



CAASTRO
ARC CENTRE OF EXCELLENCE
FOR ALL-SKY ASTROPHYSICS

THE UNIVERSITY OF
MELBOURNE



The effects of positional precision in foreground subtraction

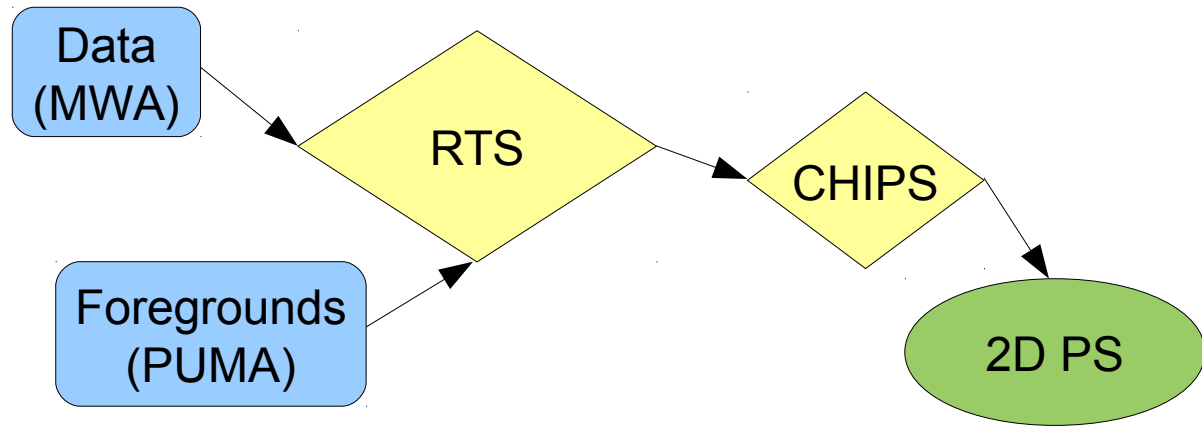
J. Line and the MWA EoR Team



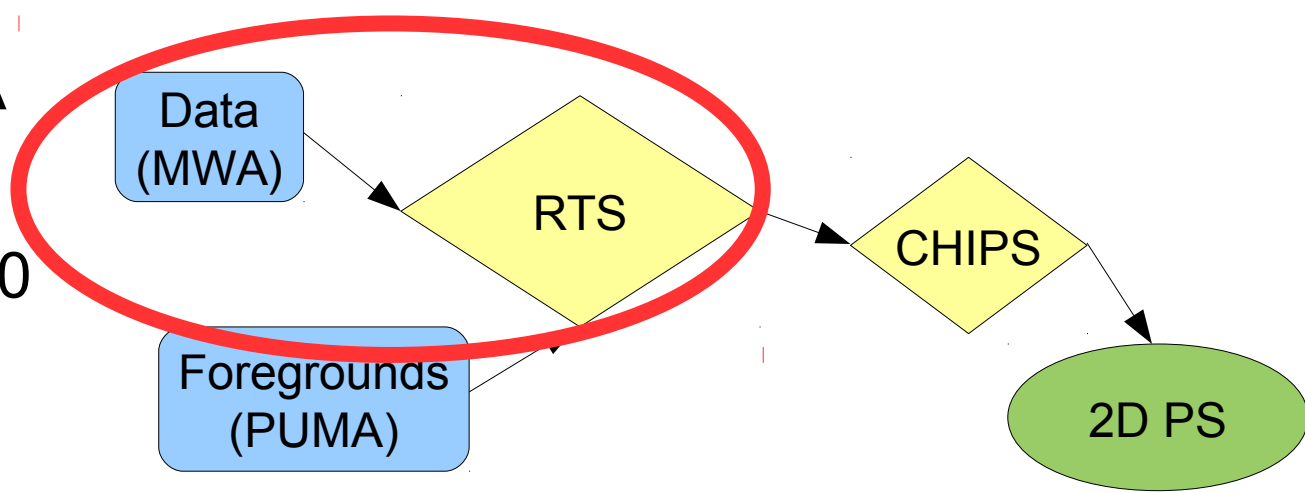
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- › Data out of MWA
 - 2s, 40kHz resolution
- › Calibrate with 300 sources
- › Subtract 1000 sources
- › 2D power spectrum for quality control

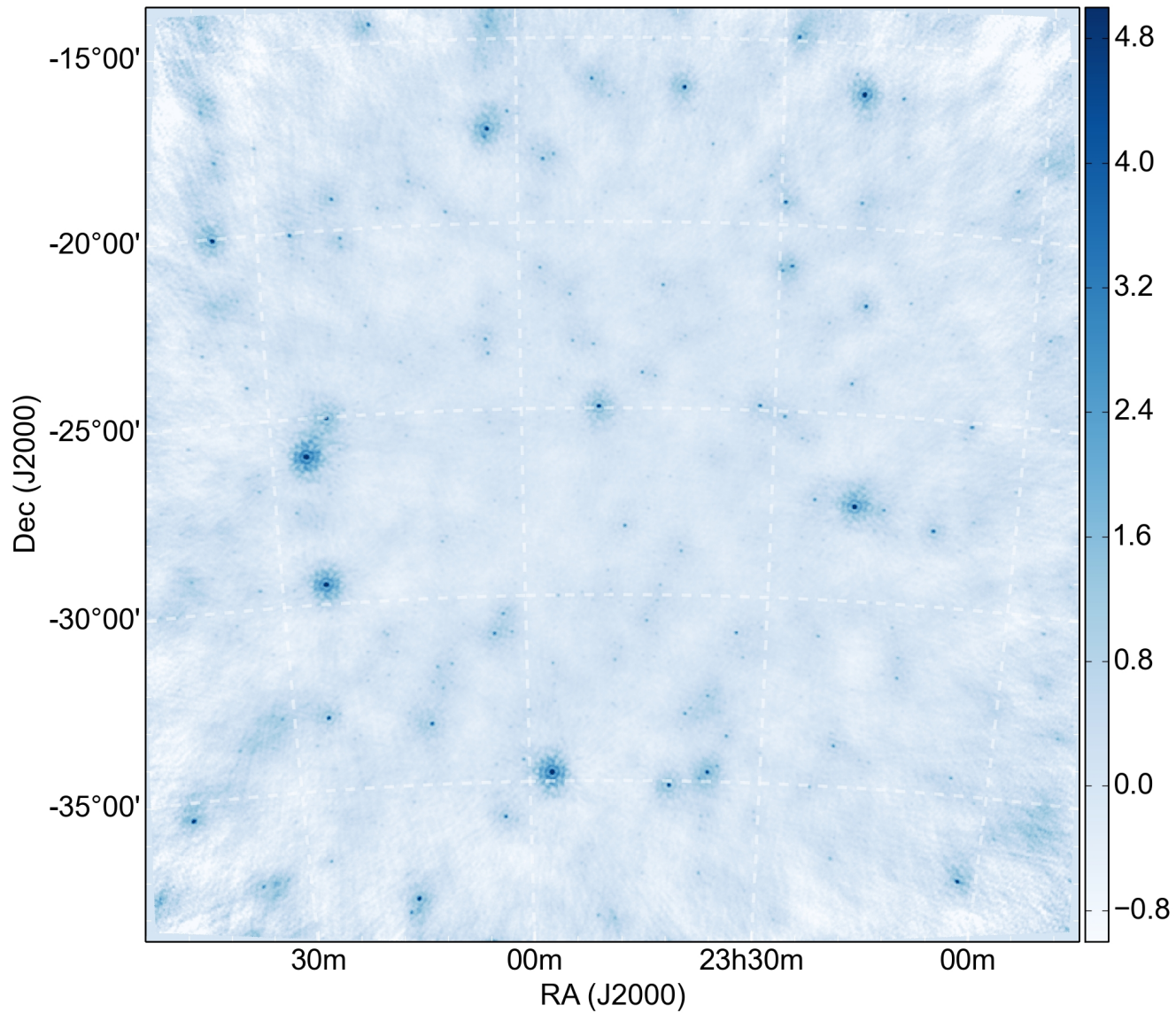


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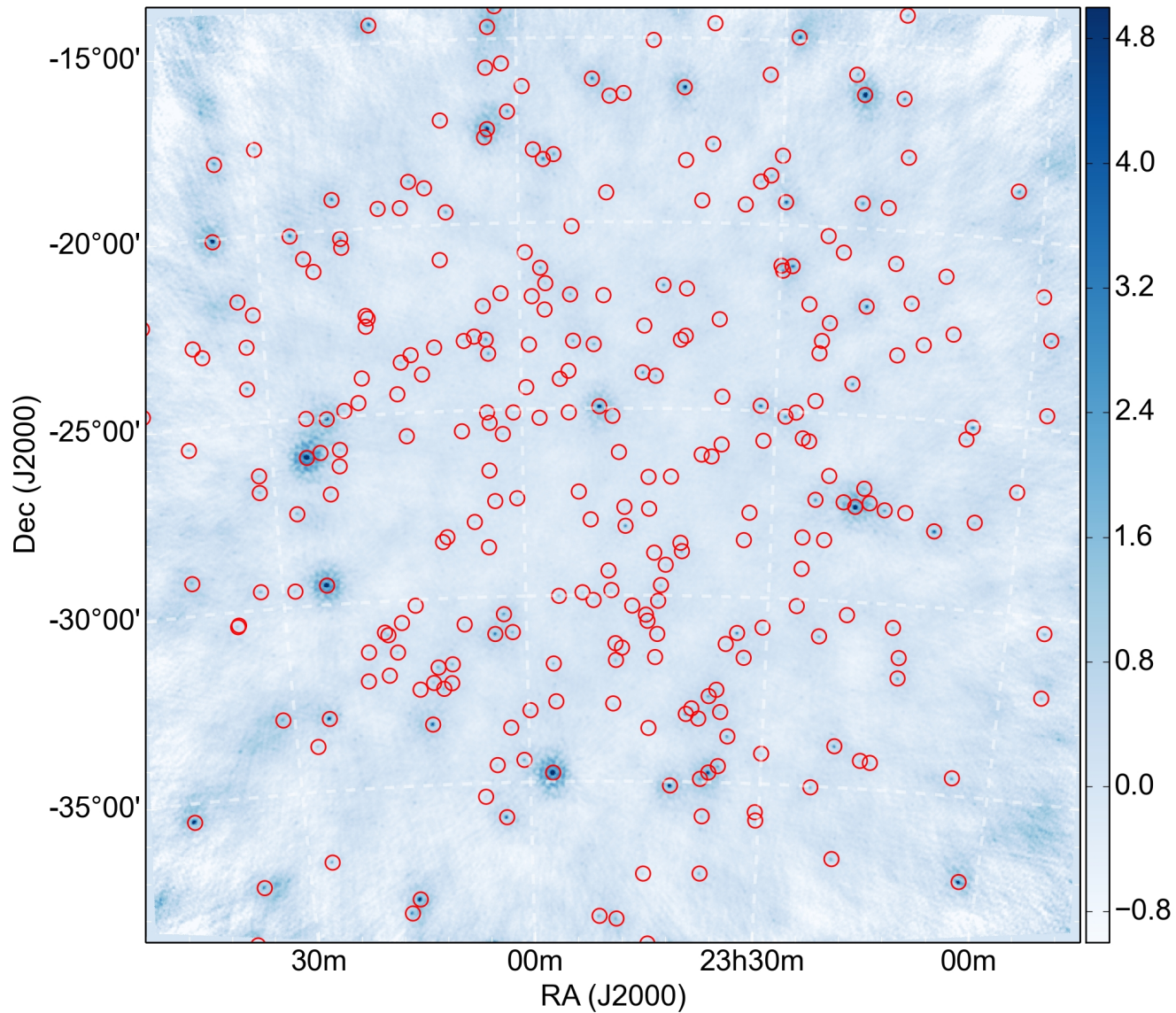
Aus EoR Pipeline



