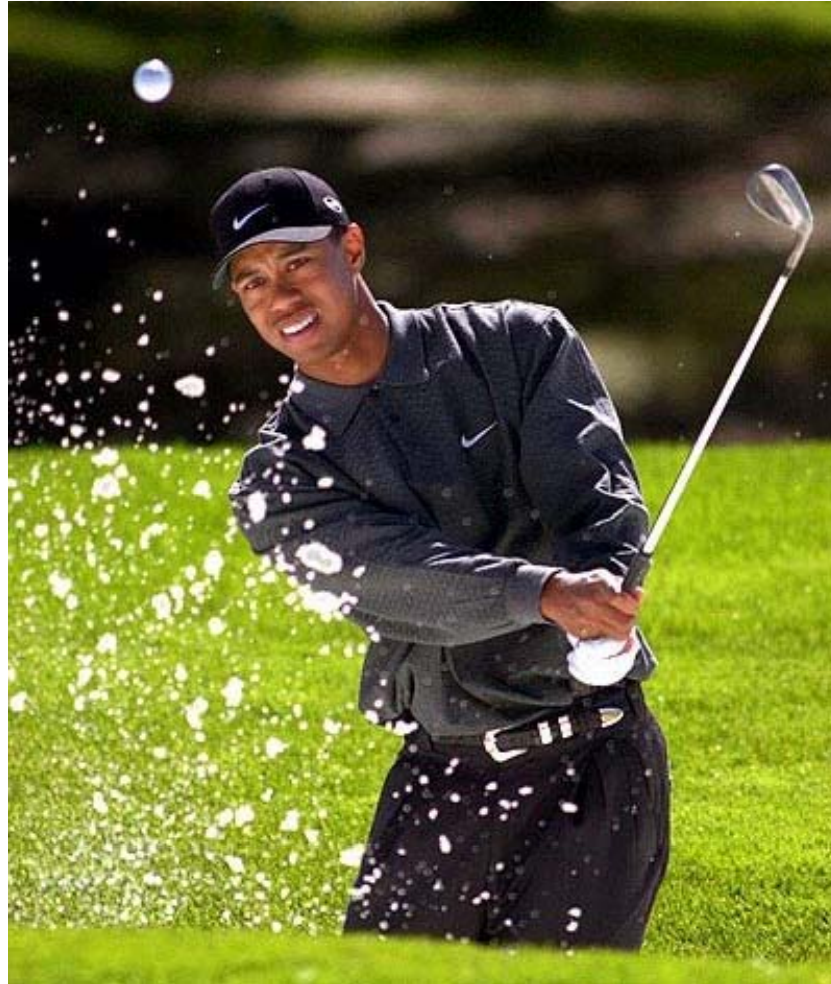
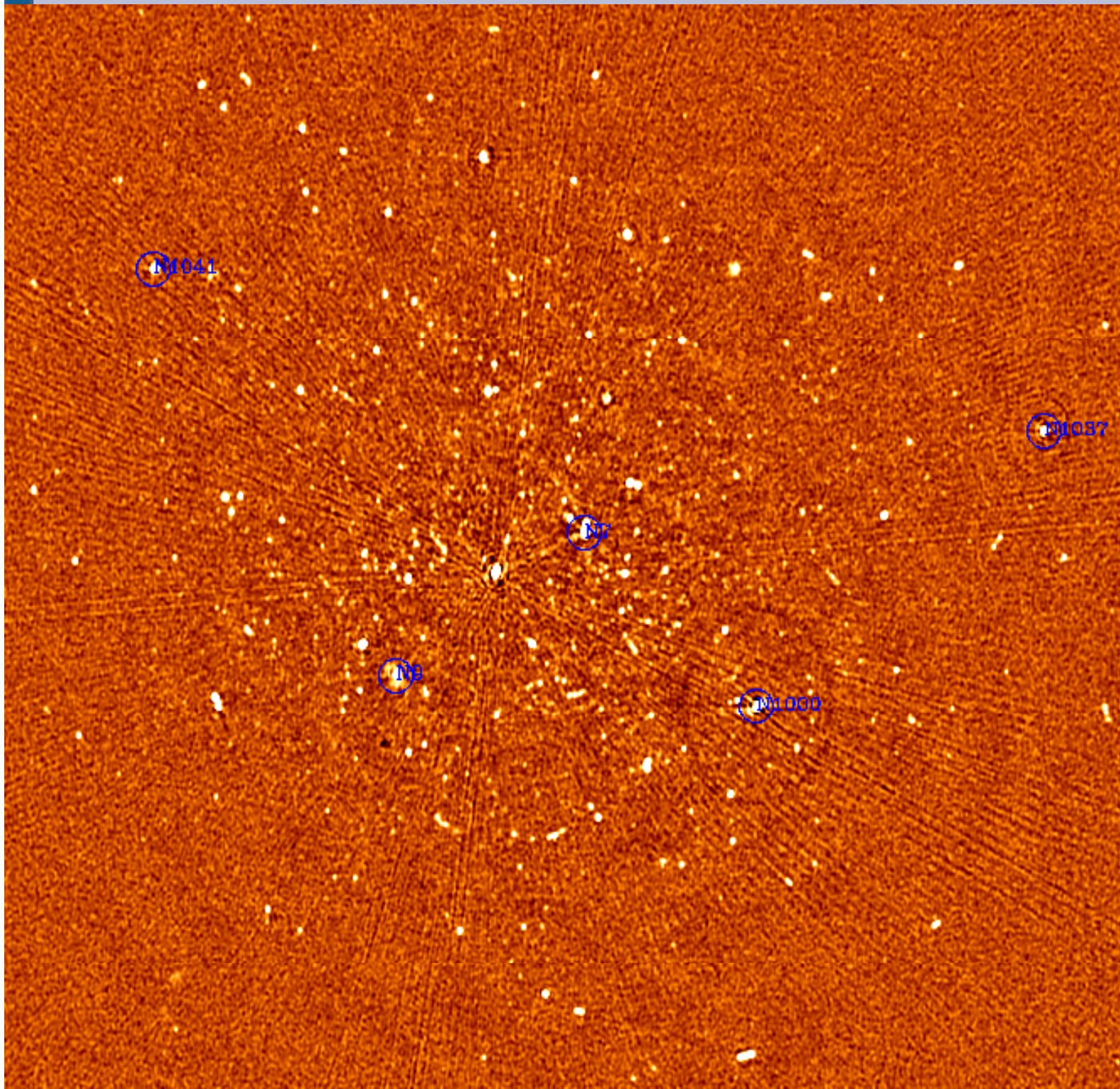


Of Luxury Problems & Limp Instruments (DDE! WSRT!)



O. Smirnov



3C147

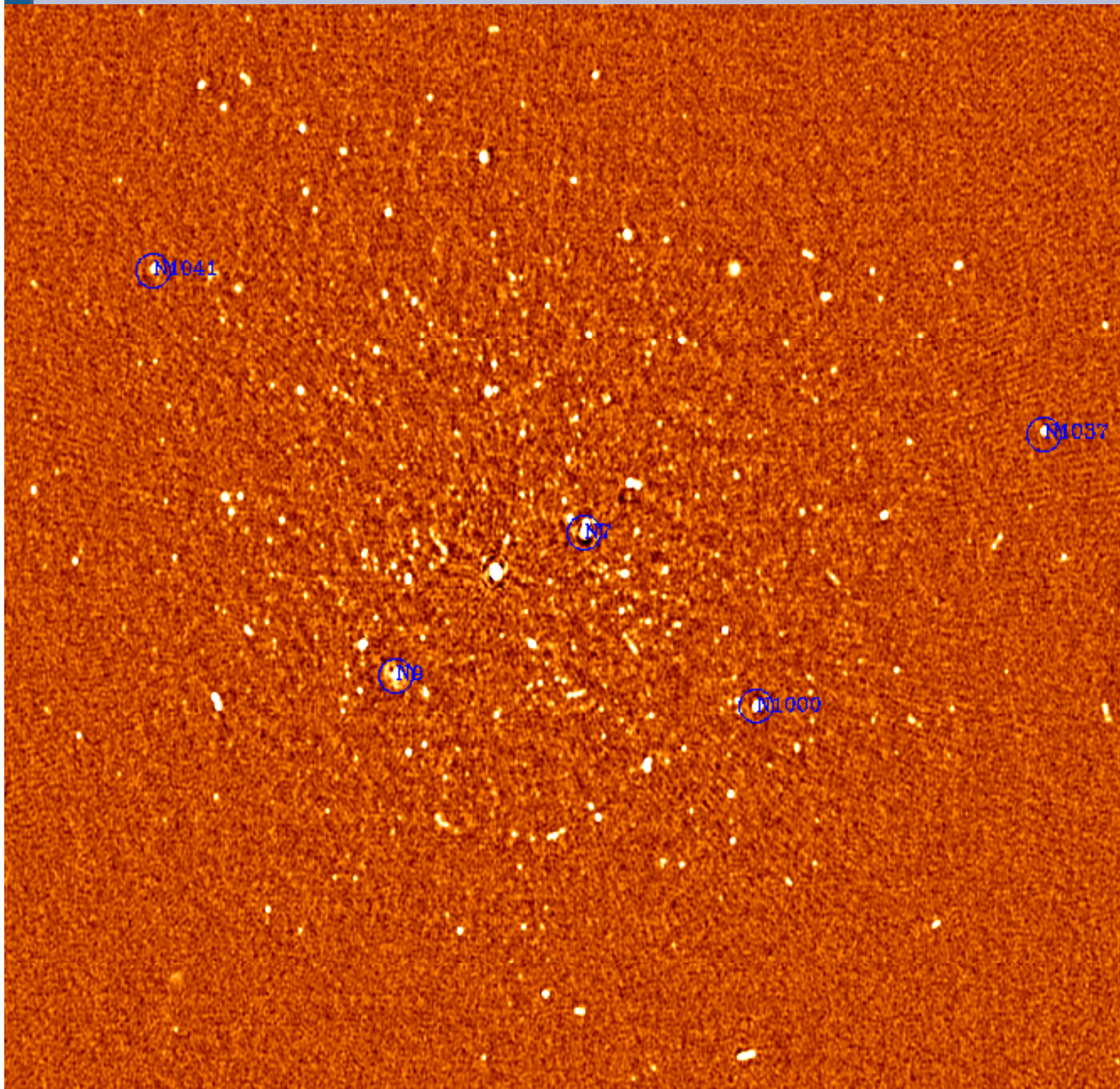
NEWSTAR image

22Jy @21cm
12h, 8 bands
13.5 uJy noise

on-axis DR:
1500000:1

off-axis DR:
1000:1

Limited by
direction-
dependent
effects
(DDEs) such as
pointing errors,
tropospheric
refraction etc.



