

more years of Operations of the VLT interferometer

Antoine Mérand
VLTI System Scientist



Challenges

- ◆ VLT operations have been optimized over the years for 1G
- ◆ 2G instruments (GRAVITY, MATISSE)
 - ◆ more complex?
 - ◆ high expectations and new techniques (astrometry)
- ◆ 2G infrastructure (increased complexity)
 - ◆ Star separators
 - ◆ GRAVITY metrology and wave front sensors
 - ◆ NAOMI, 2GFT
- ◆ Open questions:
 - ◆ can we simply maintain the level of efficiency for 2G?
 - ◆ should we work towards new modes (e.g. time coverage)?

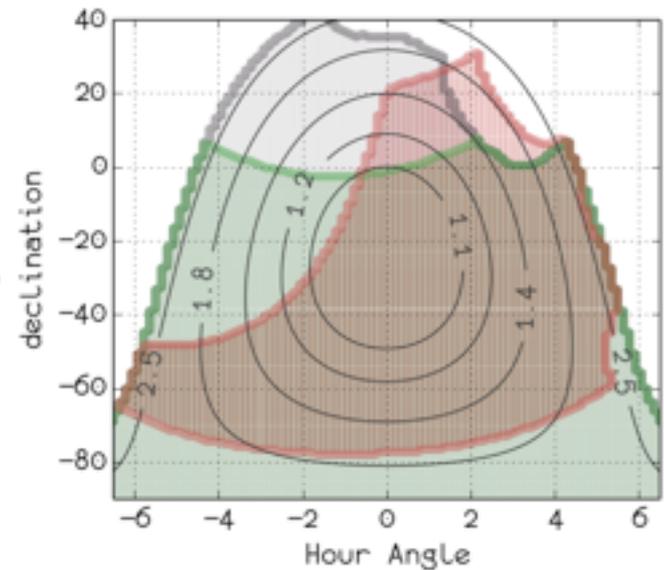
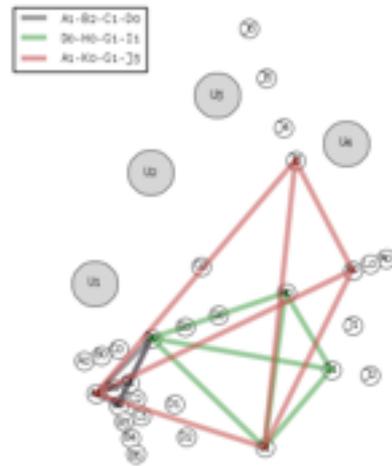
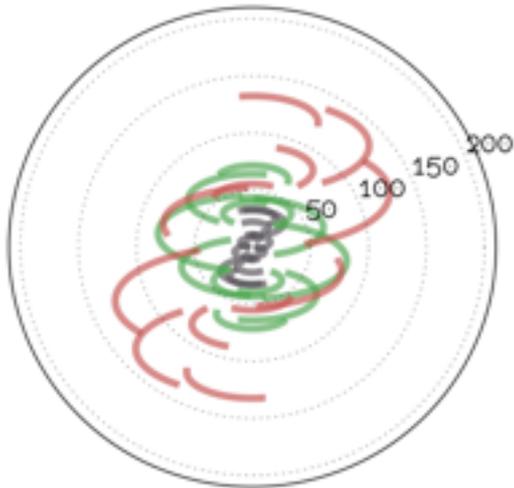
lots of idea

- ◆ improve sensitivity
 - ◆ (very) instrument dependent
 - ◆ NAOMI and 2GFT are on the way
- ◆ u,v coverage
 - ◆ new/more AT configurations?
 - ◆ larger baselines?
 - ◆ AT/UT configurations?
- ◆ Optimize operations: Can we operate differently?
 - ◆ decrease visitor mode? more service would allow “block scheduling”
 - ◆ favor large programs (easier to schedule)?
 - ◆ etc.

u,v coverage

- ◆ Science seems to be driven mostly by imaging
 - ◆ 4T will be the rule with GRAVITY and MATISSE
- ◆ 4T is not enough -> multiple AT configurations offered
 - ◆ A1-B2-C1-D0, D0-H0-G1-I1, A1-G1-J3-K0

u,v coverage dec=-24.0



not an easy choice: sky coverage is limited!!!

