

AMEGO-X POLARIMETRIC PROSPECTS



LABORATÓRIO DE INSTRUMENTAÇÃO
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partículas e tecnologia

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Introduction

The discovery of gravitational waves and neutrinos from gamma-ray sources have triggered a new era in multi-messenger astronomy and established the importance of gamma-ray observations for this emerging field. AMEGO-X (All-sky Medium Energy Gamma-Ray Observatory eXplorer) is a joint European and NASA proposal, a MeV gamma-ray instrument that will survey the sky in the energy range from ~ 100 keV to 1 GeV with unprecedented sensitivity, filling the sensitivity gap between hard X-ray and high-energy gamma ray bands. AMEGO-X scientific instrument is composed by double-sided silicon strip detector (DSSD) trackers and CsI calorimeter. The polarimetric potential of AMEGO-X is herein analysed, in particular its sensitivity to the strongest celestial gamma-ray sources as well as to GRBs, providing important contributions both to multi-messenger science and time-domain gamma-ray astronomy.

AMEGO-X Scientific Objectives

AMEGO provides three new capabilities in MeV astrophysics: sensitive continuum spectral studies, polarization, and nuclear line spectroscopy. The primary optimization for AMEGO is continuum sensitivity across a broad energy range. The extremely diverse science reach for AMEGO (see figure below) is greatly enhanced by adding polarization and nuclear line spectroscopy. Furthermore, we are at the dawn of the multimessenger era, with the recent discovery of high energy astrophysical neutrinos by IceCube and the first direct observation of gravitational waves by LIGO.

