Discussion on e-ASTROGAM White Book Section F: Fundamental Physics

- Are all important topics represented with the submitted contributions?
  If not: who should be solicited for an additional contribution?
- Are the topics correctly presented in the current version of the White Book?
  Are the expected results with e-ASTROGAM reasonable?
- Are there key figures and key sentences that must be shown to the ESA panel (interview at ESTEC on Nov 7)?

ID	Author	Title	Category
✓	Alessandro De Angelis, Giorgio Galanti, Marco Roncadelli, Fabrizio Tavecchio	ALPs and MeV space gamma-ray telescopes	Other
F02	Lucio Angelo Antonelli, Michele Fabrizio, Paola Giammaria, Saverio Lombardi	Synergy between e-ASTROGAM and optical observations for indirect Dark Matter searches	DM
✓	Richard Bartels, Daniele Gaggero, Christoph Weniger, Javier Rico, Manel Martinez	Sub-GeV dark matter searches in the Galactic Center	DM
✓	Richard Bartels, Katie Short, Christoph Weniger, Dmitry Malyshev	Galactic center gamma-ray excess: Constraining the point source contribution with e-ASTROGAM	DM
F05	Aldo Morselli, Gonzalo Rodriguez Fernandez	e-ASTROGAM and Dwarf spheroidal galaxies	DM
F06	Cosimo Bambi, Alexander D. Dolgov	Search for matter-antimatter annihilation for testing baryogenesis models	Other
F07	Andrea Addazi, Denis Bastieri, Antonino Marcianò	Limiting Mev-ish dark matter decays and neutrino masses models from e-ASTROGAM: light WIMPs, dark photons and Majorons	DM / Other
✓	G. Vankova-Kirilovai, Vladimir Bozhilov, V. Kozhuharov, Stefan Lalkovski	All-sky mapping in the 100 MeV region in search for point-like Dark Matter sources	DM
✓	Daniel Nieto, Juan A. Barrio, Miguel A. Sánchez-Conde	High Galactic latitude, unassociated gamma-ray sources: uncovering dark matter subhalos in the MeV band	DM
✓	Michele Doro, Javier Rico, and Dmitry Malyshev	Search for Primordial Black Holes Signatures with e-Astrogam	DM / Other
✓	Marco Regis, Nicolao Fornengo, Stefano Camera	Cross-correlation of large-scale structure surveys and e-ASTROGAM	DM / Other
✓	Joachim Kopp, Vedran Brdar, Jia Liu, Xiaoping Wang	Signatures of non-thermally produced dark matter on the MeV mass scale	DM
F13	Torsten Bringmann, Andrzej Hryczuk, Are Raklev, Inga Strümke, Jeriek Van den Abeele	Smoking gun spectral features from DM annihilation in the MeV range	DM

Limiting MeV-ish dark matter decays and neutrino mass models with e-ASTROGAM: light WIMPs, dark photons and Majorons

Andrea Addazi, Denis Bastieri, Antonino Marcianò

- **Light WIMPs**
  - possible if mechanism for non-thermal production
  - spectra: see talk by J. Rico, contribution by T. Bringmann et al., etc.

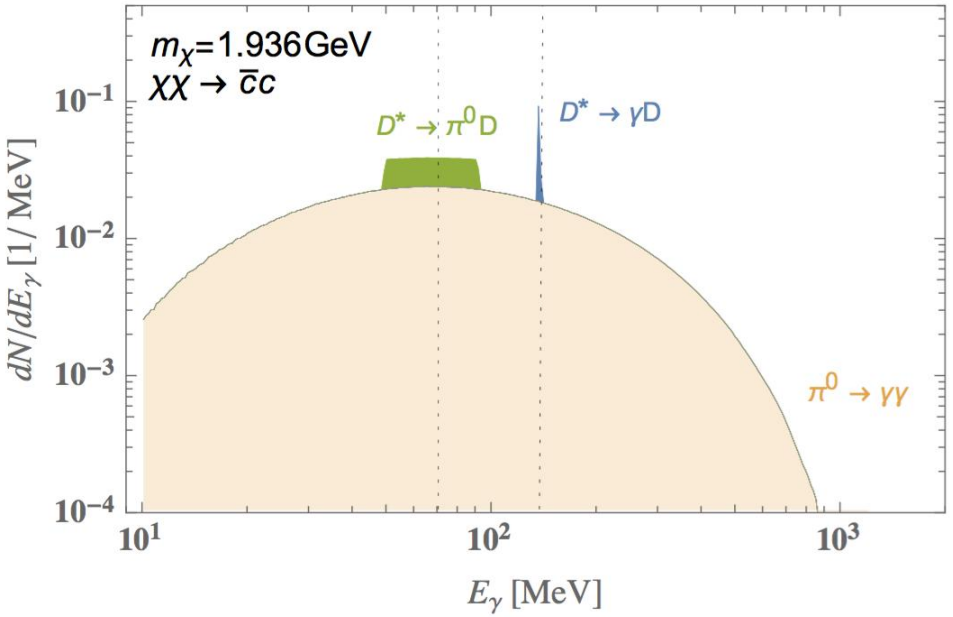
- **Majorons**
  - model to explain neutrino mass generation
  - decaying DM if in keV to MeV range
  - decay into two photons
  - CMB constraints: decay rate of the Majoron:
    $\Gamma_J < \zeta \times 2.4 \times 10^{-25}\ s^{-1}$
    ζ: inverse efficiency factor that describes how much decay energy is deposited on baryons.