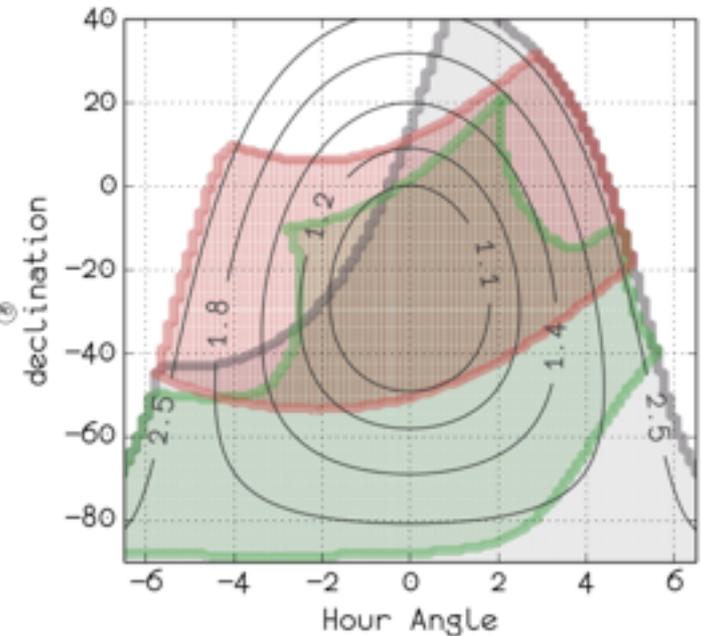
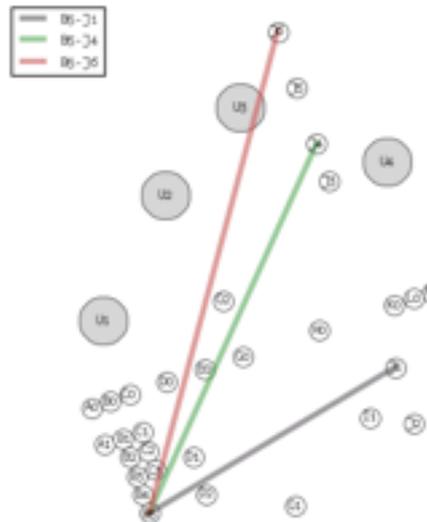
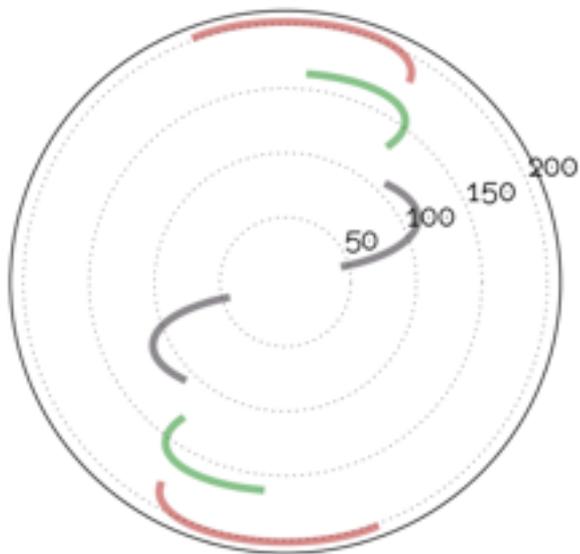
AT configurations: limitations

- ◆ Delay lines have also limited stroke ($\sim 100\text{m}$)
- ◆ only 2 ATs can be moved per day *on a regular basis*
- ◆ mirrors: station-AT-DL not flexible
- ◆ maximum of 4T in the West ($\leq G$) and 2T in the East
- ◆ Variable Curvature Mirrors (VCM)
 - ◆ use to reimaging pupils
 - ◆ far stations have field of view $<$ PSF (!)
 - ◆ have limited curvature (safety)
- ◆ more configurations mean even more difficult to schedule (as CHARA)

example: long baseline

- ◆ B5-J6 is 200+m

u,v coverage dec=-24.0

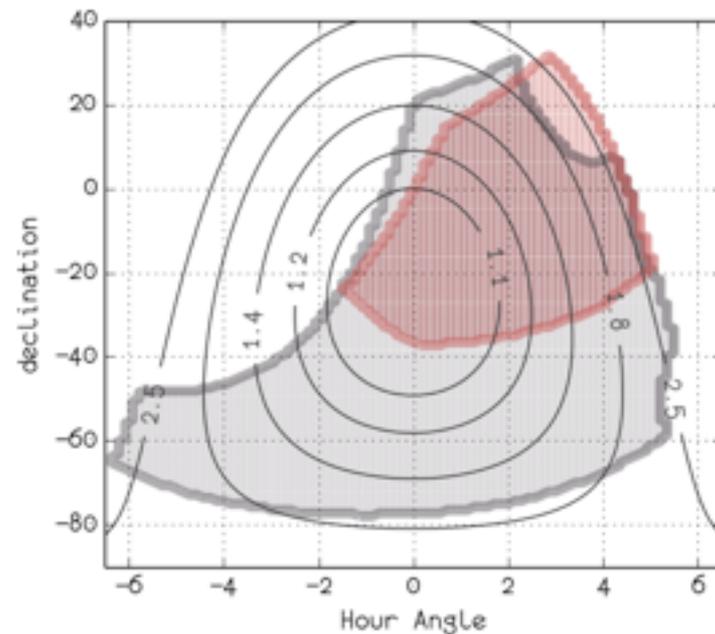
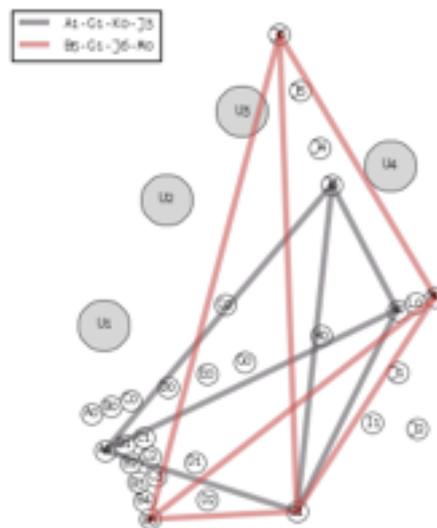
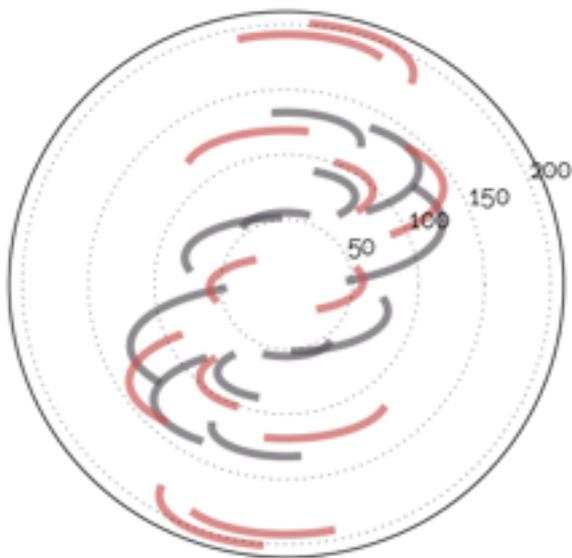


