A multi-wavelength view of RXJ1347-1145 *&* The interest of joint radio and mm cluster studies

Chiara Ferrari

in collaboration with:

H.T. Intema, E. Orrù, F. Govoni, M. Murgia, B. Mason, H. Bourdin, K.M. Asad, P. Mazzotta, M.W. Wise, T. Mroczkowski, J.H. Croston

Overview of the talk

- **Introduction**
  i. Diffuse intra-cluster radio sources
  ii. Sunyaev-Zel'dovich effect and galaxy cluster studies
- **Multi-wavelength analysis of RX J1347-1145**
  i. Comparison of radio, X-ray & mm data
  ii. Conclusions

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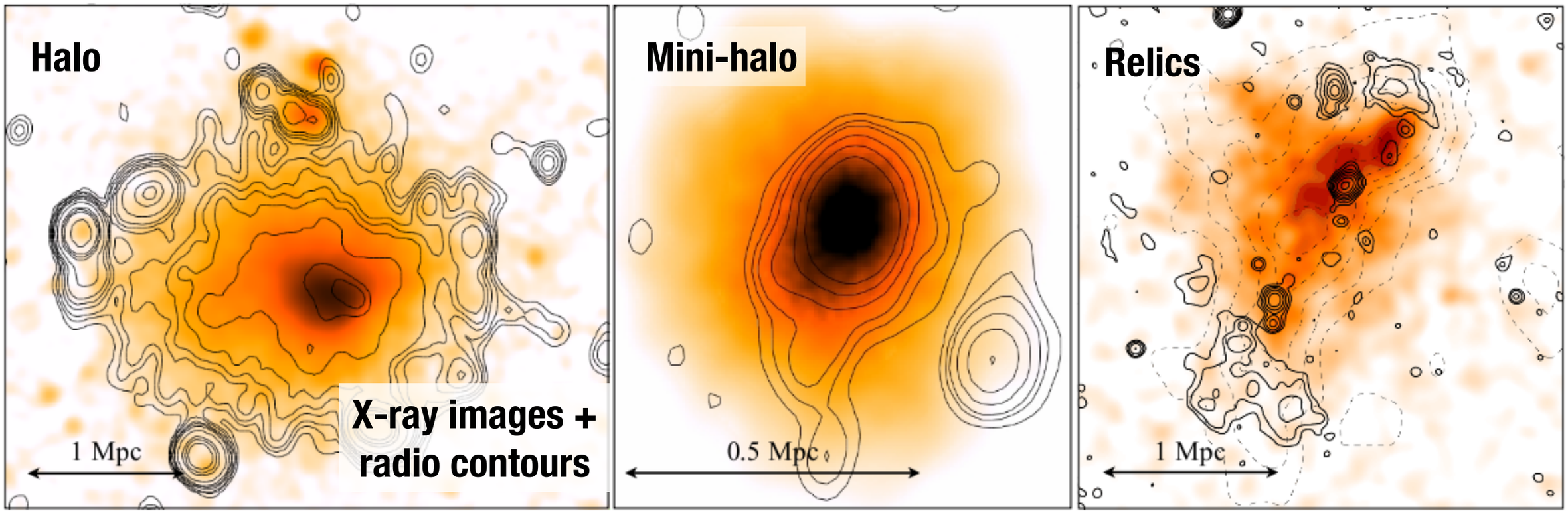
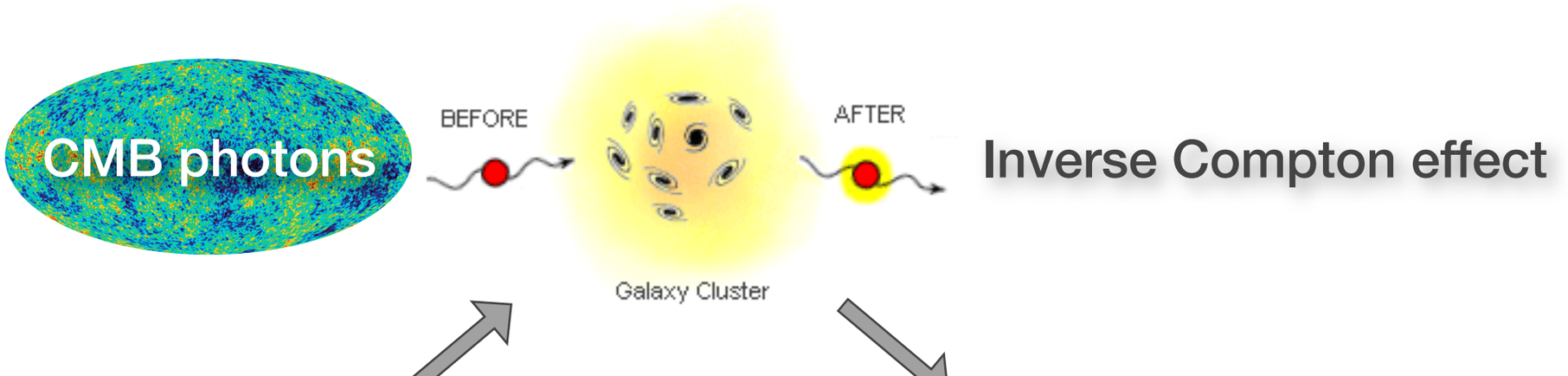
Diffuse radio sources in galaxy clusters & electron acceleration



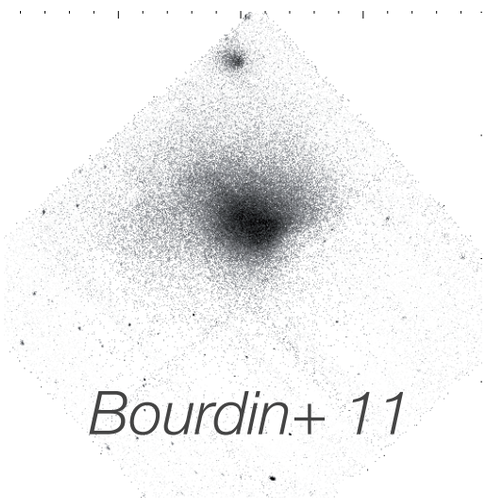
Feretti+ 01 *Gitti+ 07* *van Weeren+ 09*

- **Halos:** ICM turbulence due to cluster merging
- **Mini-halos:** Cool core turbulence and gas sloshing
- **Relics:** shocks due to cluster merging

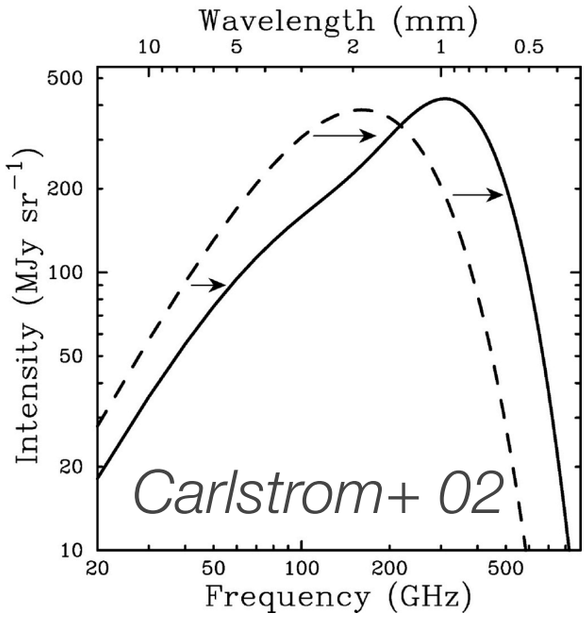
Thermal Sunyaev-Zel'dovich Effect



X-ray emission:
thermal intracluster medium



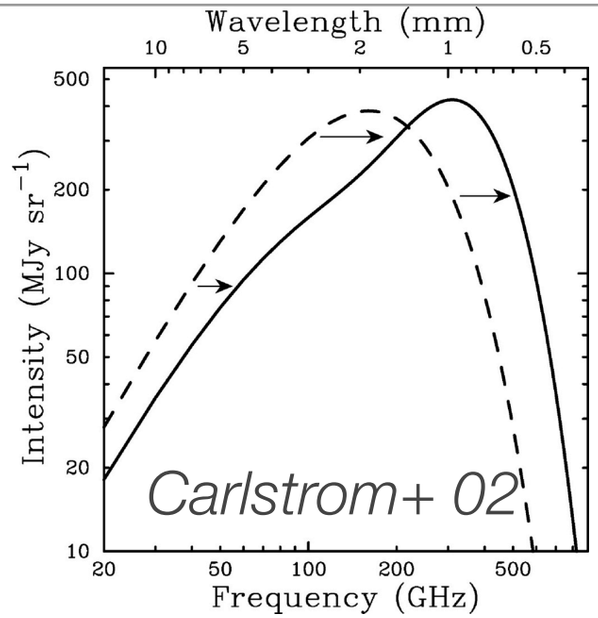
Thermal SZ effect



$$\frac{\Delta T_{SZE}}{T_{CMB}} = f(\nu)\ y$$

$$y \propto \int n_e T \ \mathrm{d}l$$

SZE: importance for cluster studies



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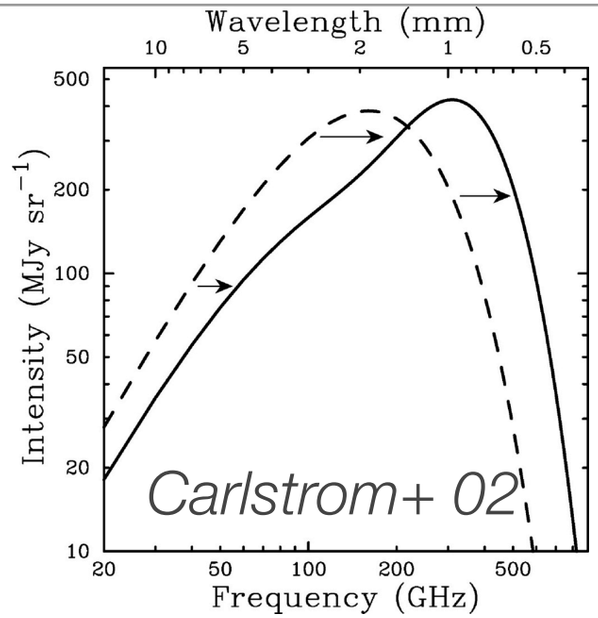
Cluster detection

