Giant galactic outflows and shocks in the cosmic web

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Abstract

The radio sky harbours both galactic and extragalactic sources of arcminute- to degree-scale emission of various physical origins. To discover extragalactic diffuse emission in the Cosmic Web beyond galaxy clusters, one must image low–surface brightness structures amidst a sea of brighter compact fore- and background sources. Angularly separating the faint from the bright radio sky requires high-quality ionospheric calibration. This thesis introduces new advances in and investigations into ionospheric calibration, the degree-scale Milky Way foreground, and two sources of megaparsec-scale emission in cosmic filaments: giant galactic outflows and cosmological structure formation shocks. Giant galactic outflows (or 'giant radio galaxies') are generated by the jets of active supermassive black holes, and transport relativistic leptons, entrained atomic nuclei, heat, and magnetic fields from the centres of galaxies to their outskirts and beyond. These outflows embody the most energetic pathway by which galaxies respond to the Cosmic Web around them. Structure formation shocks around filaments are a generic, but still elusive, prediction of cosmological simulations and trace the gravitational flow of matter from proto-voids to filaments. Both phenomena inform on the strength, topology, and origin of magnetic fields in the Cosmic Web.