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# GLAST DARK MATTER SEARCH

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ABSTRACT

The GLAST Large Area Telescope [1], scheduled for launch in 2006, is a next generation space based gamma ray telescope which will improve in point source sensitivity by a factor of 30 over that of EGRET [2] below 10 GeV, and extend beyond EGRET up to 300 GeV. Thus GLAST offers a unique opportunity to discover WIMP dark matter through precision studies of gamma rays produced in pair annihilations. The most dense region of dark matter in our galaxy is currently thought to occur at the center; in particular, dark matter should concentrate within 3 pc of the putative supermassive black hole located at the SgrA* radio source [3]. In fact, the 2nd and 3rd EGRET catalogs contain a significant point source coincident with the Milky Way galactic center within a resolution of 12 arcminutes [4]. The EGRET team has determined that the spectral and temporal characteristics of this point source are consistent with dark matter WIMP annihilations. More detailed analysis [5] has determined that the magnitude and spectrum of the EGRET source is consistent with relic WIMPs concentrated within 3 pc of the central supermassive black hole. Furthermore, the SgrA* radio emission is consistent with the synchrotron radiation expected from electrons and positrons produced in WIMP annihilations. If true, then GLAST should be able to constrain the particle properties of the postulated WIMP with 1 month of data.

The accretion of a collisionless collection of non-relativistic identical particles with asymptotic velocity $v_0$ onto a central star of mass M was first examined by Zel'dovich and Novikov [6]. In particular, we can define a critical radius



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$r_c = 2GM/v_0^2$. For distances $r >> r_c$, the density varies little from the asymptotic value; however, for $r << r_c$ the gravitational potential of the cntral mass focuses the particles together, thus greatly increasing their density. Gondolo and Silk [3] re-analyzed this situation in the context of dark matter particles focusing near the putative supermassive black hole at the center of our galaxy [7]. For $M = 2.6 \times 10^6$ solar masses $r_c = 3$ pc for an asymptotic particle dark matter velocity $v_0 = 90$ km/s. The density inside of 3 pc is high enough to produce observable signals from particle dark matter annihilation.

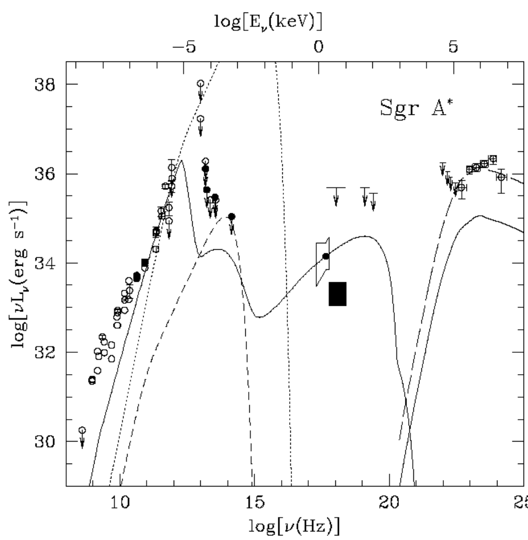


Figure 1: *From [8]: circles represent various flux measurements and upper limits of Sgr A*. The four peaks from left to right represent: synchrotron radiation, Compton scattering, bremsstrahlung, pion production. The dotted line is the spectrum corresponding to a standard thin accretion disk with accretion rate 1e-4 solar mass, and the short-dashed line is thin disk with accretion rate 1e-9 solar mass. The solid line is the advection dominated accretion flow (ADAF). The long dashed line shows ADAF with pion peak artificially raised by 1 order of magnitude. Of course, all of these models apply strictly to non-dark matter accretion scenarios. The Chandra observation in the 2-10 keV band [9] is shown as the black box.*

Multi-wavelength observational data from SgrA* has been compiled by Narayan *et al* for comparison with various (non-dark matter) accretion models, shown in figure 1. Silk *et al* [10, 5] has re-analyzed this data in terms of supersymmetric (SUSY) particle dark matter. A good fit to radio and gamma ray data has been found for typical particle dark matter paramaters. In figure 2 we show a comparison of EGRET data, SUSY model predictions, and GLAST sensitivity.

With one month of data, GLAST should be able to probe most of the supersymmetric parameter space. The final GLAST data sample should obtain an accuracy of 10 arcseconds, which corresponds to 0.4 pc at the galactic center.

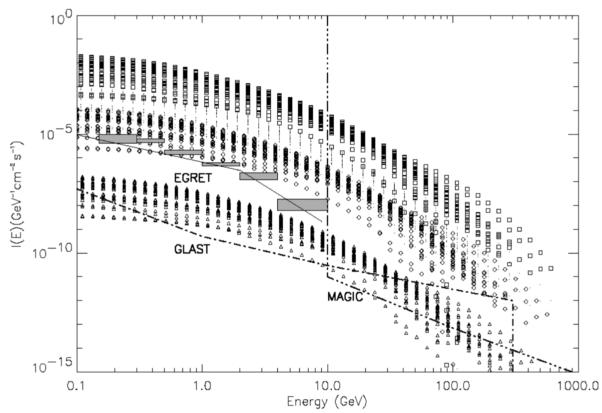


Figure 2: *From [5]: EGRET data and expected gamma ray flux from the galactic center for various SUSY models. Variation with cusp slope is also shown:* $\gamma = 0.05$ *(triangles),* $\gamma = 0.12$ *(diamonds),* $\gamma = 0.2$ *(dots),* $\gamma = 1.0$ *(squares)*

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