3C147

MeqTrees image

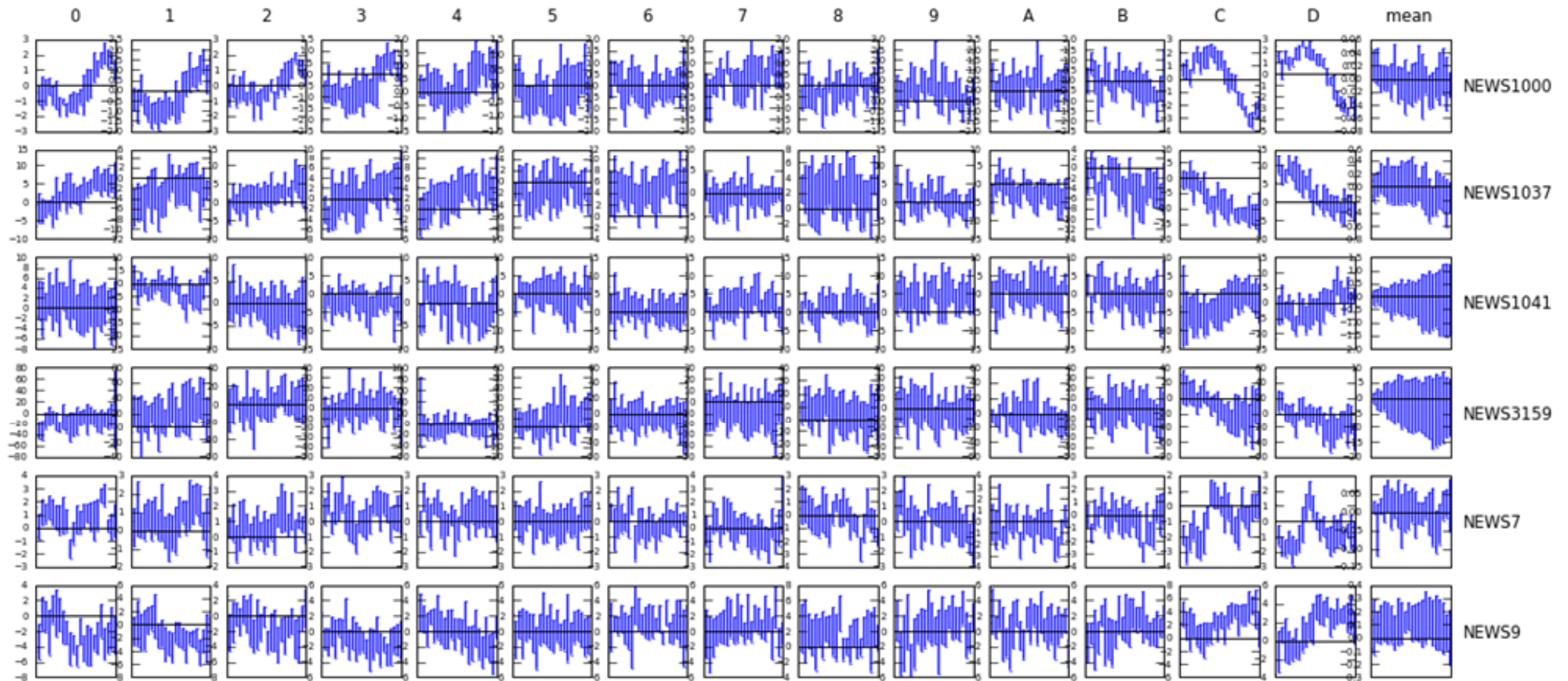
22Jy @21cm
12h, 8 bands
13.5 uJy noise

Same DR as
NEWSTAR,
but no off-
axis artifacts.

Differential Gains

- Off-axis artifacts eliminated using this M.E.:

dEyy phase (deg) mean & stddev across all bands



- Note the high S/N in frequency
- Continuity in time and space suggests dominant large-scale effect, as opposed to per-antenna things like pointing

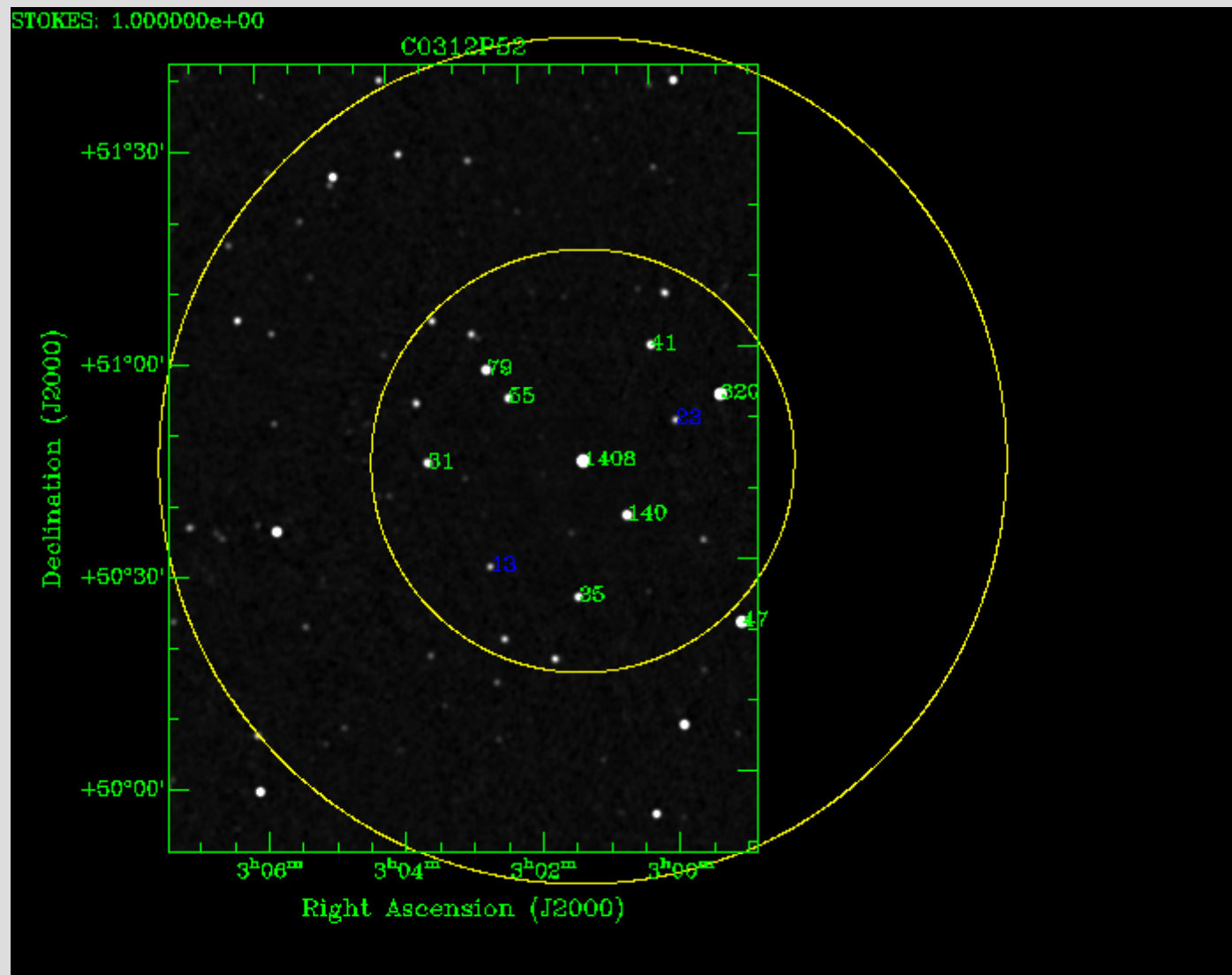
QMC Project

- Find a field containing a cluster of moderately bright sources
- Introduce deliberate (and secret) pointing errors into a few WSRT antennas
 - “limp noodle” mode
- Attempt to recover pointing errors by solving for differential gains