Courtesy: M. Douspis
& Planck collaboration

SZE: importance for cluster studies



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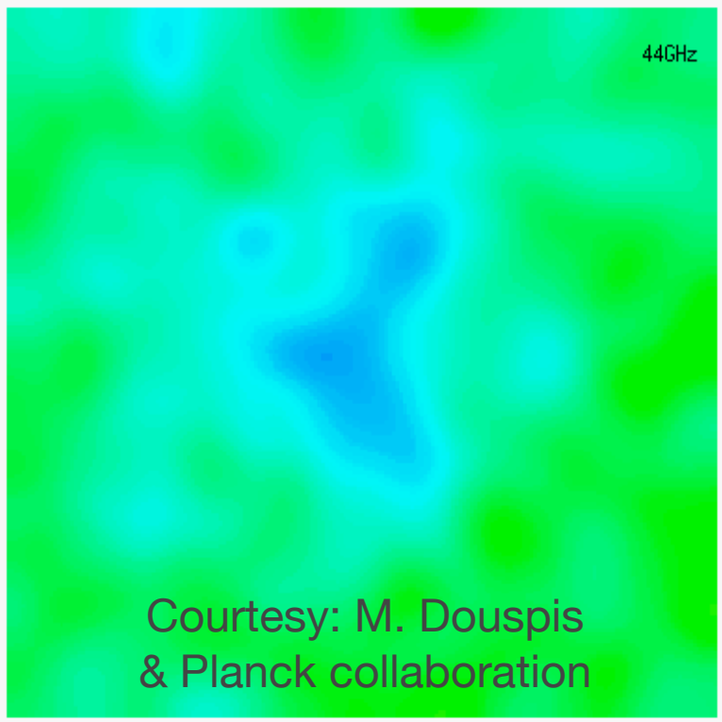
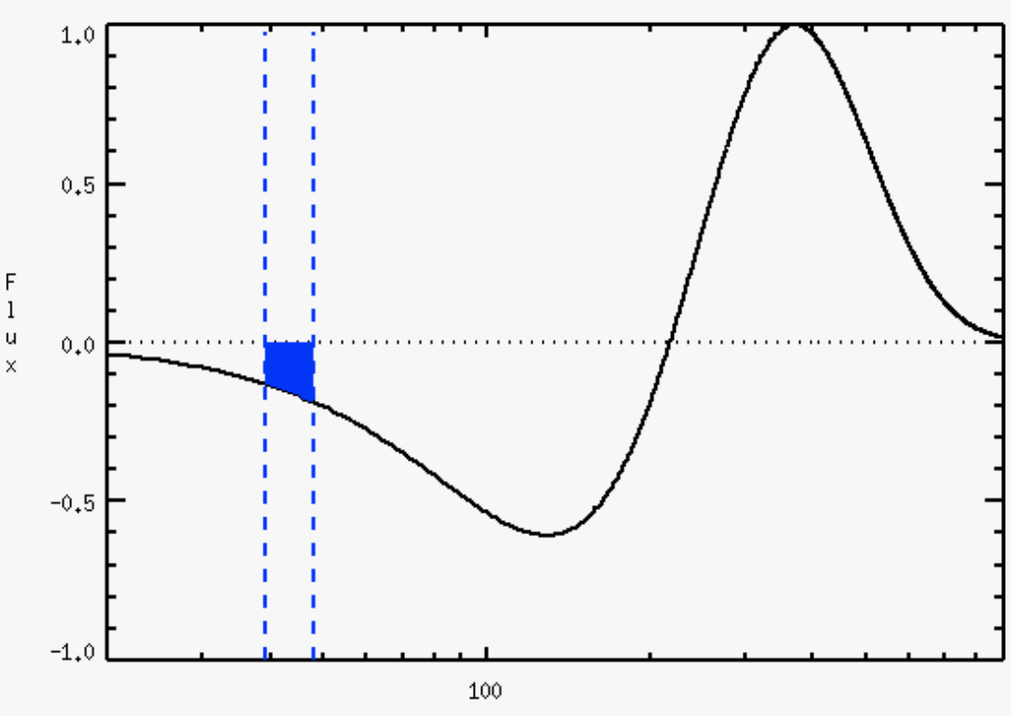


