Search for Dark Matter with H.E.S.S.

Constanze Jahn

ERLANGEN CENTRE FOR ASTROPARTICLE PHYSICS

Friedrich-Alexander-Universität Erlangen-Nürnberg

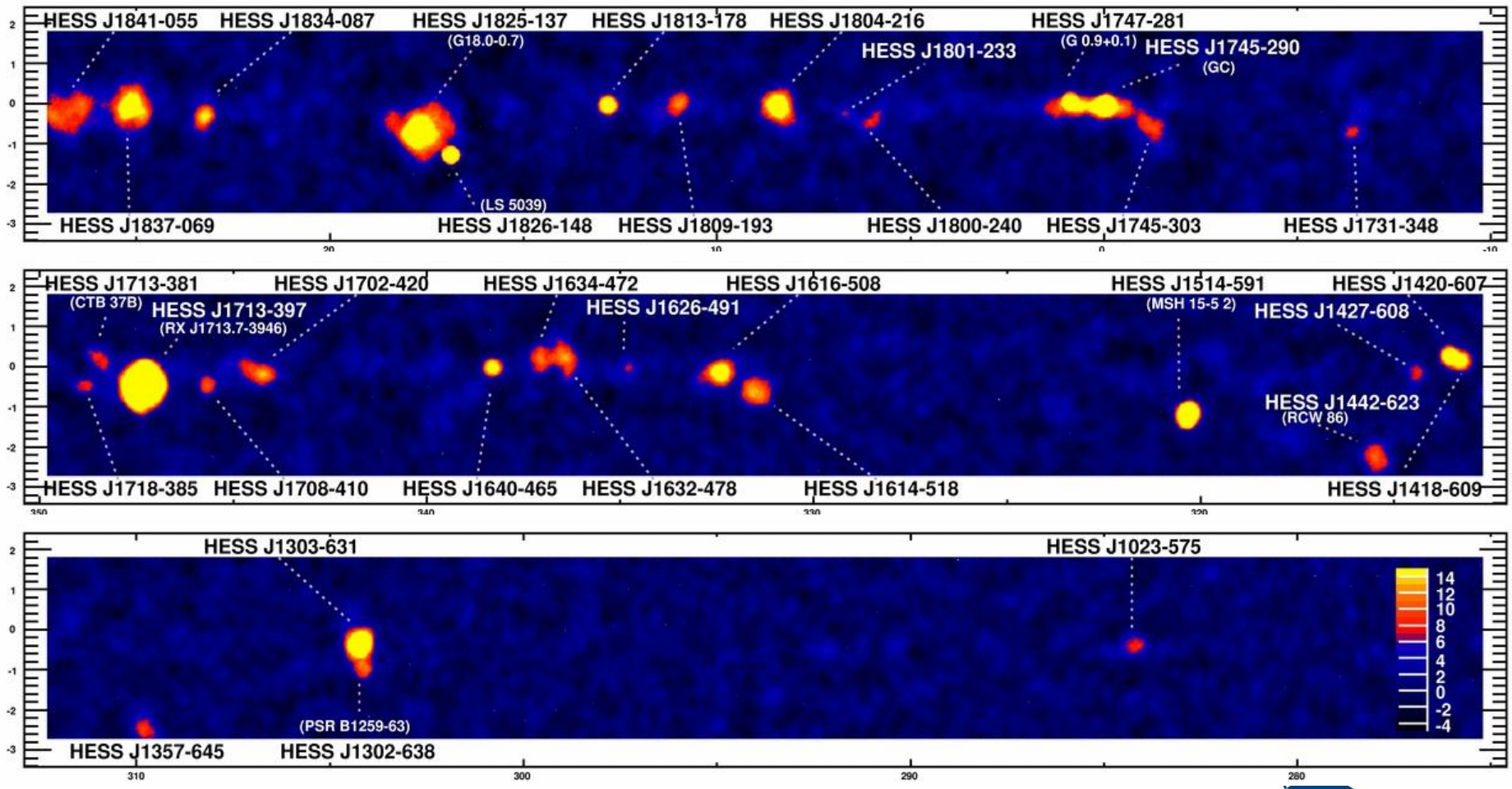
ERLANGEN CENTRE FOR ASTROPARTICLE PHYSICS

H E S S

H.E.S.S.