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Calibration and Peeling

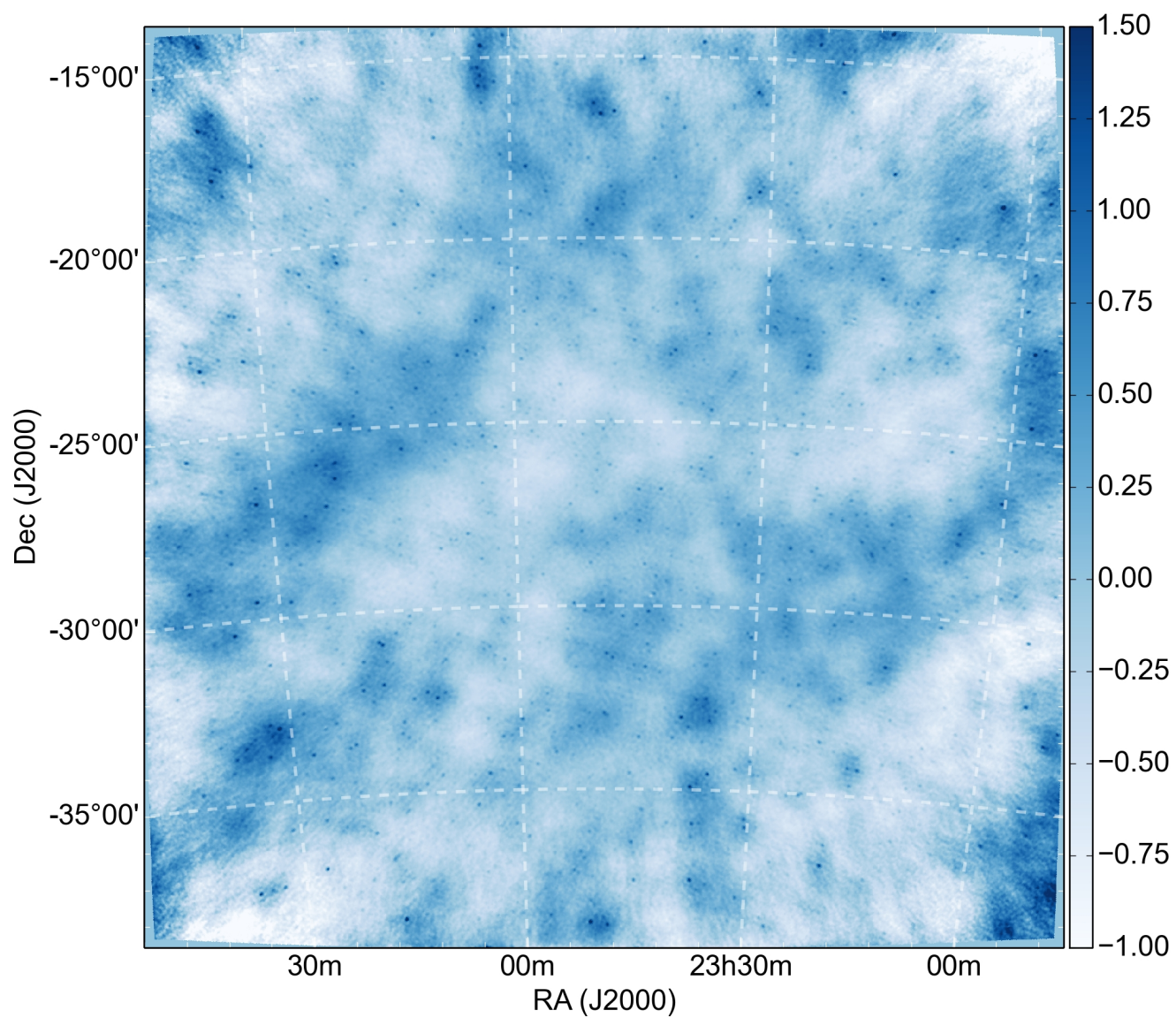




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Calibration and Peeling

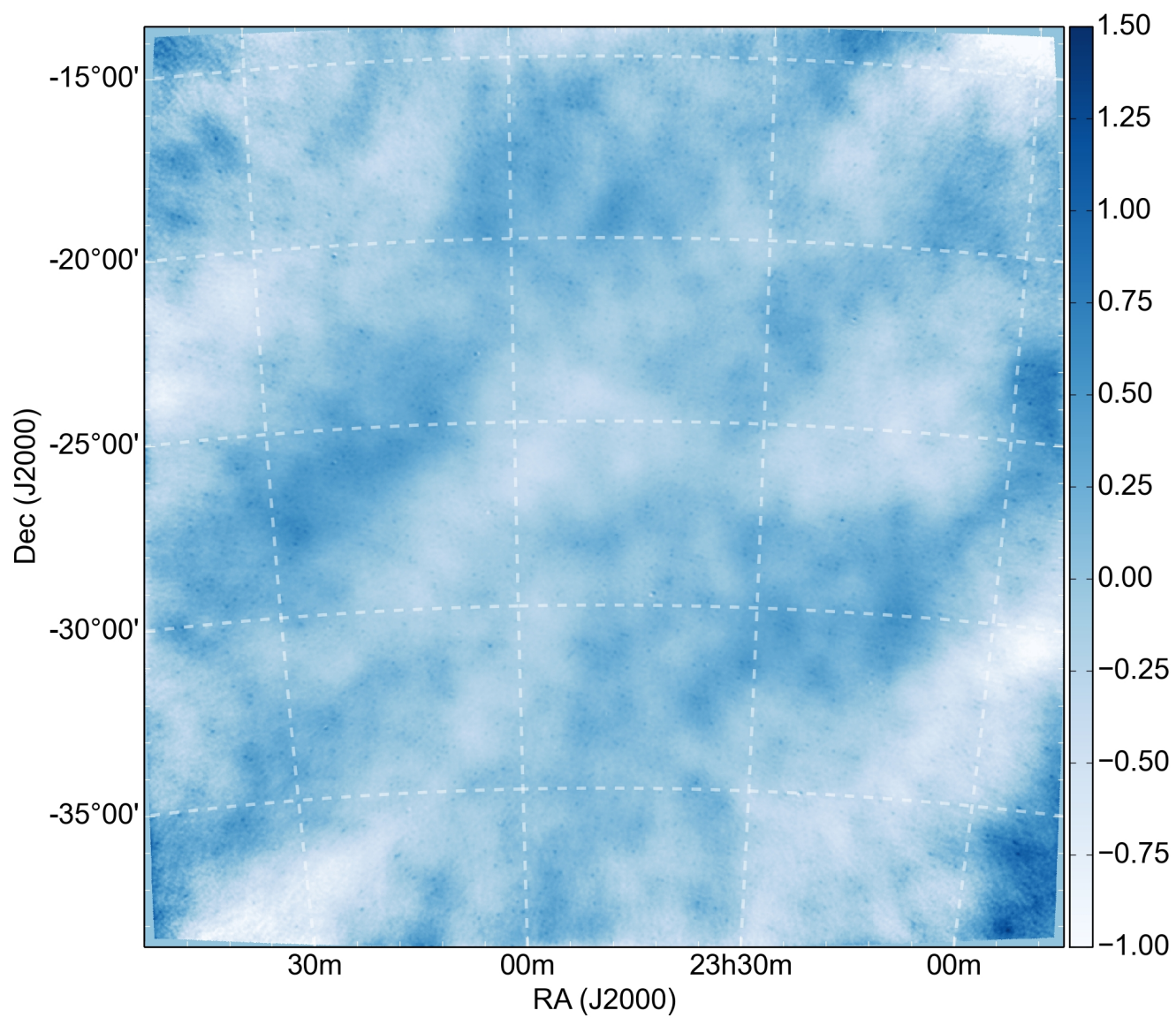




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100 sources peeled



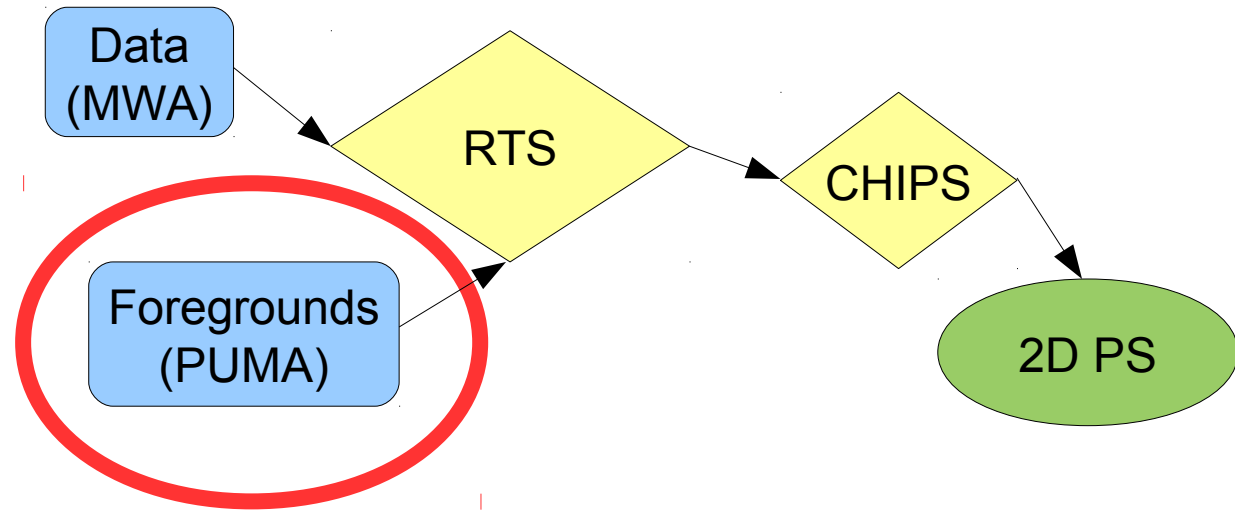


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1000 sources peeled



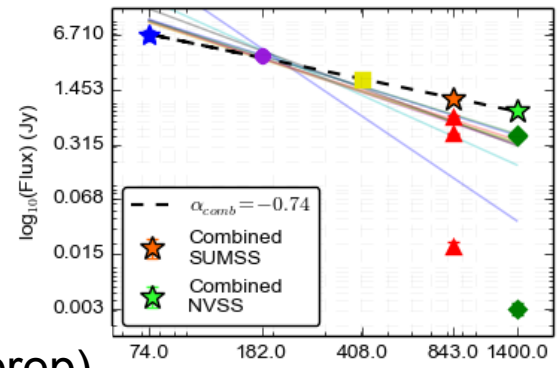
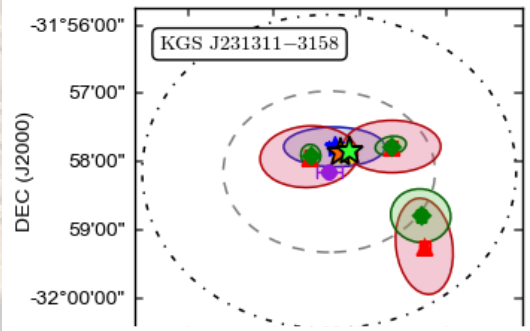
- › Data out of MWA
 - 2s, 40kHz resolution
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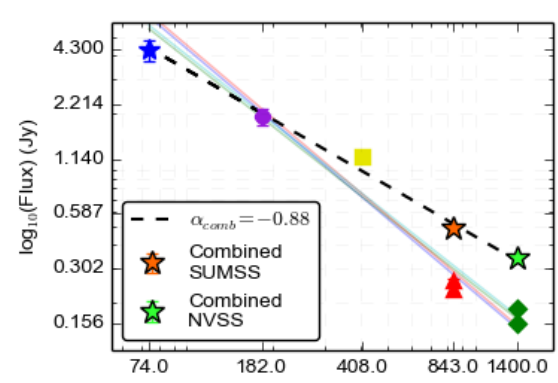