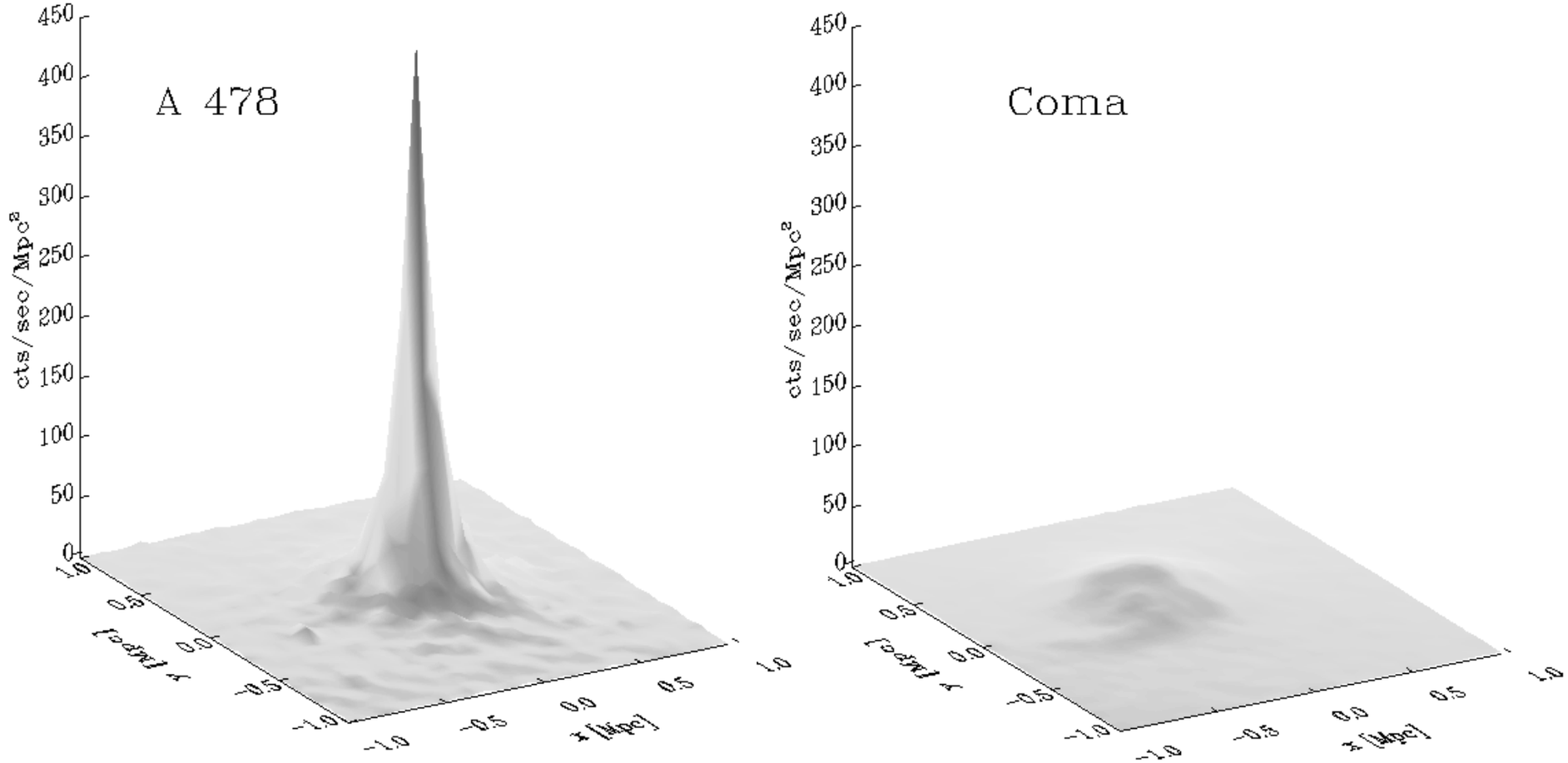


Cluster detection with X-ray and SZ observations

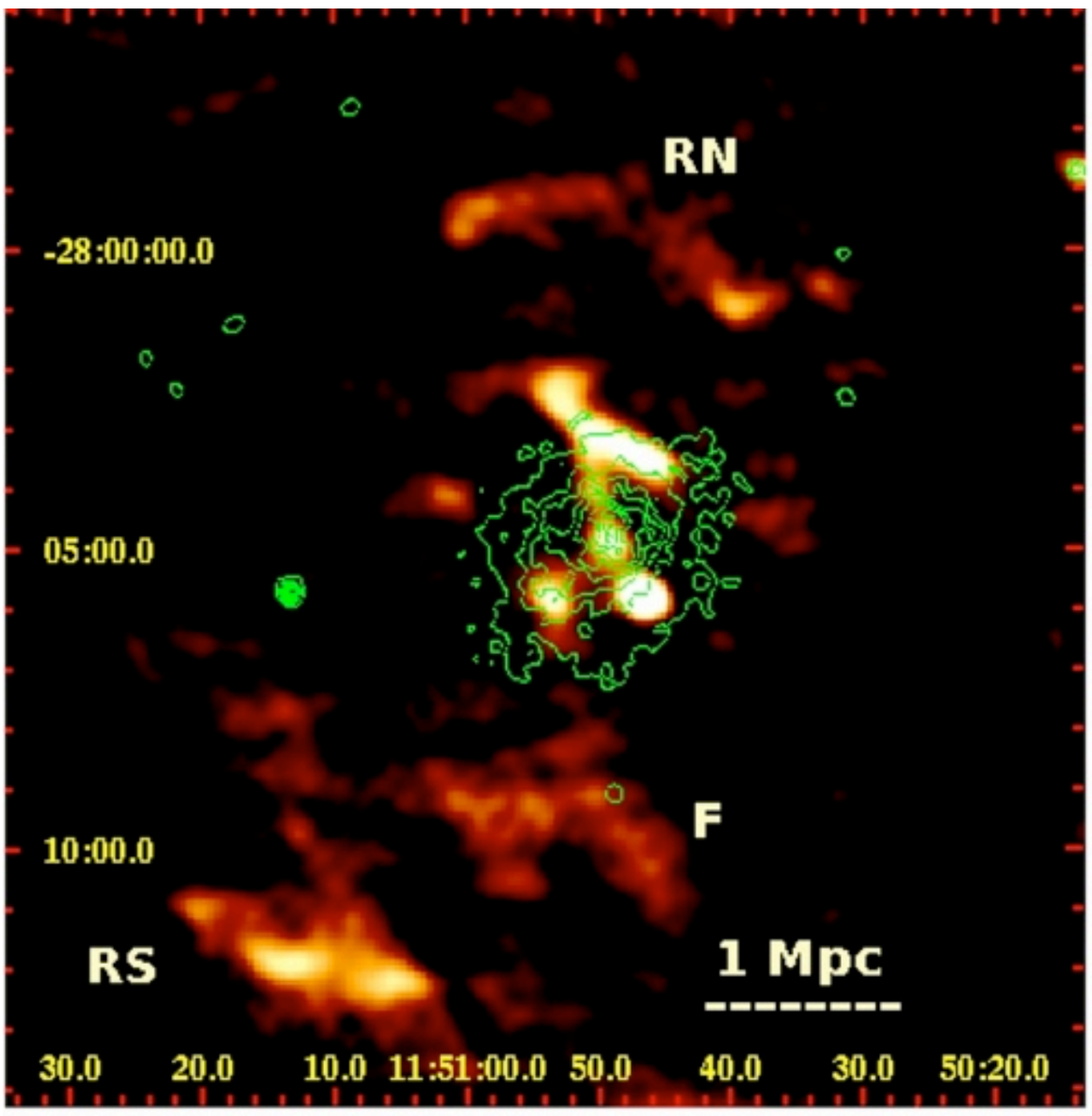
$$y \propto \int n_e T \, \mathrm{d}l$$

$$\text{X-ray emissivity} \propto \int n_e^2 T^{1/2} dl$$

ICM density



Fabian & Sanders 09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05:00.0
10:00.0
RS
F
1 Mpc
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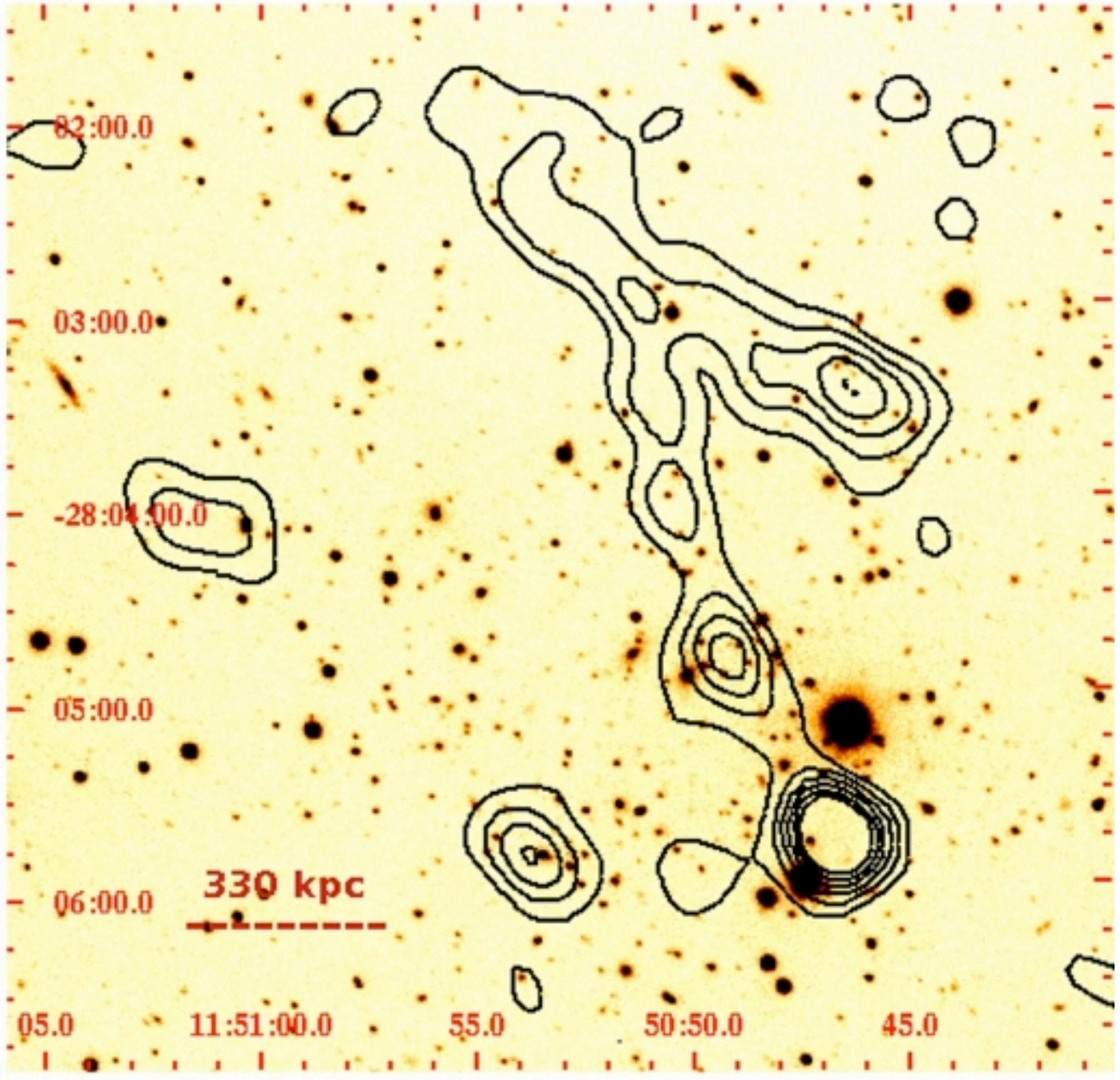
20.0
10.0
11:51:00.0
50.0
40.0
30.0
50:20.0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03:00.0
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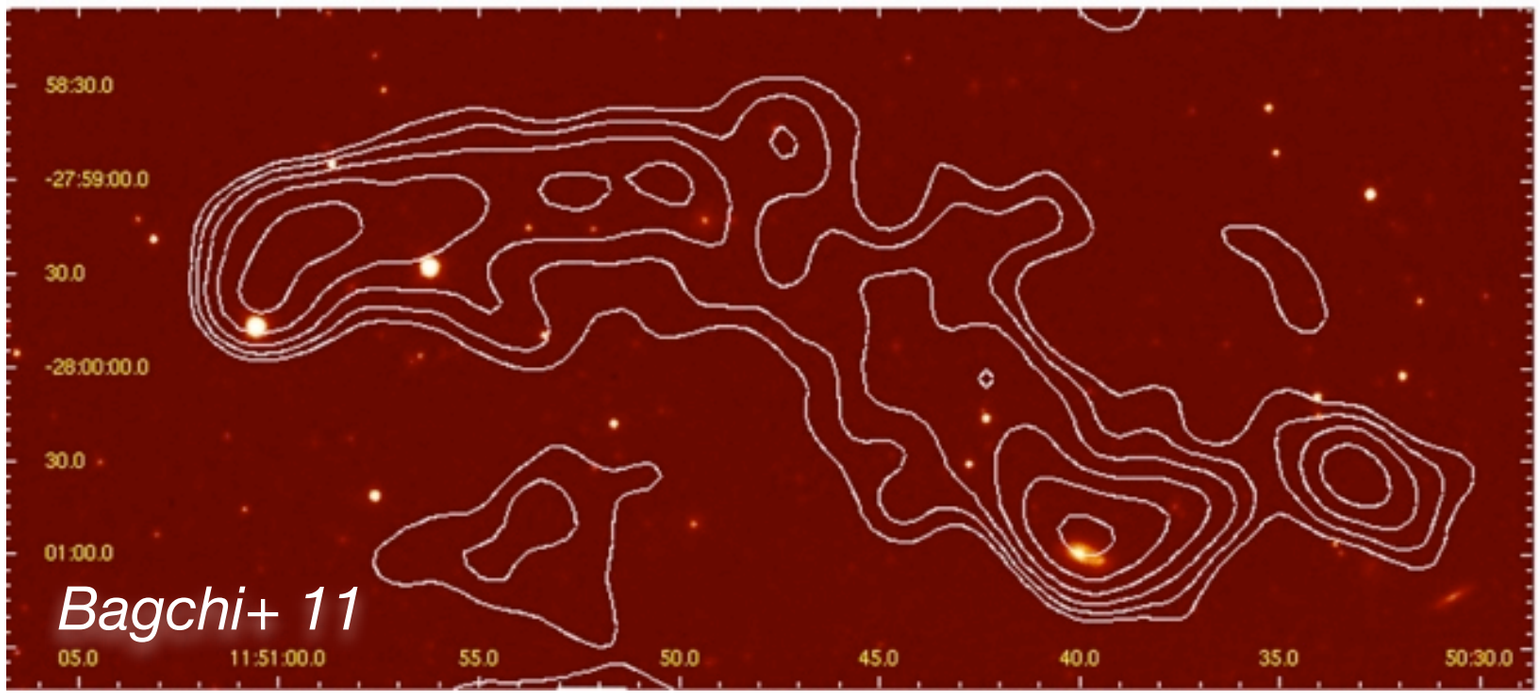
45.0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Bagchi+ 11
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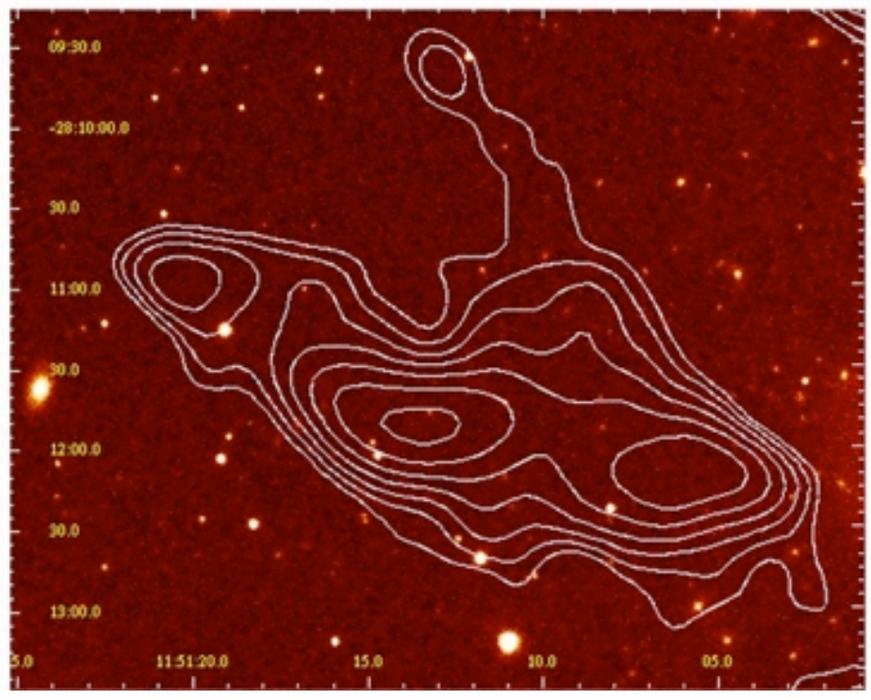
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30.0
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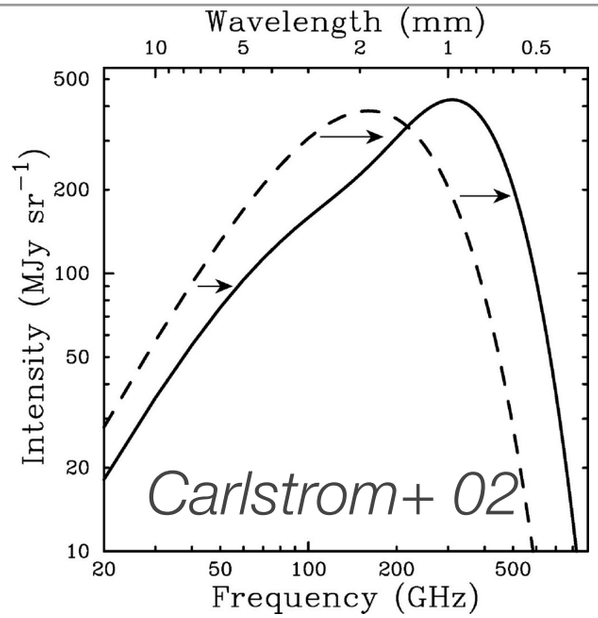
15.0
10.0
05.0

SZE: importance for cluster studies



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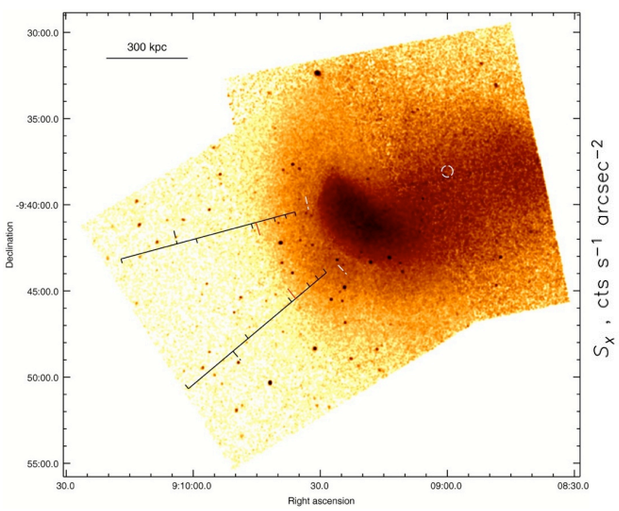
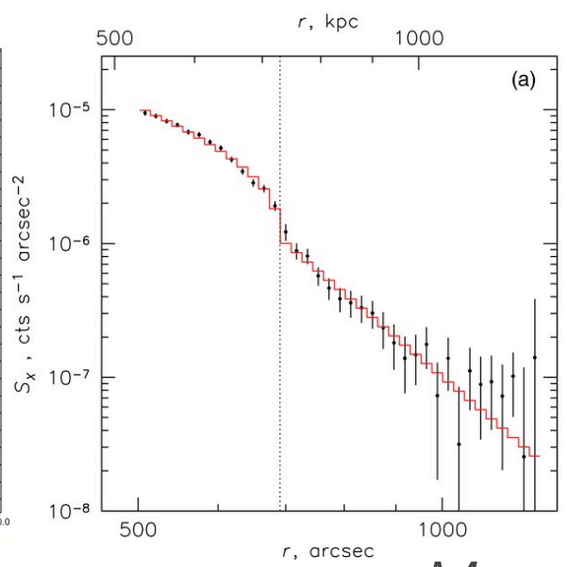
ICM shock detection

