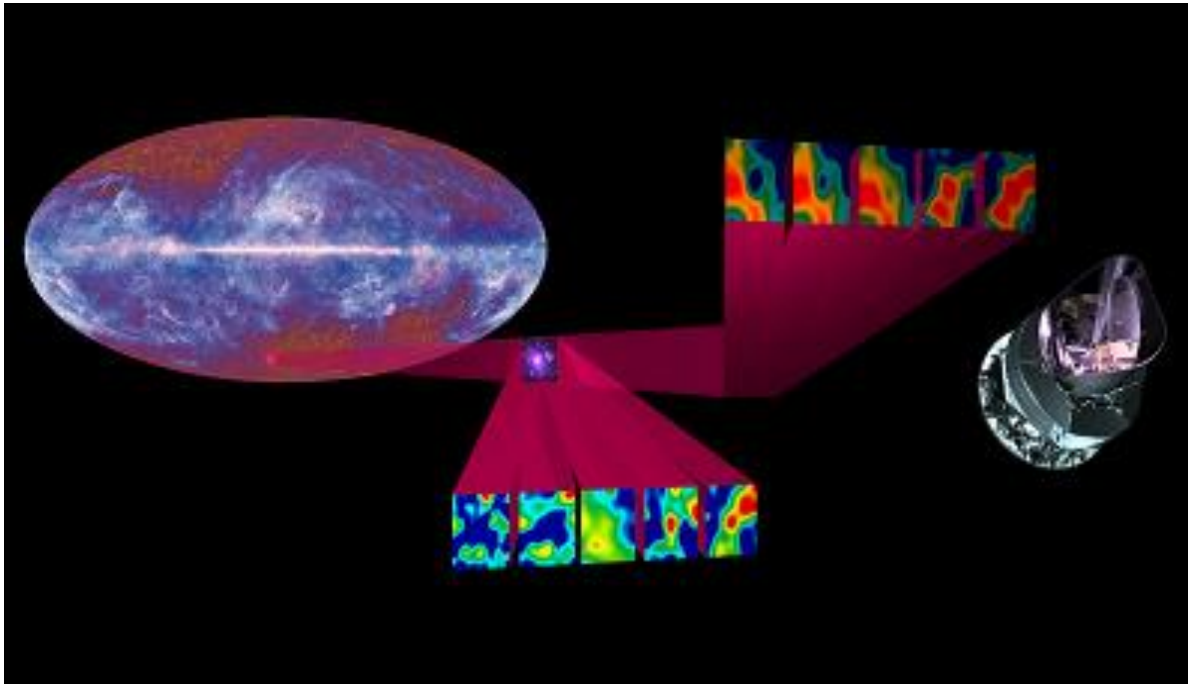# SZ effect on small patches of the sky

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NPAC computer science project, IAS, february 2016