- ◆ sadly, ~140m is the longest practical baseline (all sky coverage)

longest baselines

- ◆ a lot to pay for an increase in 1.4 in baseline...
 - ◆ A1-G1-J3-K0 (current)
 - ◆ **B5-G1-J6-M0 (best)**

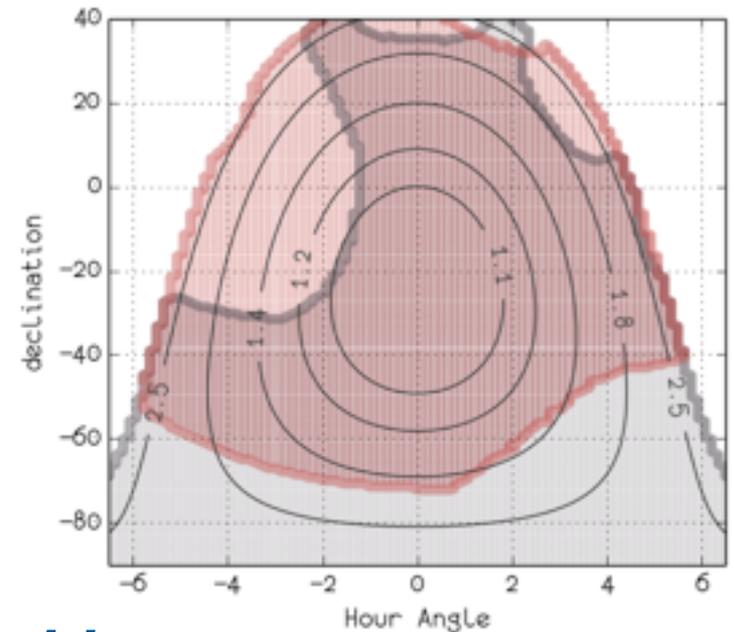
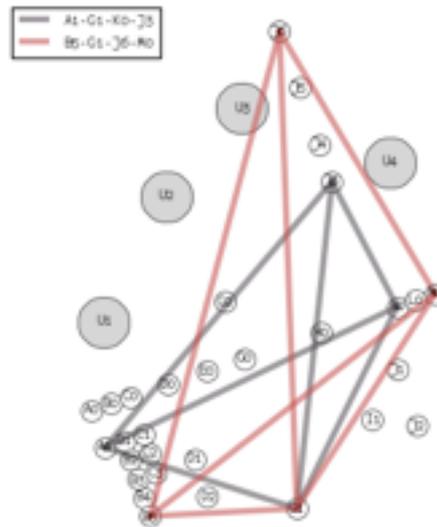
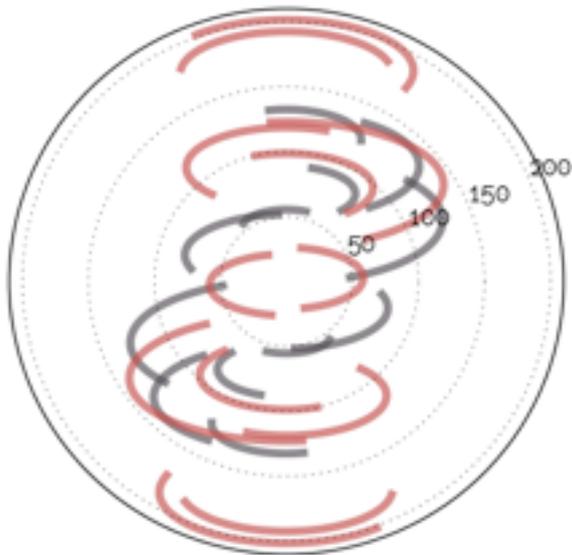
u,v coverage dec=-24.0



longest baselines

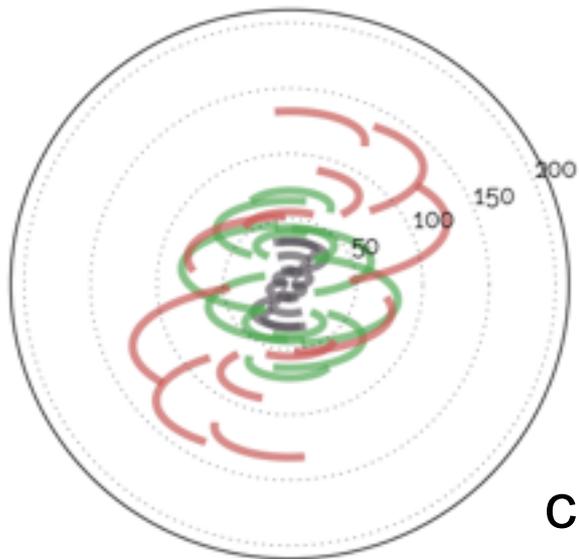
- ◆ a lot to pay for an increase in 1.4 in baseline...
 - ◆ A1-G1-J3-K0 (current)
 - ◆ B5-G1-J6-M0 (best)

