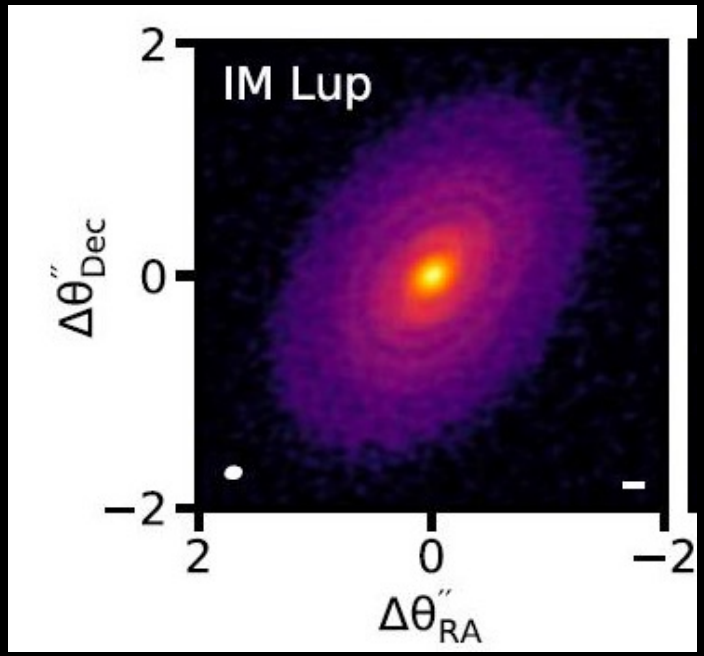
Self-Calibration to IM Lup

행복 3조
김영준, 이남욱, 이은유, 황세연

(지도 : 이석호 박사님)

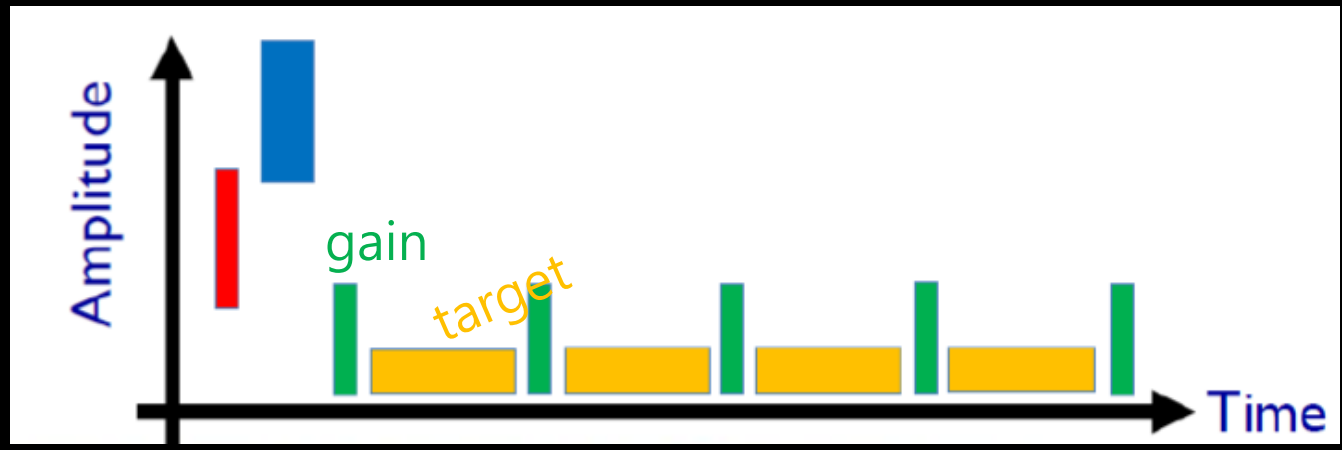


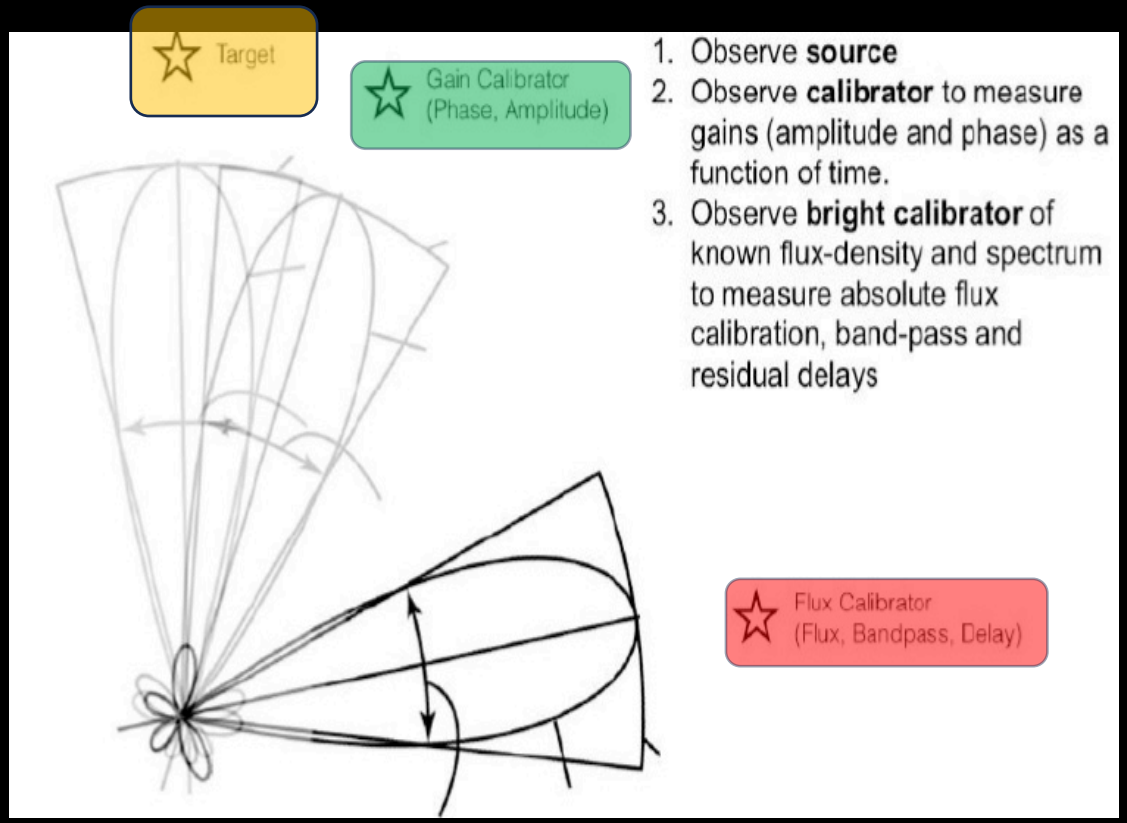
220 GHz Comitinuum image in MAPS

I. Introduction

Self-Calibration : why ?

- Calibration is carried out using the gain calibrator





- Gain = Obs data/ Model

Ex) quasar (point source): phase =0, amp= constant along uv distance

- Additional calibration could be needed due to space and time differences between the target and the calibrator.

- **Self calibration uses target itself as calibrator** to improves the quality of images (to increase S /N) --> powerful technique

Method for Self-Calibration in CASA

1) Start with shallow clean
2) Repeat with deeper cleans an d shorter solution intervals

tclean

- define & save model column for target

3) When images no longer improve, do amplitude calibra tion

gaincal (phase only calibration)

- Calculate temporal gain calibration solution (caltable = 'data'/'model')
- Solution for N antenna could be derived from N(N-1)/2 baselines
- Reject solutions below minSNR

gaincal (amp & phase calibration)

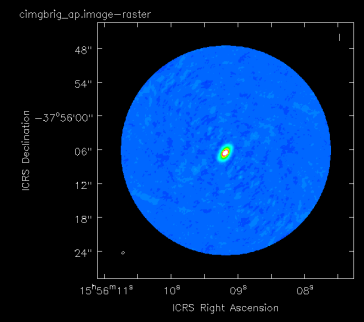
Phase -> change with atmosphere
Amplitude -> doesn't change much

applycal

- apply calibration table to data
- applycal : 'corrected' column= 'data' x 'calt able'

