Contribution ID: **472** Type: **Contributed talk**

High-energy neutrinos and gamma rays from winds and tori in active galactic nuclei

Thursday, 7 July 2022 16:00 (15 minutes)

Powerful winds with wide opening angles, likely driven by accretion disks around black holes, are observed in the majority of active galactic nuclei (AGN) and can play a crucial role in AGN and galaxy evolution. If protons can be accelerated in the wind near the black hole, e.g. via diffusive shock acceleration, $p\gamma$ processes with photons from the nucleus generate neutrinos, as well as $\gamma\gamma$ cascade emission from the gamma-ray to radio bands. The TeV neutrinos tentatively detected by IceCube from the obscured Seyfert galaxy NGC 1068 can be interpreted consistently if the shock velocity $\sim$1000 km s^{-1}, which may correspond to a failed, line-driven wind that is physically well motivated. While the $p\gamma$ cascade is mostly $\gamma\gamma$-attenuated above MeV energies, the GeV photons observed from NGC 1068 and some other radio-quiet AGN may arise from an outer shock where the wind impacts the obscuring torus, e.g. via *pp* processes, along with some observable radio emission. Observational tests and implications of this scenario are discussed. Neutrinos may offer a unique probe of the launching sites of AGN winds, particularly for objects obscured in photons.

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Session Classification: Contributed Talks