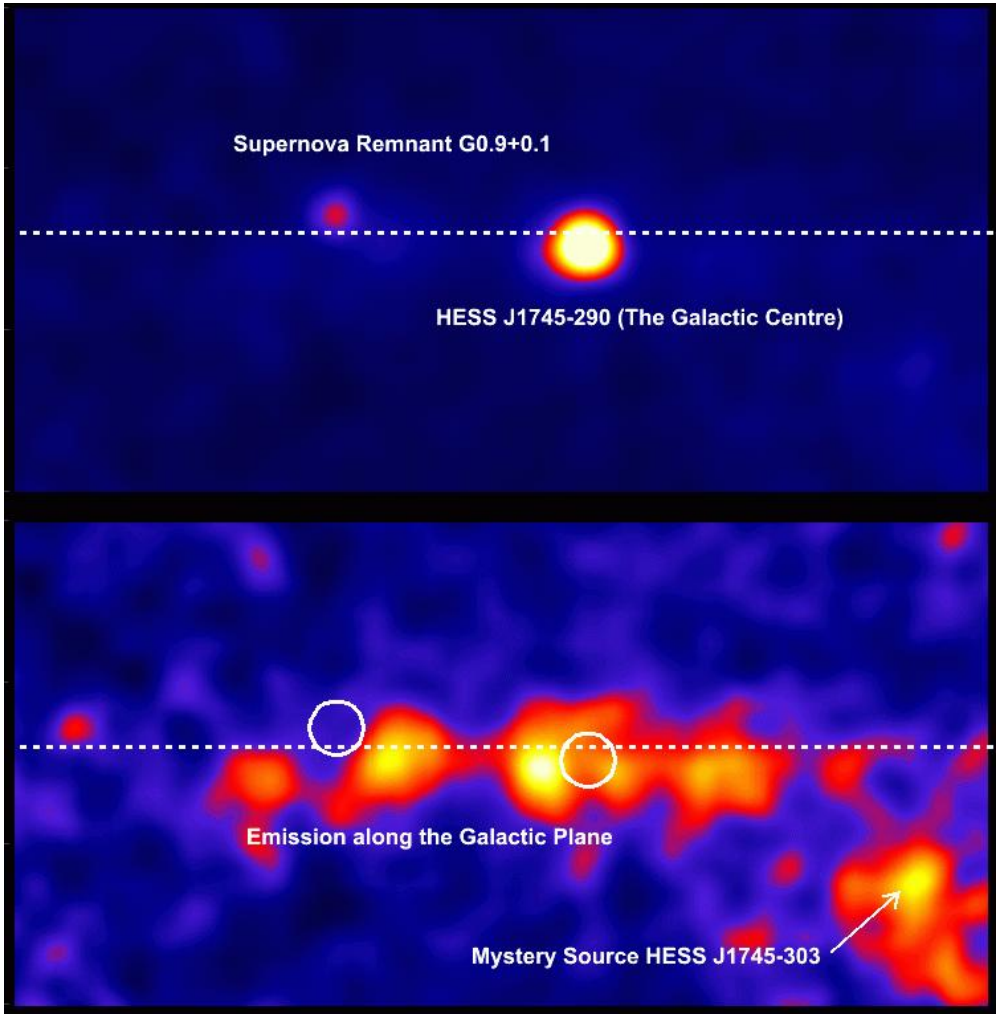
- High Energy Stereoscopic System
- 4 IACTs (Imaging Air Cerenkov Telescopes)
- Energythreshold: ~ 100 GeV
- Data taking since 2003

