**SKA Science Working Group 8**
**Intergalactic Medium**

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***Level 1 science goal:***

Thermal component: SZ imaging
Non-thermal component: high resolution imaging, spectra and polarization of halos, relics and minihalos

***Level 2 science goal:***

Rotation Measure studies

***SKA Technical Requests***

Array Configuration:

Centrally condensed
Higly filled up to 5 km, but SIMULATIONS are neeed
to extablish the baseline coverage more accurately

Field of view:

1 degree at 1.4 GHz at least

Resolution:

~arcsec at 1.4 GHz

Sensitivity:

30 nanoJy at 5 GHz in 15 min

Frequency range:

20 - 36 GHz for SZ effect
0.3 - 5 GHz for halos and relics
0.3 - 10 GHz for Rotation Measure

***Discussion***

The intracluster medium (ICM) consists of a thermal and a non-thermal component, the latter represented by relativistic particles and magnetic fields. The scientific goal is to prove these ICM components and the relationship among them and study their evolution and energetics.

The thermal component is studied at radio wavelengths through the Sunyaev-Zeldovich (SZ) effect. The future PLANCK mission will provide the detection of many thousands of rich clusters of galaxies via the SZ effect. Clusters detected by PLANCK can be selected as targets for SKA observations to map the SZ effect with high resolution, thus obtaining information on their morphology on a wide area (up to the virial radius) and imaging shocks, holes, density gradients in the thermal ICM. Arcsec resolution will also allow detection of the SZ effect arising on galactic scales during the preheating phase.

The non-thermal component of ICM is directly detected in the clusters through the presence of diffuse radio emission (radio halos, minihalos, and relics) of large extent (~Mpc), low surface brightness (0.5-1 microJy/arcsec$^2$ at 1.4 GHz) and steep spectrum. Still little is known about these sources, in particular about their i) fine structure, ii) spectral trend, iii) polarization. The detection of these low brightness extended structures requests a good coverage of short baselines. The information about the structure is crucial to understand their formation and for a comparison with X-ray data, in particular with the hard X-ray emission of Inverse Compton origin, which should be detected with the new generation X-ray telescopes (ASTROE-2, NEXT, XEUS).

Spectral maps on a wide frequency range are currently impossible to obtain, especially at frequency higher than 1.4 GHz, due to the difficulty in imaging extended low brightness sources of steep spectrum. Spectral information is needed to have information on the energy and ageing of relativistic electrons, and to constrain the models.

Polarization of radio halos is expected to be less than a few percent. Currently, only upper limits have been derived. The knowledge of the orientation and ordering of the magnetic field is very important to understand the formation of diffuse sources, to compare with the model predictions, and to generally get information on the ICM magnetic field.

The ICM magnetic field can also be proved by the Rotation Measure study of radio sources in and behind clusters. This needs analysis of polarization images at multiple nearby frequencies, high polarization purity, and good resolution to resolve the polarization structure.