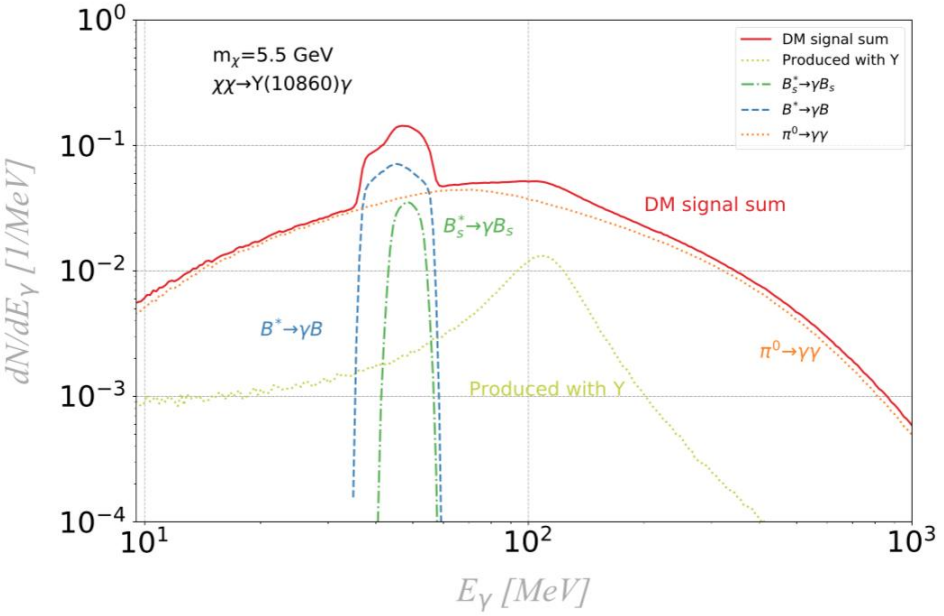
- **Dark Photons**
  - SM extension by an extra dark gauge sector. Minimal model: just an extra $U(1)_X$ gauge group is added.
  - Example: minimal particle spectrum (s,χ,A'_μ), where s is a scalar singlet, χ is a fermion charged wrt $U(1)_X$, A′ is the dark photon.
  - Portal between SM and dark sector allows an electromagnetic-like annihilation process of dark fermions into SM particles.

- **Laundry list**
  - MeV DM & gravitational waves background

Smoking gun dark matter signatures in the MeV range

Torsten Bringmann, Andrzej Hryczuk, Are Raklev, Inga Strümke, Jeriek Van den Abeele





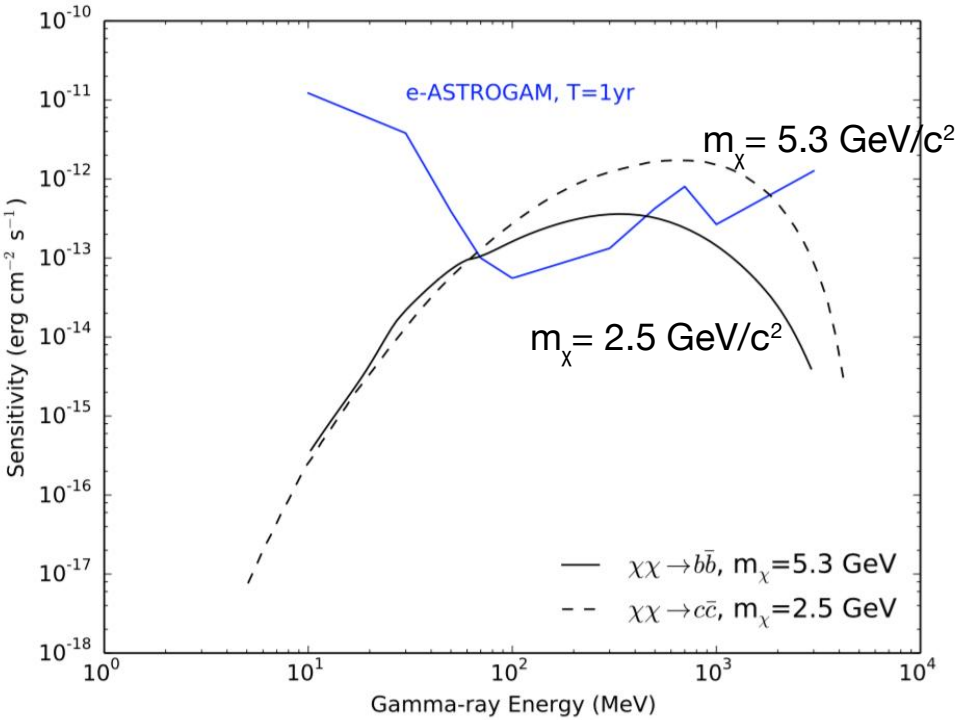
- Example of the expected gamma-ray spectrum for DM annihilation into charm quarks, with a DM mass mχ just above the kinematic threshold to produce D-mesons.
  $D^+ : c\bar{d}$ $D^0 : c\bar{u}$ (~1.87 GeV/c²)
  The sharp spectral features result from the indicated meson transitions, while the background is mostly due to $\pi^0 \to \gamma\gamma$.

