The filamentary structures revealed by large-scale galaxy surveys form the so-called cosmic web (Bond et al. 1996) that traces the matter and gas distributions in the universe. The theory behind the formation of the cosmic web is now well established (see, e.g., Bond et al. 1996; Pogosyan et al. 1996): the rare intersections of matter filaments connect around redshift \( z \approx 0.83 \) and allow the localization of the group at \( z = 0.83 \). We found a significant hot spot visible in the X-ray hardness map, close to the second peak. The spectroscopic temperature is \( T = 1.6^{+0.4}_{-0.1} \) keV within \( R_{500} = 0.6 \) Mpc and \( T = 3-5 \) keV in the hot spot. We interpret those results as Suzaku J1552+2739 being located in the center of a major merging process. The observation of a galaxy group showing multiple X-ray peaks and a hot spot at the same time is rare and we believe in particular that the study of Suzaku J1552+2739 is potentially of significant interest for better understanding the dynamical and thermal evolution of the intracluster medium with the surrounding environment.

Key words: galaxies: groups: individual (Suzaku J1552+2739) – large-scale structure of universe – X-rays: galaxies: clusters

1. INTRODUCTION

The observational target was selected to aim at the diffuse intergalactic gas within galaxy filaments and was observed by Suzaku for 80 ks on July 31 in 2010. The identification of the correct environment was achieved using the New York University Value-Added Galaxy Catalogue (Blanton et al. 2005; Padmanabhan et al. 2008; Adelman-McCarthy et al. 2008), extracted from the spectroscopic data of the SDSS Data Release 7 (Figure 1) by a visual inspection at first and was confirmed by DisPerSE (Sousbie 2010; Sousbie et al. 2010) after the submission of the proposal. The actual three-dimensional filamentary structure in the vicinity of our target is shown in Figure 1: several filaments connect around redshift \( z \approx 0.83 \), where a bright elliptical galaxy, 2MASX J15525730+2739474 (the brightest cluster galaxy (BCG); McMahon et al. 2002), is located.

As shown in the X-ray image by ROSAT All Sky Survey (RASS) displayed in Figure 1 (right), the massive cluster A2142 (\( z = 0.09 \)) is situated near the target. More importantly, no X-ray source within the field of view is found in the ROSAT faint source catalog in 0.1–2.4 keV map (Voges et al. 2000).\(^4\) We note that there is no corresponding object in the SDSS group catalog with the spectroscopic data set (Tago et al. 2010), while this region has been identified as a galaxy cluster candidate around \( z \approx 0.1 \) by previous photometric surveys: an optically selected galaxy cluster catalog of the digitized Second Palomar Observatory Sky Survey (Lopes et al. 2004) and the maxBCG technique using the SDSS photometric data to select candidates for gravitational arcs search (Estrada et al. 2007).

2. TARGET SELECTION

As mentioned previously, clusters form at the junction of filaments, and it therefore also seems reasonable to search for new X-ray halos precisely at those filamentary junctions of galaxies. In this Letter, we show the results of an X-ray observation with Suzaku (Mitsuda et al. 2007) at a filamentary junction, identified within the Sloan Digital Sky Survey (SDSS), and where no X-ray detection was previously achieved. We report the detection of a new galaxy group with significant merging features. Throughout the Letter, we assume a ΛCDM universe with \( \Omega_0 = 0.27, \Omega_\Lambda = 0.73, \) and \( h = 0.71 \).

3. AN X-RAY IMAGE AND A HARDNESS RATIO MAP

The observational target was selected to aim at the diffuse intergalactic gas within galaxy filaments and was observed by Suzaku for 80 ks on July 31 in 2010. The identification of the correct environment was achieved using the New York University Value-Added Galaxy Catalogue (Blanton et al. 2005; Padmanabhan et al. 2008; Adelman-McCarthy et al. 2008), extracted from the spectroscopic data of the SDSS Data Release 7 (Figure 1) by a visual inspection at first and was confirmed by DisPerSE (Sousbie 2010; Sousbie et al. 2010) after the submission of the proposal. The actual three-dimensional filamentary structure in the vicinity of our target is shown in Figure 1: several filaments connect around redshift \( z \approx 0.83 \), where a bright elliptical galaxy, 2MASX J15525730+2739474 (the brightest cluster galaxy (BCG); McMahon et al. 2002), is located.