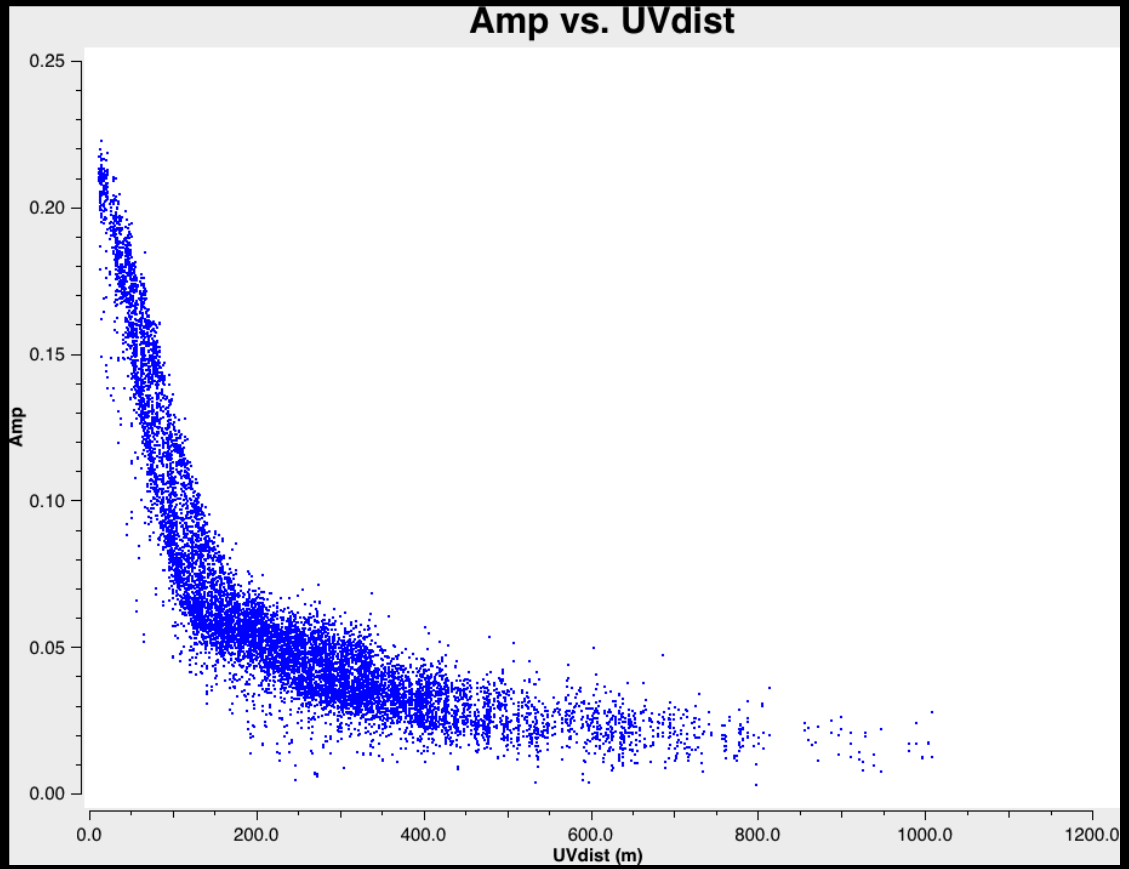
applycal

4) self-calibrated final image

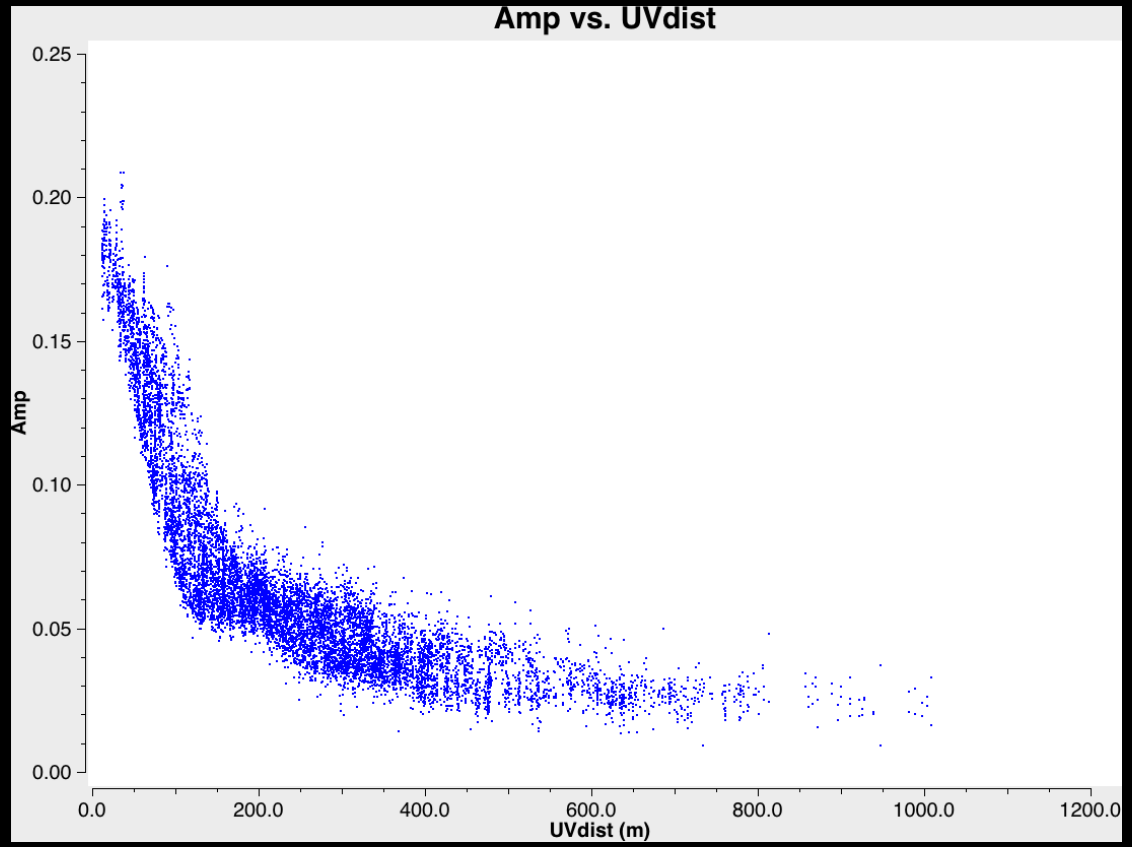


Comparison of amplitude

Before self calibration

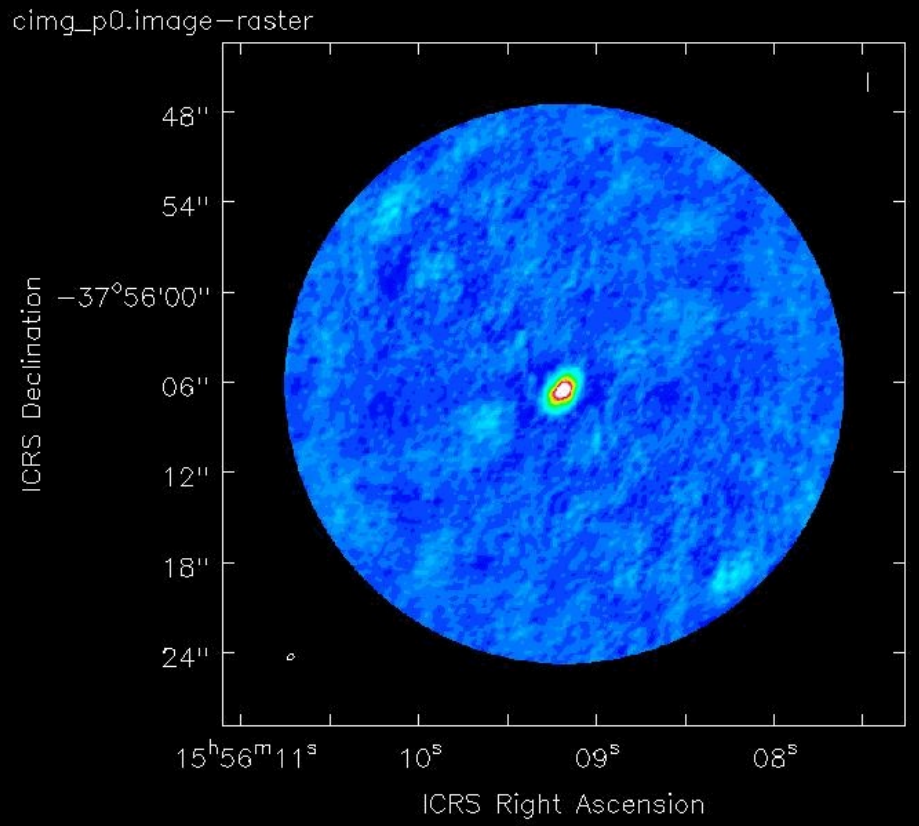


After self calibration

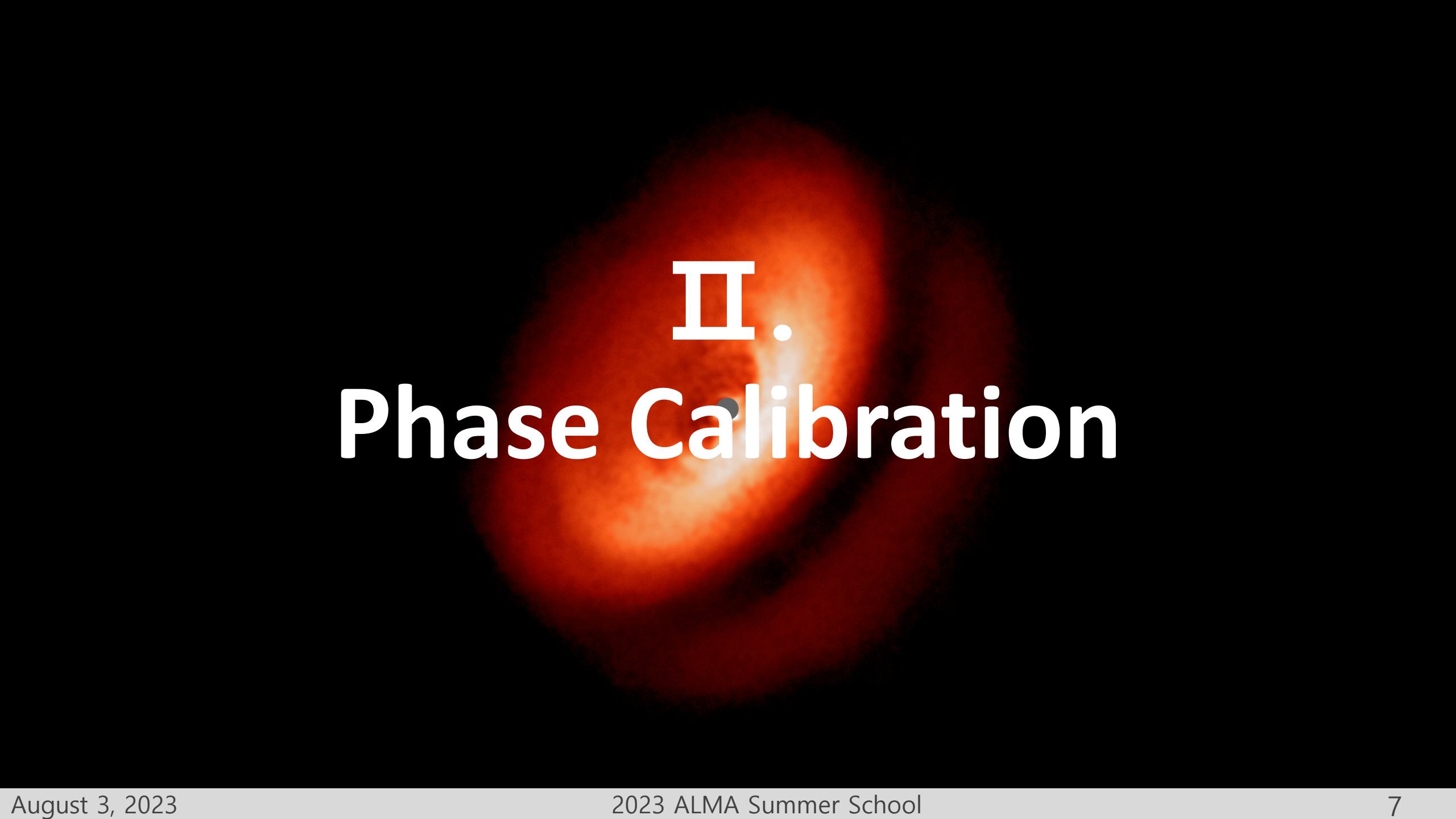


Self calibration to IM Lup (What we did)

