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Kinetic Beaming in Radiative Magnetic Reconnection: A Mechanism for Rapid Variability in Gamma-Ray Flares[1] JOHN MEHLHAFF, GREGORY WERNER, DMITRI UZDENSKY, University of Colorado, Boulder, MITCHELL BEGELMAN, University of Colorado, Boulder; JILA, University of Colorado and National Institute of Standards and Technology — Relativistic collisionless magnetic reconnection may power rapid gamma-ray flares—as observed, for example, in pulsar wind nebulae, blazars, and radio galaxies—by accelerating electrons to sufficient energies to produce the observed emission. When the particles radiate efficiently, the back-reaction force they experience influences the reconnection dynamics: the so-called radiative regime. Using a series of particle-in-cell simulations self-consistently incorporating radiation reaction, we study the impact of radiative cooling on kinetic beaming, wherein the highest energy particles are preferentially focused into beams when accelerated through the reconnection layer. We find that cooling plays a crucial role in allowing these beams to radiate their energy before decohering. Hence, only radiatively efficient reconnection produces highly collimated photon beams that can cause abrupt flares as they cross an observer's line of sight. These findings paint a remarkably compelling picture for many spectacular gamma-ray flares in astrophysics, where magnetic reconnection underlies not only the flares' energetics, but also, via kinetic beaming, their extremely short observed timescales.

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