As shown in the X-ray image by ROSAT All Sky Survey (RASS) displayed in Figure 1 (right), the massive cluster A2142 (\( z = 0.09 \)) is situated near the target. More importantly, no X-ray source within the field of view is found in the ROSAT faint source catalog in 0.1–2.4 keV map (Voges et al. 2000).\(^4\)

We note that there is no corresponding object in the SDSS group catalog with the spectroscopic data set (Tago et al. 2010), while this region has been identified as a galaxy cluster candidate around \( z \approx 0.1 \) by previous photometric surveys: an optically selected galaxy cluster catalog of the digitized Second Palomar Observatory Sky Survey (Lopes et al. 2004) and the maxBCG technique using the SDSS photometric data to select candidates for gravitational arcs search (Estrada et al. 2007).

3. AN X-RAY IMAGE AND A HARDNESS RATIO MAP

The observational target was selected to aim at the diffuse intergalactic gas within galaxy filaments and was observed by Suzaku for 80 ks on July 31 in 2010. The identification of the correct environment was achieved using the New York University Value-Added Galaxy Catalogue (Blanton et al. 2005; Padmanabhan et al. 2008; Adelman-McCarthy et al. 2008), extracted from the spectroscopic data of the SDSS Data Release 7 (Figure 1) by a visual inspection at first and was confirmed by DisPerSE (Sousbie 2010; Sousbie et al. 2010) after the submission of the proposal. The actual three-dimensional filamentary structure in the vicinity of our target is shown in Figure 1: several filaments connect around redshift \( z \approx 0.83 \), where a bright elliptical galaxy, 2MASX J15525730+2739474 (the brightest cluster galaxy (BCG); McMahon et al. 2002), is located.

As shown in the X-ray image by ROSAT All Sky Survey (RASS) displayed in Figure 1 (right), the massive cluster A2142 (\( z = 0.09 \)) is situated near the target. More importantly, no X-ray source within the field of view is found in the ROSAT faint source catalog in 0.1–2.4 keV map (Voges et al. 2000).\(^4\)

We note that there is no corresponding object in the SDSS group catalog with the spectroscopic data set (Tago et al. 2010), while this region has been identified as a galaxy cluster candidate around \( z \approx 0.1 \) by previous photometric surveys: an optically selected galaxy cluster catalog of the digitized Second Palomar Observatory Sky Survey (Lopes et al. 2004) and the maxBCG technique using the SDSS photometric data to select candidates for gravitational arcs search (Estrada et al. 2007).

4. http://heasarc.gsfc.nasa.gov/W3Browse/rosat/rassfsc.html

...
reprocessing with the standard selection criteria: the energy correction by xispi, the removal of hot/flickering pixels by cleanxsi. The exposure-corrected image shown in Figure 2(a) exhibits the presence of a diffuse X-ray halo with an irregular morphology, namely, a new object Suzaku J1552+2739. We denote three peaks as peak A, B, and C as shown in Figure 2(a). The gravitational center of Suzaku J1552+2739 is likely located near the peak A because of the presence of the BCG (see also the optical image by Digitized Sky Survey (DSS) in Figure 2(c)).

Computing the hardness ratio map shown in Figure 2(b), we found “the hot spot” from the peak B toward peak C. The definition of the hardness ratio is HR ≡ (H − S)/(H + S) with the hard (H) and soft (S) band images of the combined front-illuminated (FI) and back-illuminated (BI) images, where the energy ranges of H and S are 1.1–2.0 keV and 0.4–1.1 keV, respectively. The combination of the irregular morphology and the presence of the hot spot is a common feature in the merging cluster (e.g., Durret et al. 2005; Ferrari et al. 2006).

