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 $\gamma$-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: mχ~500 MeV to 100 GeV, ACT: >1 TeV [6-7]

• Weakly Interacting Sub-eV Particles (WISPs)
  ◦ Targets: pulsars, galaxy clusters, SN
  ◦ X-rays, LAT: mneV≤10^{-2}, 0.5 ≤ mneV ≤ 100 [8-9]

DARK MATTER CANDIDATES

• Interact via gravity and "weak" force
• Thermal: <σv> ~3x10^{26}cm^3s^{-1}
• Dark matter (χ) and dark mediators (A')
• mχ: ~10 MeV to >TeV

- WIMPs
- WISPs

- Not thermally produced
- Oscillate to γ in B fields
  ◦ QCD axion (m_a=g_{aγ}), 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].

- 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]

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

- 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]
REFERENCES

[12] Credit: NASA GSFC
[13] Credit: ESA/Hubble & NASA