

## Comments on kSZ paper – F. Mayet 5/6/2016

Overall comment: excellent paper. The result is impressive. The paper is well written.

### Comments

Title : I think the title should be changed to include “NIKA camera” rather than “kinetic inductance detectors”

I suggest

Mapping the kinetic Sunyaev-Zel’dovich effect towards MACS J0717.5+3745 with the NIKA camera.

### Abstract

-Measuring the gas velocity distribution in galaxy clusters provides a precious insight into the physics of mergers, which are at the origin of large scale structures in the Universe.

-The kSZ emission is dominated by a dipolar structure that peaks at  $-5.1\sigma$  and  $+3.4\sigma$ ,

\*the negative value might be surprising for the reader if he is not familiar with kSZ. We might either avoid this or explain this by adding a few words on the sign of the velocity.

\*.coincident with the cold dense X-ray core and a hot region undergoing a violent merging event.

→see above. I think it would be better to end the sentence with an explanation of the velocity.

For instance:

The kSZ emission is dominated by a dipolar structure that peaks at  $-5.1\sigma$  and  $+3.4\sigma$ , corresponding to two sub-clusters moving respectively away and toward us.

-We investigate the effect of possible contamination and systematic effects with a special care given to radio and sub-millimeter point sources.

-Among the sources that we detect with NIKA, we

### Section 1

-sub cluster → sub-cluster or subcluster

- the clusters observables → the cluster observables

- important from a cosmological point of view.-->ref needed

- relative motion of the cluster electrons→bulk motion of the electrons of a component of the cluster (sub-cluster)

- along the line of sight, used as a mass proxy in various cosmological surveys → along the line of sight and can be used as a mass proxy in various cosmological studies.

- It is made of four optically identified main → It is made of four optically-identified main

- The X-ray emitting gas is very disturbed ... → The X-ray emitting gas is very disturbed ([Ebeling et al. 2007](#); [Ma et al. 2009](#); [Mroczkowski et al. 2012](#)) and shows a dense core in the direction of sub-cluster B, a disturbed structure between C and D. Sub-cluster A is almost invisible in X-ray, suggesting that...

-indication the cluster → indicating that the cluster

## Section 2

-to express them in term of → in terms of

- the kSZ signal can be either positive or negative but its sign is the same at both NIKA frequencies.

→ the kSZ signal can be either positive or negative, depending on the sign of the velocity, but its sign does not depend on frequency.

-The kSZ maximum → Note that the kSZ maximum..

## Section 2.2

-NIKA clusters and has ... → NIKA clusters as detailed in

-the full noise covariance matrix form → from

-the difference maps cross spectra → the cross spectra of the difference maps.

(ou the difference-map cross spectra)

## Section 2.3

-the four regions we consider → that we consider

-unless clearly stated → unless otherwise stated

-results we present → that we present

-on the south of region D → on the south part of region D ?

## Table 1

-The uncertainty on the NIKA bandpasses is about 2% → this is unclear. Please explain.

## Section 3

-It was the largest astrophysical contribution but was also negligible. →

Despite being the largest astrophysical contribution, it has been shown to be negligible.

-CIB model we use → that we use

## Section 3.2

-poorly described and “two distinct spectral indices” → this is not clear from table 4.

Concerning “poorly”, I note that nika data and model are in agreement for F, within 1sigma (given the large error bar on the nika flux). I would say a fair agreement.

Do you think it would be useful to have a figure with the SED of the sources to highlight the agreement (or disagreement) ?

-The source model is given in ... → I think it would be useful to give a short explanation (I guess we take central value of the fit and not NIKA data ?, then you convolve with NIKA beam).

## Section 3.3

-NIKA bands → NIKA bandpasses

## Section 4

-and have to be accounted using an → and have to be accounted for by using an

-Then, it is not...

→ Then, X-ray data are also needed in order to disentangle the

gas line of sight velocity from the density and the temperature (see eq. 5). Indeed, this cannot be done with

the NIKA observations in two bands and an

extra constraint is needed, which X-ray observations can provide.

## Table 5

Give SPIRE frequency rather than wavelength

## Section 4

-Units should not be in italic.

## Section 4.1

- To each event cube we assigned an effective area cube, which we use to correct for vignetting and exposure time, and the background noise cube.

->this sentence is unclear to me...

(too many cubes ?)

- does this make sense: "To each event in the cube we assigned an effective area, which is used to correct for vignetting and exposure time, and the background noise" ?

-it's wavelet->its wavelet

-From now, all the techniques described in the following were used for both Chandra and XMM-Newton datasets, unless stated otherwise.

->In the following, all techniques described have been used for both Chandra and XMM-Newton datasets, unless otherwise stated.

#### Section 4.2

-a region free from the cluster emission in the → ?