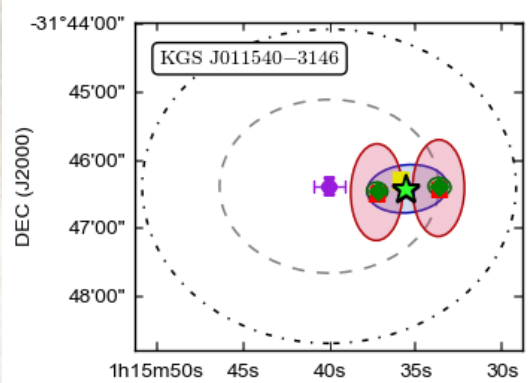
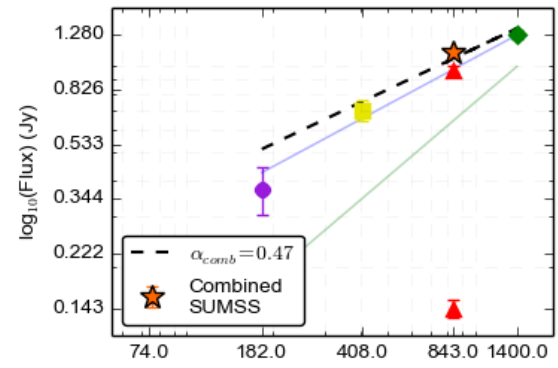
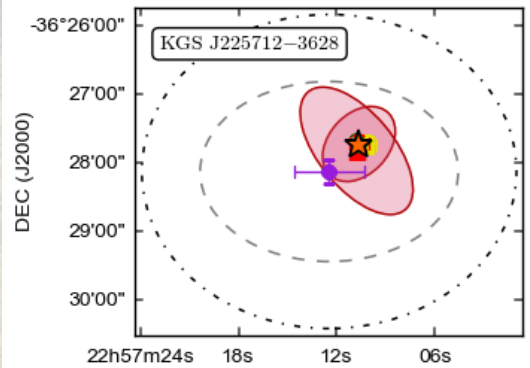
> Custom built radio-frequency cross matcher

> Uses bayesian positional probability calculation (Budavari and Szalay 2008) combined with spectral information

> Leverage higher frequencies for resolution and ionospheric conditions



(Carroll, Line, et al. in prep)



Search radius

Resolution + error

VLSSr (74MHz)

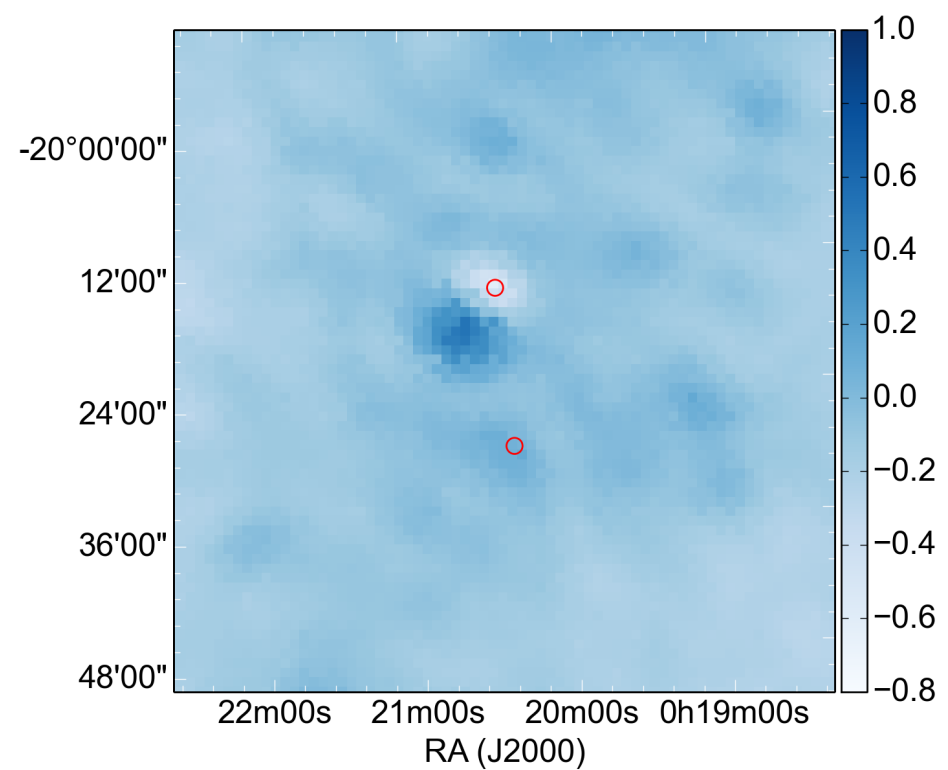
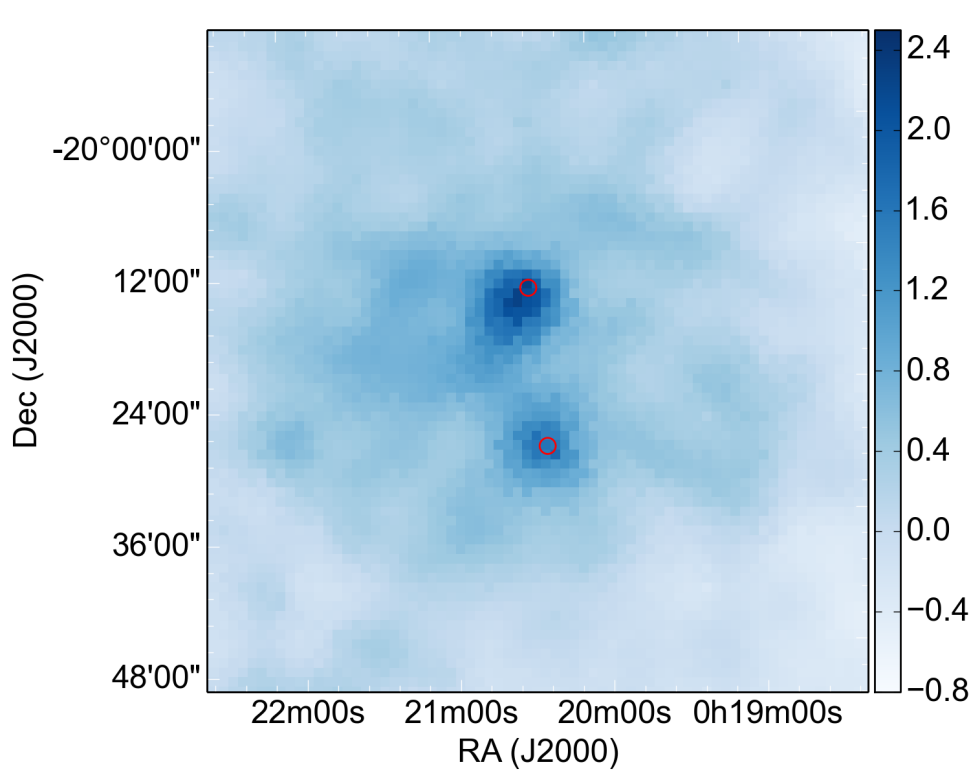
KGS (182MHz)

MRC (408MHz)

SUMSS (843MHz)

NVSS (1400MHz)





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Need for precision?

