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Cosmic magnetic fields and ways of probing them

Sunday 6 December 2015 14:00 (25 minutes)

In this talk I focus on magnetic probes and related discoveries of the physical state of space between stars and galaxies. It begins with the Milky Way disc, then clusters of galaxies, magnetic fields in the megaparsec scale filaments of Large Scale Structure (LSS), and cosmological voids. I discuss the energetics, some the physical, and gas dyamical basics, and the measurement techniques used to date –with the aim of communicating a sense of possibilities for future improvement.

I discuss an emerging convergence between particle accelerators such as at CERN, Cosmic Rays, and astrophysical jets – on scales of kpc –Mpc. I include observation –based estimates of the largest energy transfers in the extragalactic Universe. These appear largely electromagnetic, and involve recently estimated currents of $\sim 10^{18}$ Amperes. The jets feed into very large, magnetised CR clouds having accumulated energies of up to 10^{61} ergs. The jets are powered by supermassive black holes in galactic nuclei, and provide a measurable, and surprisingly efficient conversion of gravitational infall energy to electromagnetic and cosmic ray energy. Finally, I show how electric circuit models are helpful in understanding energy flows from galaxy nuclei into intergalactic space.

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