-of all the components performing →by performing

-we found that one absorbed APEC model at 0.86 keV is sufficient to reproduce the excess → ?

#### Section 4.3

-maps we obtained →that we obtained

-Furthermore, in the South-East sector we can see that there is a cold region in the North-West sector associated with the most prominent structures → ?

-As additionnel → As an additional

-respect than →with respect

#### Section 5

If think the introduction could be improved

Ideas

1) we have indication of kSZ in figure 1

2) we want to separate the tSZ and kSZ effect in order to produce maps for each one, for the first time...

The goal is to produce these maps rather than explaining our data. It is the title of the paper and hence the main result. You should make the case stronger.

Figure 3 : (caption). Color code indicate T in keV

#### Section 5.1

-which T of table 6 is used ? XMM-15 or XMM-30 ?

#### Section 5.2

-a few words on the sign of the velocity might help the reader. Also, make a link with eq. 5.

-with 22 →within a 22 arcsec radius disk.

-.. as shown in figure 4.-->Results are presented in figure 4 for the 4 subclusters.

- As the two are degenerated, however, the 150 GHz band is nonetheless not compatible with zero and therefore, we detect tSZ emission in region A if we assume that the kSZ signal is negligible there. →i do not understand the interest of this sentence...

#### Section 5.3

-which T do you use ? figure 3?

#### Section 5.4

-i.e. multiplying the map by a factor of  $\pm 1.07$  →trivial

-160 GHz →260

-of our detection →of detection

#### Section 5.5

-The dark matter follows well the main galaxies → well in principle galaxies follow dark matter as the latter defines the gravitational well...

#### Section 6

I found this section difficult to read in particular as it is not clearly stated whether we use X or not (what you call baseline case). This could be improved.

- The detection of the kSZ → The detection of the kSZ effect opens the possibility to study the motion of the gas contained within the cluster.

-toward high redshift → I think away and toward us will be easier to understand.

#### Figure 6

-Chartreuse → on reconnaît bien le dauphinois !

#### Section 6.1

-cluster component → you mean subcluster (i=1 to 4) ?

-each clump → you mean subcluster ?

-the quantity Gamma → trivial

#### Section 6.2

-The SZ models are convolved to the beam and the transfer function of the NIKA processing.

→ it sounds weird as you mean fake data from the model. I think a clear denomination for simulated data has to be chosen for clarity (everywhere in the paper)

-The chains are moved → The Metropolis-Hasting algorithm (see, e.g., [Chib & Greenberg 1995](#)) is used to define the evolution of the chains, by using...

-do not contribute the likelihood → to the likelihood

-we check a posterior → a posteriori

-footnote "is larger" → must be larger

-burn in → burn-in

#### Section 6.3

-of section → 6.2 ?

-The baseline fitting → I think you should clarify the denomination of the cases with or without X-ray. I think baseline is not clearly defined and it may lead to misunderstanding.

#### Section 6.4

-baseline → i.e. without X-ray prior

-sub cluster B and C → subclusters B and C

-The constraint with and without X-ray priors are consistent → where can we see this ?

On figure 8, I can only see the case with X-ray for B.

-This is counter intuitive → too strong. "in tension with" would be enough

- ...the X-ray density prior. In this case, the optical depth map increases ... → I think it would be interesting to include the maps with X-ray prior in the paper as you discuss them. Otherwise it is difficult to follow, especially when speaking of features on these maps (e.g. while sub cluster C is more diffuse and extends further in space)

#### Section 6.5

-The raw NIKA and Bolocam data → maps

-an strong → a strong

-overall compatible → see tab. 7

-Table 7 summaries → this sentence should appear earlier (overall compatible).

-Finally ... →I have not understood this paragraph. →how can you compare this study with a simulated cluster that is only similar to MACSJ0717 ?

#### Figure 8

- units should be given
- red contours are not defined.
- the case with X-ray prior should be presented

#### Figure 9

- Note that the field shown in here is not the same as other ones displayed in this paper. →it is smaller rather than different
- the fact that the map is model dependent should be highlighted.
- it would be interesting to add 2 maps for the case with X-ray prior, in order to follow the discussion in the text.

#### Section 7

- this frequencies →these
- that sub cluster B and C are likely to be made of sub component themselves  
→that sub clusters B and C are themselves likely to be made of sub components.
- are difficult to compare to previous constraints because the transfer function of the observations are not the same.—> I think this sentence weakens the conclusion. The comparison has been done anyway.
- with zero line of sight velocity → with a null line-of-sight velocity
- “limited by degeneracies” “overall in agreement”→I think the conclusion is not strong enough.  
This is the first kSZ mapping of a cluster. The conclusion should be more positive (of course you can keep warnings such as model-dependent for the velocity map).

Acknowledgements→please use the latest version (see NIKA wiki)