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Polarimetric prospects of a new hard X- soft gamma-ray space mission for next decades

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The polarization measurement of the high-energy photons from cosmic sources is today recognised as a key goal for understanding the emission mechanisms and the geometry of the active regions involved, and therefore to solve still open hot scientific issues. To achieve this challenging objective, a mandatory requirement for new instrumentation in this energy regime will be to provide high sensitivity for polarimetric measurements associated with spectroscopy and imaging. In this perspective the Advanced Surveyor of Transient Events and Nuclear Astrophysics (ASTENA) mission concept is under study. This mission includes two main instruments exploiting unprecedented sensitivity: the Wide field monitor (WFM-IS), with a large effective area and a broad energy passband (2-20 MeV), and the Narrow Field Telescope (NFT), with a broad energy passband (50-700 keV) with focusing capabilities based on the use of an advanced broad-band Laue lens. Both instruments will include new concept spectrometers with fine 3D spatial resolution allowing to perform scattering polarimetry along with spectroscopy, imaging and timing. The achievable high sensitivity of both these instruments coupled with the particular characteristics in terms of 3D spatial resolution of their spectrometer detectors will allow them to perform high reliable polarimetry measurements. Herein, we report on the results of a Monte Carlo study devoted to optimizing the configuration of both instruments, in particular, the modulation factor (Q), and the event detection efficiency. We present the dependence of these parameters from detector geometrical configurations (pixel/voxel shape, pixel/voxel scales), and from various filters that can be implemented. Finally, the Minimum Detectable Polarisation (MDP) results obtained for some case studies of real sources are also presented and discussed, showing that ASTENA can reach very low MDP levels, down to 1% in a reasonable observation time.

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