

Development and science perspectives of the POLAR-2 instrument: a large scale GRB polarimeter

N. De Angelis^{*a}, J.M. Burgess^d, F. Cadoux^a, J. Greiner^d, J. Hulsman^a, M. Kole^a,
H.C. Li^b, S. Mianowski^c, A. Pollo^c, N. Produit^b, D. Rybka^c, J. Stauffer^a, J.C. Sun^e,
B.B. Wu^e, X. Wu^a, A. Zdrozny^c, and S.N. Zhang^{e,f}

^aUniversity of Geneva, DPNC, 24 Quai Ernest-Ansermet, CH-1211 Geneva, Switzerland

^bUniversity of Geneva, Geneva Observatory, ISDC, 16, Chemin d'Ecogia, CH-1290
Versoix, Switzerland

^cNational Centre for Nuclear Research, ul. A. Soltana 7, 05-400 Otwock, Swierk, Poland

^dMax-Planck-Institut für extraterrestrische Physik, Giessenbachstrasse 1, D-85748
Garching, Germany

^eKey Laboratory of Particle Astrophysics, Institute of High Energy Physics, Chinese
Academy of Sciences, Beijing 100049, China

^fUniversity of Chinese Academy of Sciences, Beijing 100049, China

Abstract

Despite several decades of multi-wavelength and multi-messenger spectral observations, Gamma-Ray Bursts (GRBs) remain one of the big mysteries of modern astrophysics. Polarization measurements are essential to gain a more clear and complete picture of the emission processes at work in these extremely powerful transient events. In this regard, a first generation of dedicated gamma-ray polarimeters, POLAR and GAP, were launched into space in the last decade. After 5 months of operation, the POLAR mission has detected 55 GRBs, among which 14 have been analyzed in detail, reporting a low polarization degree and a temporal evolution of the polarization angle. Starting early 2024 and based on the legacy of the POLAR results, the POLAR-2 instrument will aim to provide a catalog of high quality measurements of the energy and temporal evolution of the GRB polarization thanks to its large and efficient polarimeter. Several spectrometer modules will additionally allow to perform joint spectral and polarization analyzes. The mission is foreseen to detect about 50 good quality GRBs per year on board of the China Space Station (CSS). The technical design of the polarimeter modules will be discussed in detail, as well as the expected scientific performances based on the first results of the developed prototype modules.

Keywords— Polarimetry, GRB, Instrumentation, Pulsars, Satellite, POLAR-2, Gamma-ray

*Corresponding author. nicolas.deangelis@unige.ch