The Very Large Telescope Interferometer – VLTI –

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VLT(i) support astronomer
AMBER Paranal instrument scientist

VLTI School – Porquerolles 2010

In a few words

- On Cerro Paranal in the Chilean Atacama desert
- Built and Operated by ESO
- 4 x 8.2m telescopes (UT) with adaptive optics
- 4 x 1.8m telescopes (AT) movable
- Network of stations from B=8m up to ~200m

History

1980s – Interferometry integral part of the VLT project

1990s – engineering of the general layout

1996 – MPG/CNRS/ESO tri-partite agreement for third AT

1997 – MIDI and AMBER proposed by community

1998 – contracts for ATs and Delay Lines awarded, MIDI and AMBER started

2000 – start of implementation on Paranal (siderostats and delay lines)

2001 – first fringes with VINCI on siderostats

2004 – MIDI offered on UTs (2005 on ATs)

2005 – AMBER offered on UTs (2007 on ATs)

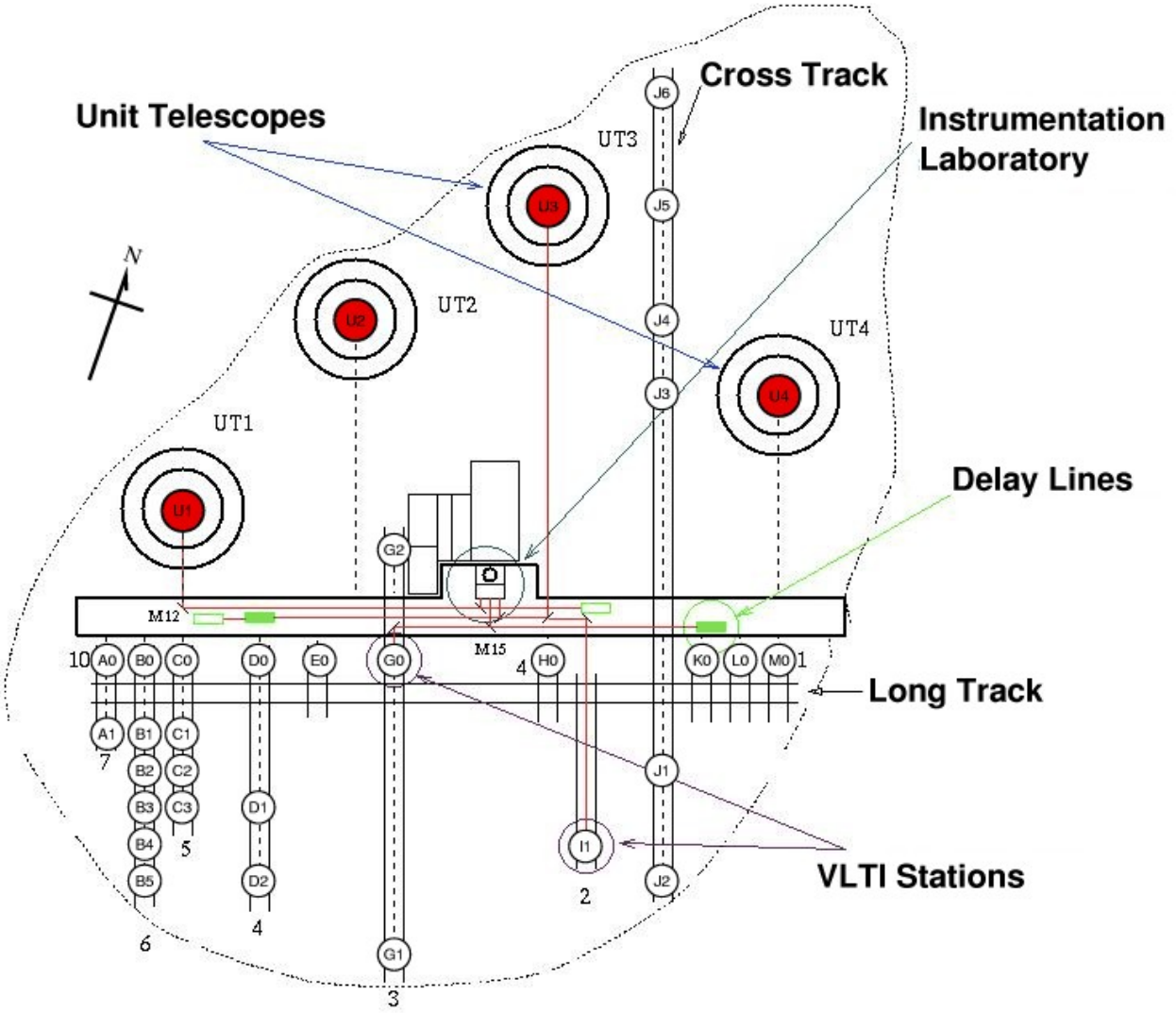
Facility

Telescopes

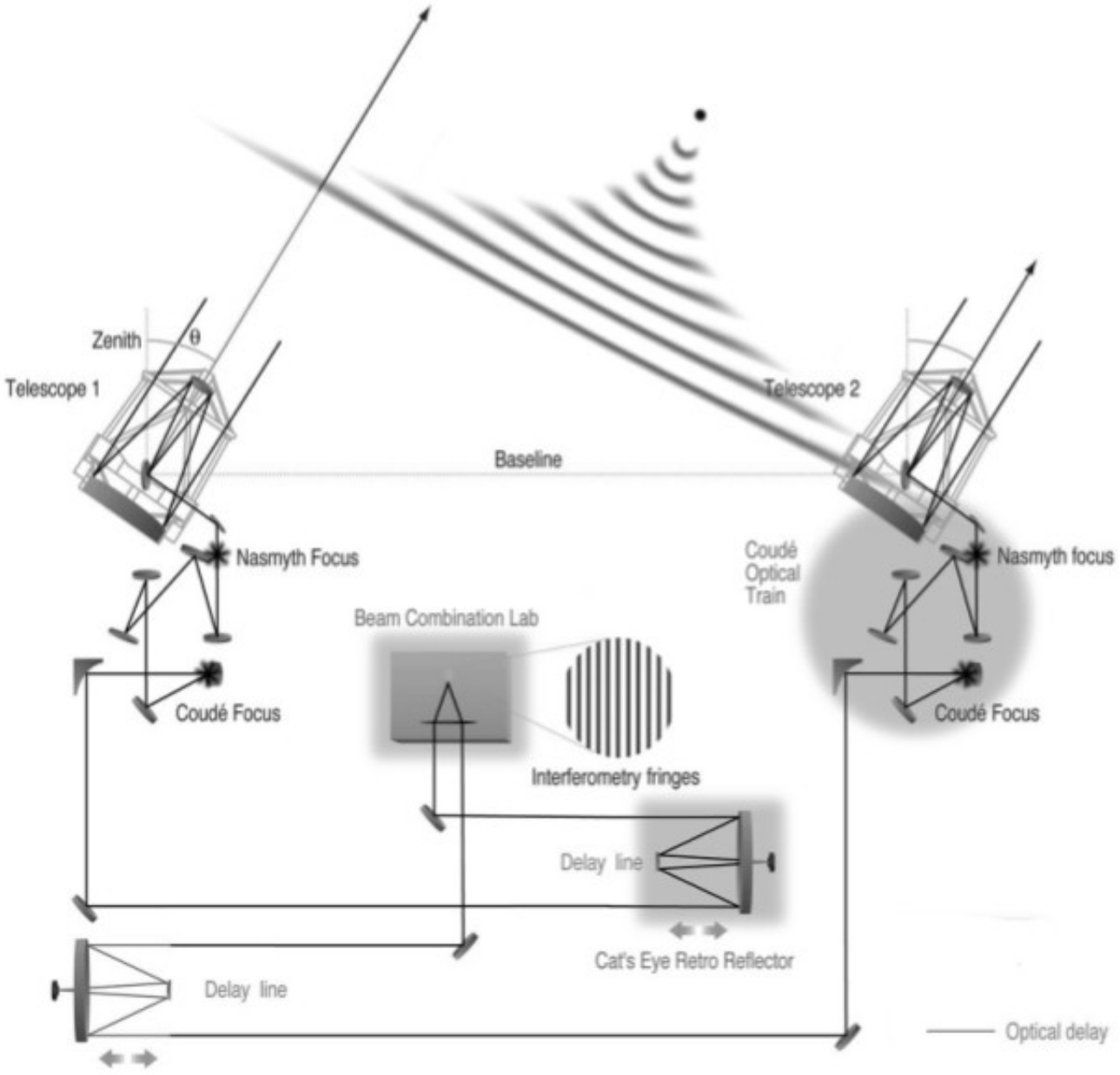
Tunnels

Delay lines

Focal lab



Reminder: Principles

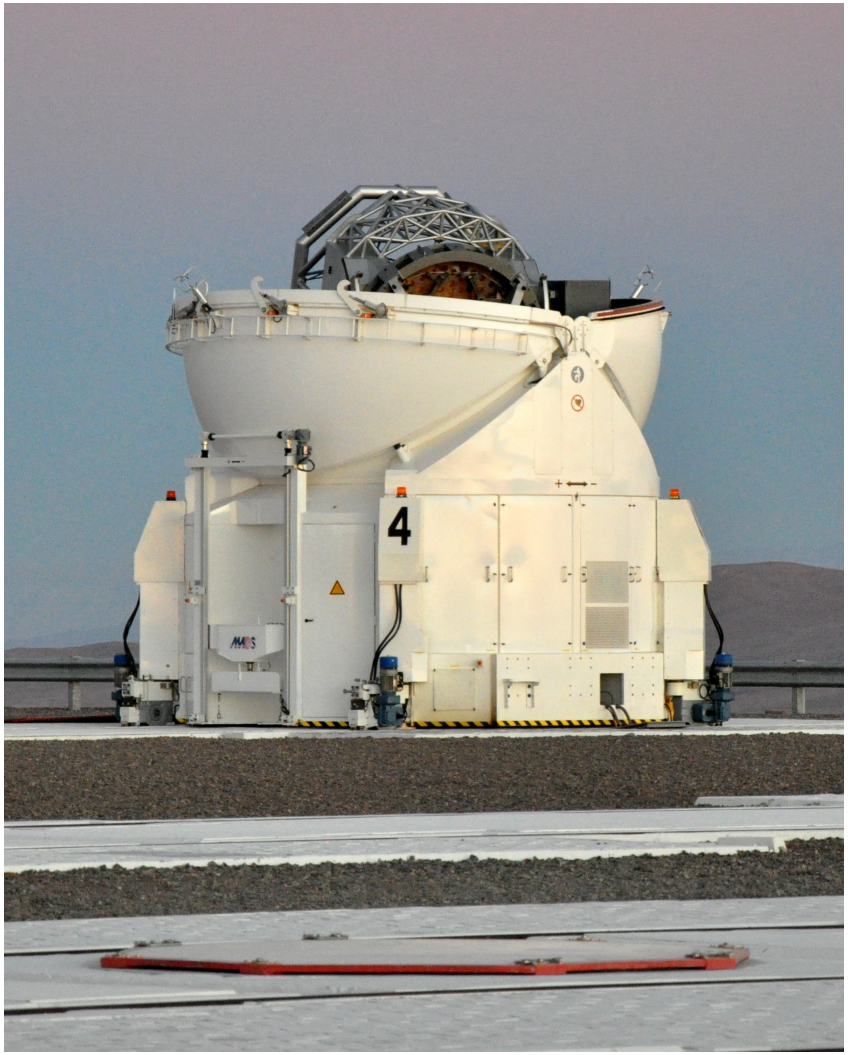


Unit Telescopes

- 8.2m in diameter
- Used with 3 instruments for non-VLTI
- Adaptive optics for VLTI (MACAO)
- Baselines up to 137m
- VLTI/UT ~2-3 nights / month

Auxiliary Telescopes

- 1.8m in diameter
- Scaled down UTs
- Flexible: movable
- No AO (yet)
- Baselines up to 200m (offered up to 128m)
- 4 in total



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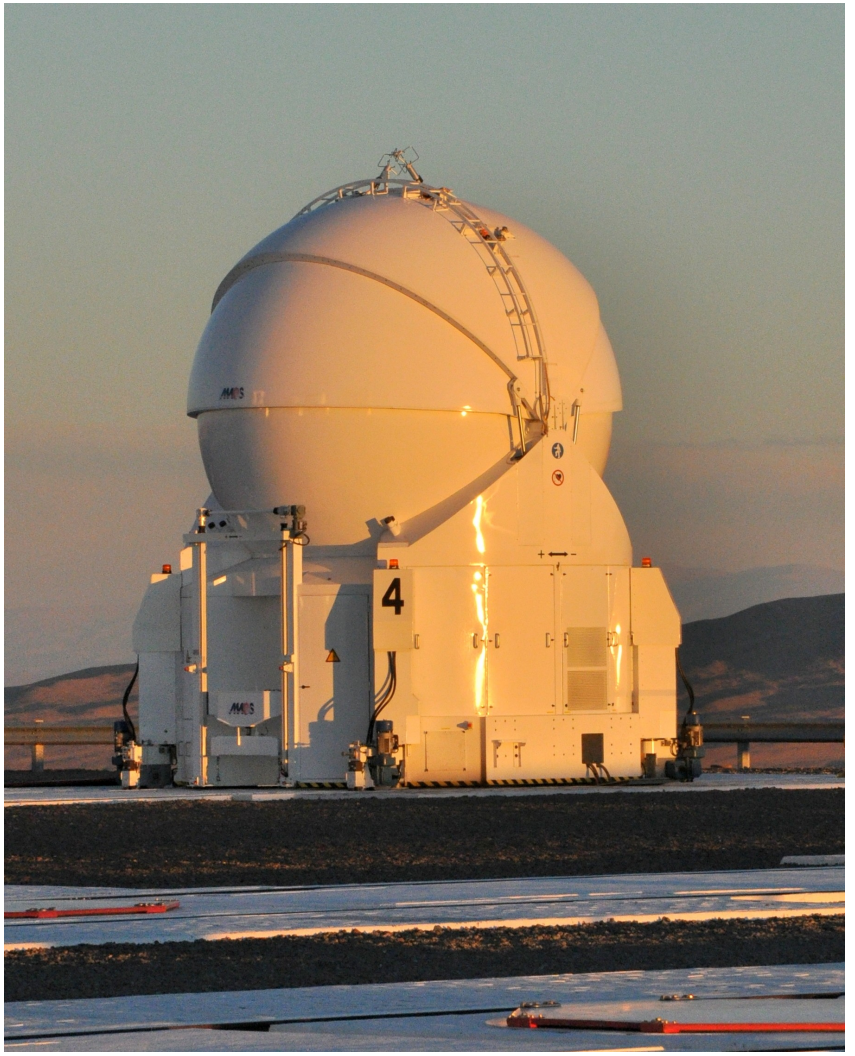
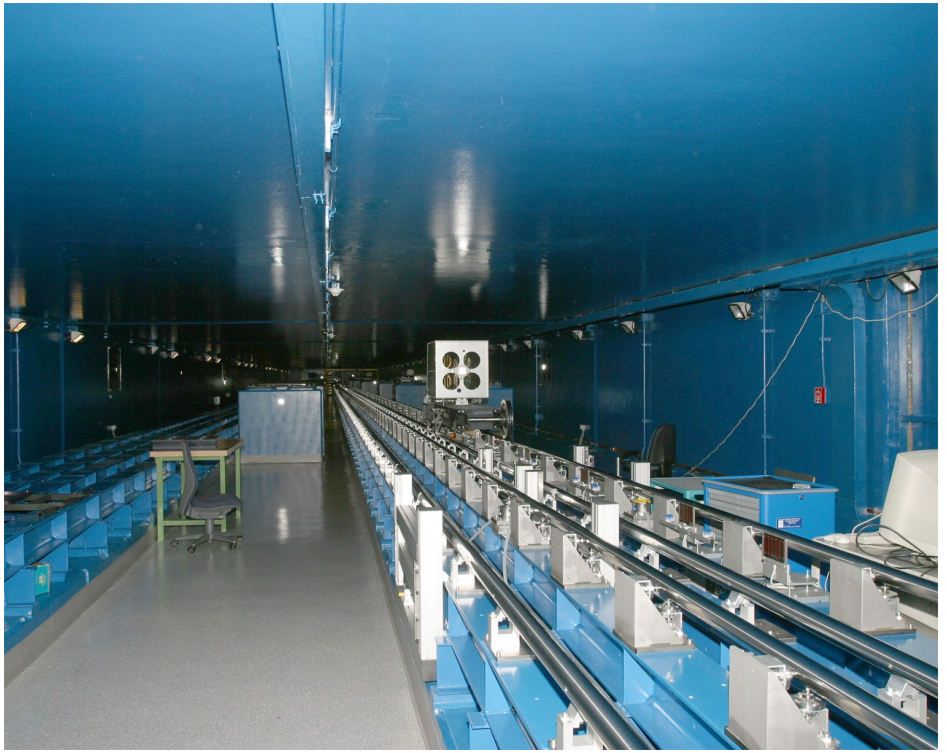
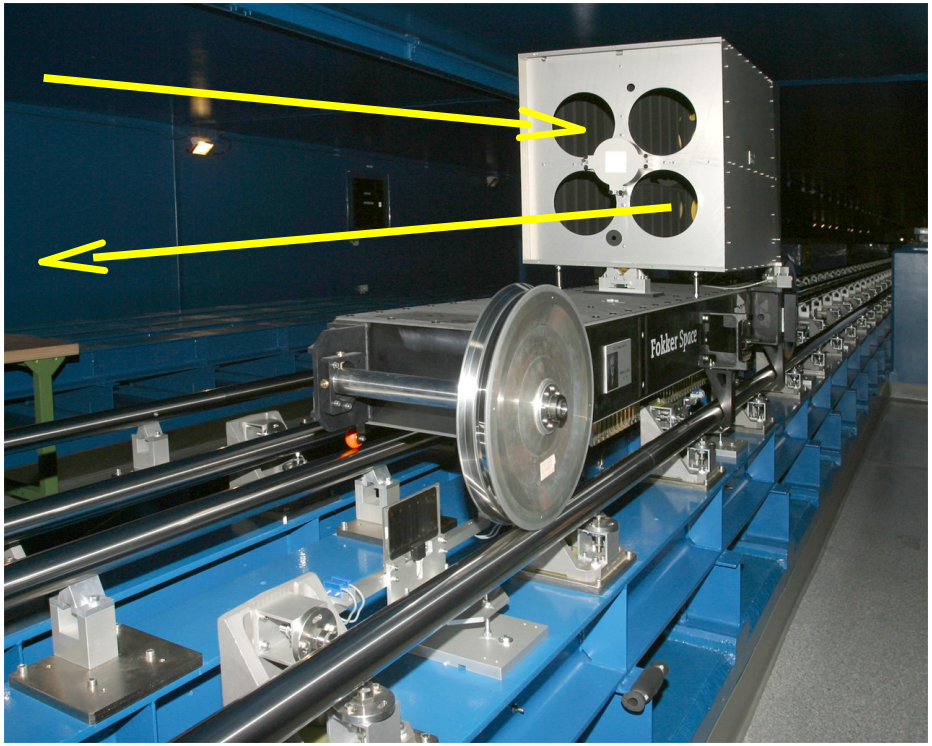


