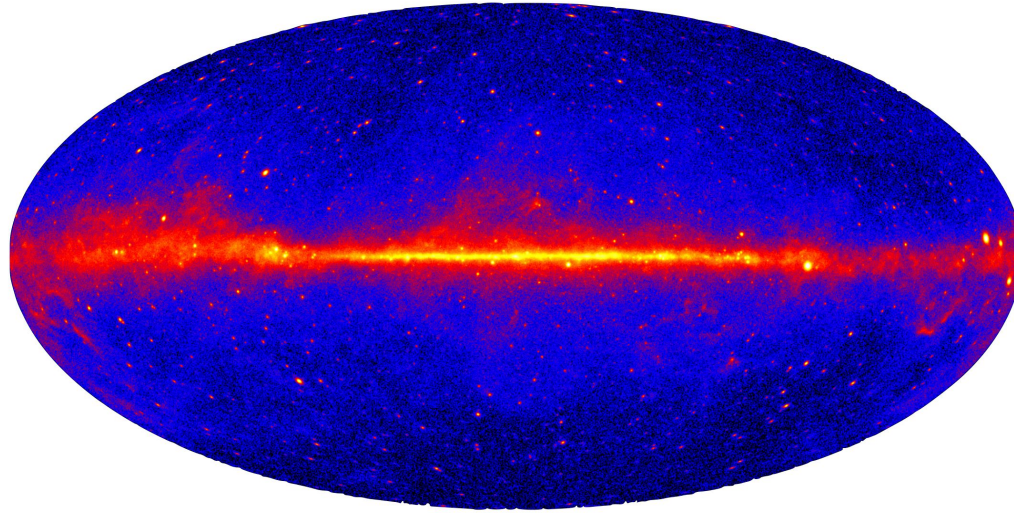


# The Dark Matter Interpretation of the Gamma-ray Excess at the Galactic Centre

Hamish Clark  
University of Sydney



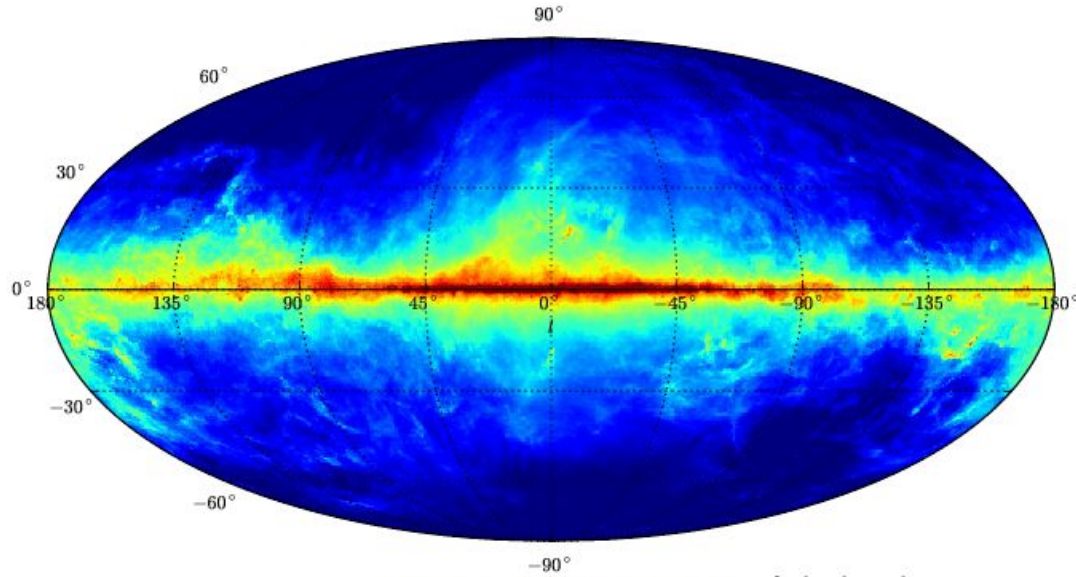
# The Galactic Centre



Fermi-LAT Collaboration (2016)



