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AN ORGANISATION FOR A NATIONAL
EARTH SCIENCE INFRASTRUCTURE PROGRAM

(Network and)
Quasar Structure Effects on the VLBI Reference Frame

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UTAS

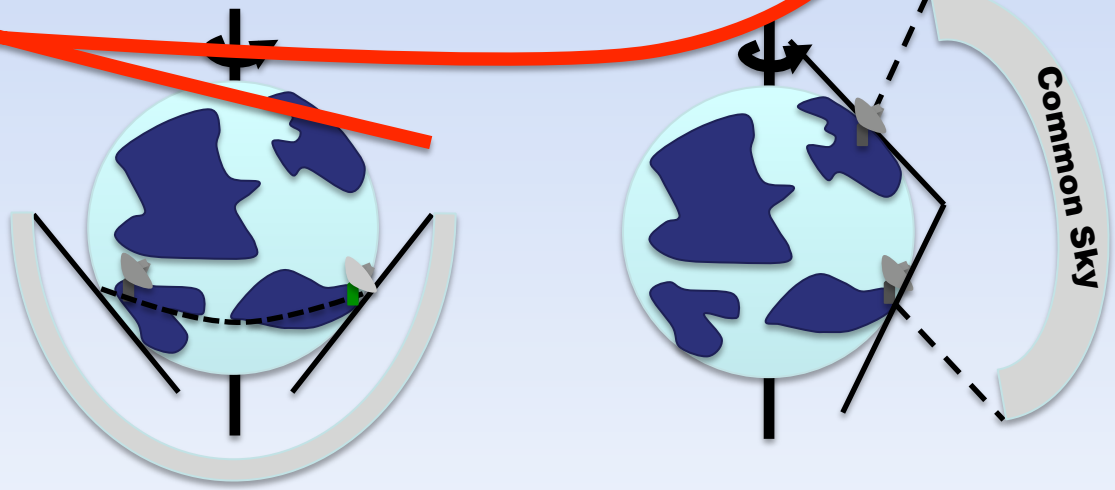
Outline

① Quasar structure

② Case study: 1144 – 379

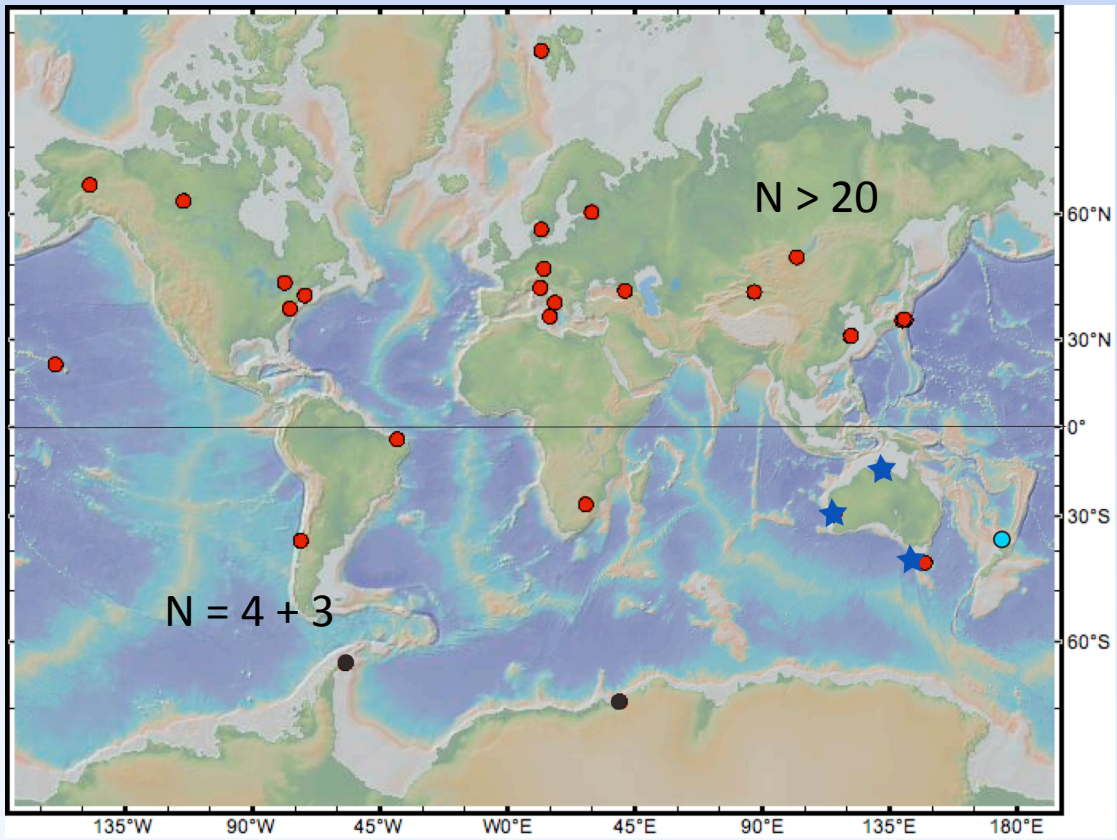
Improving the reference frame

- **What you look at**
  - Are quasars point-like?
  - Quasar structure ➔ position errors



- **How you look at it**
  - Atmospheric effects
  - Long baselines = worse solutions

International VLBI Service



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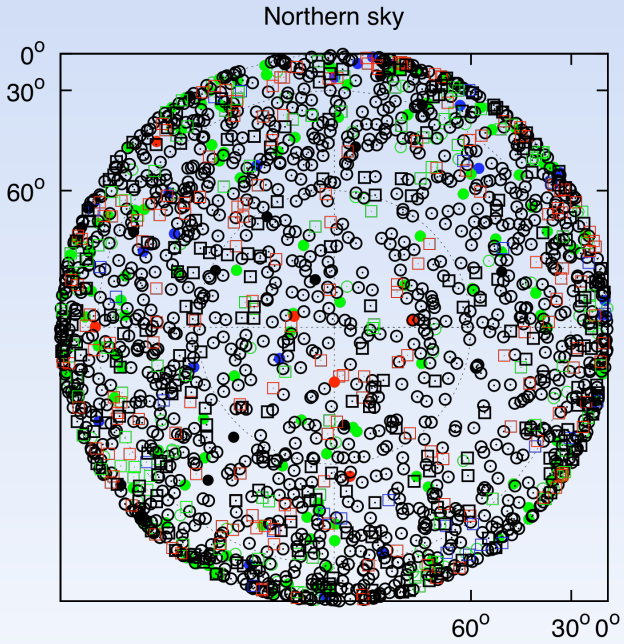
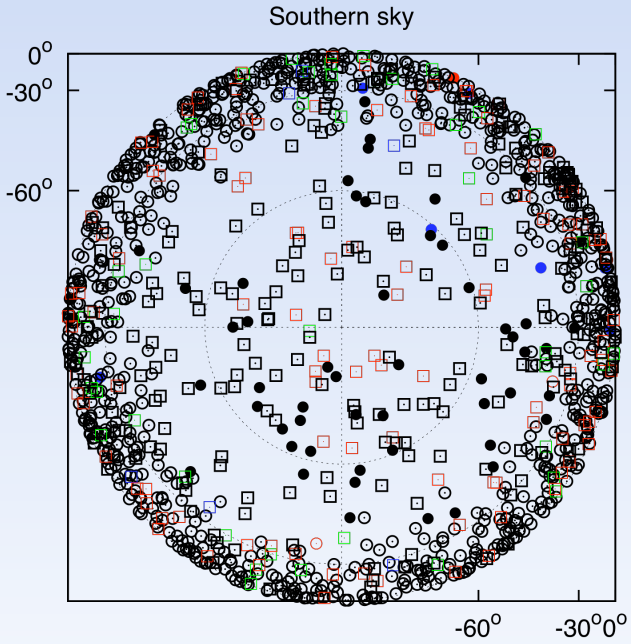
Southern Quasars

