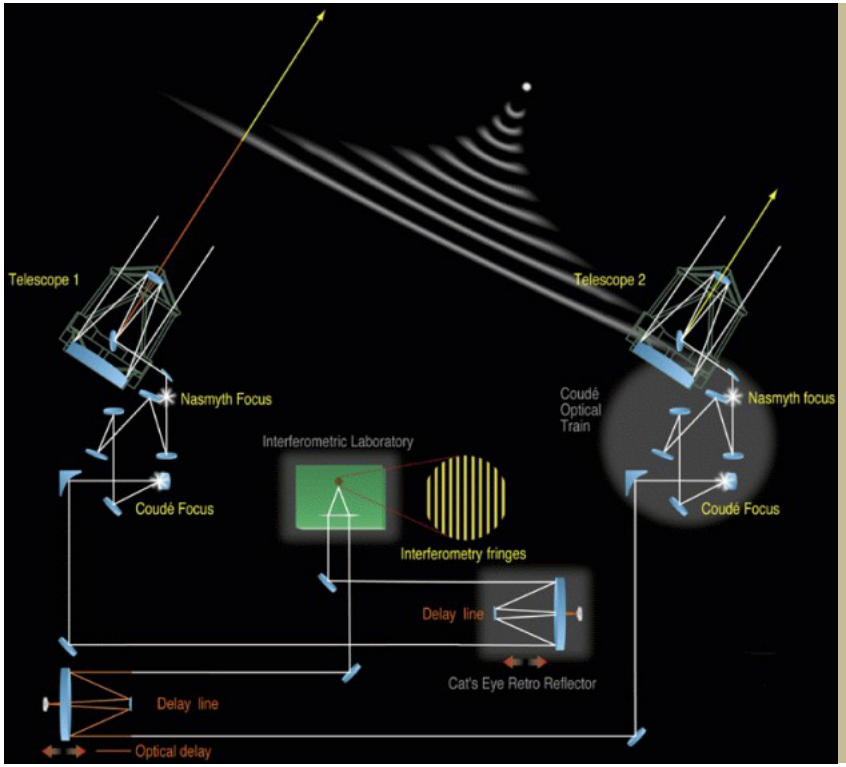


The Strap

- It consists of four avalanche photo-diode quadrants which measures the tip-tilt of the incoming wavefront

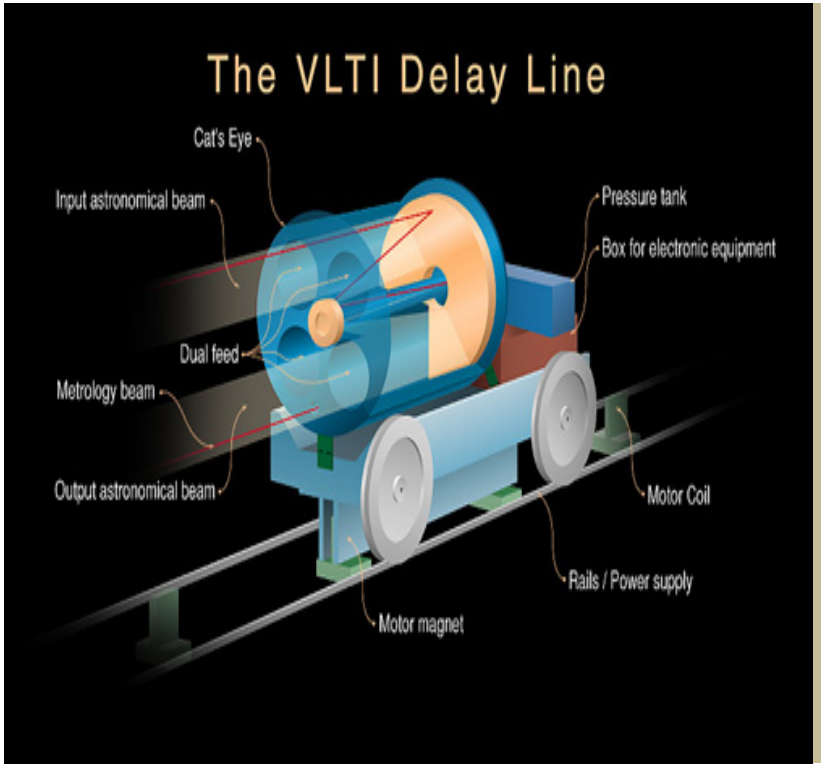
- The measured tip-tilt is compensated by acting on the M6 mobile mirror of the telescope.
  - When reaching the limit, the M6 position is offloaded to the alt-az axes of the telescope.
- The sensitivity of STRAP on the ATs is V =13.5
  - Guides on the science target (on axis)
  - If the science target is fainter than V =13.5, it is possible to perform "**off-target Coude guiding"**, for another guide-star in the FOV closer than 57.5arcsec to the science target.