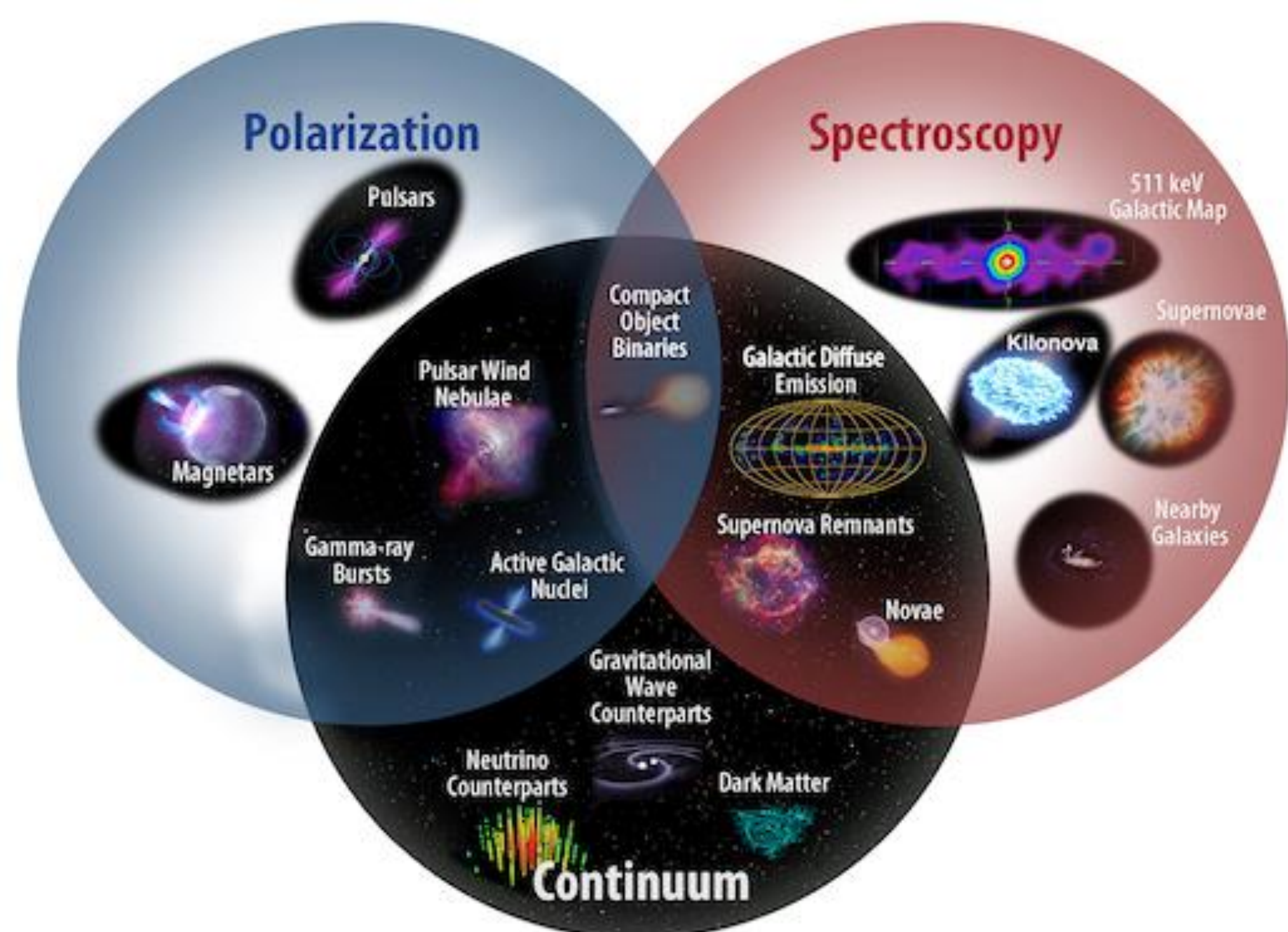


Fig. 1- AMEGO provides three new capabilities in MeV astrophysics: sensitive continuum spectral studies, polarization, and nuclear line spectroscopy.

