Searching for FRBs with the interferometric arrays

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New and future arrays/problems

What are FRBs and where do they come from?

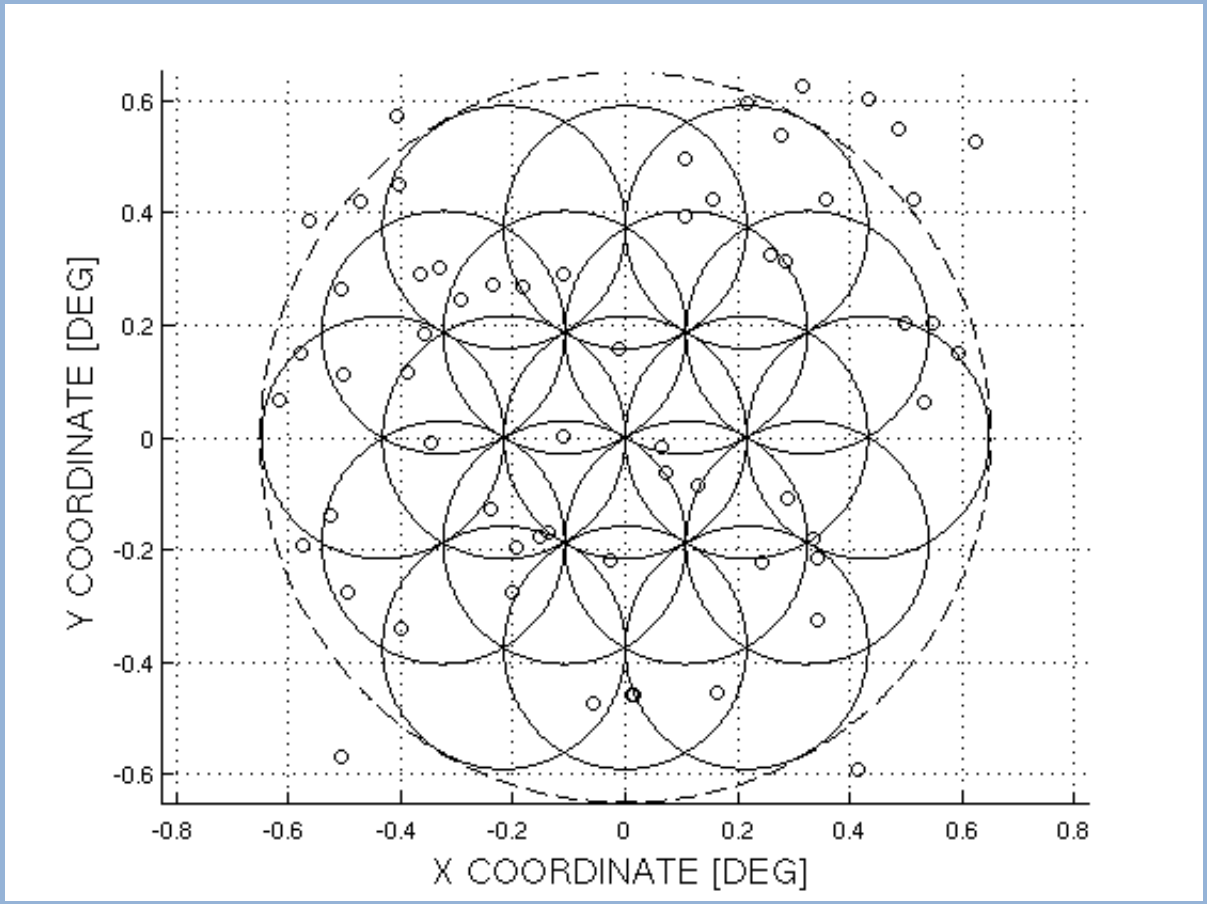
1. How to identify a host galaxy?
2. Follow-up observations at different wavelengths?

Current and future arrays offer:

- Multibeaming

Can we use multibeaming to identify a source location in real time?

Multibeaming



Important formulas

The *minimum* signal that a *telescope* can distinguish above the random background noise:

$$S_\upsilon = \beta \frac{T_{sky}\,\frac{S}{N}}{G\sqrt{n_p\,\tau\,\Delta\upsilon}}\,[Jy]$$

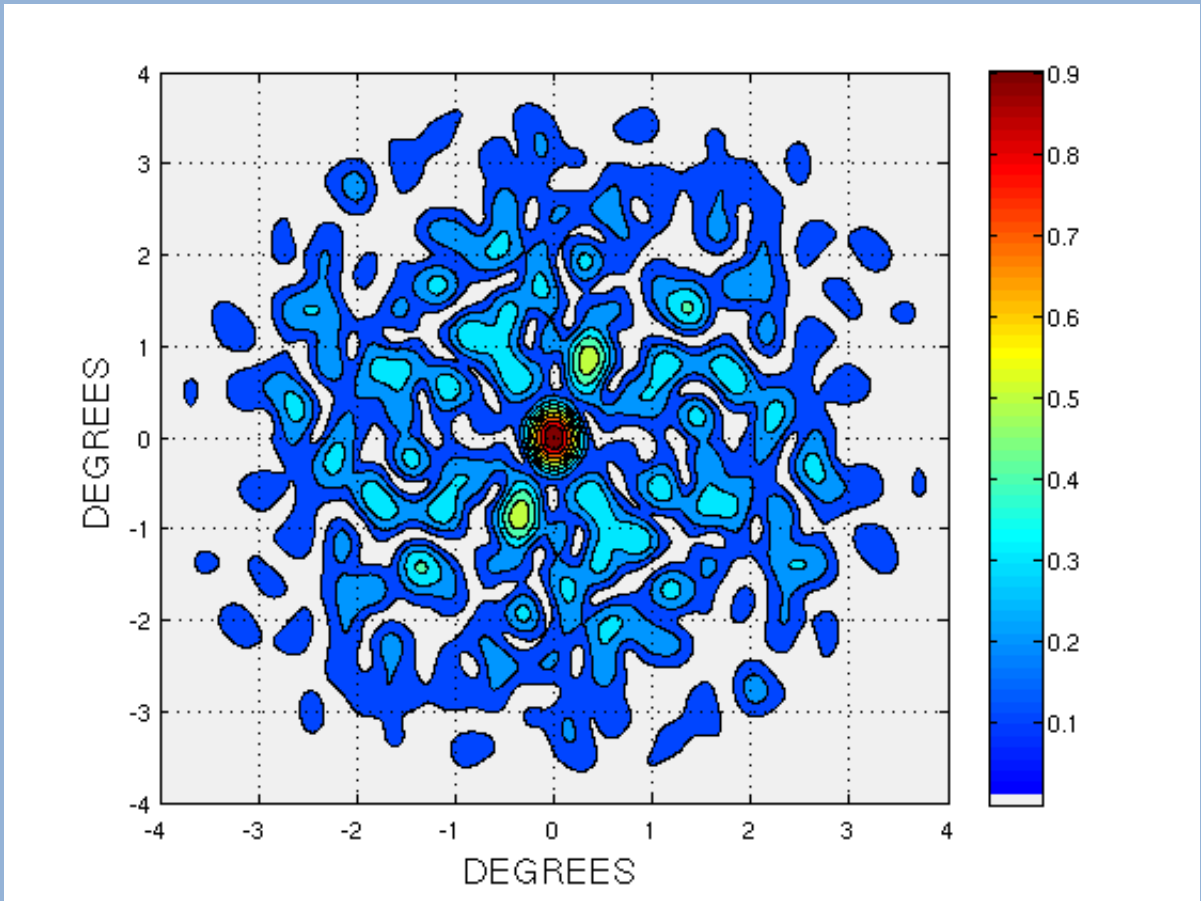
The observed flux density S often follows a power law dependency to the first order:

$$S(\upsilon) \propto \upsilon^{\alpha}$$

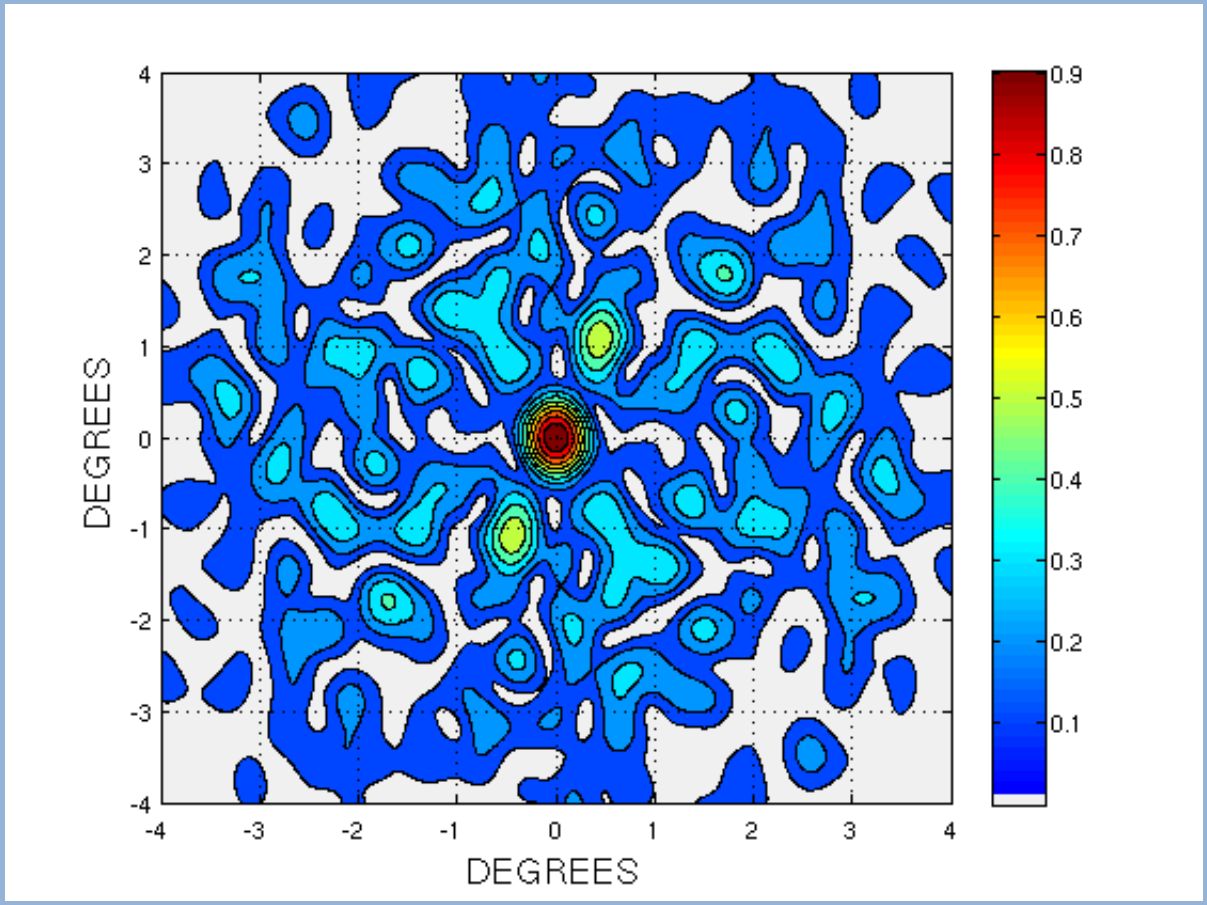
The spectral index is a function of frequency: $\alpha = \frac{\log\frac{S_L}{S_H}}{\log\frac{\upsilon_L}{\upsilon_H}}$

