



Plática Grupo Radio (2021 Feb)
Combinación de datos interferométricos y radiotelescopios single-dish para estudios multiescala de regiones de formación estelar
Single-dish + interferometer combination for multiscale studies.

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Project Goals

- Study of hierarchical relationships in Massive Star Formation Regions.
- Characterization of Massive Star Formation Regions.
 - Number and size for the structures
 - Mass Function
 - Column Densities
- Tool for data combination between Single Dish and Interferometer





Data Sets

- ALMA-IMF. First ALMA Large Program for clumps and cores study in massive star formation regions (1mm and 3mm)
- MGPS90. Galactic Plane Survey at 3mm. Green Bank Telescope (GBT).
- BOLOCAM. Galactic Plane Survey at 1.1mm. Caltech Submillimeter Observatory (CSO)





FIRST AND SECOND SEMESTER WORK





Feathering Combination ALMA-IMF + MGPS90

- Focus on data combination from MGPS90 and ALMA-IMF (Feathering Algorithm)
- First approx to data combination from BOLOCAM and ALMA-IMF
- First approx to free-free maps.





Feathering Combination ALMA-IMF + MGPS90

Match ALMA-IMF & MGPS90

`check_fields.py <mgps90 folder> <alma-imf folder>`

Reprojection, Crop &
Alignment

`alignment.py <almaimf fits> <mgps90 fits>`
`(image_registration && reproject)`

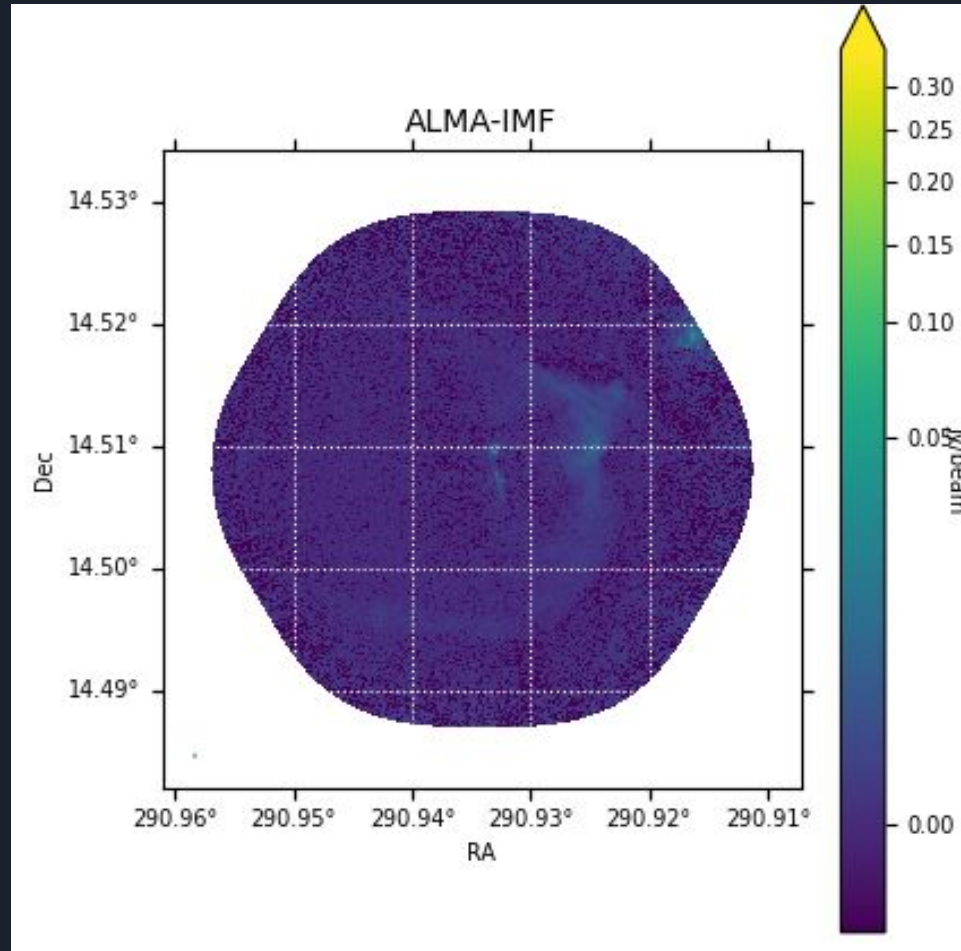
Scaling Factor for MGPS90
(Calibration differences)

Feather Combination

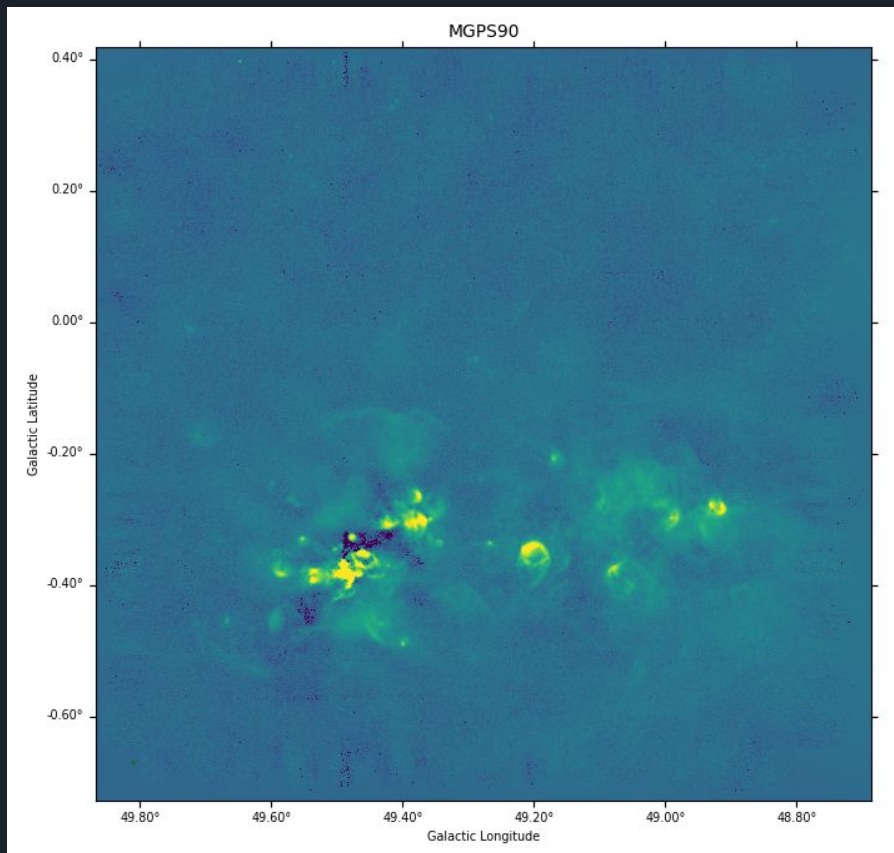
`feather_combine.py <almaimf fits> <mgps90 fits>`
`(uvcombine)`