4. SPECTROSCOPIC ANALYSIS

We now measure the spectroscopic temperature. All spectral fittings were performed with XSPEC 12.6.0 (Arnaud 1996) with Suzaku Calibration Database. We exclude data having a revised cutoff rigidity (COR2) less than 6 GV. Using xissimarfgen, we created two different the Ancillary Response Files (ARFs), A0 and A0 assuming the observed XIS image in the energy range of 1–4 keV and uniform sky emission, which are applied to the group component and the cosmic X-ray background (CXB) plus other diffuse galactic components, respectively (Ishisaki et al. 2007).

To determine the foreground and background models, we choose TCRB as a fiducial offset (Figure 1 (right)). We also analyzed A2142 offset and FIL offset as references although these two regions are close to A2142 and possibly include leakage. After excluding a central target of TCRB and several point-like sources, we simultaneously fit the spectra of the FI and BI chips by the two-temperature model: phabs *(pow + apec1) + apec2, where pow indicates the power law of the CXB with the photon index Γ = 1.41 (fix; Kushino et al. 2002) and the CXB intensity S_{CXB}, apec1 is the thermal emission model with T = T1 (APEC; Smith et al. 2001) interpreted as the transabsorption emission (TAE; Kuntz & Snowden 2000) from outside of the Galaxy, such as the Galactic Halo emission, apec2 assumes the thermal emission with T = T2 from inside of the Galaxy, such as the local hot bubble and we fix the Galactic absorption (phabs) using the neutral hydrogen column density N_H provided by Kalberla et al. (2005). We use the data in the energy range of 0.4–5.0 keV and 0.5–5.0 keV for the BI and FI chips. The best-fit values are given in Table 1. The CXB intensity of TCRB is consistent with the results by ASCA, S_{CXB,asca} = (6.38 ± 0.07 ± 1.05) × 10^{-8} erg cm^{-2} s^{-1} sr^{-1} keV^{-1} (90% statistical and systematic error; Kushino et al. 2002).

We extract the spectra of the overall region of the group within the radius of 0.6 Mpc = 6.6 around the BCG. The hot spot was excluded with the radius of 0.2 Mpc based on the hardness ratio map (Figure 2(c)). We fit the spectra by the thermal emission model (apec) with the two-temperature model provided by the offset observation: phabs *(pow + apec1 + apec2) + apec2. We use the fiducial offset (TCRB) for the temperatures of the galactic components and leave normalizations as free parameters and fix Γ = 1.41 and S_{CXB,asca} for the normalization of the CXB. We compute the systematics originated from the uncertainty of the CXB intensity by extrapolating the results of GINGA with the field of views Ω (Hoshino et al. 2010) and the temperatures of the galactic components assuming that the errors are ±0.05 keV and ±0.02 keV for the TAE and the local component. Although it is difficult to estimate the real fluctuations, the results of the other offset observations are

---

5 FIL offset was obtained as part of the same observation.
within the assumed errors. The spectra with the fitted lines are shown in Figure 3 and the best-fit parameters are summarized in Table 1. The spectroscopic temperature is $1.6^{+0.4}_{-0.1}$ keV and the corresponding $R_{500}$ is 0.59 Mpc using Vikhlinin et al. (2006), which approximately corresponds to the overall region. The group probably escaped from the detection of the RASS due to its marginal flux ($3.5^{+0.3}_{-0.2} \times 10^{-13}$ erg s$^{-1}$ cm$^{-2}$ for 0.5–2.0 keV) compared with the RASS flux limit $\sim 3 \times 10^{-13}$ erg s$^{-1}$ cm$^{-2}$. The bolometric luminosity $2.4 \times 10^{43}$ erg s$^{-1}$ is consistent with the observed $L_X-T$ relation for $T = 1.6$ keV (e.g., Mulchaey 2000).

As shown in Figure 2(c), we divide three shells around the BCG center to $R = 0.6$ Mpc with the width of 0.2 Mpc = 2 Rac. The same analysis was done for the three shells and the hot spot. We exclude the hot spot region in the analysis of the three shells. The fitting temperatures and metallicities are provided in Table 1. The half-decrement of temperature from the center to $R_{500}$ and the abundance profile agree well with a previous systematic study of groups (Rasmussen & Ponman 2007; Sun et al. 2009). The hot spot has significantly higher temperature ($T \sim 4$ keV) than that of surrounding shells, even than the central temperature within $R = 0.2$ Mpc.