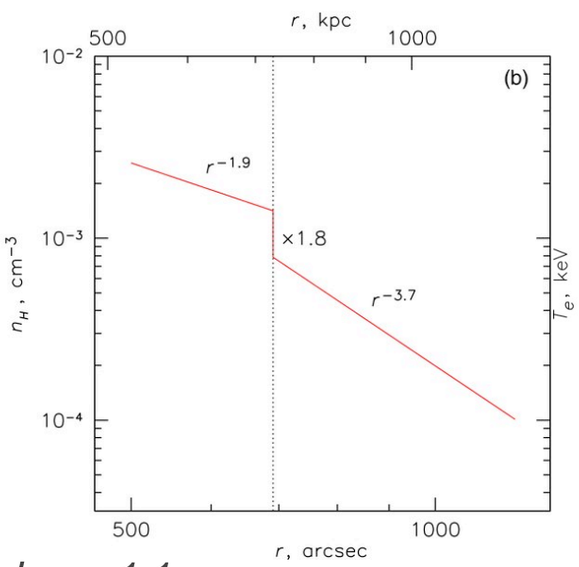
X-ray Image



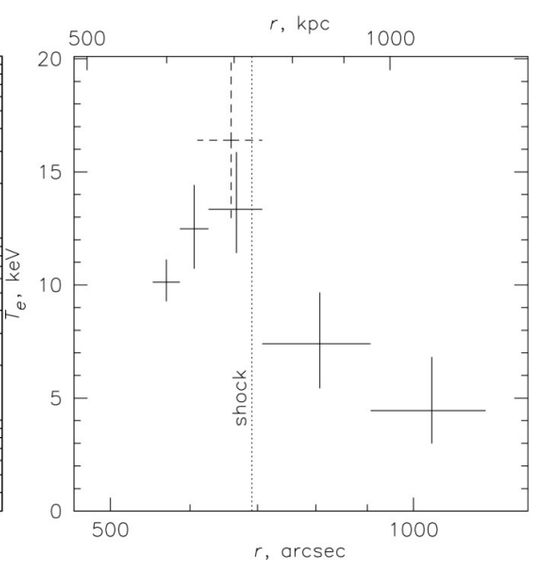
Surface brightness profile



Density profile

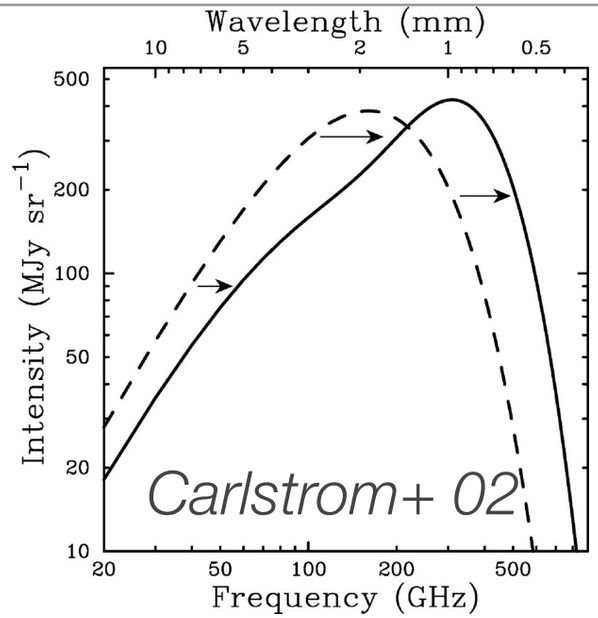


Temperature profile



Macario+ 11

SZE: importance for cluster studies



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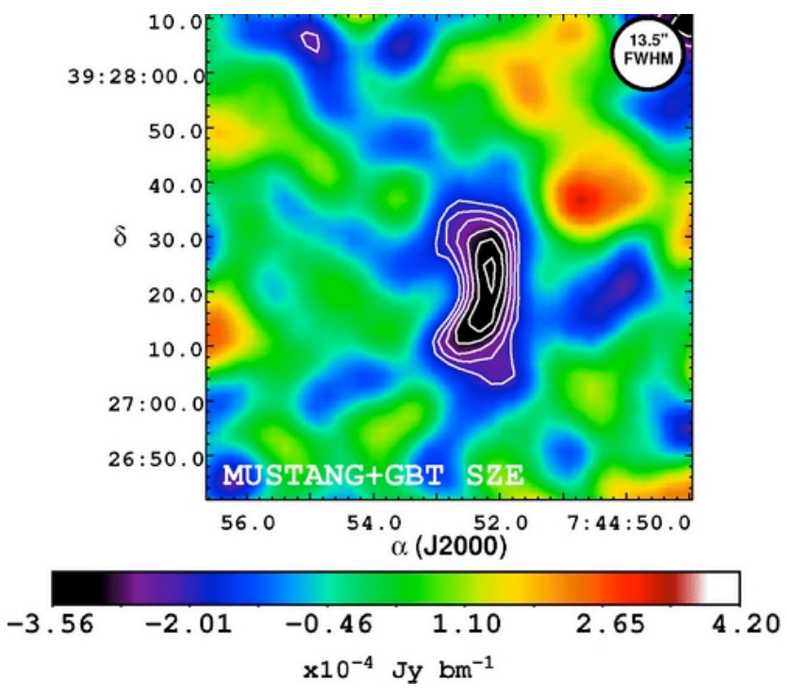

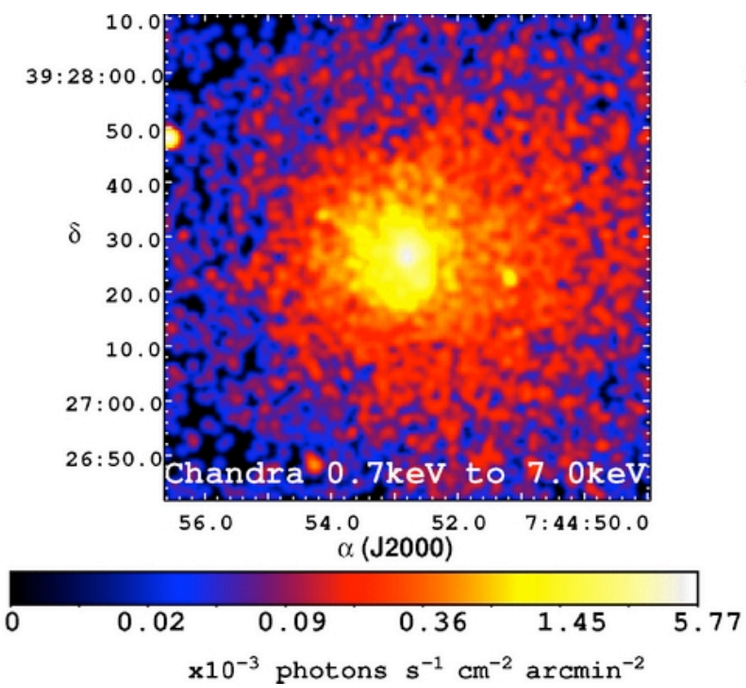

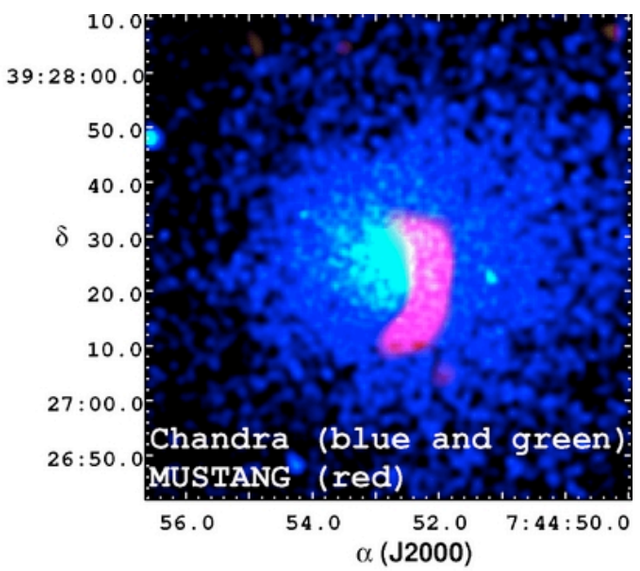

Korngut+ 11

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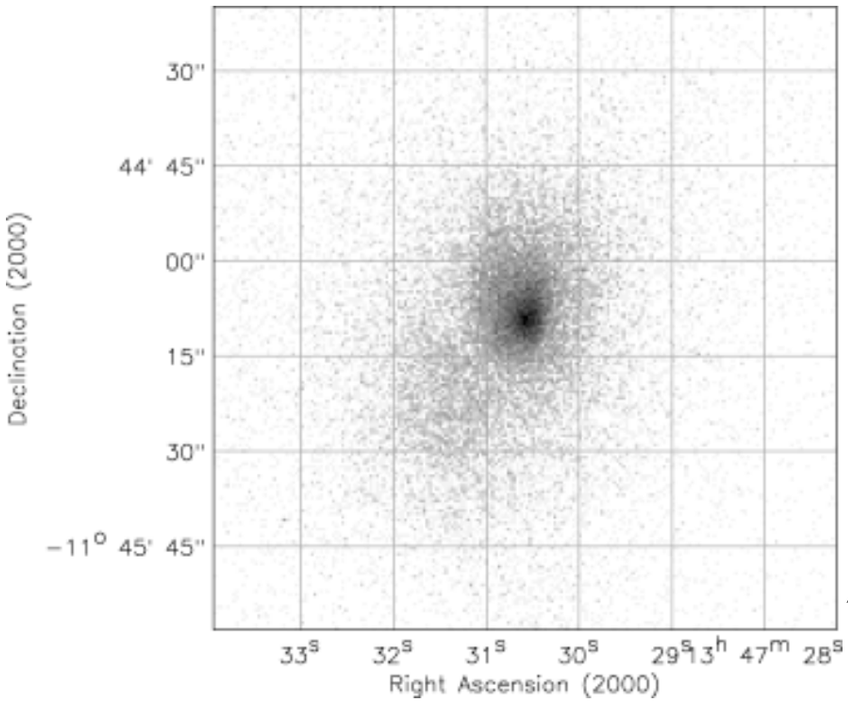
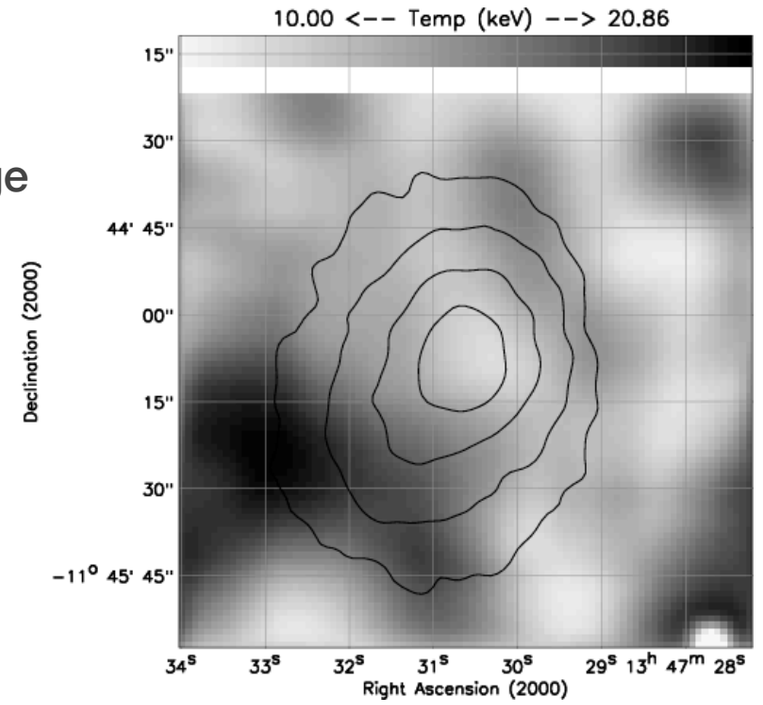
RXJ1347-1145