Supervisors : Marian Douspis, Alexandre Beelen, Hervé Dole

Outline

- Internal Linear Combination

– Context : Planck and the SZ effect

– Method to compute the coefficients
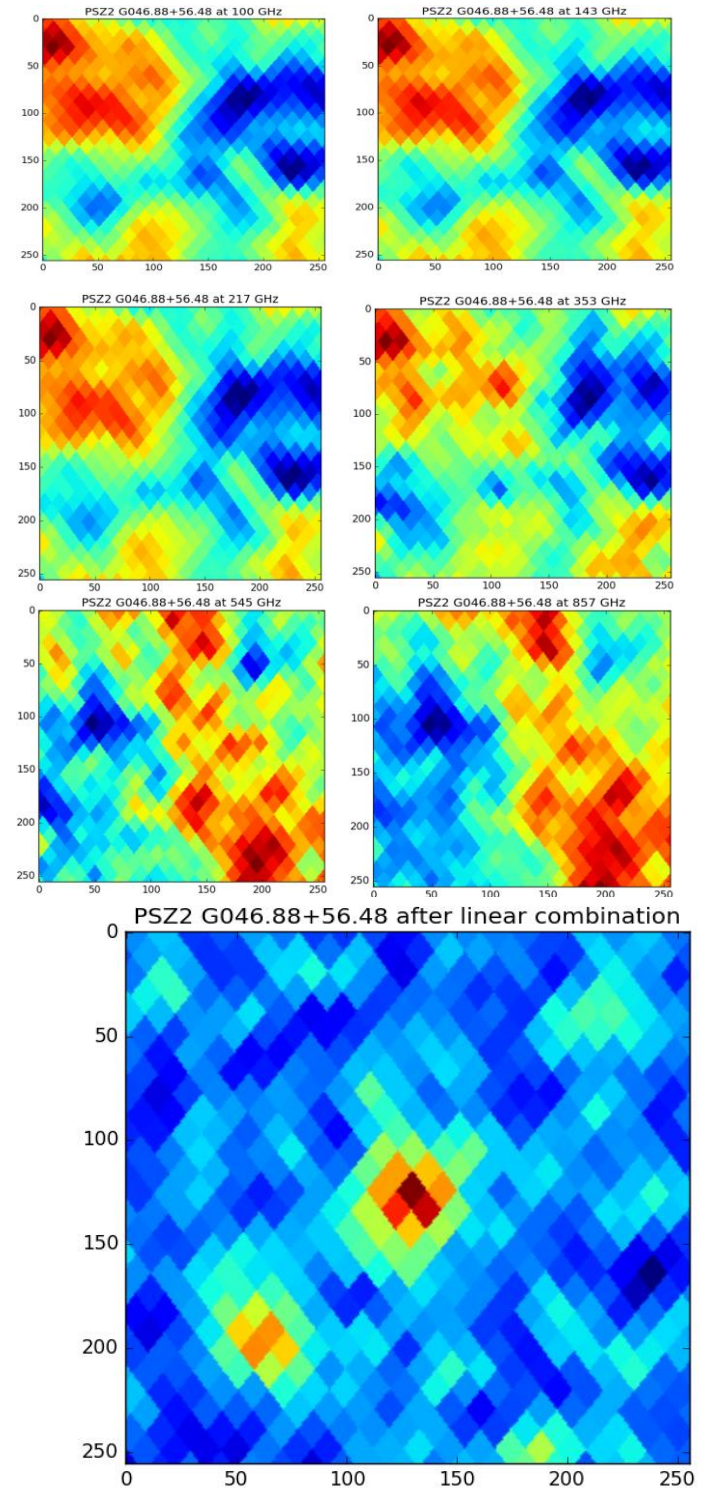
– Results