VLTI Optical Train



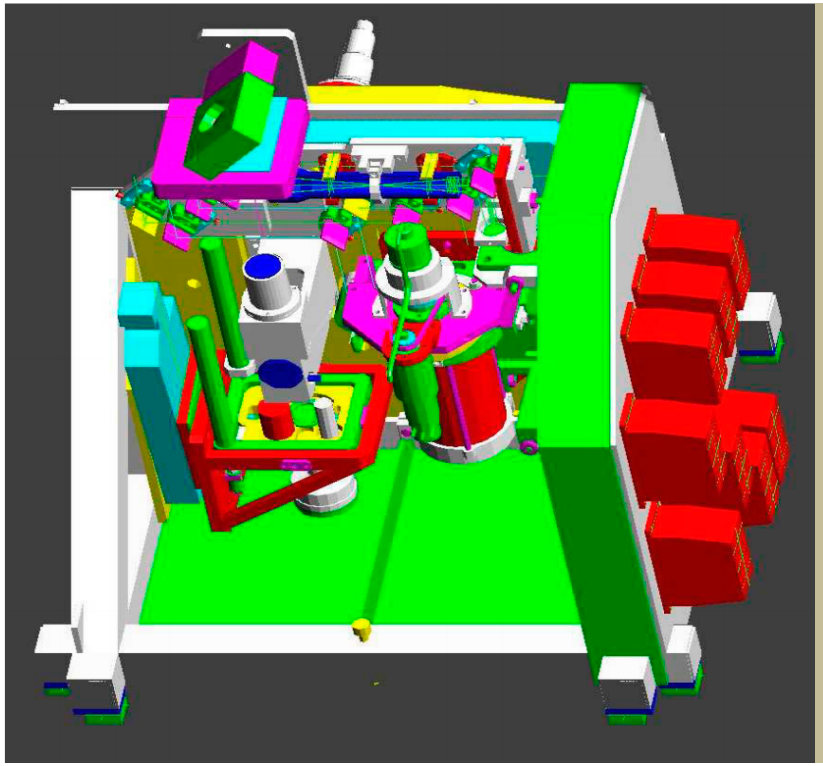
- Active Optics
- Adaptive Optics /Tip-Tilt
- Delay Tracking
- Vibration Control in each
- FRINGES !!!!

Delay Lines



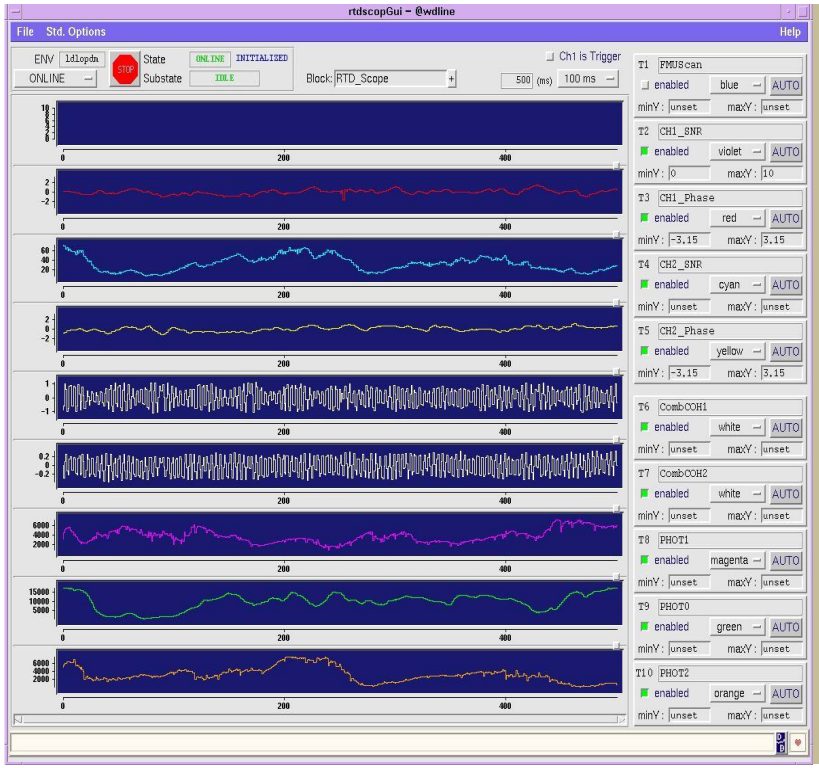
- DLs are used to compensate for the ***OPD*** between two telescopes
  - Stroke: 105m in OPL
  - Resolution: < 5nm
  - Speed: 0.5m/s
  - Stability: <14nm rms (jitter)
- **VCM** (Variable Curvature Mirror)
  - Re-image pupil inside the laboratory
  - Mounted on piezo translator for fast OPD correction

