Mapping the kinetic Sunyaev-Zel'dovich effect toward MACS J0717.5+3745 with NIKA
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Introduction

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I think you should not put cluster peculiar velocity and velocity of sub-clusters in merging systems on the same level. This introduction should focus on mergers and only mention cluster peculiar velocity in general.
To shorten the introduction, for example, I propose:

« In addition, as mergers are driven by the collapse of structures under the influence of grav- ity, the peculiar velocity distribution of galaxy clusters is related to the underlying cosmology. Therefore, such velocity measurements provide a complementary cosmological probe to constrain structure formation (Bhattacharya & Kosowsky 2007) and the understanding of the properties of the velocity field is a subject of active research (e.g., using numerical simulations, Hahn et al. 2015). Cluster peculiar velocities are particularly sensitive to the redshift evolution of dark energy (Hernández-Monteagudo et al. 2006; Bhattacharya & Kosowsky 2008; Ma & Zhao 2014) and can be used to distinguish it from modified gravity models (Kosowsky & Bhattacharya 2009). » —> « In addition, such velocity measurements provide a complementary cosmological probe to constrain structure formation (Bhattacharya & Kosowsky 2007) and the understanding of the properties of the velocity field is a subject of active research (e.g., using numerical simulations, Hahn et al. 2015). »

« motion of the electrons of the cluster electrons » —> « motion of the electrons of the cluster »

« can be used as a mass proxy in var- ious cosmological studies » —> « can be used as a mass proxy to derive cosmological constraints »

« Several attempts to measure the kSZ effect has been performed toward in- dividual clusters (e.g. Holzapfel et al. 1997; Benson et al. 2003; Adam et al. 2015; Sayers et al. 2015) and on statistical samples (e.g. Kashlinsky et al. 2008; Planck Collaboration et al. 2014b). While Kashlinsky et al. (2008) claimed for the detection of a large amplitude bulk flow, their results have been disputed in the literature (see also Atrio-Barandela 2013), and the first clear kSZ detection was obtained only recently by Hand et al. (2012) using the mean pairwise momentum of a large sample of clusters (see also Soergel et al. 2016, for a recent result). The kSZ effect was also used to detect unbound gas at large scales from the cross correlation between kSZ fluctuations and central galaxies radial peculiar velocities (Planck Collaboration et al. 2015a). » —> This can be simply removed.

The part dedicated to the literature about this cluster could be shortened, given that it is recalled in section 6.5 in which the comparison with previous results is discussed. Without any reference to a figure, it is hard to follow such a detailed description of all the sub-clusters and related morphological features characterizing the cluster at the different wavelengths. Try only to summarize what has been observed at the different frequencies. For example:
« The X- ray emitting gas is very disturbed (Ebeling et al. 2007; Ma et al. 2009;

Mroczkowski et al. 2012), with an X-ray spectroscopic temperature (Ma et al. 2009; Mroczkowski et al. 2012; Sayers et al. 2013) that is very high (~ 20 keV) between the too sub-clusters undergoing a violent merging event, while it is much colder (~ 10 keV) towards the one showing up as a dense cose on the X-ray map, likely to be still in a pre-merging state. Edge et al. (2003) discovered the presence of powerful radio emission around the high temperature region, indicating the presence of non-thermal support (see also van Weeren et al. 2009; Bonafede et al. 2009; Pandey-Pommier et al. 2013, for more recent studies). MACS J0717.5+3745 was also observed using 30 GHz interferometric SZ data by the Sunyaev-Zel'dovich Array (SZA), indicating that the cluster was a hot and massive system (LaRoque et al. 2003). Mroczkowski et al. (2012) reported high angular resolution (effective beam FWHM of 13 arcsec) SZ observations at 90 GHz using MUSTANG (The MUltiplexed SQUID/TES Array at Ninety GHz) at the Green Bank Telescope (GBT). The data revealed small scales structures in the pressure distribution between the merging sub-clusters and signal toward the X-ray dense core, in agreement with the merger scenario.
-new paragraph-
The velocity distribution of MACS J0717.5+3745 was first studied using optical spectroscopy (Ma et al. 2009), showing that the galaxy groups have exceptionally large relative line of sight velocities, providing a more detailed picture of the merger kinematics. The first indication of the presence of kSZ signal in MACS J0717.5+3745 was reported by Mroczkowski et al. (2012), using Bolocam SZ data from the difference between their 140 and 268 GHz bands, finding velocities that were consistent with optical measurements. »

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2. Sunyaev-Zel'dovich observations and data reduction
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2.1. The Sunyaev-Zel'dovich effect

« Only the thermal and the kinetic SZ effects have been observed so far » —> The thermal and the kinetic SZ effects have been observed in the direction of clusters of galaxies

« but in principle the SZ effect can also arise from the CMB interaction onto more exotic electron populations, such as ones originating from dark matter annihilation (Colafrancesco 2004) or ultra relativistic electrons accelerated in radio lobes (Colafrancesco 2008). Nevertheless, these other contributions are expected to be small and, in this paper, we assume that only the tSZ and the kSZ effects contribute the SZ signal. »
—>lower order effects may exist (e.g. …..) but they are negligible here.

