Contribution ID: **136** Type: **Oral presentation**

Particle acceleration and nonthermal emission from fast winds in active galactic nuclei

Monday, 26 October 2015 15:30 (15 minutes)

X-ray observations of active galactic nuclei (AGN) are revealing the widespread existence of powerful, baryonic outflows reaching mildly relativistic velocities, seen as variable, blue-shifted absorption lines of ionized heavy elements, in both radio-quiet and radio-loud objects. Sometimes called ultra-fast outflows (UFOs), they are plausibly interpreted as winds driven by the accretion disk and may be the key agents for AGN feedback onto their host galaxies, although their formation mechanism is not yet clear. We discuss the possibility of acceleration of electrons and hadrons in collisionless shocks that are likely to form at different locations in such fast winds, together with expectations for the consequent nonthermal emission from the radio band up to high-energy gamma-rays. We find that: 1) For some radio-quiet AGN with known outflows, synchrotron emission from electrons can account for their radio emission whose origin is not yet clear. 2) For radio-quiet AGN with known outflows and tentative GeV associations such as ESO 323-G77, external inverse Compton emission provide a potential explanation of the gamma-rays. 3) For radio galaxies with known outflows and tentative GeV associations such as 3C111 and 3C120, external inverse Compton emission provide an explanation of the gamma-rays (and partially of the X-rays) that is unrelated to jets. 4) For radio-quiet AGN with known outflows and GeV upper limits such as NGC 4151, lower limits on magnetic fields can be inferred and may point to magnetically driven outflows. We conclude with a discussion of future prospects.

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Session Classification: Gamma-Ray Astrophysics

Track Classification: Gamma-ray Astrophysics