Telescope beam shape changes with frequency: $\frac{\lambda}{D}$

LOFAR beam pattern at 150MHz



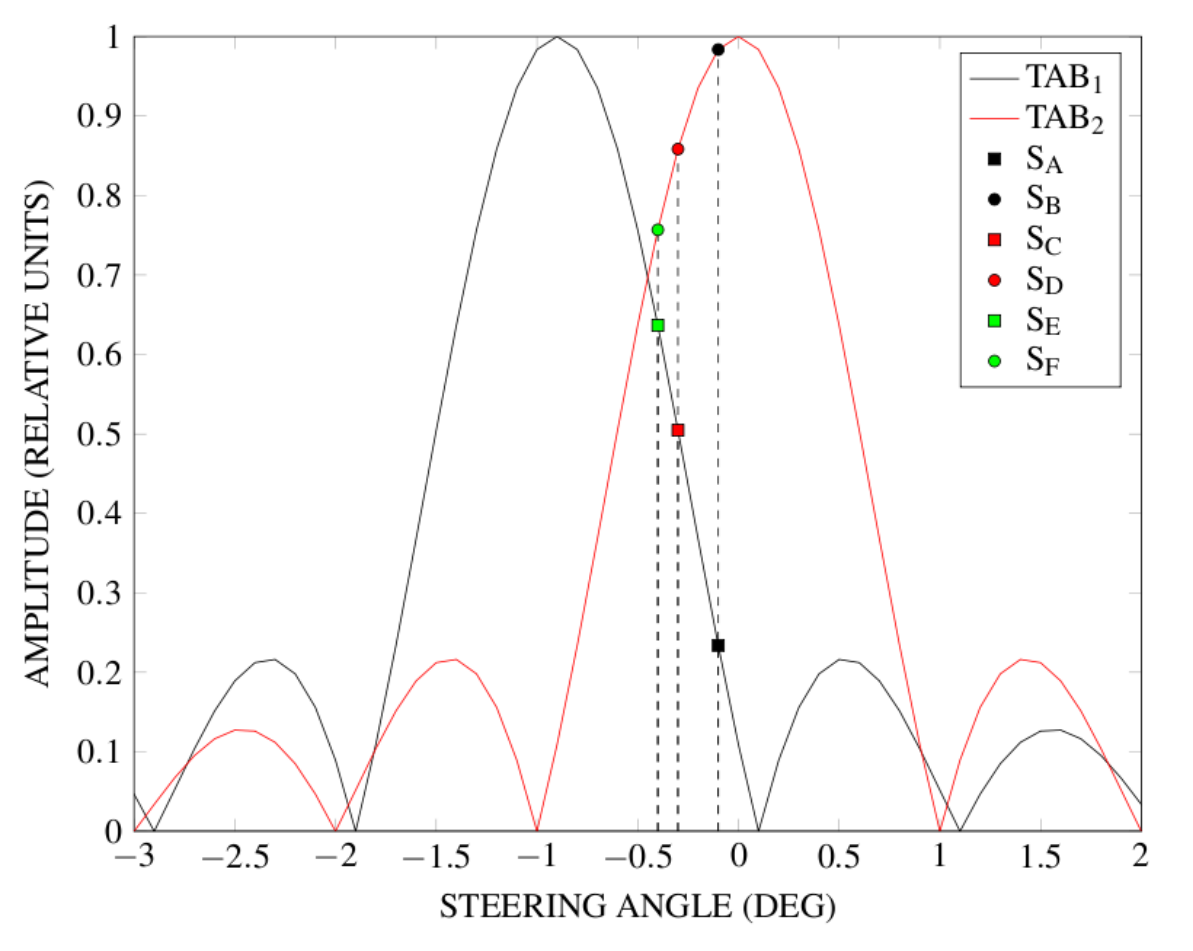
LOFAR beam pattern at 119MHz



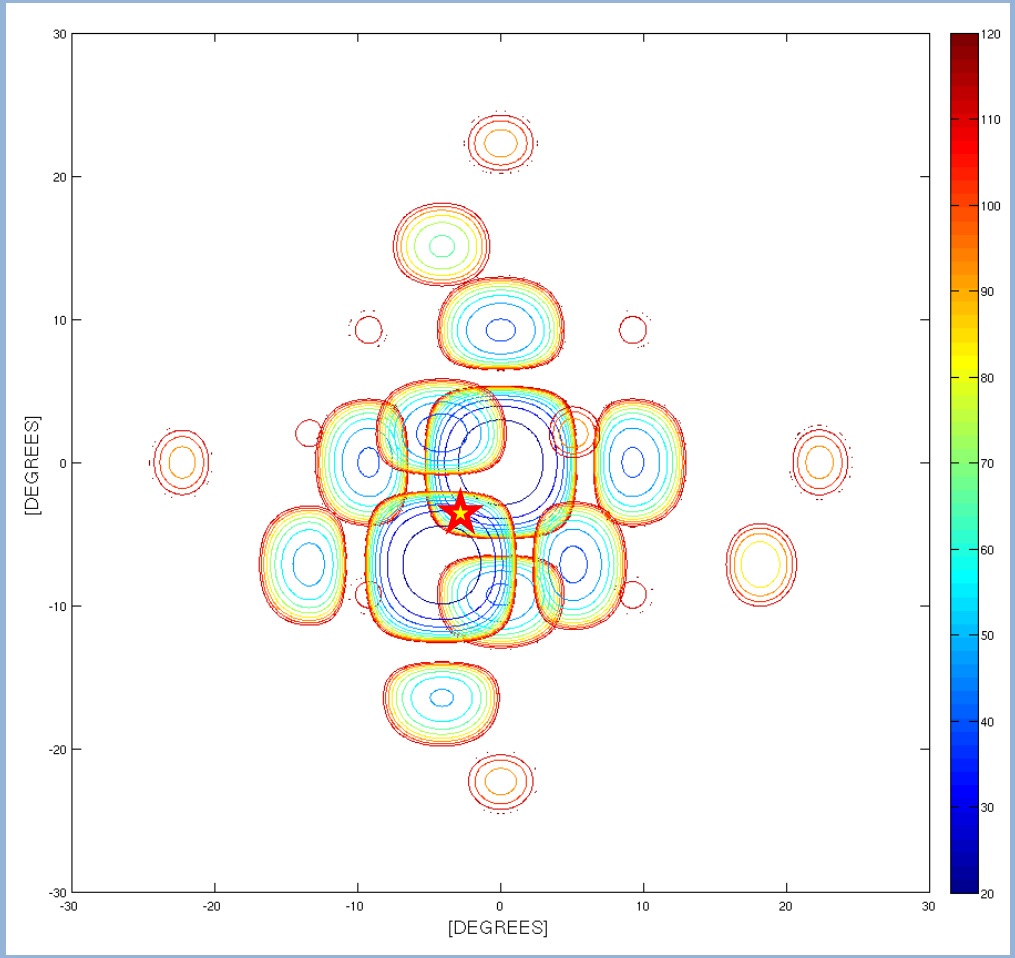
Real time first order identification of position