« vz is the gas line of sight velocity1 », why a footnote?

2.3. NIKA raw maps

At the end of this sub-section there is a detailed discussion of point sources. I think that only the discussion of the general features of the map should be left here, saying that a more detailed discussion is provided later.

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3. Astrophysical contamination of the Sunyaev-Zel'dovich signal
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3.1. Diffuse galactic emission and cosmological background

« We reproduce the work detailed in » —> We apply the same approach used in

3.2. Radio sources
« Following Adam et al. (2016), we assume the radio SED » —> « We assume the radio SED.. » or « As in Adam et al. (2016), we assume the radio SED.. »

3.3. Submillimeter point sources
« We use the method detailed in Adam et al. (2016) » —> We use the approach detailed in Adam et al. (2016)

You say that « Most of the model predictions are fully compatible with the NIKA observations ». We expect the model to bel less accurate for those that are SZ contaminated and for which the NIKA flux is not used in the fit. Otherwise you should try to see what happens if you remove the NIKA constraints also for the others.

3.4. Diffuse submillimeter emission from the ICM
I think that a whole sub-section dedicated to this is a little too much. This point should be synthesized in one-two sentences and put in the introduction of this section or at the and of sub-mm point sources.

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4. X-ray data analysis
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« In the work presented in this paper, X-ray data are needed for two reasons. » —> In the work presented in this paper we have complemented SZ data with X-ray observations for two reasons.

« Indeed, this cannot be done with the NIKA observations in two bands and an extra constraint is needed, which X-ray observations can provide. » = this is kind of a repetition of what has been said before, you should instead use these lines to introduce what will be discussed later (« In the following we then describe… »).

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5. A map of the kinetic Sunyaev-Zel'dovich signal
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« The main goal of this section is, therefore, to produce » —> remove « therefore »

5.1. Reconstruction of the kinetic Sunyaev-Zel'dovich signal
« The two NIKA maps, cleaned of contaminants, provide a mea- surement of » —> ref. to Sect. 3

5.3. Mapping of the kSZ and tSZ signal
Given that you say that « The results of section 5.2 provide quantitative illustration of our constraints, but they directly depend on the choice of the region coordinates and their aperture size » you should somehow quantify it, or provide a qualitative SHORT discussion.

« Therefore, we now consider the full surface brightness NIKA data » —> Therefore, we now take advantage of the resolved nature of the NIKA data.

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6. Constraints on the gas line of sight velocity distribution of MACS J0717.5+3745

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« Therefore, in this section, » —> In this section

« However, measuring the absolute line of sight velocity from our kSZ map requires disentangling it from the integrated line of sight electron density, » : put ref to Eq. 5 and ref. to Sect. 4 at the end of the sentence. In the following sentence you have a repetition of the verb « present ».

6.1. Physical modeling of the gas distribution of MACS J0717.5+3745

You do not discuss at all your choice for the beta-model. You should briefly say why you preferred it and why it is adapted (more complex is useless, analytical integral etc.)

Eq. 9 : (m, n) are introduced only later. Anyway, given that you say that you do that pixel by pixel, I do not think that it is really needed to add these indices. To me they only make the equation harder to read. They are useful only in Eq. 11.

« In order to fit parameters of our model, we need to compare our data to the expected simulated signal according to the val- ues of the parameters and to the description of the gas discussed in section 6.1. » : you can remove this sentence.

« The SZ simulated maps are convolved » —> The SZ maps obtained for each explored point of the parameter space are convolved… (I am afraid that « simulated » could lead to some confusion)

6.3. X-ray prior on the gas density

« As our baseline, hereafter F1, we do not consider X-ray imaging. The fit relies only on SZ imaging and X-ray estimates of the gas temperature. »: you should make clearer what is used for the temperature (you have presented a temperature map before and later, sect. 6.4, you mention the constant temperature assumption)

« would strongly affected » —> would BE strongly

« While fit F1 is conservatif, » —> conservative

6.4. Constraints on the velocity

It is a little bit wired to have the description of how tau is computed after the discussion of residuals. This section needs maybe to be reorganized (and divided in two sub-sections?)

6.5. Comparison to previous results and discussions

« the best fit model of Sayers et al. (2013) » (S13 hereafter), you refer to this paper at least ten times in this paragraph ….

« Ruan et al. (2013) …. disturbed system. » : Is this really needed ? Anyway, if you leave it, you should make clear from the very beginning that their work is based on simulations.

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7. Summary and conclusions

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« Despite this limitation » —> However

« open a new way »: this is an extremely hie result, but « open a new way » seems a little too strong to me (the feasibility of this kind of study with state of the art instruments?)

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Tables and figures

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Table 1. and 6: These tables should be reduced to half-column size.

Table 3. and Table 4.: The coordinates reported in Tab. 3 could be placed below HT, B, F, C1, C2, C3, C4 to reduce the number of tables. The coordinates of the sub-mm sources are in fact reported in the same table of the fluxes (Tab. 5).

Figure 3. Why no units and color bar only for the bottom right panel ?