![Image](image_url)

**Table 1**

| Name       | ObsID     | $N_H$ b | $\Gamma$ | $S_{\text{CXB}}$ | $kT_1$ (keV) | $kT_2$ (keV) | $\chi^2$/dof | $\sigma_{\text{CXB}}$ (%) |
|------------|-----------|---------|----------|-----------------|--------------|--------------|--------------|--------------------------|
| TCRB       | 401043010 | 4.73\textsuperscript{a} | 1.41\textsuperscript{e} | 5.21$^{+0.2}_{-0.19}$ | 0.28$^{+0.023}_{-0.019}$ | 0.50$^{+0.015}_{-0.014}$ | 0.087$^{+0.007}_{-0.005}$ | 4.5$^{+0.8}_{-1.2}$ | 1.20 |
| FIL offset | 805029010 | 3.47\textsuperscript{b} | 1.41\textsuperscript{e} | 5.83$^{+0.17}_{-0.18}$ | 0.28$^{+0.023}_{-0.019}$ | 0.69$^{+0.10}_{-0.09}$ | 0.087$^{+0.007}_{-0.004}$ | 9.0$^{+0.0}_{-4.4}$ | 1.10 |
| A2142 offset | 802032010 | 3.46\textsuperscript{b} | 1.41\textsuperscript{e} | 7.23$^{+0.27}_{-0.28}$ | 0.24$^{+0.042}_{-0.025}$ | 0.607$^{+0.032}_{-0.19}$ | 0.0756$^{+0.026}_{-0.021}$ | 0.79$^{+0.0}_{-7.1}$ | 1.22 |

Fixed parameters: $N_H = 3.06^{+0.5}_{-0.1}$, $\Gamma = 1.41$, $S_{\text{CXB}} = 6.38^{+0.07}_{-0.06}$, $kT_1 = 0.286$ keV, $kT_2 = 0.087$ keV.

**Notes.**

1 We assume the solar metallically given by Anders & Grevesse (1989).
2 $10^{20}$ cm$^{-2}$.
3 $10^{-8}$ erg cm$^{-2}$ s$^{-1}$ sr$^{-1}$ keV$^{-1}$ for the energy range of 2–10 keV.
4 The normalization of the APEC model, norm = $/[n_n \text{HdV}/[4\pi D_s^2(1+z)^2] \times 10^{-20}/\Omega$ cm$^{-3}$ deg$^{-2}$.
5 The parameter is fixed.
6 We use the solar abundance table of Anders & Grevesse (1989).
7 We assume the flux limit of $\Delta_{\text{Suzaku}}$ as $10^{-14}$ erg cm$^{-2}$ s$^{-1}$.
8 The former error indicates the statistical and the latter is the systematics from the temperatures of the galactic components and the CXB.

**Figure 2.** Left: the combined image of JXJS, 1, and 3 (0.5–5.0 keV). The vignetting is corrected for by a mono-energetic exposure map extracted at a photon energy of 1 keV. The unit is $10^3$ counts s$^{-1}$ cm$^{-2}$ sr$^{-1}$. The SDSS spectroscopic identified galaxies between $z = 0.07$–0.09, $z = 0.09$–0.1, and $z = 0.1$–0.3 (background) are shown by circles, triangle and boxes, the central BCG at $z = 0.083$ by a cross, and a galaxy at $z = 0.087$ on the peak B by $\times$. Middle: the hardness ratio map of the combined image. Contour lines indicate the X-ray image shown in panel a. Right: spectroscopic analysis regions. Contour lines indicate the X-ray image overlaid on the photographic image provided by the DSS.
relatively high metallicity which is comparable to that of the center.

The main systematic source of $\chi^2$ is the slight inconsistency of the BI and FI chips below $E < 0.8$ keV likely due to the Non X-ray Background (NXB) subtraction. However, we confirmed that this effect does not change the result by neglecting $E < 0.8$ keV. We believe that future update of the NXB calibration will improve this inconsistency.

