POLAR: GRB Polarimeter on the Chinese TG-2 Space Lab

Launched: September 15 2016!

5 institutes from 3 countries: Switzerland (UniGE, PSI), Poland (NCBJ) and China (IHEP)
Gamma-Ray Bursts

• Most energetic events observed in the Universe
  – Occurred in distance galaxies, believed to be results of a supernova or hypernova explosion or a merger of 2 neutrons stars or black holes
  – So far away that typically the gamma burst is observed first
• Timing, Direction and Energy spectrum has been measured in great detail
  – Two parameters remain: polarization degree and polarization angle
Compton Polarimetry

- Detect photons and measure the polarization with Compton scattering
  - Azimuthal scattering angle dependence on polarization
  - Require 2 interactions of the incoming photon in the detector
The POLAR Instrument Idea

- Heritage from particle physics with compact segmented plastic scintillator array detectors
  - Optimal for Compton scattering in the 50-500 keV energy range
- POLAR: 1600 plastic scintillators bar (6x6x176 mm) in 25 modules
  - Lightweight allows a relatively large effective area, with low mass (30kg)
  - Small granularity results in high angular resolution thus high sensitivity for polarization measurements

Fig. 2. Schematic view of the POLAR detector.

POLAR, a compact detector for gamma-ray bursts photon polarization measurements

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POLAR on Tiangong 2

Polarimeter:
• Photon polarisation from GRB
• Hard x-rays, 50 keV < \( E_\gamma \) < 500 keV
• FoV 30% of sky

OBOX (Europe):
• 5x5 modules in carbon fibre box
• Central trigger and power supplies
• Switzerland: UniGE (DPNC, ISDC), PSI
• Poland: NCBJ Swierk

IBOX (Chinese Academy of Sciences):
• Space craft interfaces
• Central computer, data transmission
POLAR Module

- CFRP socket (1mm thick carbon prepreg)
- 64 Bars
- Baffles
- PMT
- End Cap
- Back seal
- FEE (PSI Villigen)
## The POLAR Timeline

<table>
<thead>
<tr>
<th>Year</th>
<th>Phase</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>Phase 0</td>
<td>NIM Publication</td>
</tr>
<tr>
<td>2007-2009</td>
<td>Phase A</td>
<td>DM, EQM I</td>
</tr>
<tr>
<td>2010-2011</td>
<td>Phase B</td>
<td>EQM II</td>
</tr>
<tr>
<td>2012-2016</td>
<td>Phase C/D</td>
<td>FM, FMS</td>
</tr>
<tr>
<td>2016–2020</td>
<td>Data analysis</td>
<td>Science publications</td>
</tr>
</tbody>
</table>
POLAR Constructed and Qualified

Full Flight Model calibrated on ground with polarized beams, performance confirmed!
POLAR at launch site

- POLAR FM shipped to the Jiuquan Satellite launch center at the end of June
  - Final tests at the launch site completed, FM now mounted on TG-2!
POLAR ready for space!
Towards the first light ...

- Successfully launched on Sept. 15, 2016
  - $t_0 + 22.5h$: INBOX turns on
  - $t_0 + 7d$: OUTBOX turns on
  - $T_0 + 28d$: first observation period
  - ...

- Operation period: at least 2 years

Expected to detect 50 GRBs per year and measure the polarization of 2 or 3 strong GRBs with an unprecedented precision!