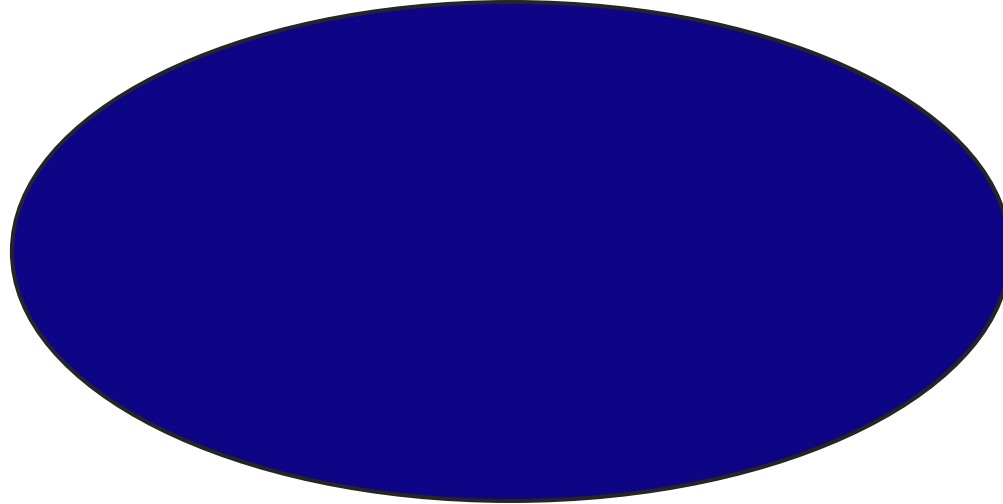
# The Galactic Centre



Fermi-LAT Collaboration (2016)

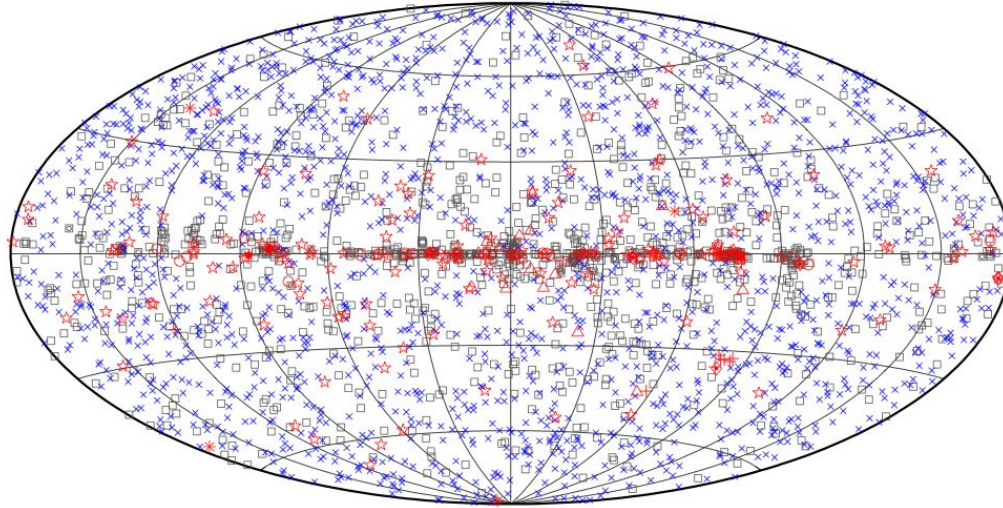


# The Galactic Centre





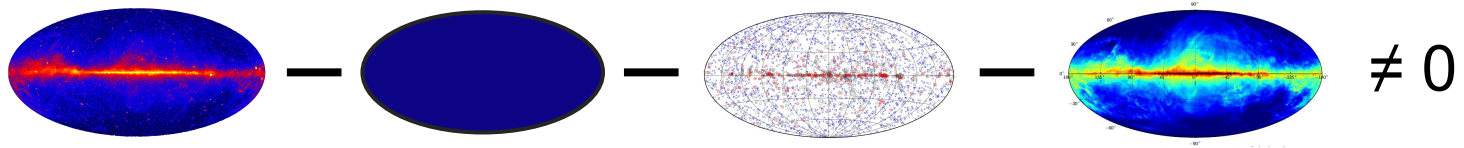
# The Galactic Centre



Fermi-LAT Collaboration (2016)