AMEGO Scientific Instruments

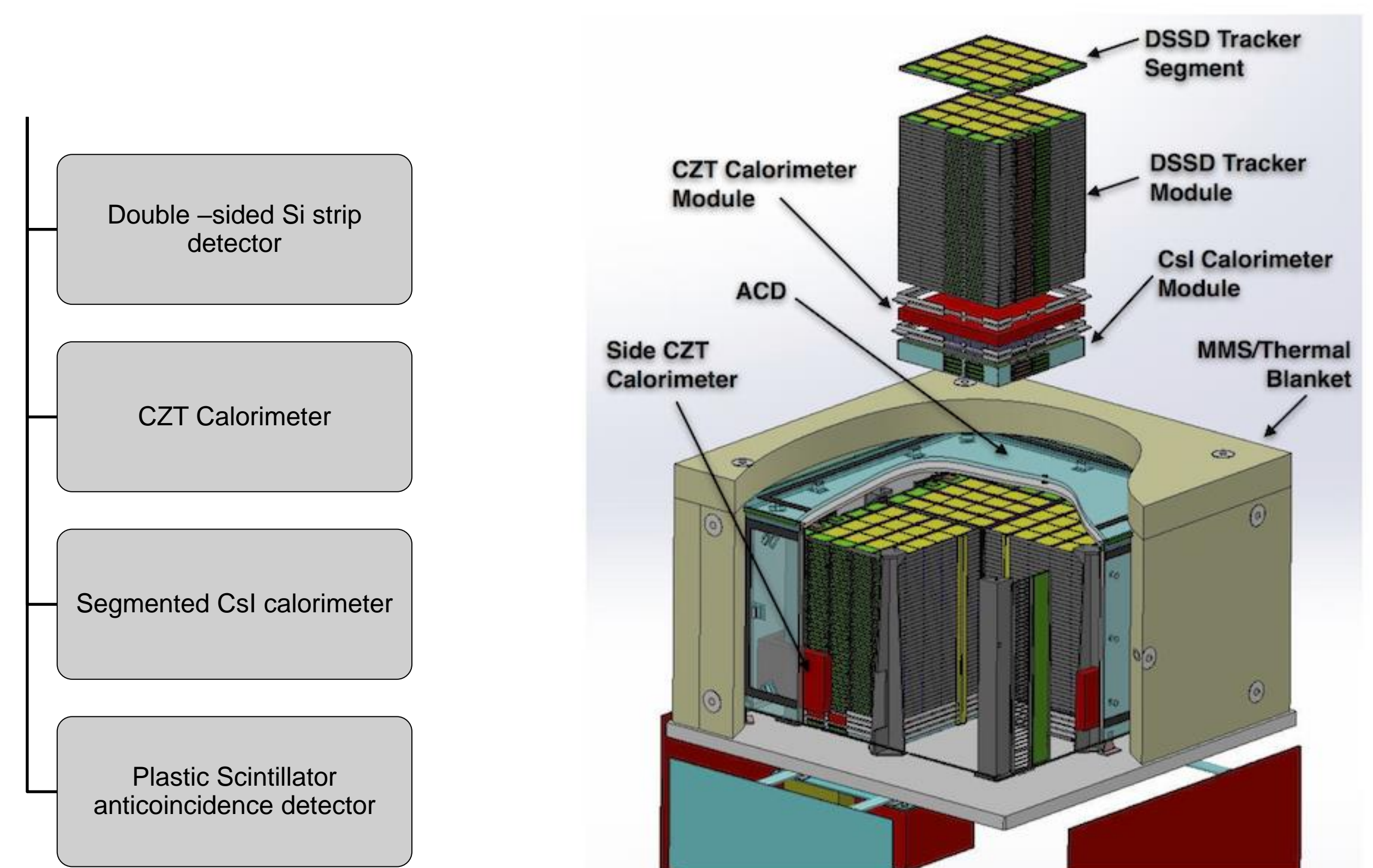


Fig. 2 - AMEGO-X is a MIDE mission concept that is based largely on Fermi-LAT heritage but is optimized for the MeV range. The instrument is composed of three subsystems: a Silicon Tracker, a Cesium Iodide (CsI) calorimeter, and an anti-coincidence detector (ACD). The Tracker and Calorimeter work together to detect photons which undergo Compton scattering and pair conversion in the detector volume, allowing for a photon-by-photon reconstruction, while the ACD vetoes the background from charge particles.