u, v coverage dec=-24.0

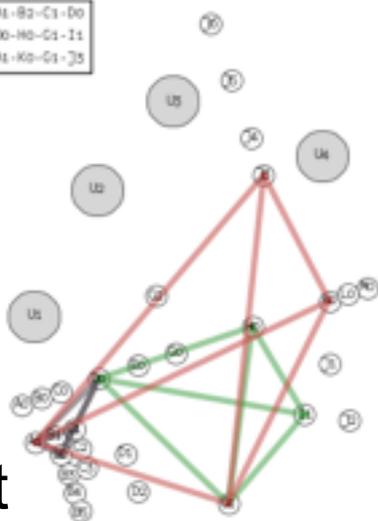


with delay lines in double pass

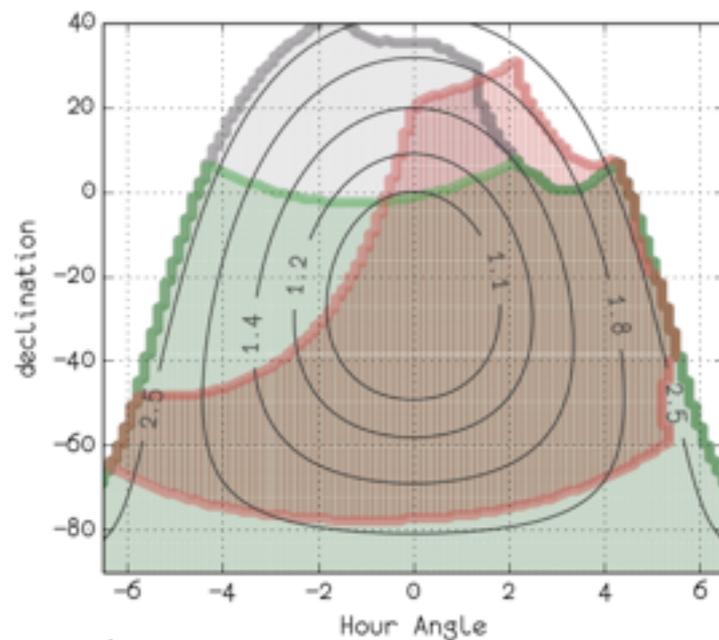
u,v coverage dec=-24.0



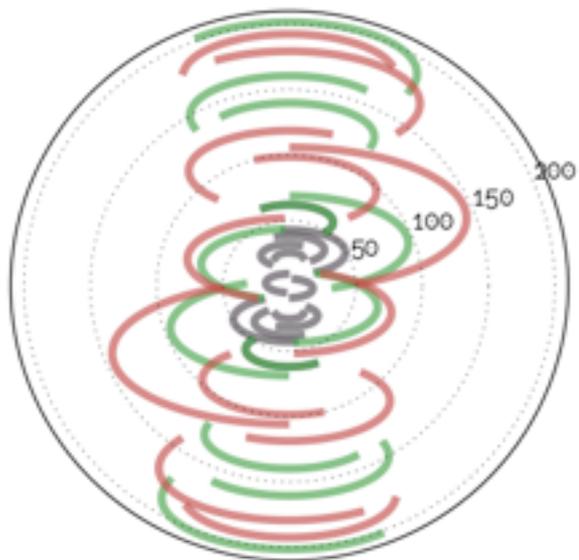
— A1-B2-C3-D0
 — D0-H0-C1-I1
 — A1-K0-C1-J0