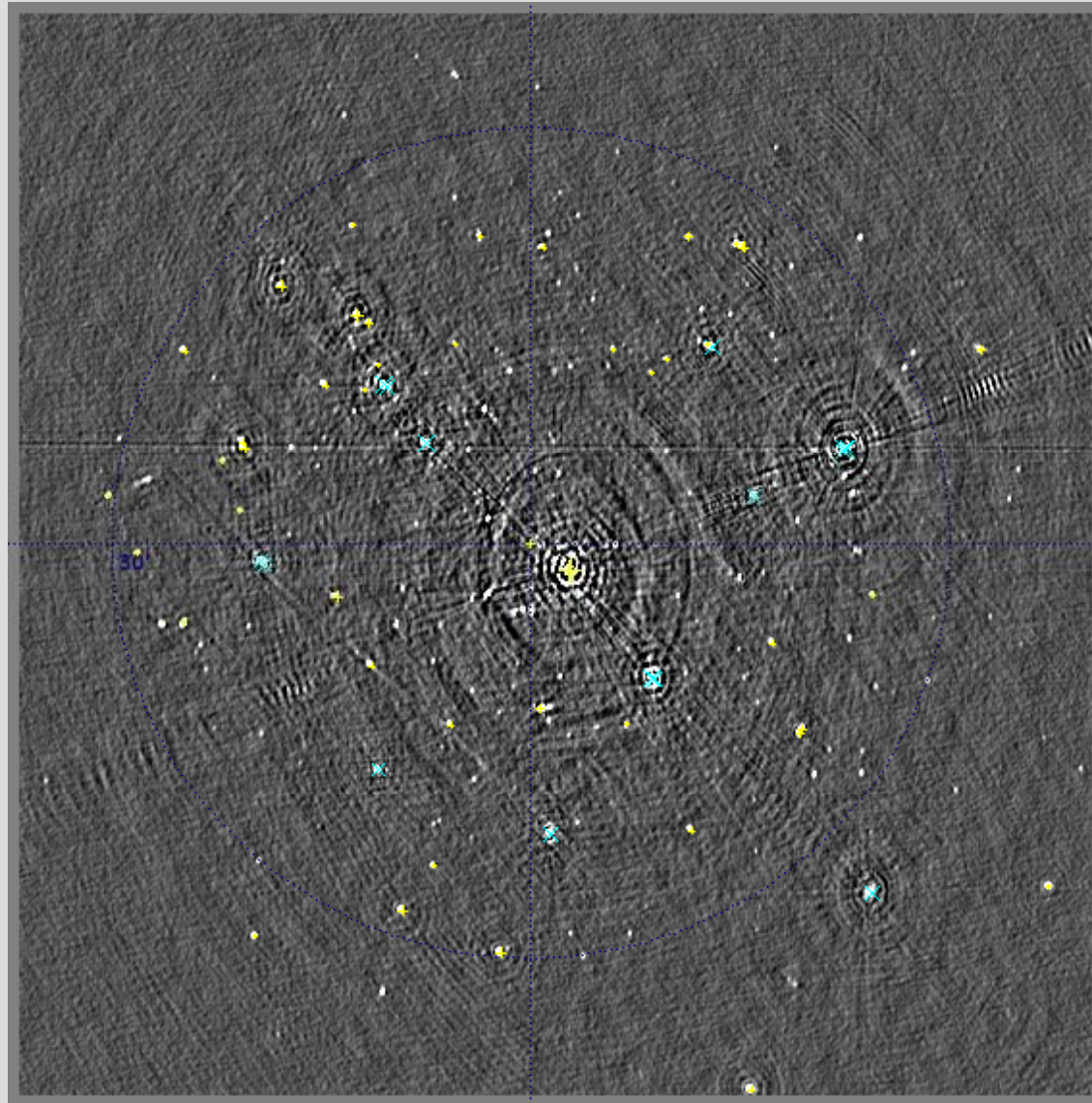


The QMC Field

(Quality Monitoring Committee)

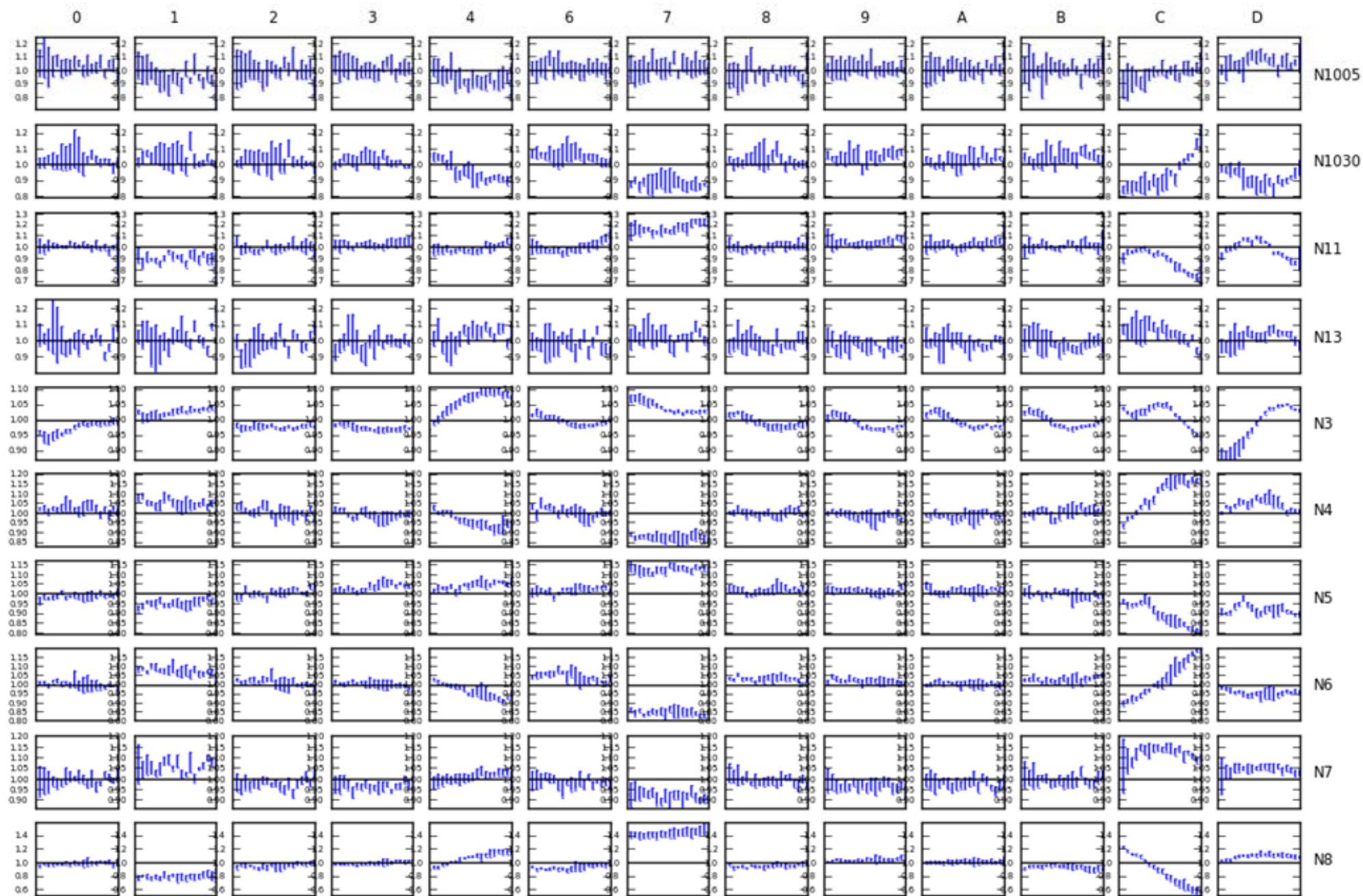


QMC Proves Tricky...