Galactic plane in gamma-rays (May 2007)



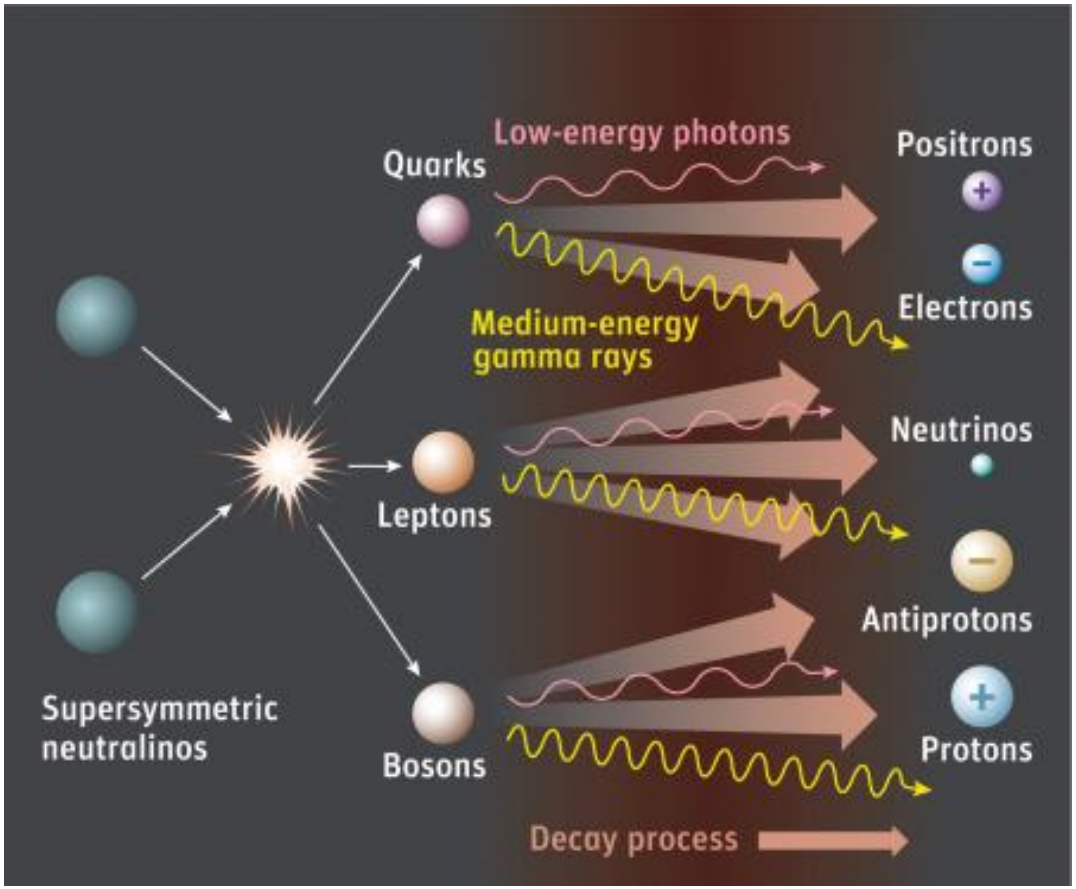
ERLANGEN CENTRE FOR ASTROPARTICLE PHYSICS

Galactic center seen by H.E.S.S.