Chandra

Raw X-ray image

Allen+ 02



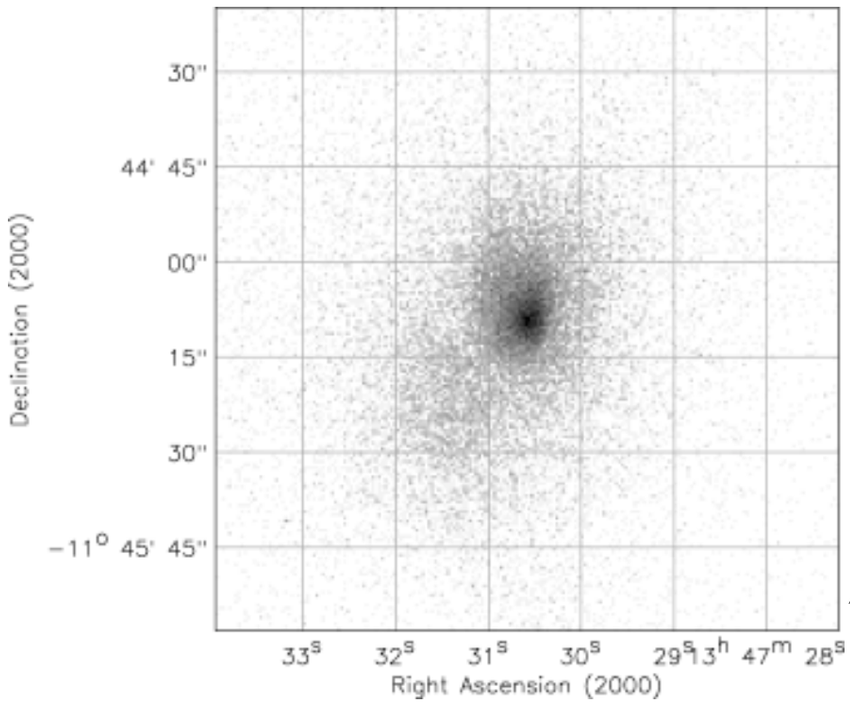
XMM

ICM temperature map

X-ray contours

Gitti+ 04

RXJ1347-1145



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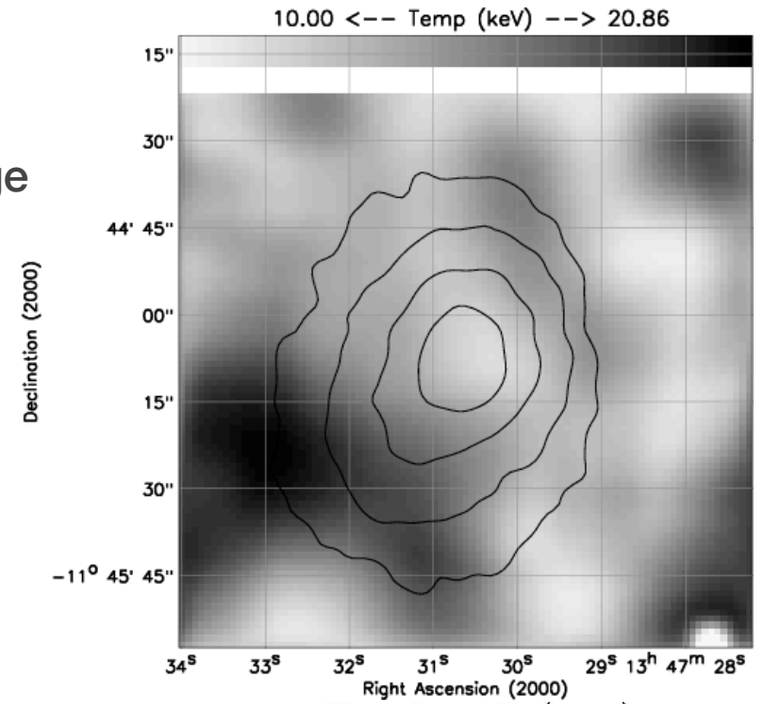

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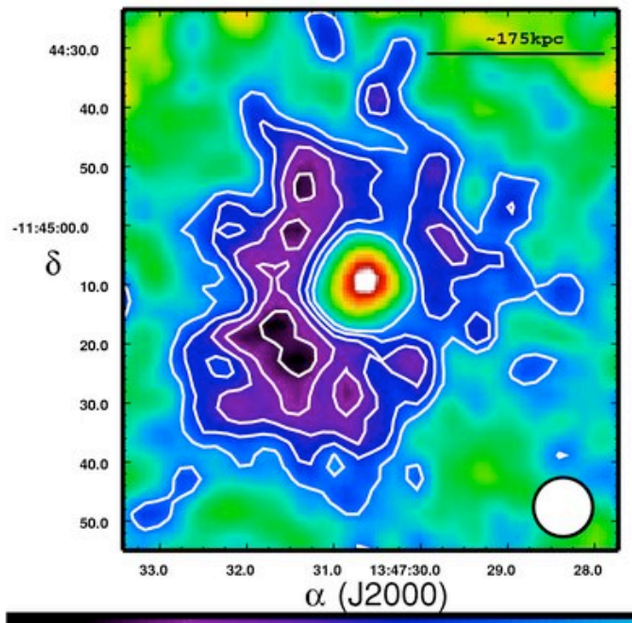
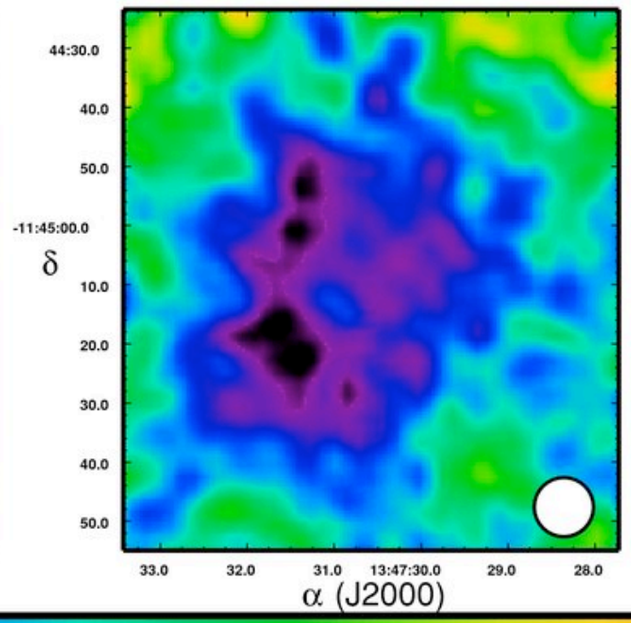
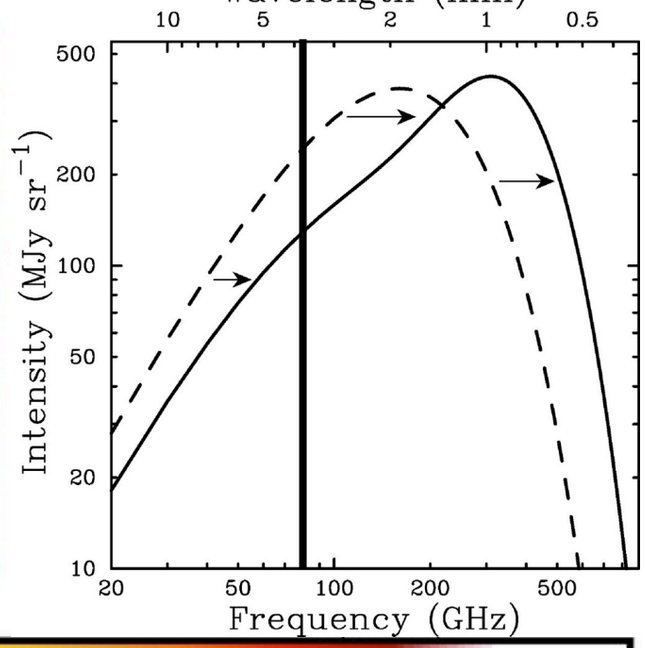