VLTI AO- MACAO



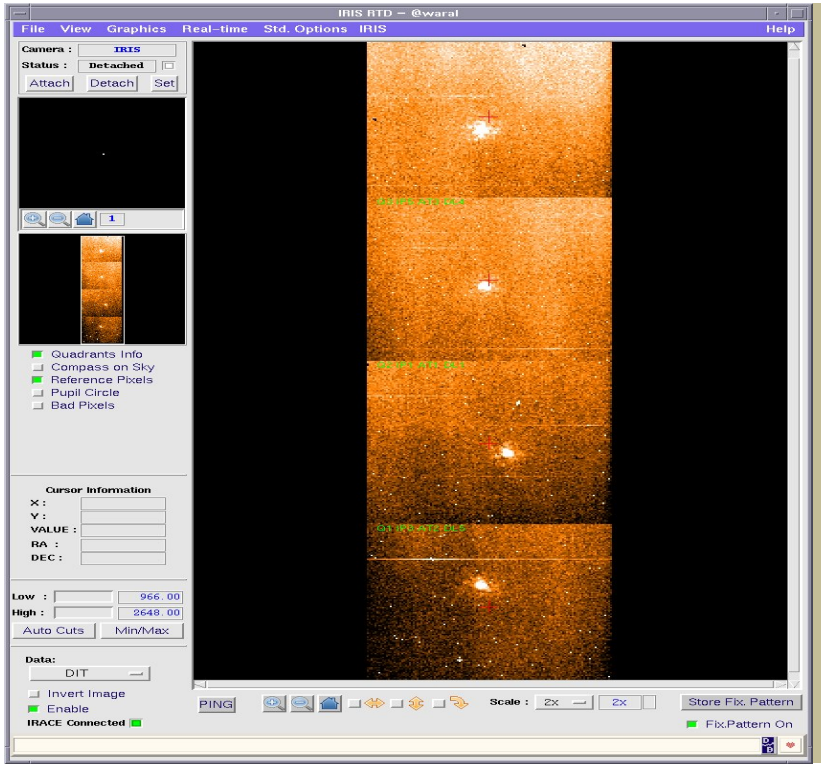
- Multi-curvature AO system for VLTI-UTs
- 60 elements curvature system
  - Wavefront sensor using APDs coupled with optical fibers
  - Deformable mirror on tip-tilt mount
  - Vibrating membrane
  - Radial geometry micro-lenses
- X-Y Table allows reference source different from target

VLTI Fringe Tracker - FINITO



- Compensates atmospheric piston between the telescopes to stabilize the fringes
- H-Band