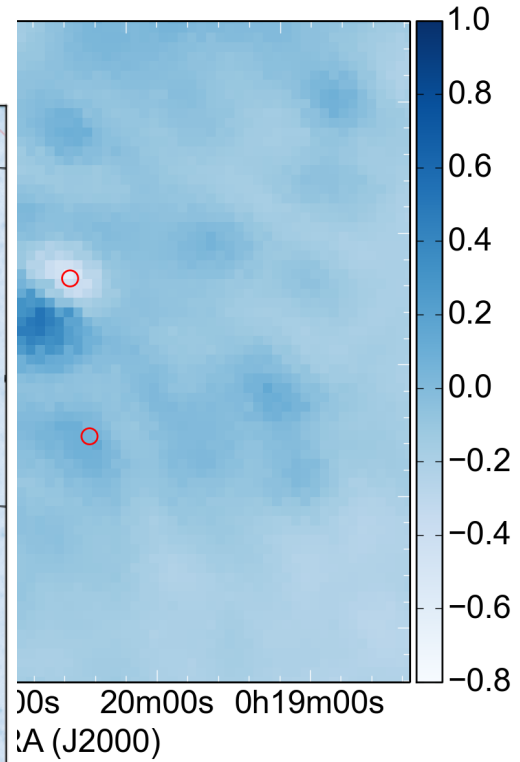
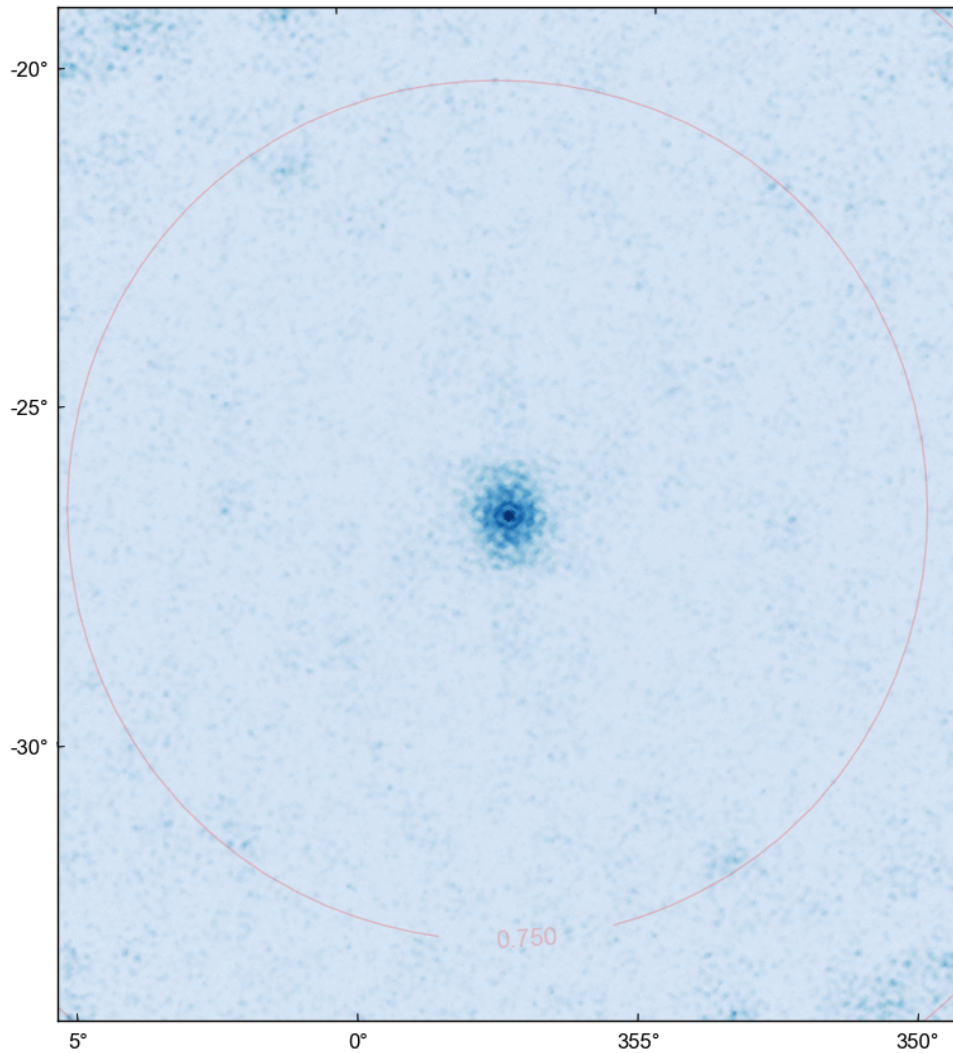


167.675MHz

Dec (J2000)

-20°00'00"
12'00"
24'00"
36'00"
48'00"

22m00s 21

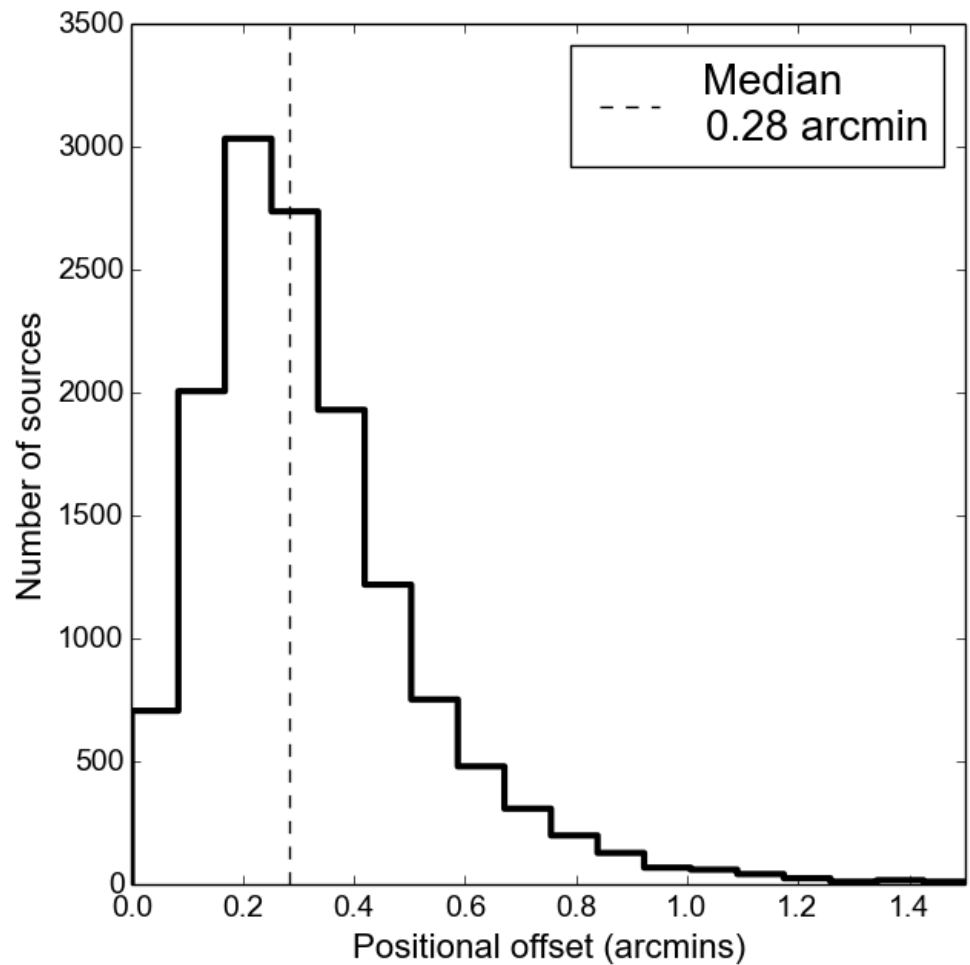


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Need for precision?



- › Cross matching MWACS (180MHz) to VLSSr (74MHz), MRC (408MHz), SUMSS (843MHz), NVSS (1400MHz)
- › Use matched SUMSS or NVSS positions
- › How to test these effects on power spectrum?