Calibration with deeper clean



- ✓ We aim to perform self-calibration using the co ntinuum data of a disk source IM Lup.
- ✓ **investigate how much the image quality can be different through self-calibration paramet ers**
  (minSNR, threshold, weighting …)



II.
Phase Calibration

Self Calibration

1. **It would be better to clean conservatively. It is hard to get rid of real sources, but easy to add new ones.**

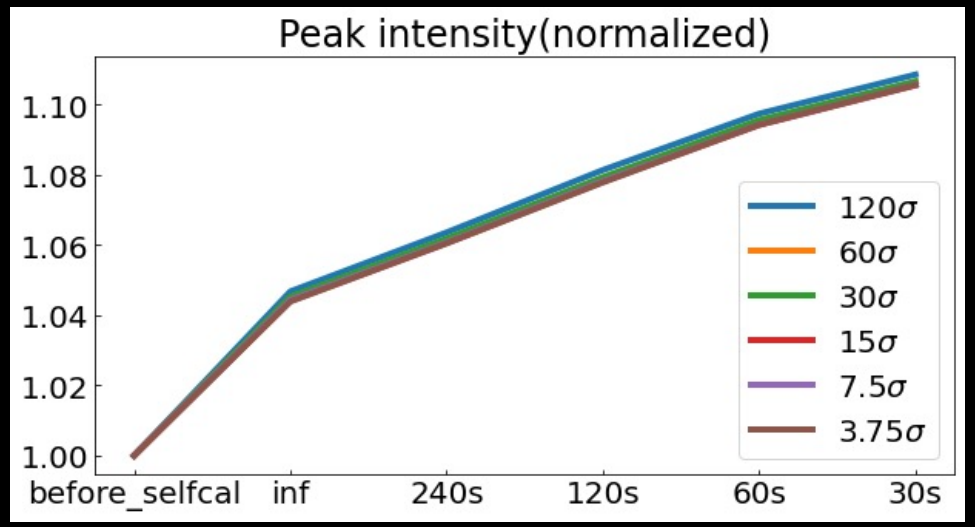
2. Make sure to check your solutions and compare the original visibility values to the new ones.

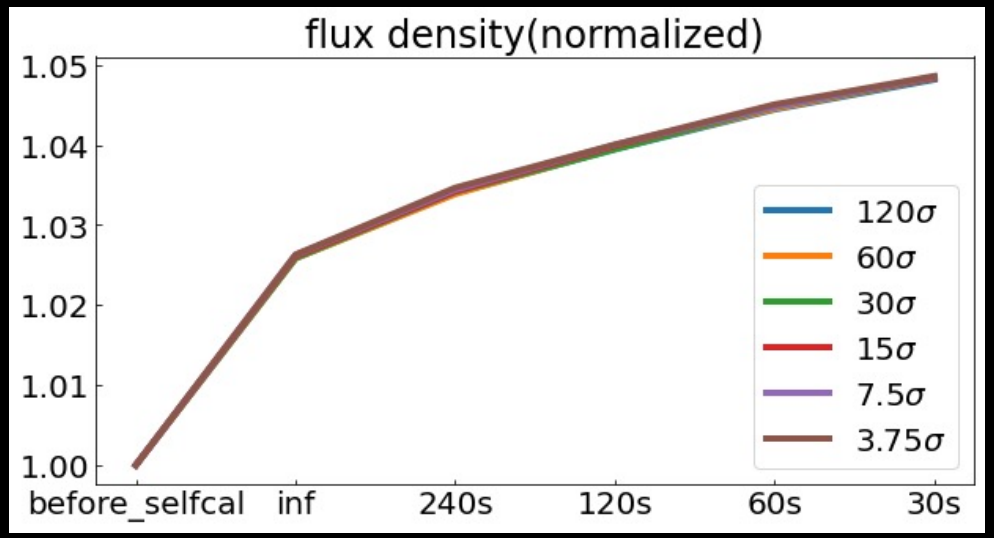
3. We have to check manually for each calibration step.

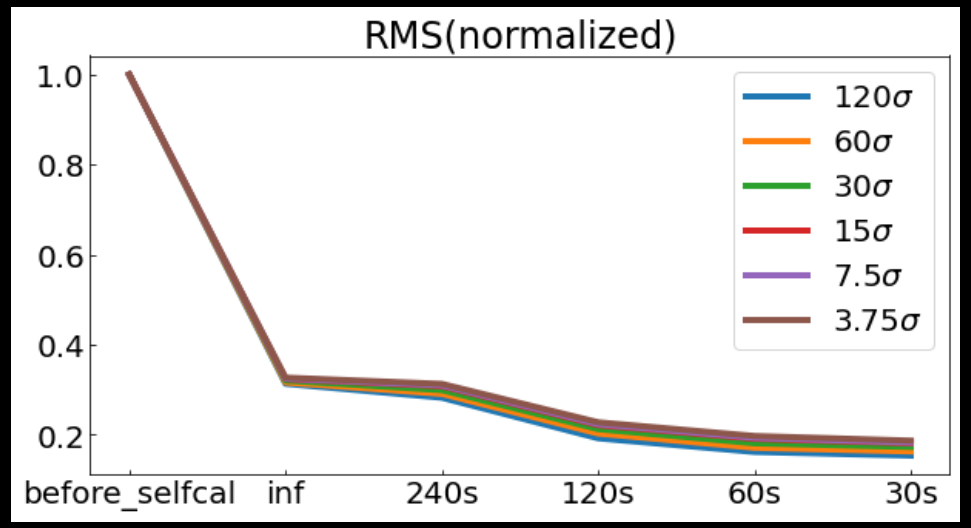
4. Amplitude self-calibration has more free parameters than phase calibration, so you need to exercise a bit more caution, especially if there's extended emission.

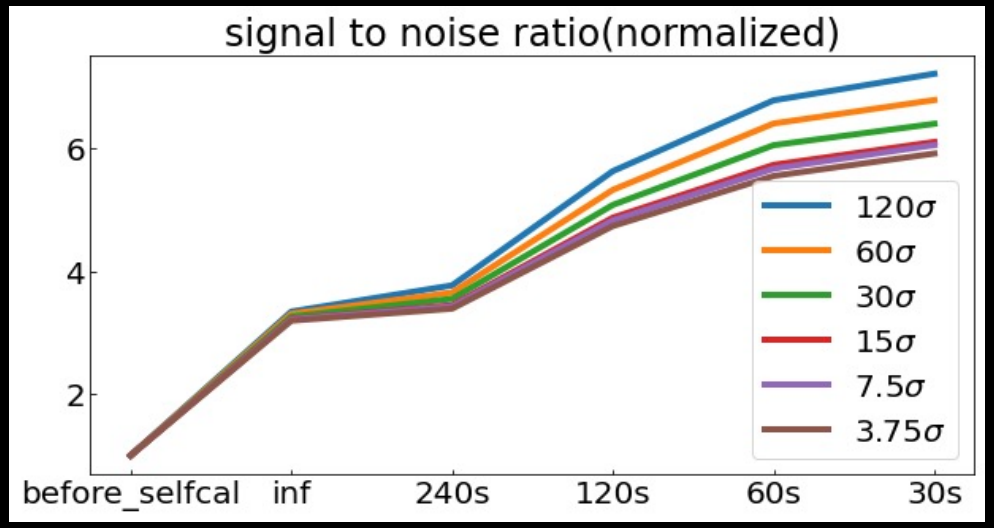
Let's see results with different depth of calibration and solint value!