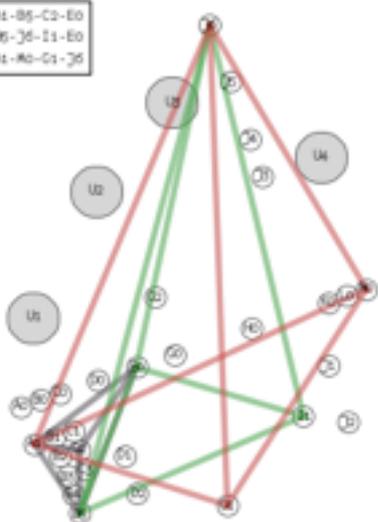
current



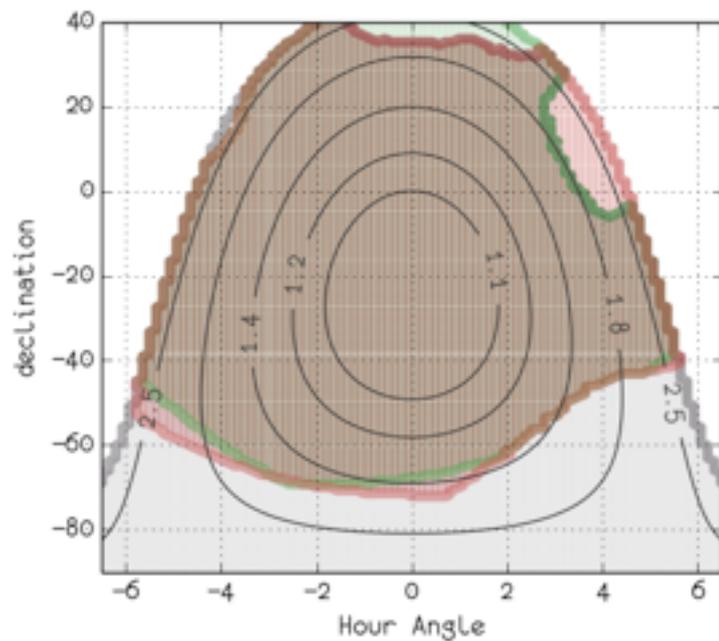
u,v coverage dec=-24.0



— A1-B5-C2-E0
 — B5-J6-I1-E0
 — A1-K0-C1-J0

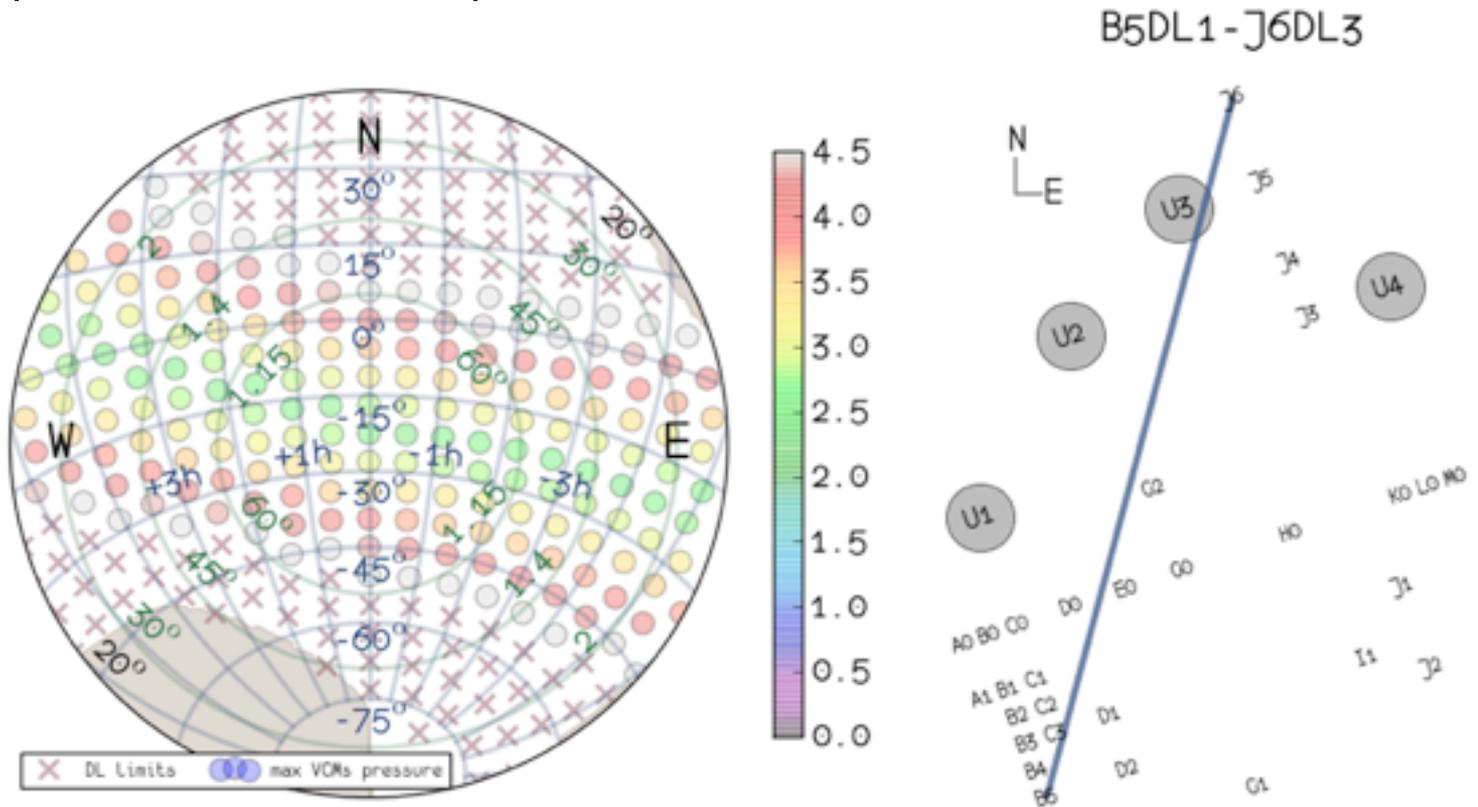


dream (with double pass)



VCM: long baselines

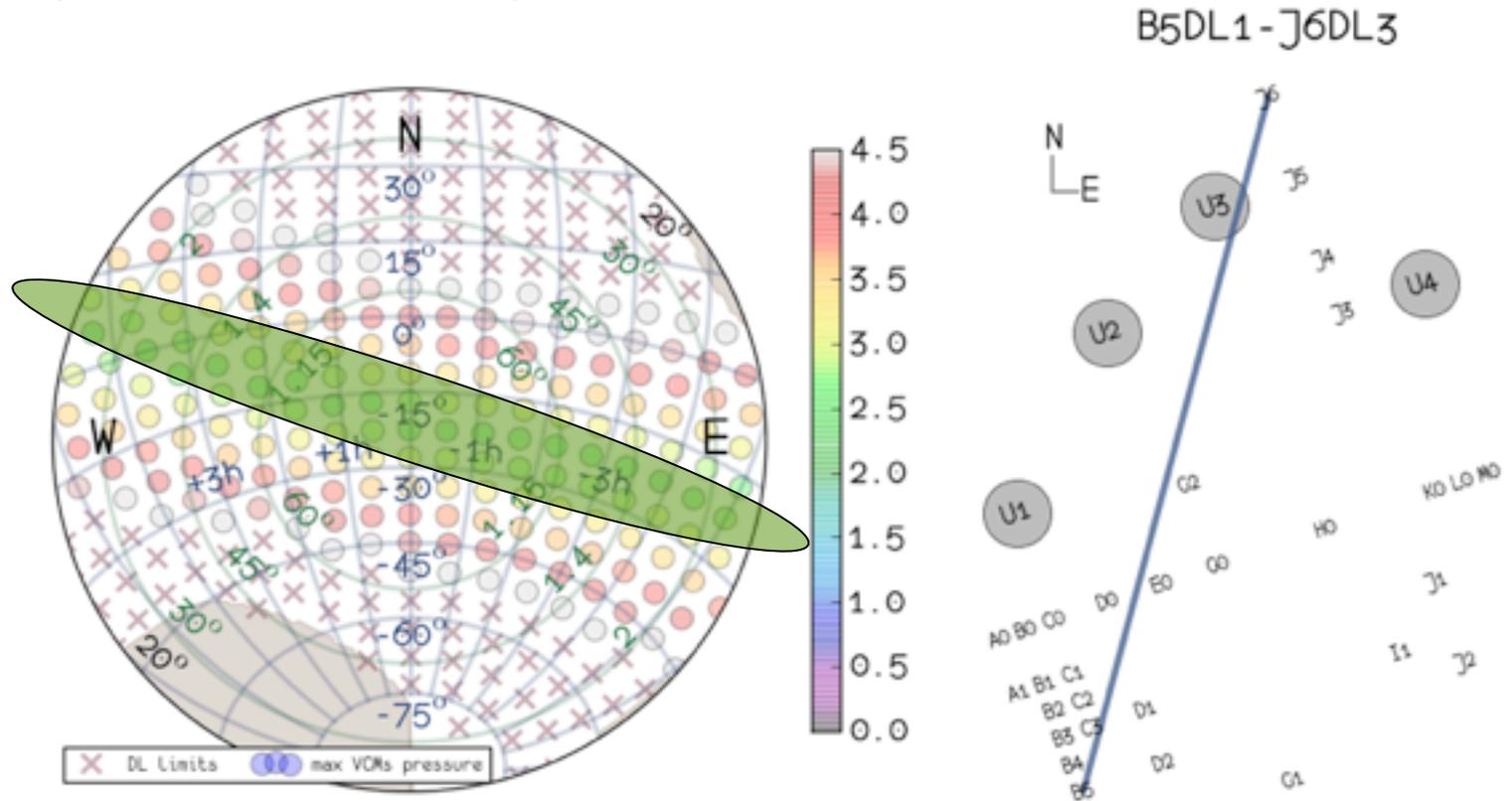
VCM pressure limited to 2.5bar after one failed in 2010 (another in 2013)



