

Gamma-ray emission model for the Sagittarius A* accretion flow

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Abstract

The origin of the very-high-energy (VHE) gamma-ray point source HESS J1745-290 at the Galactic Center is still under debate. The spectrum of the diffuse emission detected in the Central Molecular Zone (CMZ), on the other hand, suggests the existence of a central source capable of accelerating protons to \sim PeV energies. Although it is suggestive to consider that both emissions owe their origin to VHE cosmic rays (CRs) coming from the same source, the spectrum of HESS J1745-290 shows a break at \sim 10 TeV, which is not shown by the diffuse emission. We propose that the spectra of both emissions can be explained by the interaction of CRs injected by the accretion of gas onto Sgr A*. In our model, the break in the gamma-ray spectrum of HESS J1745-290 is due to an energy-dependent transition in the way the CRs diffuse in the accreting gas, which depends on the relation between the gyro-radius of the CRs and the coherence length of the magnetic turbulence in the accretion flow. The lack of a break in the spectrum of the diffuse emission in the CMZ is because the coherence length is much larger in that region, which would avoid the occurrence of such transition. Our study supports the idea that Sgr A* can be a “PeVatron”, and proposes constraints on the acceleration efficiency of CRs and on the structure of the magnetic turbulence in the Sgr A* accretion flow.

References

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