AMEGO

ALL-SKY MEDIUM ENERGY GAMMA-RAY OBSERVATORY

Dark Matter Prospects

R. Caputo[a], M. Meyer[b], M. Sánchez-Conde[c], for the AMEGO Team[d]

[a]UMD/NASA/GSFC, [b]SLAC/Stanford, [c]IFT UAM-CSIC, [d]https://asd.gsfc.nasa.gov/amego/

The era of precision cosmology has revealed that ~85% of the matter in the universe is dark matter.

Two leading candidates, are weakly interacting massive particles (WIMPs) and weakly interacting sub-eV particles (WISPs) like axions and axionlike particles.

Both **WIMPs** and **WISPs** produce **distinct γ-ray signatures**.

AMEGO will allow us to explore new areas of dark matter parameter space and provide unprecedented access to its particle nature

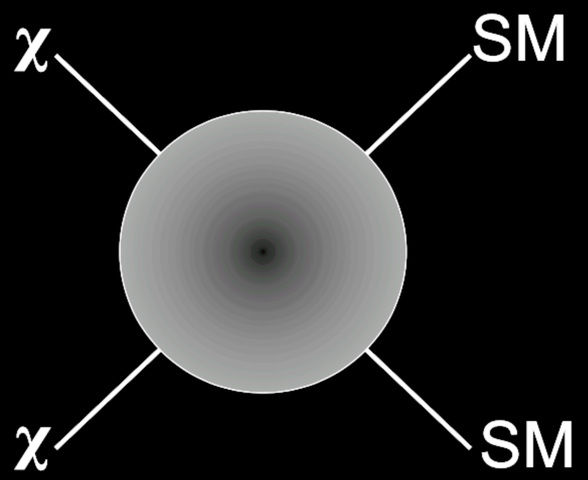
INTRODUCTION TO AMEGO

- ***Probe Concept: 2020 NASA Astrophysics Decadal Review***
- Observing strategy: survey
  - 80% sky/orbit, ~2.5 sr FoV
- Well ***understood***, ***tested*** technologies with ***space heritage***
- Science: pulsars/magnetars, gamma-ray bursts and multimessenger astrophysics, active galaxies, dark matter

DARK MATTER DETECTION

- Dark matter detection
  - High energy: Fermi-LAT, Very High Energy: ACTs
  - Good spatial and spectral resolution, full-sky sensitivity
- Weakly Interacting Massive Particles (WIMPs)
  - Targets: dwarf spheroidal galaxies, Galactic Center
  - LAT: m_χ~500 MeV to 100 GeV, ACT: >1 TeV [6-7]
- Weakly Interacting Sub-eV Particles (WISPs)
  - Targets: pulsars, galaxy clusters, SN
  - X-rays, LAT: $m_{neV} \leq 10^{-2}$, $0.5 \leq m_{neV} \leq 100$ [8-9]