other prbm: >2.5bar makes alignment very hard to

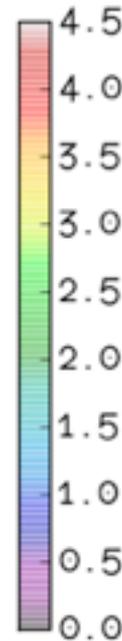
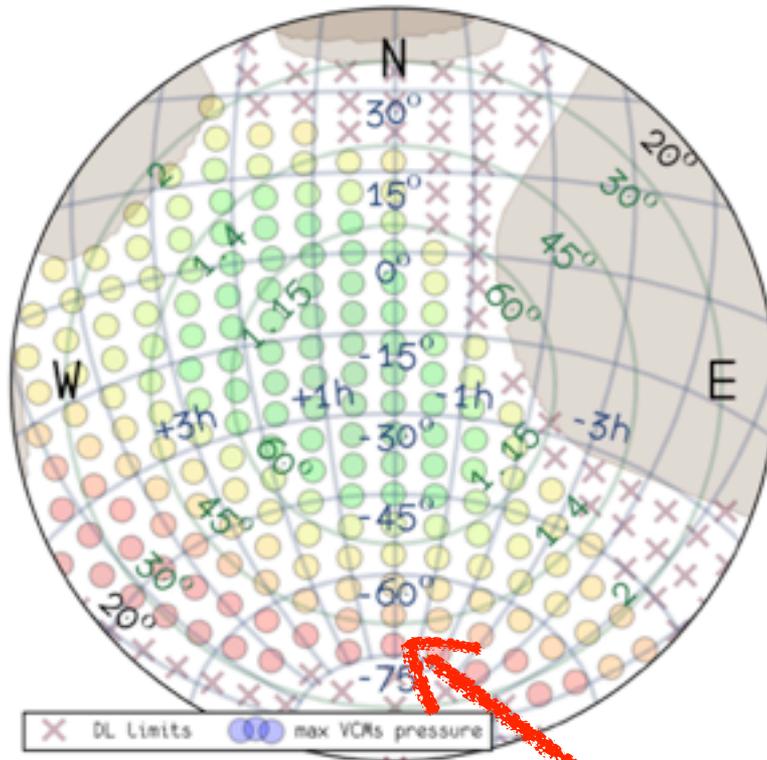
VCM: long baselines

VCM pressure limited to 2.5bar after one failed in 2010 (another in 2013)

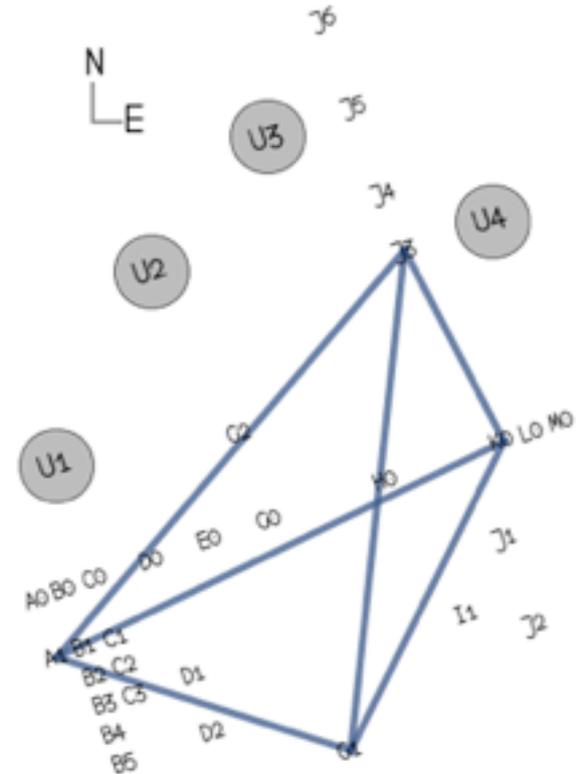


other prbm: >2.5bar makes alignment very hard to

VCM: not so long baselines...