W51-E

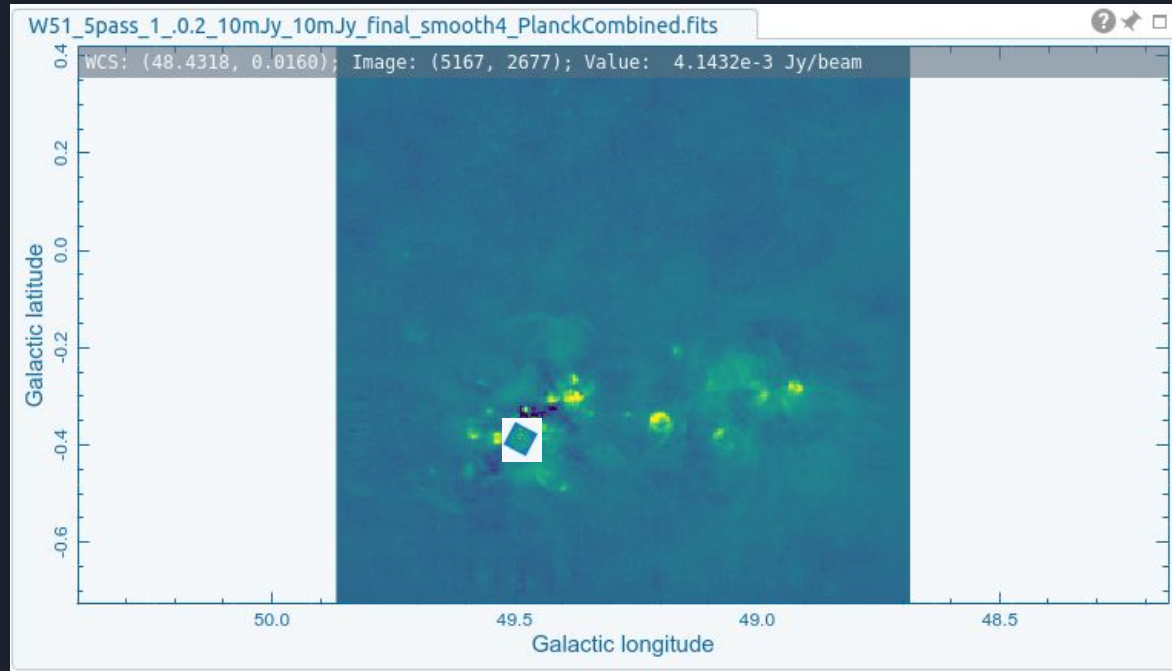


Feathering Combination ALMA-IMF + MGPS90

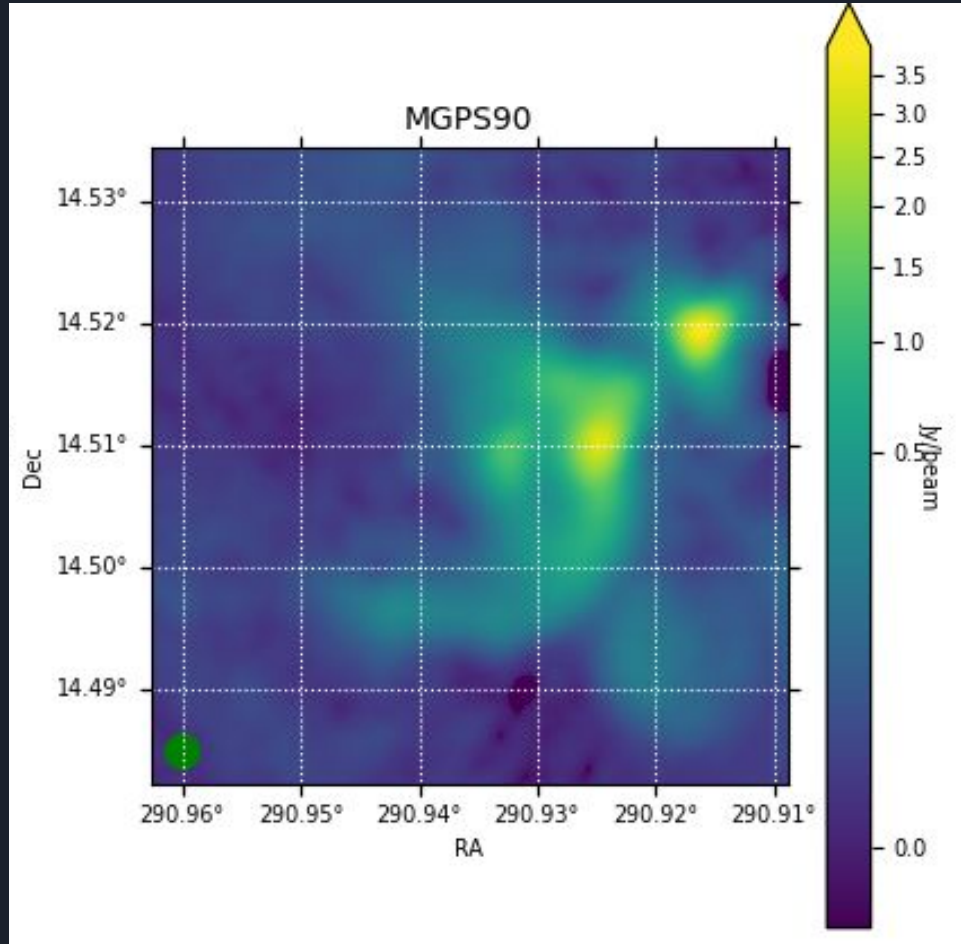


Feathering Combination ALMA-IMF + MGPS90

W51-E



W51-E



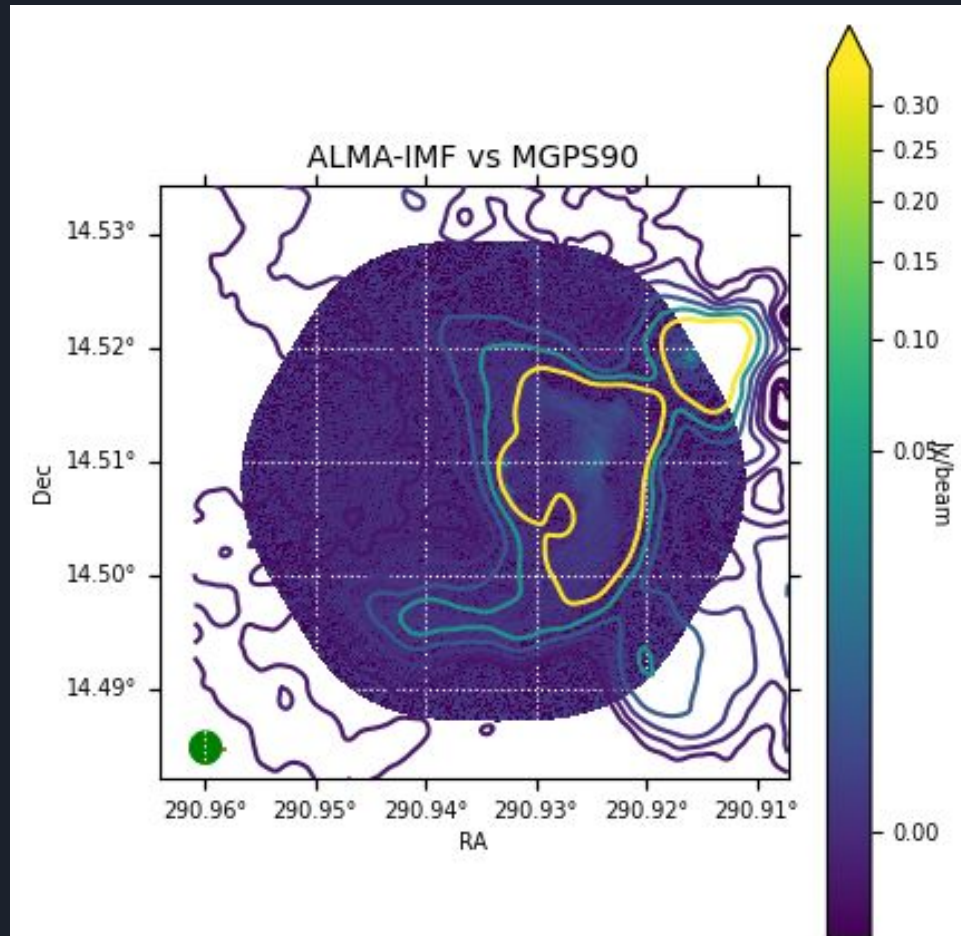


Feathering Combination ALMA-IMF + MGPS90

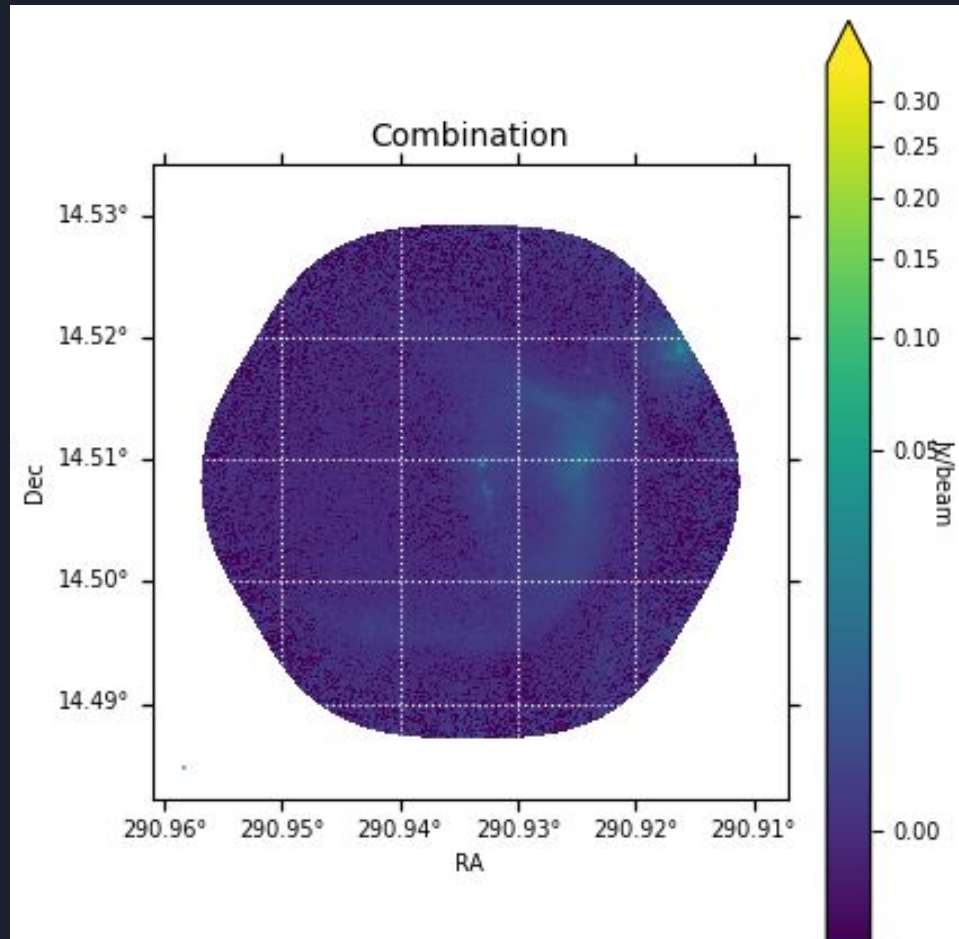