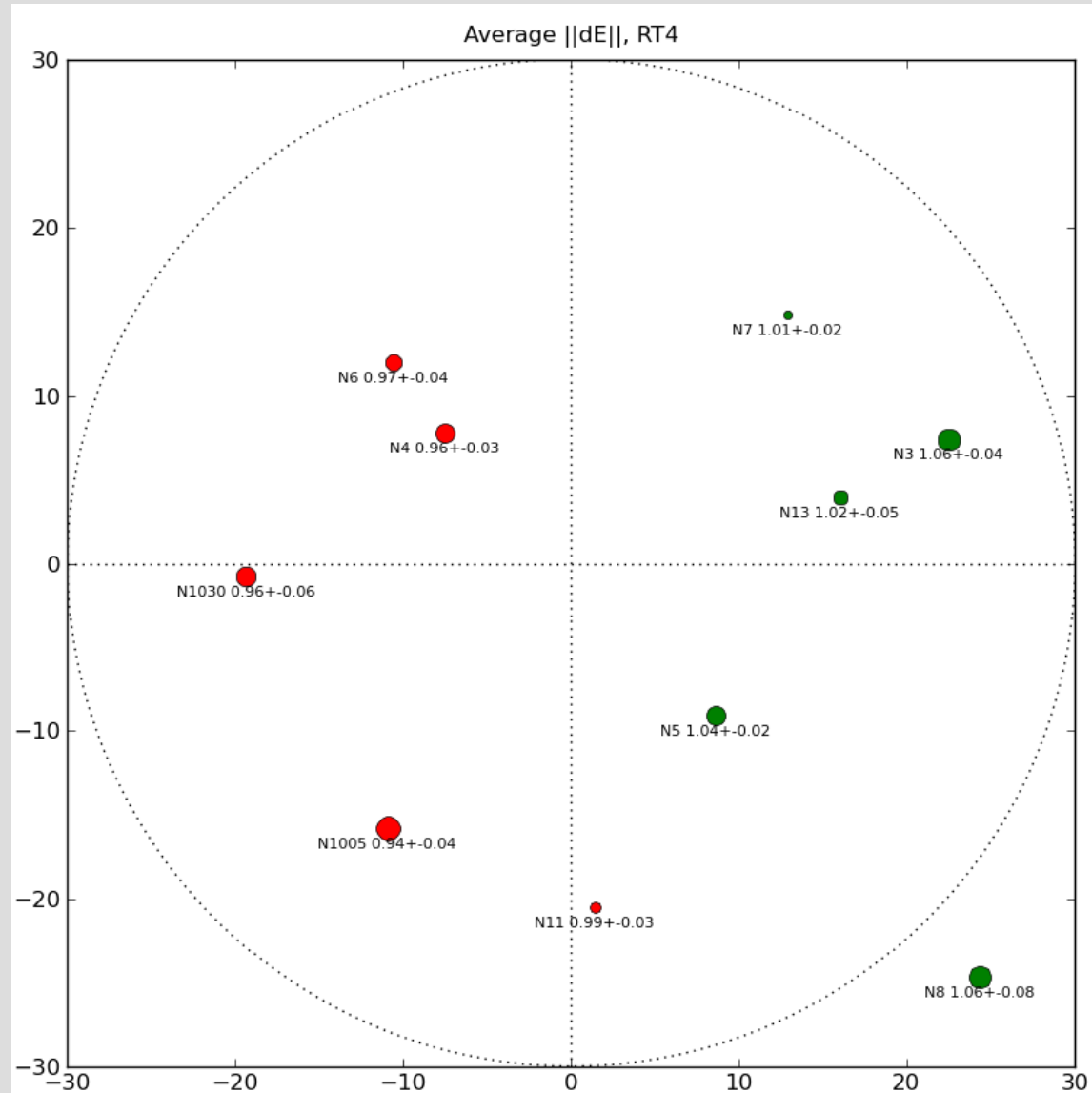


QMC Issues

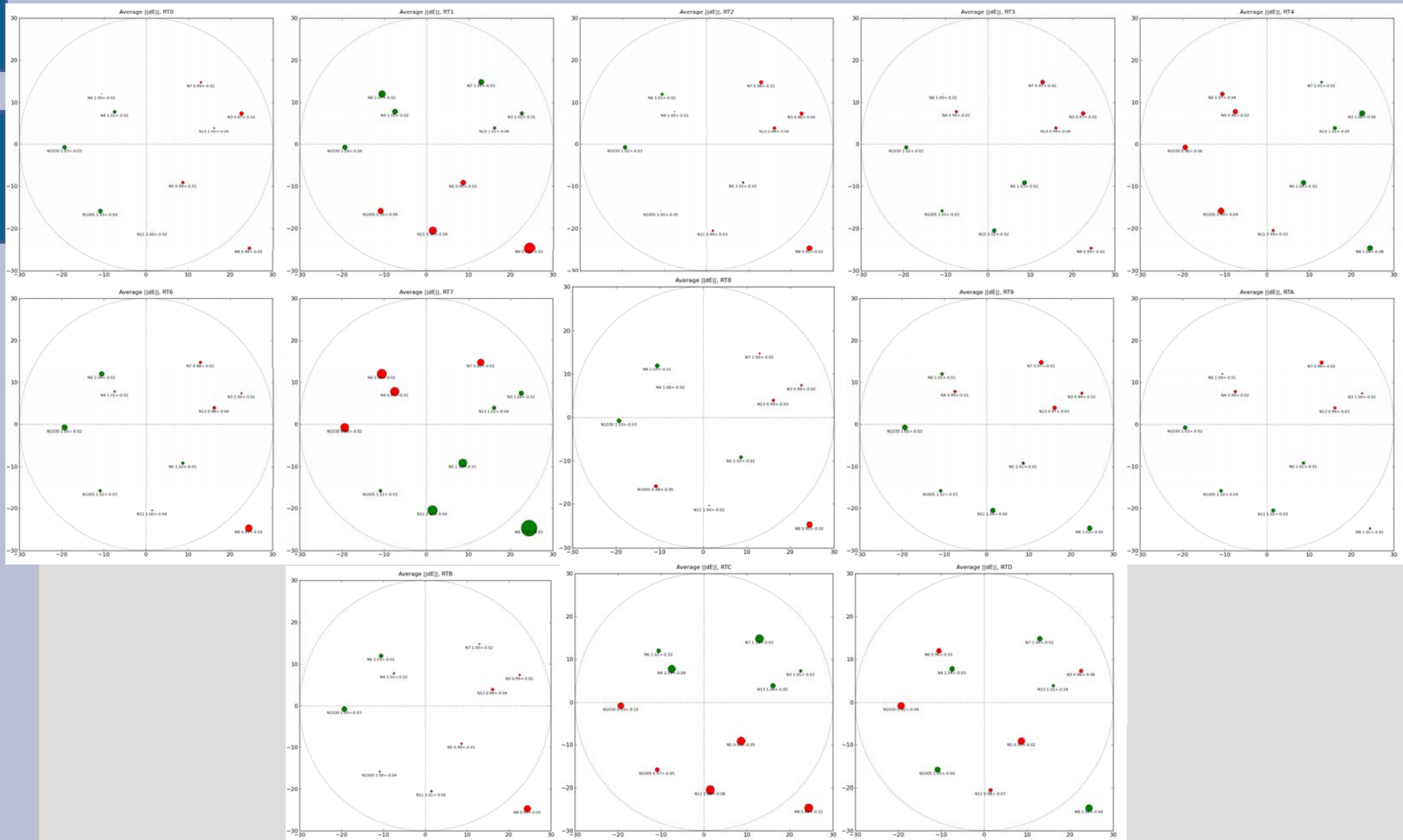
- A number of slightly resolved sources
 - Including central 1.4 Jy one
- Difficult to distinguish source structure from gain effects
 - an extended source will have an HA-dependent visibility amplitude (on long baselines)
 - how to distinguish this from real gain errors on antennas C and D?
- Need to bootstrap a sky model!

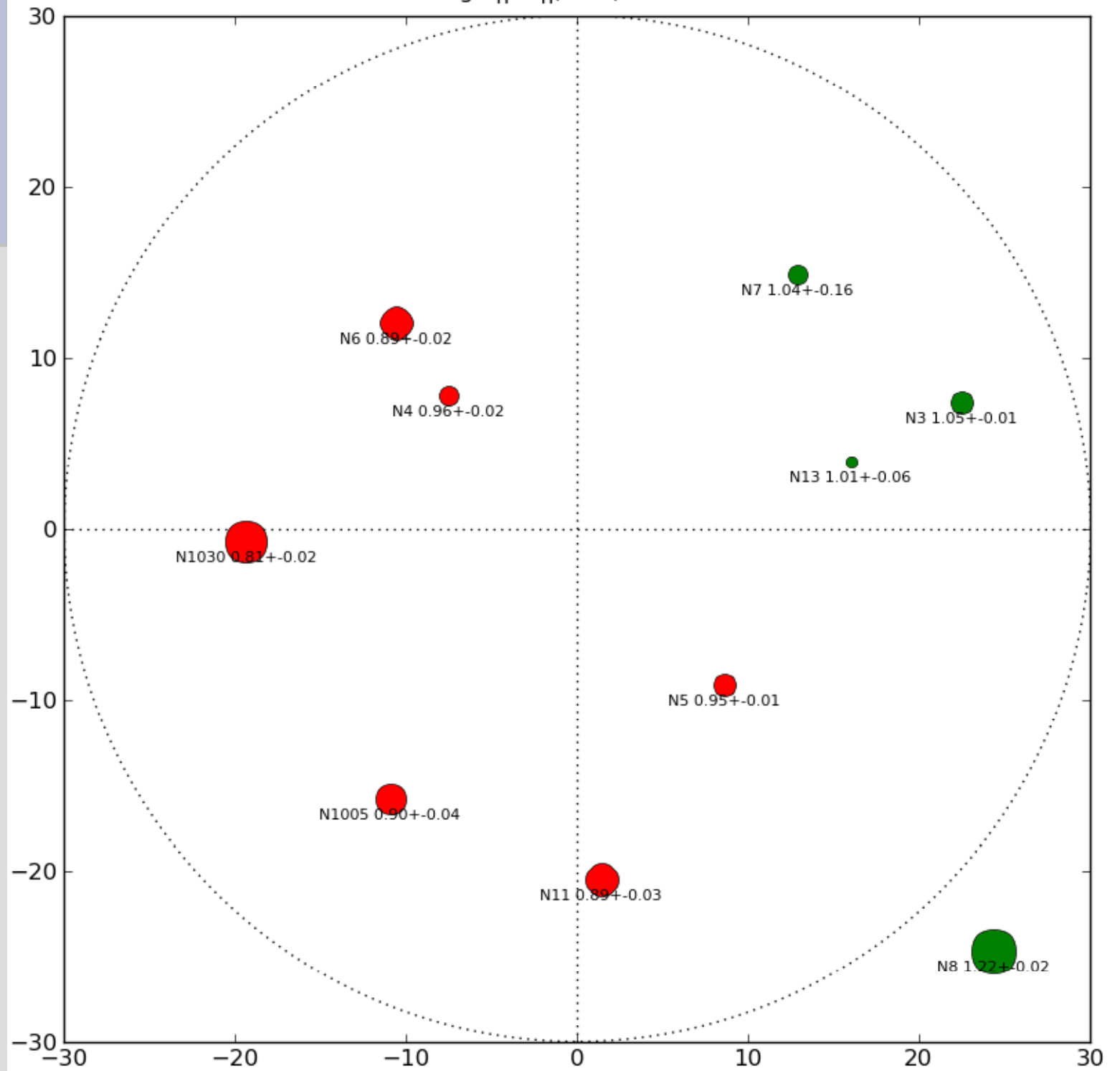
Renormalized $||dE||$ mean & stddev across all bands

