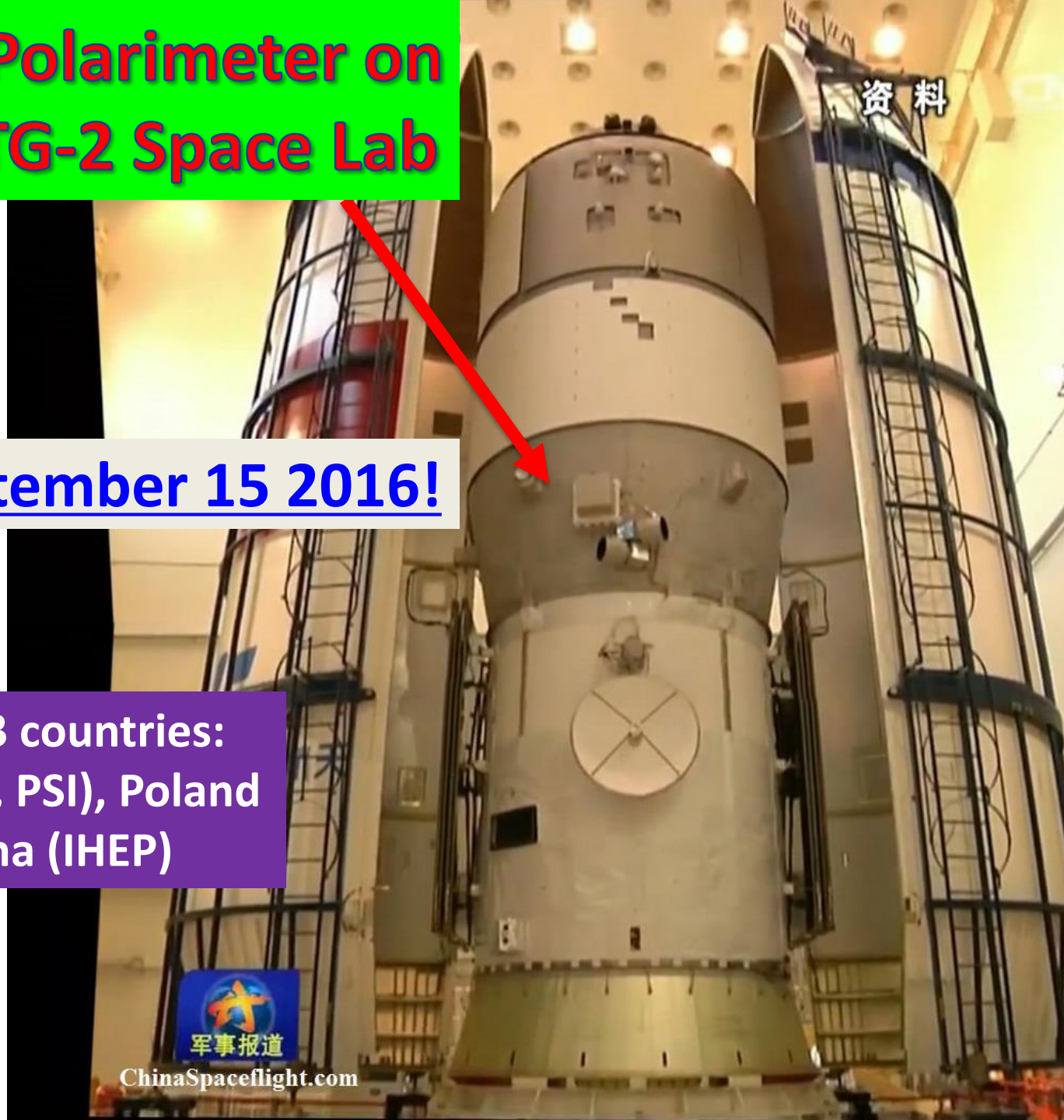
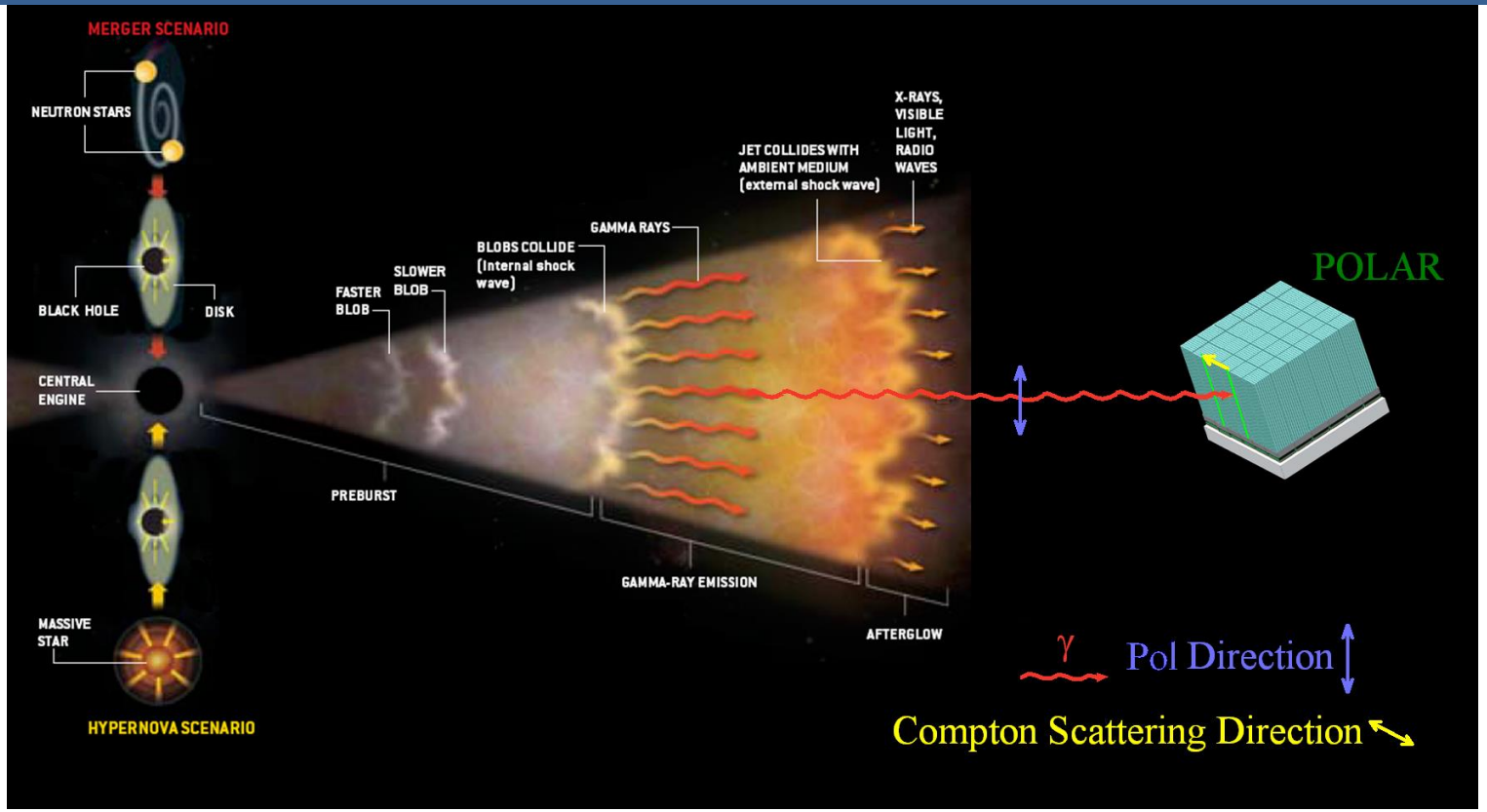
POLAR: GRB Polarimeter on the Chinese TG-2 Space Lab



