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High energy neutrino emission from obscured sources through the pp channel

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The existence of an astrophysical neutrino flux at TeV to PeV energies has now been firmly established by the IceCube collaboration. However, the sources responsible for this flux have not yet been identified. The most important candidates, steady emitting blazars and transient gamma-ray bursts, favoured on the basis of their high gamma-ray luminosity, are now ruled out as the dominant source populations. Therefore, it is necessary to investigate alternative source classes. The observed neutrino flux is at the level expected from its presumed connection to ultra-high-energy cosmic rays, implying high interaction efficiencies of the parent cosmic rays in the sources. When assuming sources transparent to gamma-rays, this leads to a tension with the intergalactic gamma-ray background observed by Fermi. This severely constrains the possibility that the neutrino flux originates in cosmic ray reservoirs where pp-interactions are efficient, but gamma-rays can escape unhindered. We investigate the possibility that the astrophysical neutrino flux originates in sources which are obscured by dense columns of gas, which can attenuate the gamma-ray flux. This scenario is applied to ultra-luminous infrared galaxies, which are among the most powerful sources in our universe, common at high redshift, and feature high gas densities. We show such a source class can contribute to the observed neutrino flux.

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