

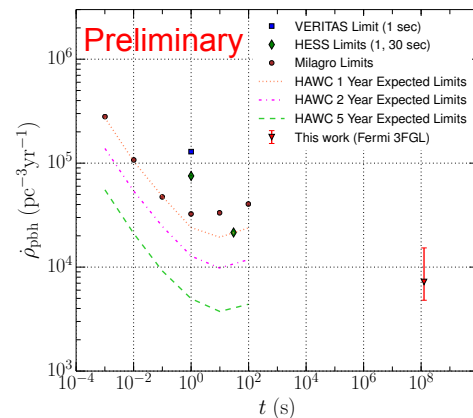


# Fermi LAT limit on primordial black holes



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- Primordial black holes (PBH) with masses below  $\sim 10^{15}$  g are expected to emit gamma rays with energies above a few tens of MeV
- Fermi LAT is most sensitive to PBHs with temperatures near 16 GeV, which have a lifetime of a few years and would appear as potentially moving point sources
- We check for proper motion of 3FGL sources which are
  - Not associated
  - Have spectra consistent with PBH evaporation
- We use the non-detection of moving sources among the non-associated sources in 3FGL to put a limit on evaporation of individual PBHs in the vicinity of the Earth. The limit is stronger than the current limits from Cherenkov telescopes

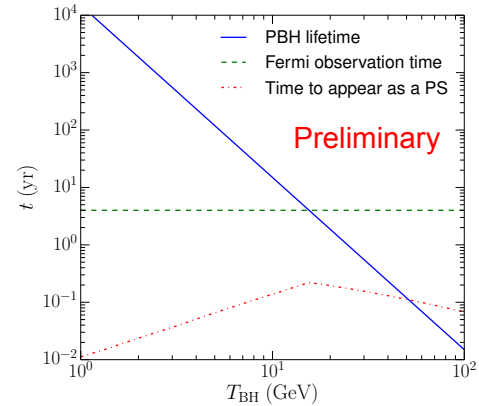
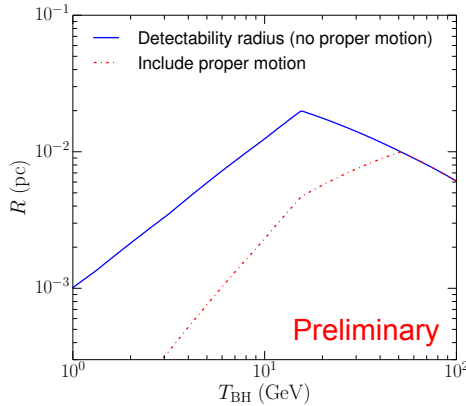
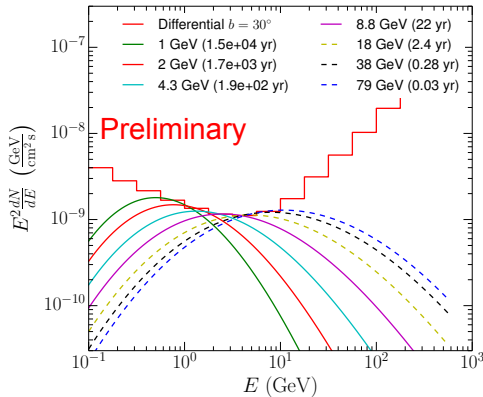




# Fermi LAT sensitivity to PBHs



- We use the differential Fermi LAT sensitivity to estimate the detectability radius and the characteristic lifetime of a PBH that can be detected by the LAT
  - The typical radii are less than  $\sim 0.01$  pc
  - Temperature  $\sim 10 - 50$  GeV
  - Lifetime  $\sim$  few months to few years

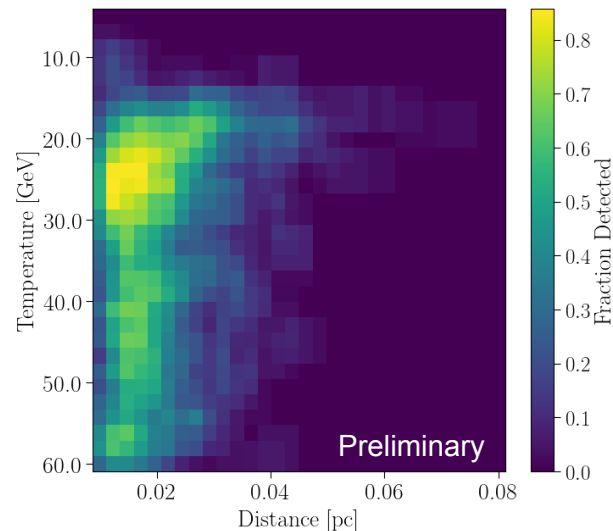


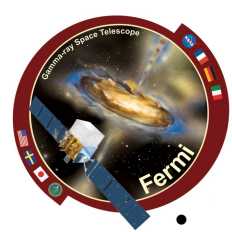


# Search for PBH candidates and MC tests



- To search for PBH candidates we use PS from the Fermi LAT 3FGL catalog. We
  1. Select PS at  $|b| > 10$  deg that do not have associations
  2. Subselect PS that have spectra consistent with PBH evaporation
  3. Test the candidate PS for proper motion
- We test the PBH search algorithm with MC simulations: we create PBHs with a distribution of initial temperatures, distances and velocities around the Earth and apply the selection criteria described above.
- Plot on the right shows the fraction of PBHs which pass the selection criteria (as a function of distance and initial temperature).





# Fermi LAT limit on PBHs



- We apply the selection criteria to 3FGL Fermi LAT sources.
- There are
  - 1010 non-associated sources
  - 318 sources that have spectra consistent with PBH
  - 1 source that has a proper motion above 2 sigma (global)  
\* the source turned out to be associated with a solar flare that was not listed in 3FGL
- Provided that there are no PBH candidates, we put a 99% confidence limit on the local PBH evaporation rate
- The limit is more stringent than the existing limits from Cherenkov telescopes