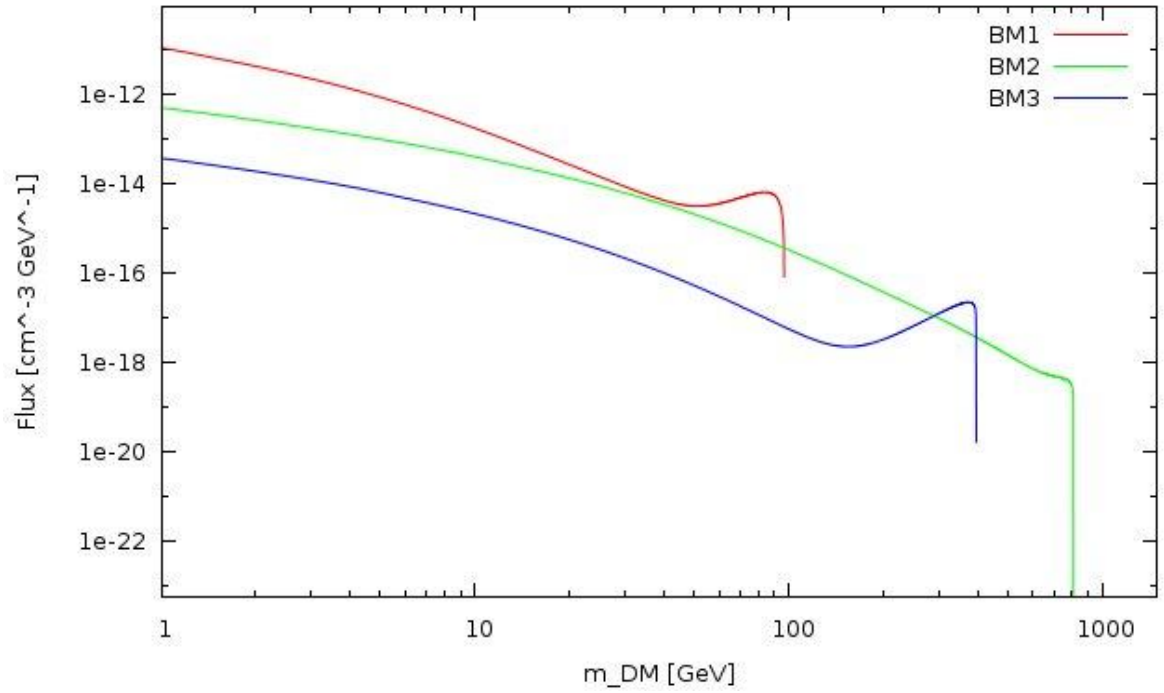
Dark Matter Annihilation

- SUSY: Neutralinos



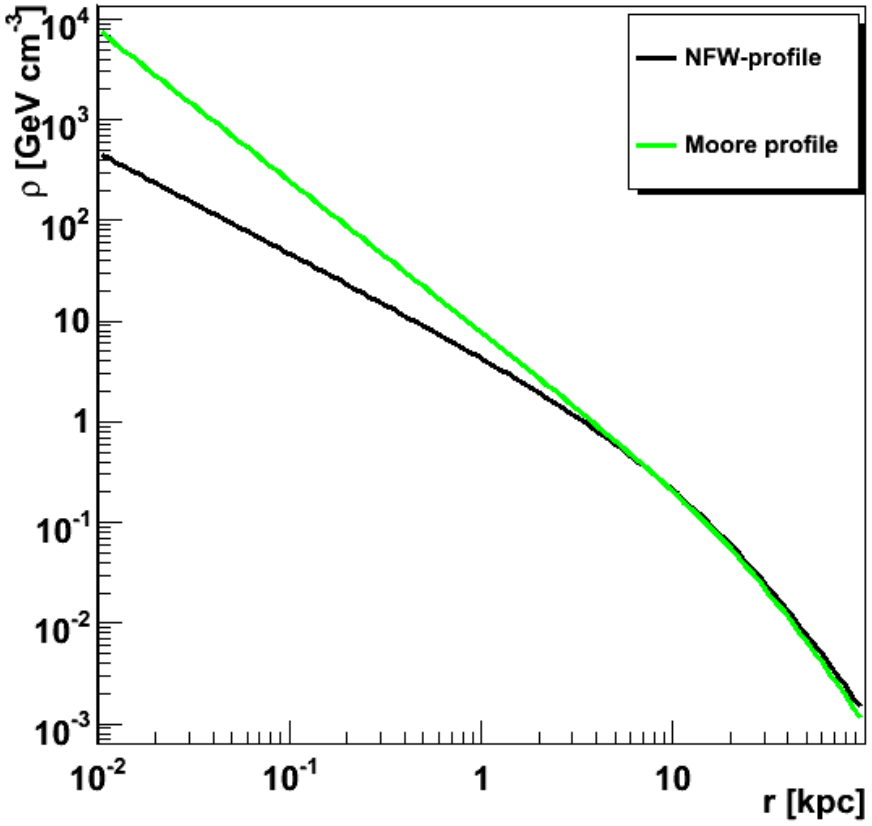
Expected Spectrum

- Cut-off at neutralino mass
- ‘peak’ from Bremsstrahlung

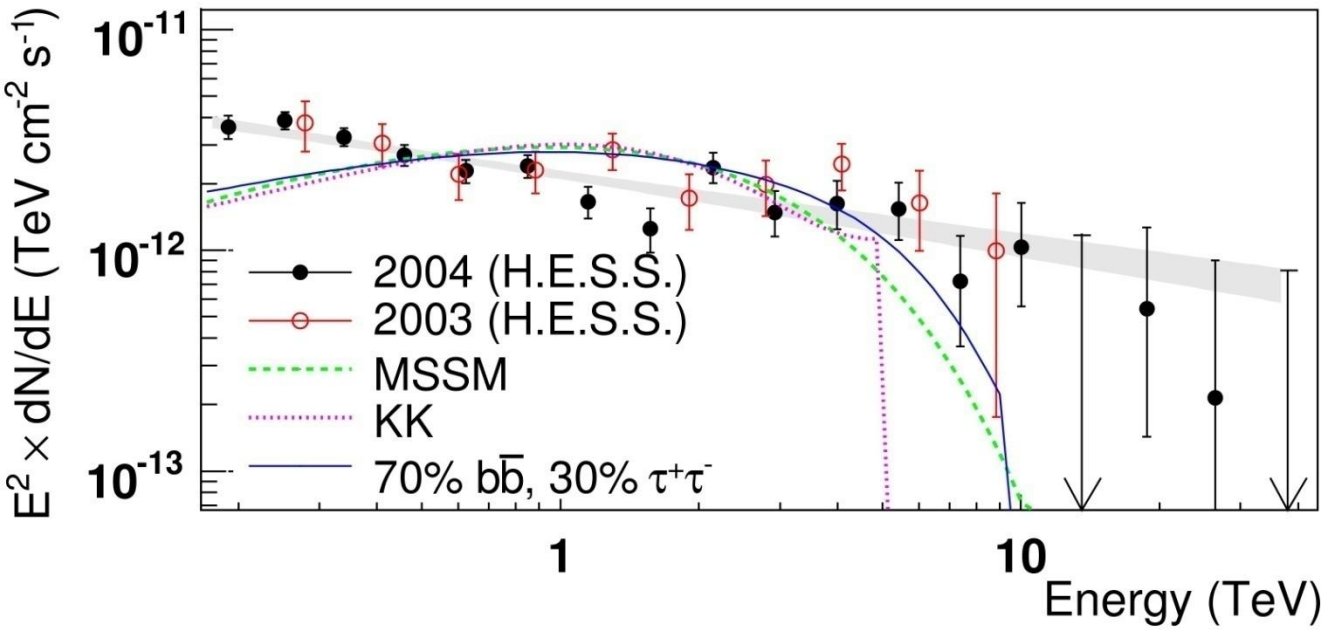