- Results for W51-E Alignment
 - Xoffset = 162.15px (-6.08 ")
 - Yoffset = -13.58px (-0.51 ")
 - Angle = -4.79°



W51-E

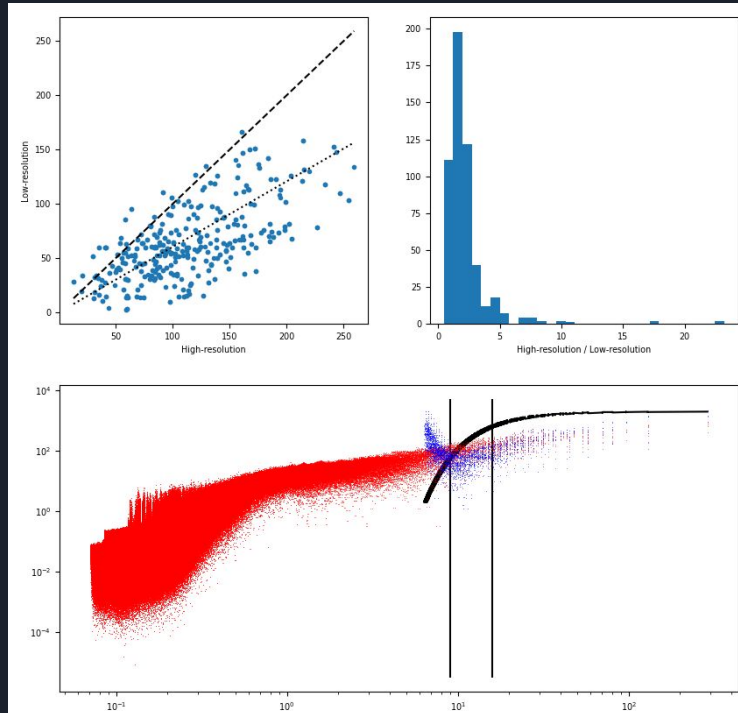


W51-E

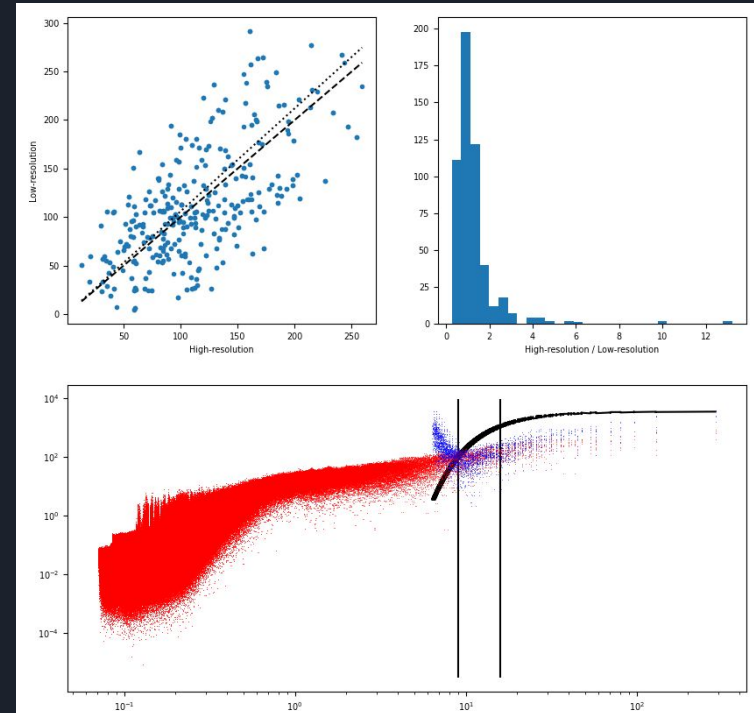


Feathering Combination ALMA-IMF + MGPS90

W51-E before scale

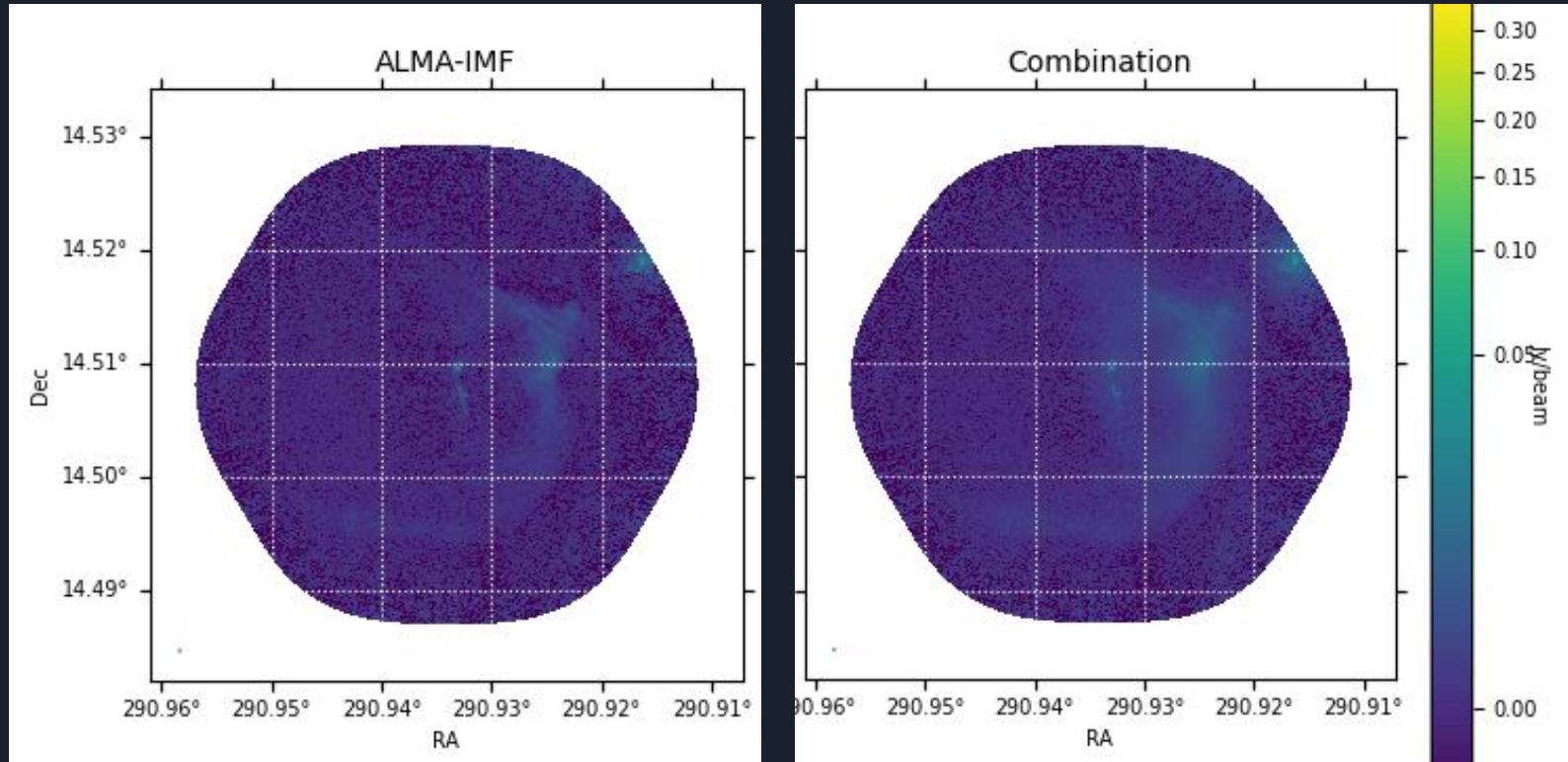


W51-E after scale (x1.4042)