Introduction

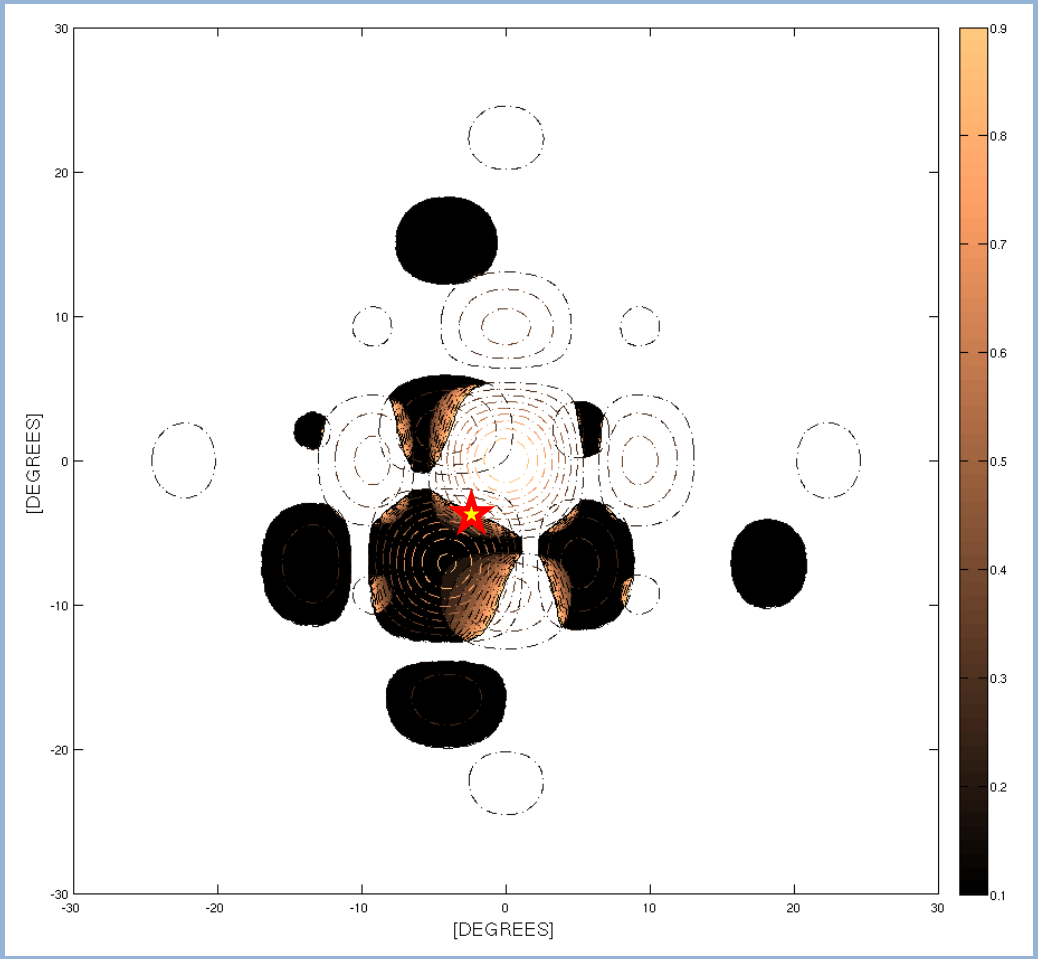
Overlapping beams ratio



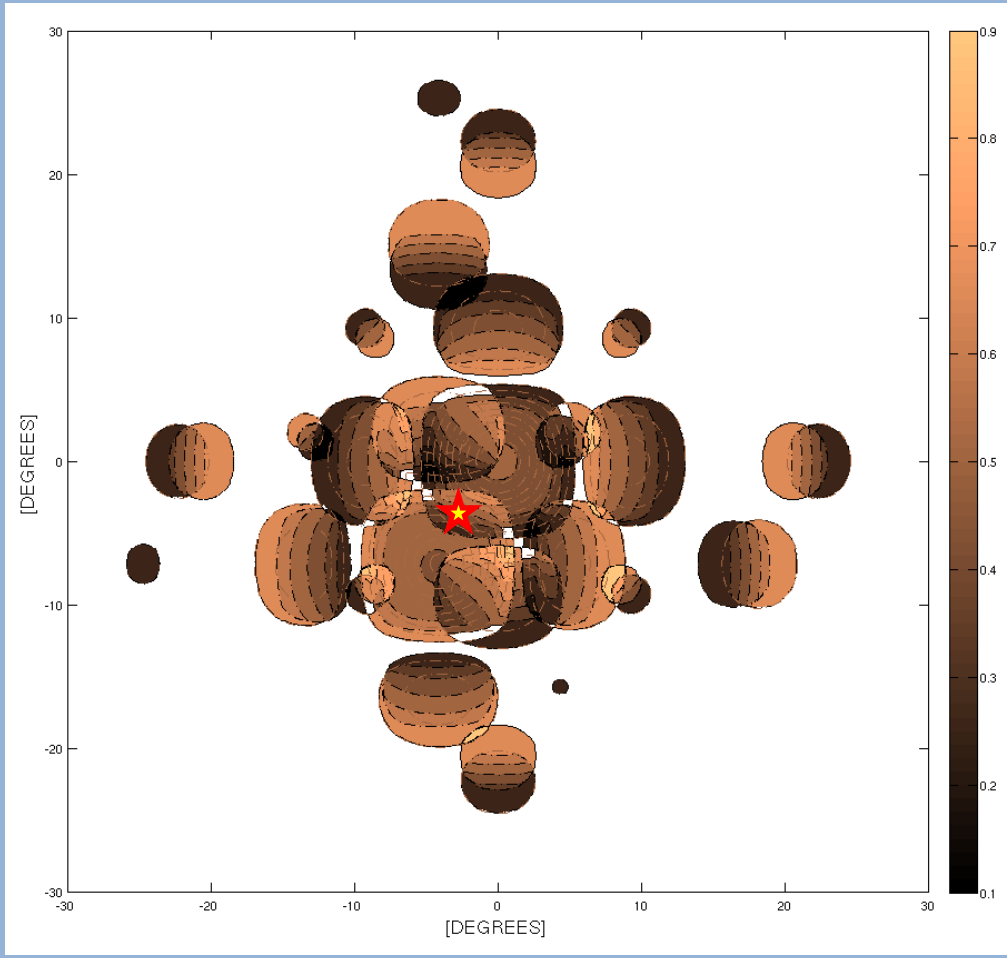