Another Way To Visualize $||dE||$



Rogues' Gallery

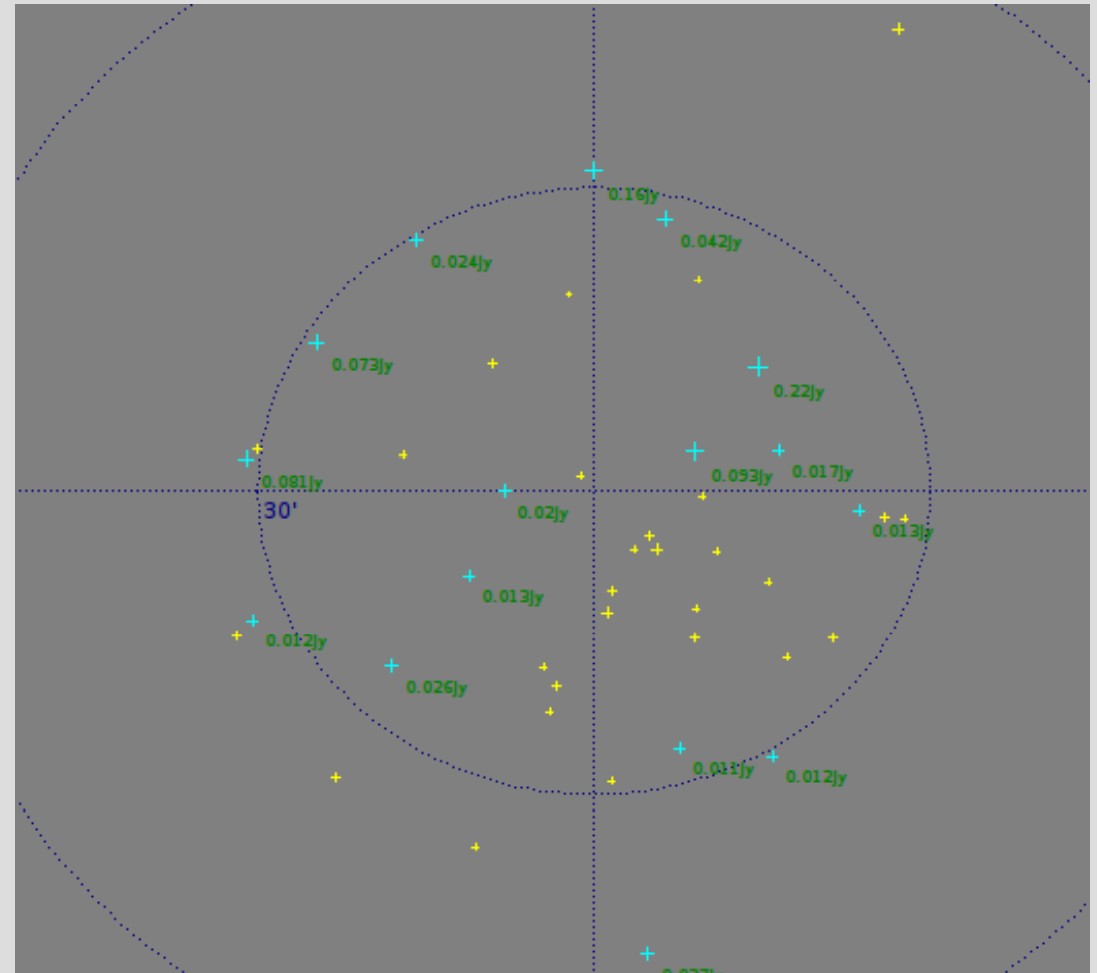


Average $\|dE\|$, RTC, time slice 0

R

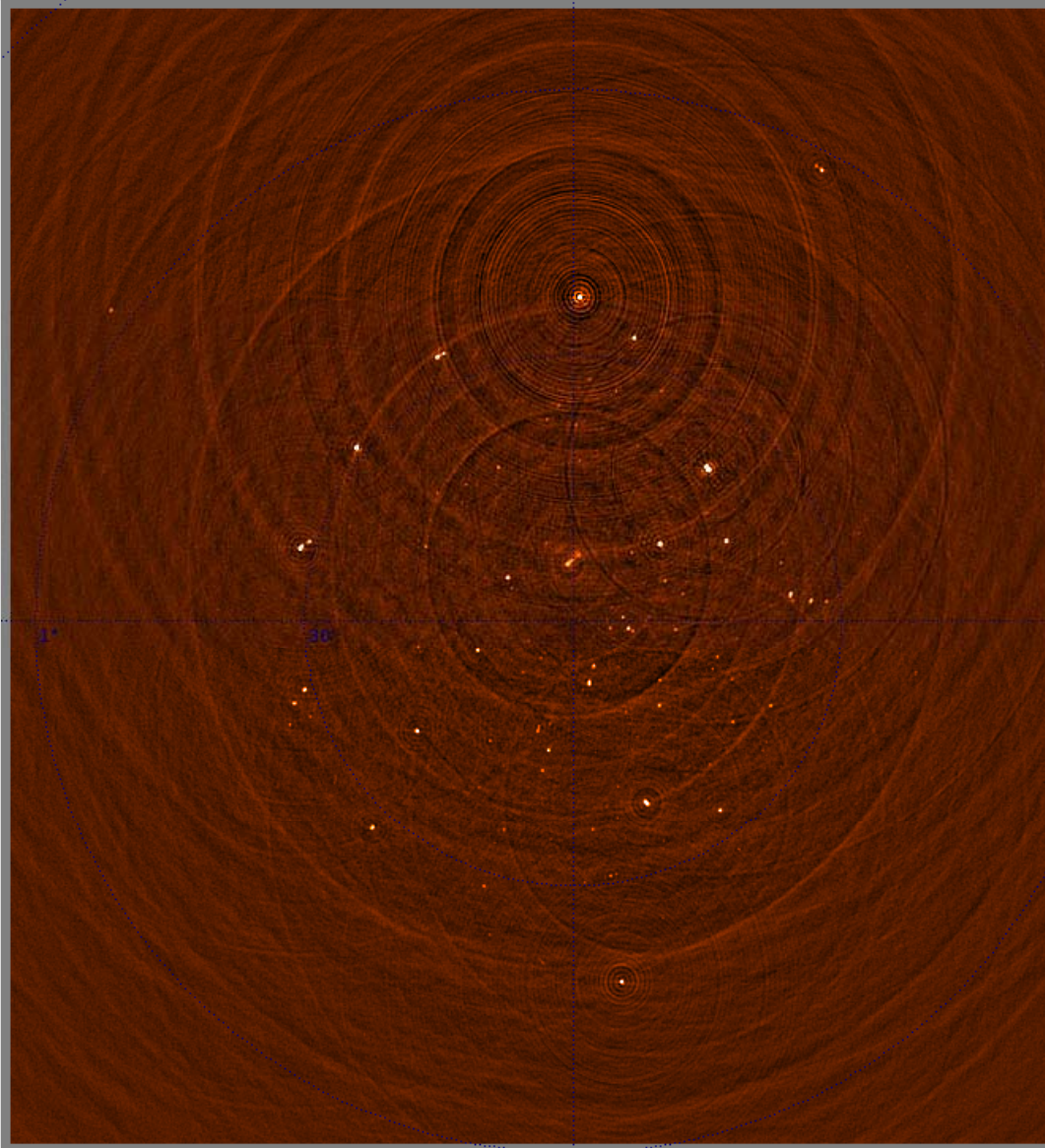
QMC2: Son Of QMC

- Offered extra time at RA=0h
- Found suitable field
 - No bright central source
 - 160, 200 mJy brightest
 - Nice spread of 10+ mJy sources
 - 3C source at almost 1°
- Asked for an error-free observation to build up sky model

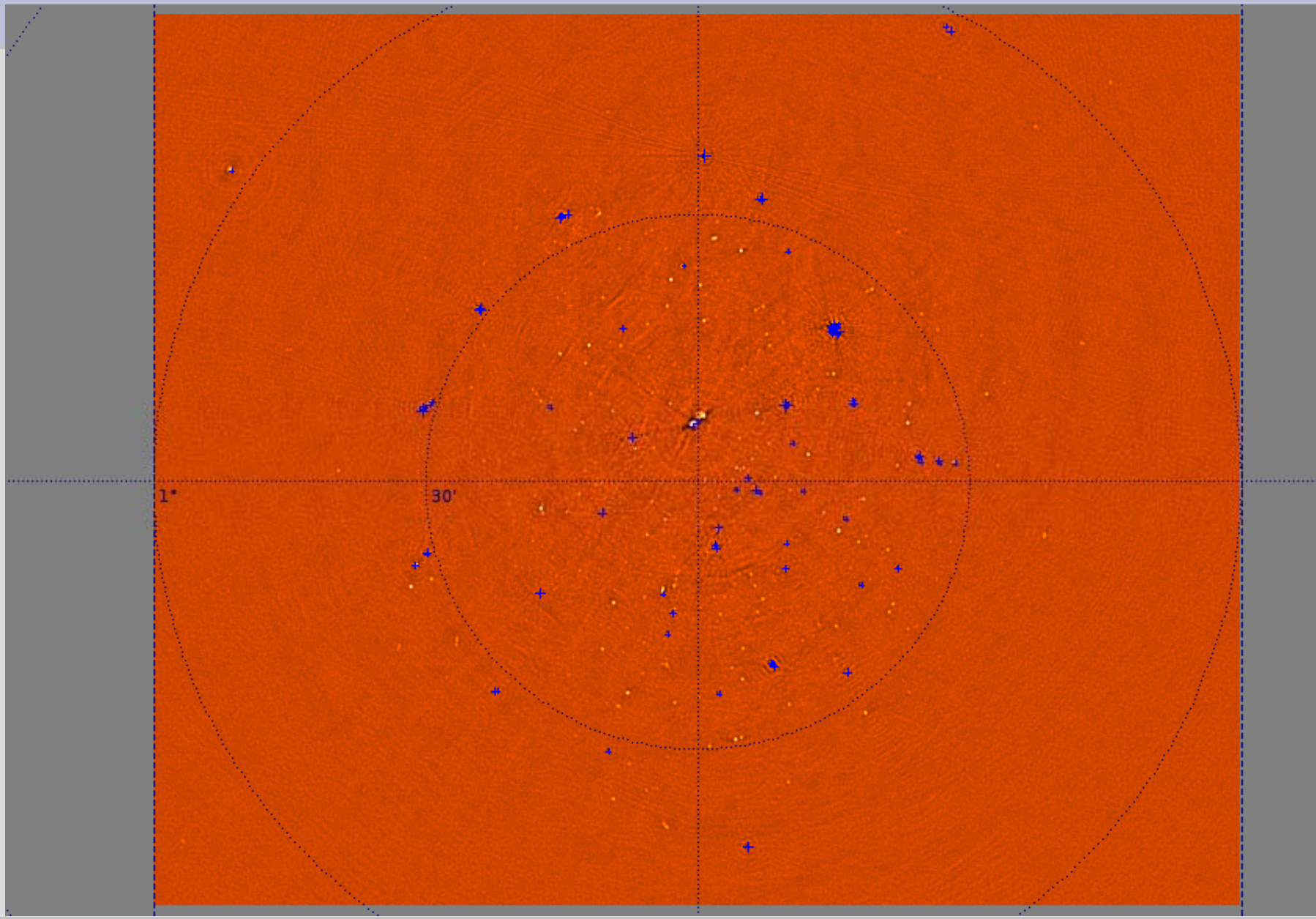


Error-free?