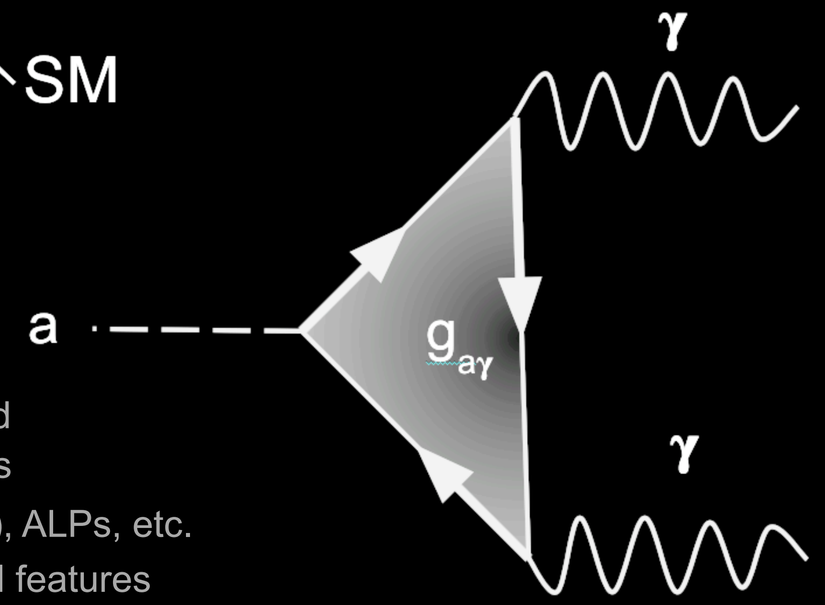
DARK MATTER CANDIDATES



WIMPs

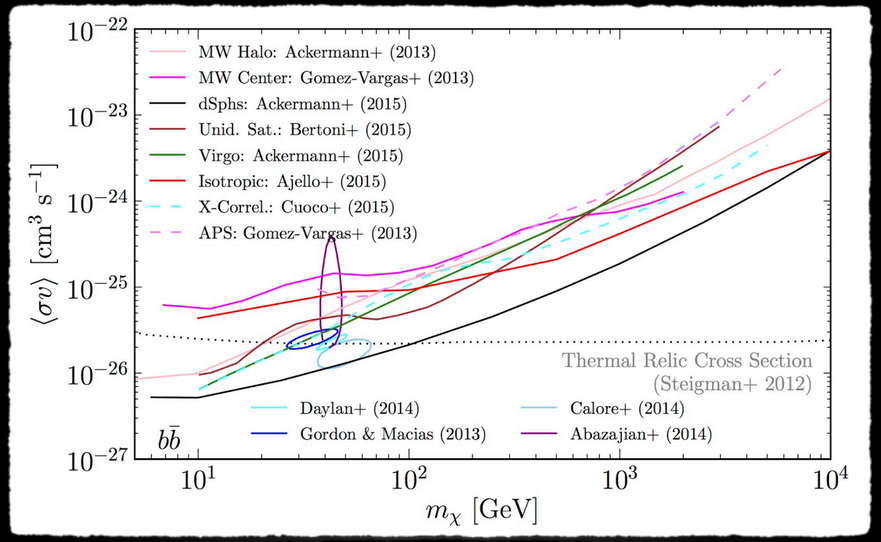
- Interact via gravity and "weak" force
- Thermal: $\langle \sigma v \rangle \sim 3 \times 10^{26} cm^3 s^{-1}$
- Dark matter (χ) and dark mediators (A')
- m_χ: ~10 MeV to >TeV

WISPs

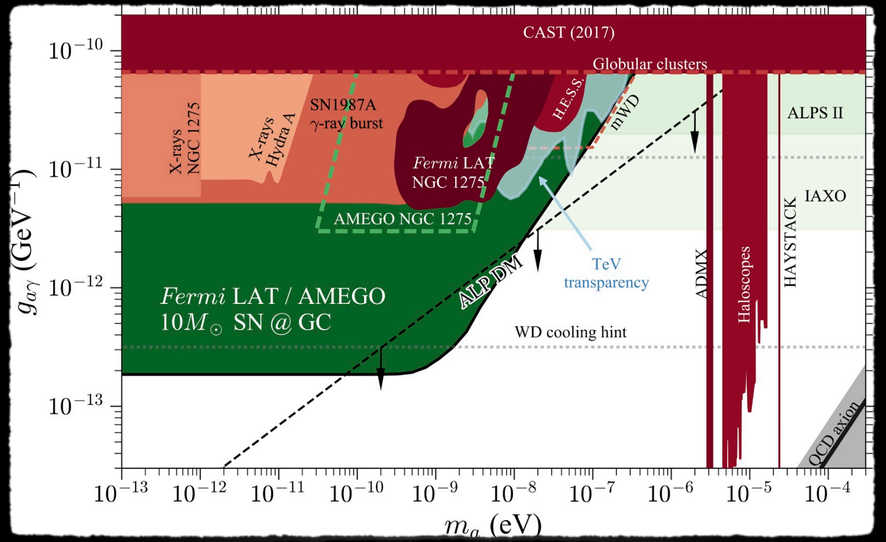


- Not thermally produced
- Oscillate to γ in B fields
  - QCD axion ($m_a \propto g_{a\gamma}$), ALPs, etc.
- WISP-induced spectral features
- Polarization

WIMPs and WISPs with AMEGO

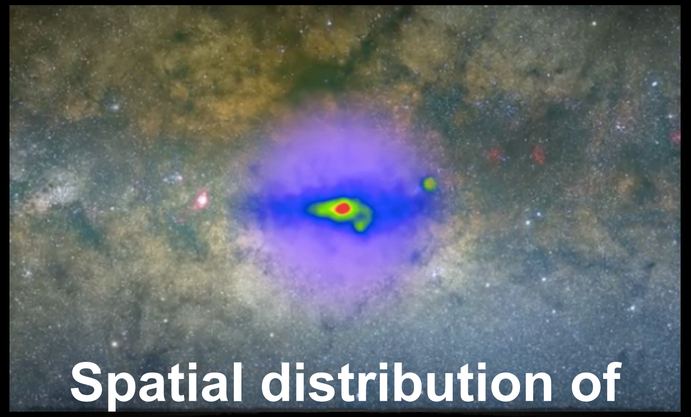


Summary of WIMP dark matter results obtained with *Fermi*-LAT. Lines are upper limits while closed contours are the Galactic Center Excess from dark matter annihilations [7, 10].



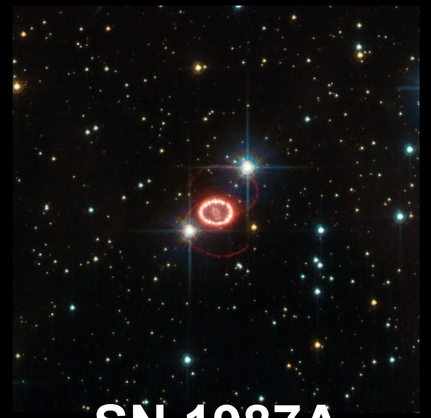
Summary of ALP results obtained with *Fermi*-LAT and regions of sensitivity for AMEGO. Shaded regions are excluded [11].

- Angular resolution in MeV
  - Better understanding in GC
    - Population of sources vs. DM
  - Search lower mass WIMPs
- New searches for dark photons
  - Dark sector physics
- Higher sensitivity in MeV
  - Deeper searches



Spatial distribution of Fermi-LAT Galactic center excess [12]

- Energy resolution/Polarization
  - Spectral features from oscillations
- Angular resolution in MeV
  - Signatures sensitive to lower WISP masses
- Higher sensitivity in MeV
  - WISP flux- SN peak ~50 MeV



SN 1987A Hubble [13]

AMEGO Dark Matter Searches

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