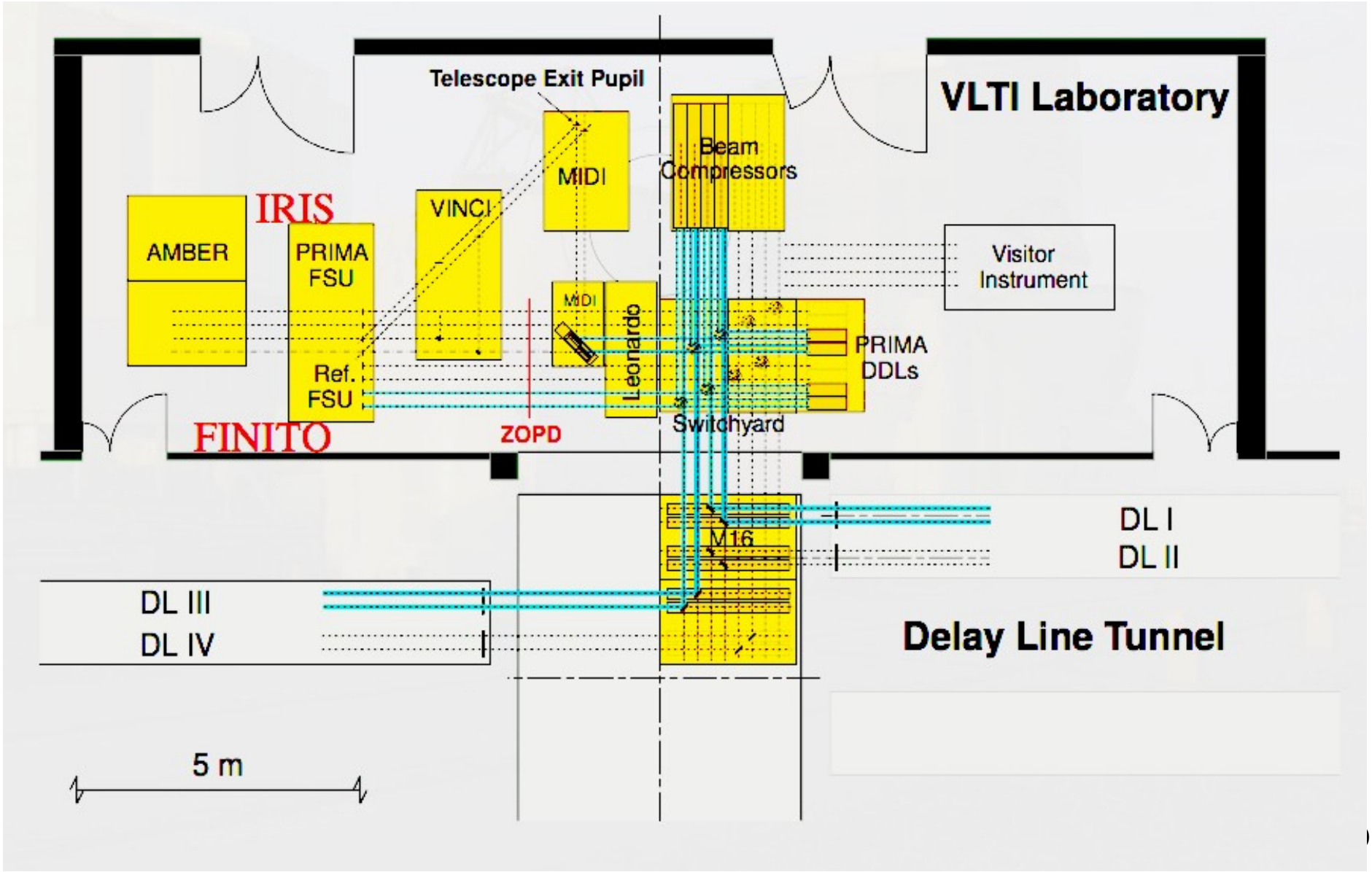
Delay Lines

- Under ground (thermal stability)
- Correct for about 100m of delay
- Flexible: use of switchyards
- Can propagate 2 beams for off-axis





The focal lab

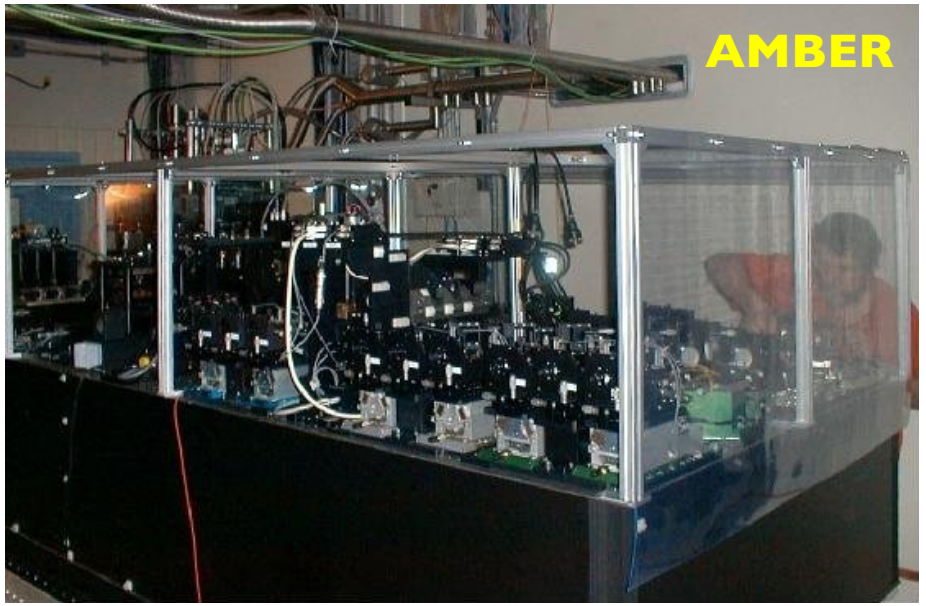


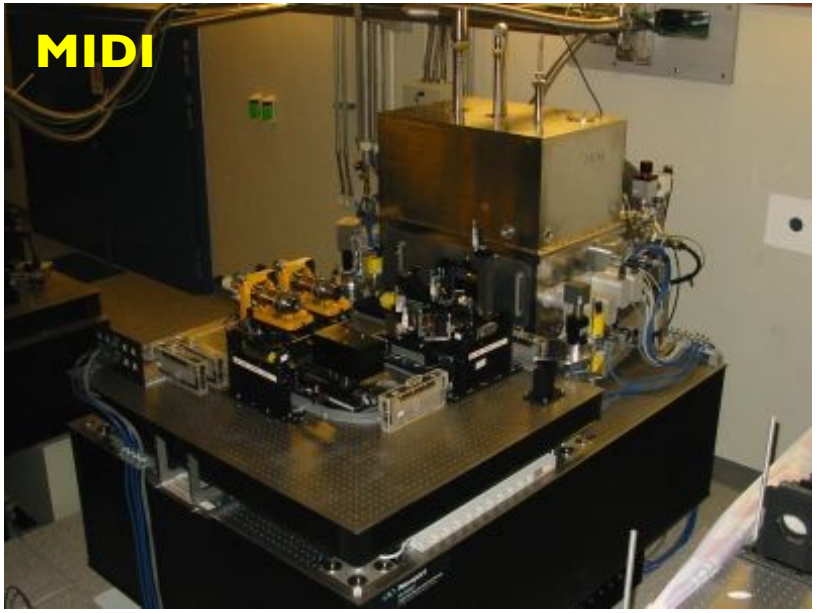
The focal lab

- Underground and restricted access: thermal stability
- Instruments and Facilities: Quite complex and quite crowded
- Uses switchyard to select telescopes / beams
- Minimal disturbance: no light, no heat sources, etc.

The current instruments

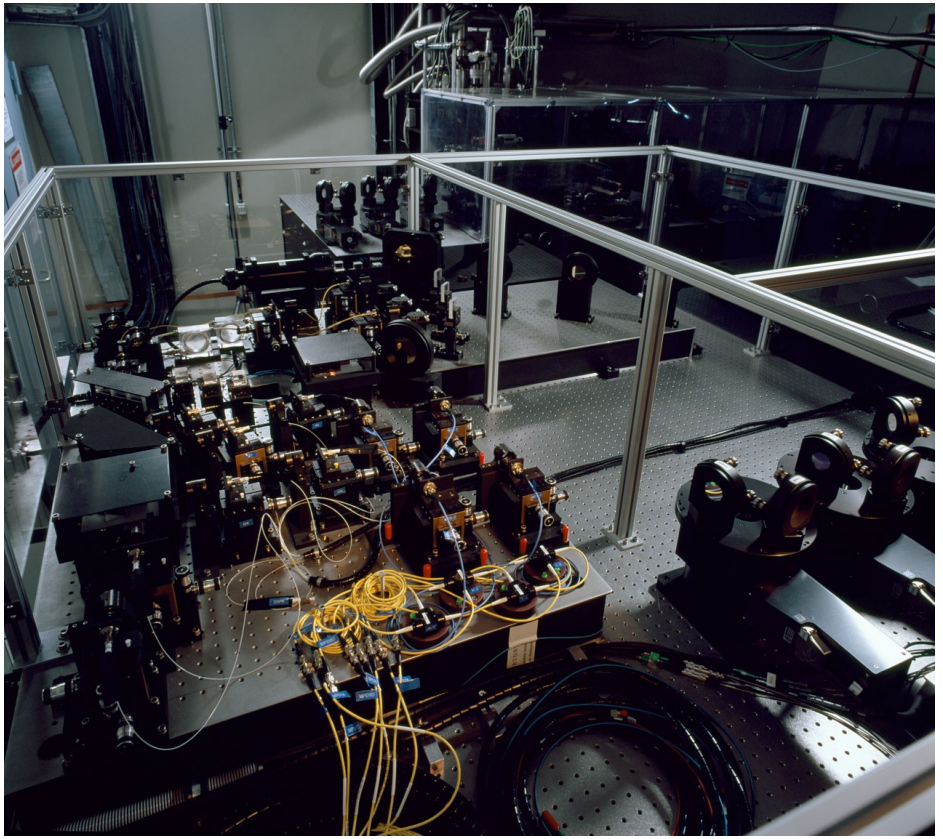
	Range		Resolution	Mag. Lim.
AMBER	1-2.5 microns	3T	R=25, 1500 ,15000	~7/5
MIDI	8-12 microns	2T	R=30,230	~1/20 Jy





FINITO

- **Fringe Tracker:** measures fringes phase every 1ms and actively corrects
- 2 x 2T in H band
- Freezes atmosphere turbulence for seconds
- Allows AMBER to integrate for seconds



Active Alignments

Pupil tracking: ARAL

- make sure you see only the sky...
- critical for MIDI (thermal IR)