- A method on patches of the sky

– Zoom on a map
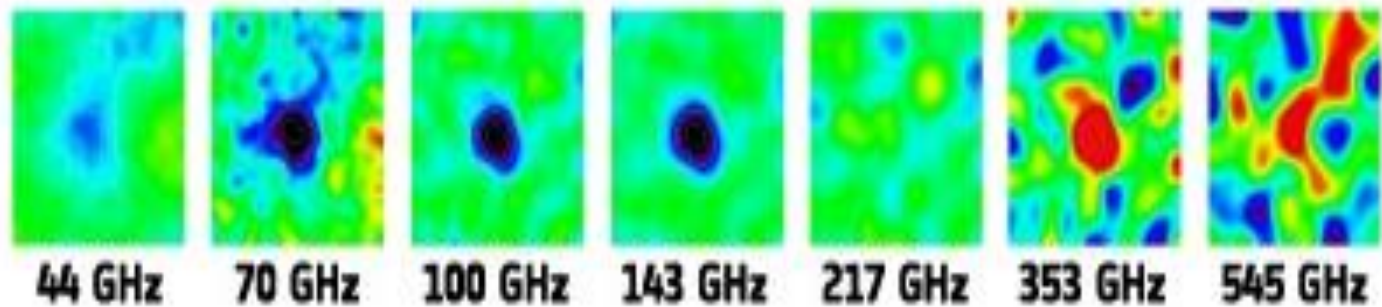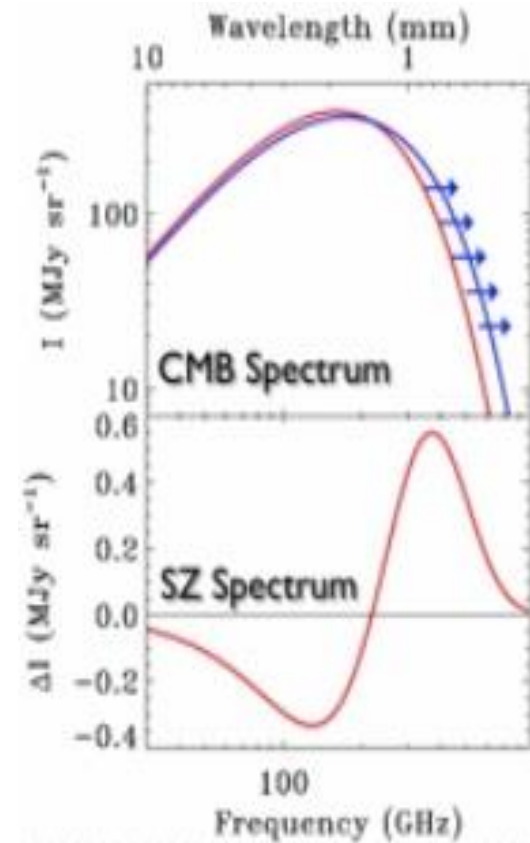
– Comparison local global
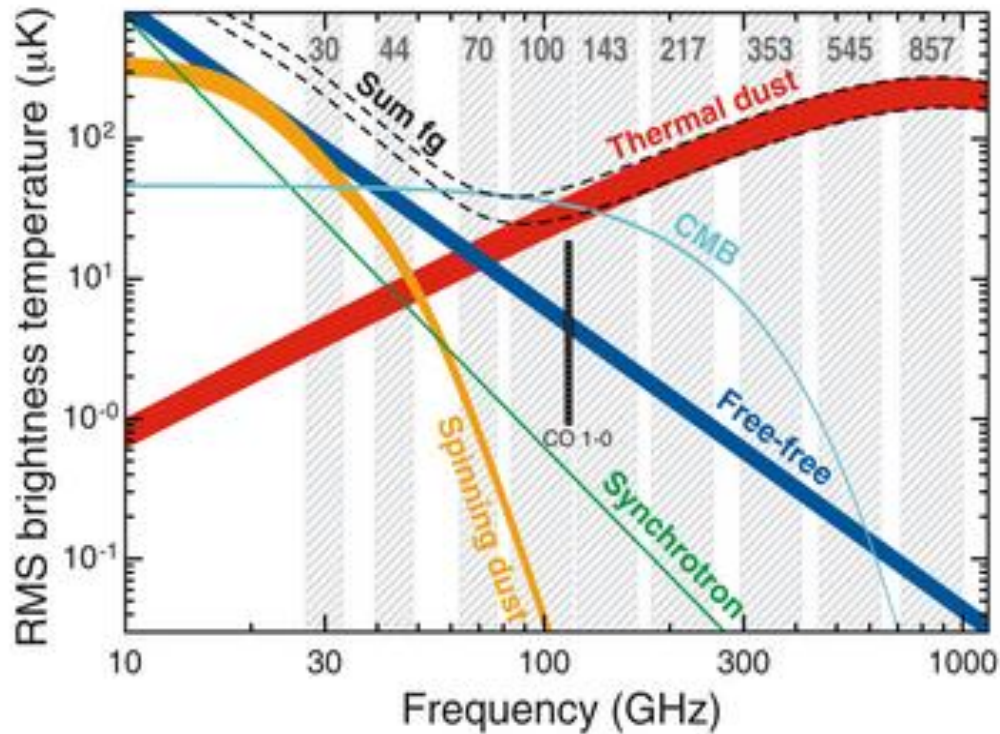
- Conclusion