North Celestial Pole



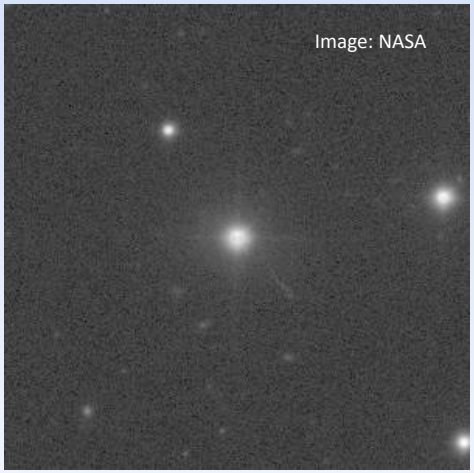
South Celestial Pole



Quasars

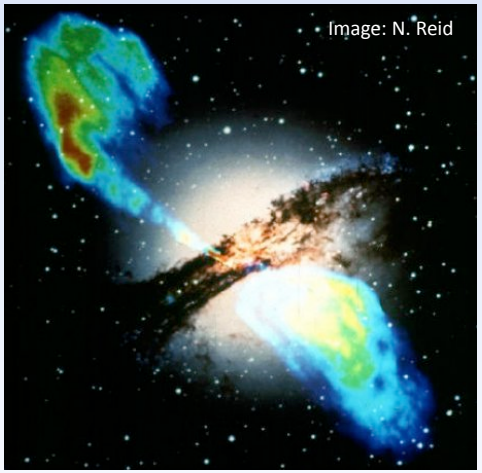
What you want them to be

- ✧ Bright point sources
- ✧ Fixed in space and time



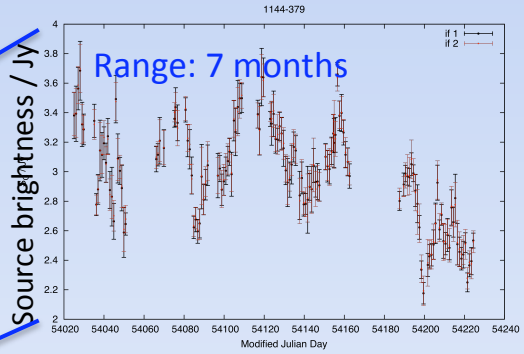
What they are

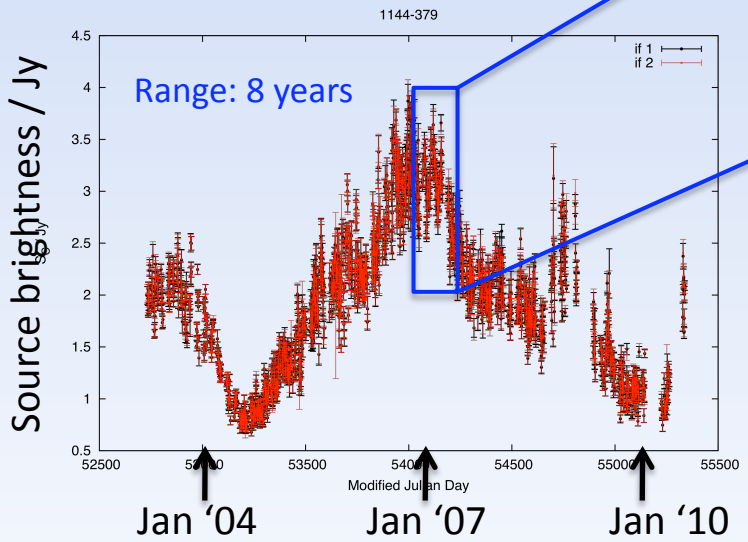
- ✧ Supermassive black holes
- ✧ Jets and outflows
  - ➔ structure
- ✧ Evolving on all timescales



Southern quasar variability: 1144 - 379

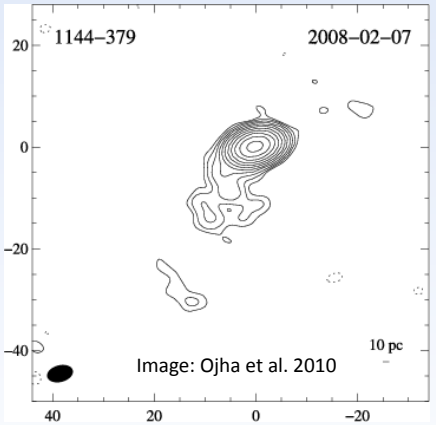
- UTas Ceduna 30m telescope
  - Single dish flux density monitoring
  - Highly variable over weeks!