Peak intensity & RMS & SNR for one phase-only calibration



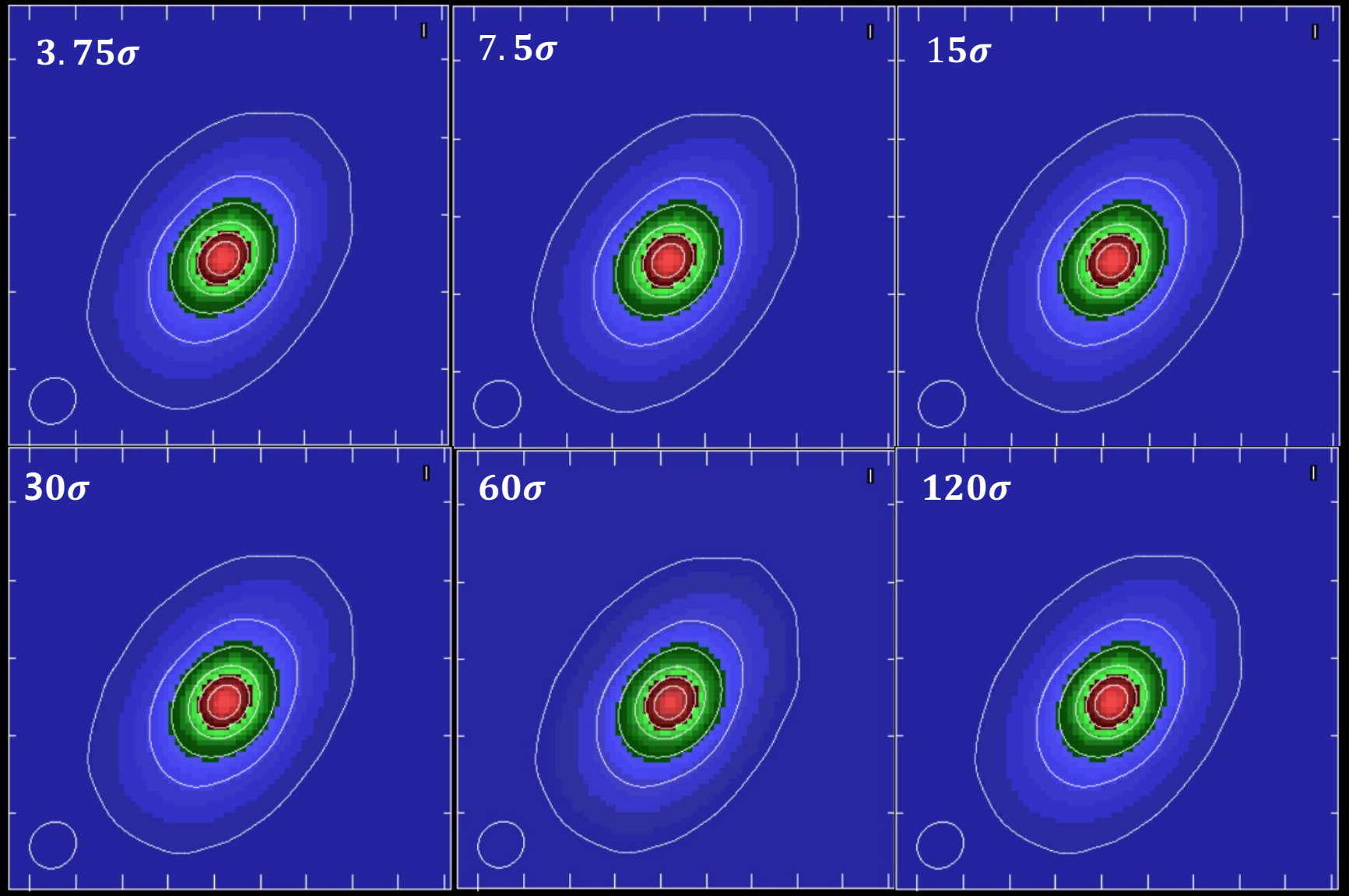






Shallow calibration => High Signal to noise Ratio (?) ➡ **We have to check images manually**

Peak : 4.8e-2
Rms : 2.0e-4
S/N = 240 …

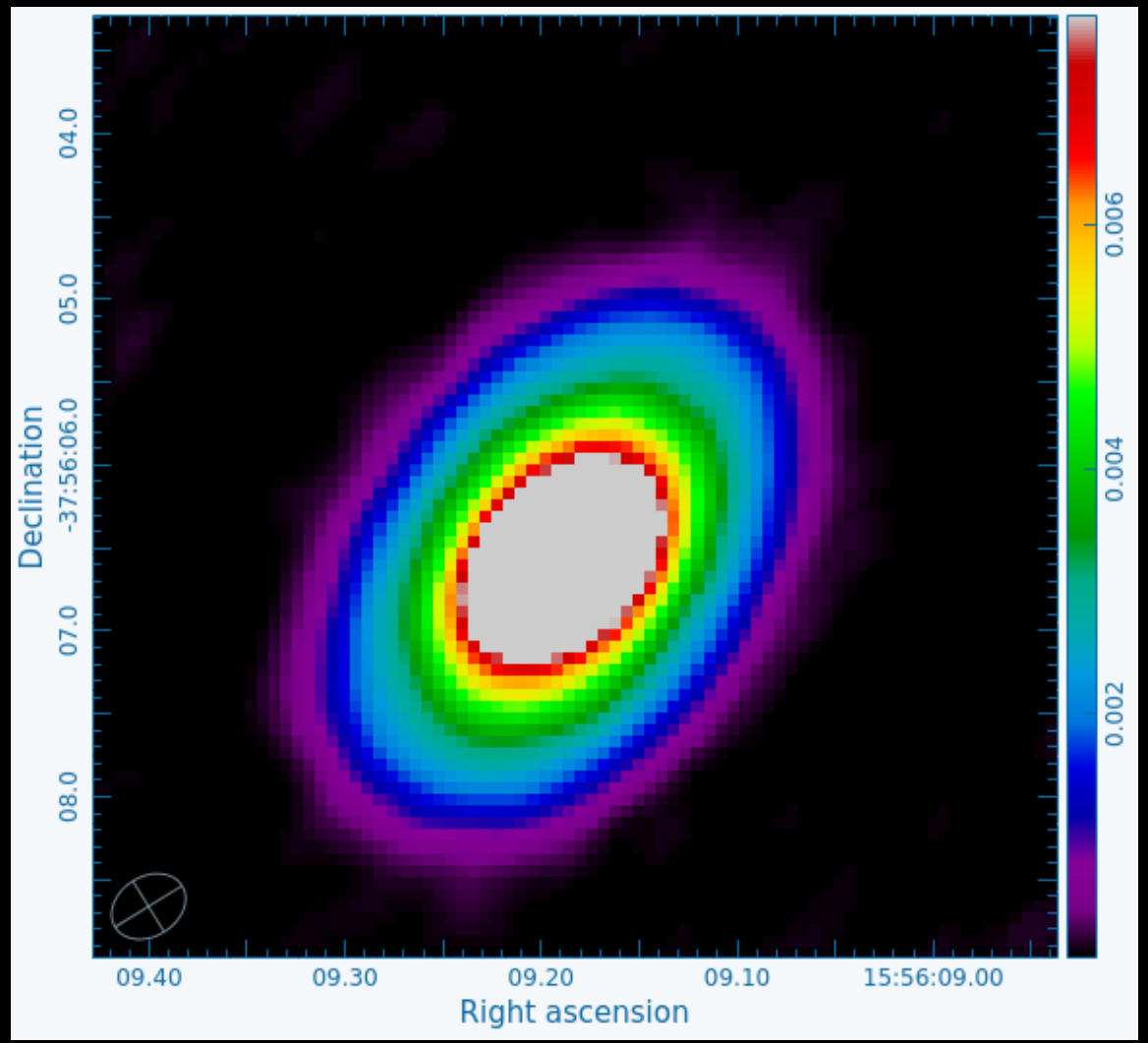


We couldn't see any big difference among different depth of self-calibrations. **Why?**