– Comparison with different SNR

– Prospects

Context : Planck and SZ effect

Internal Linear Combination

Map-to-map covariant matrix elements :

$$C_{ij} = \langle \Delta T_i \Delta T_j \rangle = \frac{1}{N_{\text{pix}}} \sum_{p=i}^{N_{\text{pix}}} (T^i(p) - \bar{T}^i)(T^j(p) - \bar{T}^j).$$

Weights :

$$w_i = \frac{\sum_{j=1}^{k} C_{ij}^{-1}}{\sum_{jk} C_{jk}^{-1}},$$

Converting to get the SZ effect

| Band [GHz]	$U_{C\ IRAS}$ [MJy/sr/K$_{CMB}$]		$C_{C\ dust}$		$(U_{C\ IRAS})(C_{C\ dust})$ [MJy/sr/K$_{CMB}$]		$U_{C\ SZ}$ [y$_{SZ}$/K$_{CMB}$]	
100-avg	244.1	± 0.3	0.8938	± 0.0019	218.2	± 0.3	-0.24815	± 0.00007
100-detset1	244.9	± 0.4	0.889	± 0.003	217.6	± 0.4	-0.24833	± 0.00010
100-detset2	243.8	± 0.4	0.896	± 0.003	218.4	± 0.4	-0.24807	± 0.00009
143-avg	371.74	± 0.07	0.9632	± 0.0004	358.04	± 0.07	-0.35923	± 0.00006
143-detset1	365.03	± 0.15	1.0058	± 0.0009	367.15	± 0.15	-0.35398	± 0.00011
143-detset2	369.30	± 0.13	0.9773	± 0.0008	360.93	± 0.13	-0.35743	± 0.00010
143-SWBs	378.58	± 0.14	0.9238	± 0.0008	349.74	± 0.14	-0.36446	± 0.00011
217-avg	483.690	± 0.012	0.85895	± 0.00011	415.465	± 0.012	5.152	± 0.006
217-detset1	480.36	± 0.02	0.88411	± 0.00016	424.69	± 0.02	7.212	± 0.019
217-detset2	480.314	± 0.019	0.88235	± 0.00017	423.804	± 0.019	7.046	± 0.018
217-SWBs	486.331	± 0.018	0.84069	± 0.00015	408.855	± 0.018	4.236	± 0.006
353-avg	287.450	± 0.009	0.85769	± 0.00011	246.543	± 0.009	0.161098	± 0.000011
353-detset1	289.620	± 0.012	0.88255	± 0.00015	255.606	± 0.012	0.163757	± 0.000014
353-detset2	287.967	± 0.013	0.86548	± 0.00014	249.229	± 0.013	0.160904	± 0.000014
353-SWBs	286.786	± 0.011	0.84997	± 0.00014	243.759	± 0.011	0.160456	± 0.000013
545-avg	58.04	± 0.03	0.85444	± 0.00016	49.59	± 0.03	0.06918	± 0.00003
545-detset1	58.02	± 0.03	0.8513	± 0.0002	49.39	± 0.03	0.06924	± 0.00004
545-detset2	58.06	± 0.05	0.8612	± 0.0003	50.00	± 0.05	0.06905	± 0.00005
857-avg	2.27	± 0.03	0.9276	± 0.0002	2.09	± 0.03	0.0380	± 0.0004
857-detset1	2.26	± 0.03	0.9231	± 0.0003	2.08	± 0.03	0.0380	± 0.0005
857-detset2	2.27	± 0.04	0.9333	± 0.0003	2.11	± 0.04	0.0380	± 0.0005