Feathering Combination ALMA-IMF + MGPS90

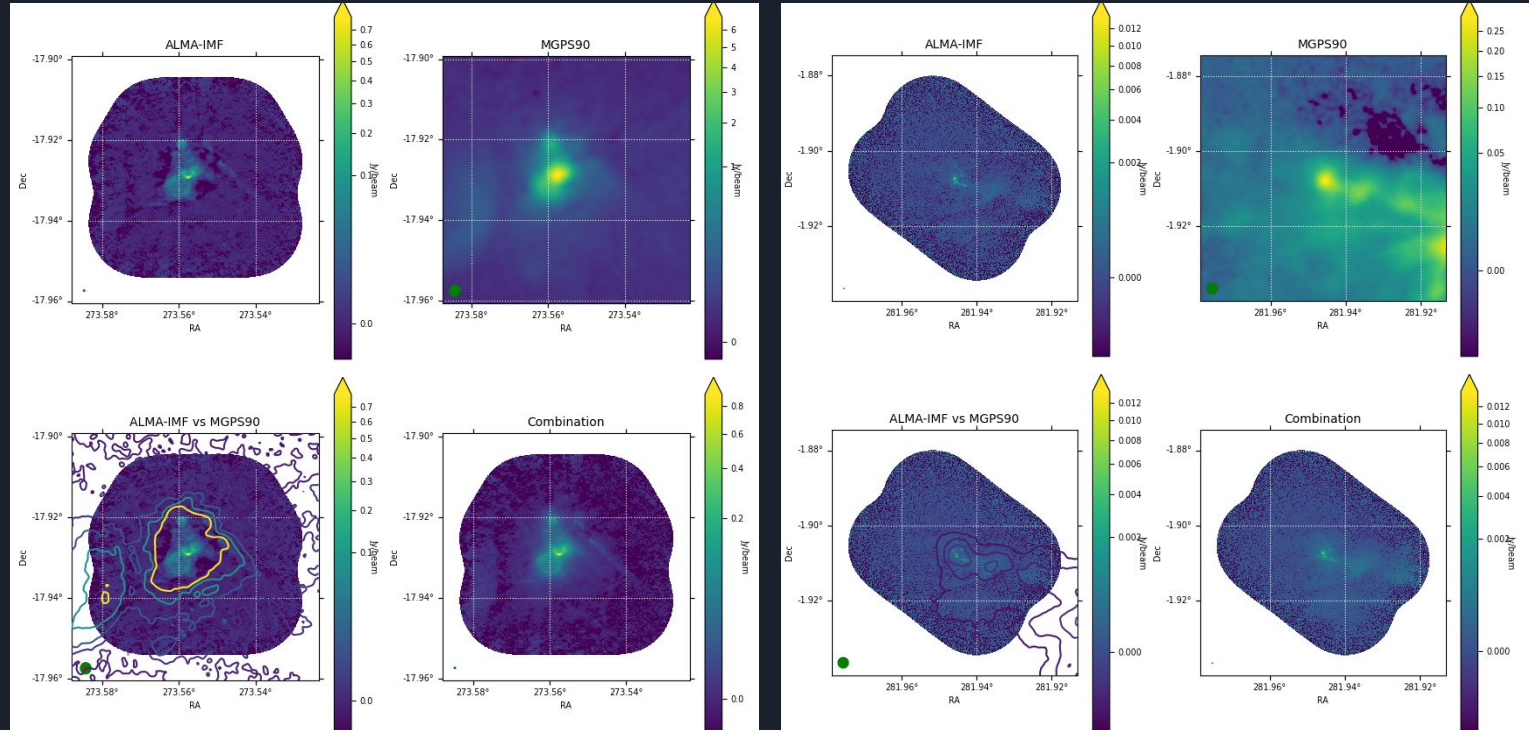
W51-E



Feathering Combination ALMA-IMF + MGPS90

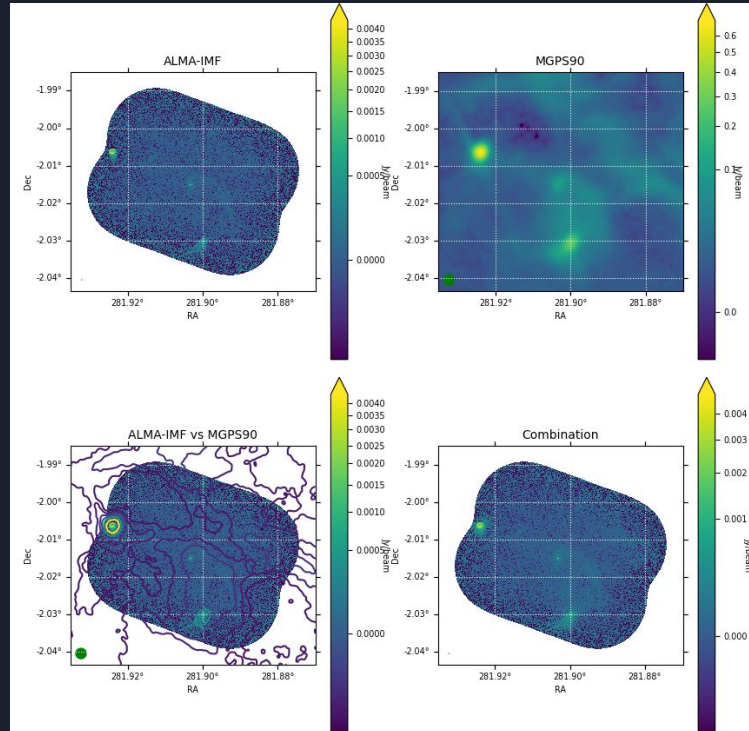
G012.80

W43-MM1

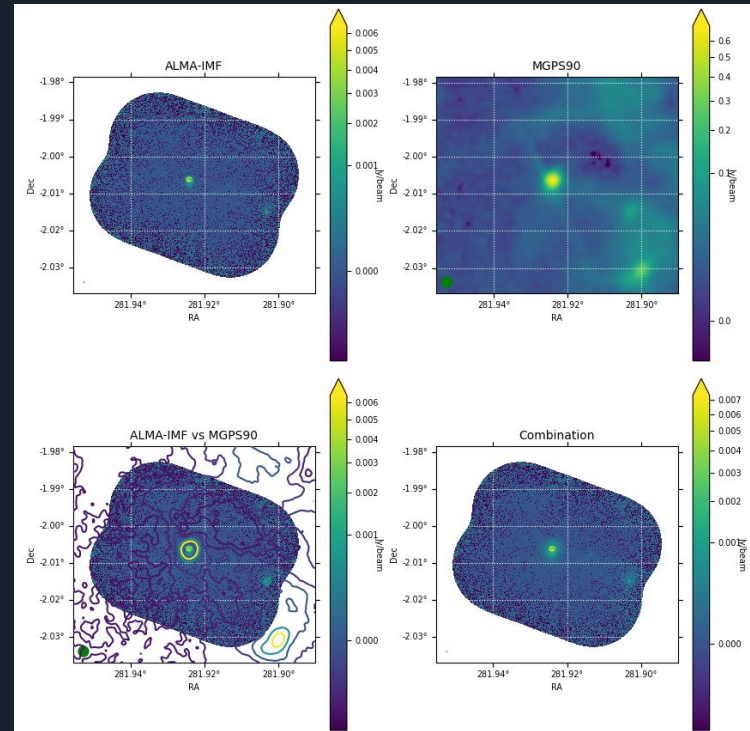


Feathering Combination ALMA-IMF + MGPS90

W43-MM2

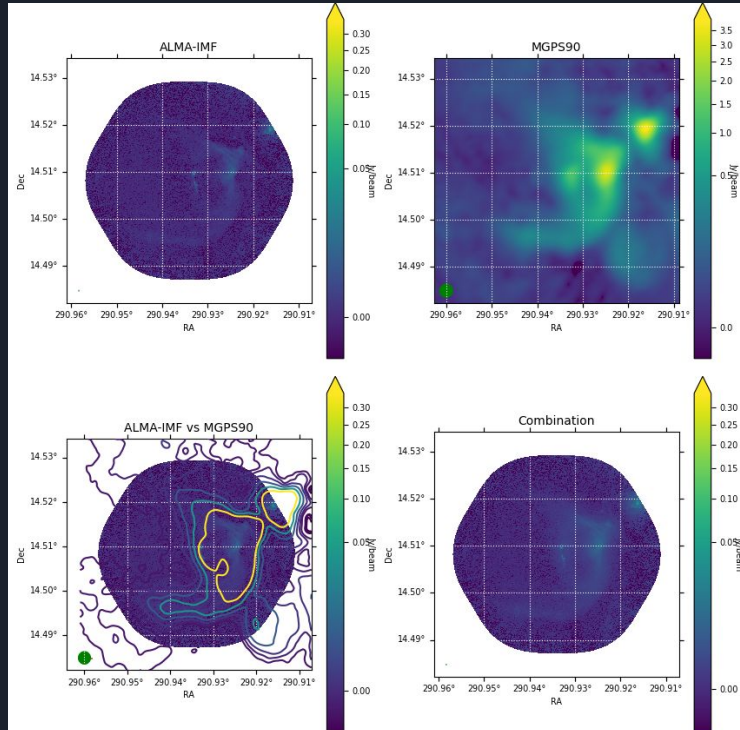


W43-MM3

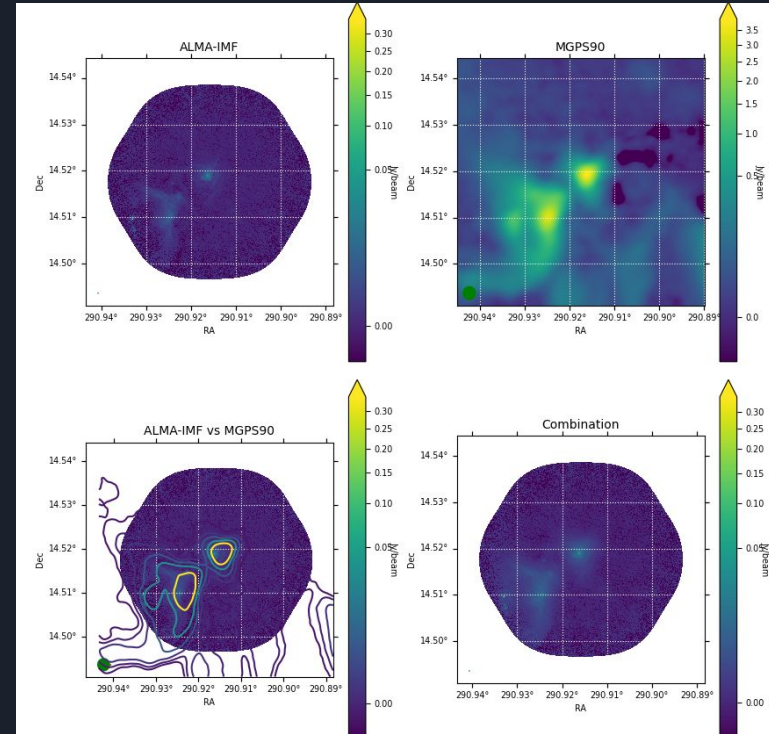


Feathering Combination ALMA-IMF + MGPS90

W51-E



W51-IRS2



Feathering Combination ALMA-IMF + MGPS90

Alignment offsets

Region	X_{offset} [px]	Y_{offset} [px]	X_{offset} [arcsec]	Y_{offset} [arcsec]	Angle [degree]
W43-MM1	13.06640625	-5.62109375	-0.914648437499791	-0.39347656249991003	-23.27710047538306
W43-MM2	11.330078125	-3.833984375	-0.5665039062500453	-0.19169921875001533	-18.695301703970234
W43-MM3	7.87890625	-4.05078125	-0.551523437499874	-0.2835546874999352	-27.209050762879304
G012.80	-6.638671875	1.310546875	1.5268945312500268	0.3014257812500053	-11.167228461473384
W51-E	162.154296875	-13.580078125	-6.080786132814446	-0.509252929687663	-4.787228683927281
W51-IRS2	117.162109375	-5.791015625	-5.858105468750468	-0.28955078125002315	-2.829677170400324

```
aux_beam = deconvolve(sing_beam, alma_beam)
conv_img = convolve(alma_img, aux_beam)
offsets = image_reprojection.chi2_shift(conv_img, single_img)
```



Feathering Combination ALMA-IMF + MGPS90

Region	From	Beam	Flux [Jy]	Avg Flux [Jy/beam]	MAD ¹	Max _A ²	Min _A ³	DR	Scale	PixSize ["]	Npix _{pb} ⁴ [pix]	Npix _{mask} ⁵ [pix]
W51-E	MGPS90	10.00" x 10.00" (70.69")	3.27E+01	2.43E-01	6.95E-04	3.31E+00	-5.47E-03	4.77E+03	1.0000	0.04 x 0.04	10834492	8841619
W51-E	ALMA	0.29" x 0.26" (70.69")	1.76E+01	1.01E-04	2.60E-04	3.45E-01	-2.76E-03	1.26E+03	1.0000	0.04 x 0.04	10834492	8841619
W51-E	COMB	0.29" x 0.26" (70.69")	5.44E+01	3.12E-04	3.10E-04	3.46E-01	-2.76E-03	1.11E+03	1.4042	0.04 x 0.04	10834492	8841619
W51-IRS2	MGPS90	10.00" x 10.00" (-61.27")	3.55E+01	2.67E-01	4.29E-03	3.89E+00	-2.10E-02	9.07E+02	1.0000	0.05 x 0.05	6026732	4557610