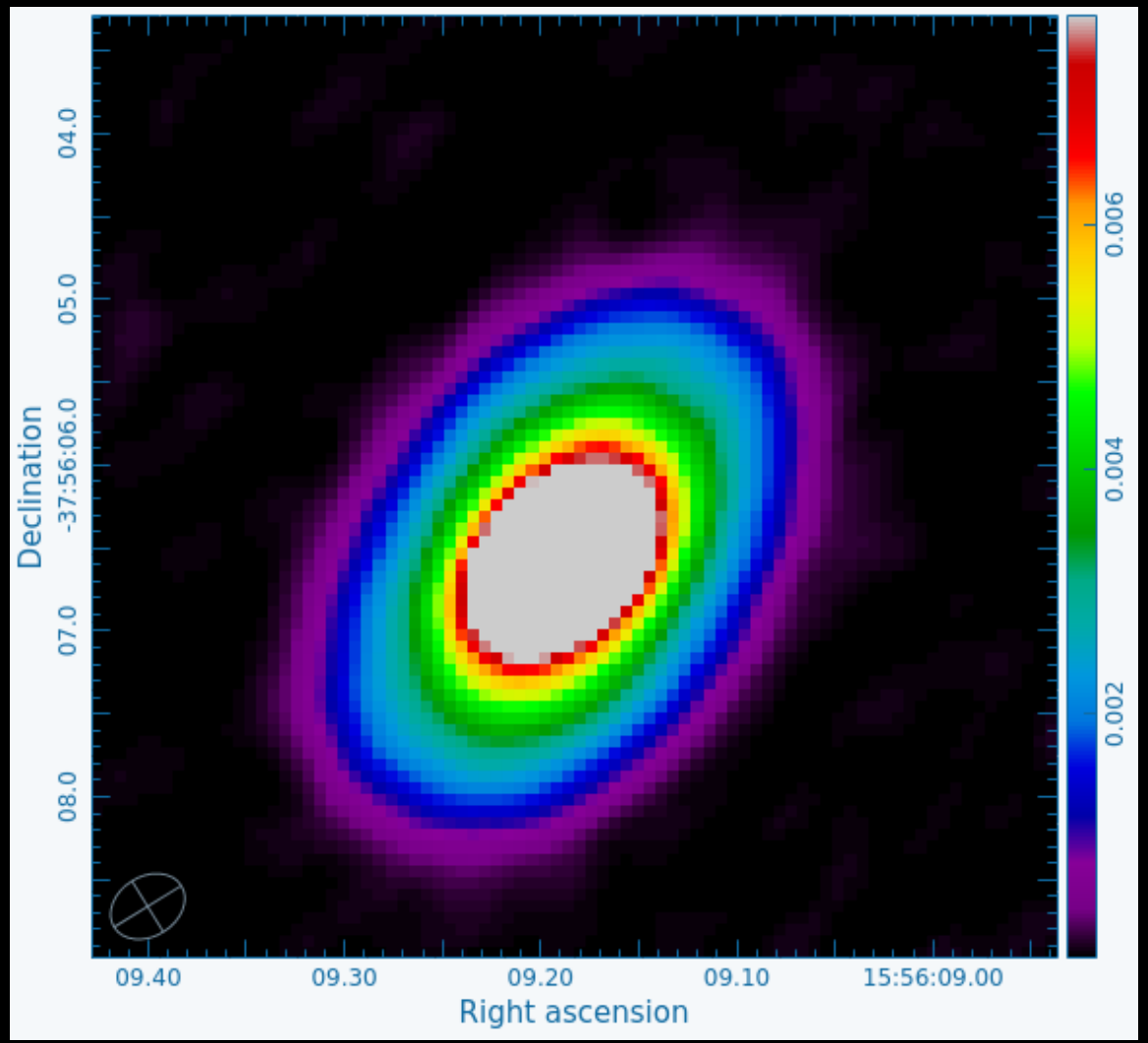
Ⅲ.
Amplitude Calibration

Comparison of image

Before amplitude calibration

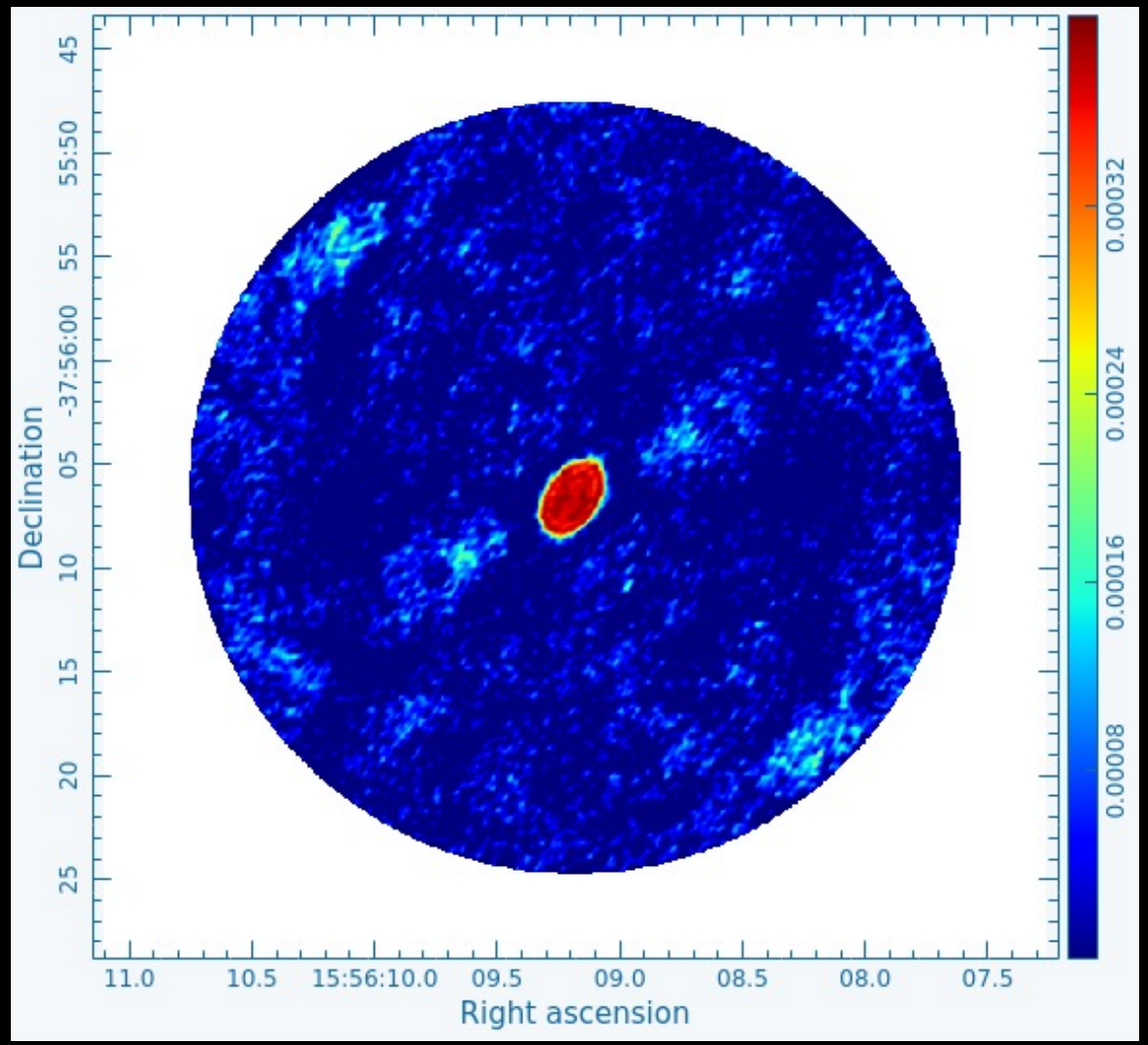


After amplitude calibration

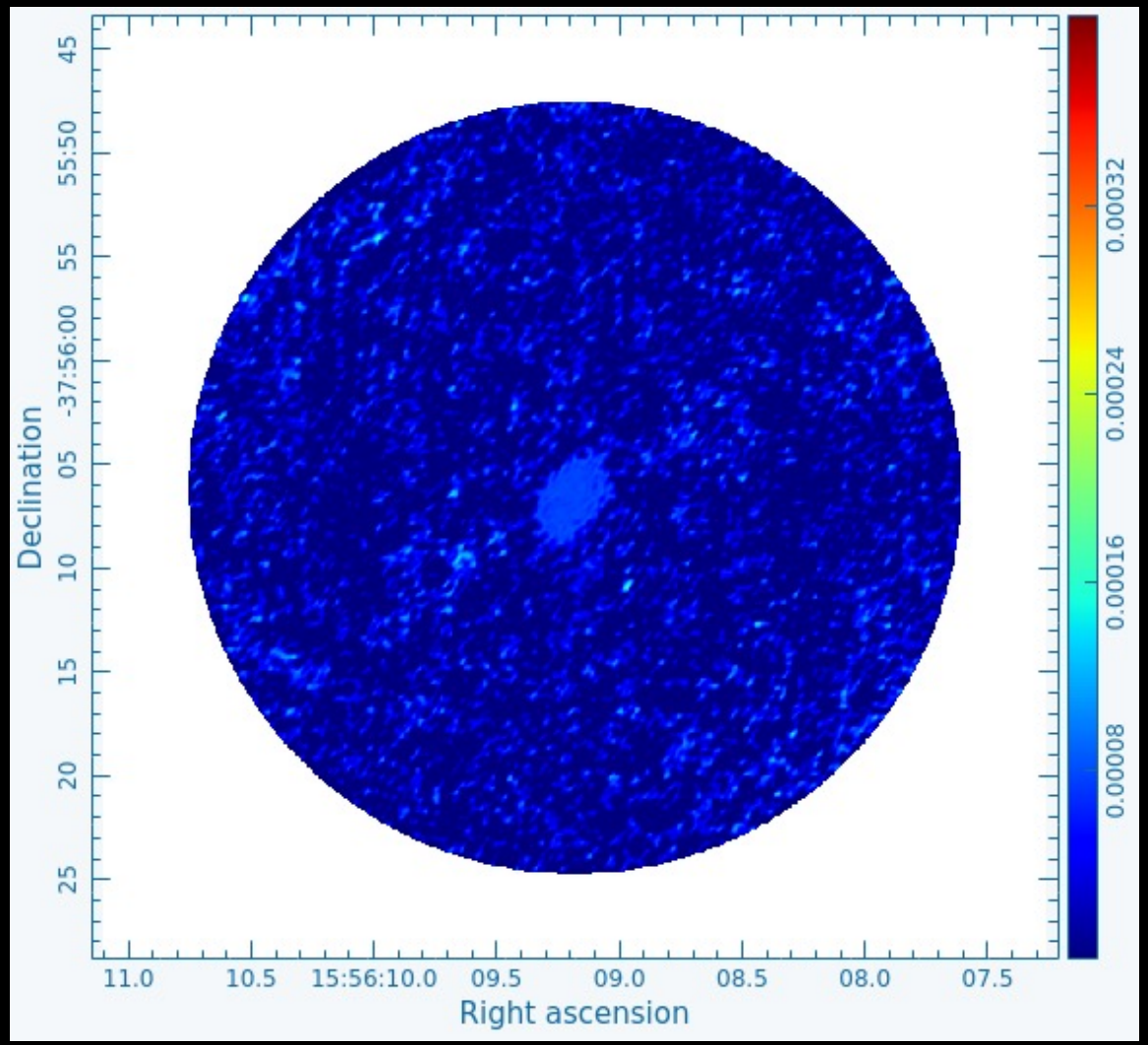


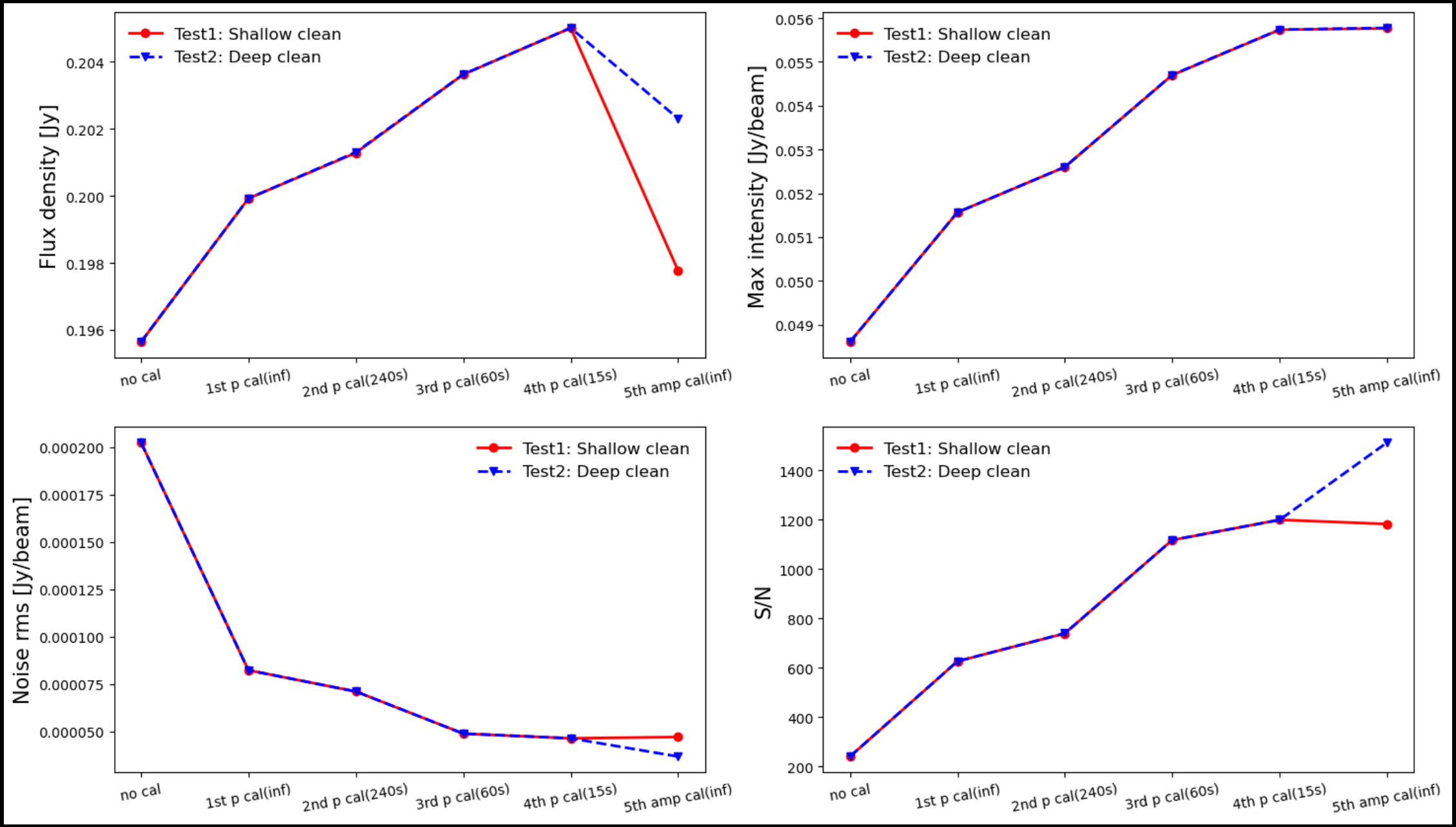
Comparison of residual

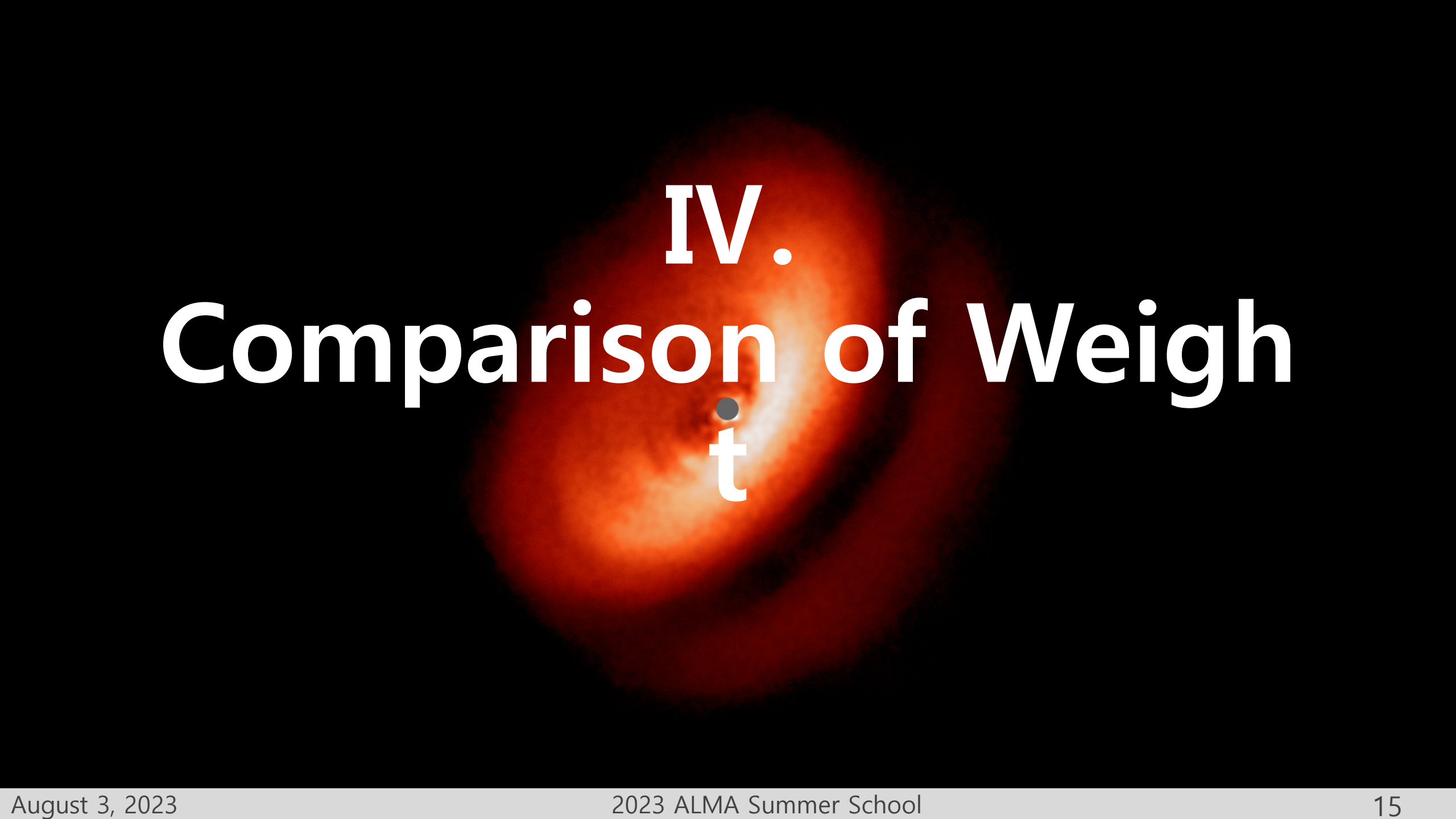
Shallow clean



Deep clean



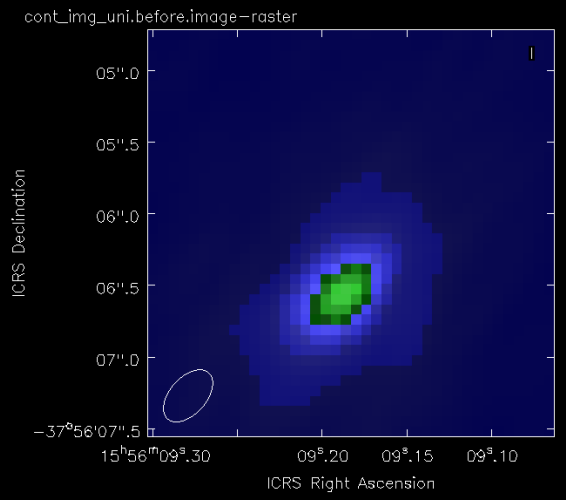

Test1: Shallow clean
Test2: Deep clean
Flux density [Jy]
0.204
0.202
0.200
0.198
0.196
no cal
1st p cal(inf)
2nd p cal(240s)
3rd p cal(60s)
4th p cal(15s)
5th amp cal(inf)
Test1: Shallow clean
Test2: Deep clean
Max intensity [Jy/beam]
0.056
0.055
0.054
0.053
0.052
0.051
0.050