- Core + jet

Core position
≠
Source position



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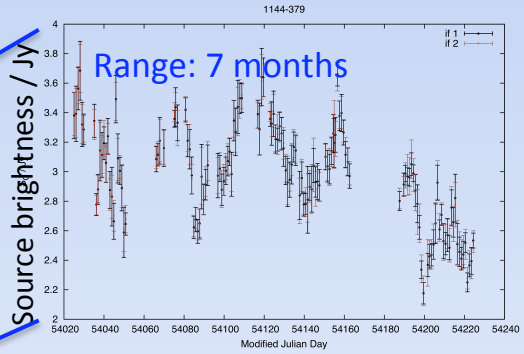
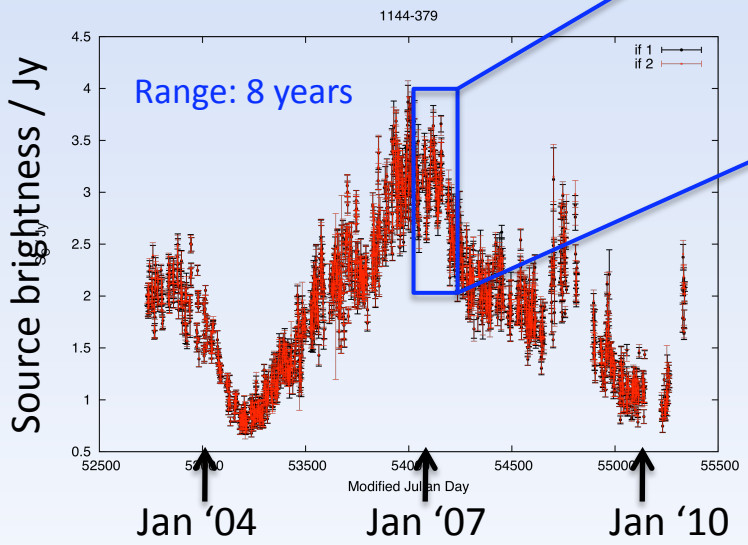
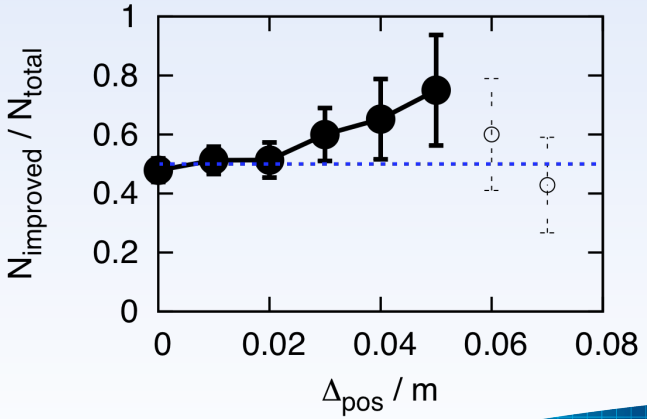
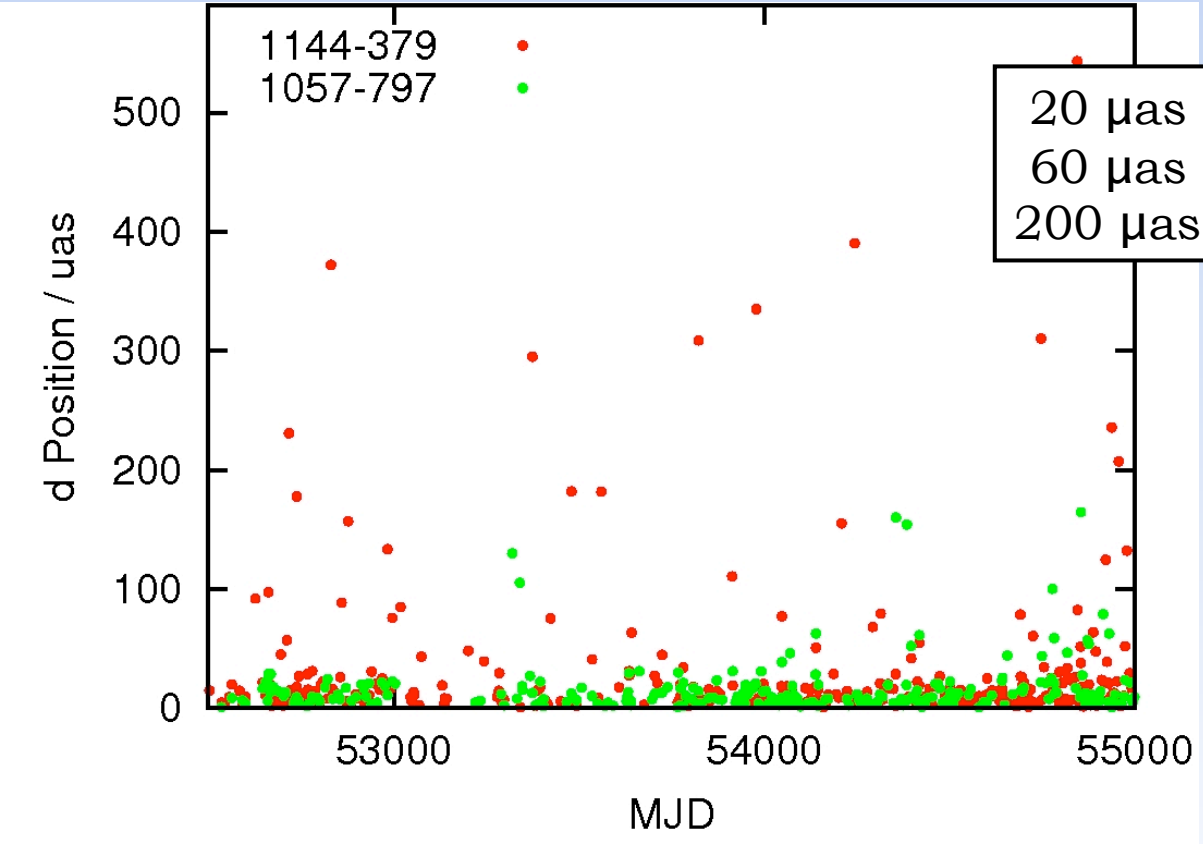




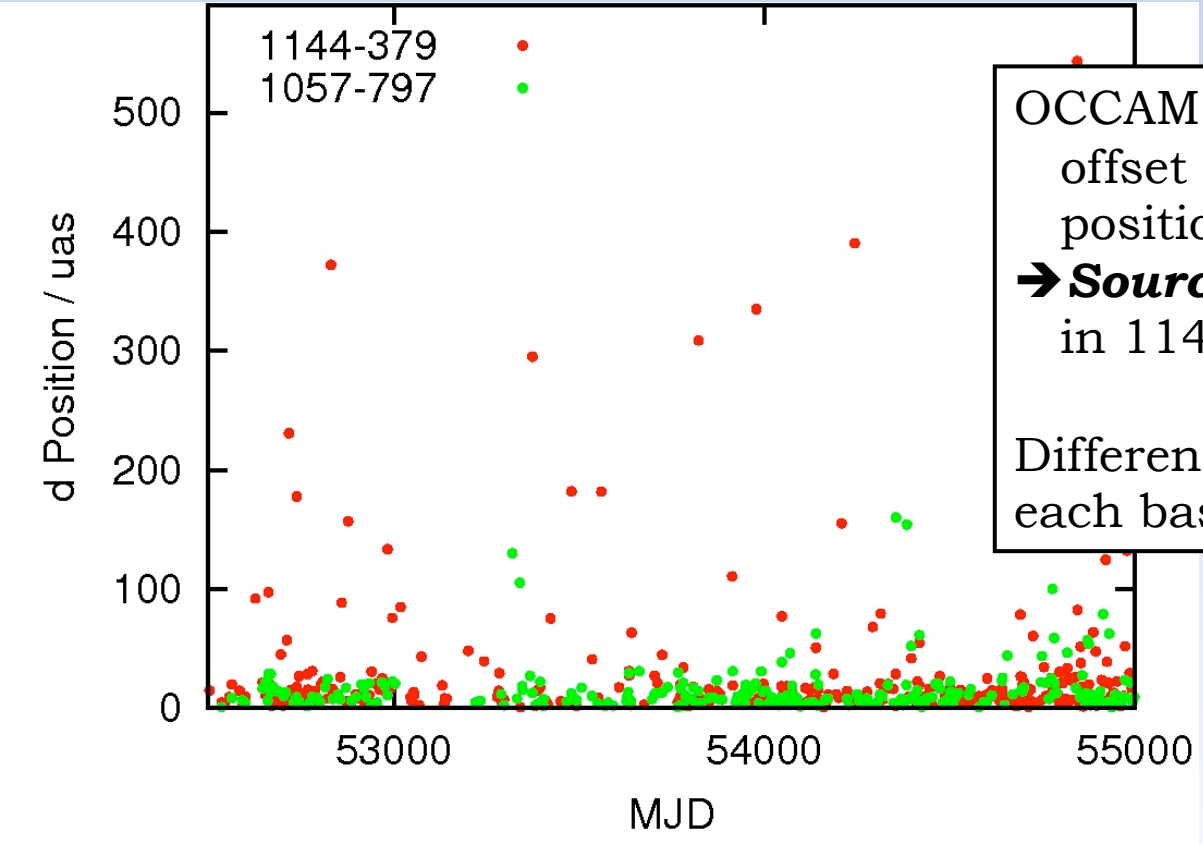
- Excluding 1144-379 improves OCCAM solutions for station positions