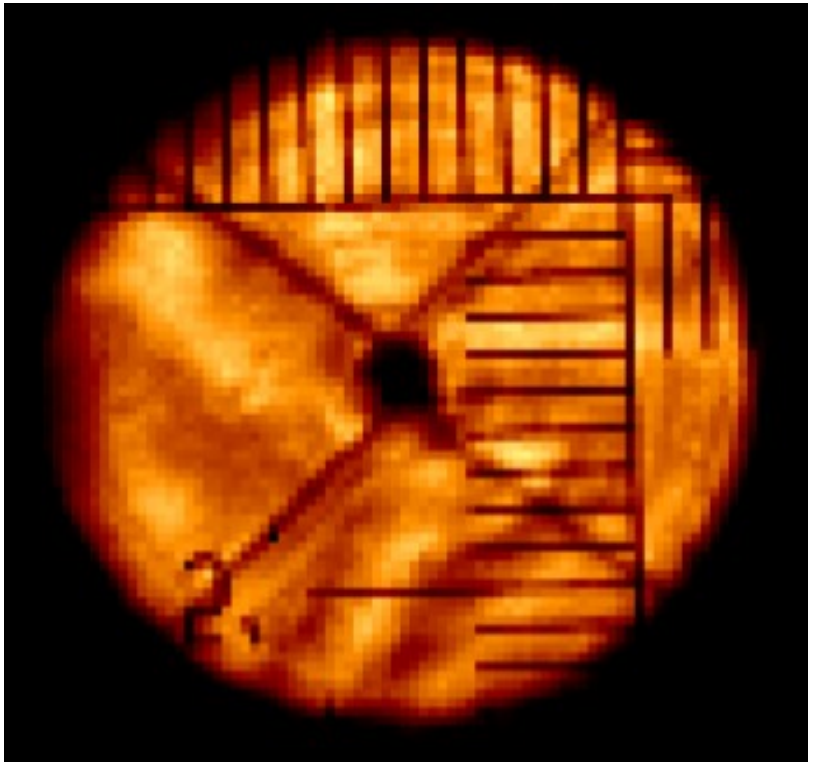
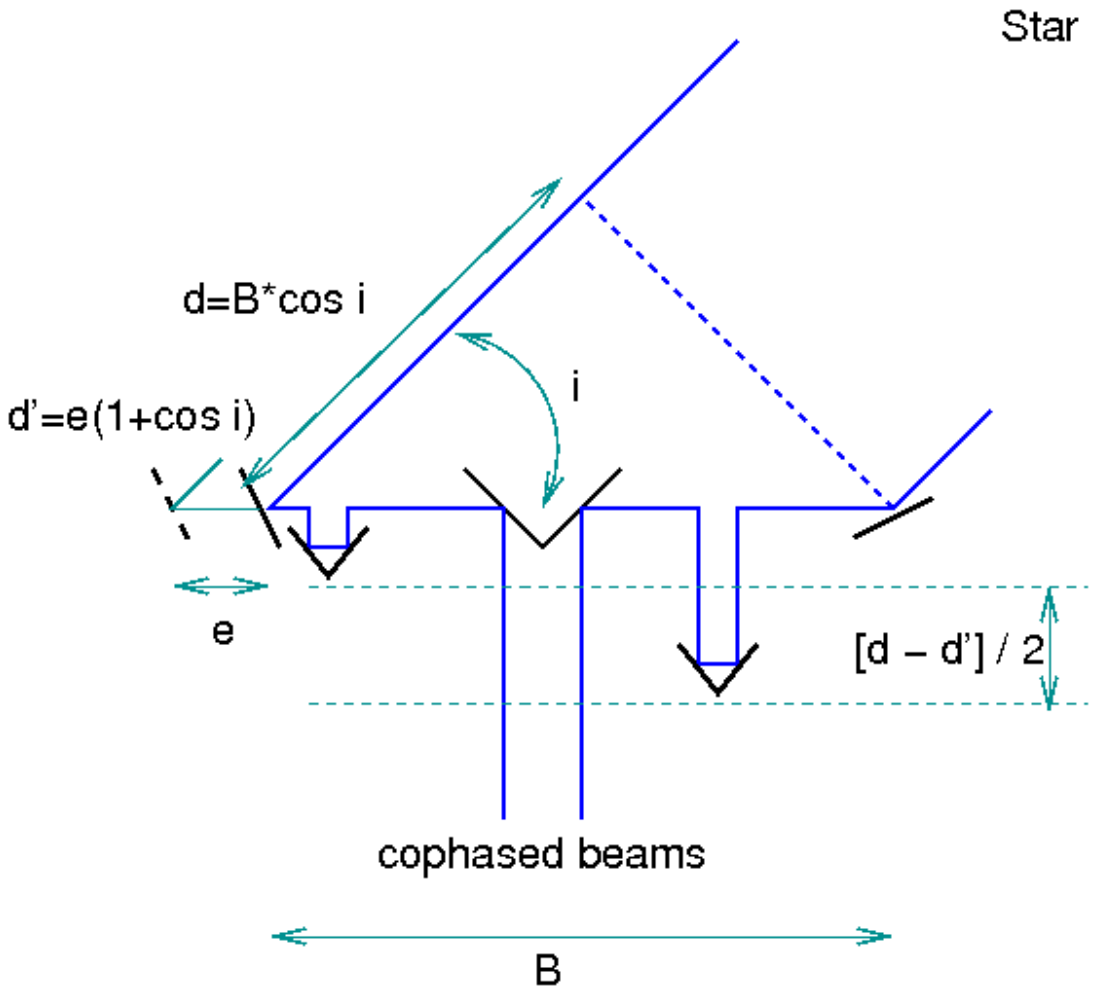


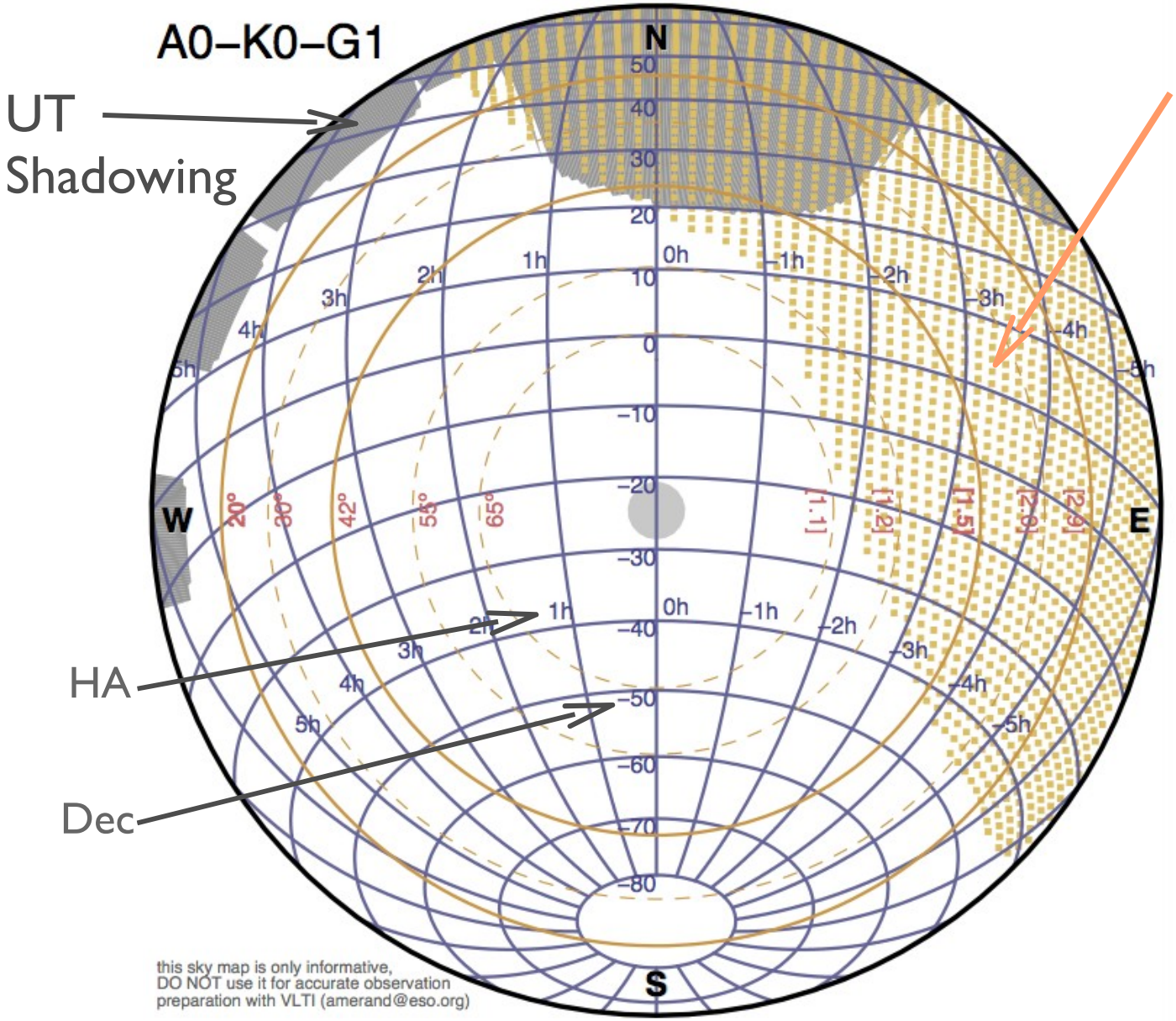
Image alignment and tracking: IRIS

- maintains the VLTI optical axis
- corrects for residual tip-tilt motion: improves injection