To sum up

- Smoothing and degrading

- Making patches of the sky

- Converting to Ysz

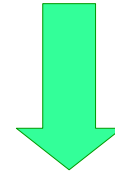- Computing map-to-map covariance matrix and weights

- Summing the maps
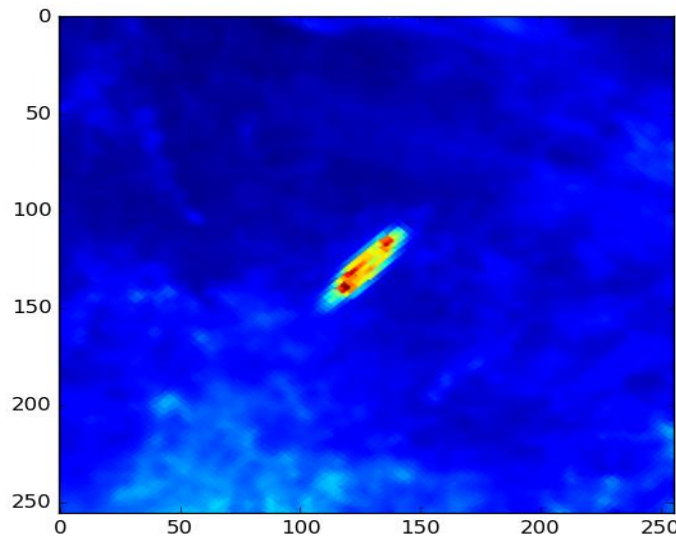
A method on patches of the sky

Zoom on a map
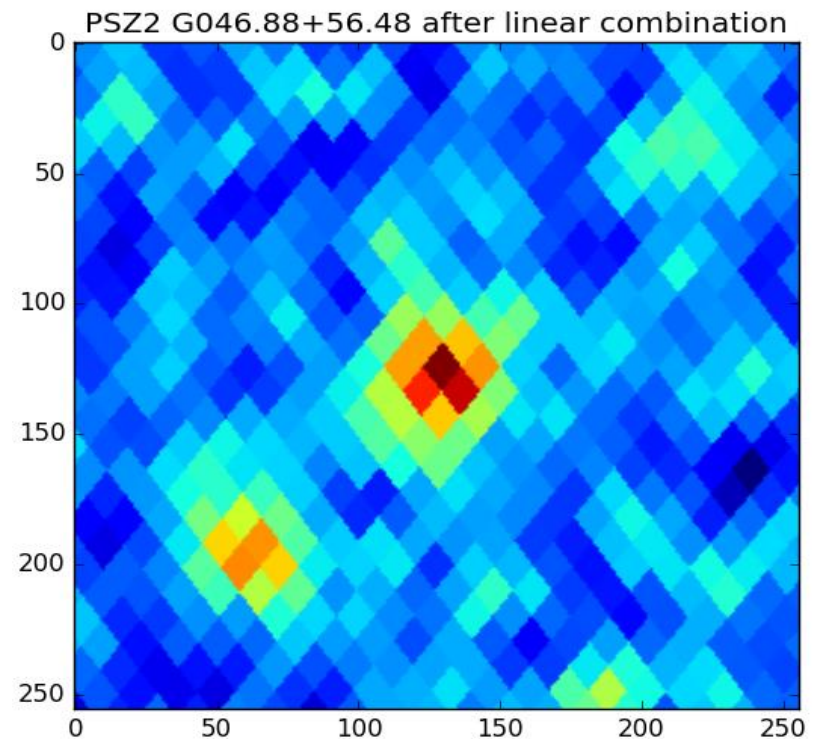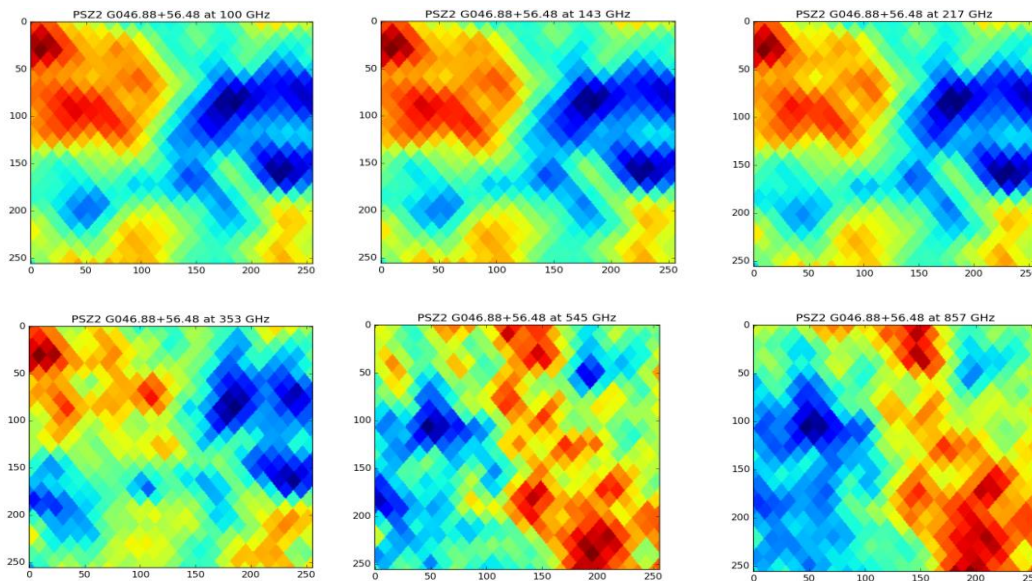
- We build patches with a preselected cluster in the middle.
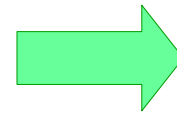
- LC only on the patches.