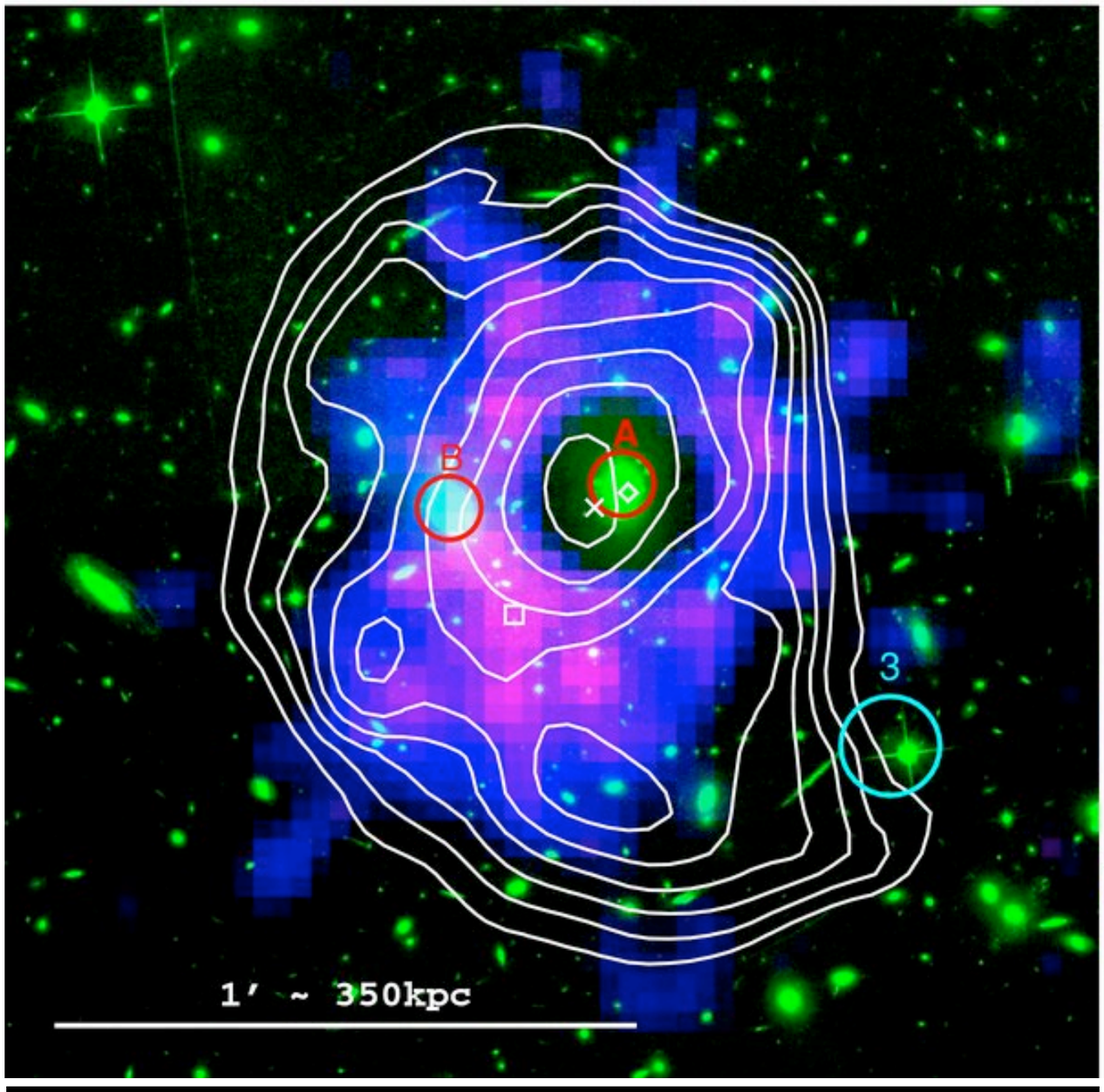
MUSTANG

90 GHz

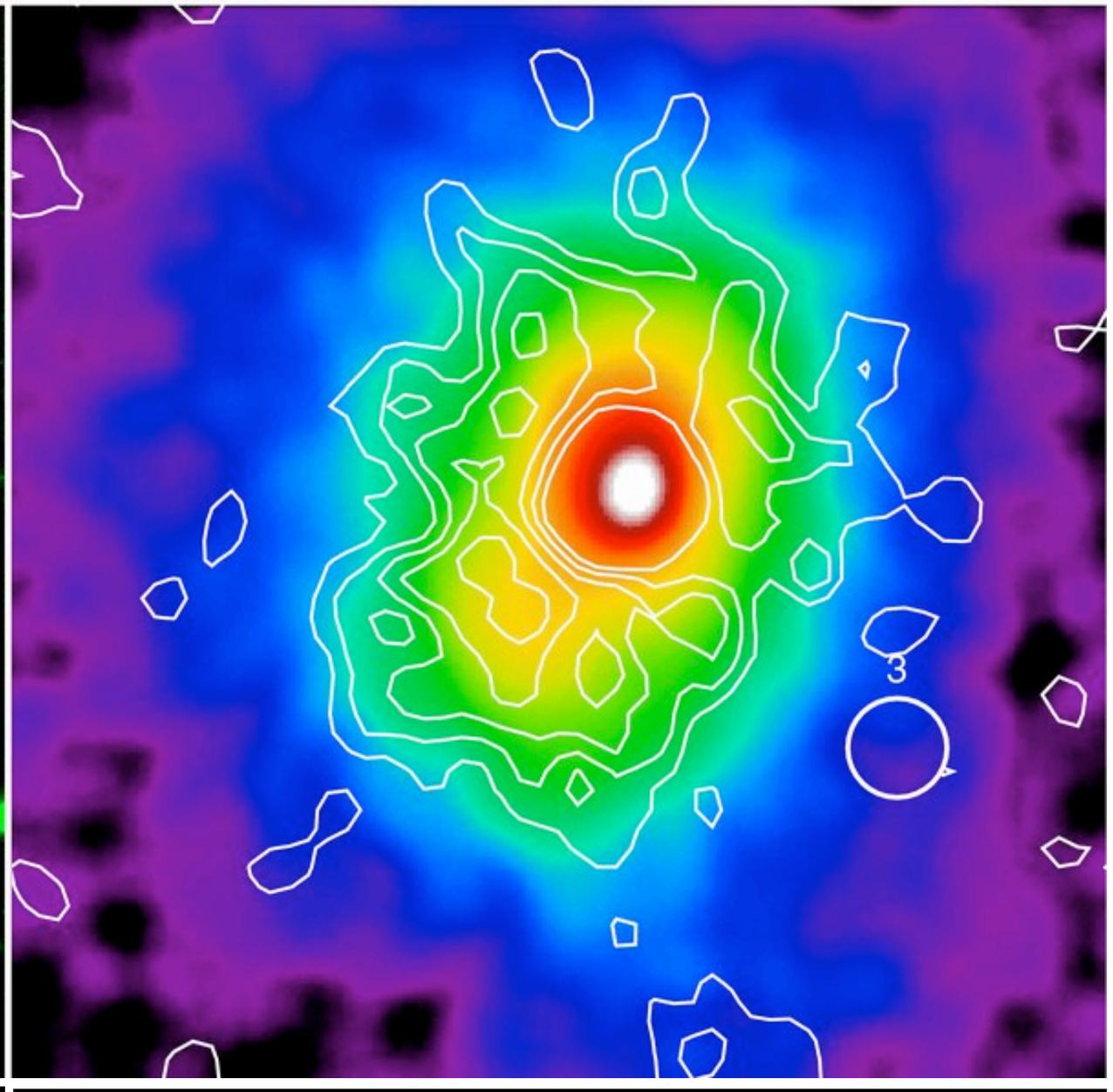
res. 10”

Mason+ 10

Merging scenario



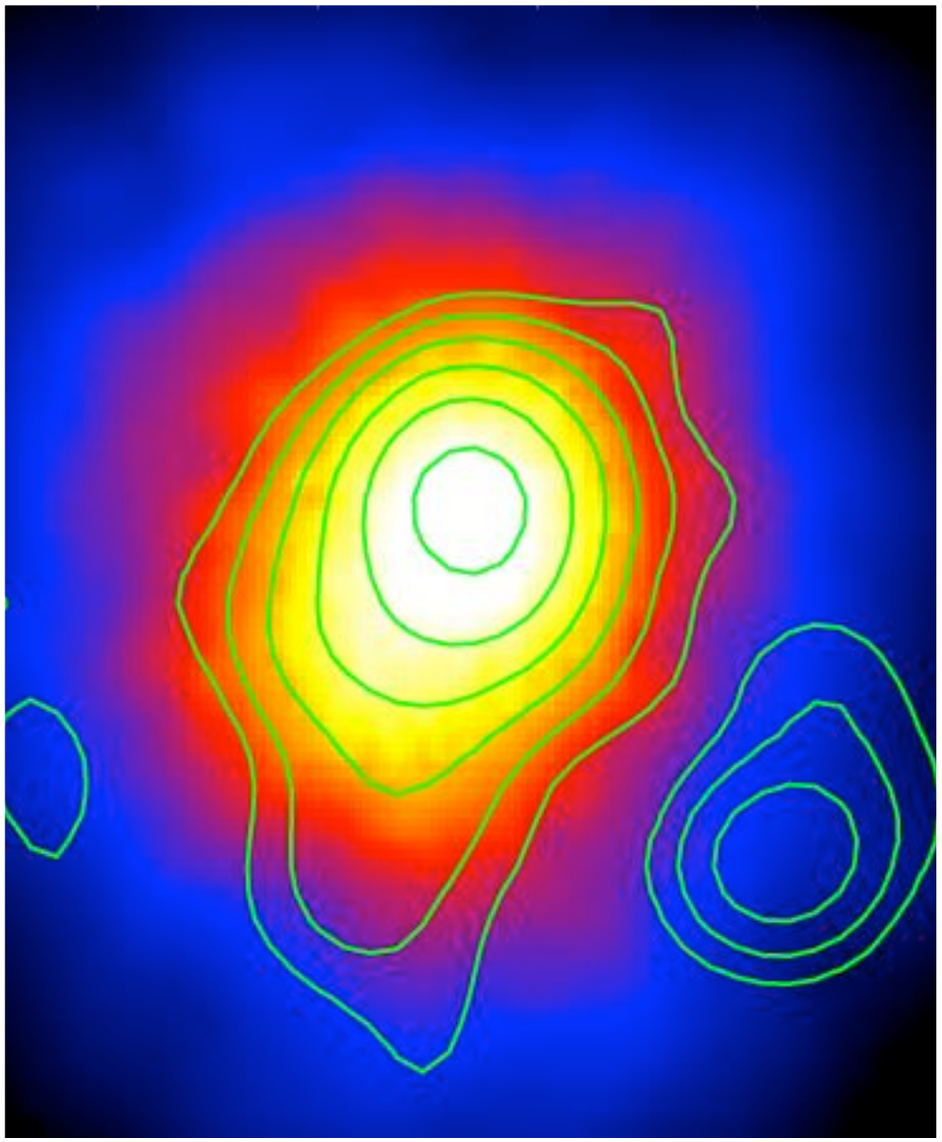
MUSTANG SZE image
HST optical image
Surface mass density contours



Chandra X-ray image
MUSTANG SZE contours

Mason+ 10

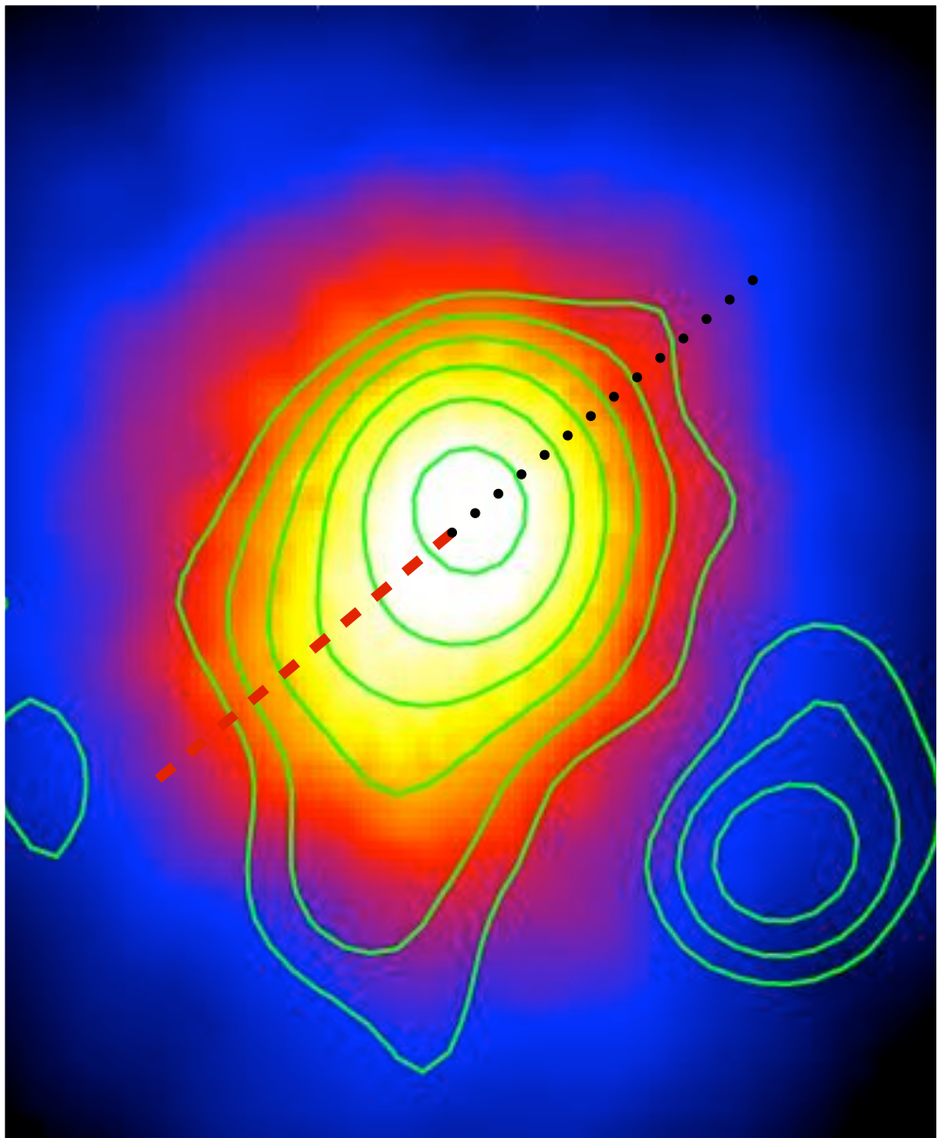
Previous radio results



X-ray image (XMM)
Radio contours (VLA @ 1.4 GHz)