Launched: September 15 2016!

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

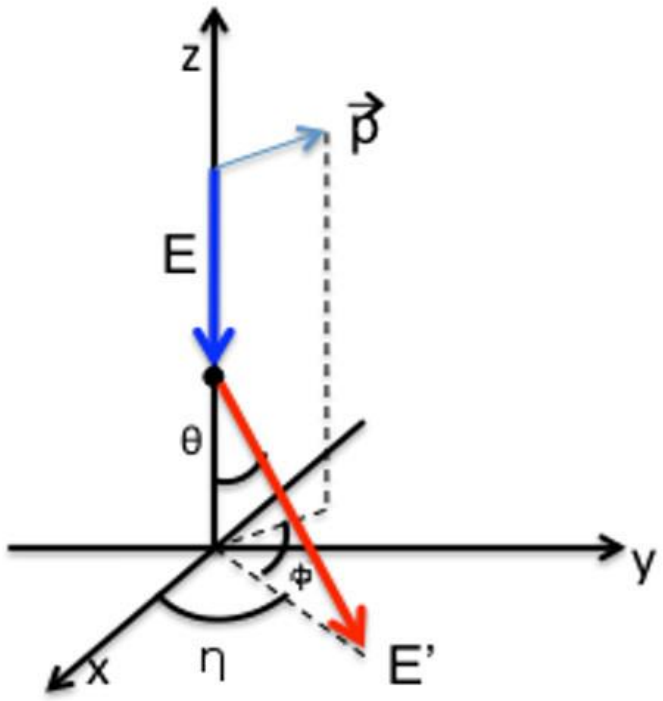
Gamma-Ray Bursts

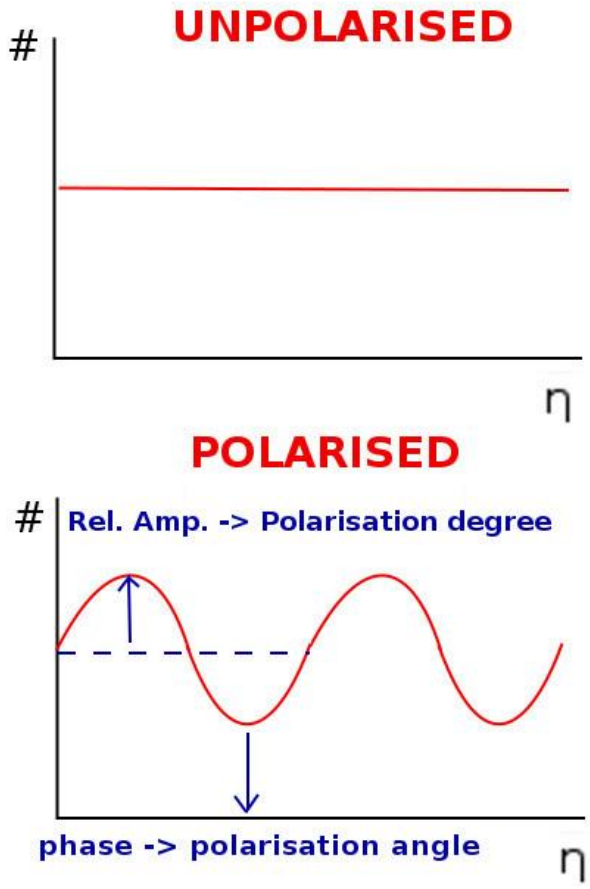


- Most energetic events observed in the Universe
  - Occurred in distance galaxies, believed to be results of a supernova or hypernova explosion or a merger of 2 neutrons stars or black holes
  - So far away that typically the gamma burst is observed first
- Timing, Direction and Energy spectrum has 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

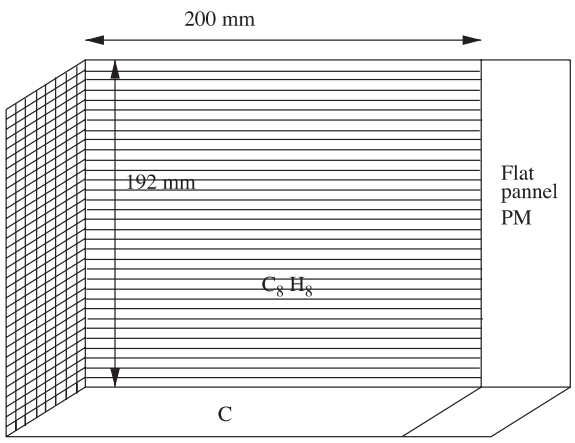
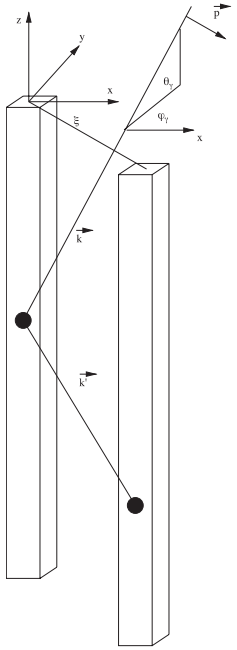