- Reconstruct clusters using the SZ effect.

Andromeda
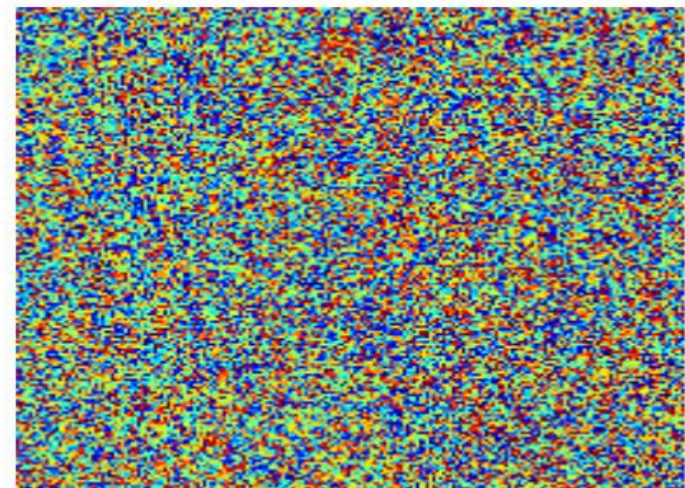
Comparisons: local-global SZ effect

Cluster	SNR	Local (us)	Global
PSZ2 G006.76+30.45	35.01	Yes	Yes
PSZ2 G006.49+50.56	23.17	Yes	Yes
PSZ2 G003.93-59.41	17.36	Yes	Yes
PSZ2 G046.88+56.48	12.93	Yes	Yes
PSZ2 G008.47-56.34	10.05	Yes	Yes
PSZ2 G004.45-19.55	9.07	Yes	Yes
PSZ2 G029.80-17.40	9.01	No	No
PSZ2 G028.77-33.56	8.74	Yes	No
PSZ2 G044.77-51.30	8.27	Yes	No
PSZ2 G002.82+39.23	8.07	Yes	Yes
PSZ2 G028.89+60.13	7.52	Yes	No
PSZ2 G012.59-20.10	7.01	Yes	No
PSZ2 G049.09+25.23	6.10	Yes	No
PSZ2 G029.55-60.16	5.03	Yes	No
PSZ2 G069.35-15.58	4.57	Yes	No

.We compare our results with the team that did the same work but on the whole sky.

