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Exploring the potential hadronic gamma-ray emission from a protostellar jet

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Massive young stellar objects (MYSOs) can drive high-speed, collimated outflows capable of propagating at hundreds of kilometers per second through the circumstellar medium. The strong shocks produced in the internal regions of these jets, as well as the powerful termination shocks, can create favorable conditions for particle acceleration. In this study, that has been published in the beginning of 2025, we analyzed 15 years of data from the Fermi LAT instrument to investigate gamma-ray emission in the vicinity of IRAS 18162-2048, a ~20 $M_\odot$ MYSO that powers the longest and one of the most energetic jets known in the Galaxy.

Previous radio observations of this object have revealed linearly polarized emission, indicating the presence of ~GeV electrons radiating synchrotron emission along the inner regions of the jet. Our analysis identifies the protostellar jet as the most likely source of the observed gamma-ray emission, suggesting an extension of the relativistic particle population to at least tens of GeV. Furthermore, given the jet's energetics and ambient conditions, we cannot rule out a hadronic origin for the gamma rays. These findings position MYSOs as potential contributors to the hadronic cosmic-ray acceleration in star-forming regions and provide compelling evidence that protostellar jets can indeed radiate in gamma rays.

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