Geodetic source positions



Geodetic source positions



OCCAM can correct offset in 1057-797 position

➔ ***Source structure*** in 1144-379

⬇

Different centroid for each baseline

Evolution !

Can we *predict* whether a quasar will misbehave?

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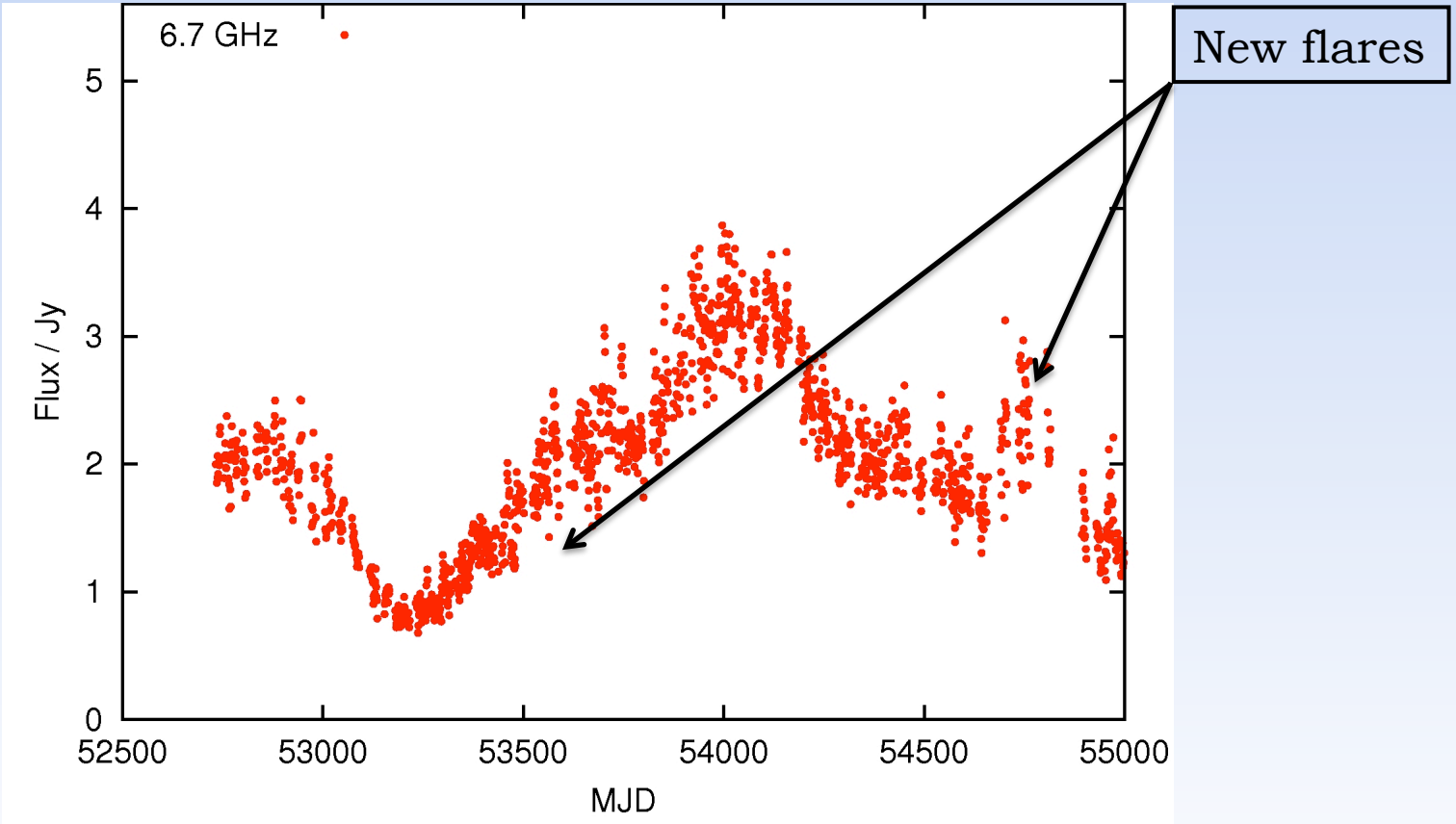
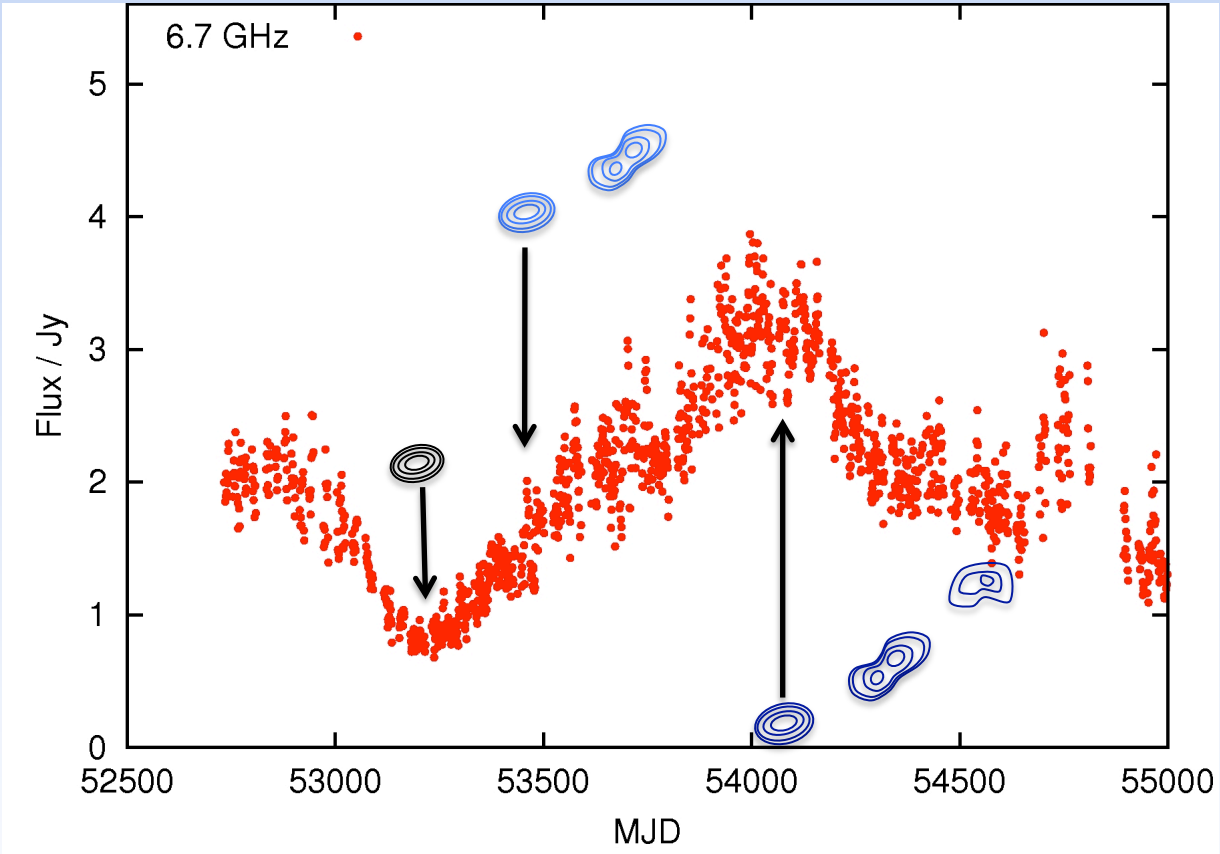
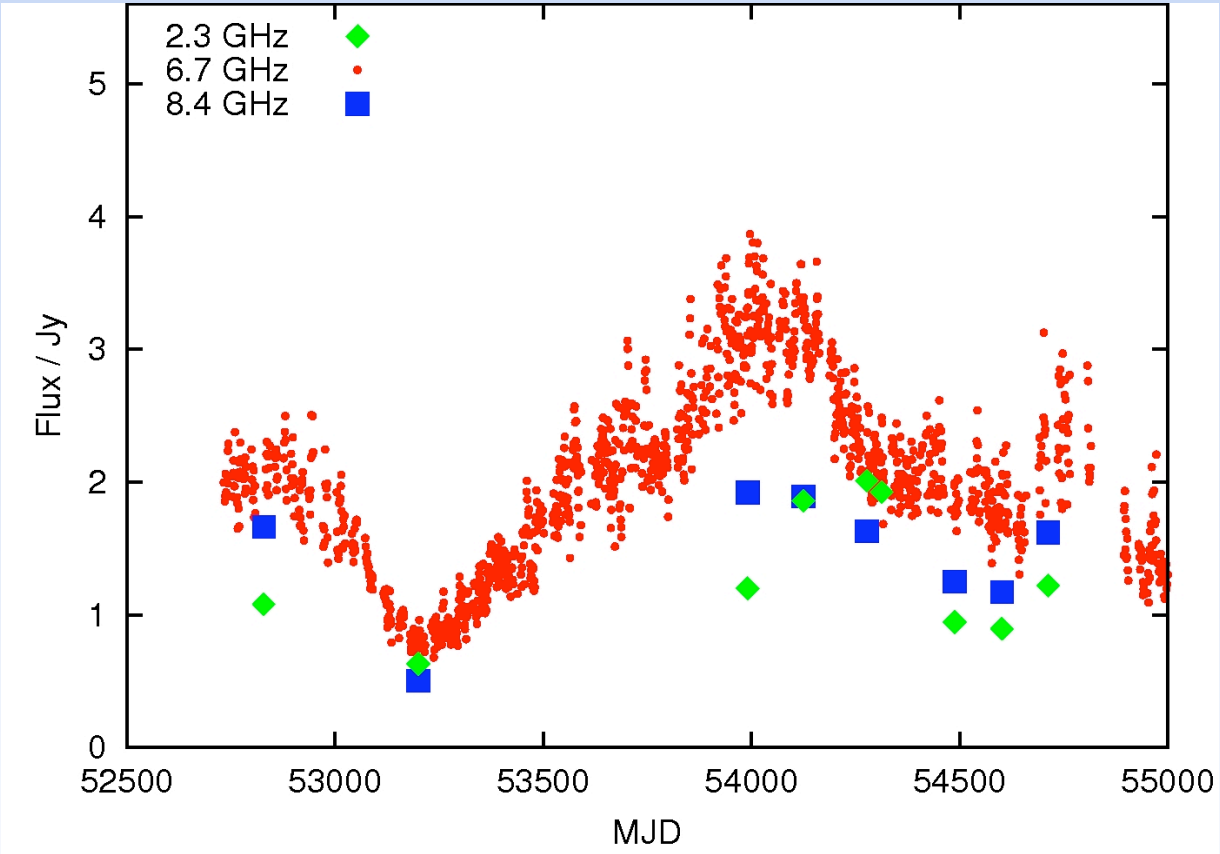
Flux density monitoring