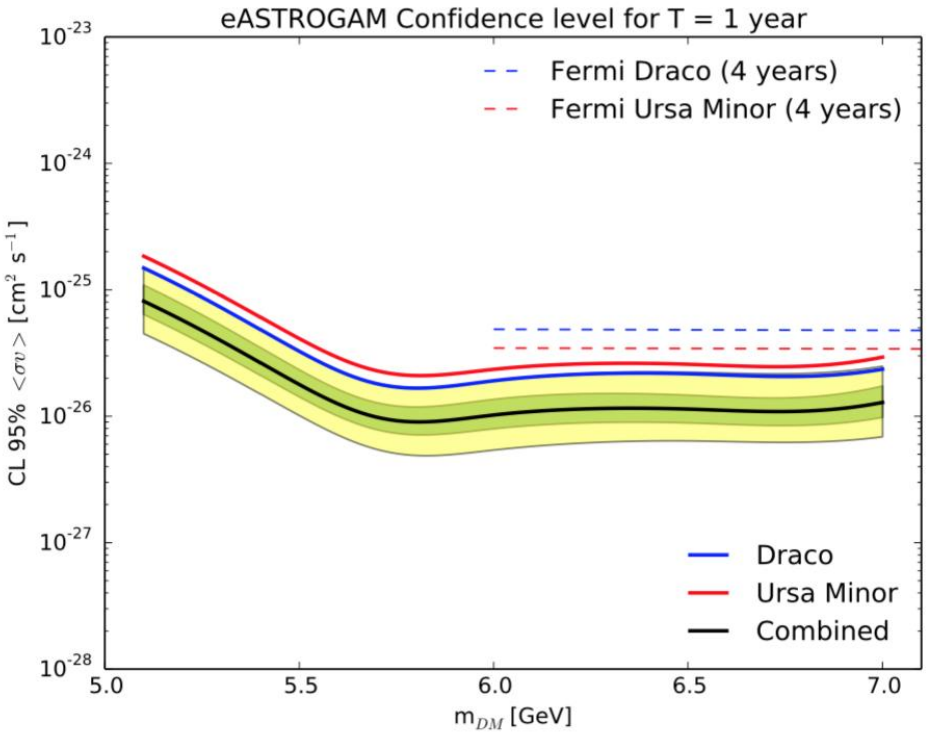
- Gamma-ray spectrum from DM annihilation through the quarkonium ($b\bar{b}$) channel $\chi\chi \to \Upsilon(10860)\gamma$.

- The three visible spectral features are due to two different meson transitions and the photon produced in conjunction with the quarkonium.

e-ASTROGAM and dwarf spheroidal galaxies

Aldo Morselli, Gonzalo Rodriguez Fernandez





- Expected flux from Draco for J=1.7e19 GeV^2 cm^{-5}, $<\sigma v>$ = 3e-26 cm^3 s^{-1}, m_χ= 2.5 and 5.3 GeV and two self-annihilation channels, compared to
- point source continuum sensitivity for e-ASTROGAM for an effective exposure of 1 yr for a source at high Galactic latitude.

- Sensitivity for $<\sigma v>$ from observation of the classical dwarf galaxy Draco and Ursa Minor for self-annihilation channel $b\bar{b}$ for 1 yr of effective exposure compared to 4 years of Fermi LAT in survey mode.

Search for matter-antimatter annihilation testing baryogenesis models

Cosimo Bambi, Alexander D. Dolgov

- Looking for signatures of $p\bar{p}$ annihilation from (compact) primordial antimatter lumps in the energy range ~0.5 – 100 MeV
- e-ASTROGAM will improve existing limits by 1 (30-100 MeV) to 2 (1-30 MeV) orders of magnitude compared to existing observations
- What is the relevance of improving these limits?

Synergy between e-ASTROGAM and optical observations for indirect Dark Matter searches

Lucio Angelo Antonelli, Michele Fabrizio, Paola Giammaria, Saverio Lombardi

- New optical surveys have discovered numerous new satellites.
- Instruments such as GAIA will put constraints on DM distribution.
- not much new information here, mostly pointing to work on dwarf spheroidals