0.049
no cal
1st p cal(inf)
2nd p cal(240s)
3rd p cal(60s)
4th p cal(15s)
5th amp cal(inf)
Test1: Shallow clean
Test2: Deep clean
Noise rms [Jy/beam]
0.000200
0.000175
0.000150
0.000125
0.000100
0.000075
0.000050
no cal
1st p cal(inf)
2nd p cal(240s)
3rd p cal(60s)
4th p cal(15s)
5th amp cal(inf)
Test1: Shallow clean
Test2: Deep clean
S/N
1400
1200
1000
800
600
400
200
no cal
1st p cal(inf)
2nd p cal(240s)
3rd p cal(60s)
4th p cal(15s)
5th amp cal(inf)

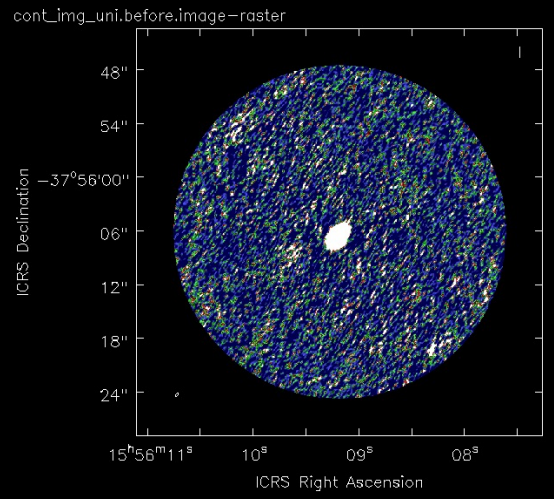


IV.
Comparison of Weight

uniform

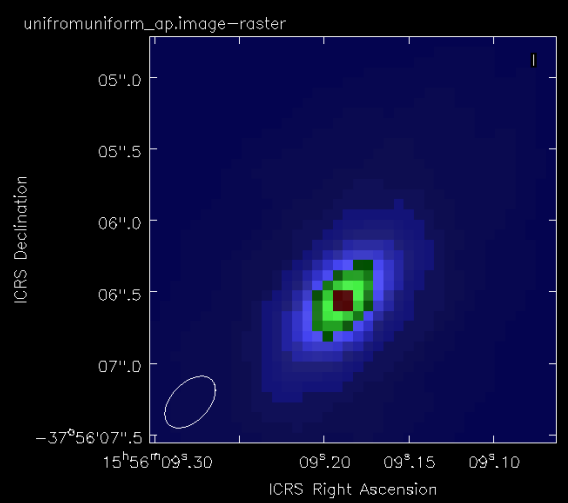
no self

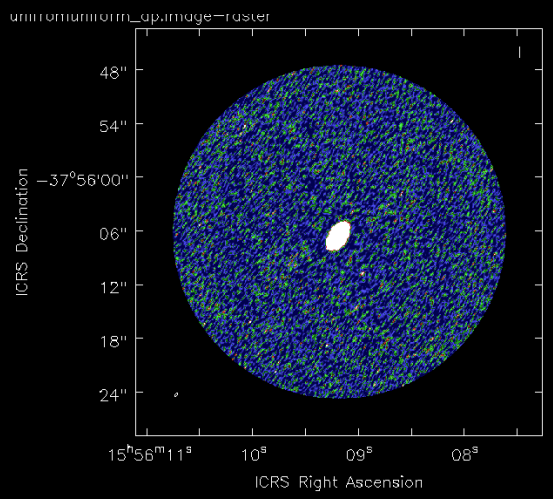




159

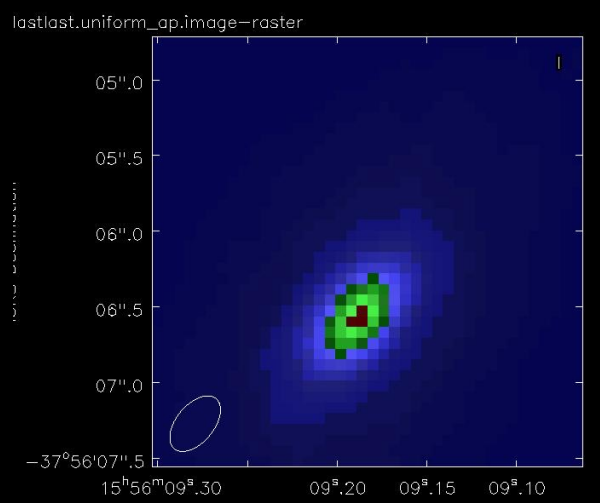
Model(uniform)