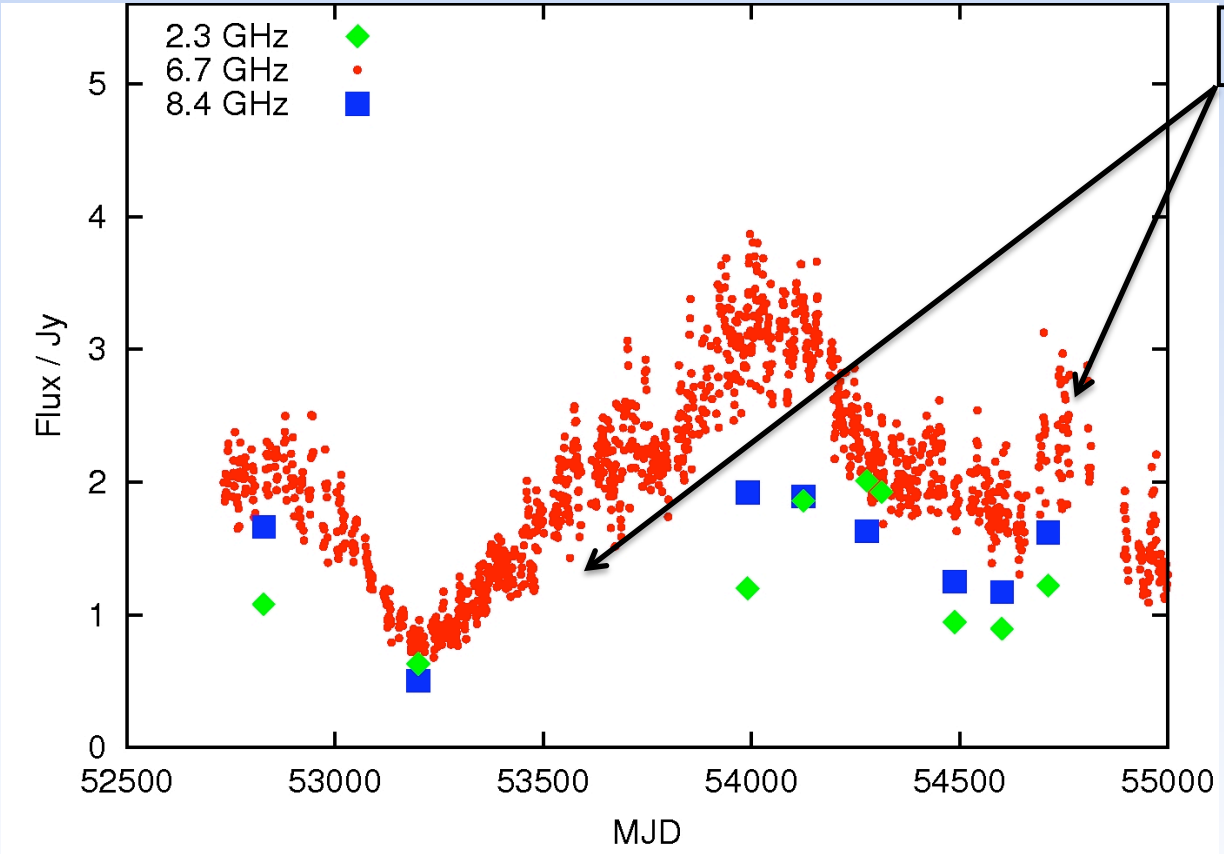
Flux density monitoring



Frequency dependence



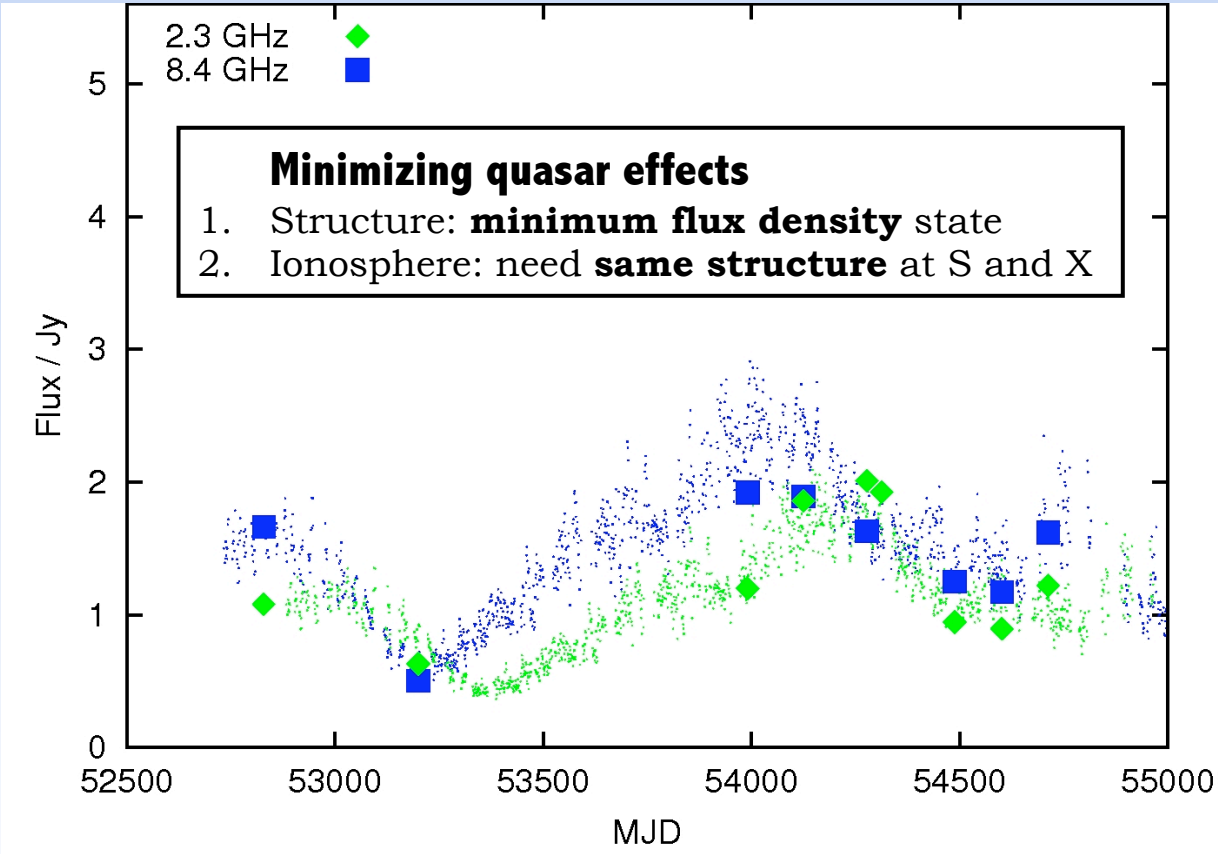
Frequency dependence



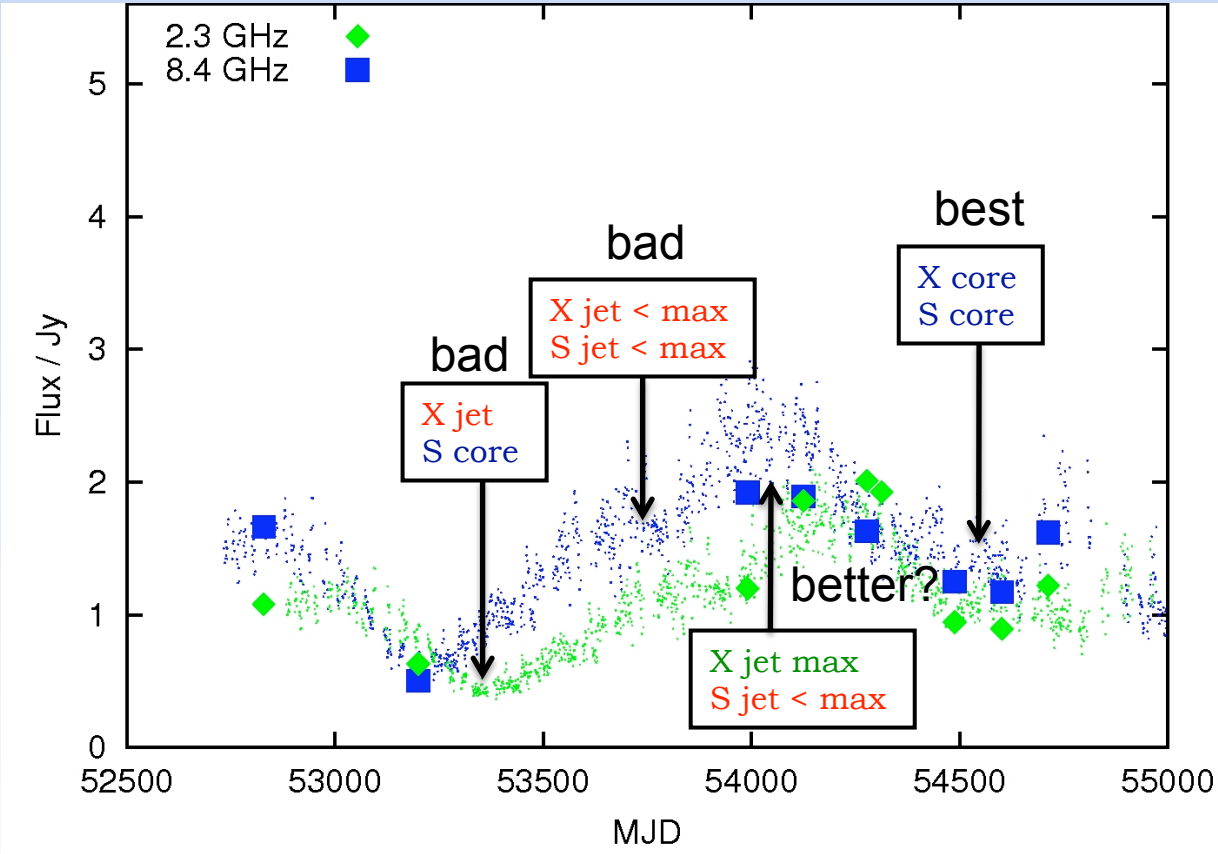
New flares

High ➔ low frequencies

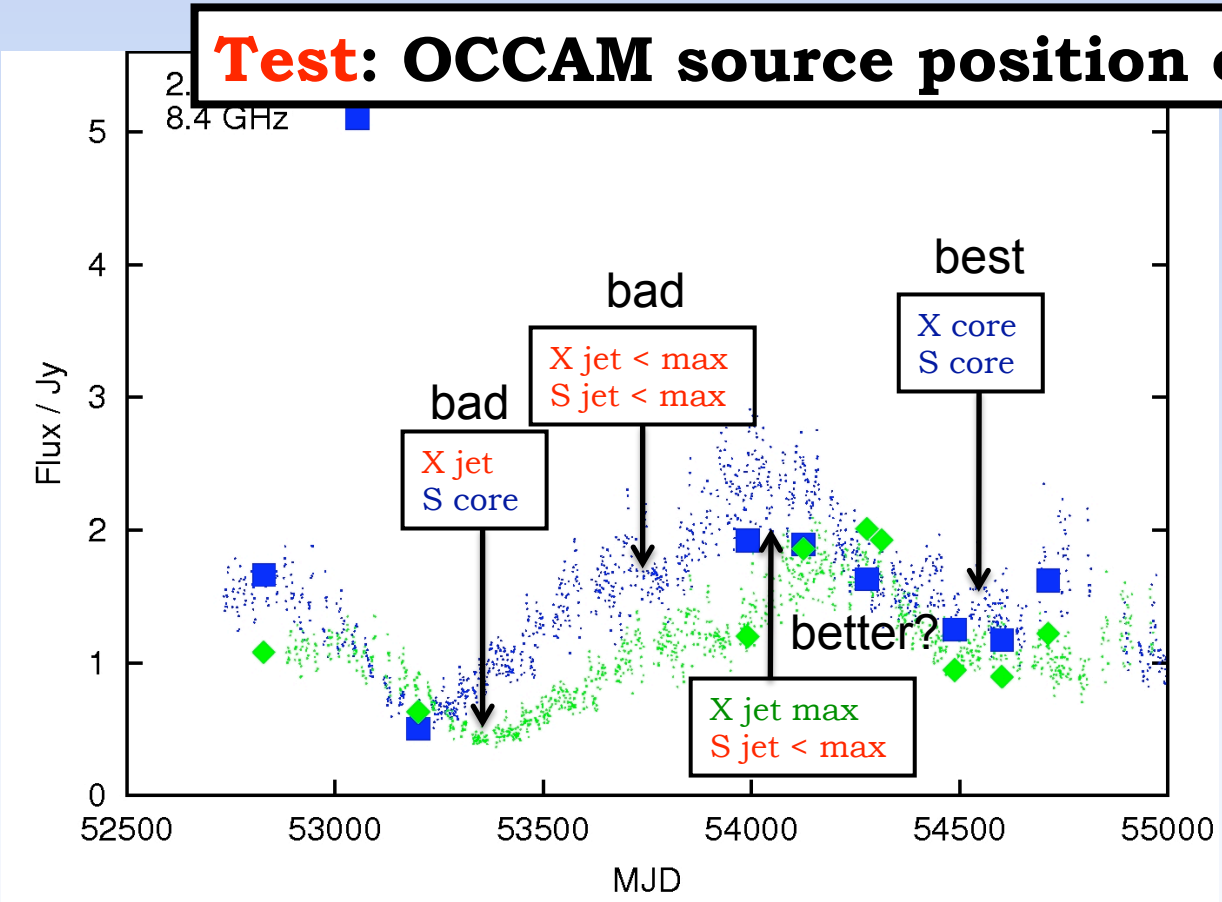