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PUMA positional corrections



- › Visibility generator designed for SKA simulations
- › Capable of simulating large aperture arrays with multi-source sky models
- › GPU accelerated so runs in realistic times

The OSKAR Simulator

Current Version (2.6.1)

Last updated: 2015-06-24

Documentation

1. [OSKAR-Introduction.pdf](#)
2. [OSKAR-Release-Notes.pdf](#)
3. [OSKAR-Install.pdf](#)
4. [OSKAR-Example.pdf](#)
5. [OSKAR-Theory.pdf](#)
6. [OSKAR-Apps.pdf](#)
7. [OSKAR-Sky-Model.pdf](#)
8. [OSKAR-Telescope-Model.pdf](#)
9. [OSKAR-Pointing-File.pdf](#)
10. [OSKAR-Settings.pdf](#)
11. [OSKAR-Binary-File-Format.pdf](#)

Source Code

- [OSKAR-Source.zip](#)

Example Data

- [OSKAR-Example-Data.zip](#)

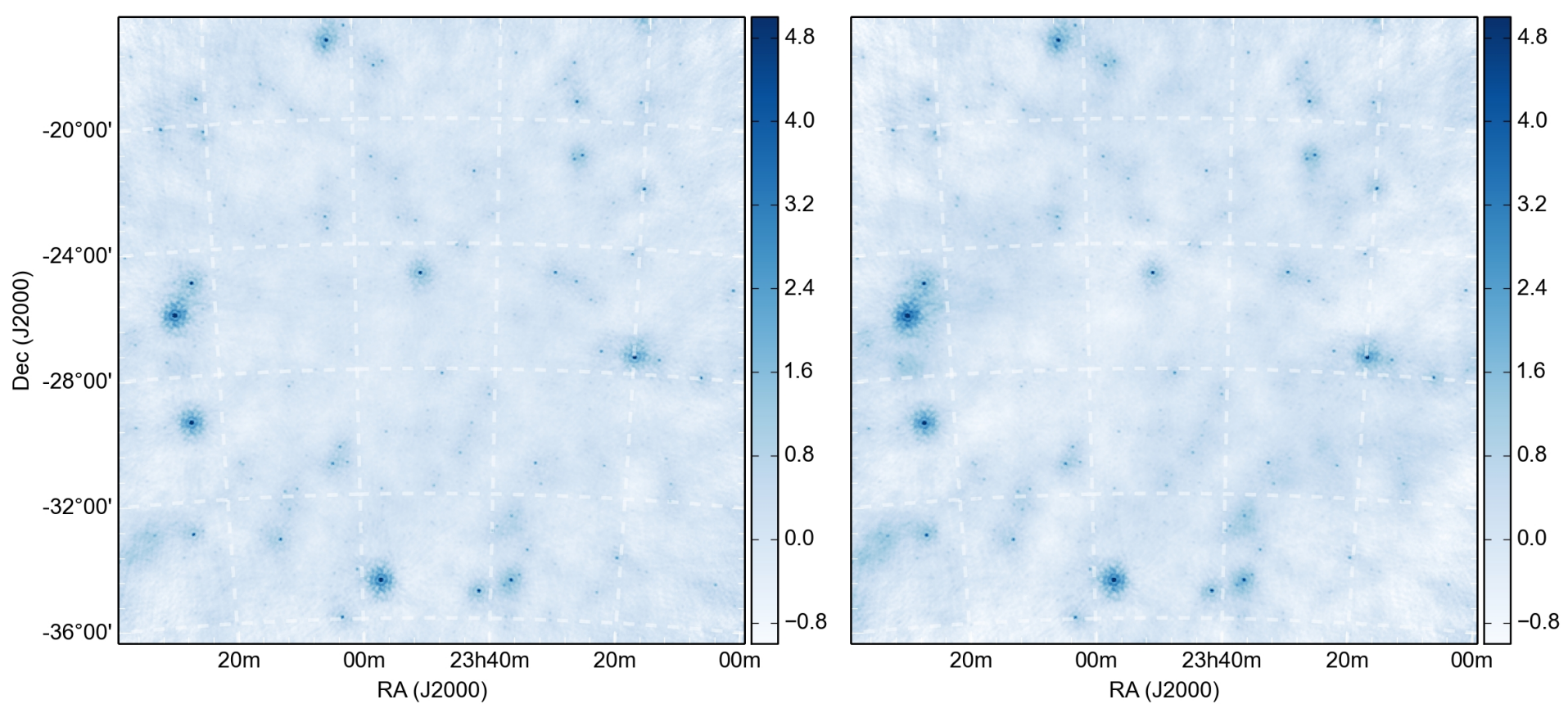




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Hacking.com

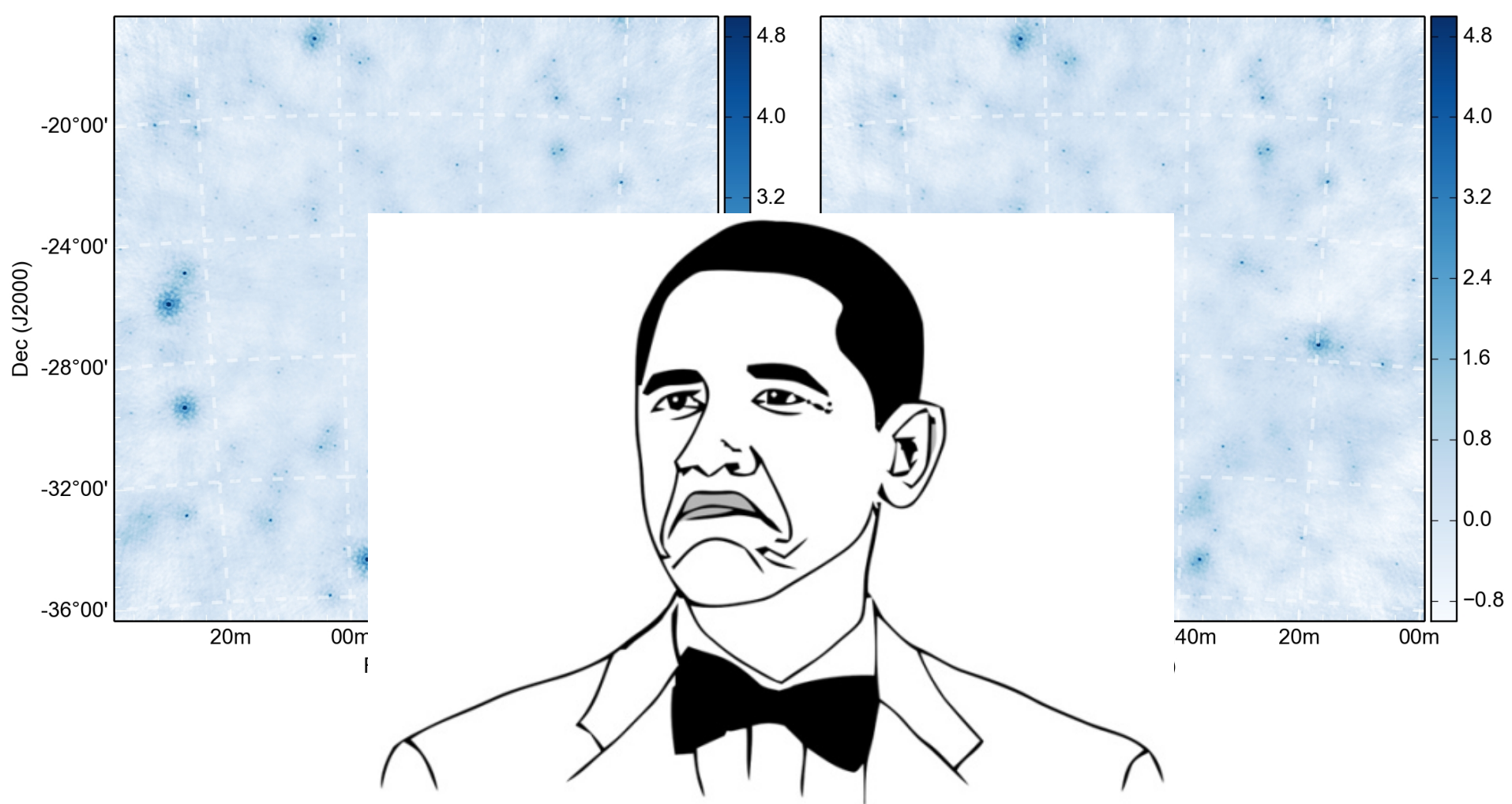




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Does it work?





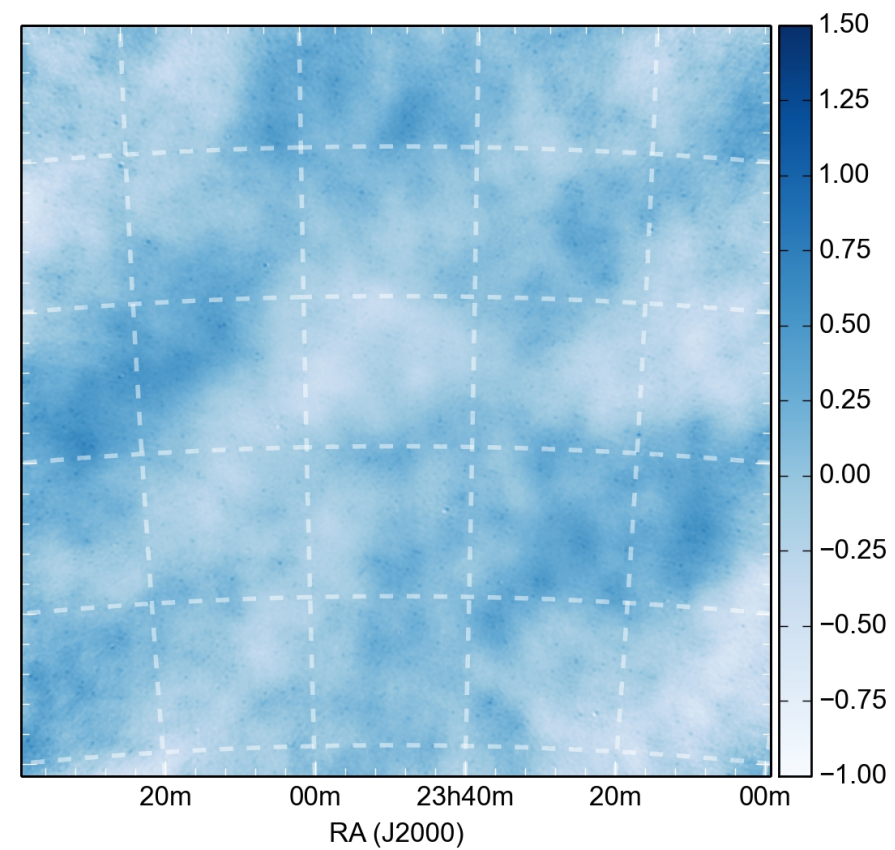
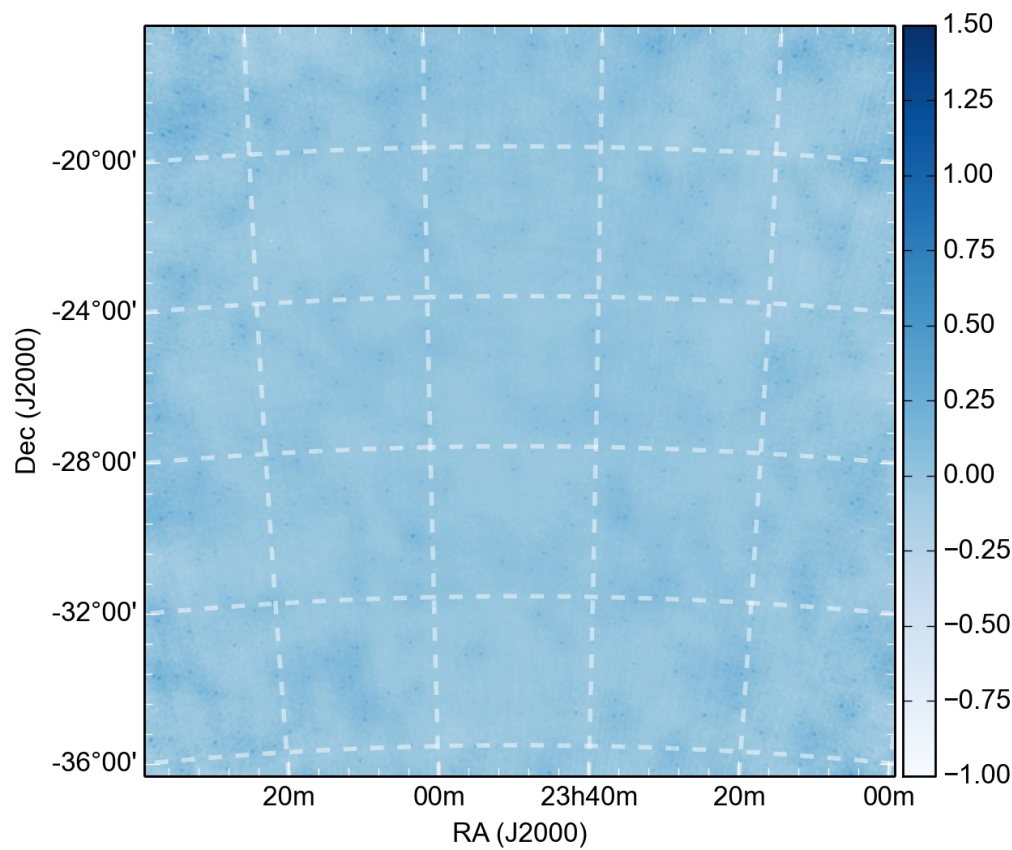
NOT BAD



