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Diffuse gamma ray and neutrino produced by AGN winds

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Various observations are revealing the widespread occurrence of fast and powerful winds in active galactic nuclei (AGNs) that are distinct from relativistic jets, likely launched from accretion disks and interacting strongly with the gas of their host galaxies. During the interaction, strong shocks are expected to form that can accelerate nonthermal particles to high energies. Such winds have been suggested to be responsible for a large fraction of the observed extragalactic gamma-ray background (EGB) and the diffuse neutrino background, via the decay of neutral and charged pions generated in inelastic pp collisions between protons accelerated by the forward shock and the ambient gas. However, previous studies did not properly account for processes such as adiabatic losses that may reduce the gamma-ray and neutrino fluxes significantly. We evaluate the production of gamma rays and neutrinos by AGN-driven winds in detail by modeling their hydrodynamic and thermal evolution, including the effects of their two-temperature structure. We find that they can only account for less than ~ 30% of the EGB flux, as otherwise the model would violate the independent upper limit derived from the diffuse isotropic gamma-ray background. If the neutrino spectral index is steep with $\Gamma \gtrsim 2.2$, a severe tension with the isotropic gamma-ray background would arise as long as the winds contribute more than 20% of the IceCube neutrino flux in the 10–100 TeV range. At energies $\gtrsim 100$ TeV, we find that the IceCube neutrino flux may still be accountable by AGN-driven winds if the spectral index is as small as Γ~2.0–2.1.

Primary author: Dr LIU, Ruoyu (DESY)

Presenter: Dr LIU, Ruoyu (DESY)

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