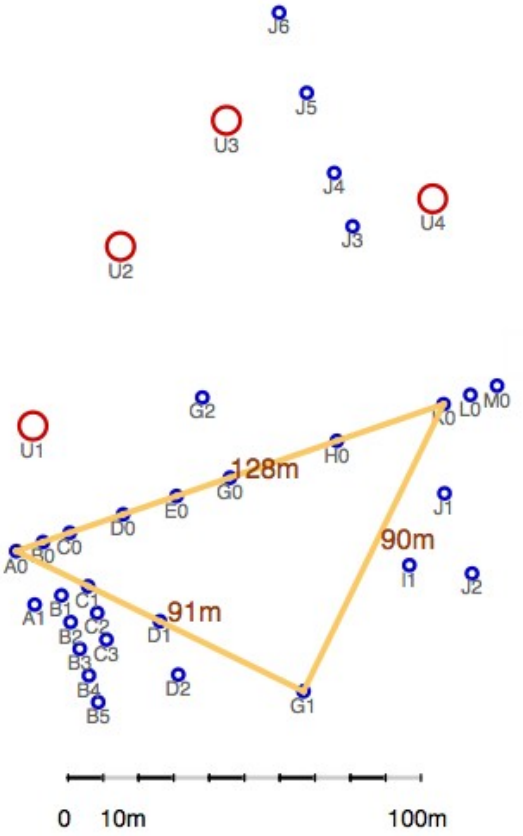
Limited Sky Coverage

- Beams need to be cophased
- Delay lines positions need to be adjusted
- Depends on
  - star apparent position
  - baseline vector
  - lab position / B
- Limited DL length == limited sky coverage

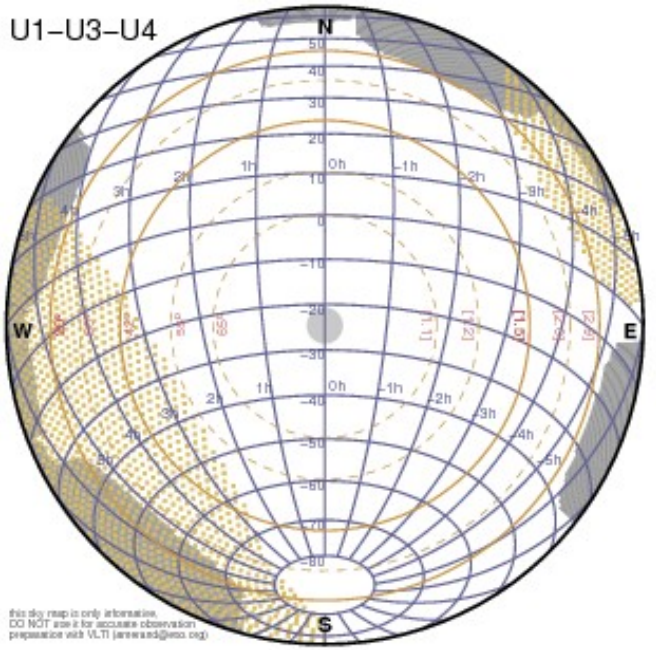


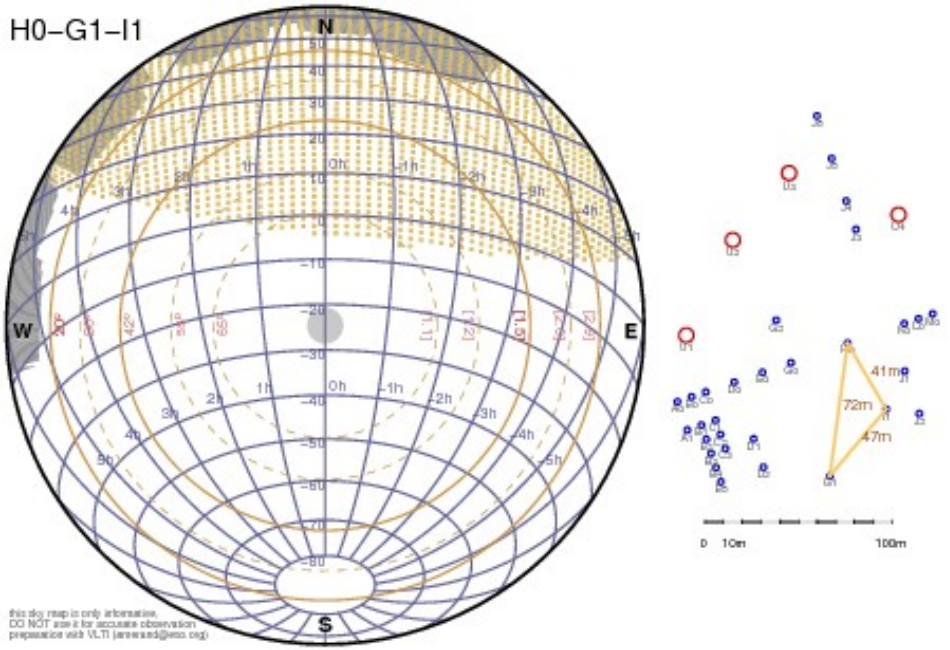


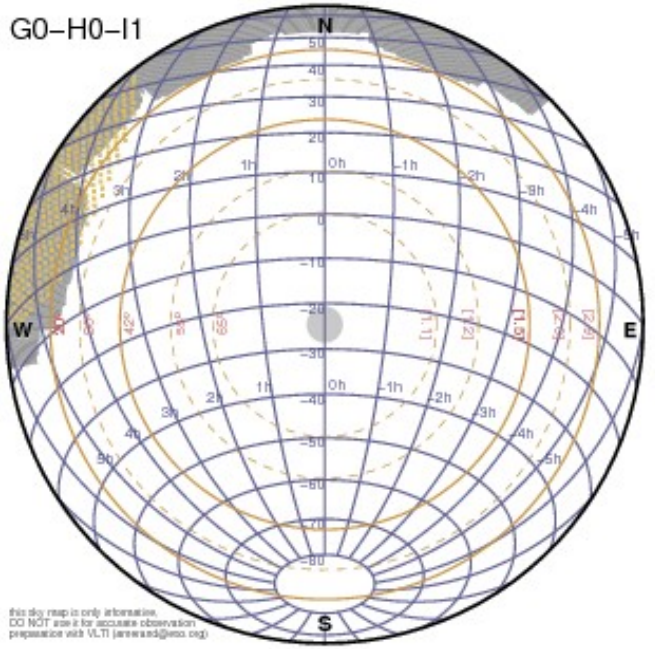
DL length limitation



The longest the baseline and the further the stations from the VLTI lab, the most limited the sky coverage







Baselines currently offered

4 quadruplets:

- A0-G1-K0-I1, D0-H0-G1-I1, E0-G0-H0-I1 + All UTs

AT baselines from 16m to 128m (UTs from 47 to 130m)

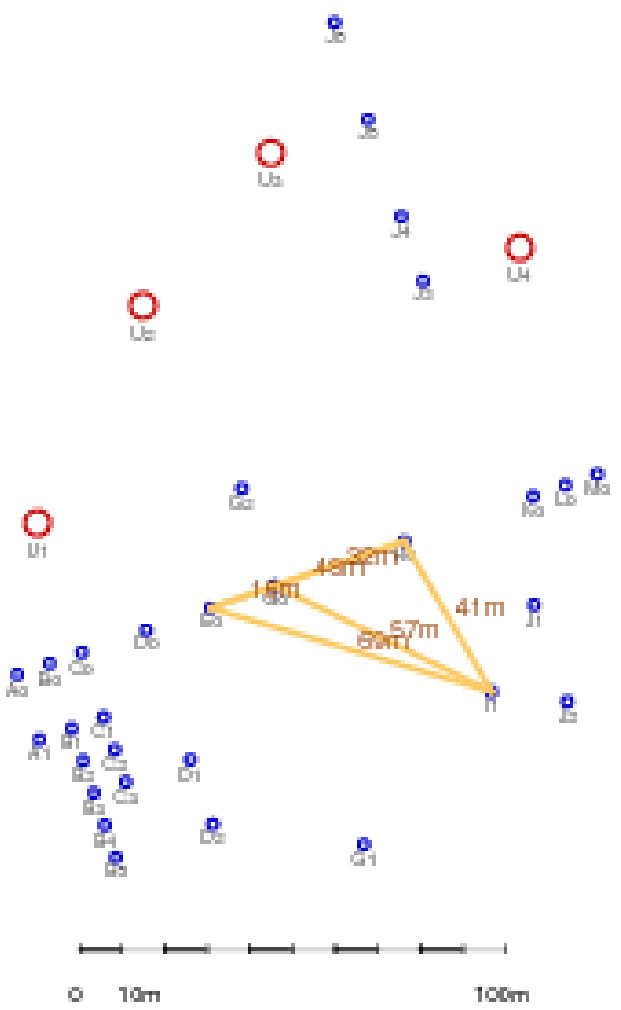
- 12 triplets (AMBER)
- 16 baselines (MIDI)

Operational constraints:

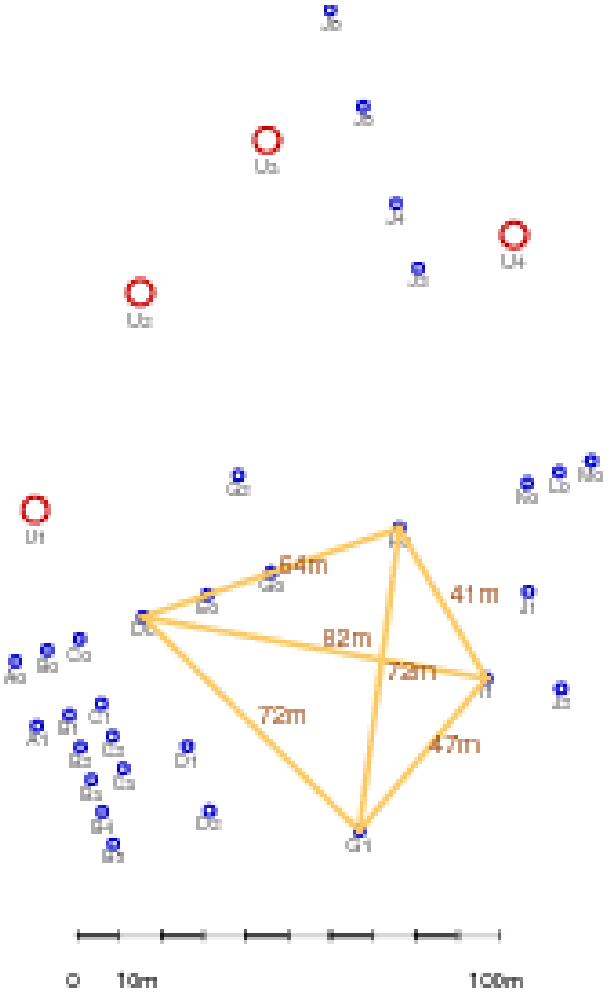
- one AT per lettered track
- only AT 2 movements per day