W51-IRS2	ALMA	0.28" x 0.26" (-61.27")	2.29E+01	1.28E-04	1.49E-04	3.46E-01	-2.93E-03	2.22E+03	1.0000	0.05 x 0.05	6026732	4557610
W51-IRS2	COMB	0.28" x 0.26" (-61.27")	6.40E+01	3.59E-04	1.65E-04	3.47E-01	-2.24E-03	2.09E+03	1.4987	0.05 x 0.05	6026732	4557610
W43-MM1	MGPS90	10.00" x 10.00" (-72.96")	5.04E+00	2.61E-02	6.52E-03	2.88E-01	-7.01E-03	4.42E+01	1.0000	0.07 x 0.07	4459803	3897043
W43-MM1	ALMA	0.57" x 0.34" (-72.96")	9.88E-01	9.92E-06	8.72E-05	1.35E-02	-1.46E-03	1.48E+02	1.0000	0.07 x 0.07	4459803	3897043
W43-MM1	COMB	0.57" x 0.34" (-72.96")	5.19E+00	5.21E-05	9.83E-05	1.40E-02	-1.45E-03	1.41E+02	0.9035	0.07 x 0.07	4459803	3897043
W43-MM2	MGPS90	10.00" x 10.00" (-72.49")	5.48E+00	2.85E-02	1.05E-03	6.97E-01	-1.94E-03	6.62E+02	1.0000	0.05 x 0.05	8731999	7878926
W43-MM2	ALMA	0.30" x 0.24" (-72.49")	1.14E+00	4.33E-06	6.31E-05	4.36E-03	-8.43E-04	6.73E+01	1.0000	0.05 x 0.05	8731999	7878926
W43-MM2	COMB	0.30" x 0.24" (-72.49")	6.36E+00	2.41E-05	6.59E-05	4.89E-03	-8.42E-04	7.39E+01	1.0789	0.05 x 0.05	8731999	7878926
W43-MM3	MGPS90	10.00" x 10.00" (-87.39")	3.34E+00	1.73E-02	9.07E-04	6.97E-01	-1.94E-03	7.68E+02	1.0000	0.07 x 0.07	4459324	4031835
W43-MM3	ALMA	0.43" x 0.28" (-87.39")	1.12E+00	7.03E-06	6.92E-05	6.44E-03	-8.72E-04	9.14E+01	1.0000	0.07 x 0.07	4459324	4031835
W43-MM3	COMB	0.43" x 0.28" (-87.39")	4.26E+00	2.67E-05	7.13E-05	7.32E-03	-8.66E-04	1.02E+02	1.0800	0.07 x 0.07	4459324	4031835
G012.80	MGPS90	10.00" x 10.00" (-89.28")	3.24E+01	1.45E-01	7.82E-04	6.81E+00	-6.87E-04	8.71E+03	1.0000	0.23 x 0.23	480280	396757
G012.80	ALMA	1.39" x 1.21" (-89.28")	2.00E+01	1.50E-03	3.59E-04	7.94E-01	-3.77E-03	2.12E+03	1.0000	0.23 x 0.23	480280	396757
G012.80	COMB	1.39" x 1.21" (-89.28")	4.19E+01	3.14E-03	4.97E-04	9.01E-01	-4.35E-03	1.80E+03	0.9986	0.23 x 0.23	480280	396757

¹ The MAD in ALMAIMF image has been calculated on the non-emission mask. Non-emission mask has been obtained in the combined image: pixels with flux < 2 × MAD_{comb}.