# The Galactic Centre





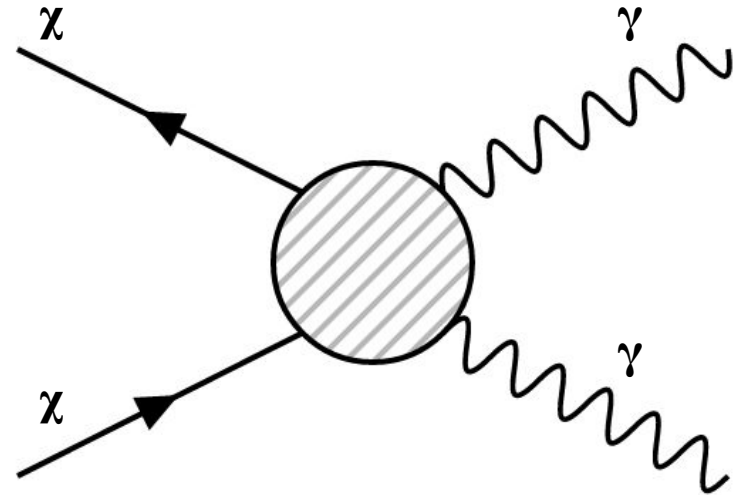
# The Galactic Centre Excess

- Spherically symmetric population of *something*
- Radial slope of  $r^\Gamma \rightarrow 2.2 \lesssim \Gamma \lesssim 2.4$
- Spatially extended out to  $10^\circ$
- Spectral peak at around 2 GeV



# Dark Matter Annihilation

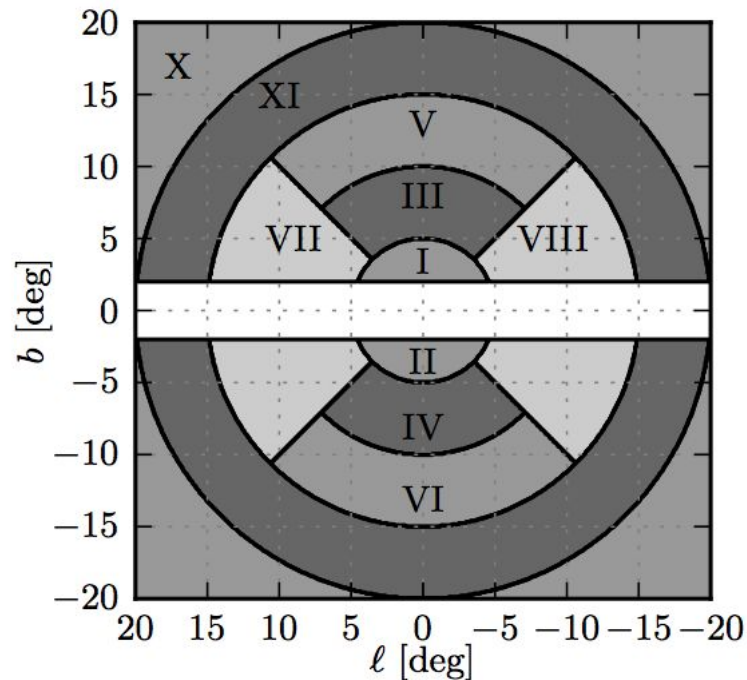
- Spherically symmetric population of  $DM$ ?
- Radial slope of  $r^\Gamma \rightarrow 2.2 \lesssim \Gamma \lesssim 2.4$
- Spatially extended out to  $10^\circ$
- Spectral peak at around 2 GeV