Baselines currently offered (P85)

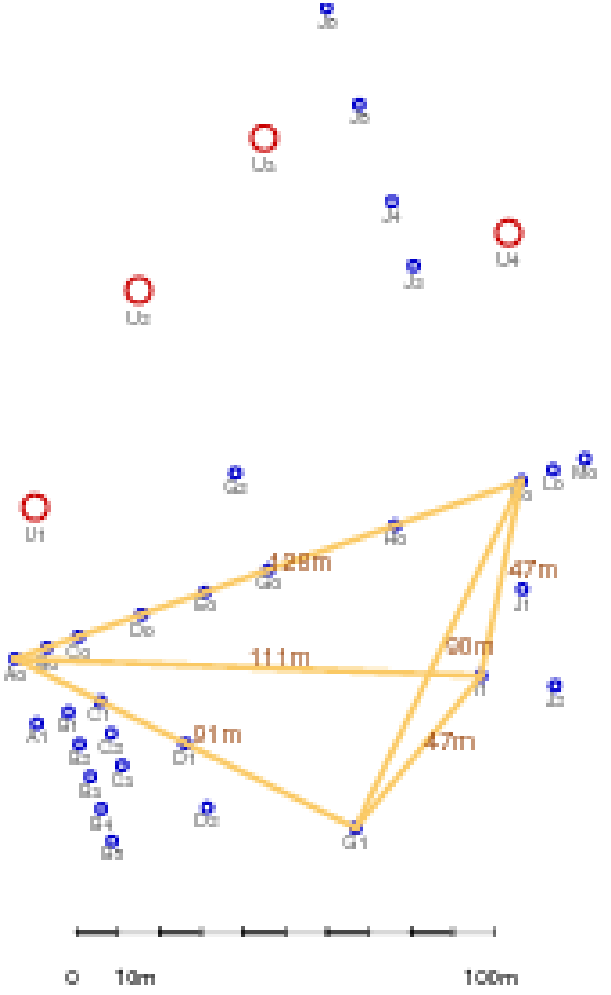
E0-G0-H0-I1



D0-H0-G1-I1



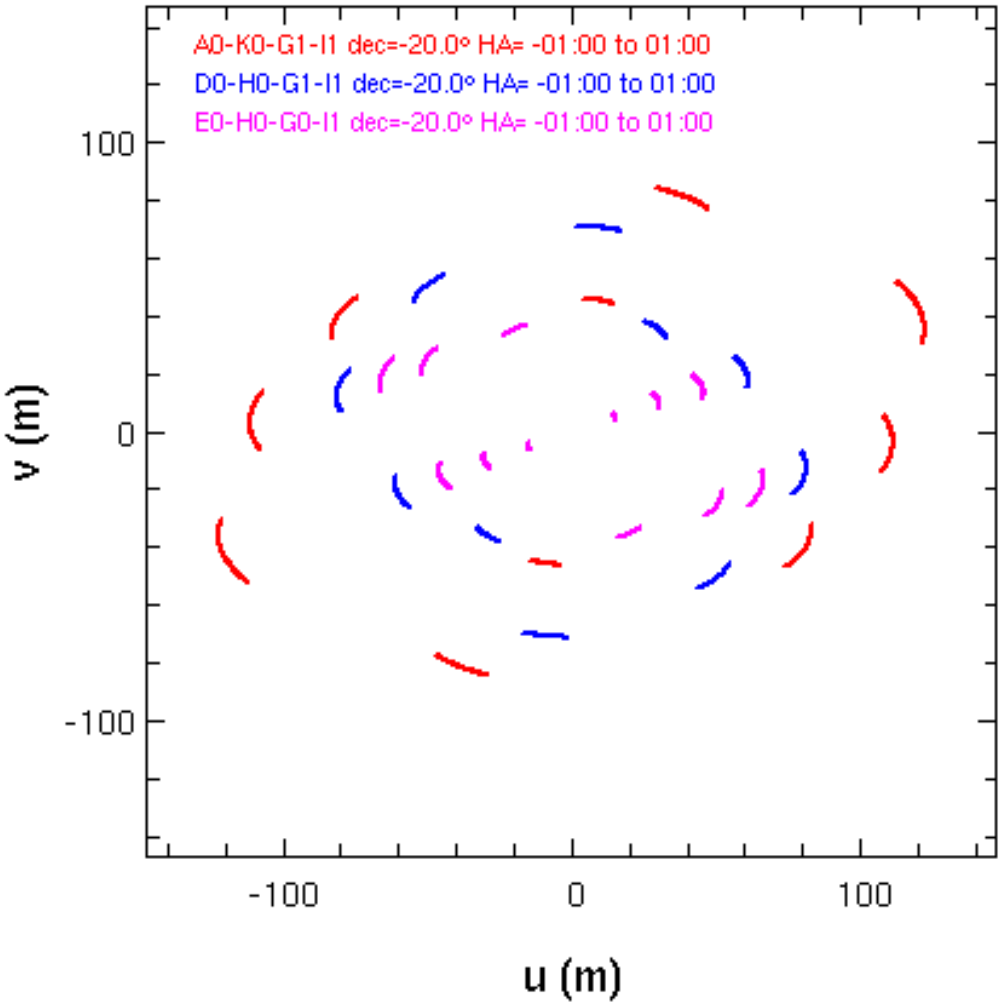
A0-G1-K0-I1



AT [u,v] coverage

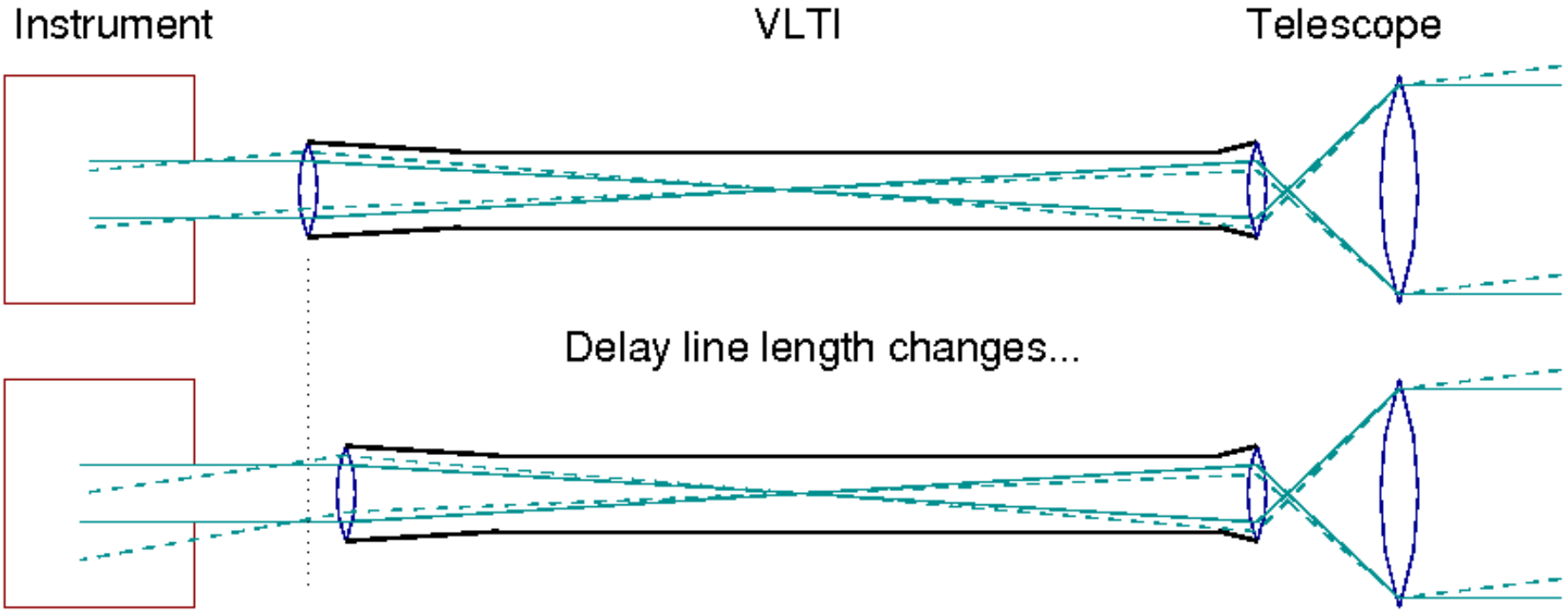
We are trying to satisfy everybody:

- AMBER community wants imaging
- MIDI community wants small baselines
- Operational constraints