Overlapping beams Sensitivity maps



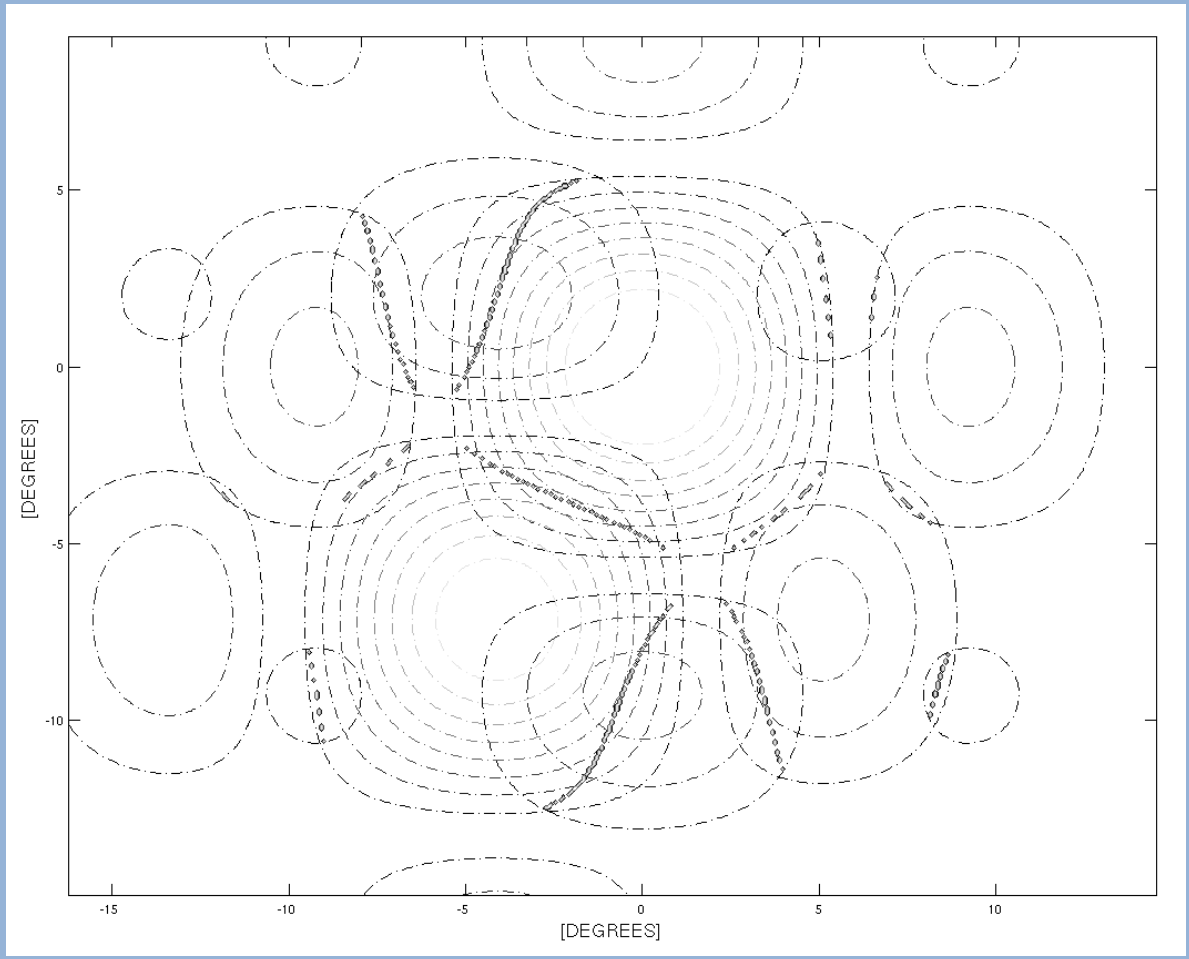
Flux density ratio map (FDR)