5. DISCUSSION

The observation of a group with several X-ray peaks is not so common so far. For instance, Mulchaey et al. (2003) compiled 109 nearby groups observed by ROSAT and found that only five groups have bimodal X-ray peaks and others have rather a single peak. While Suzaku J1552+2739 has three clear peaks at least. Moreover, as far as we know, this is the first clear example of the merging group-scale halo ($T \lesssim 2$ keV) with the hot structure associated with the second peak.

All the second peaks in the bimodal groups of ROSAT have a luminous early-type galaxy as well as the first one. In our target, a relatively faint galaxy is located at the peak B ($z = 0.877$; $\times$ in Figure 2(a)) although the physical association is difficult to establish. Its absolute magnitude in the $r$ band is $-21.1$, which is not the second brightest but the ninth brightest one within $R_{500}$, and its color and morphology are red (the rest frame $g - r = 0.88$) and S0, respectively (visually no spiral and the inverse concentration index $= 0.37$; Shimasaku et al. 2001).

We confirm that no QSO, group, and cluster can be found within $R = 10'$ in the SDSS spectroscopic data. We also examined the radio emission in the archival data of NRAO VLA Sky Survey (1.4 GHz; Condon et al. 1998) and the VLA FIRST survey (21 cm; Becker et al. 1995) and found two signals in both data within $R = 10'$: one is clearly associated with the BCG and the other is located at the background galaxies ($z \sim 0.14$; indicated by “bg” in Figure 2(a)). Thus, it is unlikely that the peaks B and C are associated with background or foreground objects.

Though, we cannot state any strong conclusions about the detailed merger process due to the limited angular resolution, from the position of the hot spot, the absence of luminous galaxies in the peak B and relative high metallicity in the hot spot, we suggest the following possible scenario: a substructure recently passed close to the BCG with mixing, from north to south, and the central part of the substructure became the brightest peak B by compression, like the bullet cluster (Markevitch et al. 2002).

In the above, the presence of the peak C is not necessary. Such a faint peak aligned with two other peaks also has been found in other merging clusters (Sun et al. 2002; Maurogordato et al. 2011). Sun et al. (2002) discussed the origin of the faint peak in A2256 and suggest another previous merger origin or the scenario that a fainter peak is originated from the gas of a middle peak, which lagged behind when merger occurs (in this scenario the peak B should move from south). The former scenario is possible for our target, but the latter do not explain the hot spot. In addition, we propose an another possible scenario: the peaks B and C belonged to one clump before the merging and it fell and split into two. One passed near the center, decreasing its velocity by pressure of ambient dense gas (peak B), and the other passed through relatively far from the center or in a less dense region (peak C). Thus, the peak C went ahead of the peak.
B. For the last scenario, the merger should be so significant as to separate gas from dark matter subclump. If the galaxy on the peak B is associated with the peak, however, the merger is not so strong. In either case, we suggest that the hot spot is originated from adiabatic compression and heating by the densest clump (peak B).

Figure 4 shows the galaxy distribution of the SDSS spectroscopic data along the line of sight. We found the bimodal distribution around the group. As shown by triangles in Figure 2(a), the galaxies in the distant peak ($z = 0.09 - 0.092$) are widely distributed in the group. If we assume that both peaks are associated with the group, the velocity dispersion $\sigma_V = 1197 \pm 191$ km s$^{-1}$ is unusually higher than the expected value from $T$-$\sigma_V$ and $L_X$-$\sigma_V$ relations (e.g., Osmond & Ponman 2004). Performing the Anderson–Darling test, we found that the distribution deviates from the Gaussian ($A^2 > 1.93$; Hou et al. 2009). If we take the single peak belongs to the member galaxies admits of an interpretation.

The X-ray luminosity is consistent with the $L$–$T$ relation despite the merging signature. It is known that the temperature decrement and density increment in the center of group are shallower than that of massive clusters (e.g., Osmond & Ponman 2004; Rasmussen & Ponman 2007). This feature might weaken the influence of merger to the luminosity and keep trajectory in the $L$–$T$ plane to be parallel to the $L$–$T$ relation during a merger rather than scattering off the relation along either the $L$ or the $T$ axis (Ricker & Sarazin 2001). In addition, the large scatter of the $L$–$T$ relation in the group regime may also help to keep this merging group consistent with the $L$–$T$ relation.