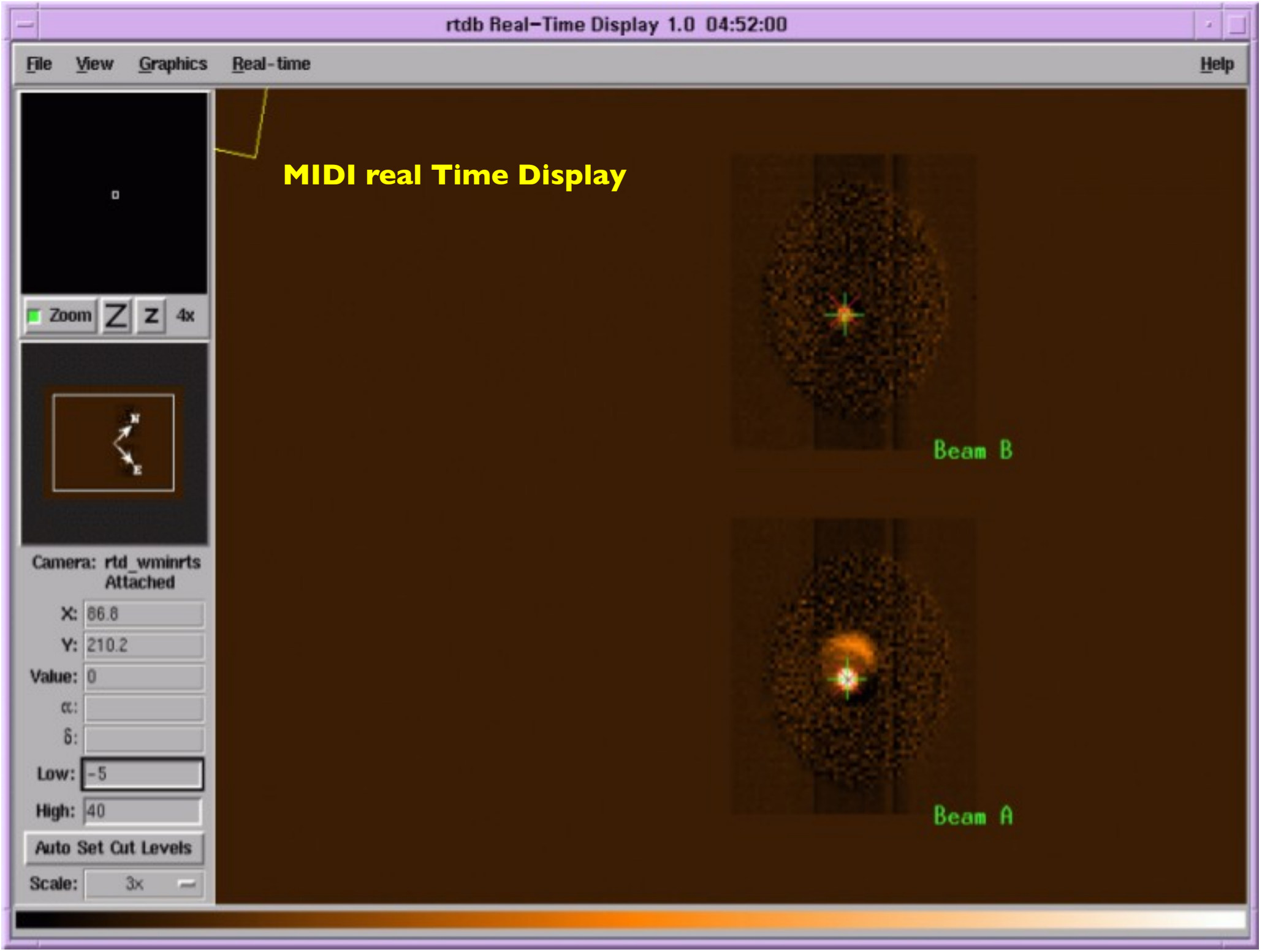


I want longer and or N/S baselines!!!

sure... but there is a catch:



- Input and instrument pupils need to be matched
- Unmatched pupils restrict the field of view, increase background emission
- Pupil re-imager (Variable Curvature Mirrors) are limited


rtdb Real-Time Display 1.0 04:52:00
File
View
Graphics
Real-time
Help
MIDI real Time Display
Zoom
4x
Camera: rtd_wminrts
Attached
X: 86.8
Y: 210.2
Value: 0
α:
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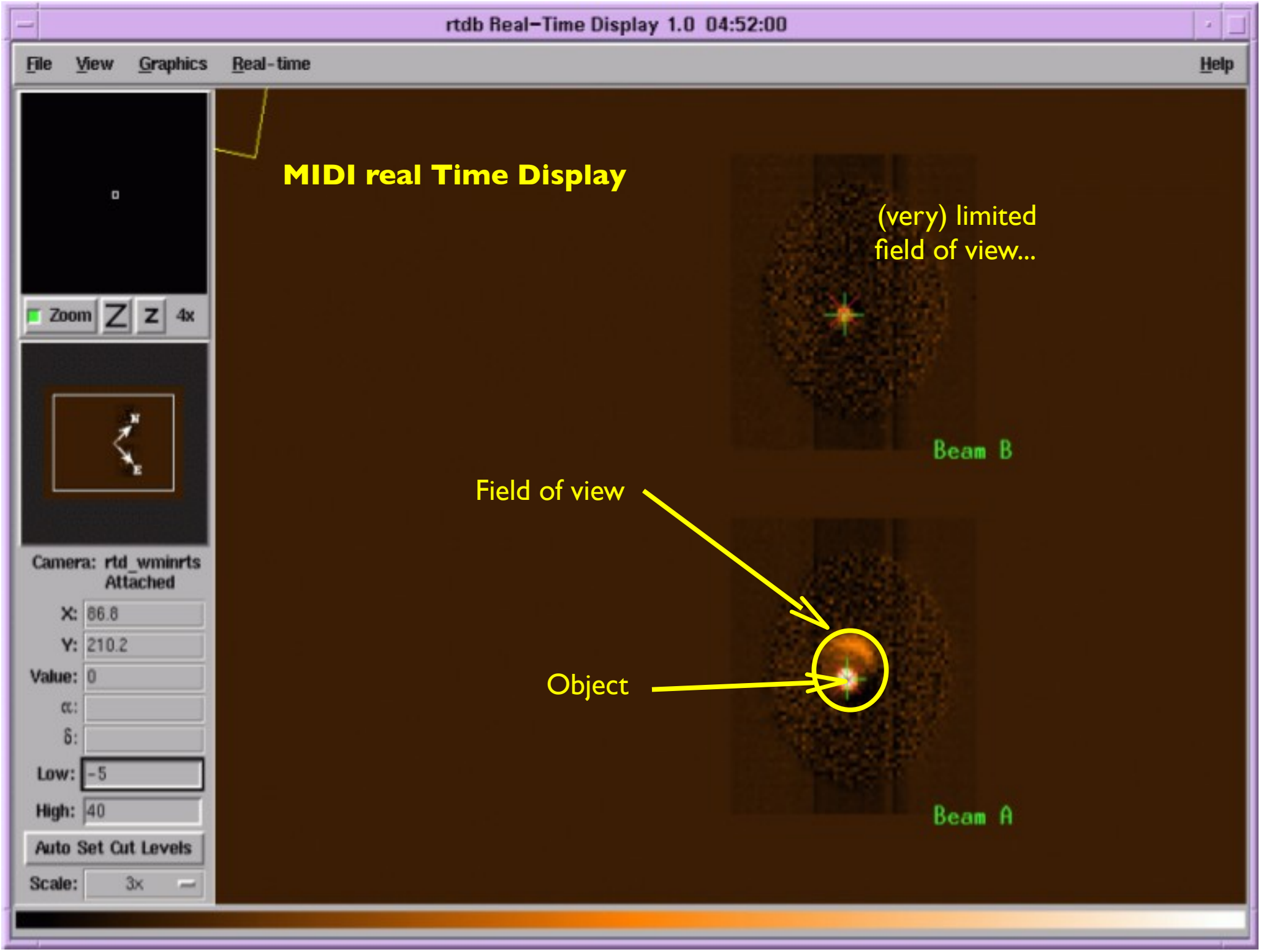
Low: -5
High: 40
Auto Set Cut Levels
Scale: 3x
Beam B
Beam A


rtdb Real-Time Display 1.0 04:52:00
File
View
Graphics
Real-time
Help
MIDI real Time Display
(very) limited
field of view...
Beam B
Field of view
Object
Beam A
Zoom
4x
Camera: rtd_wminrts
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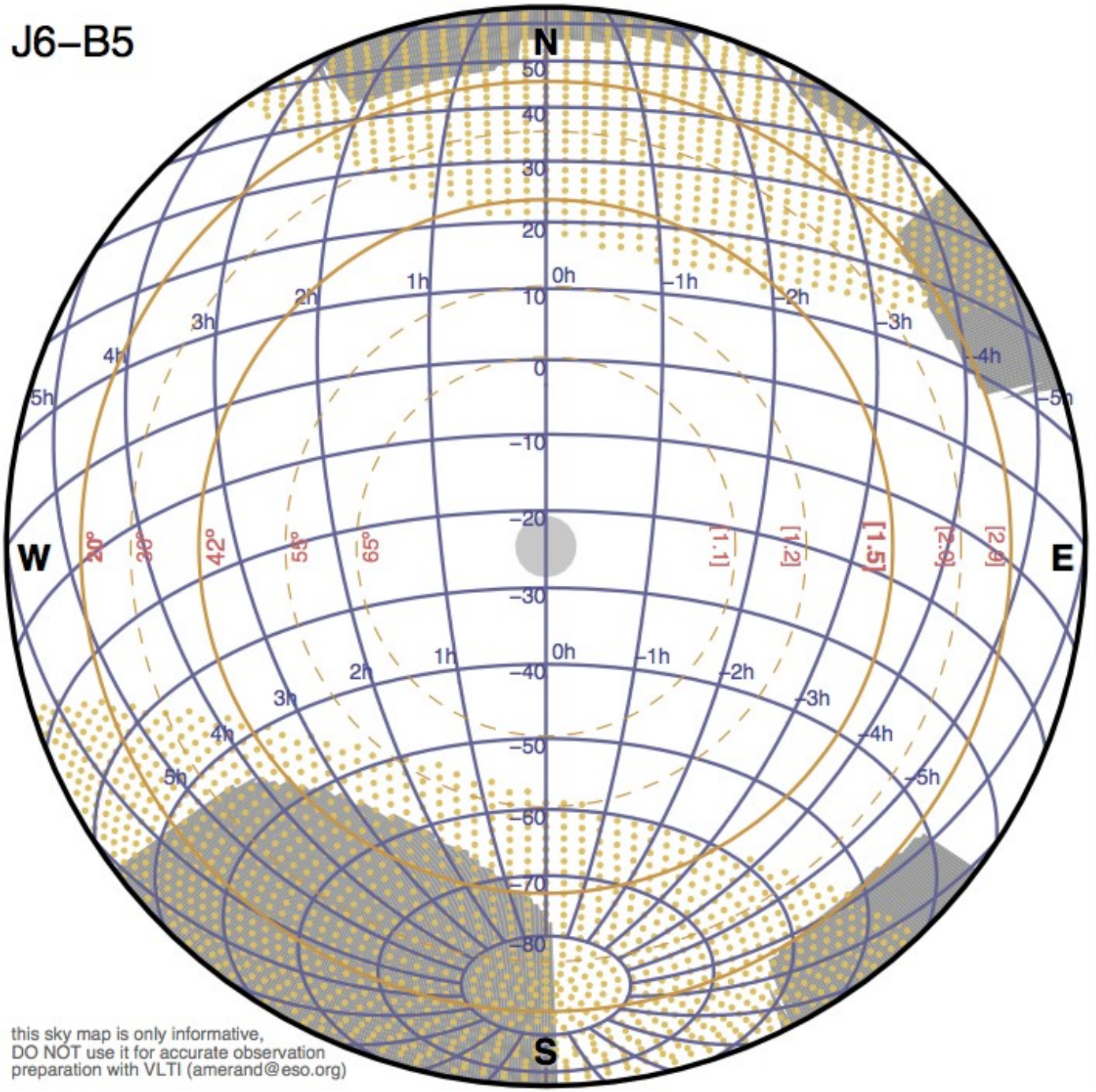
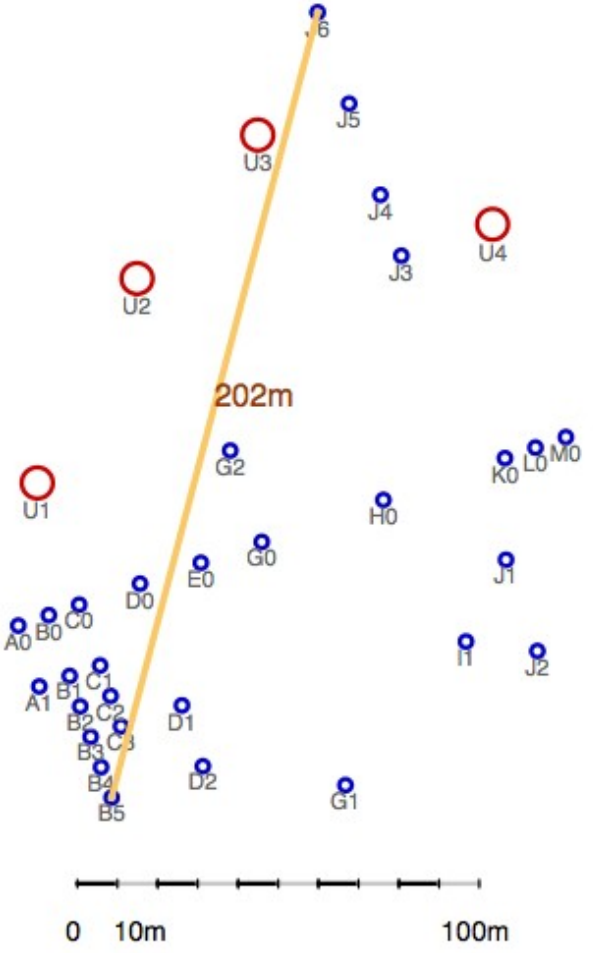