AMEGO – Expected Performances

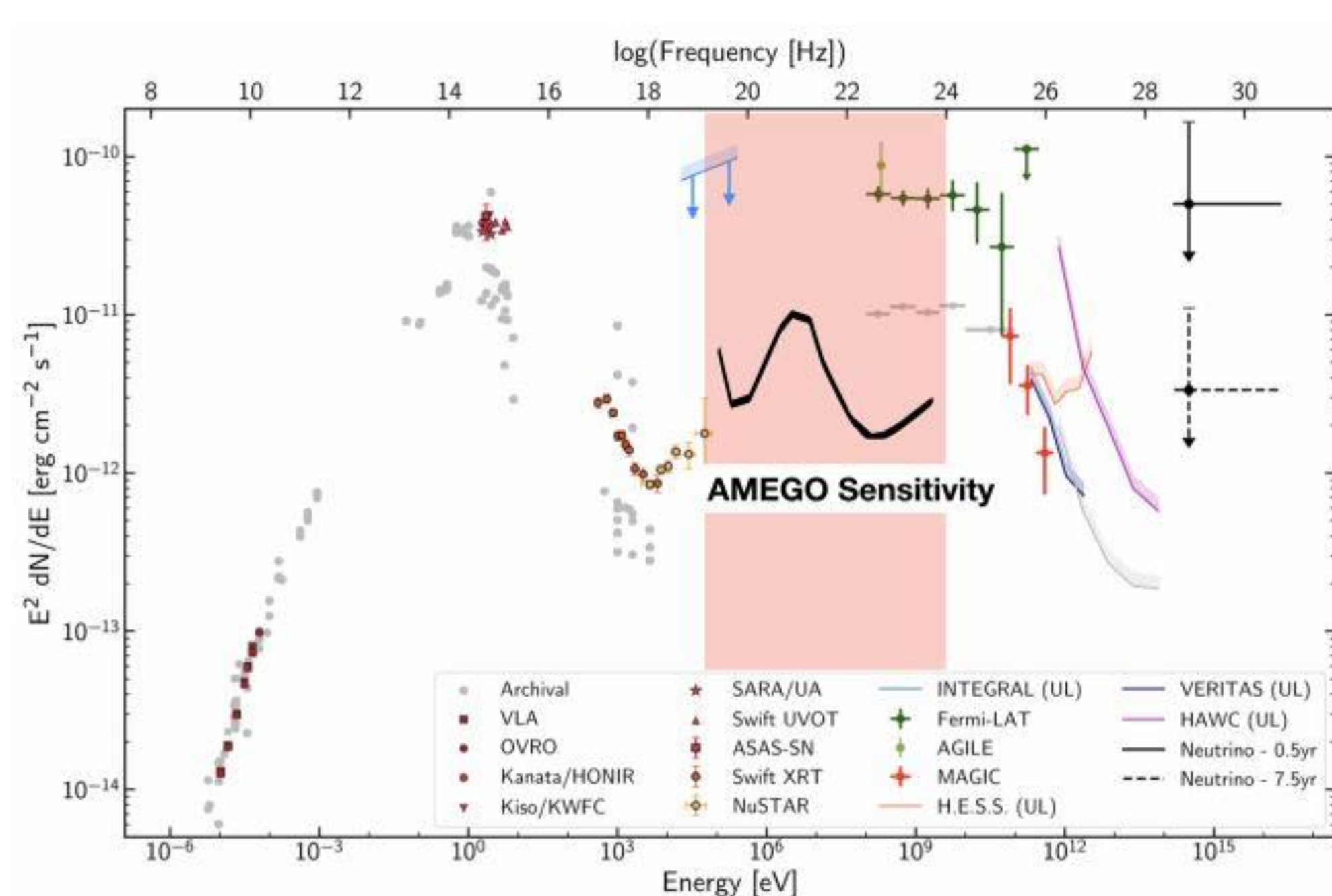
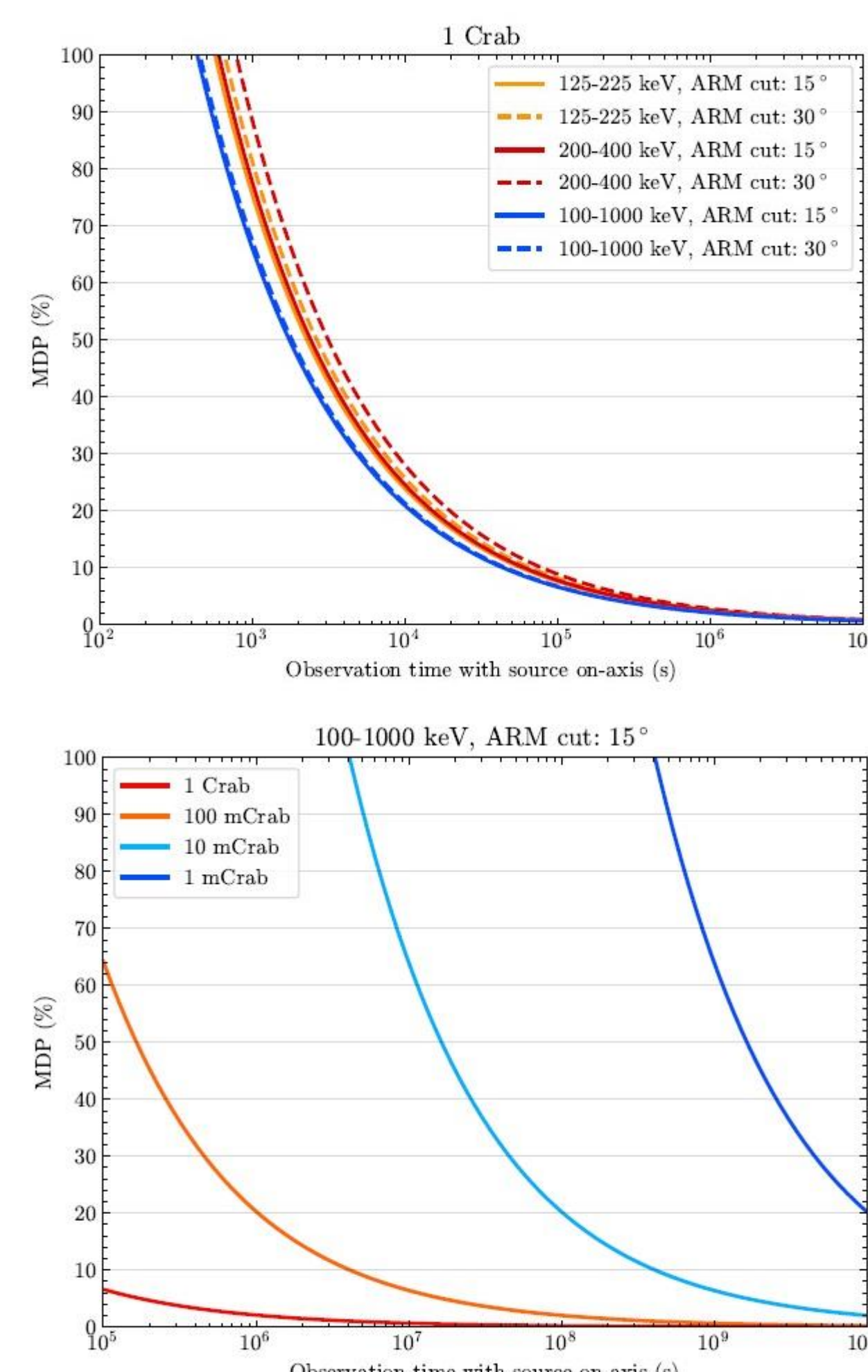


Fig. 3 – Expected performances of AMEGO mission will fill a sensitivity gap in the MeV up to GeV band.



