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Tidally disrupted stars as a possible common origin of cosmic rays and neutrinos at the highest energies

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Abstract content

The origin of ultra-high energy cosmic rays (UHECRs) is still one of the biggest unsolved questions in astrophysics. We present a novel approach combining the knowledge about neutrinos and cosmic rays at the highest energies to give an alternative, joint solution to this question with Tidal Disruption Events (TDEs). TDEs are processes where stars are torn apart by the strong gravitational force close to a massive or super-massive black hole. Some of these objects happen to launch a relativistic jet, where particles may be accelerated in internal shocks.

We simulate the photo-hadronic interactions in the TDE jet as well as in the propagation through extra-galactic space in a combined source-propagation model, which is a key novelty of our work beyond the state-of-the-art. We demonstrate that it is possible to fit the UHECR spectrum and composition and describe PeV neutrino data simultaneously if a nuclear cascade develops in the source. Out of the fit procedure we obtain the necessary abundance and power of such events in order to draw a self-consistent picture, which is compatible with current constraints and which is testable by further observations.

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