INTRACLUSTER MAGNETIC FIELDS

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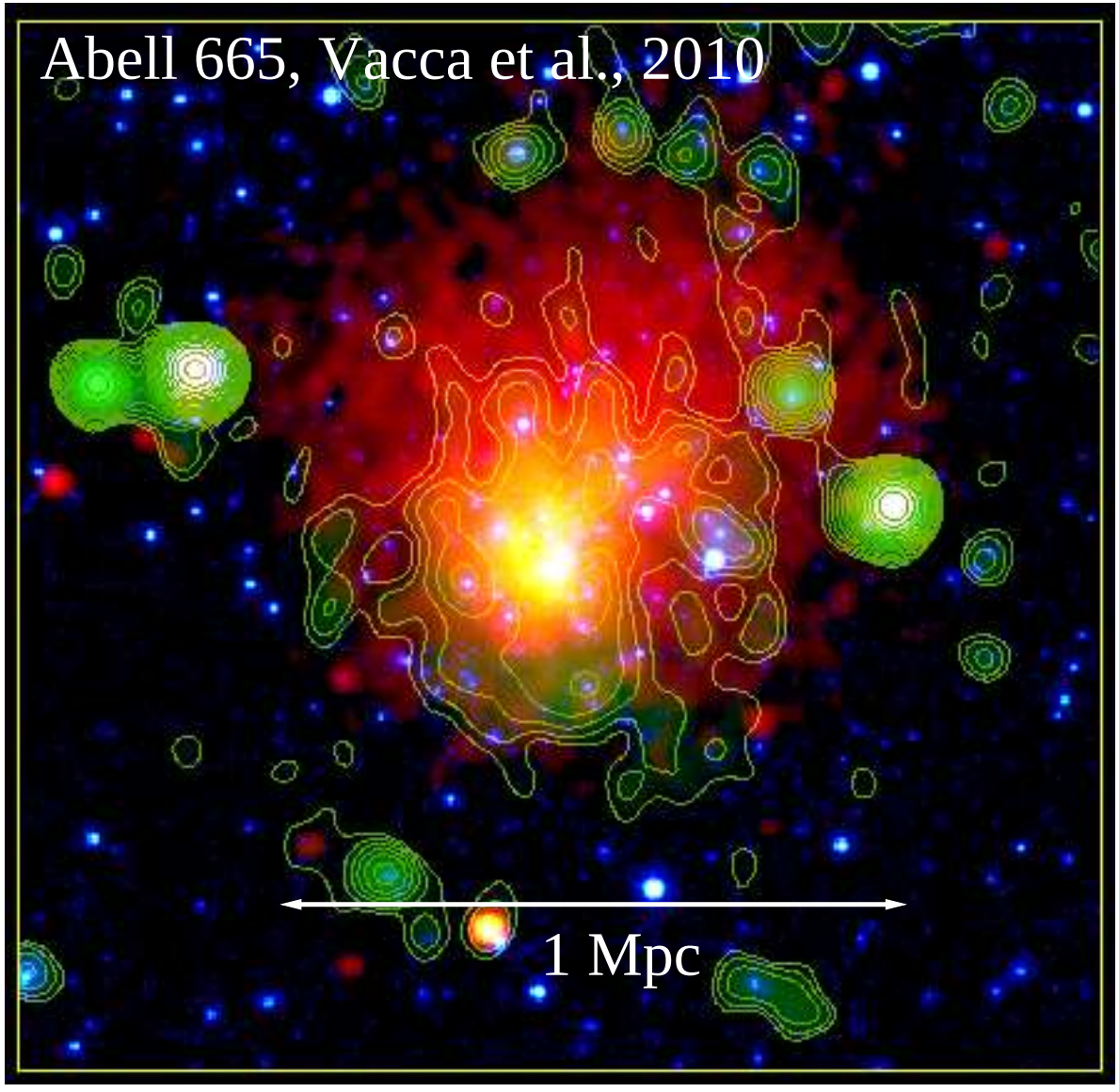
Magnetic fields in galaxy clusters