A connection between the filamentary junction and the merging halo is also an interesting issue, although it is difficult to state something from one case. Indeed, most clusters found at the filamentary junction have merging feature, such as multiple peaks, irregular morphology, and radio halos (Arnaud et al. 2000; Boschin et al. 2004; Cortese et al. 2004; Braglia et al. 2007; Girardi et al. 2008). To explore this connection, we submitted a proposal for further observations of junctions with Suzaku.

We are grateful to Noriko Yamasaki, Takaya Ohashi, Yoshitaka Ishisaki, Christophe Pichon, Klaus Dolag, and Eugene Churazov for insightful discussion. We also thank an anonymous referee for a lot of constructive comments. H.K. is supported by a JSPS Grant-in-Aid for science fellows. This work is supported by Grant-in-Aid for Scientific research from JSPS and from the Japanese Ministry of Education, Culture, Sports, Science and Technology (nos. 22-5467, 09J08405, 22-181, and 09P8324) and by World Premier International Research Center Initiative, MEXT, Japan.

Funding for the SDSS has been provided by the Alfred P. Sloan Foundation, the Participating Institutions, the National Aeronautics and Space Administration, the National Science Foundation, the U.S. Department of Energy, the Japanese Monbukagakusho, and the Max Planck Society. The SDSS Web site is http://www.sdss.org/

The SDSS is managed by the Astrophysical Research Consortium for the Participating Institutions. The Participating Institutions are the University of Chicago, Fermilab, the Institute for Advanced Study, the Japan Participation Group, The Johns Hopkins University, Los Alamos National Laboratory, the Max-Planck-Institute for Astronomy, the Max-Planck-Institute for Astrophysics, New Mexico State University, University of Pittsburgh, Princeton University, the United States Naval Observatory, and the University of Washington.

The DSS were produced at the Space Telescope Science Institute under U.S. Government grant NAG W-2166. The images of these surveys are based on photographic data obtained using the Oschin Schmidt Telescope on Palomar Mountain and the UK Schmidt Telescope. The plates were processed into the present compressed digital form with the permission of these institutions.

REFERENCES

Adelman-McCarthy, J. K., et al. 2008, ApJS, 175, 297
Anders, E., & Grevesse, N. 1989, Geochim. Cosmochim. Acta, 53, 197
Arnaud, K. A. 1996, in ASP Conf. Ser. 101, Astronomical Data Analysis Software and Systems V, ed. G. H. Jacoby & J. Barnes (San Francisco, CA: ASP), 17
Arnaud, M., Maurugordato, S., Slezak, E., & Rho, J. 2000, A&A, 355, 461
Becker, R. H., White, R. L., & Helfand, D. J. 1995, ApJ, 450, 559
Blanton, M. R., et al. 2005, AJ, 129, 2562
Bond, J. R., Komian, L. & Postyvan, D. 1996, Nature, 380, 603
Boschin, W., Girardi, M., Barrena, R., Biviano, A., Feretti, L., & Ramella, M. 2004, A&A, 416, 839
Braglia, F., Pierini, D., & Böhringer, H. 2007, A&A, 470, 425
Buote, D. A., Zappacosta, L., Fang, T., Humphrey, P. J., Gastaldello, F., & Tagliaferri, G. 2009, ApJ, 695, 1351
Condon, J. J., Cotton, W. D., Greisen, E. W., Yin, Q. F., Perley, R. A., Taylor, G. B., & Broderick, J. J. 1998, AJ, 115, 1693
Cortese, L., Gavazzi, G., Boselli, A., Iglesias-Paramo, J., & Carrasco, L. 2004, A&A, 425, 429
Durrett, F., Lima Neto, G. B., & Forman, W. 2005, A&A, 432, 809
Estrada, J., et al. 2007, ApJ, 660, 1176
Ferrari, C., Arnaud, M., Ettori, S., Maurugordato, S., & Rho, J. 2006, A&A, 446, 417
Girardi, M., Barrena, R., Boschin, W., & Ellington, E. 2008, A&A, 491, 379
Hoshino, A., et al. 2010, PASI, 62, 371
Hou, A., Parker, L. C., Harris, W. E., & Wilman, D. J. 2009, ApJ, 702, 1199
Ishisaki, Y., et al. 2007, PASJ, 59, 113
Kalberla, P. M. W., Burton, W. B., Hartmann, D., Arnal, E. M., Bajaja, E., Morras, R., & Pöppel, W. G. L. 2005, A&A, 440, 775
Kuntz, K. D., & Snowden, S. L. 2000, ApJ, 543, 195
Kushino, A., Ishisaki, Y., Morita, U., Yamasaki, N. Y., Ishida, M., Ohashi, T., & Ueda, Y. 2002, PASJ, 54, 327
Lopes, P. A. A., de Carvalho, R. R., Gal, R. R., Djorgovski, S. G., Odewahn, S. C., Mahabal, A. A., & Brunner, R. J. 2004, AJ, 128, 1017
Markevitch, M., Gonzalez, A. H., David, L., Vikhlinin, A., Murray, S., Forman, W., Jones, C., & Tucker, W. 2002, ApJ, 567, L27