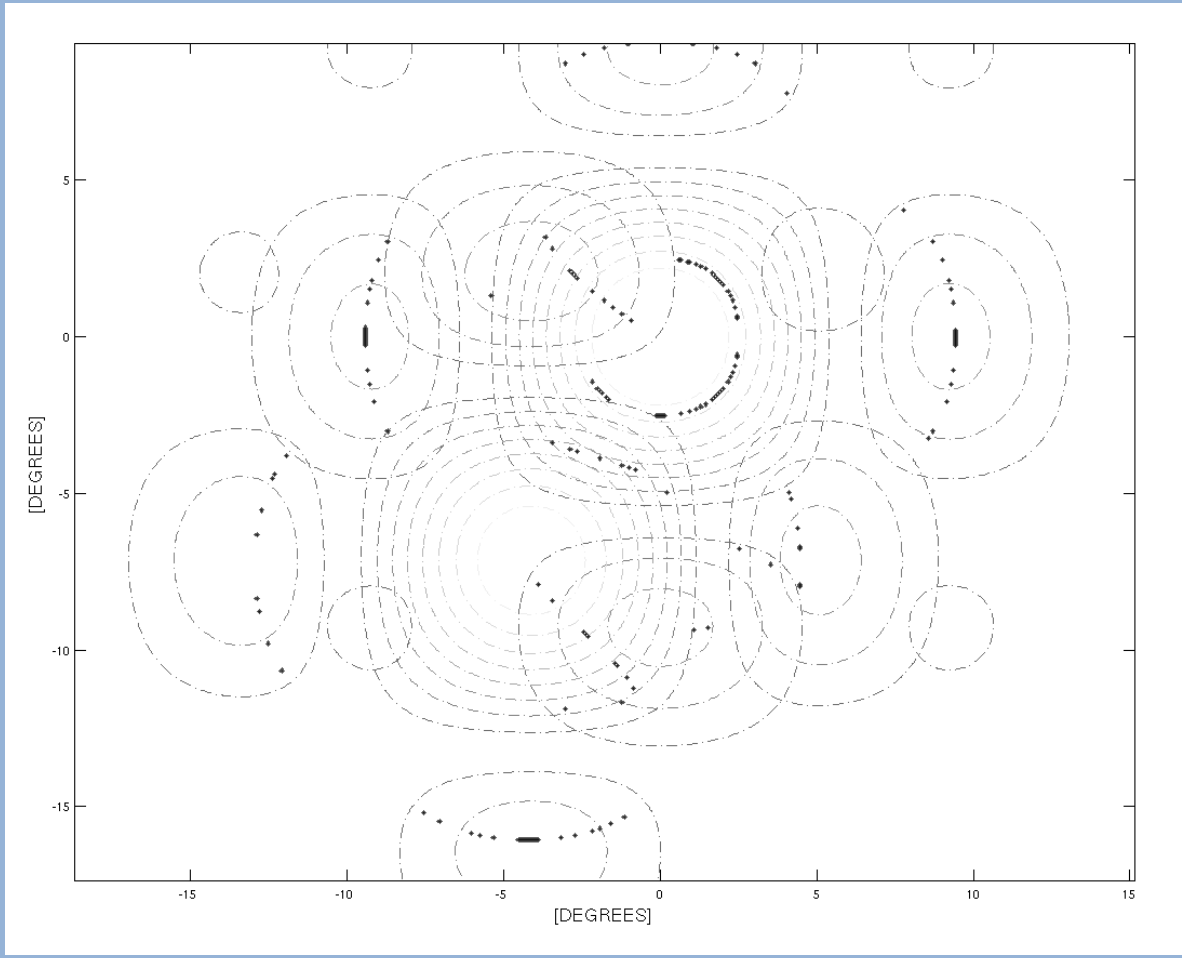
Differential spectral index map (DSI)



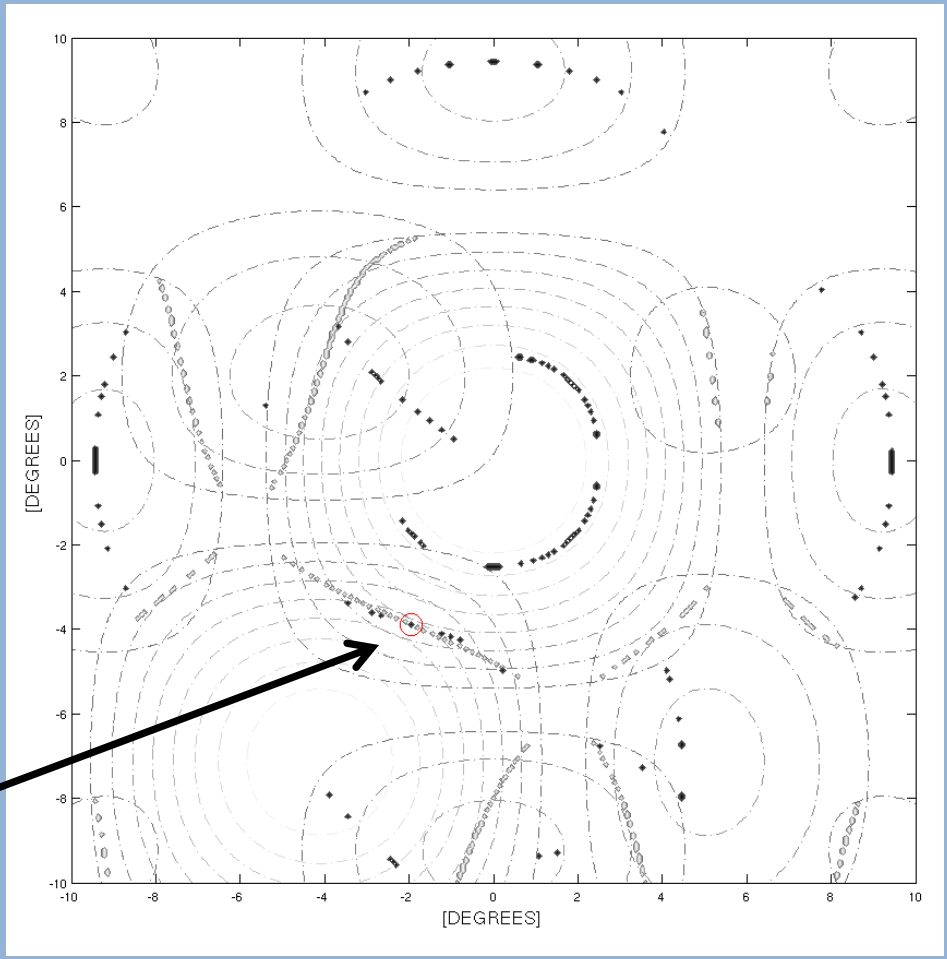
Matching values from the FDR map



Matching values from the DSI map



Putting it all together



Caveats

- We know the beam shape very well;
- We assume that the bandwidth is flat (no scintillation);
- Transient events are very short (neglect the Earth's movement).