Optical emission
~1000 galaxies

X-ray emission
T=10^7–10^8 K
$n_e = 10^{-4}$–$10^{-3} cm^{-3}$
$L_X \sim 10^{44}$–10^{45}erg/s

Radio emission
radio galaxies
radio halos
radio relics

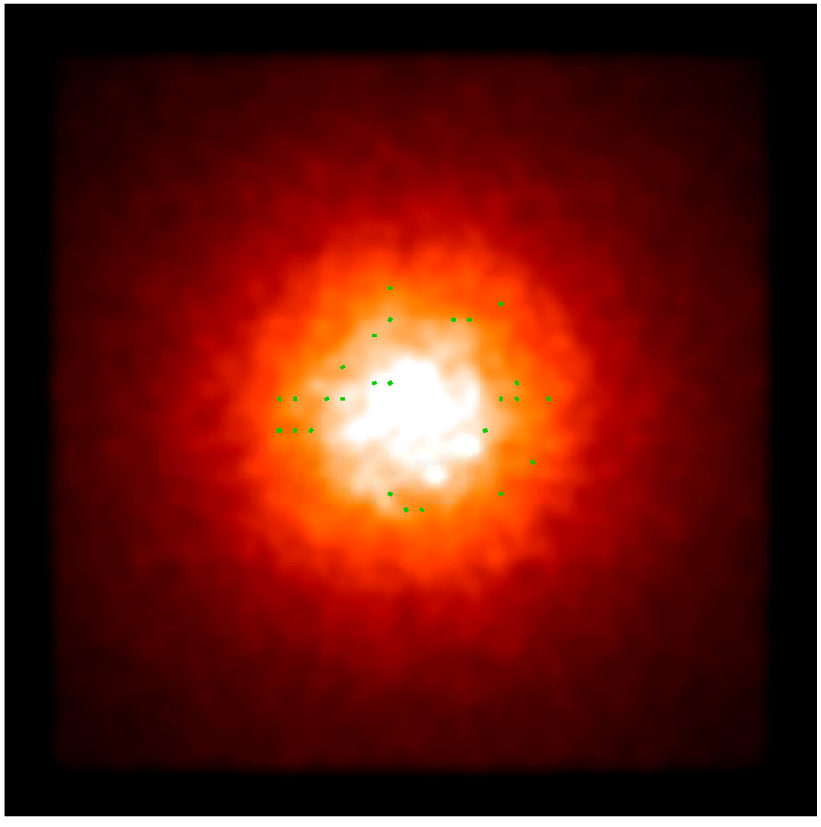


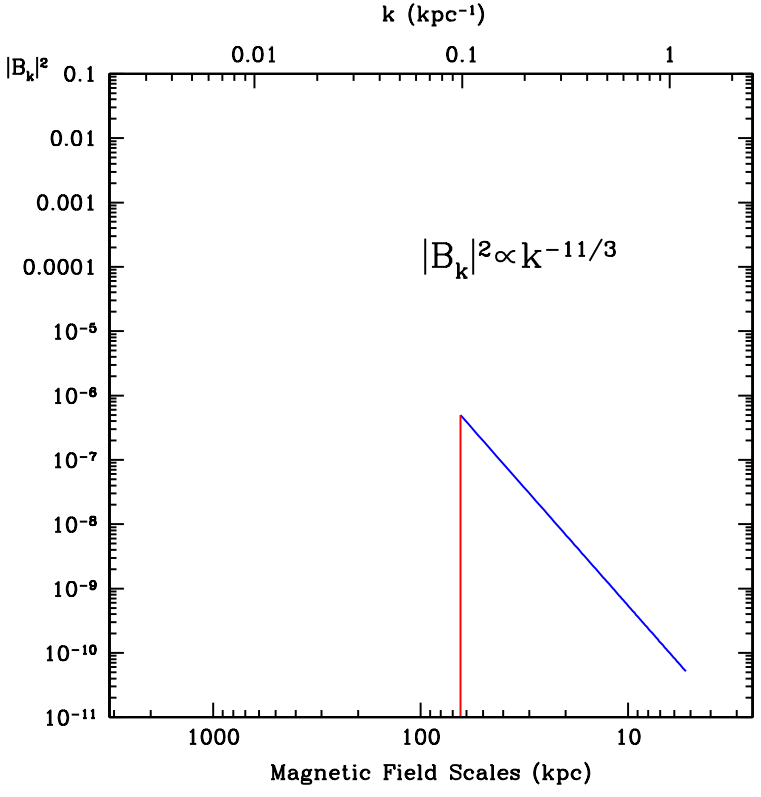
SYNTHETIC IMAGES AND POLARIZED VECTORS

for a turbulent Kolmogorov index magnetic field

$\Lambda_{\max} = 64\, kpc$

Murgia et al. (2004)