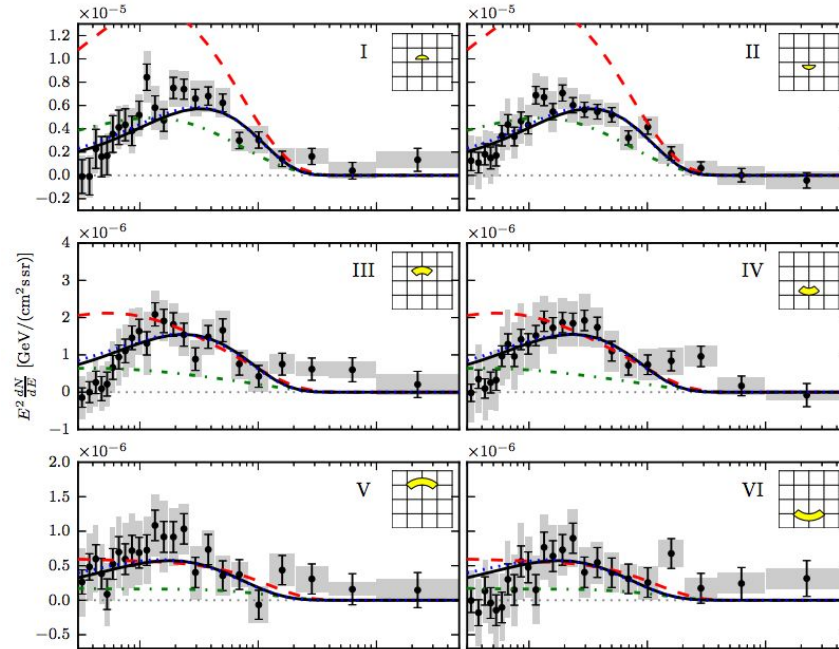
# Dark Matter Annihilation

- Spherically symmetric population of *DM*?
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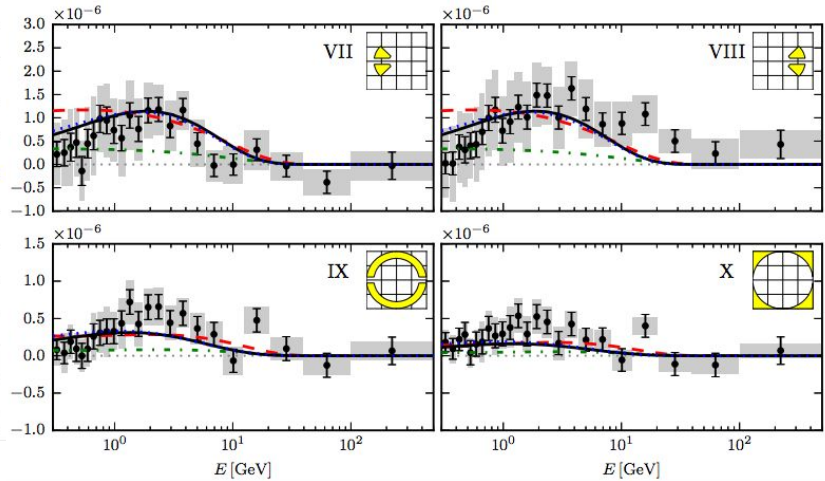




# The Galactic Centre Excess



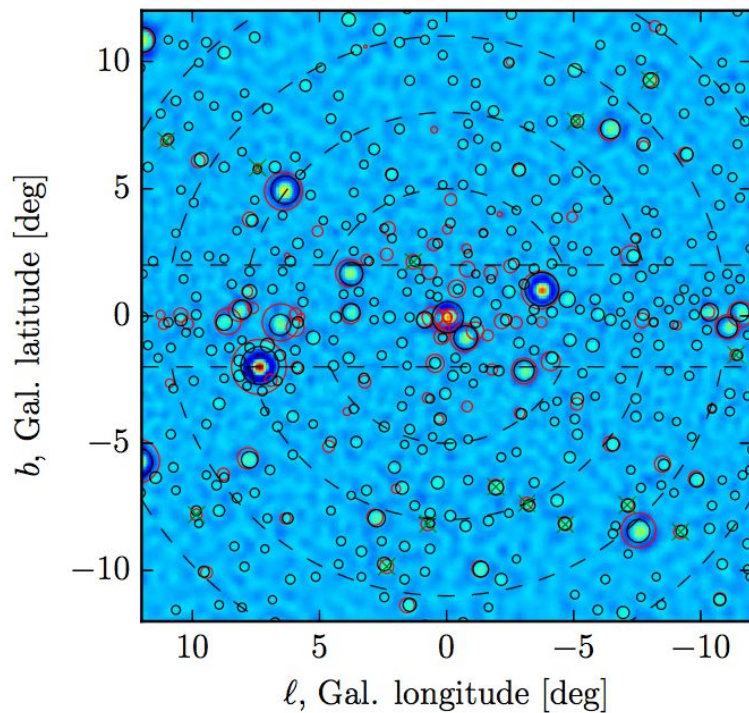
Best fit ( $\mu^+\mu^-$ ):  
 $\langle\sigma v\rangle = 1.75 \times 10^{-26} \text{ cm}^3 \text{ s}^{-1}$   
 $m_\chi = 48.7 \text{ GeV}$



Calore et al. (2015)