² Max_A Maximum intensity value in image on primary beam mask with flux > 0.2

³ Min_A Minimum intensity value in image on primary beam mask with flux > 0.2

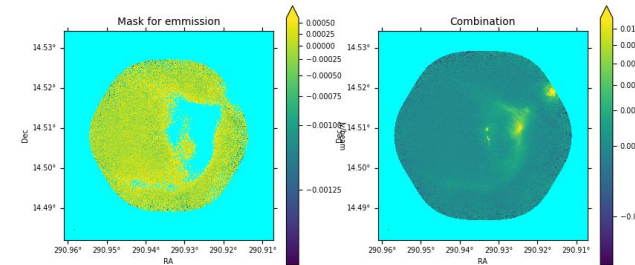
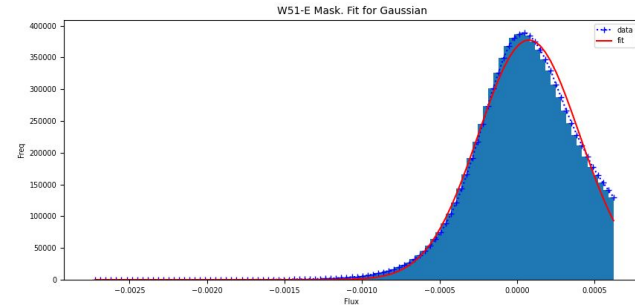
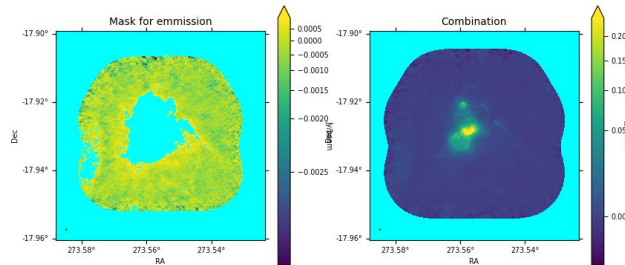
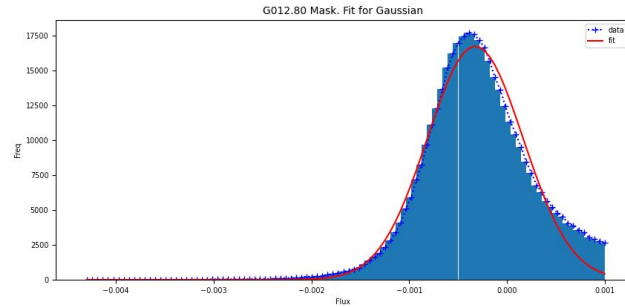
⁴ Npix_{pb} Number of pixels with value > 0.2 in primary beam response.

⁵ Npix_{mask} Number of pixels in non-emission mask.



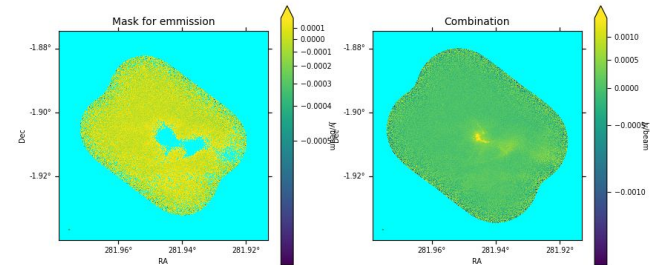
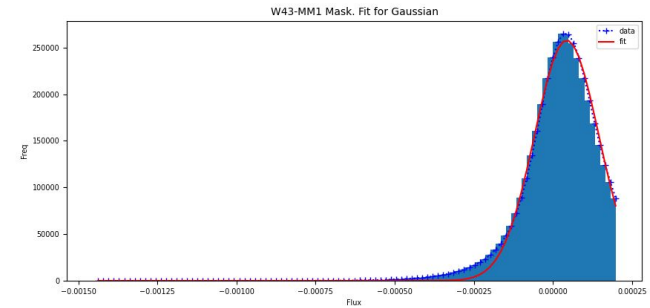
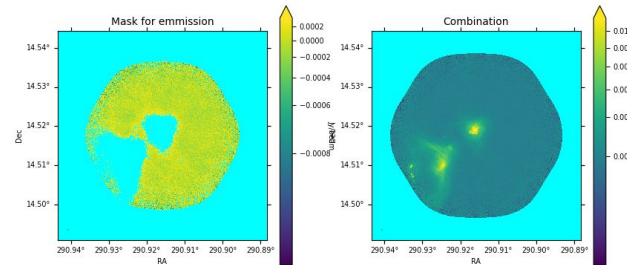
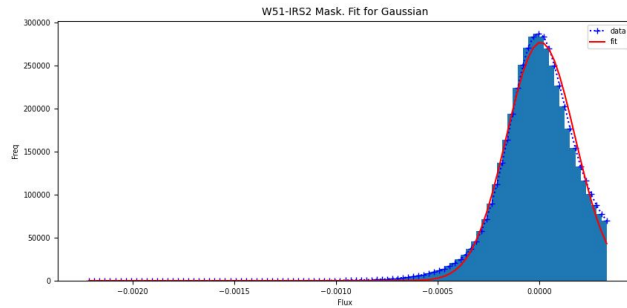
Feathering Combination ALMA-IMF + MGPS90

Comparison Area



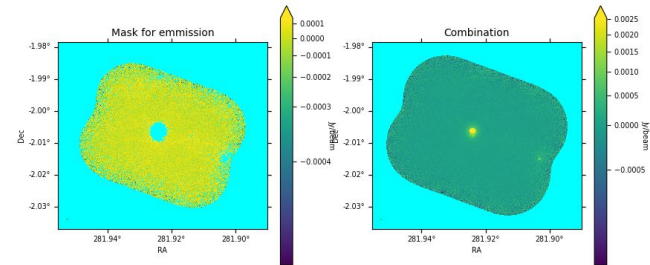
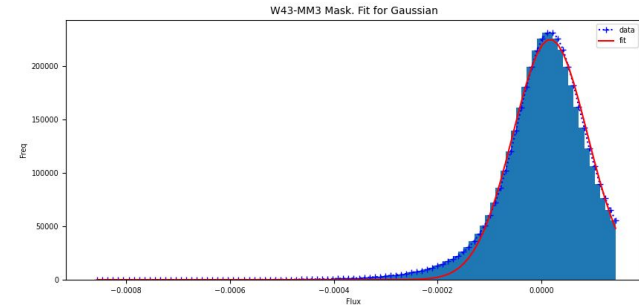
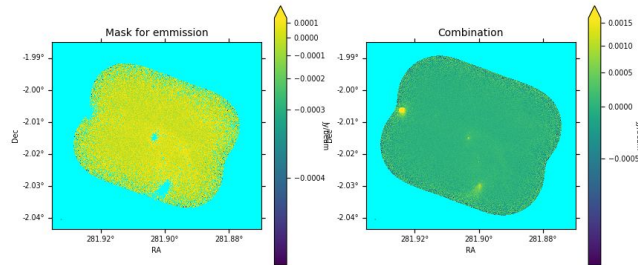
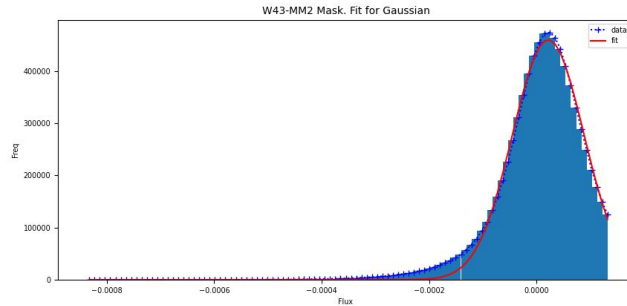
Feathering Combination ALMA-IMF + MGPS90