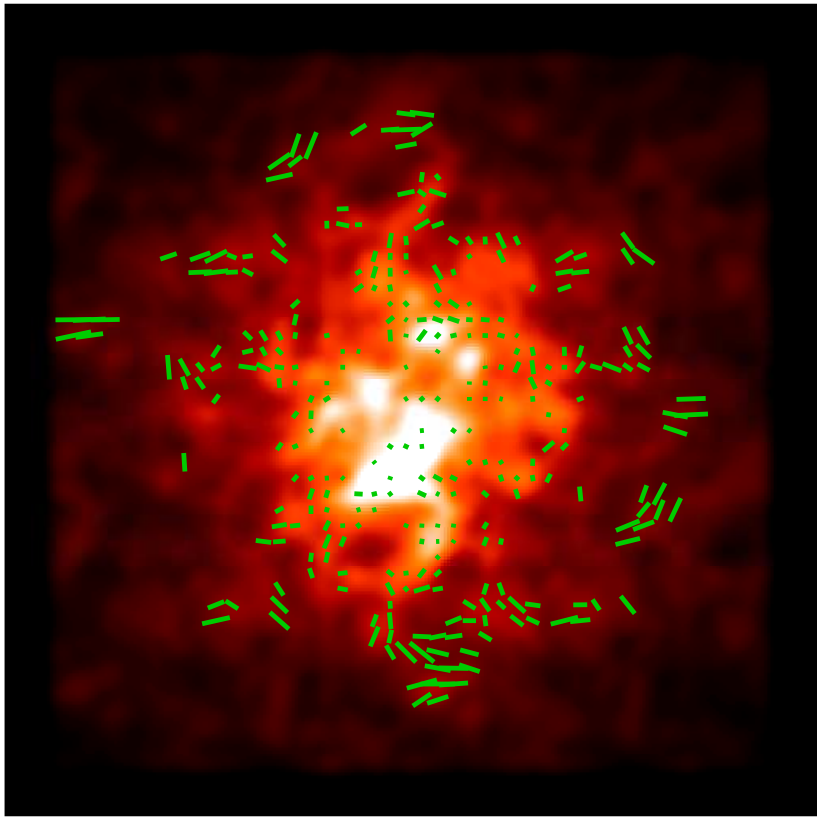


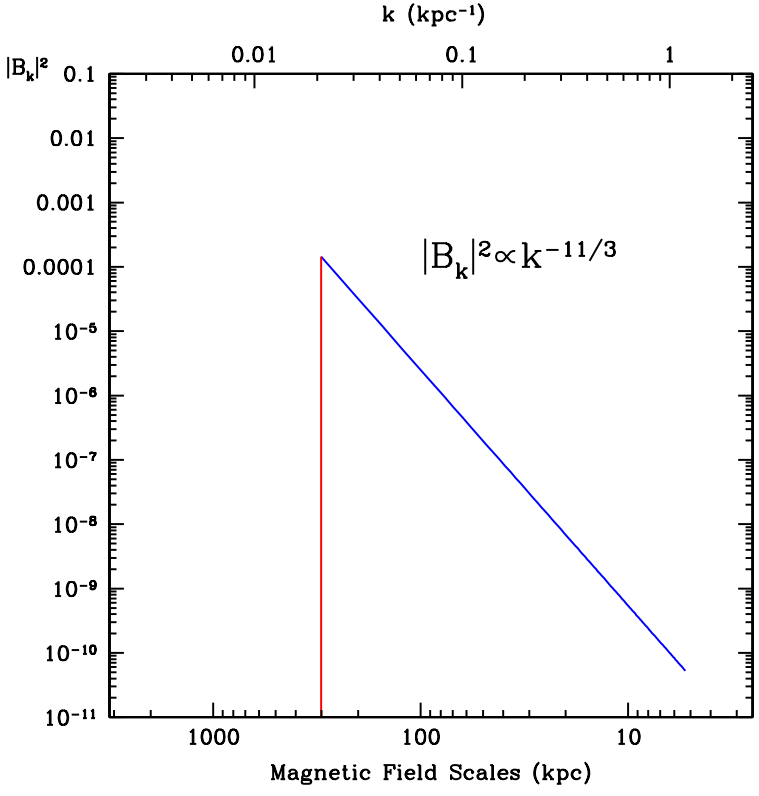
SYNTHETIC IMAGES AND POLARIZED VECTORS

for a turbulent Kolmogorov index magnetic field

$\Lambda_{\max} = 300\, kpc$

Murgia et al. (2004)