Fig. 2. Schematic view of the POLAR detector.



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

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Available online 7 July 2005

POLAR on Tiangong 2

Polarimeter:

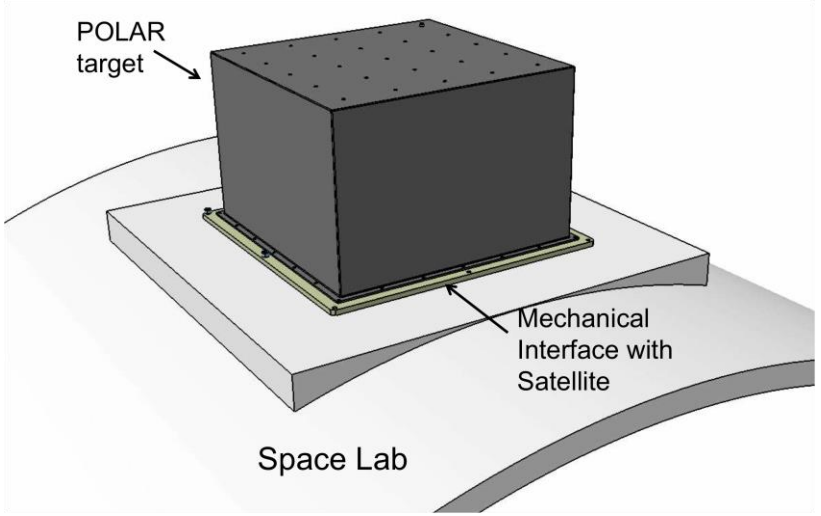
- Photon polarisation from GRB
- Hard x-rays, 50 keV < Eγ < 500 keV
- FoV 30% of sky

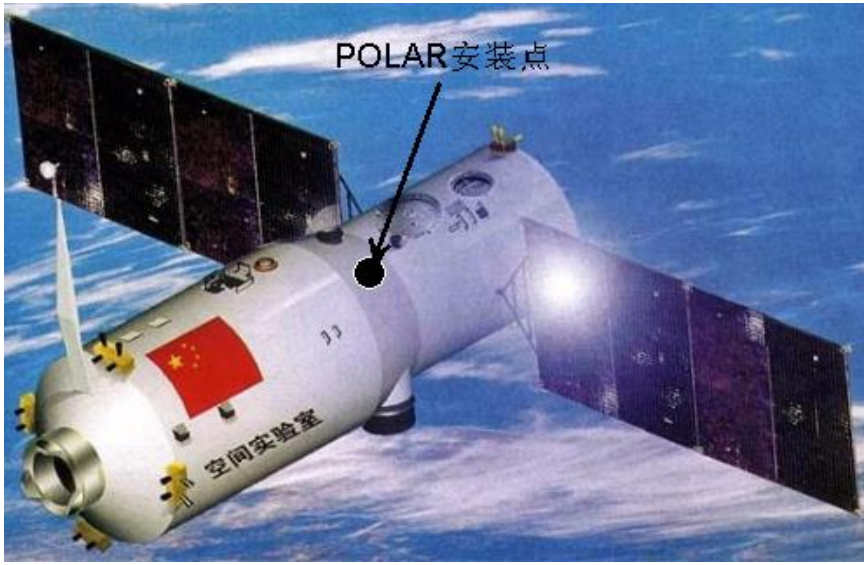
OBOX (Europe):