Stabilisation Devices - IRIS

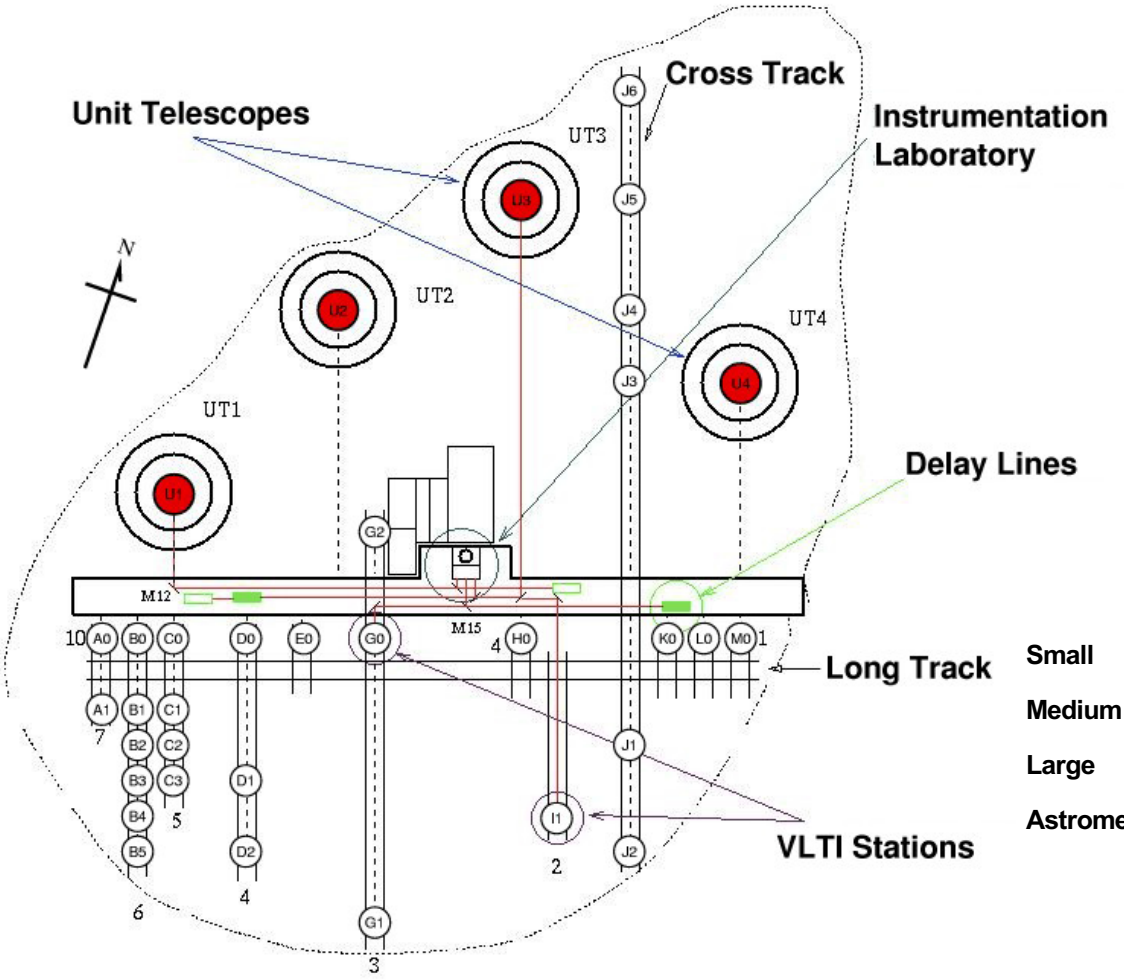


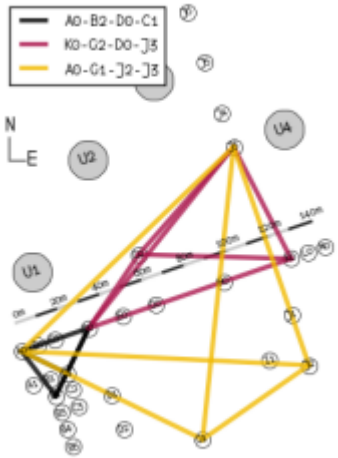
Infrared Field Stabilizer

Performs FS on the telescope by measuring low frequency tip-tilt in the VLTI lab

- K-band camera
- 1 image per beam
- Guarantees correct alignment of the beam during observations.
- Two modes: slow and fast guiding
- Pupil alignment

VLTI Array





	AT1	AT2	AT3	AT4
Small	A0/DL6	B2/DL5	D0/DL1	C1/DL2
Medium	K0/DL4	G2/DL2	D0/DL1	J3/DL3
Large	A0/DL6	G1/DL5	J2/DL4	J3/DL3
Astrometry	A0/DL1	G1/DL5	J2/DL4	K0/DL3

VLTI Operations

- All operations are done by a team including:
  - One Night Astronomer (NAs)
  - One Telescope Operator (TIO)
- Workforce *(as of march 2017)*:
  - Five (5) VLTI Astronomers
  - Nine (7) VLTI TIOs
    - Two new TIOs (2) in training starting p99
- All NAs know and operate the *ATs* from the simplified panels in the *ISS* and all TIOs operate all instruments or are on their way to being certified.
- In order to follow the Observatory operations scheme by the end of this year ***Sciops 2.0*** should be implemented fully on VLTI