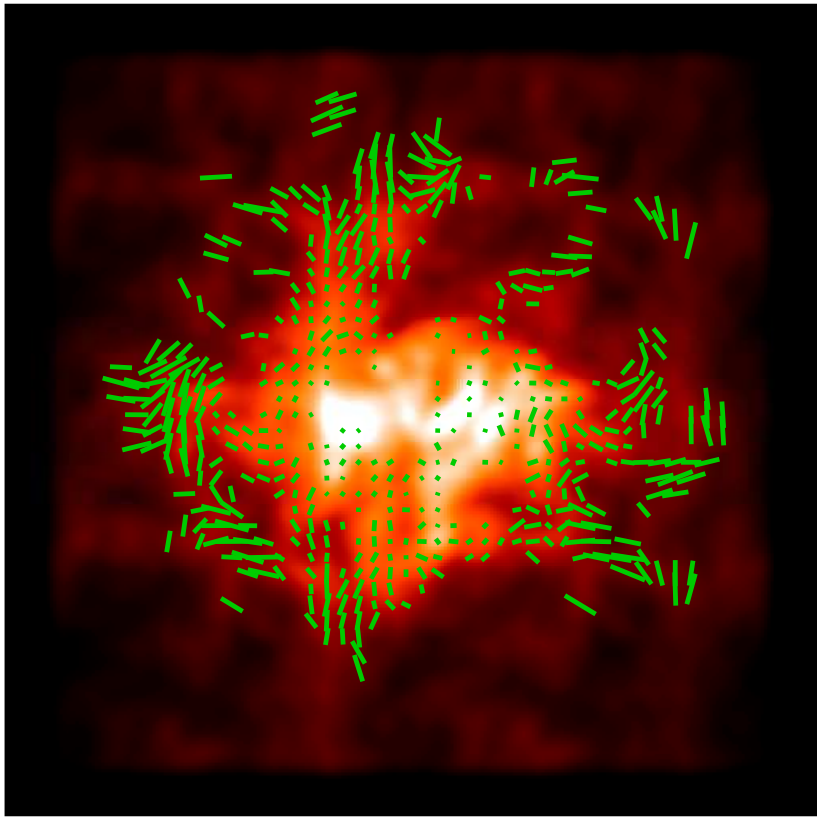


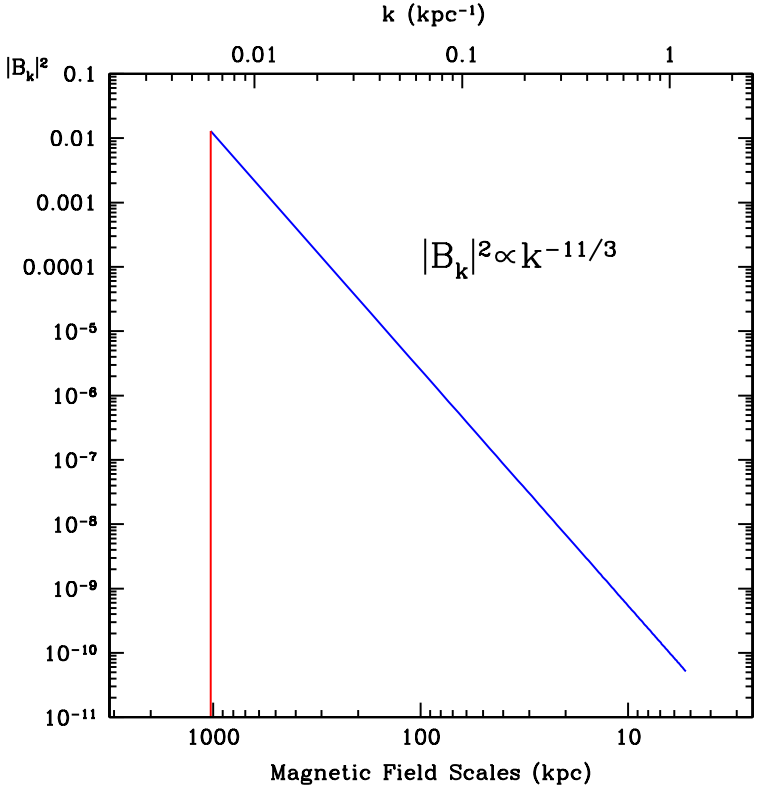
SYNTHETIC IMAGES AND POLARIZED VECTORS