Possible Dark Matter source

- High density at the galactic center



Spectrum at the Galactic center



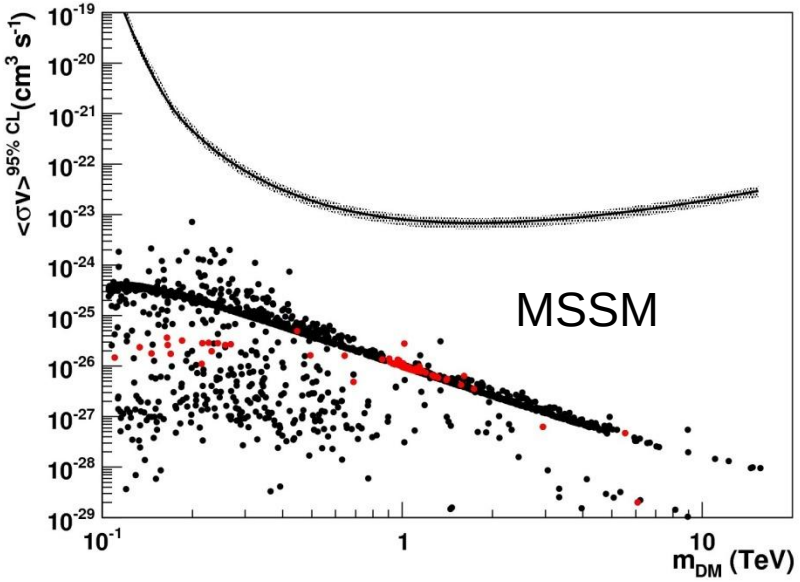
Taken from: “H.E.S.S. observations of the Galactic Center region and their possible dark