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Identifying Black Hole Central Engines in Gamma-Ray Bursts

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The nature of the gamma-ray burst (GRB) central engine remains an enigma. Entities widely considered to be capable of powering the extreme jets are: (i) a hyper-accreting stellar-mass black hole, and (ii) a rapidly spinning, highly magnetized, neutron star (NS) or fast magnetar. The maximum rotational energy that is feasible in a millisecond magnetar to form a jet is ˜10ˆ52 erg and hence presents an upper limit on energy budget available for the magnetar model. In this paper, analysing the jet-opening angle-corrected energetics of the prompt emission of gamma-ray bursts detected by the Fermi gamma-ray space telescope for the last eleven years, we identify eight long GRBs whose central engines are black holes. The majority of these GRBs exhibit significant emission in the sub-GeV energy range. Their X-ray light curves also lack the 'plateau' feature often attributed to magnetars; however, a few cases exhibit flares and multiple breaks. By considering the Blandford–Znajek mechanism of jet formation, we estimate the masses of these black holes to range between ˜2 and 60 Msun. Interestingly, some of the lighter black holes formed in these catastrophic events are likely candidates to lie in the mass-gap region (2–5 Msun).

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