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Searching for Primordial Black Holes with TeV Gamma Ray Detectors

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Primordial black holes (PBHs) are gravitationally collapsed objects that may have been created by density fluctuations in the early universe and could have arbitrarily small masses down to the Planck scale. Hawking showed that due to quantum effects, a black hole has a temperature inversely proportional to its mass and will emit all energetically allowed species of fundamental particles thermally. PBHs with initial masses of order 5×10ˆ15 g should be expiring in the present epoch with bursts of high-energy particles, including gamma radiation in the GeV – TeV energy range. The Milagro high-energy observatory, which operated from 2000 to 2008, is sensitive to the high end of the PBH evaporation gamma-ray spectrum. A search of five years of Milagro data set a local (parsec-scale) upper limit of 3.6×10ˆ4 PBH bursts/year/pc3. We will also report the sensitivity of the High-Altitude Water-Cherenkov (HAWC) observatory to PBH evaporation events. Finally, we investigate the final few seconds of black hole evaporation using Standard Model physics and calculate energy dependent PBH burst time profiles in GeV/TeV range. We calculate PBH burst light curves observable by HAWC and explore search methods and potentially unique observational signatures of PBH bursts.

Oral or Poster Presentation

Oral

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