Frequency dependence



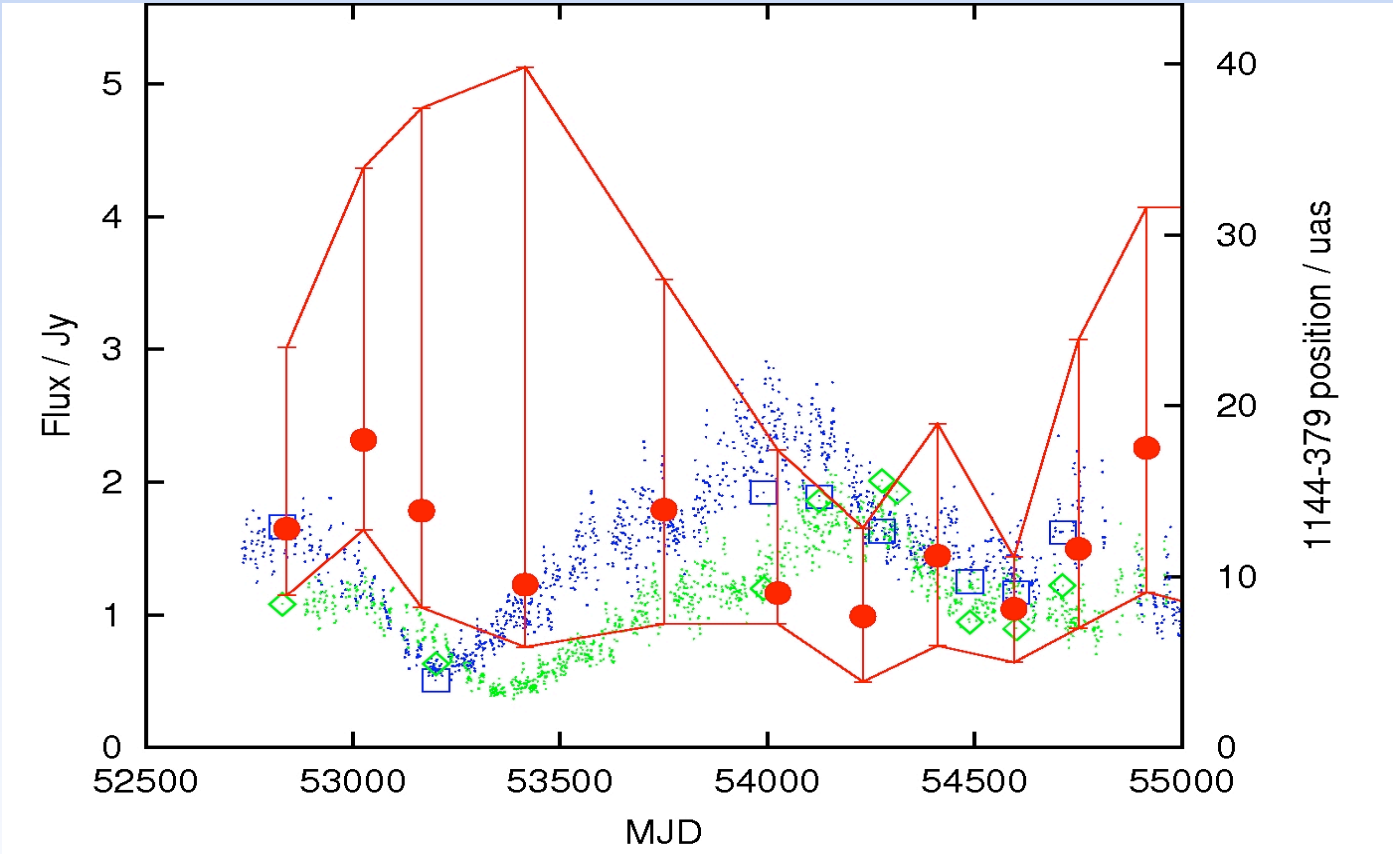
Predicted stability



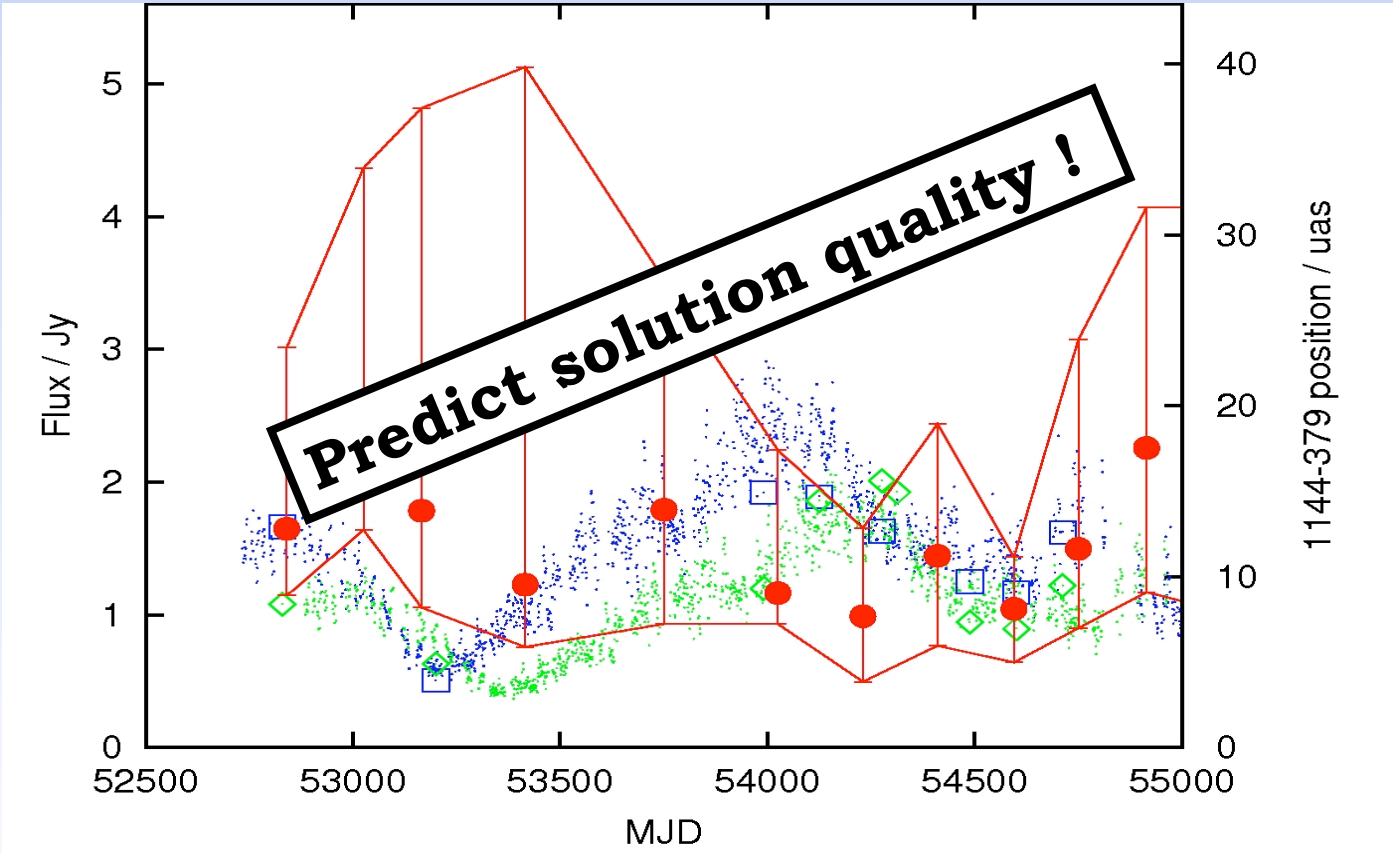
Predicted stability



Observed stability

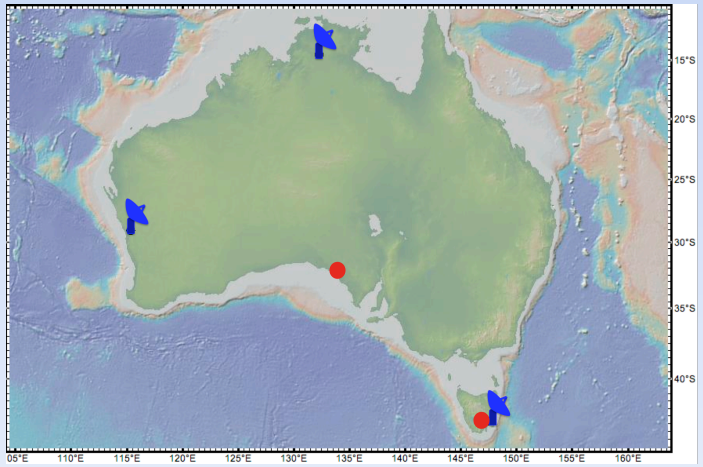


Observed stability



Summary

- Choice of quasars important
- **Frequency dependence** of source structure
- Quality control:
  - Multi-frequency **flux density monitoring**
  - IVS amplitude calibration
  - ➔ Quasar stability during an observation



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