Gitti, Ferrari+ 07

Previous radio results



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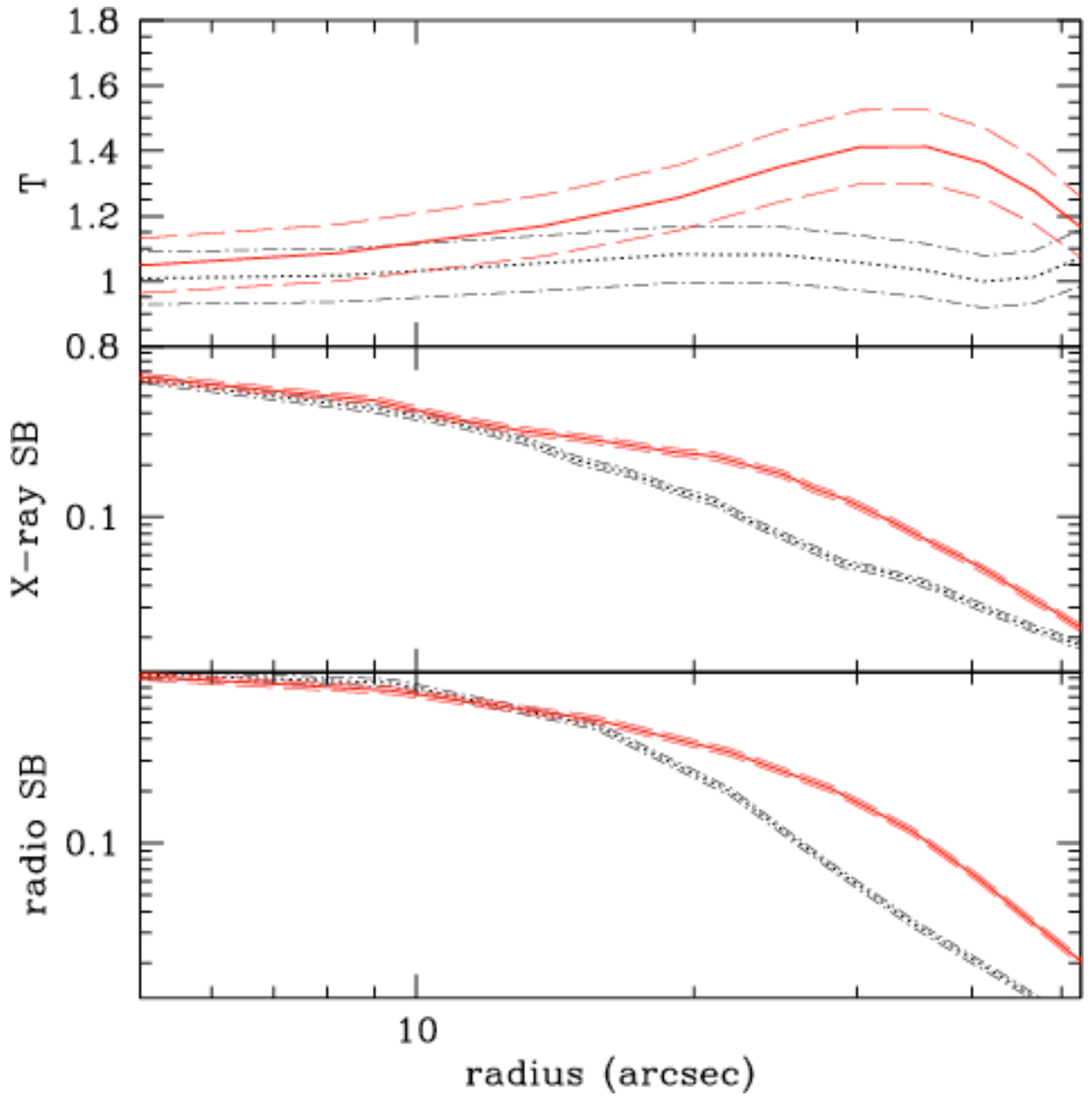
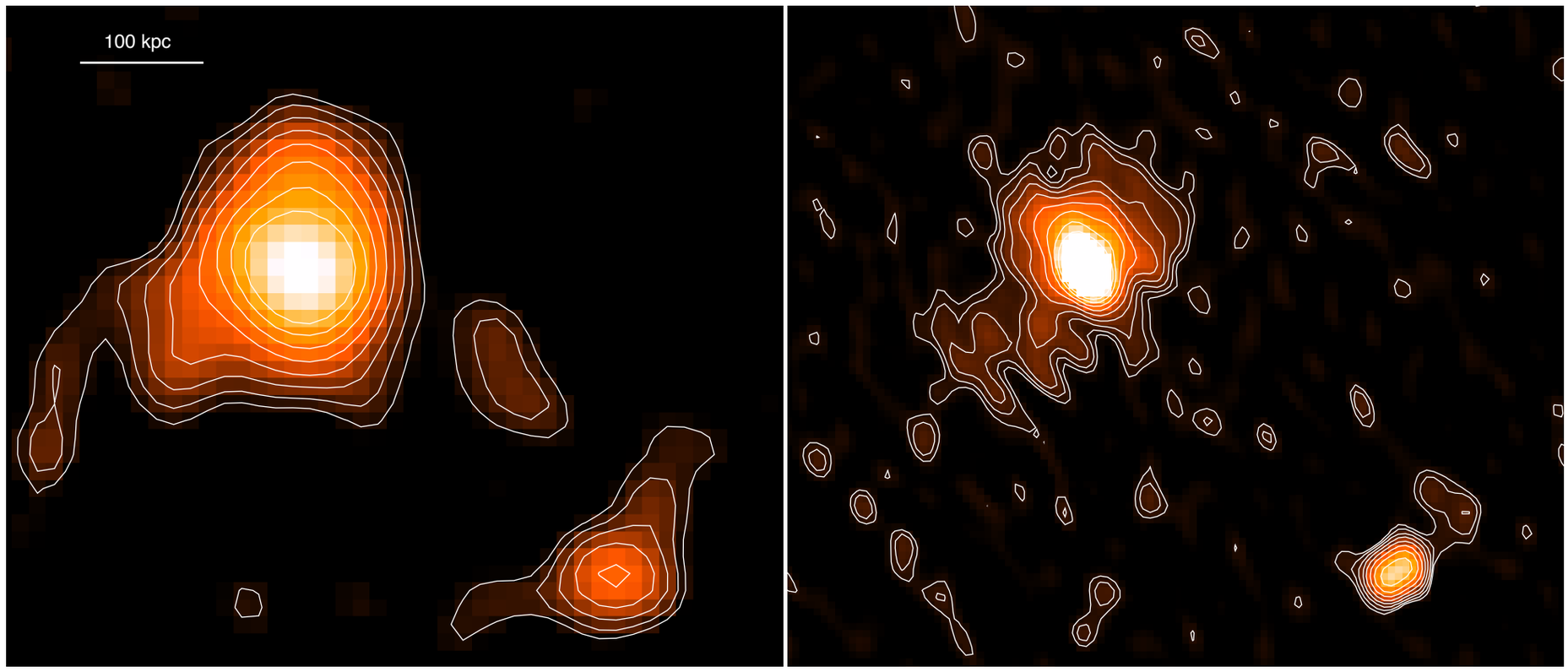


Gitti, Ferrari+ 07

New GMRT observations

237 MHz

res. 11.7”× 9.3”
rms = 2.7 mJy/b



614 MHz

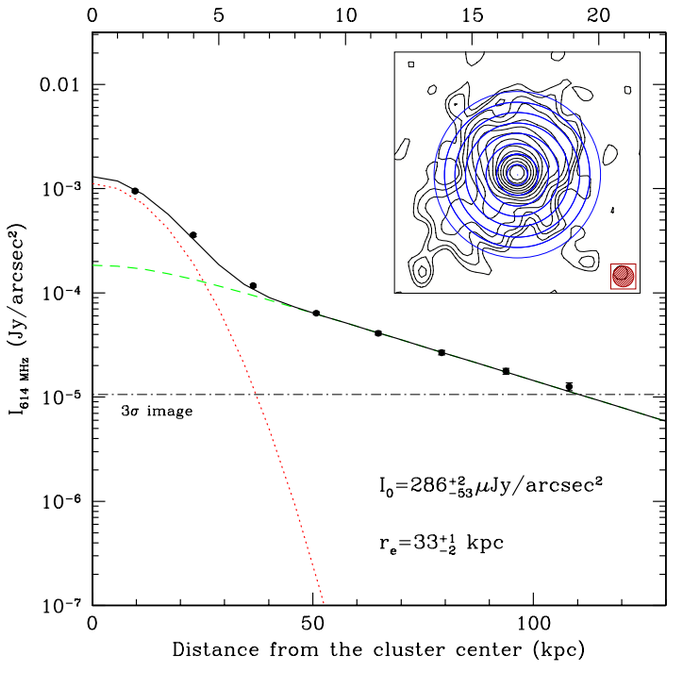
res. 4.8” × 3.5”
rms = 0.3 mJy/b

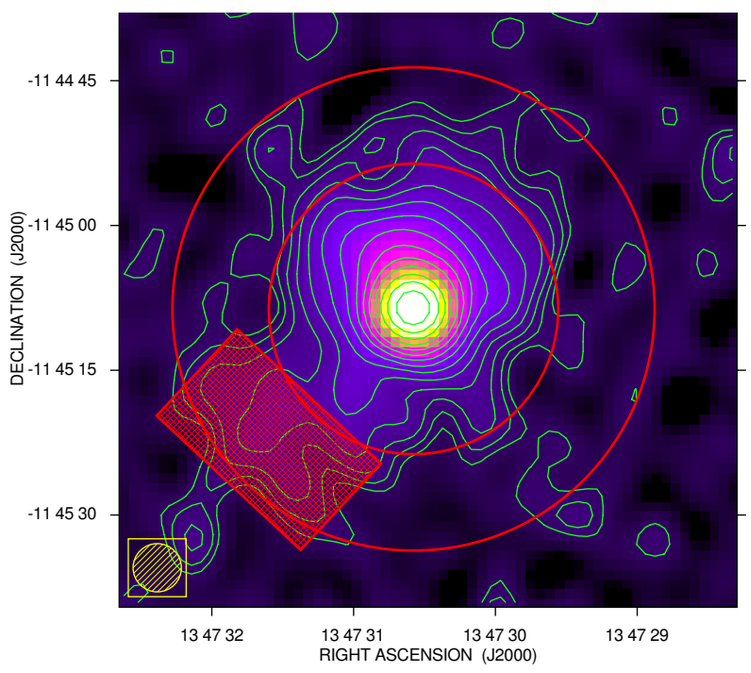
Mini-halo:

$S_{237\ MHz}$ = 131 ± 6 mJy
$S_{614\ MHz}$ = 50 ± 2 mJy

SE excess:

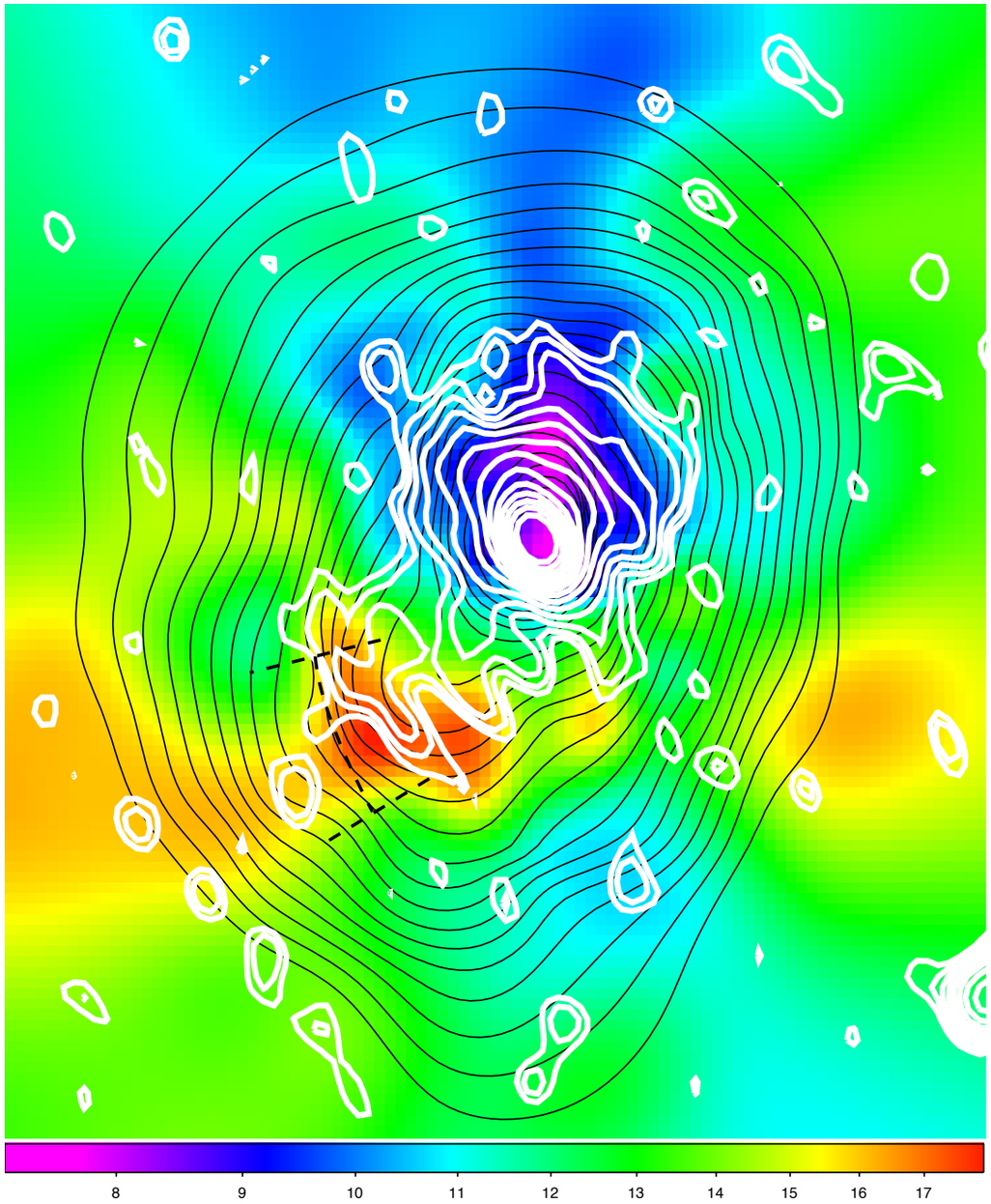
$S_{614\ MHz}$ = 3.3 ± 0.3 mJy



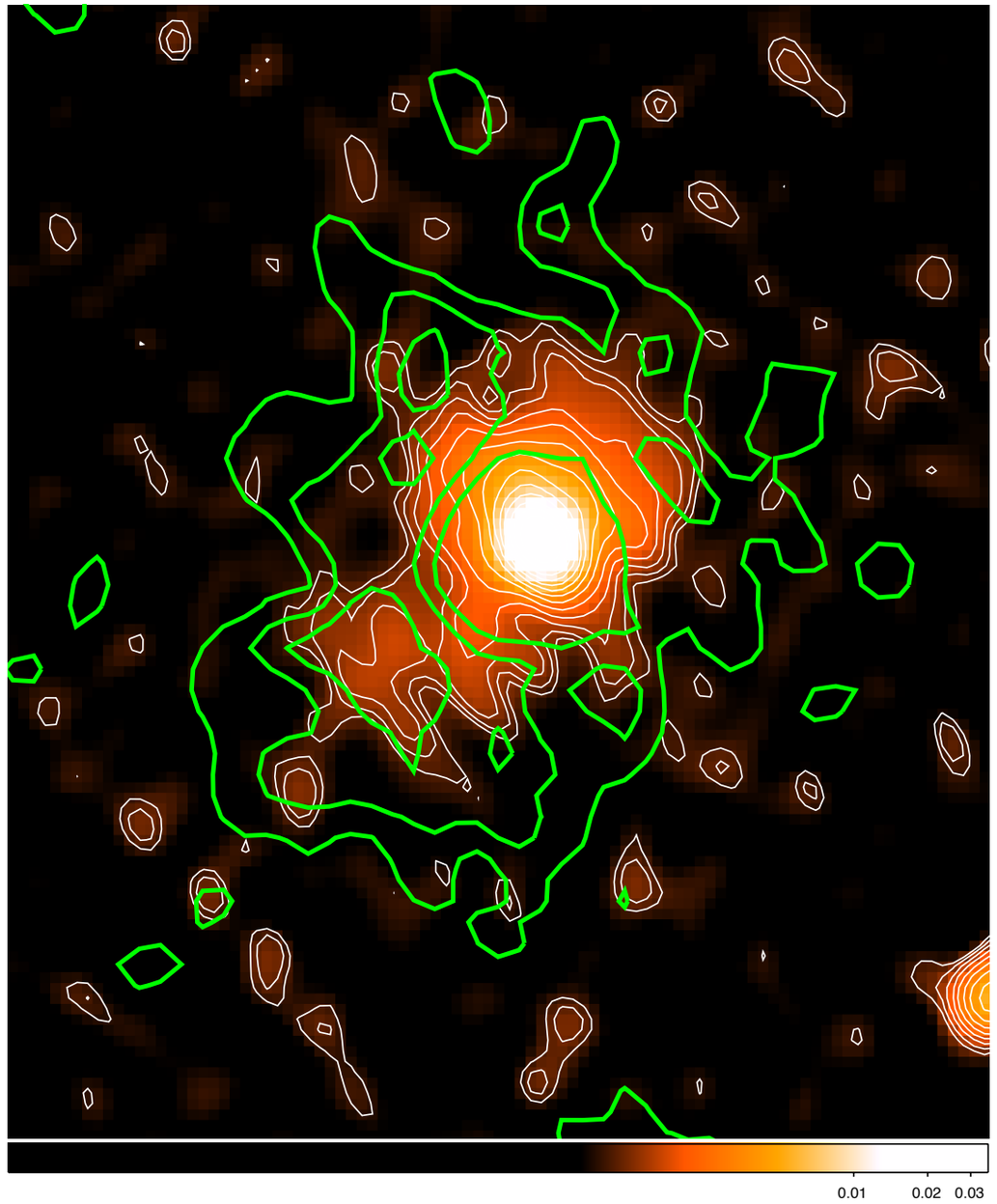


Ferrari+ sub.

Comparison with X-ray and mm data



Temperature map (XMM)
614 MHz contours (GMRT)
X-ray surface brightness contours (Chandra)



614 MHz map & contours (GMRT)
SZE contours (MUSTANG - Mason+ 10)

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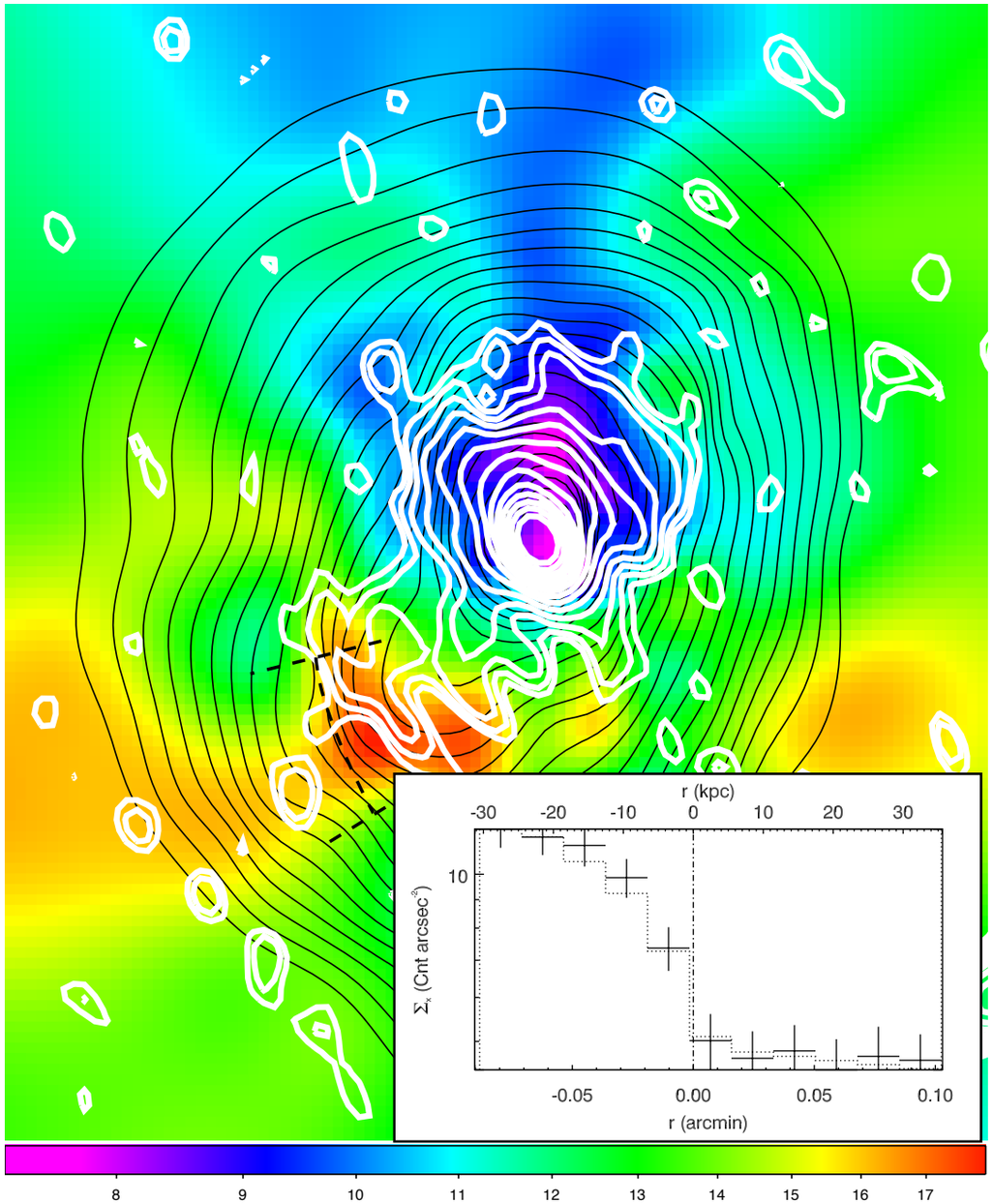

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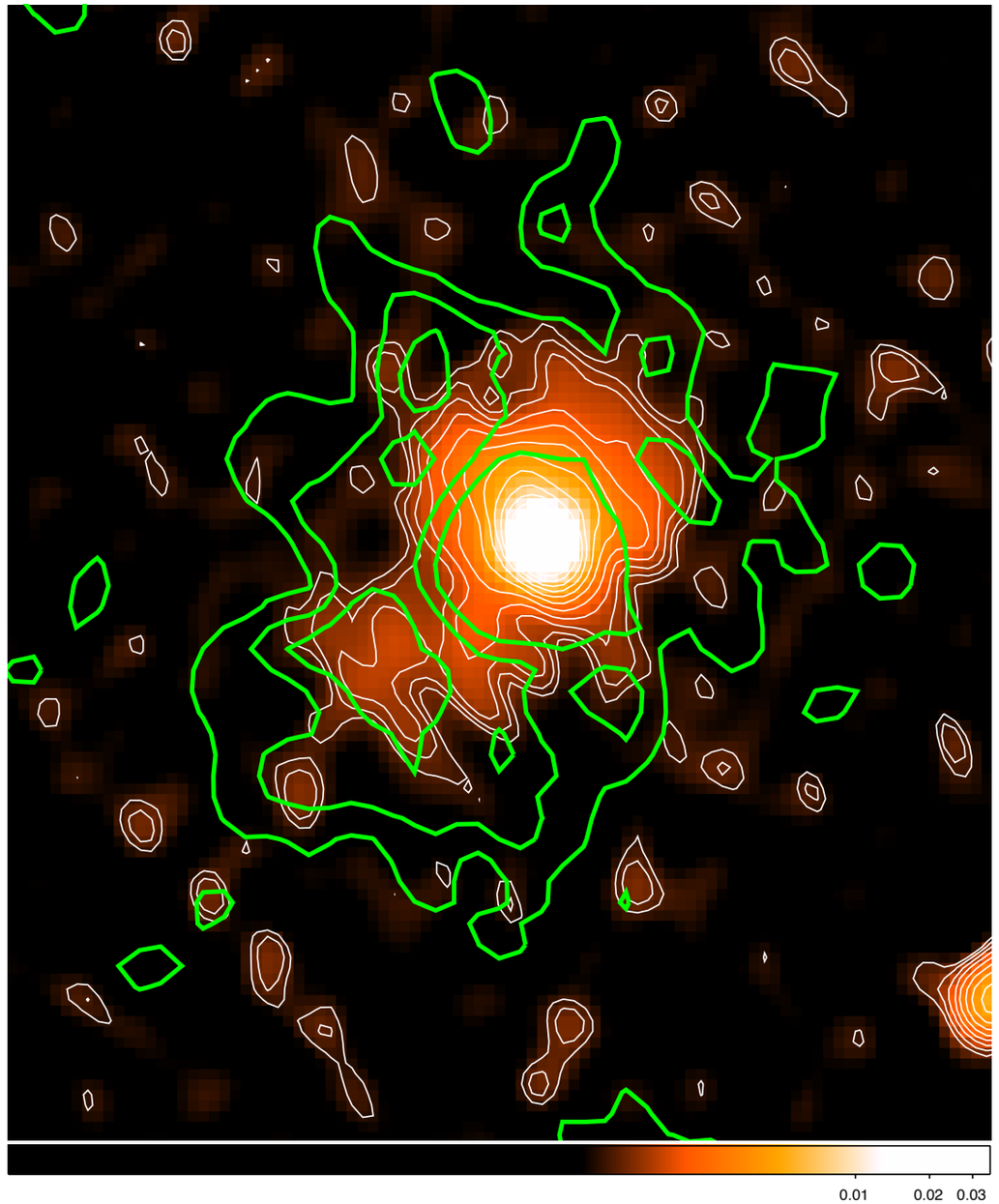

614 MHz map & contours (GMRT)

SZE contours (MUSTANG - Mason+ 10)

Conclusions

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  ii. Cluster physical properties

- **Multi-wavelength analysis of RX J1347-1145**

  i. Discovery of the correspondence between intra-cluster radio emission and high-pressure region detected through SZE

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Thanks !