(Ger: "I have never seen such terrible WSRT maps!")

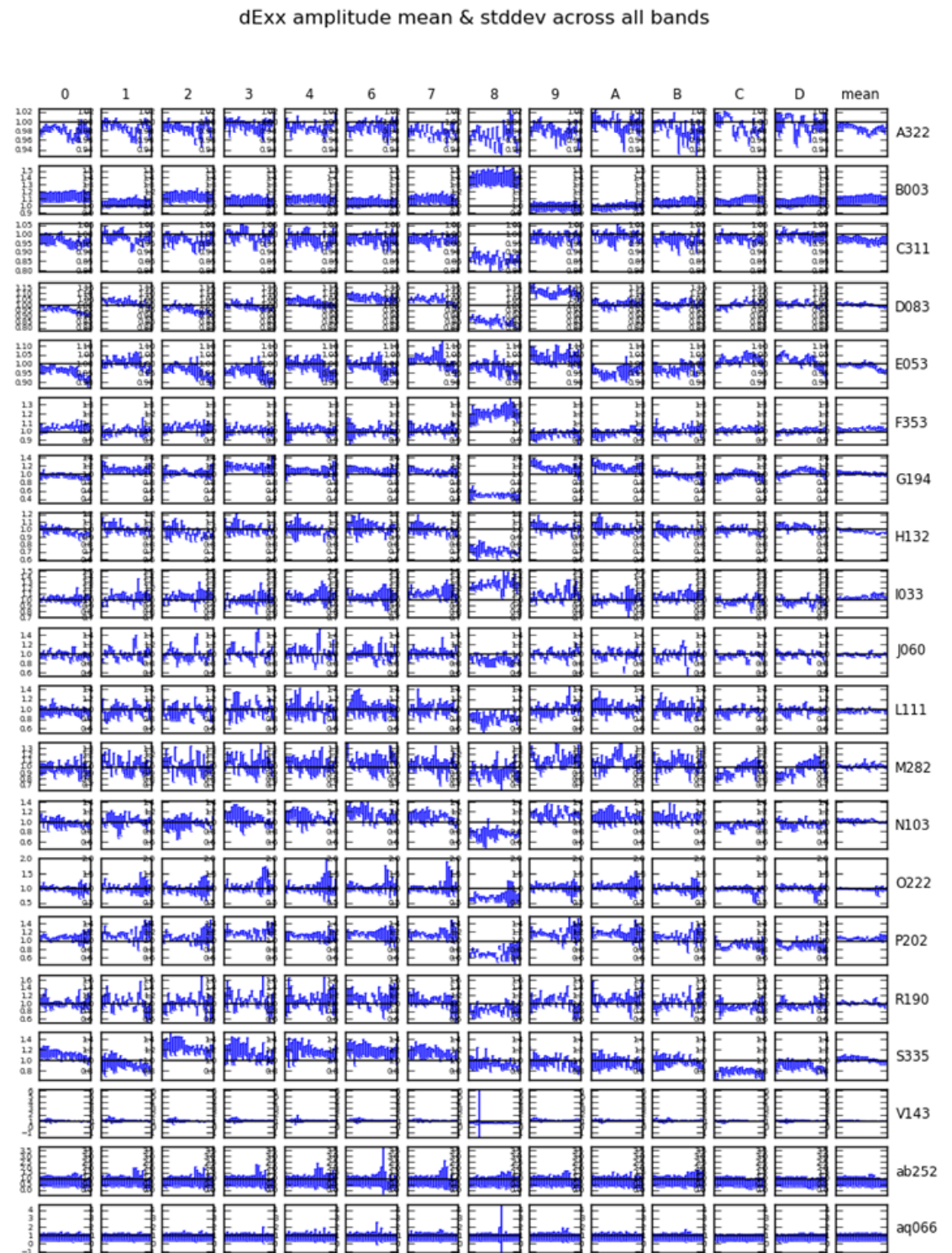


dEs Prevail, Yet Again...

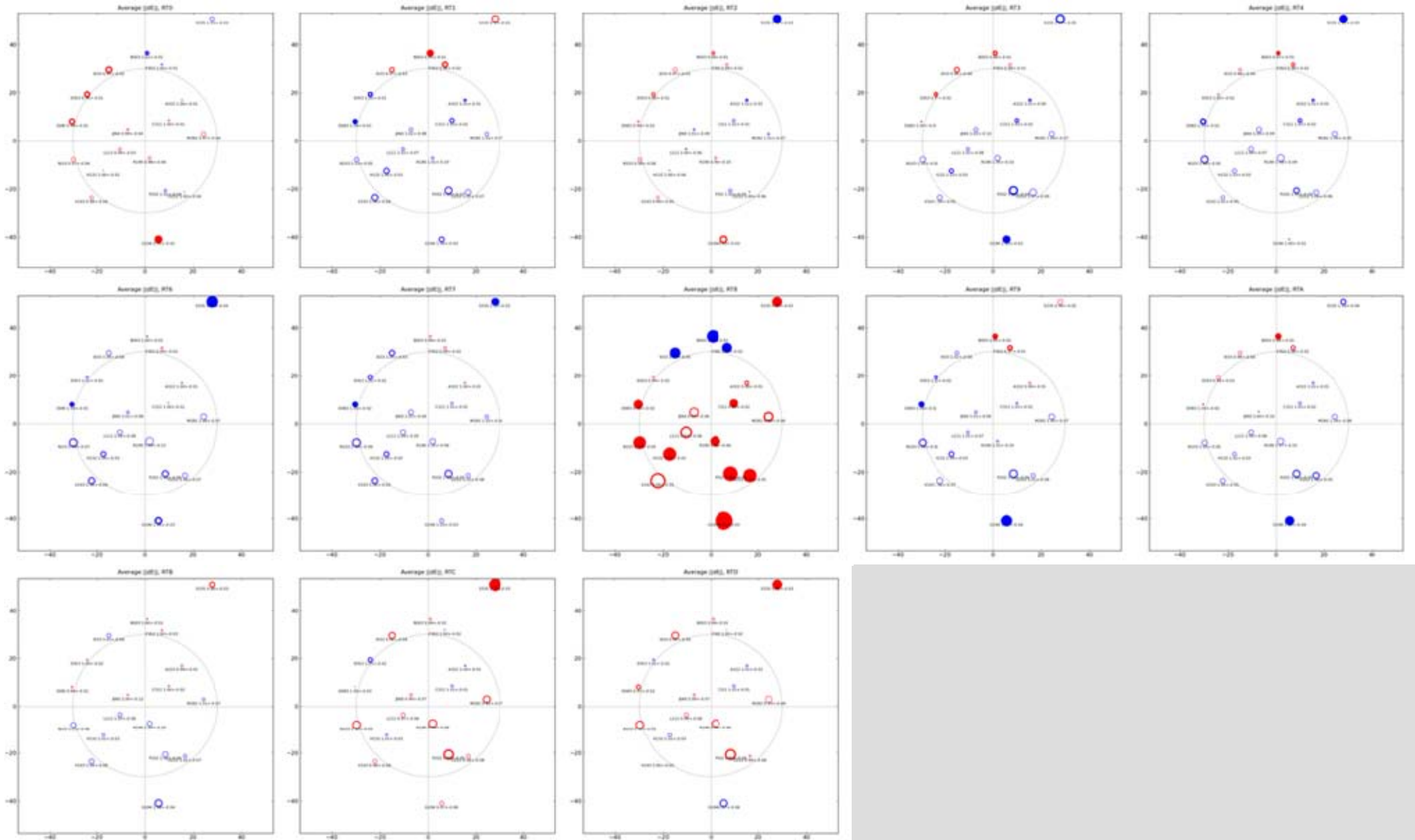


Spot The Limp Noodle

- Faintest source is ~5 mJy!
- Source of error is obvious...



