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Cosmic magnetic fields and ways of probing them

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A non-negligible fraction of a Supermassive Black Hole's (SMBH) rest mass energy gets transported into extragalactic space - by remarkable processes in jets which are not completely
understood. The bulk of the energy flow from the SMBH (e.g. 10^7 $M_{\odot}$) appears to be
electromagnetic, rather than via a particle beam flux. Also, remarkably, these jets contain current flows that remain largely intact over multi-kpc distances. Accretion disk models have independently calculated that a $\sim 10^8$ $M_{\odot}$ SMBH should generate O(10^{18-19}) Ampères in the vicinity of the SMBH.
I describe the best yet observational estimate of the current flow along the axis of a jet that extends from the nucleus of the active elliptical galaxy in 3C303. This is I $\sim 10^{18}$ Ampères at a projected 20 kpc from the AGN. This points to the existence of cosmic scale electric circuits. The power flow is P = I^2Z, watts, where Z $\sim$ 30 Ohms, which is O (the impedance of free space), Z (ϵ_0, μ_0), where (ϵ_0, μ_0) are the permittivity and magnetic permeability. These, in turn, uniquely determine c. The electrical potential drop ($\sim$ 10^{20} V) across the jet diameter (which is a few times rG of the SMBH) is, interestingly that required to accelerate Ultra High Energy Cosmic Rays (UHECR).
Jets and high energy outflows have different progenitors, forms, sizes, luminosities, and ambient environments. This talk focuses on electromagnetically dominated (Poynting flux) jets from supermassive BH's located in a rarified intergalactic environment - i.e. not in rich galaxy clusters.

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