PSZ2 G069.35-15.58 after linear combination
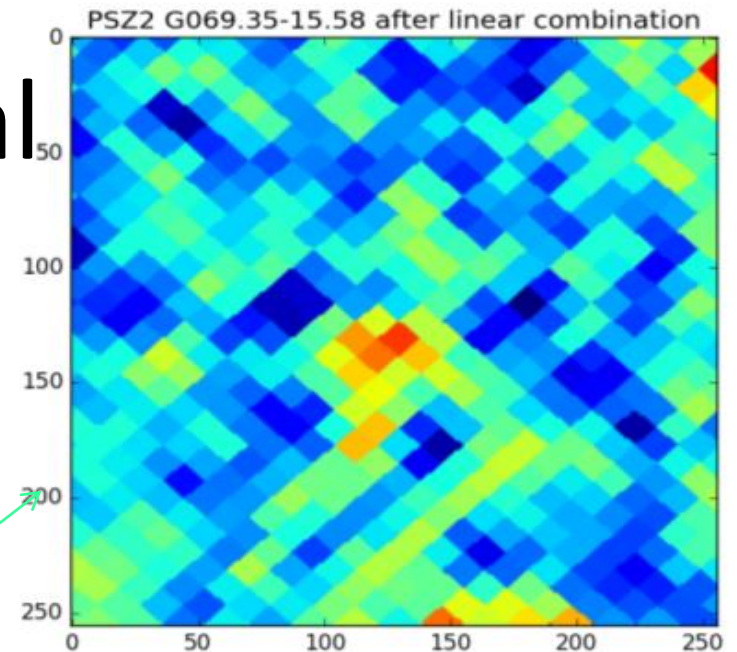
Region of the sky around cluster PSZ2 G069.35-15.58 after linear combination on this patch

Same region of the sky, around cluster PSZ2 G069.35-15.58, after linear combination on the whole sky
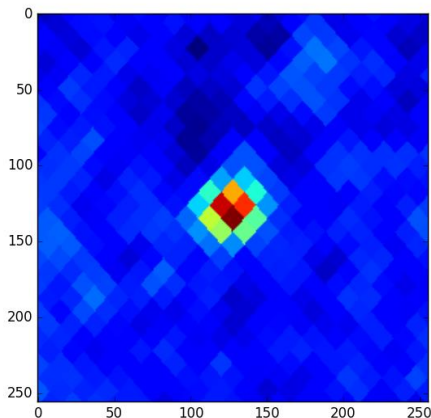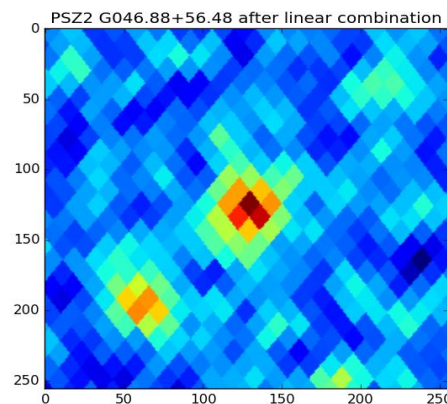
4.57-SNR-cluster.

Conclusions

• The local method enables us to reconstruct signals until lower values of SNR.

• The constrast diminishes with the SNR,
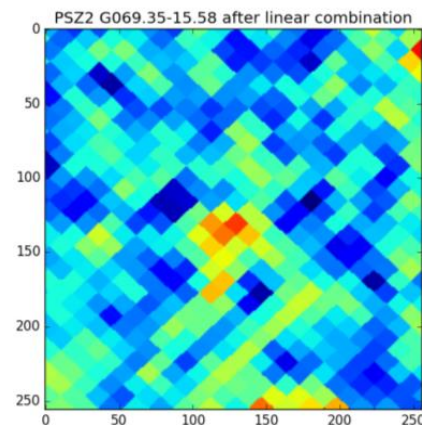but we can still recognize the cluster's signal.