J6–B5
N
W
E
S
0h
1h
2h
3h
4h
5h
-1h
-2h
-3h
-4h
-5h
20°
30°
42°
54°
65°
[1.1]
[1.2]
[1.5]
[2.0]
[2.4]
this sky map is only informative,
DO NOT use it for accurate observation
preparation with VLTI (amerand@eso.org)


J6
J5
U3
J4
U4
J3
U2
202m
G2
K0
L0
M0
U1
H0
G0
J1
E0
D0
C0
B0
A0
I1
J2
C1
B1
A1
D1
C2
B2
C3
B3
D2
B4
G1
B5
0
10m
100m

Opening stations far from the laboratory (J)?

Additional Variable Curvature Mirrors are coming in ATs with PRIMA subsystems...

be patient

Typical Observation

- Preset the telescopes
- Send DL to expected position (known at most +/-1mm)
- Guide on guide star (+MACAO)
- Guide in the lab (IRIS)
- Check pupil (not all the time)
- Find Fringes

AT: ~7min
UT: ~12min

- Record Fringes

~10-15 minutes

Flexibility

- Change AMBER to MIDI in <10min
- Change of configuration inside 4T configuration in <10min (ATs) and <20min (UTs), but
  - pupils need to be realigned
  - calibration between baselines does not work
- SCI / CAL in ~1h (or less if long sequences... in visitor)
- Service Mode: adapted to changing atmospheric conditions

VLTI control room on Paranal

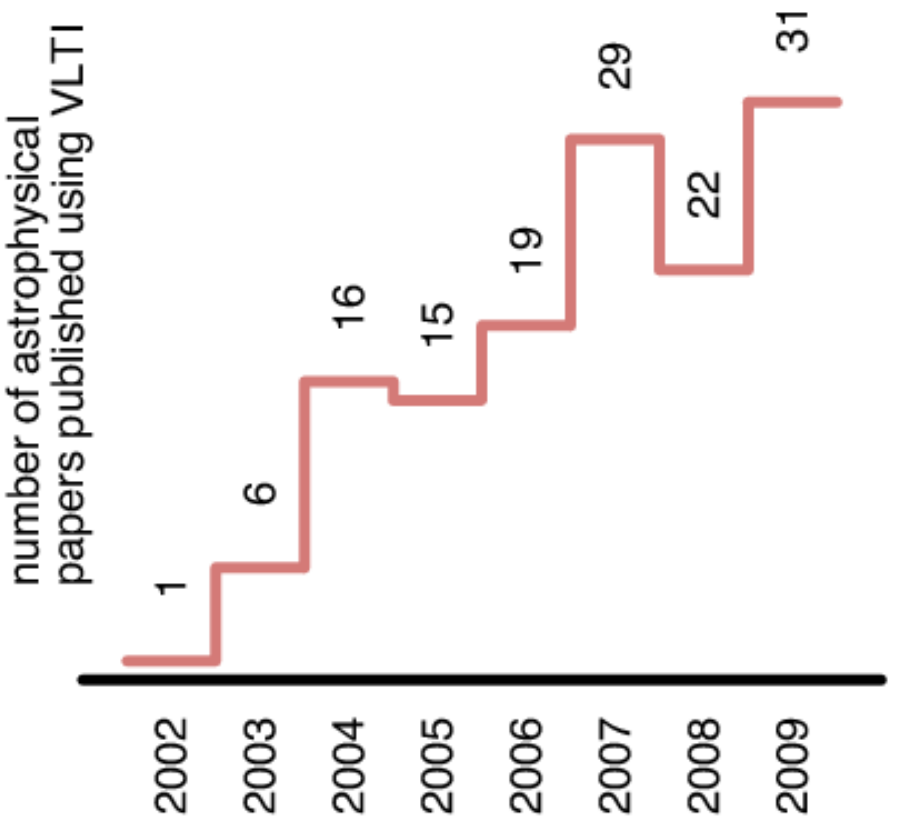
Continuously improving

Efforts in the community:

- astrophysical results
- new instruments

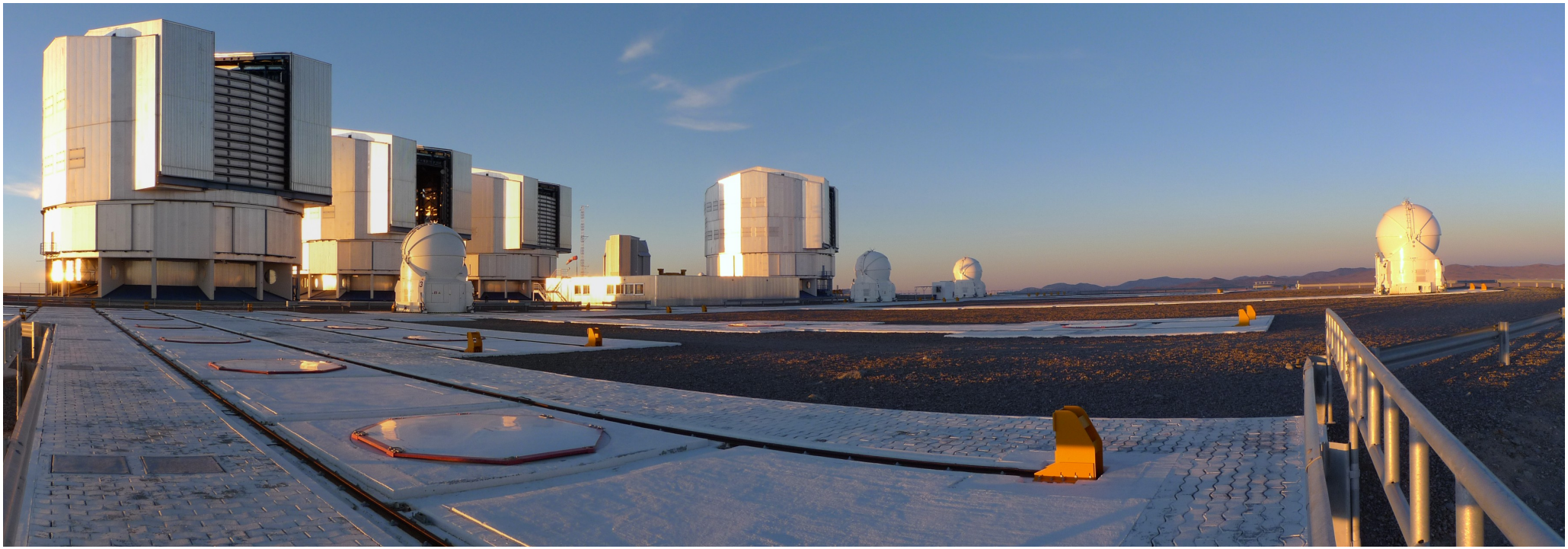
at ESO, with the community

- improving the operations
- improving the current instruments



Future Instruments

- **PRIMA** – currently integrated
  - 2T, astrometry – *see specific talk*
- **PIONIER** – late 2010 (visiting instrument)
  - 4T, H band, integrated optics: "snapshot imager"
- **MATISSE** – 2015/2016
  - 4T, thermal infrared – *see specific talk*
- **GRAVITY** – 2015/2016
  - 4T, K band, AO, astrometry... – see *specific talk*



See you there when you come to observe!

...or join us as a fellow or a student.
deadlines: October for fellowship
June for studentship

http://jobs.eso.org