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Does it work?



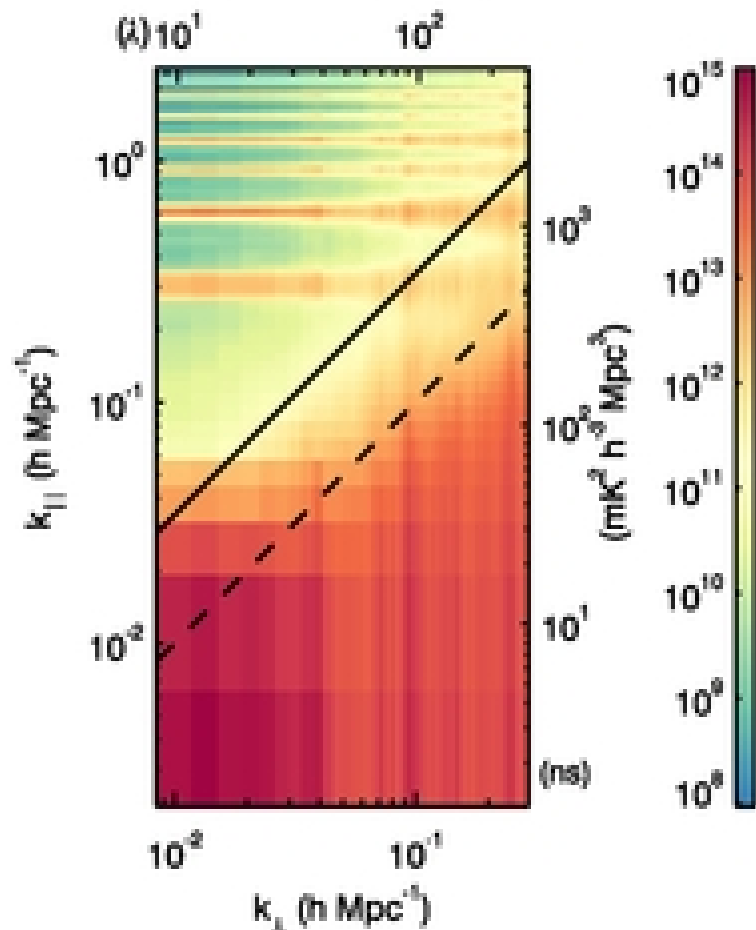


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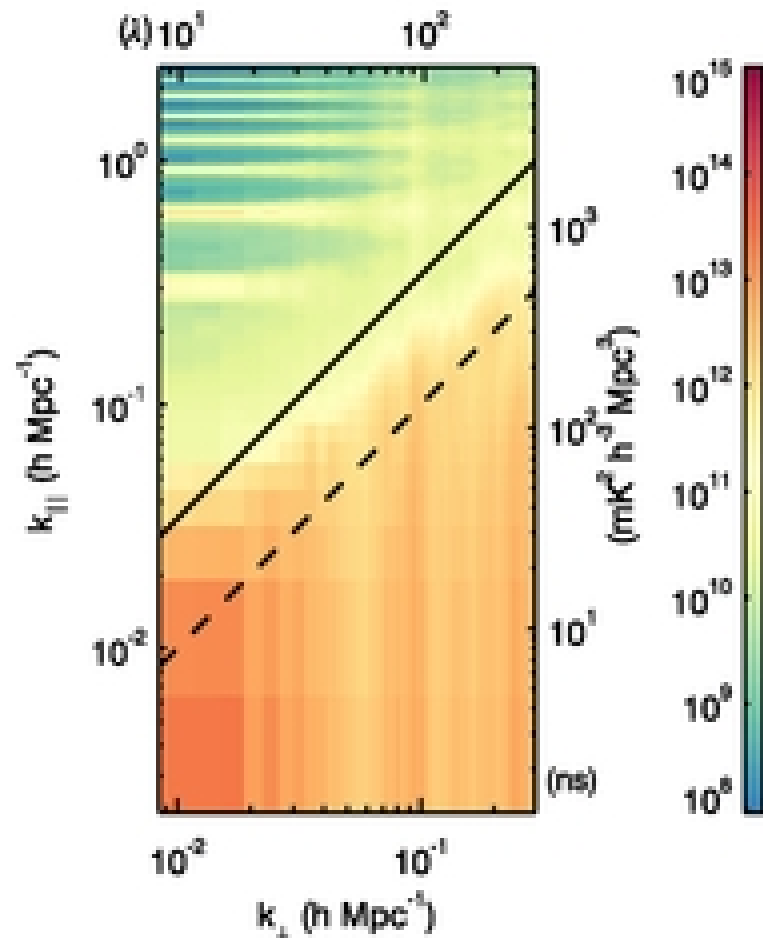
OSKAR vs MWA - 1000 peel



sim EoR0 p0 P_k



sim EoR0 p1000 P_k



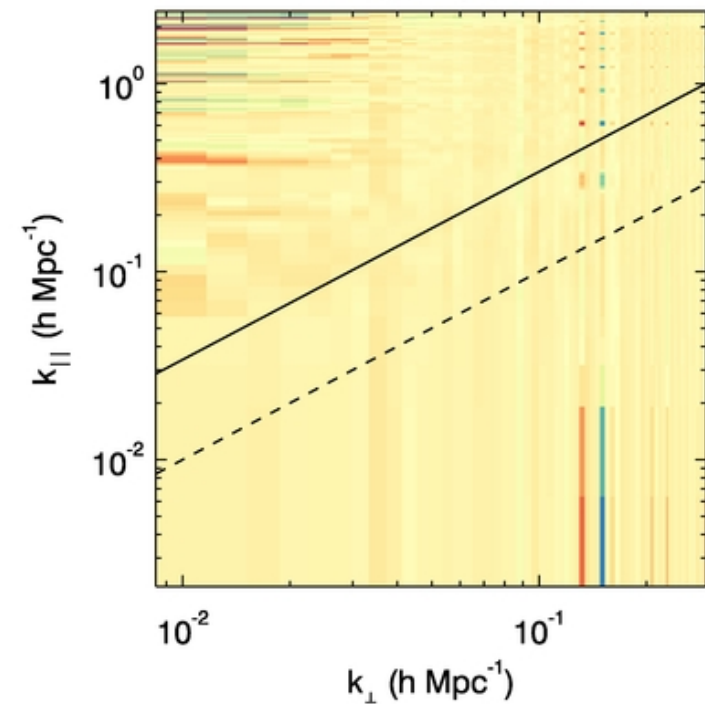
CAASTRO
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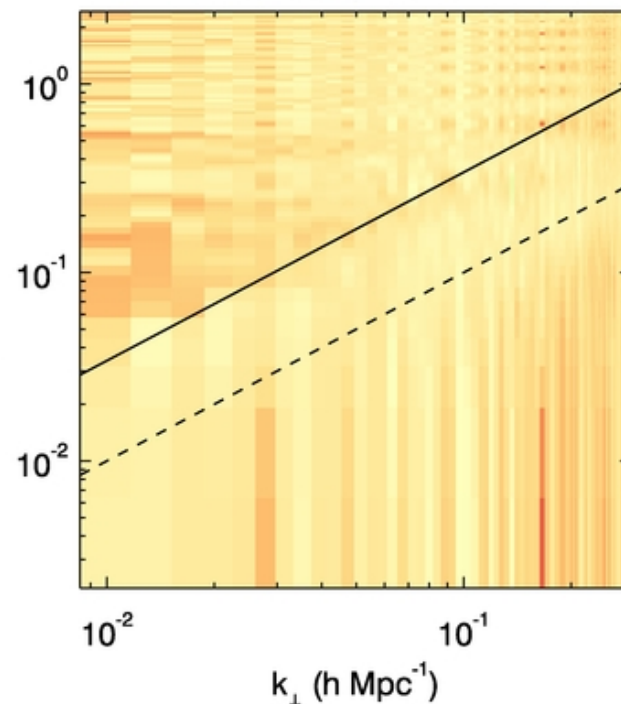
Power Spectrum



Ratio p0

Ratio p1000


 κ_{\parallel} (n Mpc 3)

 10^0
 κ_{\parallel} (n Mpc 3)

 κ_{\parallel} (n Mpc 3)

 10^0

- › Ratio of positionally exact calibration/peeling to slightly offset calibration/peeling catalogues
- › 10 minutes of data – need more!