Simulation Conditions:

- Source: Monoenergetic
- Beam Type: Far-Field Point Source

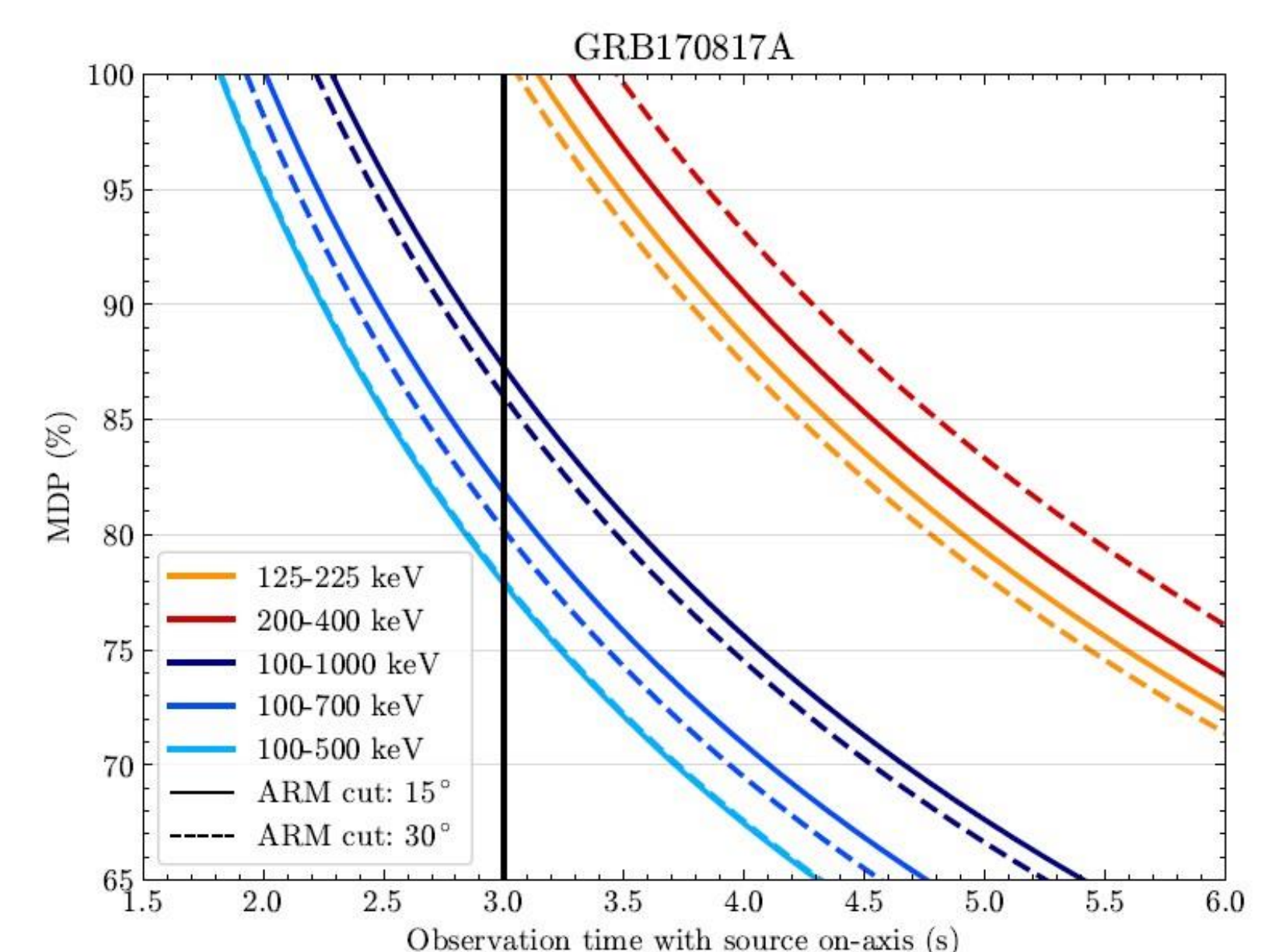


Fig. 4 – Expected Minimum Detectable Polarization (MDP) of AMEGO-X mission for 1 Crab source (top left); for variable Crab source 1 mCrab – 1 Crab (bottom left) for the GRB 170817A

Future Work

The simulation results will provide valuable information to optimize the original configuration of AMEGO-X and show how it influences the performance of the instrument. Furthermore, we will simulate gamma-ray objects studying supernovae, fusion of compact objects, excess of gamma-ray emission in the center of galaxies and blazars. Finally, we will ascertain which type of observations as possible and which scientific questions that may potentially be addressed, in particular, for multi-messenger astrophysics.