Comparison Area

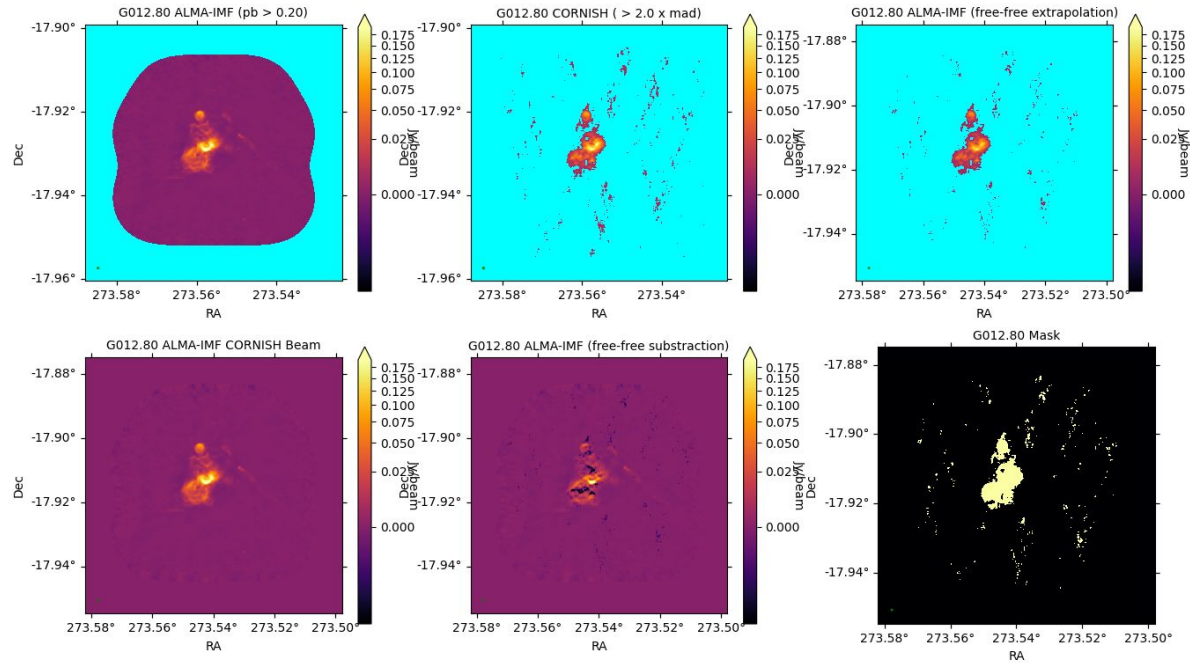


Feathering Combination ALMA-IMF + MGPS90

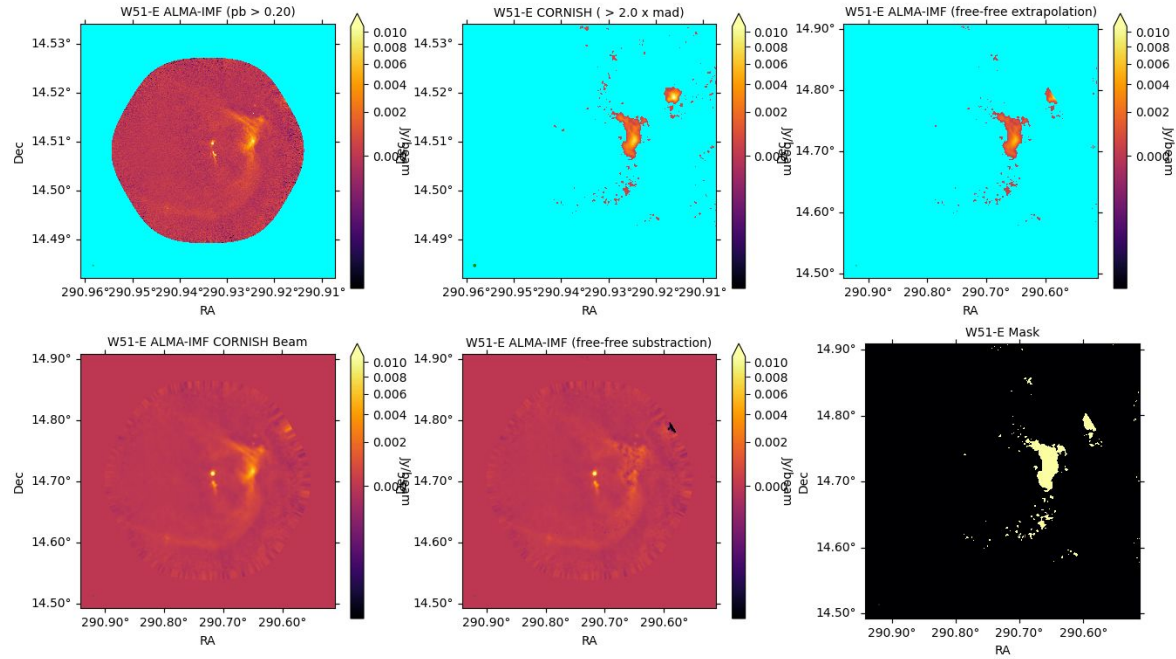
Comparison Area



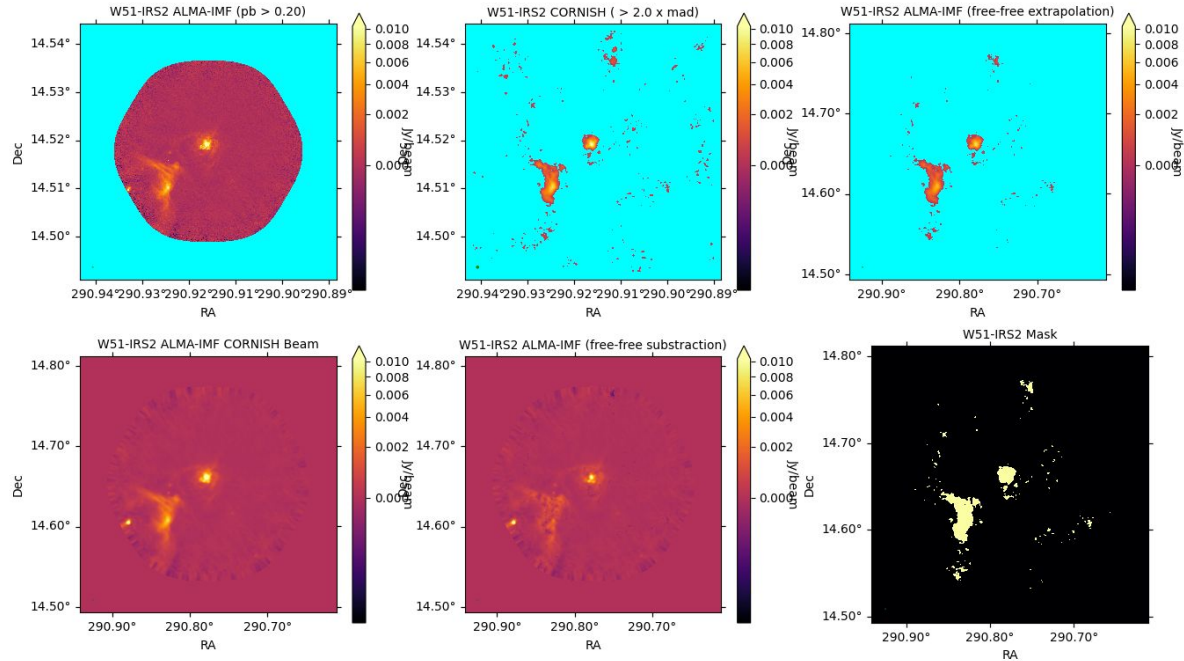
Free-Free maps. CORNISH Extrapolation



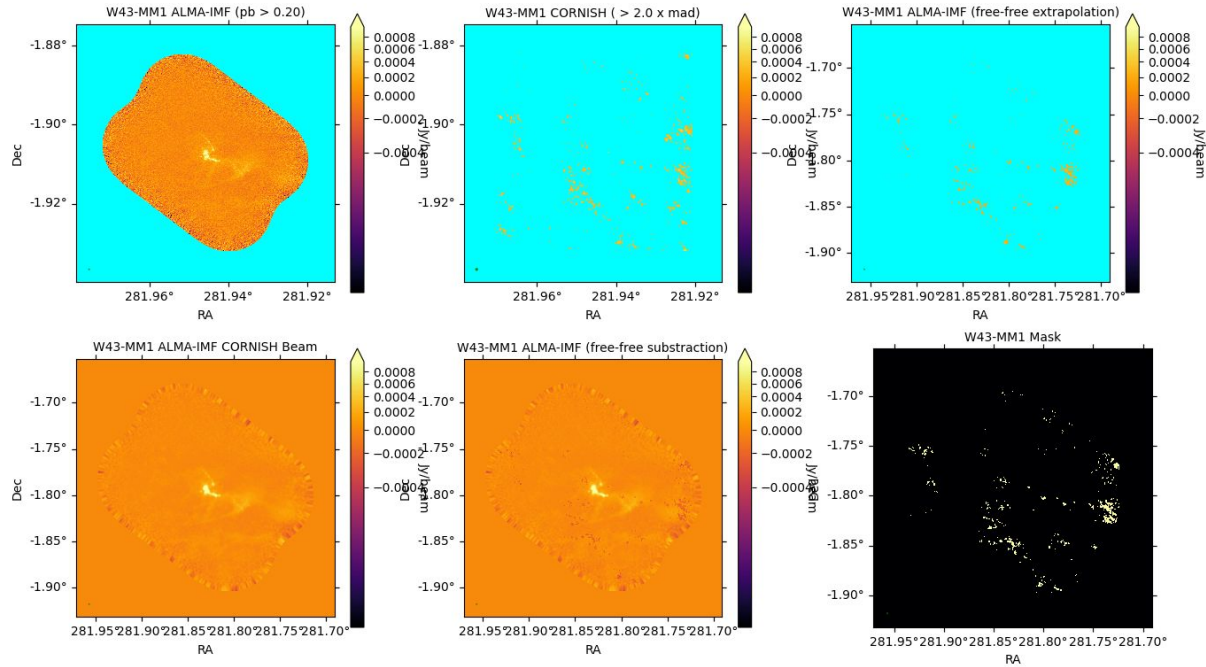
Free-Free maps. CORNISH Extrapolation



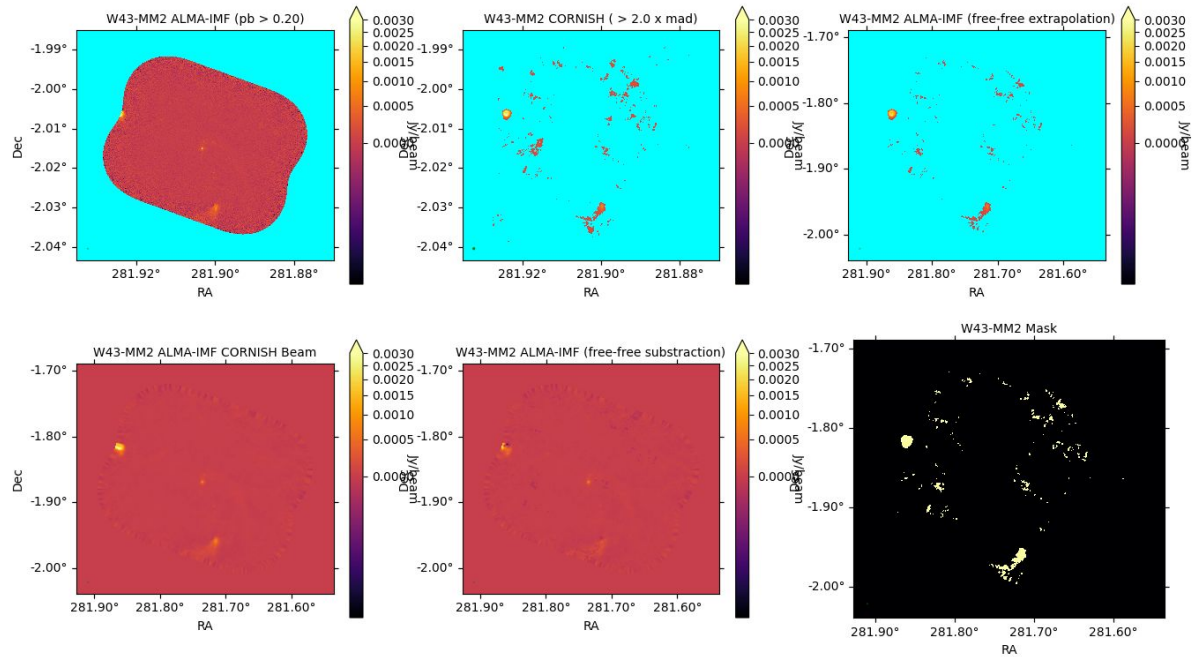
Mapas de libre-libre. Extrapolación de CORNISH



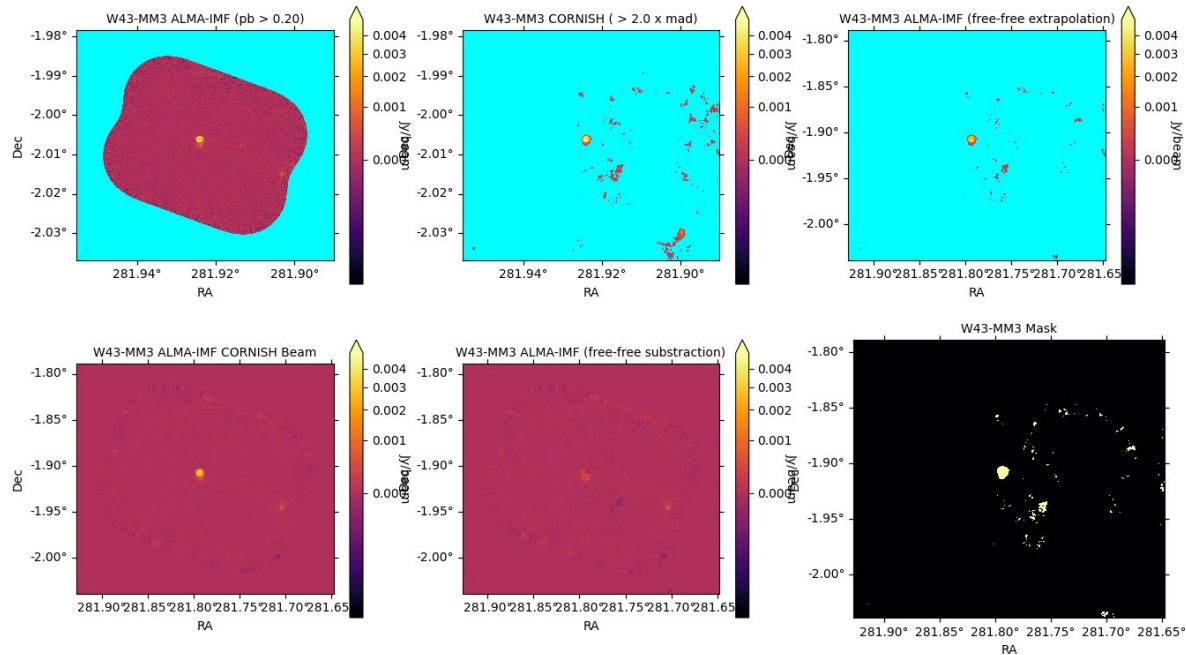
Mapas de libre-libre. Extrapolación de CORNISH



Free-Free maps. CORNISH Extrapolation



Free-Free maps. CORNISH Extrapolation





Next Steps

- Set the Science Goals for the first paper and start it.
- ALMA-IMF + BOLOCAM combination. Don't have common angular resolution.
- Spectral Index map from $(\text{BOLOCAM} + \text{ALMA-IMF}) / (\text{MGPS90} + \text{ALMA-IMF})$ Combination
- Comparison of Flux Recovery from $(\text{BOLOCAM} + \text{ALMA-IMF}) / (\text{MGPS90} + \text{ALMA-IMF})$.





Thanks!!!

