SPACE AND COSMIC RAY PHYSICS SEMINAR

University of Maryland
Computer & Space Sciences Building, Rm 2400
4:30 PM Monday, April 12, 2004
Tea & cookies 4:00-4:30 PM

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The Origin and Propagation of the Highest Energy Cosmic Rays, the Nearby Sources

In the picture for the activity of relativistic jets one aspect that we model, but cannot yet fully constrain, is the hadronic part of the energetic particle population. We can set limits on the maximum energy of individual particles from the Larmor radius condition: The Larmor orbit has to fit inside the jet. In the Parker regime of the magnetic field topology of jets this condition is independent of distance along the jet. We can also constrain the energetics and so give an upper limit on the high-energy cosmic ray power coming out from any observed compact radio jet. Using these simple constraints derived from a well-tested model for the activity of black holes, we can sum all the cosmic ray contributions possible from the cosmologically nearby black holes. We find that at the highest energy M87 dominates, at somewhat lower energies (around 20 EeV) Cen A dominates, and at still lower energies NGC1068 contributes. However, since the maximum particle energy is quite low, a few EeV or even less for most sources, the sum over many weak sources does not contribute significantly around even 10 EeV, contrary to a first simple expectation. Introducing then a simple model for a turbulent magnetic halo wind of our Galaxy, akin to the Solar wind in some aspects, we can simulate readily all presently observed properties of the highest energy cosmic rays, such as spectrum and sky distribution. This would give a strong handle on the energetics of all radio galaxies that contribute to the overall energetics in clusters and filaments of galaxies. The conclusion is confirmed that this activity injects noticeable power into clusters, filaments and sheets.

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