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Positional Differences

- › If you need to cross match, consider PUMA (<https://github.com/JLBLLine/PUMA>)
- › OSKAR is an effective way to simulate MWA visibilities
- › Next steps:
 - Include diffuse emission
 - Include an actual EoR signal
 - Use a proper primary beam model
- › Need to generate far more data to be sure of calibration / peeling differences due to source catalogues...



› If you need to cross match, consider PUMA
(<https://github.com/JLBLLine/PUMA>)

› OSKAR is an effective

› Next steps:

- Include diffuse emis
- Include an actual Ec
- Use a proper primar

› Need to generate far
differences due to so

**SIMULATE ALL THE
VISIBILITIES**



memegenerator.net



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Conclusions



Backup Slides



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◆ 1326.0
 ◆ J232102-162306
 ◆ 2318-166
 ◆ 232102-162305

Search radius

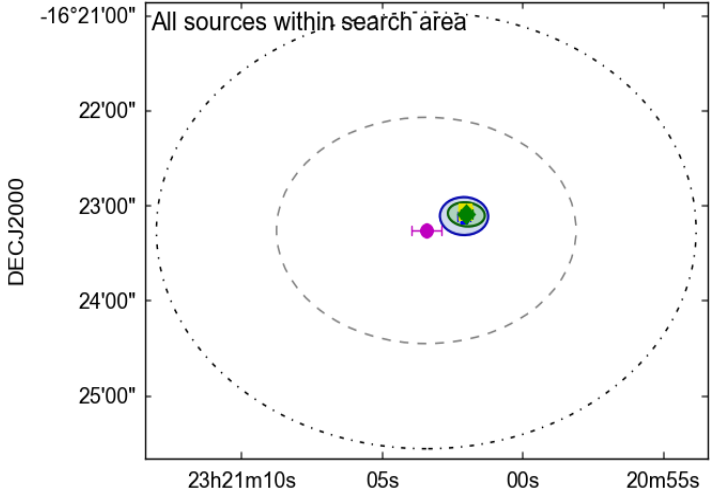
Resolution + error

vlsr

mrc

nvss

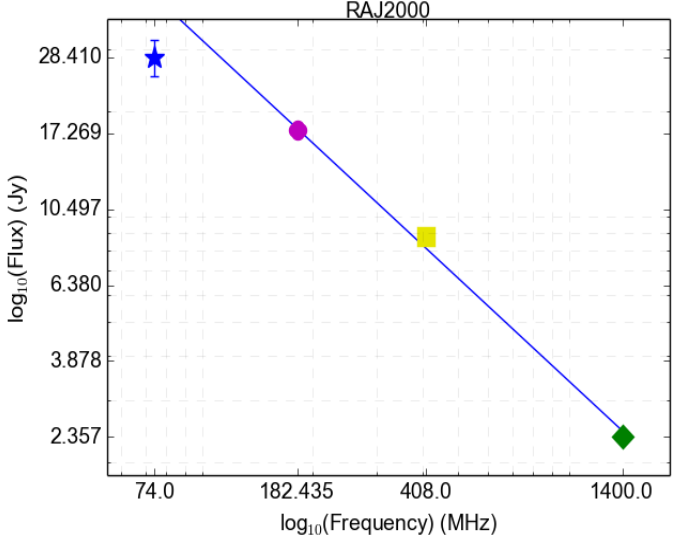
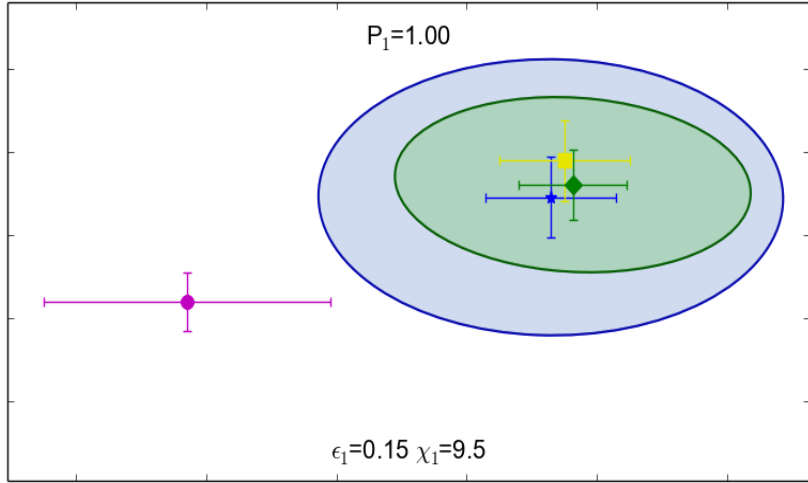
comp_v11



Match Criteria:
 Combination (1)
 possible
 0 repeated cats

Dominance Test:
 N/A

Outcome:
 Pos. accepted
 by $P > P_u$



Search radius

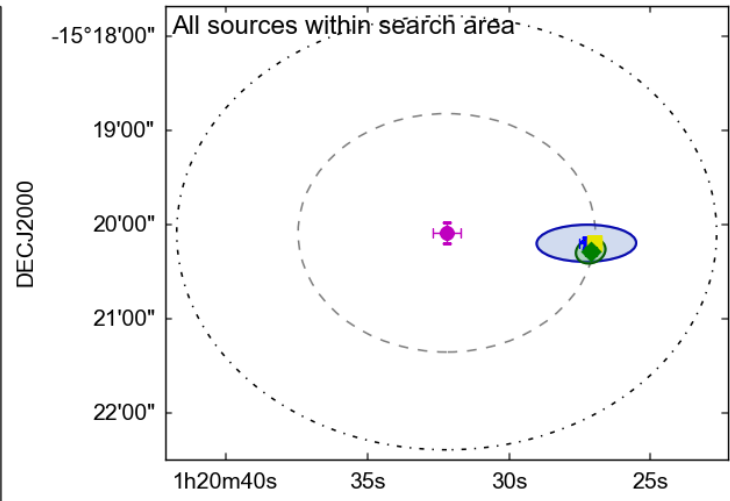
Resolution + error

vlsr

mrc

nvss

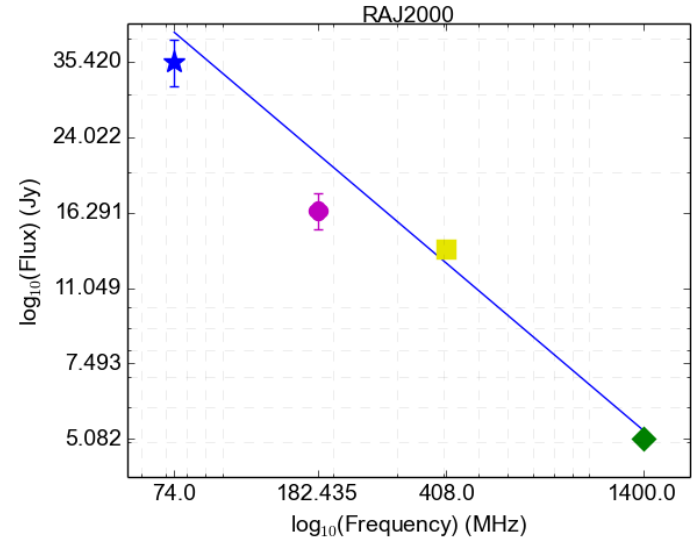
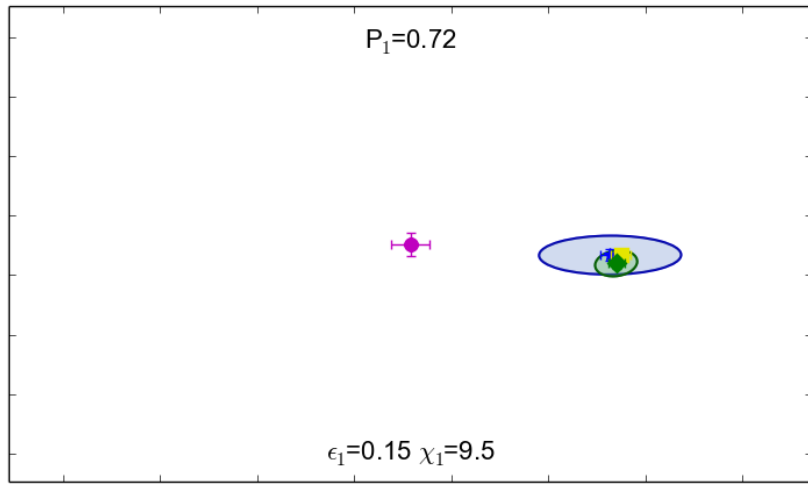
comp_v11



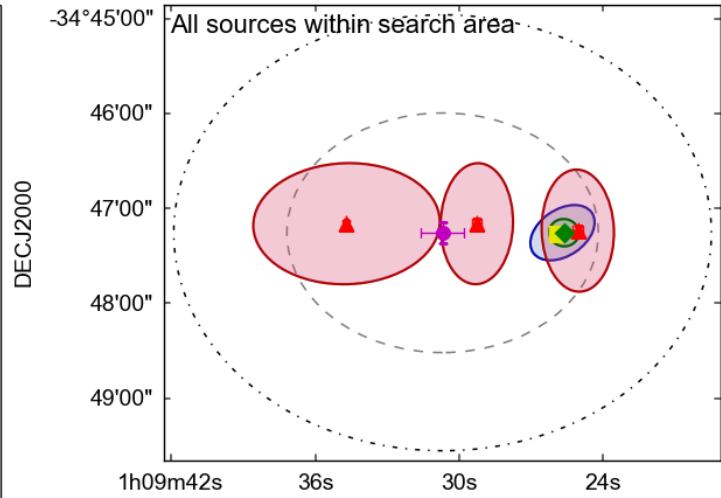
Match Criteria:
 Combination (1)
 possible
 0 repeated cats