Spot The Culprit II

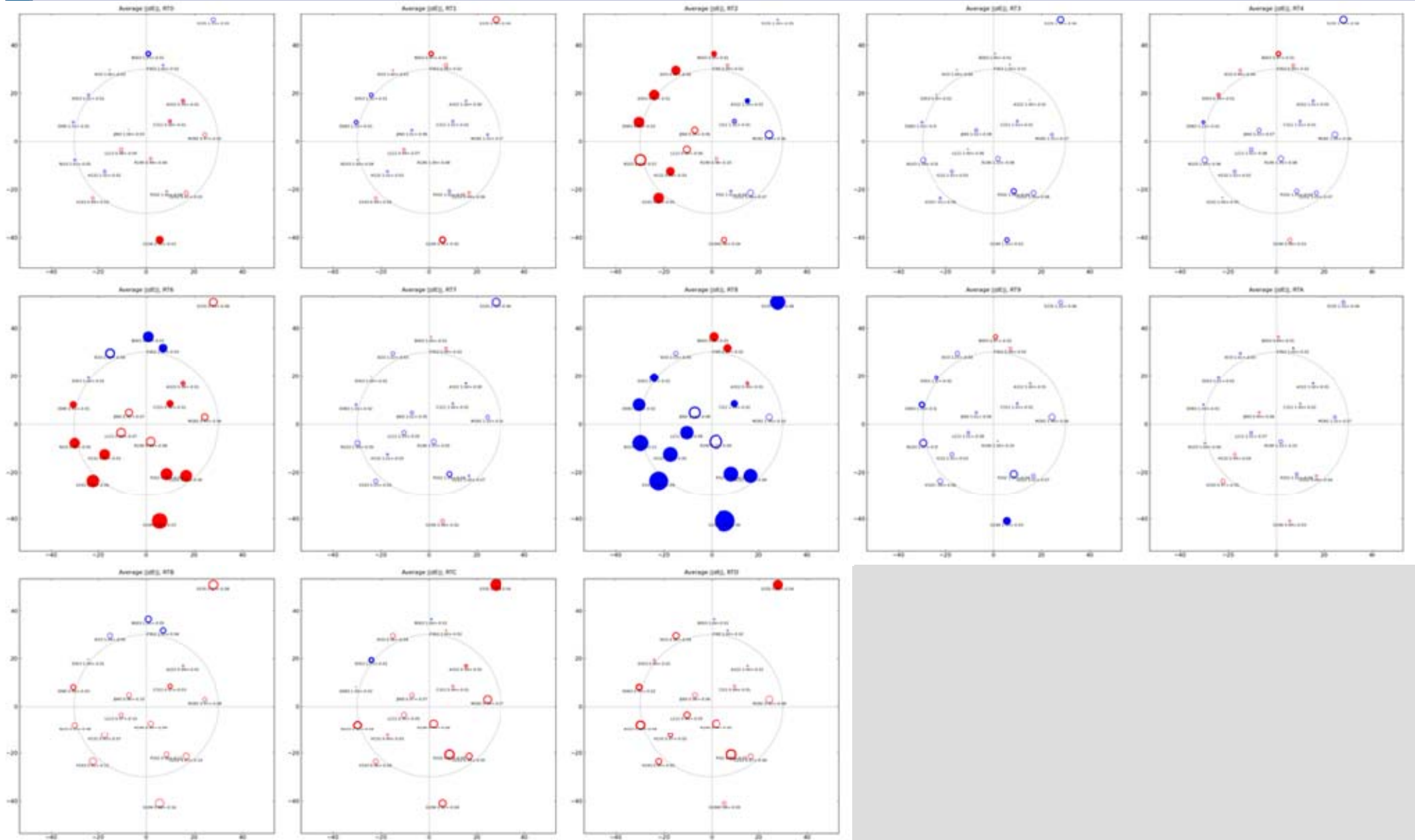


RT8 Problems

- Turned out to be a tracking problem with RT8 (bad elevation encoder)
- ...which we could “predict” from the data!

- Observations were repeated on July 21 with fixed RT8
 - ...but new deliberate errors on other dishes