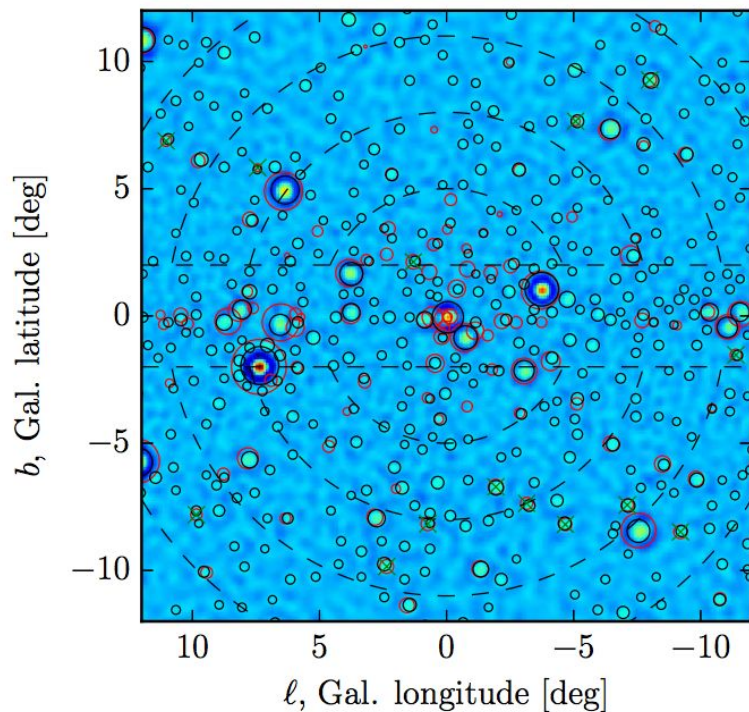
# A Complication: Photon Statistics



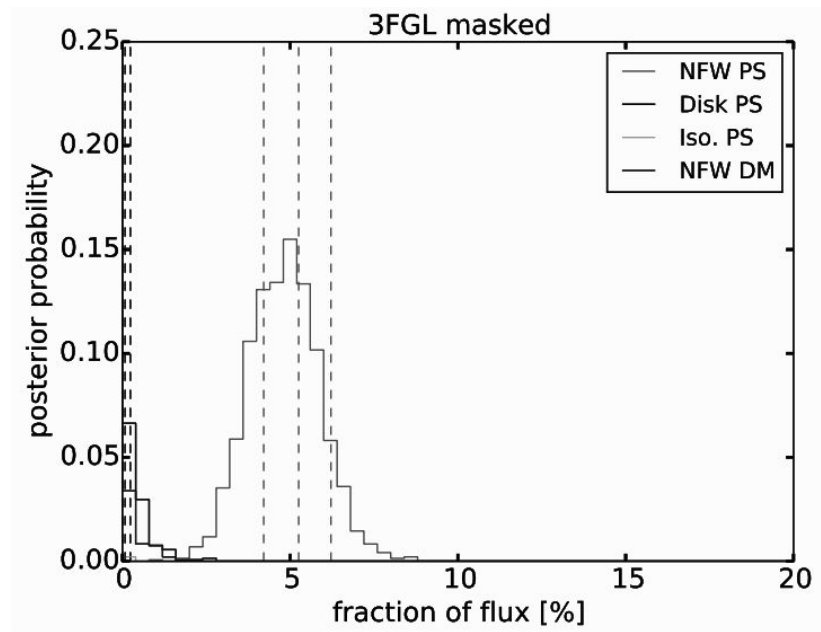
Bartels et al. (2016)



# A Complication: Photon Statistics

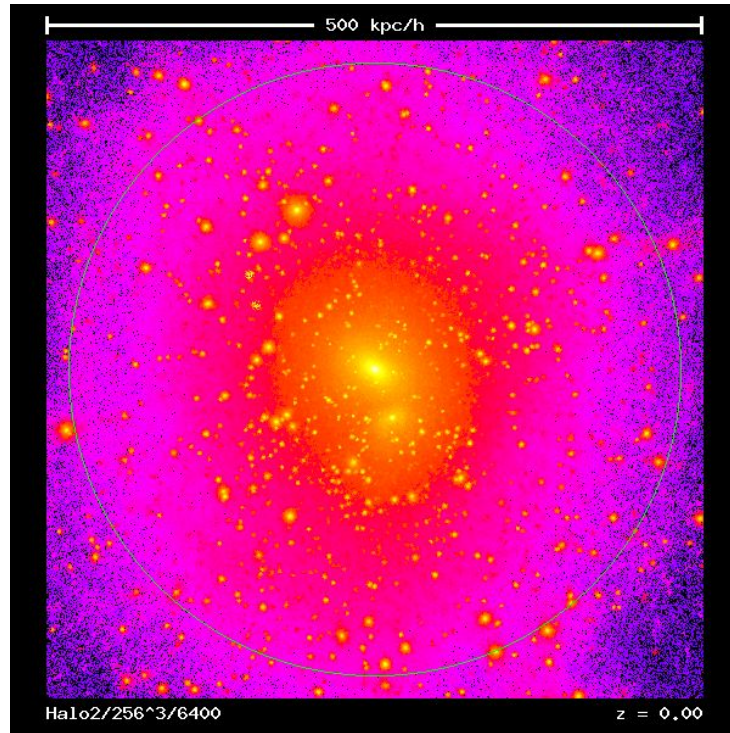


Bartels et al. (2016)