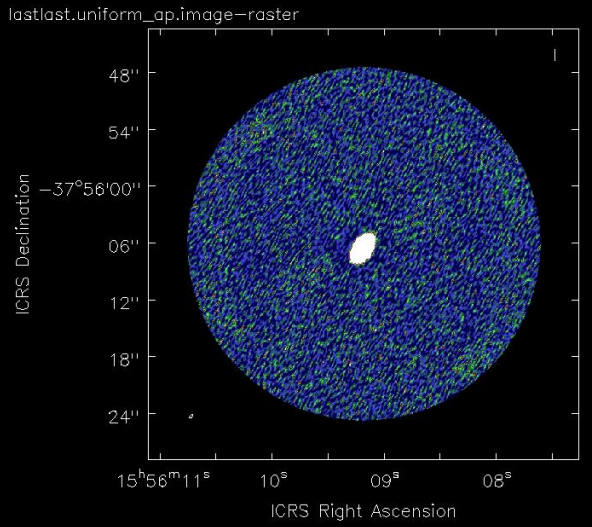




327

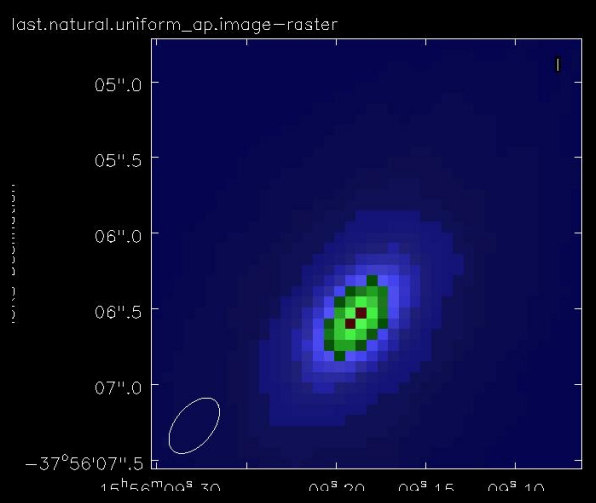
Model(briggs)

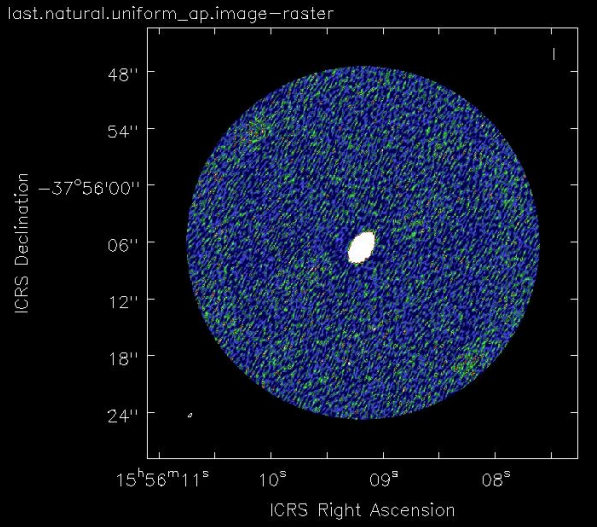




328

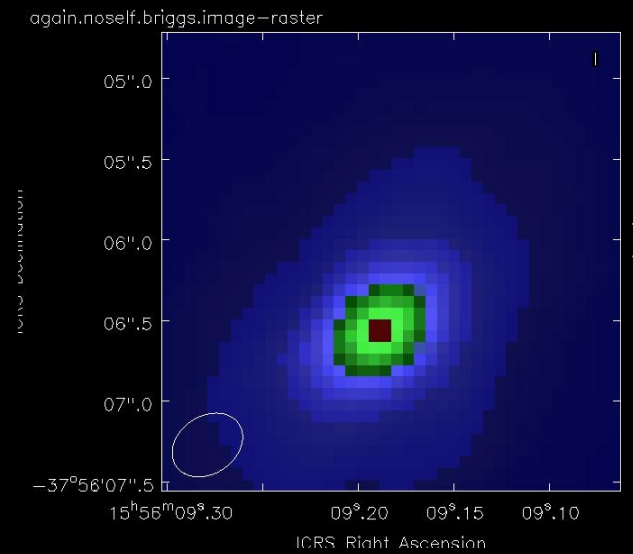
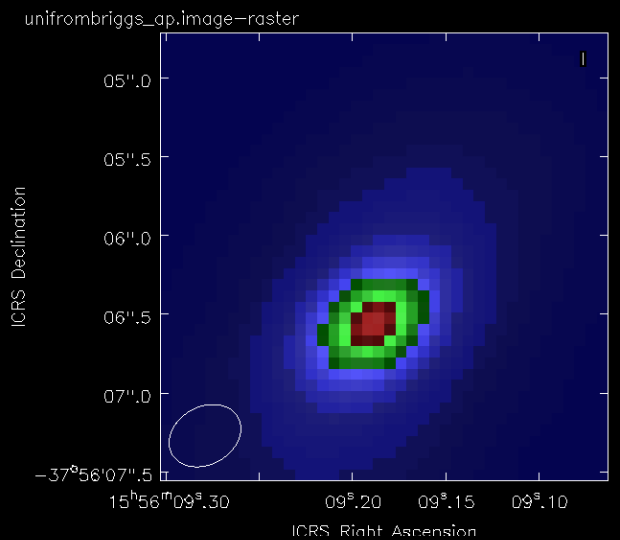
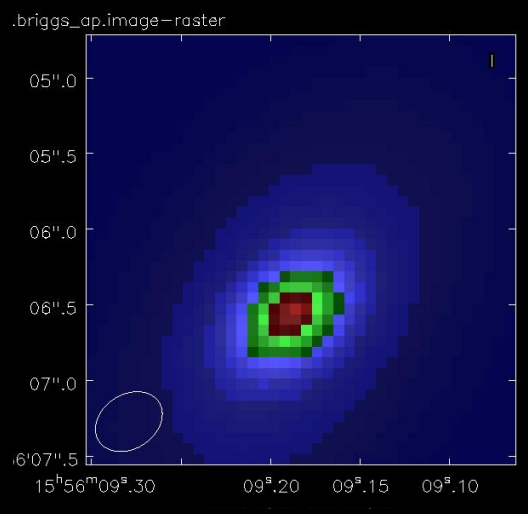
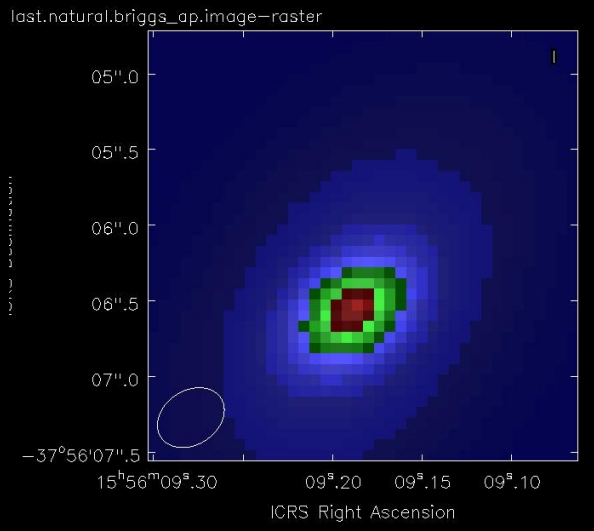
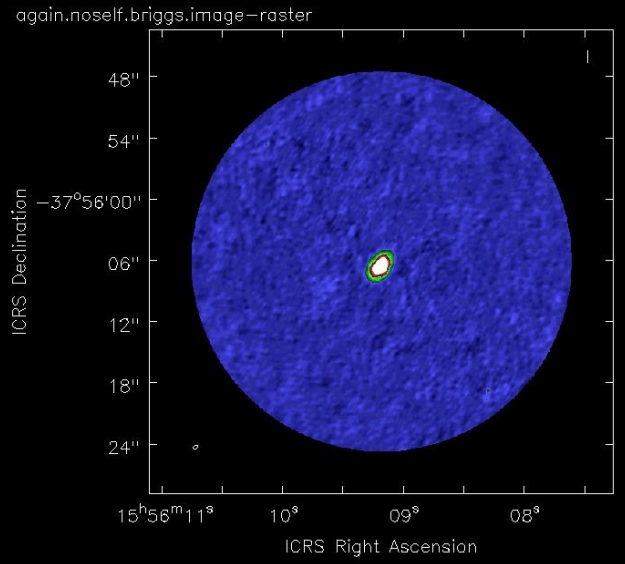
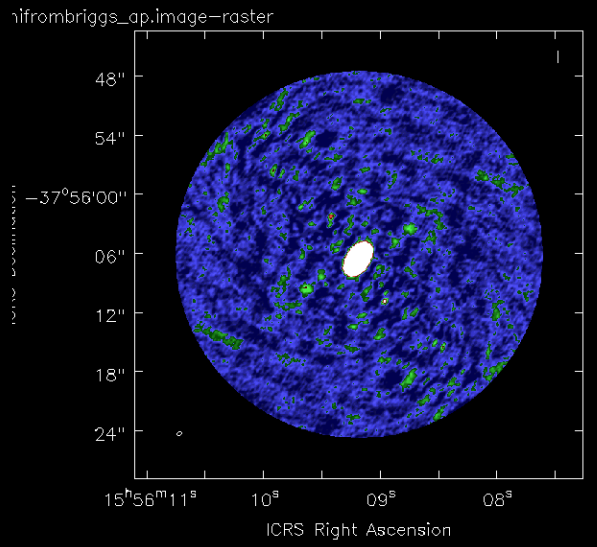
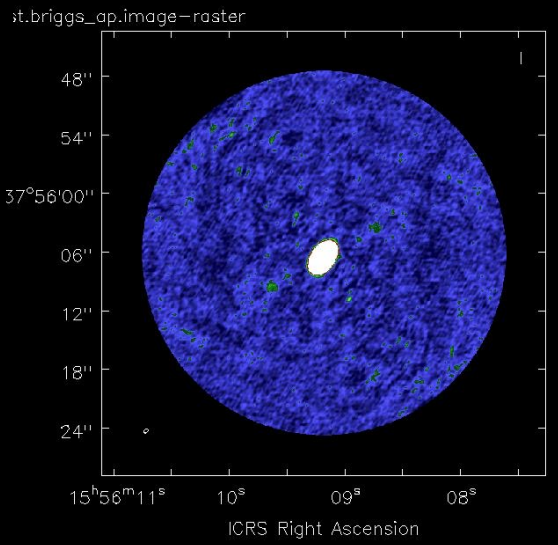
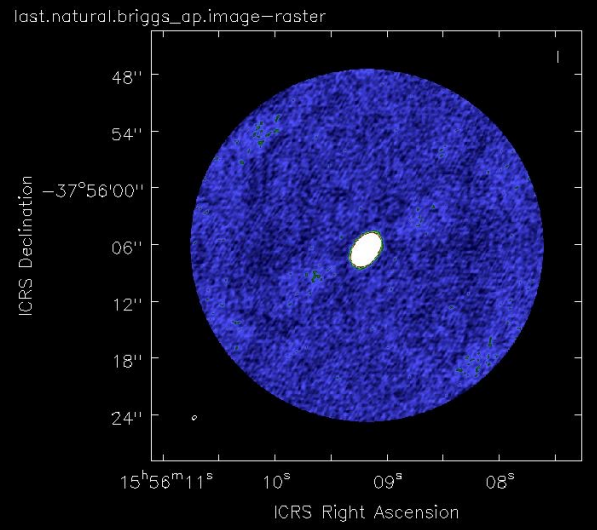
Model(natural)