for a turbulent Kolmogorov index magnetic field

$\Lambda_{max} = 1024\, kpc$

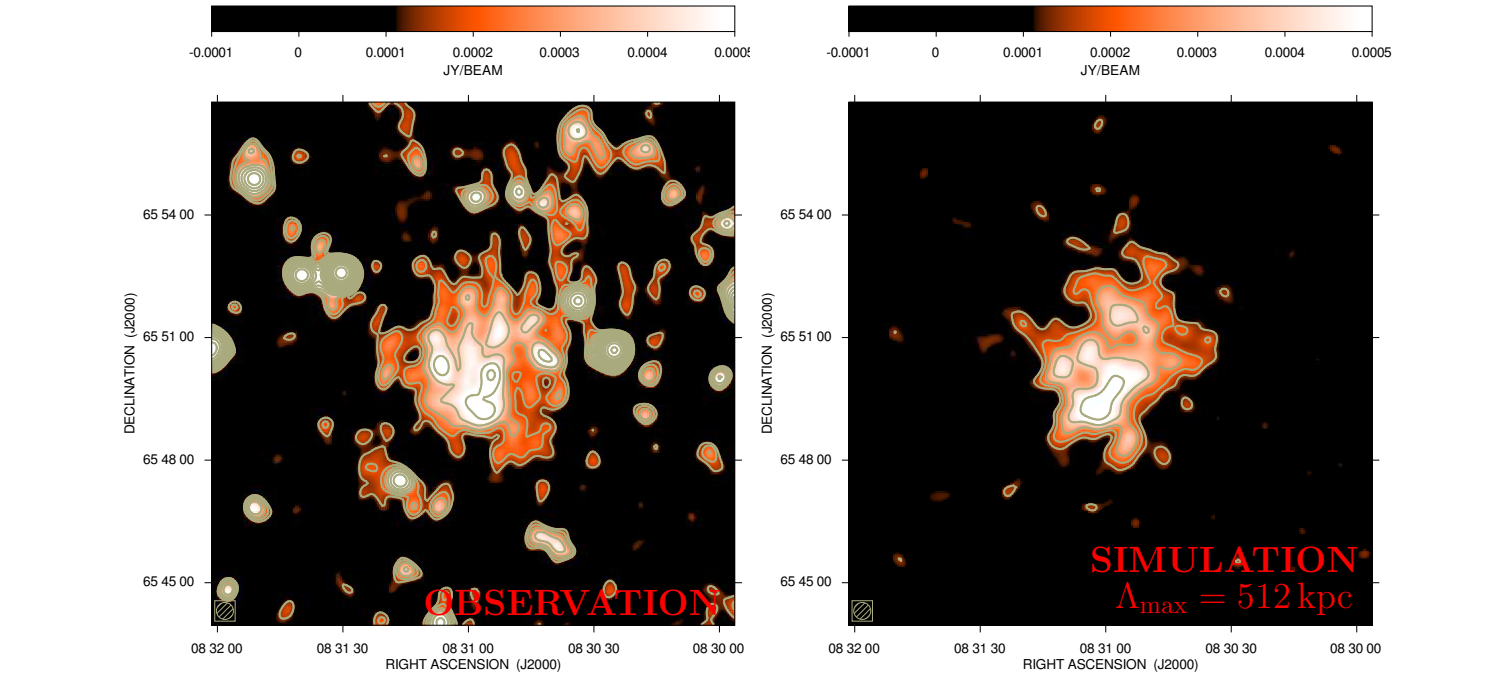
Murgia et al. (2004)