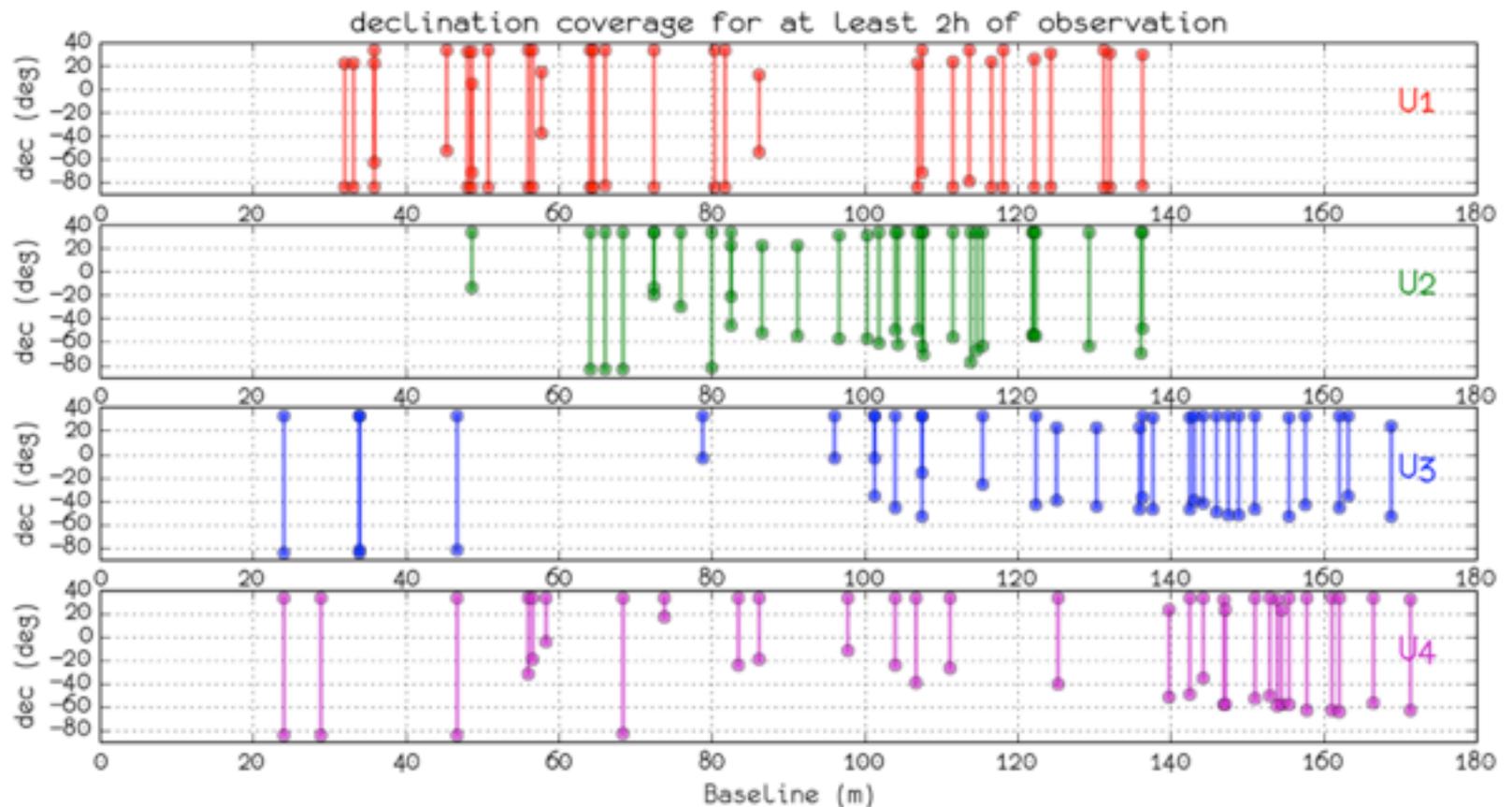
A1DL5 - J3DL3 - K0DL4 - G1DL6



PIONIER flux mores than +10x fainter than the 3 other beams!