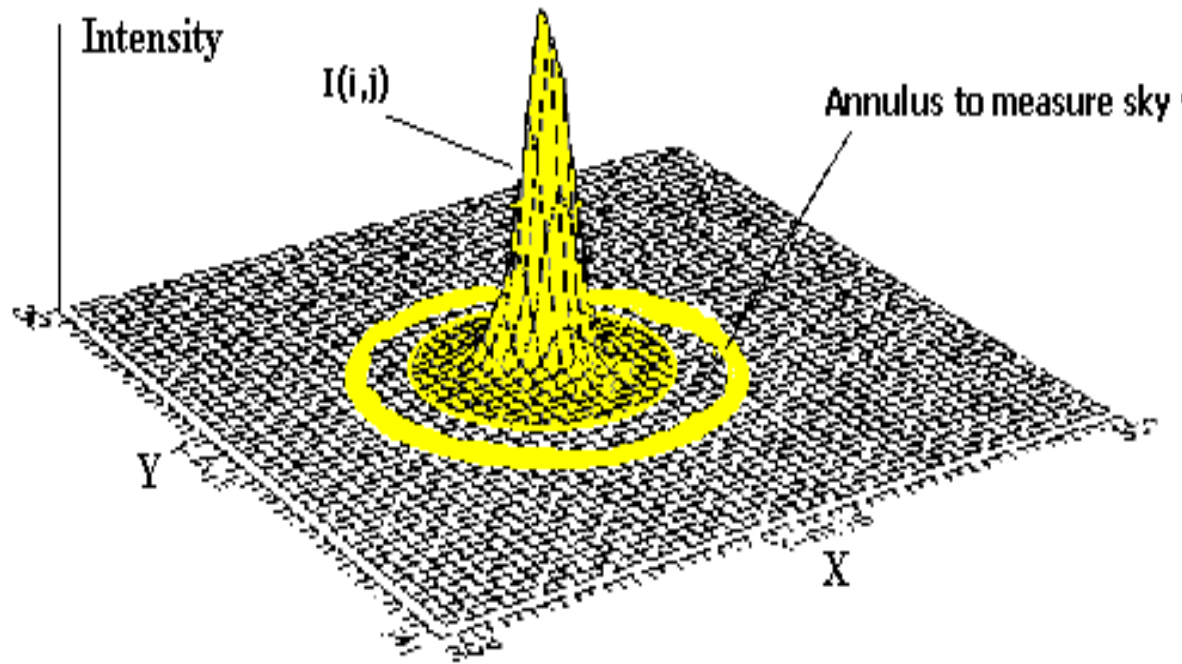| Cluster	SNR	Detected
PSZ2 G006.76+30.45	35.01	Yes
PSZ2 G006.49+50.56	23.17	Yes
PSZ2 G003.93-59.41	17.36	Yes
PSZ2 G046.88+56.48	12.93	Yes
PSZ2 G008.47-56.34	10.05	Yes
PSZ2 G004.45-19.55	9.07	Yes
PSZ2 G029.80-17.40	9.01	No
PSZ2 G028.77-33.56	8.74	Yes
PSZ2 G044.77-51.30	8.27	Yes
PSZ2 G002.82+39.23	8.07	Yes
PSZ2 G028.89+60.13	7.52	Yes
PSZ2 G012.59-20.10	7.01	Yes
PSZ2 G049.09+25.23	6.10	Yes
PSZ2 G029.55-60.16	5.03	Yes
PSZ2 G069.35-15.58	4.57	Yes

12.93-SNR

PSZ2 G046.88+56.48 after linear combination

35.01-SNR

PSZ2 G069.35-15.58 after linear combination

4.57-SNR

Next Steps

- Review of the 1653 cluster using photometry.

Thank you for your attention !