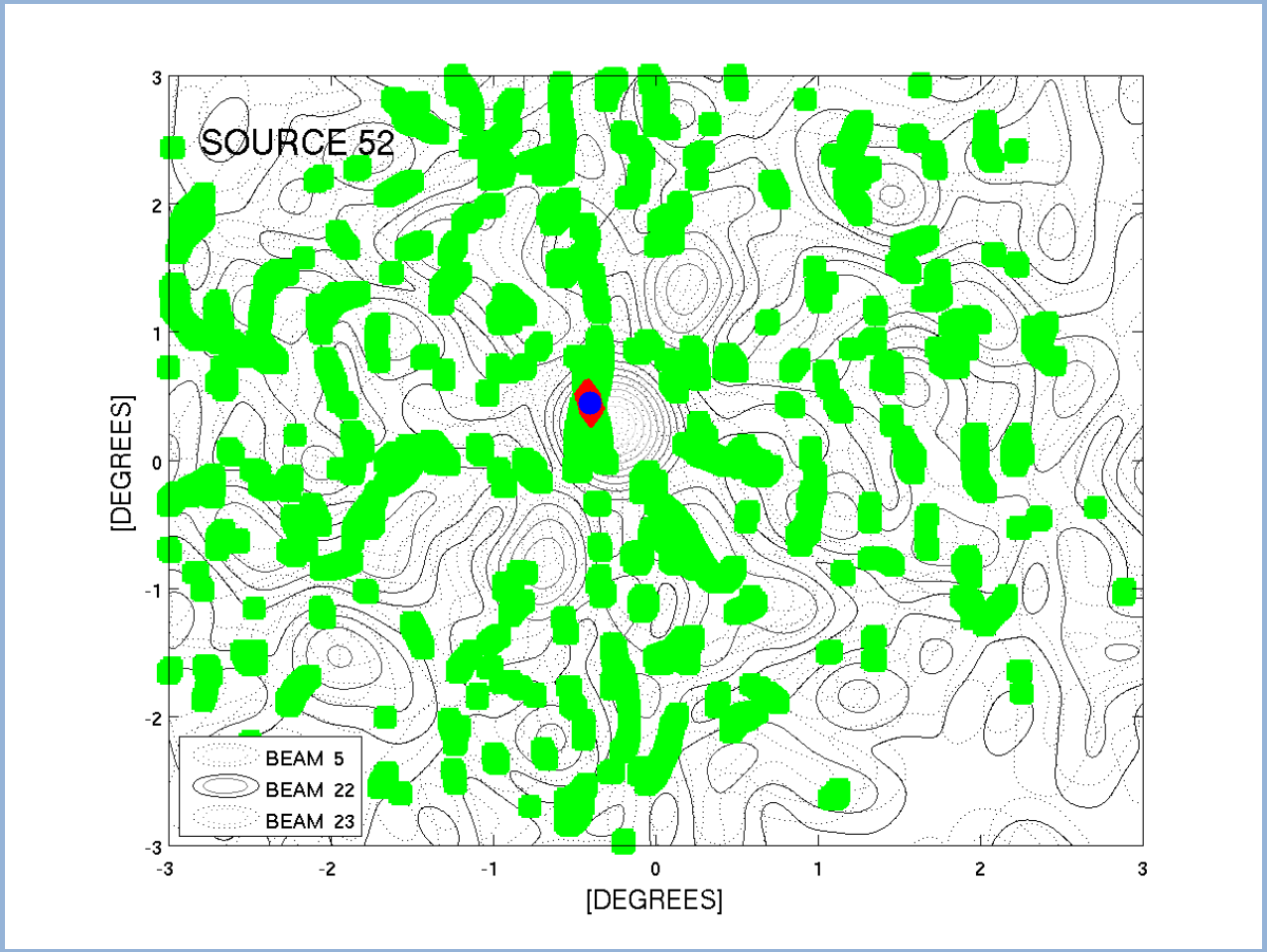
Paper (in preparation)

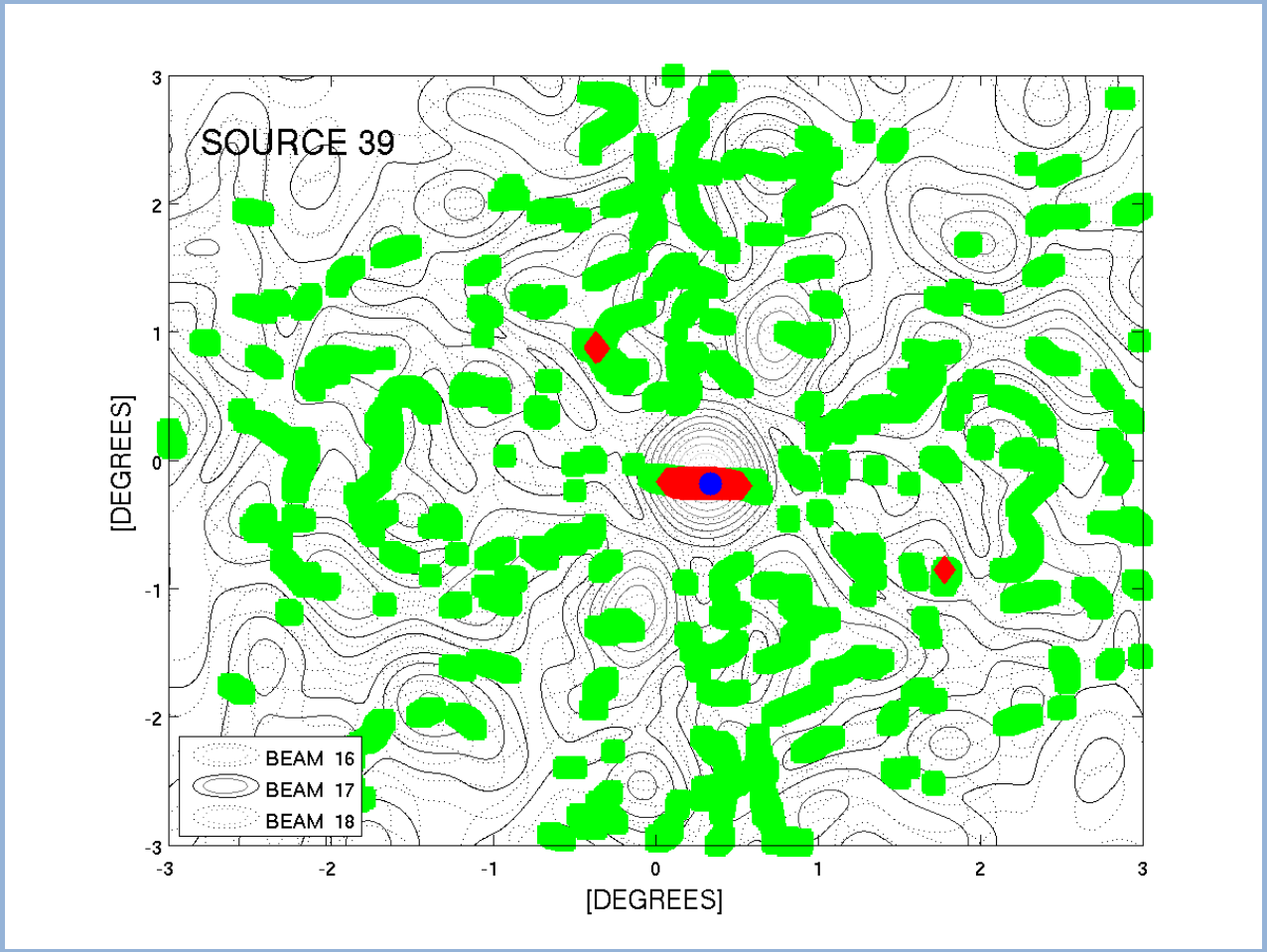
- Methodology (in detail);
- Results of the simulations for the MUST, LOFAR and MeerKAT arrays;
  - Intrinsic spectral index recovery;
  - Position accuracy.