matter interpretation”, F. Aharonian et. al. 2006

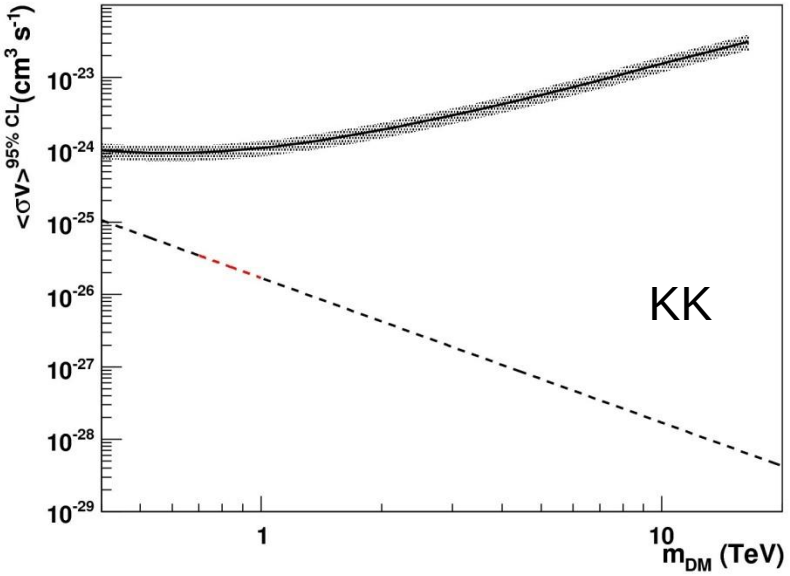
More Dark Matter Search

- Other regions, e.g. Sagittarius Dwarf galaxy or Canis Major
- high density in the center of dwarf galaxies
- Dark Matter clumps