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

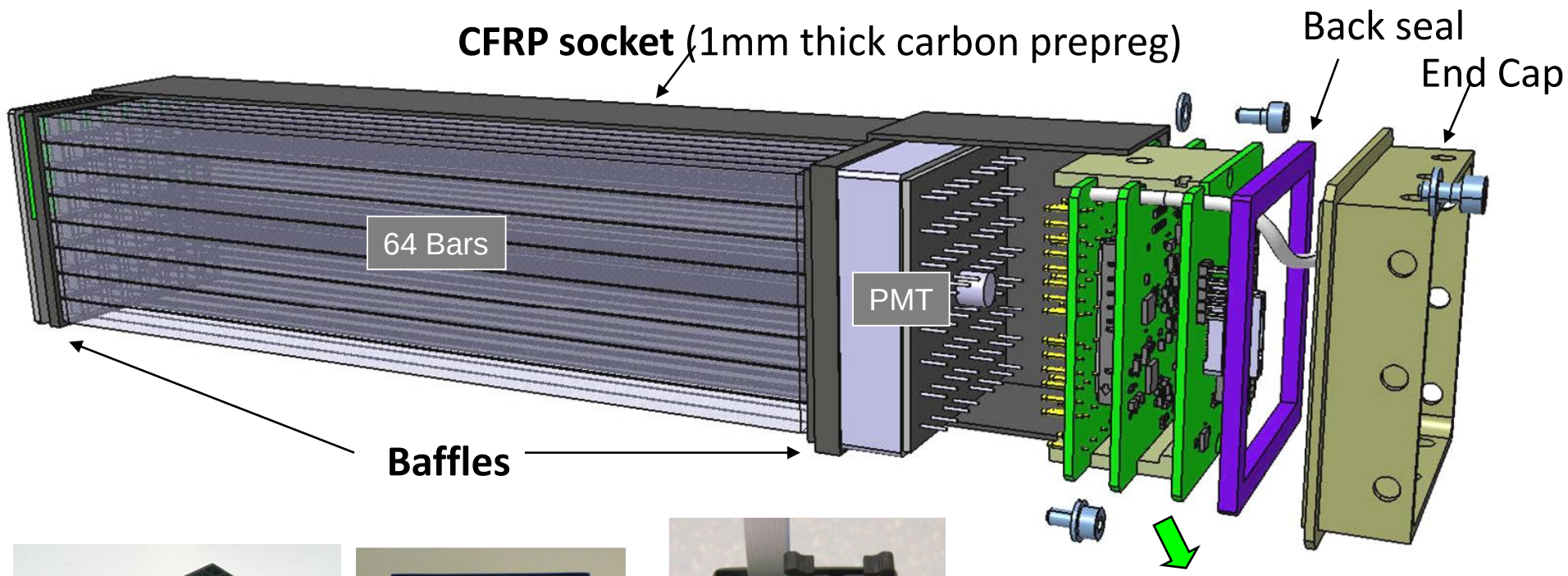
IBOX (Chinese Academy of Sciences):

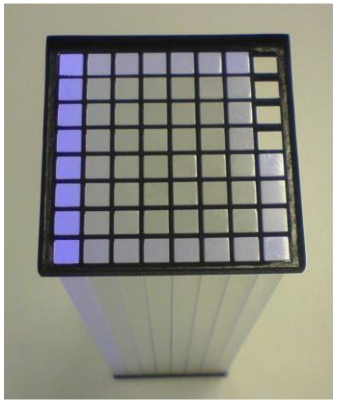
- Space craft interfaces
- Central computer, data transmission