Dominance Test:
 Spec. passed

Outcome:
 Accept by spec



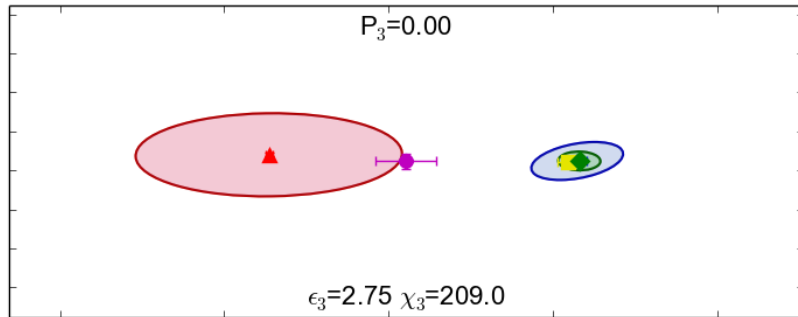
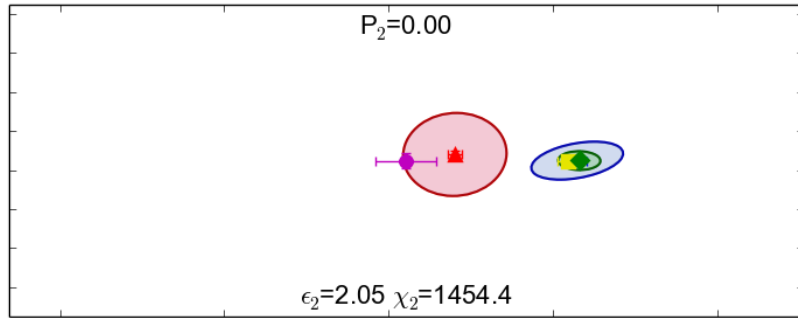
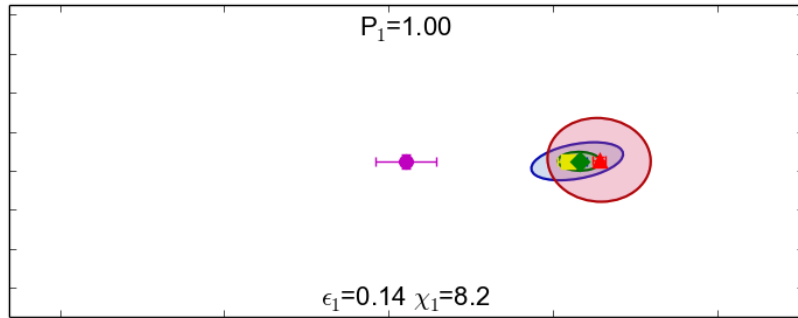
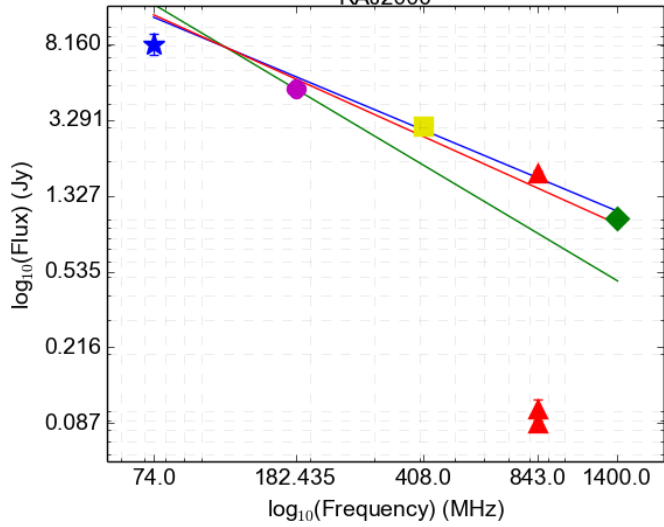
- Search radius
- Resolution + error
- vlsr
- sumss
- mrc
- nvss
- comp_v11

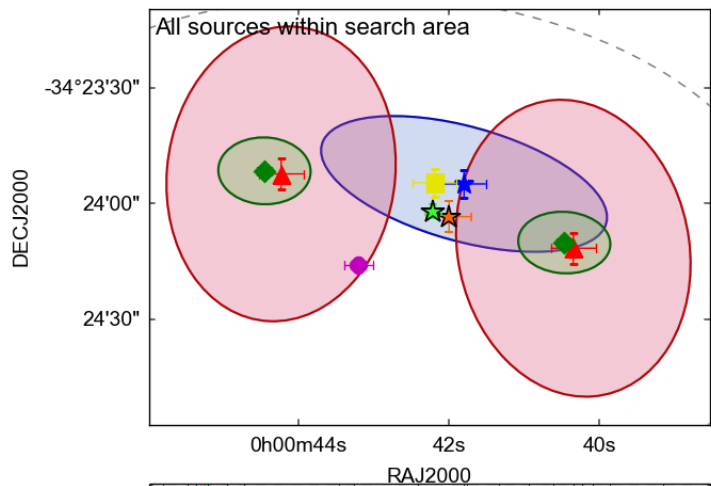
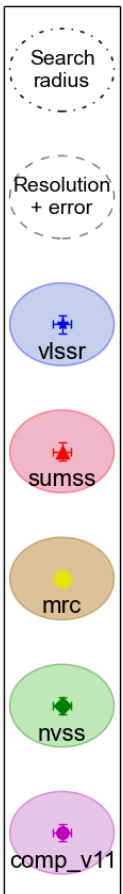


Match Criteria:
3 of 3 combinations possible
1 repeated cats

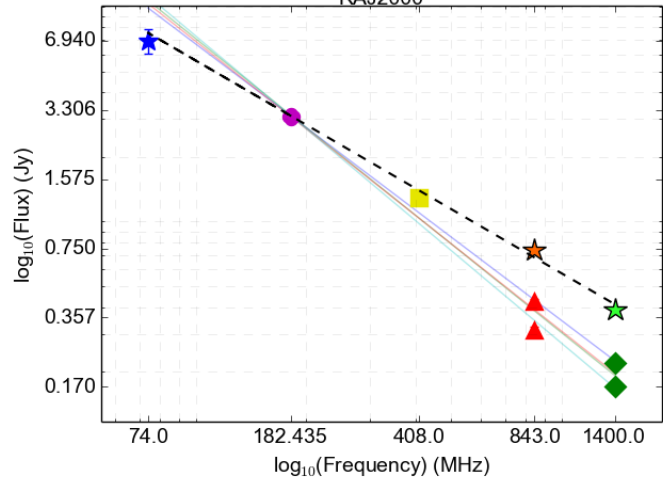
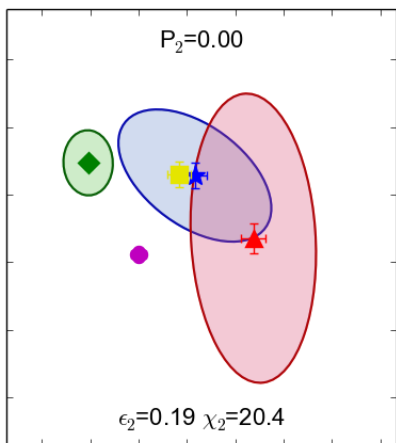
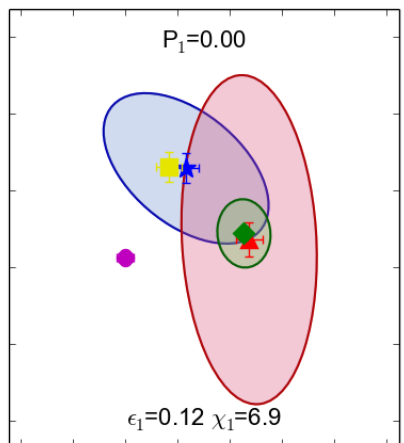
Dominance Test:
Dom source (1)

Outcome:
Accept dom. source

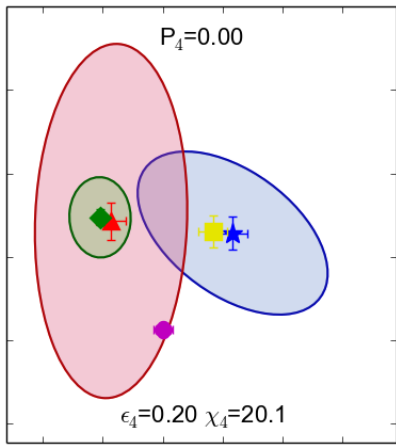
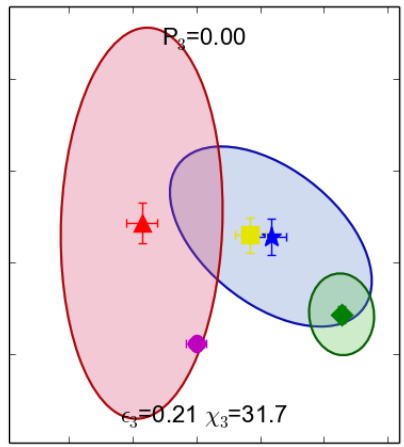




Match Criteria:
 4 of 4 combinations possible
 2 repeated cats
 Dominance Test:
 No dom. source
 Outcome:
 Accepted - combined



$\alpha_1 = -1.29$
 $\alpha_2 = -1.37$
 $\alpha_3 = -1.35$
 $\alpha_4 = -1.43$
 $\alpha_{comb} = -0.99$



KATALOGSS - Carroll et al. 2015, in prep

Match result	Number of matches	Percentage of all sources	Percentage of class modified	Number included in final catalogue
Match < 2.3'	6925	98.86	2.63	6915
No match < 2.3'	80	1.14	22.50	18
Accepted	6842	97.67	1.49	6835
by isolated	5618	80.20	0.39	5611
by dominant	350	5.00	1.14	350
by multiple	874	12.48	8.70	874
Rejected	25	0.36	88.00	22
To investigate	58	0.83	100.00	58
Total included in final catalogue:				6933