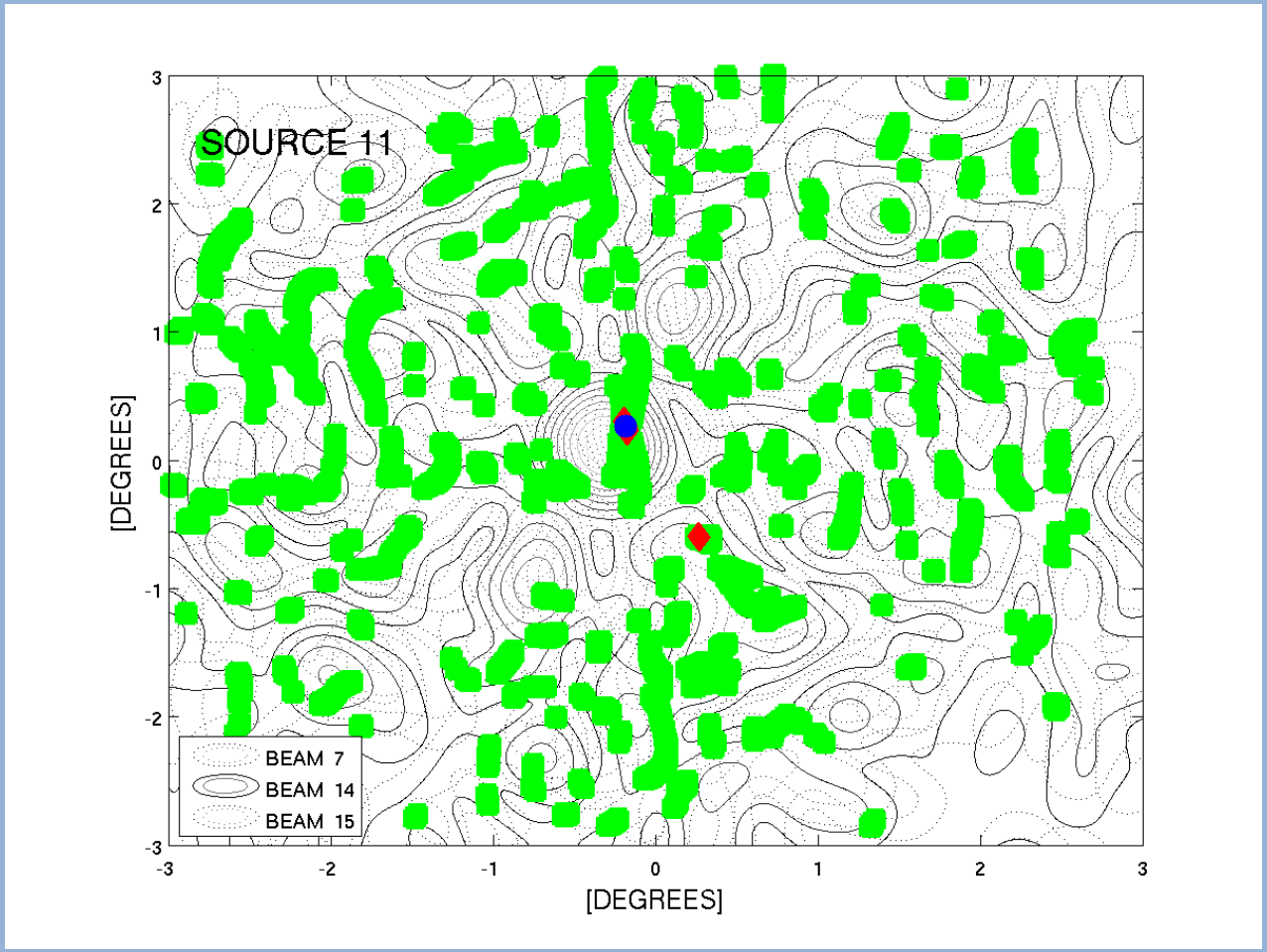
Even more details in PhD dissertation

Additional slides

Example detection (LOFAR)




SOURCE 39
BEAM 16
BEAM 17
BEAM 18
[DEGREES]
[DEGREES]
3
2
1
0
-1
-2
-3
-3
-2
-1
0
1
2
3


SOURCE 11
BEAM 7
BEAM 14
BEAM 15
[DEGREES]
[DEGREES]
3
2
1
0
-1
-2
-3
-3
-2
-1
0
1
2
3