Figure 4. Galaxy distribution of the SDSS spectroscopic data within $R_{500}$. The distribution around the BCG is displayed in the inset. Dashed and dotted curves are fitted Gaussians by the Gapper algorithm using data in 0.080–0.092 (both peaks) and $z = 0.080–0.088$ (a single peak). The former case fails in the Anderson–Darling test of Gaussianity, while, the latter passes the test.
Markevitch, M., et al. 2000, ApJ, 541, 542
Maurogordato, S., Sauvageot, J., Bourdin, H., Cappi, A., Benoist, C., Ferrari, C., Mars, G., & Houairi, K. 2011, A&A, 525, A79
McMahon, R. G., White, R. L., Helfand, D. J., & Becker, R. H. 2002, ApJS, 143, 1
Mitsuda, K., et al. 2007, PASJ, 59, 1
Mulchaey, J. S. 2000, ARA&A, 38, 289
Mulchaey, J. S., Davis, D. S., Mushotzky, R. F., & Burstein, D. 2003, ApJS, 145, 39
Osmond, J. P. F., & Ponman, T. J. 2004, MNRAS, 350, 1511
Padmanabhan, N., et al. 2008, ApJ, 674, 1217
Pogosyan, D., Bond, J. R., Kofman, L., & Wadsley, J. 1996, BAAS, 28, 1289
Rasmussen, J., & Ponman, T. J. 2007, MNRAS, 380, 1554
Ricker, P. M., & Sarazin, C. L. 2001, ApJ, 561, 621
Shimasaku, K., et al. 2001, AJ, 122, 1238
Smith, R. K., Brickhouse, N. S., Liedahl, D. A., & Raymond, J. C. 2001, ApJ, 556, L91
Sousbie, T. 2010, arXiv:1009.4015
Sousbie, T., Pichon, C., & Kawahara, H. 2010, arXiv:1009.4014
Sun, M., Murray, S. S., Markevitch, M., & Vikhlinin, A. 2002, ApJ, 565, 867
Sun, M., Voit, G. M., Donahue, M., Jones, C., Forman, W., & Vikhlinin, A. 2009, ApJ, 693, 1142
Tago, E., Saar, E., Tempel, E., Einasto, J., Einasto, M., Nurmi, P., & Heinämäki, P. 2010, A&A, 514, A102
Vikhlinin, A., Kravtsov, A., Forman, W., Jones, C., Markevitch, M., Murray, S. S., & Van Speybroeck, L. 2006, ApJ, 640, 691
Voges, W., et al. 2000, VizieR Online Data Catalog, 9029, 0
Williams, R. J., Mulchaey, J. S., Kollmeier, J. A., & Cox, T. J. 2010, ApJ, 724, L25