Contribution ID: **16** Type: **not specified**

Deep L-band VLA observations of the Toothbrush cluster

Thursday, October 5, 2017 12:45 PM (15 minutes)

We present the results of deep L-band VLA observations of the merging galaxy cluster 1RXS J0603.3+4214, which host one of the brightest relics, known as Toothbrush, and an elongated giant radio halo. Our new VLA images provide an unprecedented detailed view of the Toothbrush, revealing enigmatic filamentary structures. These VLA observations in combination with GMRT and LOFAR data, allowed us to study the spectral index distribution at very high resolution. A simple toy model suggest that there are significant variations of the magnetic field strength along the line of sight. The downstream spectral profile, between 150 MHz to 1.5 GHz, can be explained by an inhomogeneous magnetic field and high Mach number shock. The radio halo shows an average spectral index of about $\alpha = -1.16 \pm 0.05$ and a slight gradient from north to south. Excluding the southernmost part, the halo morphology agrees very well with the X-ray morphology. A power-law correlation is found between the radio and X-ray surface brightness. We will also present our preliminary polarization results.

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Session Classification: Science symposium