More Dark Matter search

- Derivation of an upper limit on the velocity weight cross-section

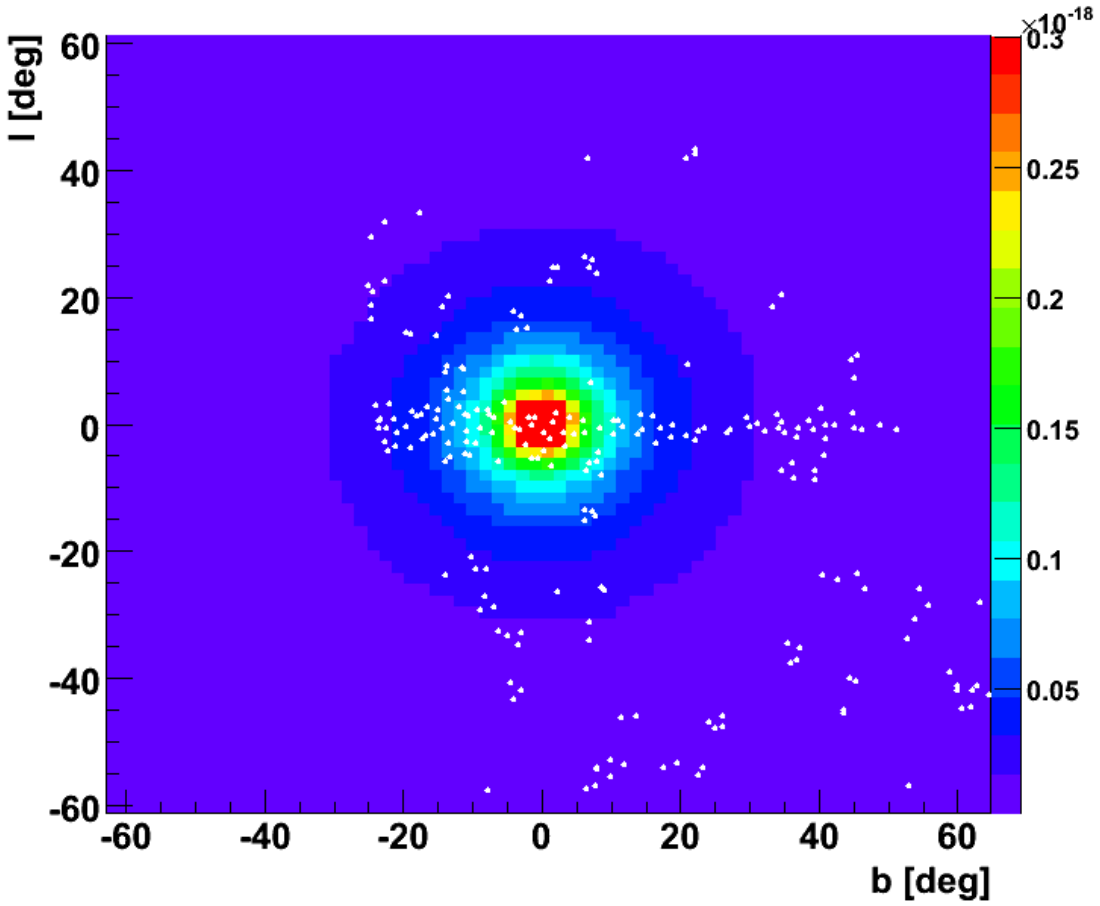




Taken from: “A search for a dark matter annihilation signal towards the Canis Major overdensity with H.E.S.S.”, F. Aharonian et. al., 2008

