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Elucidating the radio-optical offset in FR I jet with mass entrainment

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The Fanaroff-Riley (FR) classification system provides a fundamental framework for understanding the morphological dichotomy observed in some radio galaxies. Jet properties, acceleration mechanisms, and environmental interactions of extragalactic jets are often discussed to understand FR I/FR II galaxies.
Recent numerical works show the role of mass loading from stellar winds in decelerating the jet and explain the typical characteristics of FR I jets. Additionally, observations have revealed a radio-optical emission offset where the optical centroid emission is detected further down the jet compared to the radio one. This feature challenges the conventional explanations that rely on the presence of recollimation shocks and/or instabilities within the jet.
In this work, we use the radiative transfer code RIPTIDE to simulate synthetic synchrotron maps in both radio and optical bands from jet simulations that incorporated various mass-loading profiles. Our findings highlight the role of mass entrainment in reproducing the extended and diffused radio/optical emission observed in FR I, as well as the radio-optical offsets, whose characteristics depend on the physical properties of the jet, its surrounding environment, and observational biases. Overall, our results demonstrate that positive offset measurements can be used to unveil fundamental properties of FR I galaxies.

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