Lee et al. (2016)

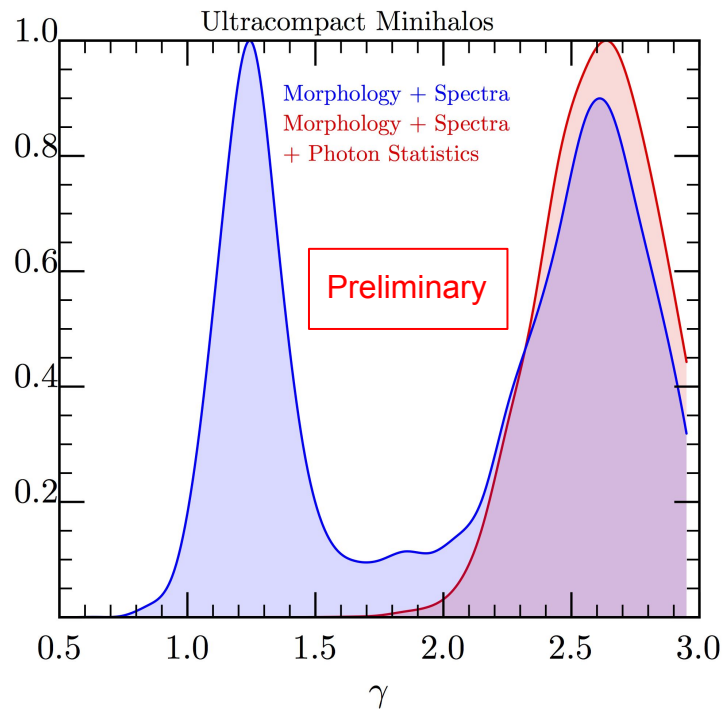
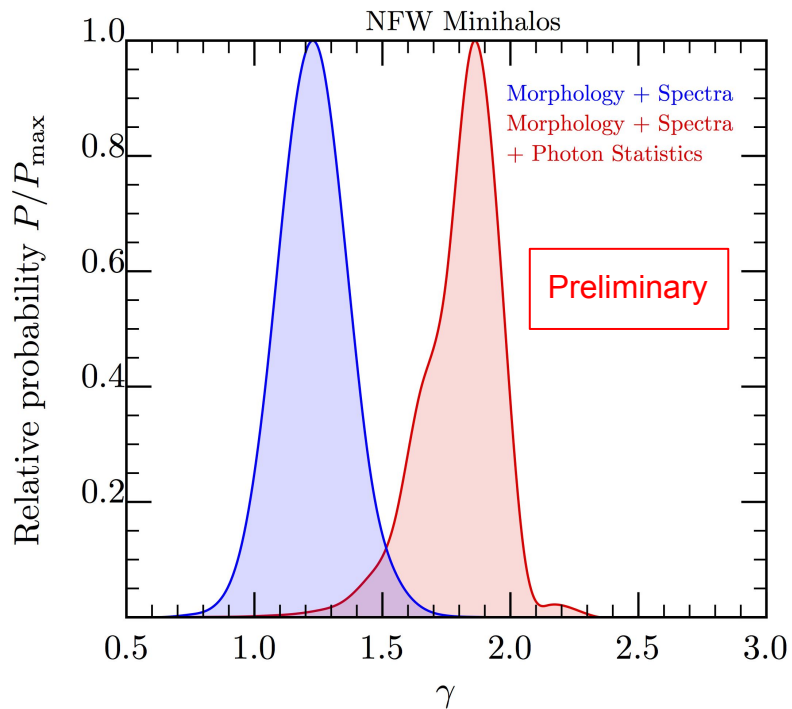
# Unresolved DM halos?



- Standard CDM predicts small scale dark matter substructure (NFW minihalos)
- Ultracompact minihalos (formed in the early universe), could be extremely bright annihilation sources
- Low mass substructure would not be resolvable by Fermi



# Unresolved DM halos?



Clark, Scott, Lewis & Trotta (In Prep.)



# Summary

- Dark matter doesn't *seem* to be the source of the excess, but it isn't ruled out.
- An astrophysical source seems to be a more likely candidate
- Continuation of the Fermi mission will provide marginally higher resolution, potentially allowing the point source population to be observed