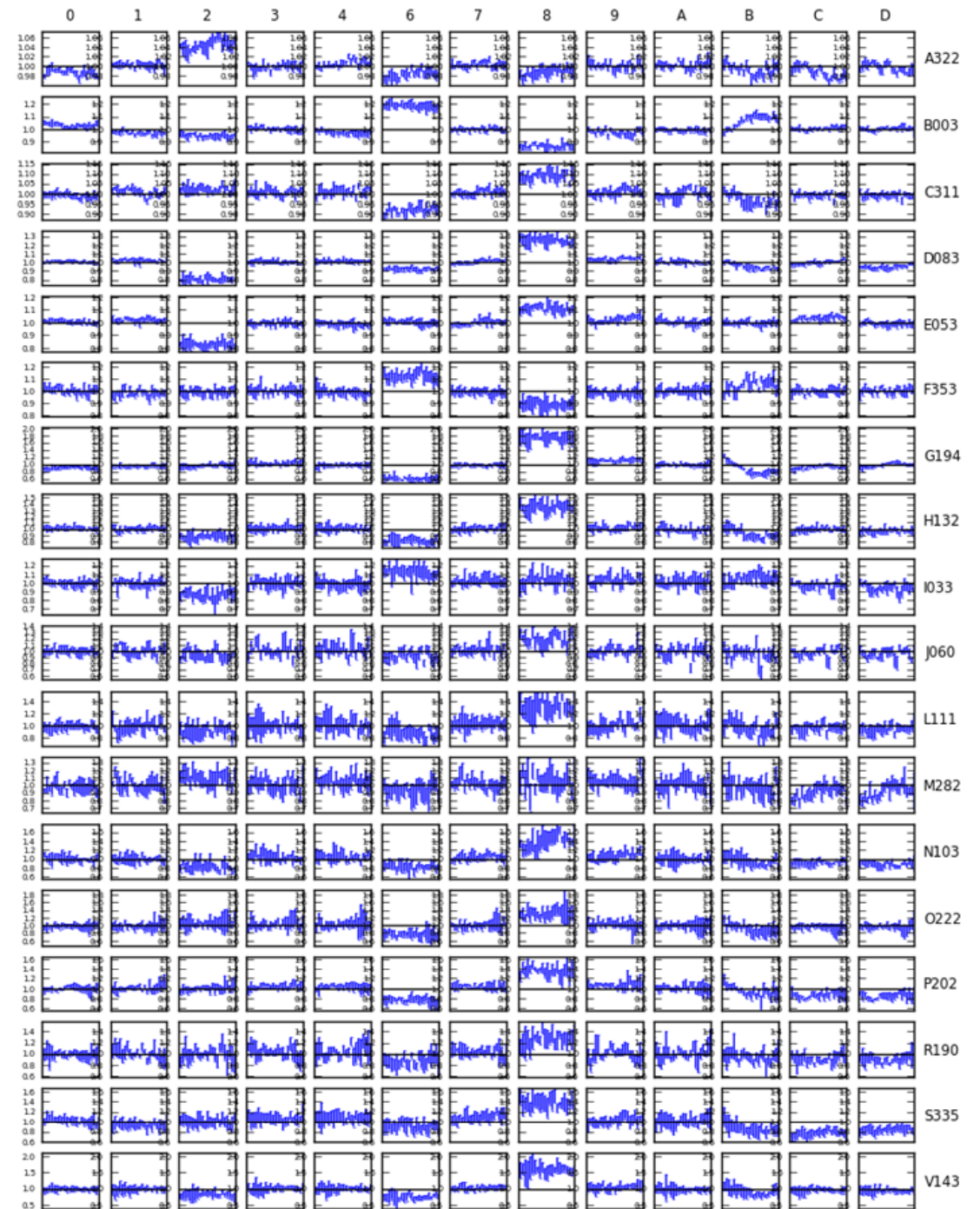
QMC2, Jul 21 observation



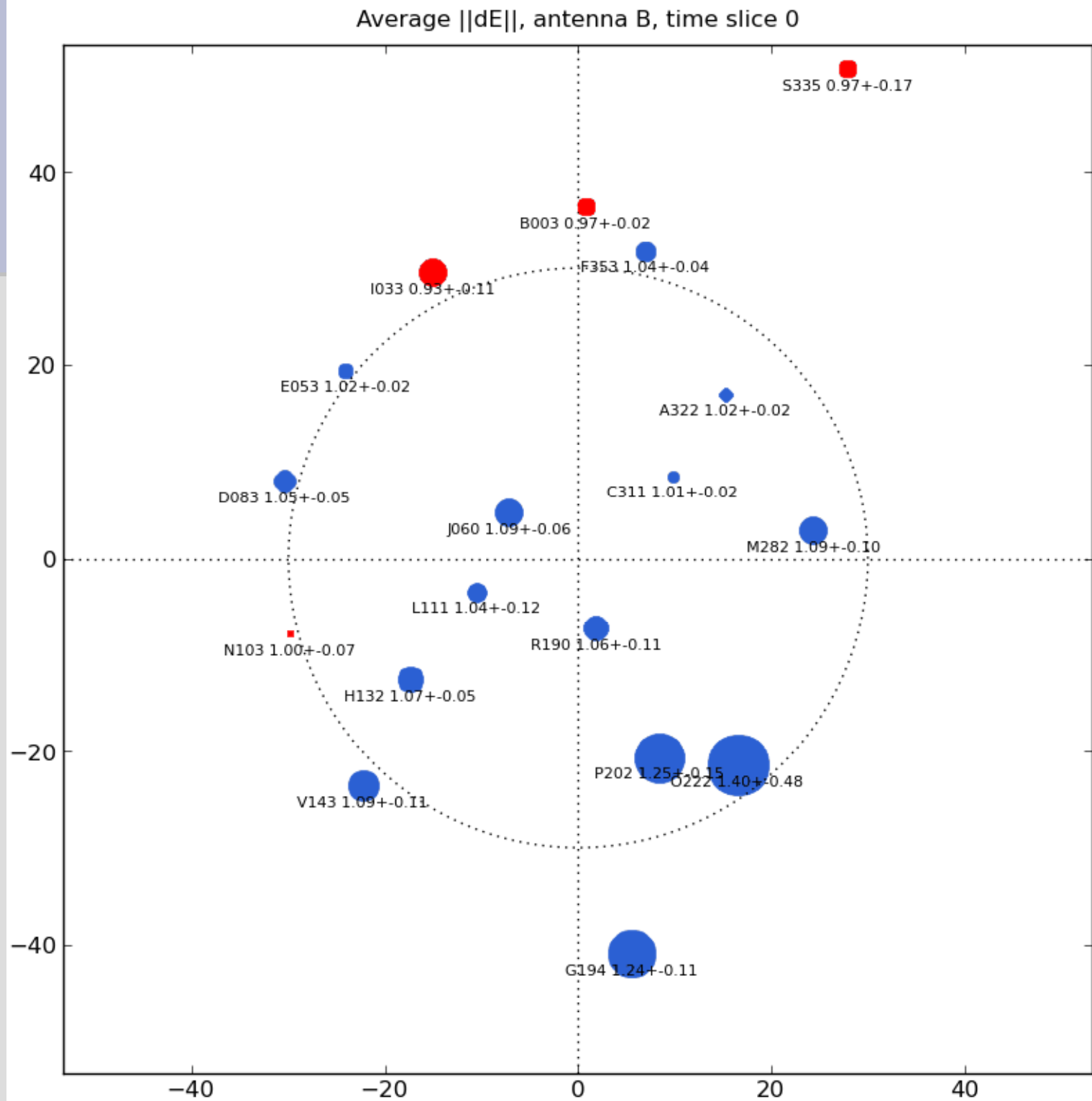
QMC2

Jul 21

- 3 static mispointings
- 1 time-variable one

Renormalized $||dE||$ mean & stddev across all bands

QMC2 Jul 21 RTB



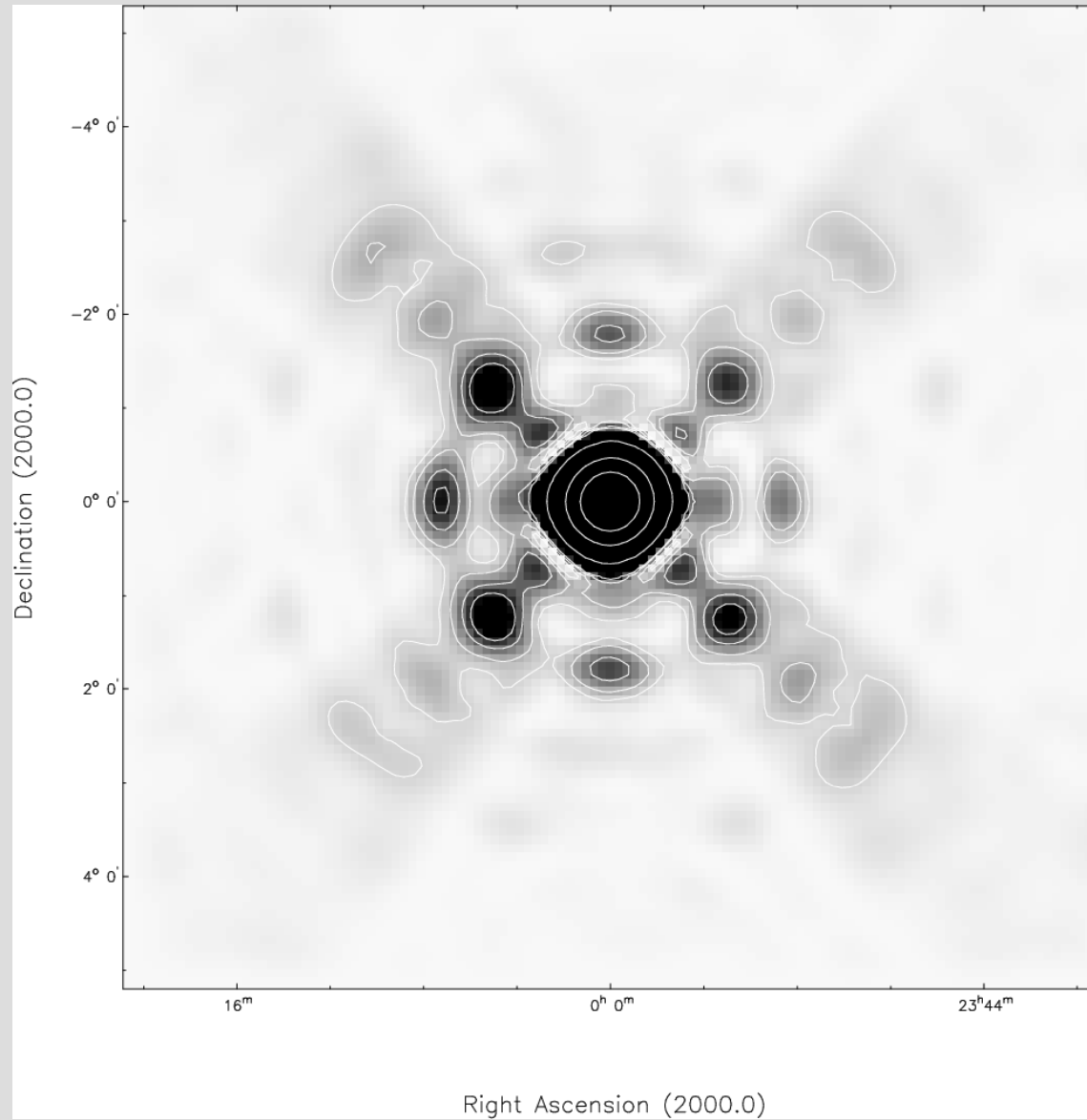
QMC2 Jul 21 Conclusions

- Static mispointing on RT2, RT6, RT8
- Time-variable (N-S) mispointing on RTB
- Confirmed by Hans van Someren

- Bad pointing on RT9
 - not deliberate!

- 3C source is on sidelobe: has opposite gain behaviour

WSRT Primary Beam (Popping & Braun)



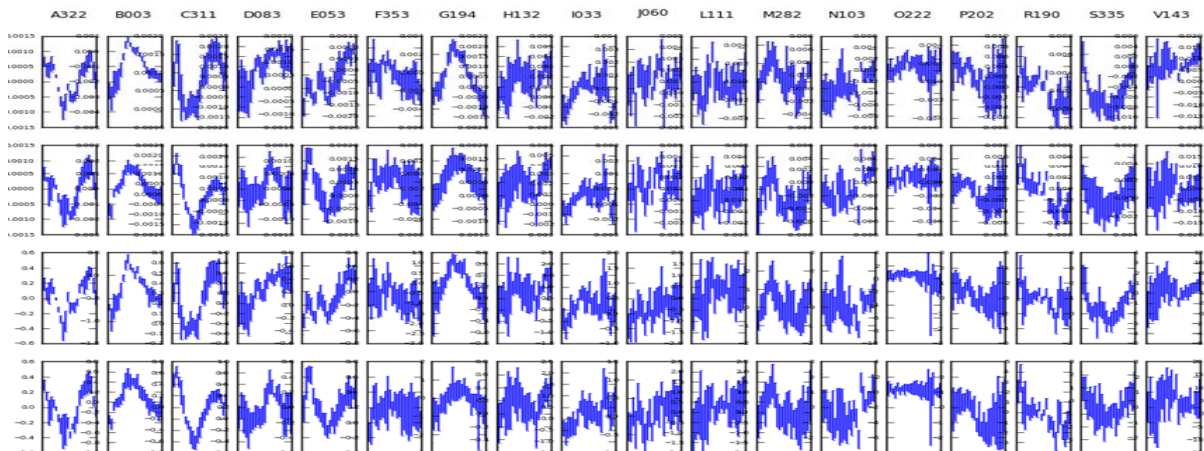
Future Plans

- Repeat QMC2 observations on short (<4h) synthesis
 - smaller pointing errors?
- Observe highly polarized field
 - haven't touched instrumental polarization yet
- Set up as a “QC pipeline”
 - Use QMC2 as an APERTIF/EMBRACE test?
- Fit a global beam model
 - A-la “pointing selfcal” of S. Bhatnagar
 - Need a decent model first
- Further mysteries...

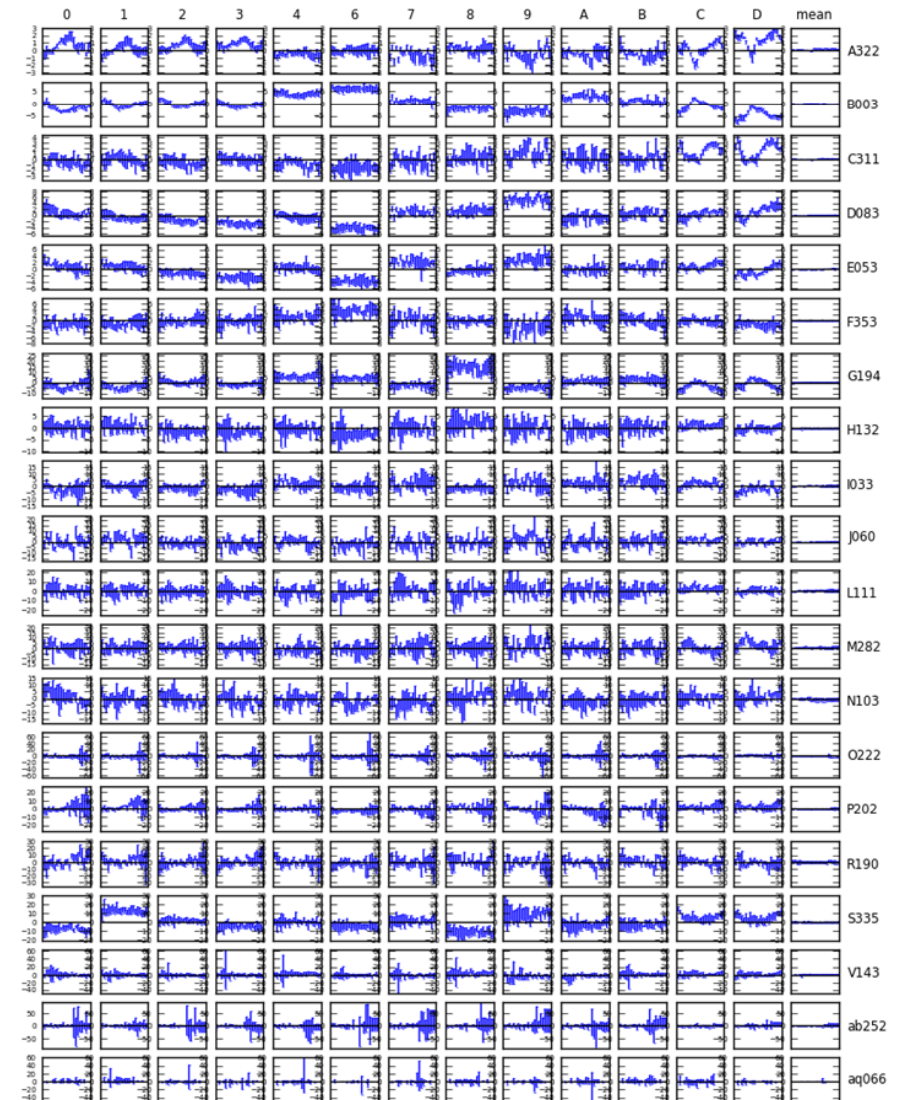
Phase Slopes?

- Structure in dE phases
- Phase slopes over array
 - different in X and Y
- Still lots to figure out....

Fitted differential phase slope over array



dExx phase (deg) mean & stddev across all bands



Epilogue: Google Images Solves Mystery of RT8