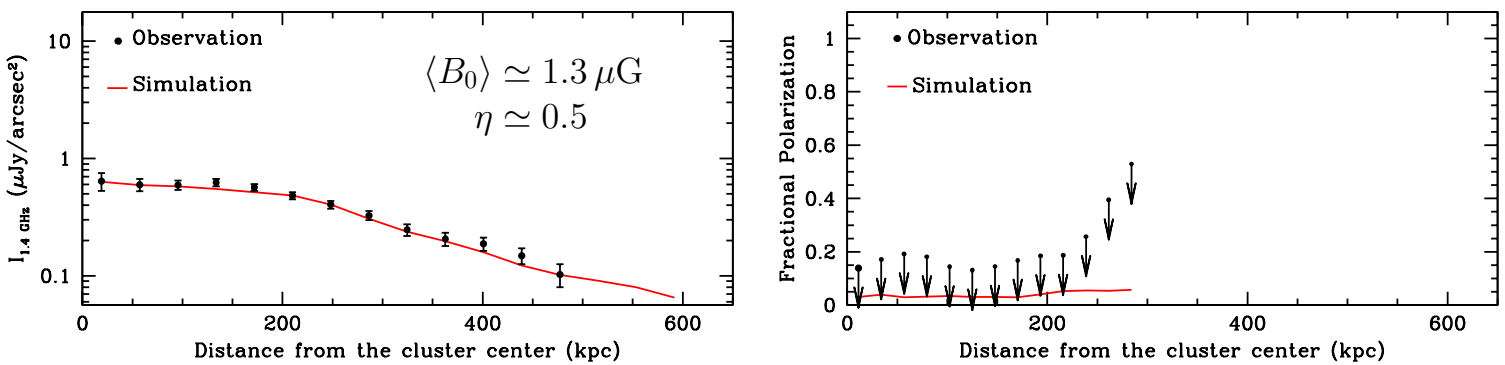




A665, Vacca et al. (2010)

This work made use of results produced by the Cybersar Computer Cluster and the software FARADAY (Murgia et al. 2004)