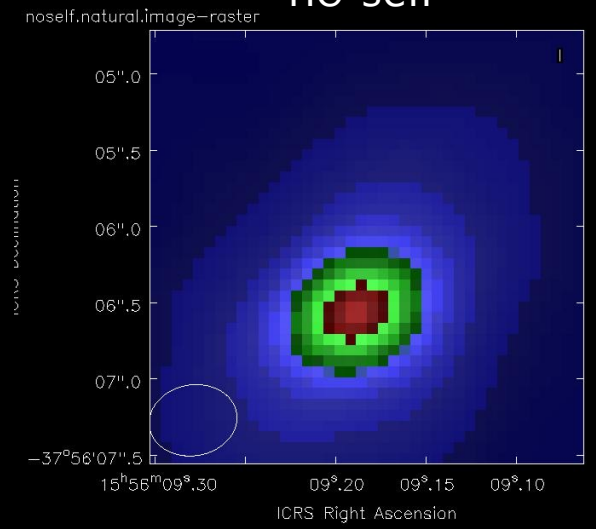
438

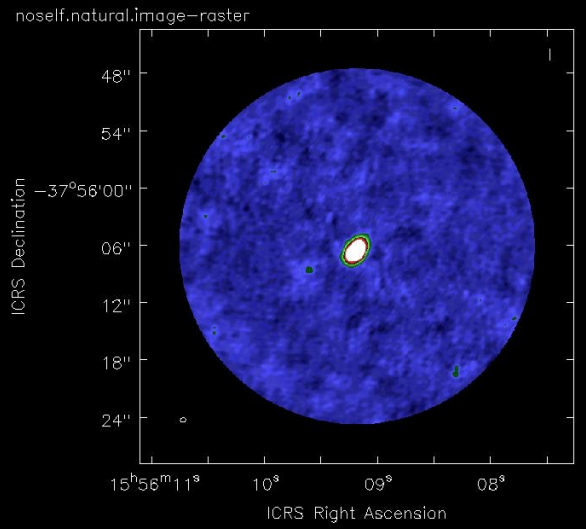
briggs

no self	Model(uniform)	Model(briggs)	Model(natural)
			
			
234	**787**	**1180**	**1416**

natural

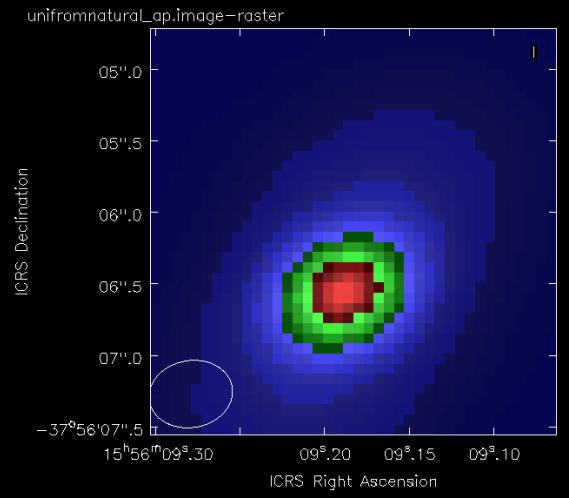
no self

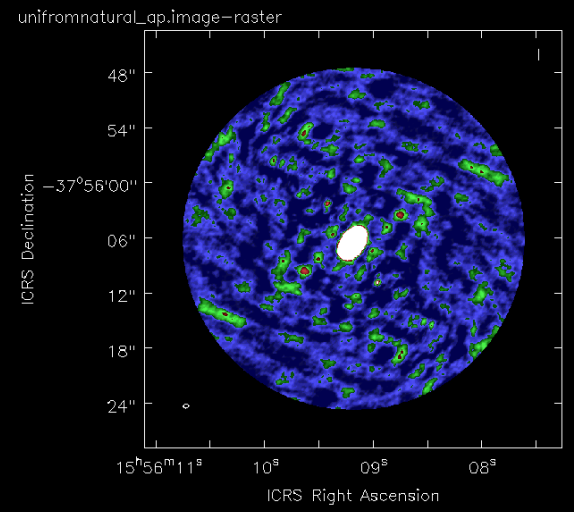




208

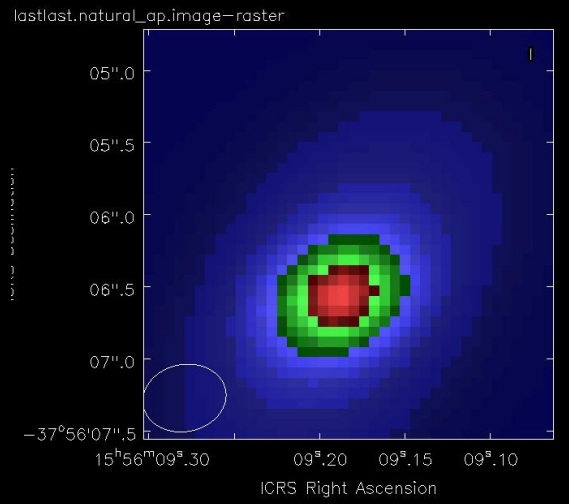
Model(uniform)

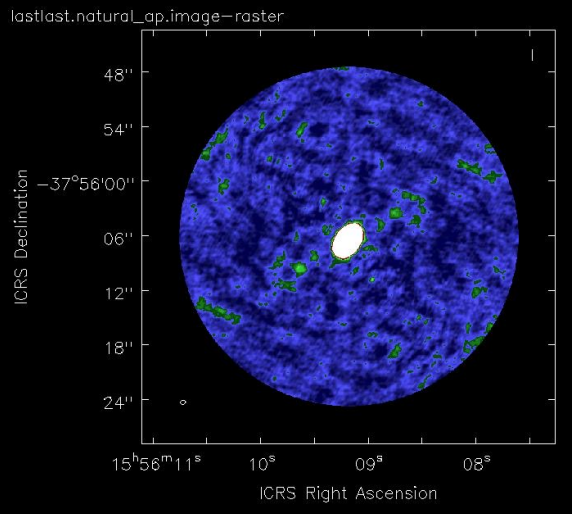




658

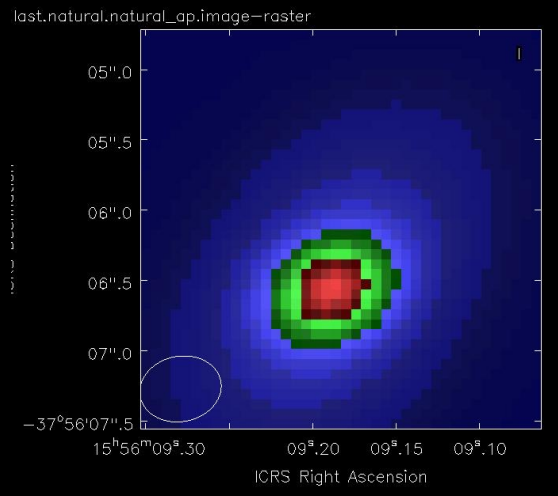
Model(briggs)

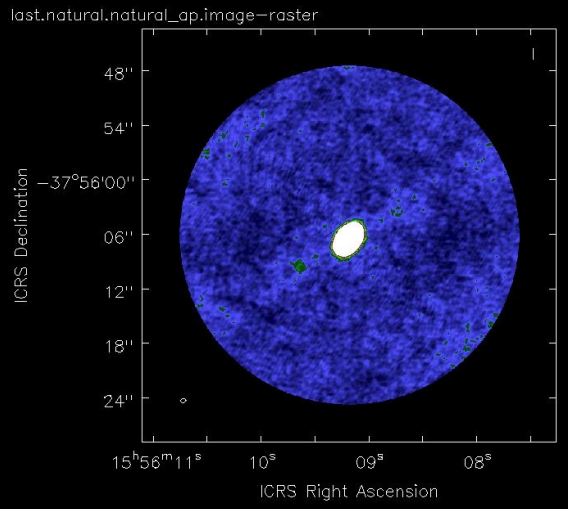




1121

Model(natural)





1180