More Dark Matter search

- Flux and H.E.S.S. runs



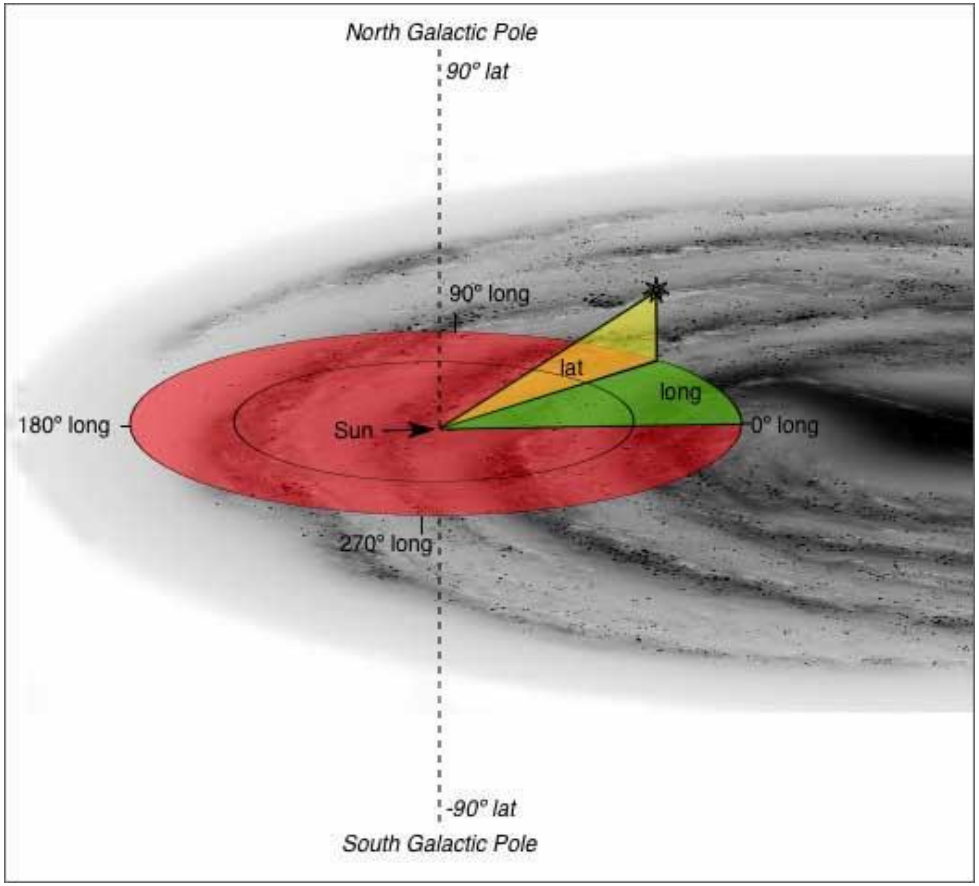
Outlook

- H.E.S.S. II
  - lower energy threshold
  - Higher sensitivity
- Eliminate/Reduce systematic effects
- Improve Analysis

Backup Slides

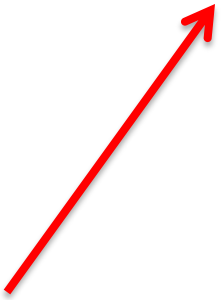
$$\Phi_\gamma(\psi) = \frac{N_\gamma \, v\sigma}{4\pi M_\chi^2} \int_{line\,of\,sight} \rho^2(l) dl(\psi)$$

$$J^{AP}(\psi) = \int_{line\,of\,sight} \rho^2(l) dl(\psi)$$



$$\psi = \sqrt{l^2 + b^2}$$

$$\langle \sigma v \rangle_{min}^{95\%\, C.L.} = \frac{4\pi}{T_{obs}} \frac{m_{DM}^2}{\bar{J}(\Delta\ )\Delta} \frac{N_\gamma^{95\%\, C.L.}}{\int_0^{m_{DM}} A_{eff}(E_\gamma) \frac{dN_\gamma}{dE_\gamma} dE_\gamma}$$



Bergstroem et. al. :

$$\frac{dN_\gamma}{dE_\gamma} = \frac{0.73}{m_{DM}} \frac{e^{-7.8 \frac{E_\gamma}{m_{DM}}}}{\left(\frac{E_\gamma}{m_{DM}}\right)^{3/2}}$$

Tasitsiomi et. al. :

$$\frac{dN_\gamma}{dE_\gamma} = \frac{5}{8} \frac{1}{m_{DM}} \left(\frac{16}{3} + \frac{2}{3} \cdot \left(\frac{E_\gamma}{m_{DM}}\right)^{-1.5} - 4 \cdot \left(\frac{E_\gamma}{m_{DM}}\right)^{-0.5} - 2 \cdot \left(\frac{E_\gamma}{m_{DM}}\right)^{0.5}\right)$$