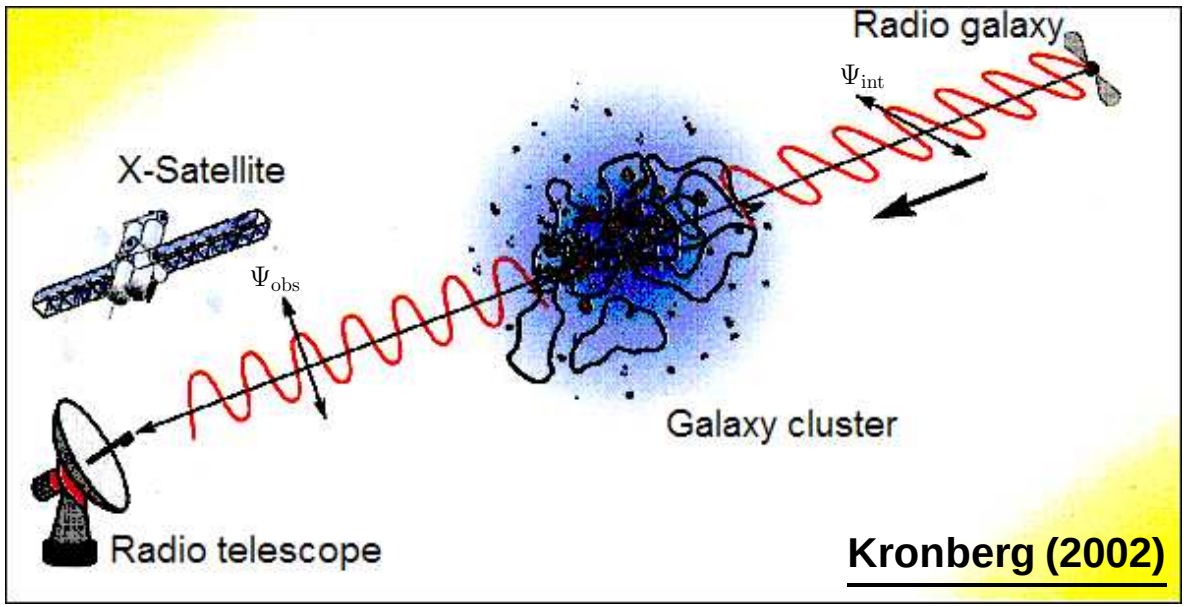


SKA will provide an improvement in sensitivity of 50X compared to the eVLA with high polarization sensitivity. This will allow to detect possible polarized emission from radio halos.

-Total intensity: relativistic electron distribution and magnetic field strength;
- Polarized intensity: relativistic electron distribution and magnetic field structure.

Strong constraints about the magnetic field power spectrum can be given by the ratio between total and polarized brightness.