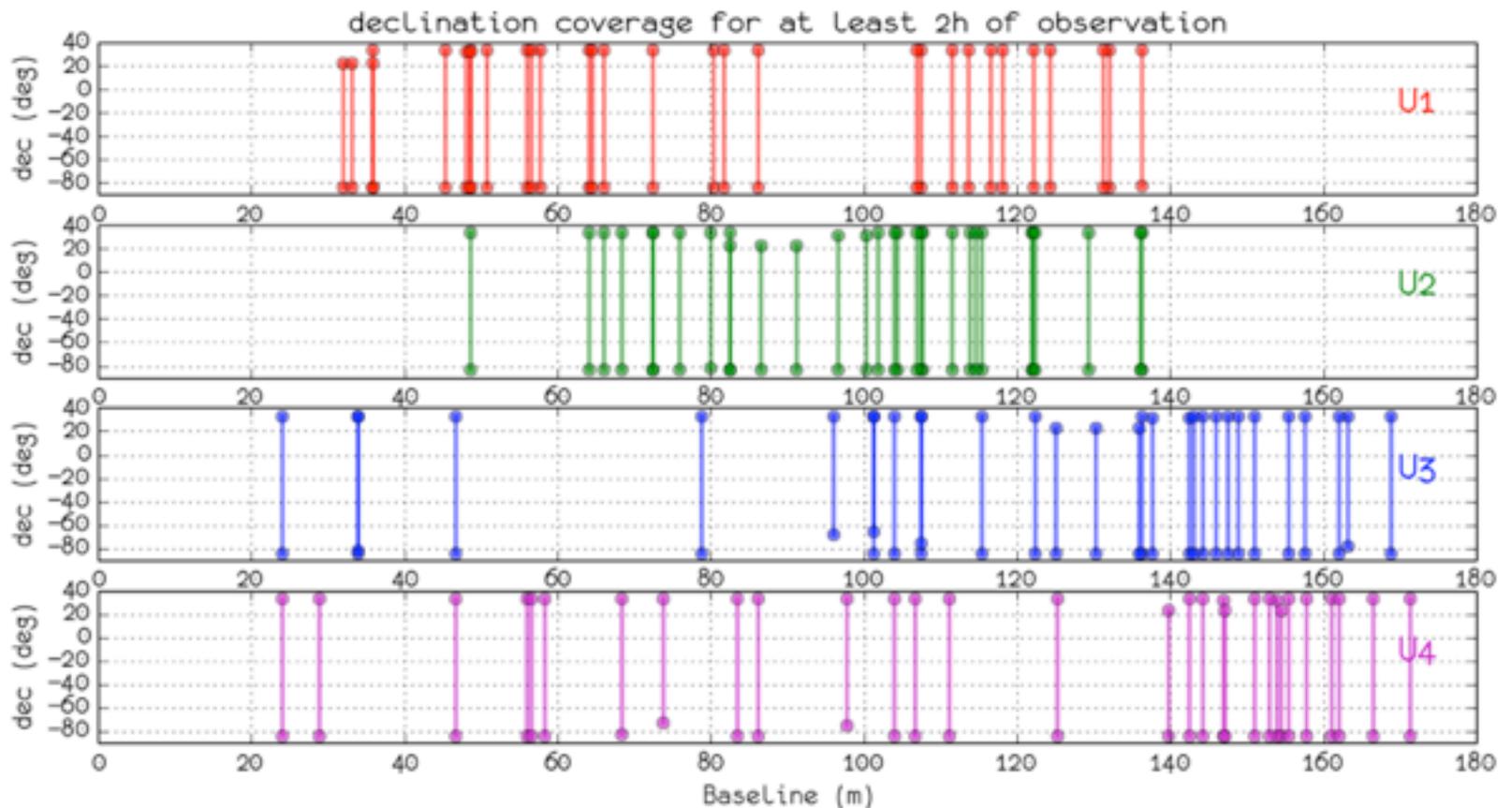
AT-UT

- ◆ mode is known to work (with MIDI)
- ◆ systematic search for AT-UT baselines: hard to access the South...



AT-UT, double pass DL

- ◆ double pass brings the max OPL correction from ~100m to ~200m

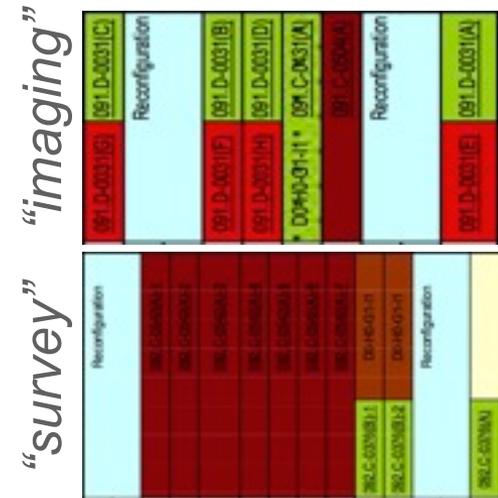


Telescope configurations

- ◆ The set of AT configurations we offer is quite optimized
 - ◆ lots of constraints: dec coverage, operations, scheduling...
 - ◆ is it the best? what are the criteria?
- ◆ Longer baselines are hard to imagine
 - ◆ VCM issue -> solved by VCM at the telescope?
 - ◆ declination coverage limited to -50° to 0° due to DL
- ◆ AT-UT is also challenging
 - ◆ known to work (has been tried a few times)
 - ◆ ... but strongly limited by DL limits
- ◆ **one possibility:** modify the Delay Lines for double pass?
 - ◆ would give full sky coverage to almost all AT baselines
 - ◆ would open 200m AT baselines
 - ◆ would allow useful sky coverage fo AT-UT
 - ◆ not plan yet (with what resources?)

Scheduling

- ◆ SO many parameters to take into account...
- ◆ Highest ranked programs
 - ◆ set the AT schedule
 - ◆ so are favored
- ◆ Large parameters space:
 - ◆ AT configurations (24), seeing slots (3), LST slots (24)
 - ◆ too few service mode for flexibility
- ◆ Many users are unhappy with the results
- ◆ ESO astronomers are also often frustrated
 - ◆ as scientist, users and operators



Future

- ◆ Service scheduling simplifications with 4T instruments
 - ◆ one AT configuration \leftrightarrow one instrumental configuration
- ◆ Should we keep asking for LST/AT config?
 - ◆ about 50% of the MIDI and AMBER OBs have “alternate” configurations leading to same u,v points
 - ◆ find inspiration in ALMA operations? *100% visitor mode, requests by angular resolution and field of view*
- ◆ DL optical path modification seems sensible
 - ◆ double pass
 - ◆ pupil reimaging overhaul (VCM)
 - ◆ bring **only** 40% longer baselines but allows flexibility (AT-UT)

Challenges

- ◆ Short term:
 - ◆ Can ESO maintain operational efficiency in spite of all the changes (2G ins., NAOMI, 2GFT)?
- ◆ Many wishes from community and no clear winner:
 - ◆ imaging snapshot / time monitoring / survey / etc.
 - ◆ **sensitivity** / longer baselines / bands / spectroscopy / etc.
- ◆ Balance between:
 - ◆ “VLTI has to open to a wider community of non-experts”
 - ◆ “VLTI has to keep improving current results”
 - ◆ “VLTI has to allow continuous experimentation”
- ◆ **ESO internal constraints**
 - ◆ VLTI has a small user base and is perceived has consuming a huge amount of resources in comparison
 - ◆ VLTI is perceived has working fine and not needing special effort: in Paranal: VLTI-SE -> S&A