FARADAY ROTATION

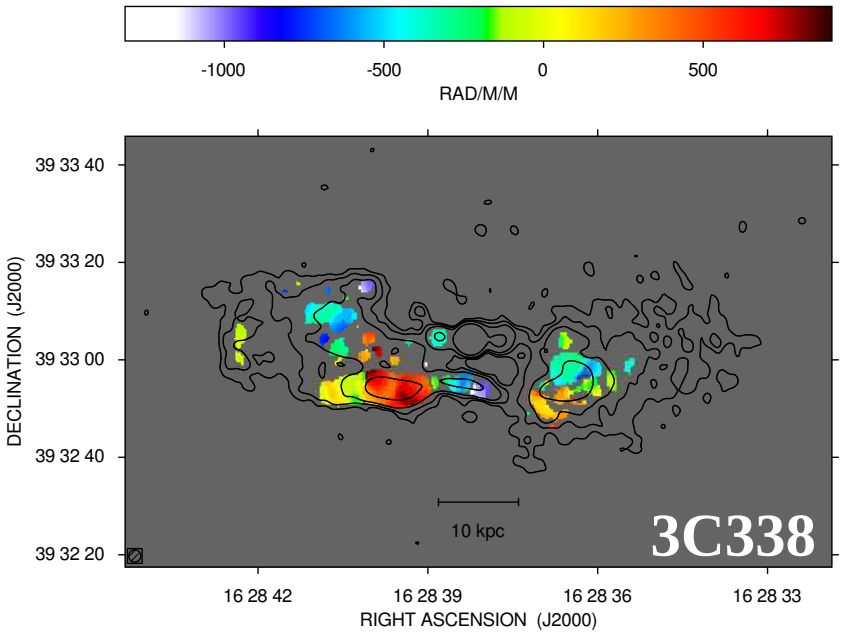


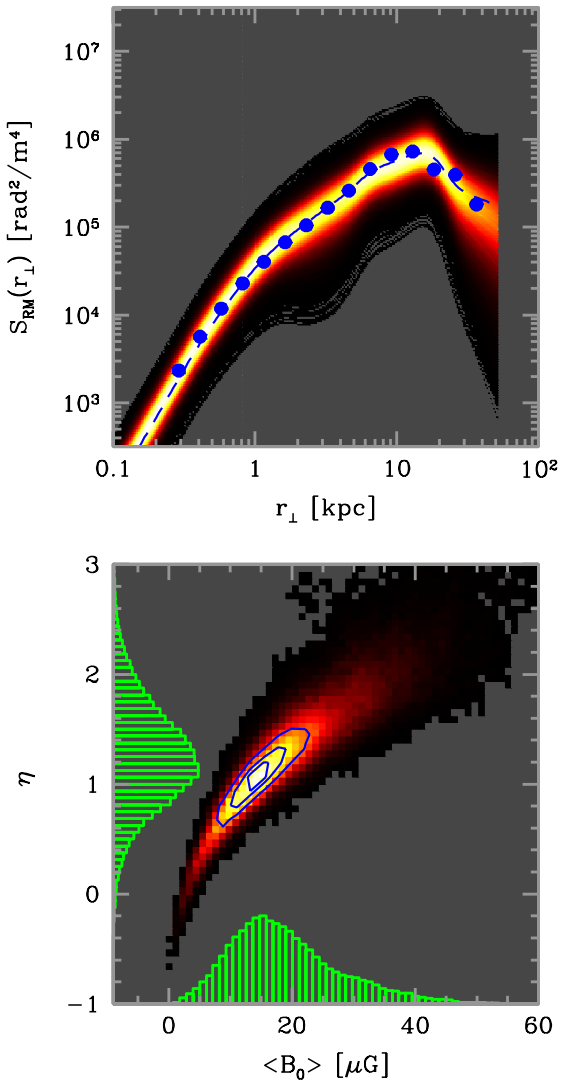
$$\Psi_{\rm obs} = \Psi_{\rm int} + \lambda^2 RM$$

$$RM(\mathrm{rad/m^2}) = 812 \int_0^{\mathrm{L(kpc)}} n_{\rm e}(\mathrm{cm^{-3}}) B_{\parallel}(\mu\mathrm{G}) dl$$

A2199, Vacca et al. (2012)

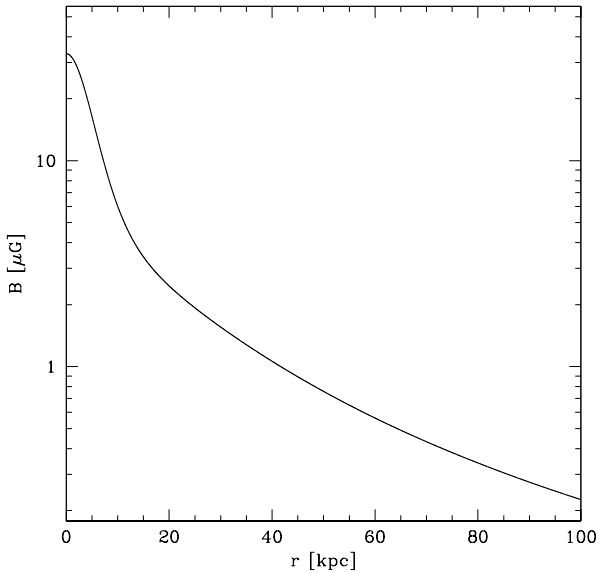
This work made use of results produced by the Cybersar Computer Cluster and the software FARADAY (Murgia et al. 2004)





$$S_{\rm RM} = \left\langle |RM(r'_\perp) - RM(r'_\perp + r_\perp)|^2 \right\rangle_{r'_\perp} =$$

$$= 2(\sigma^2_{\rm RM} + \langle RM \rangle^2) - A_{\rm n} \int_0^\infty J_0(kr_\perp) |B_{\rm k}|^2 k dk$$



$B(r) \propto n_e^{\eta}$ *e.g.*, Dolag et al. 1999, 2002, 2005

To date rotation measure images are available just for few radio galaxies per cluster (best cases are seven galaxies in the Coma Cluster, Bonafede et al. 2010, five galaxies in A514, Govoni et al. 2001).

Krause et al. (2009) calculate for a 100h pointing with the full SKA:

- more than 1000 background sources per cluster for nearby clusters;
- more than 100 background sources $z \sim 0.5$.

SUMMARY

The SKA high-sensitivity and spectral resolution capabilities will allow:

- to detect possible polarized emission from radio halos;
- to study polarized properties of thousands of background and cluster galaxies per square degree.

A detailed study of the intracluster magnetic field power spectrum will be possible.

THANK YOU!