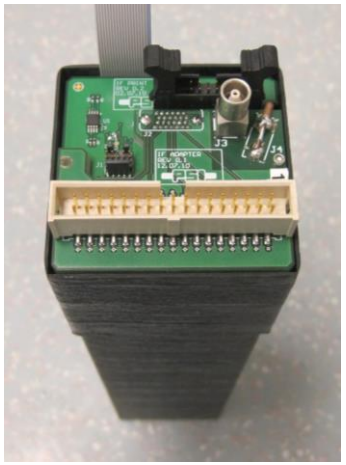


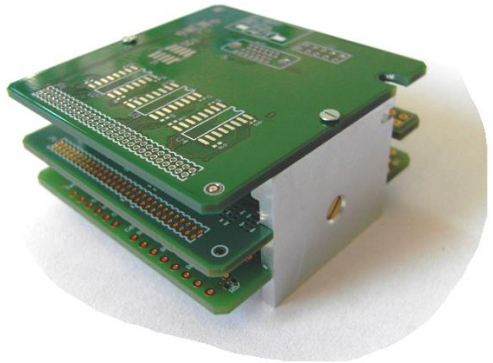


POLAR Module



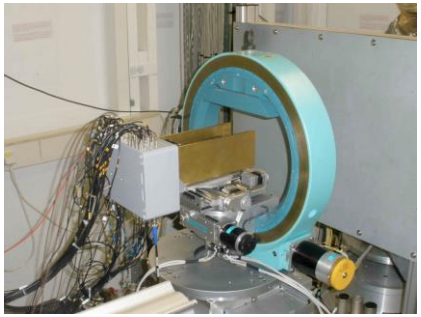
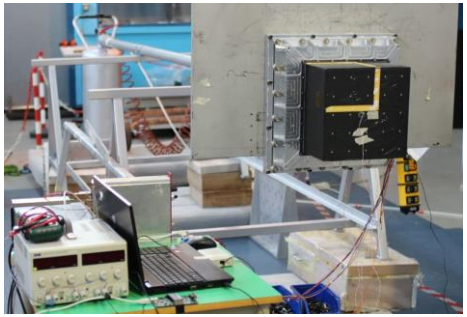
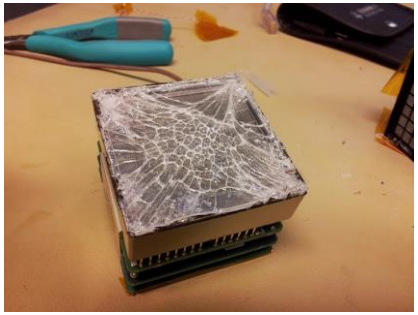
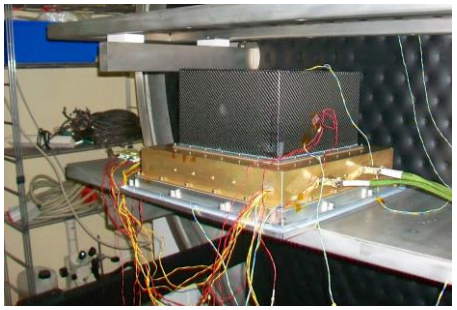




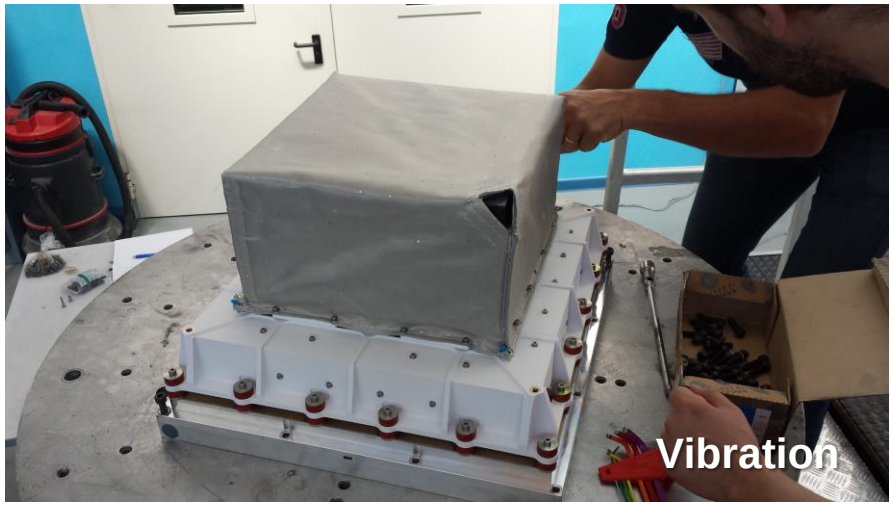


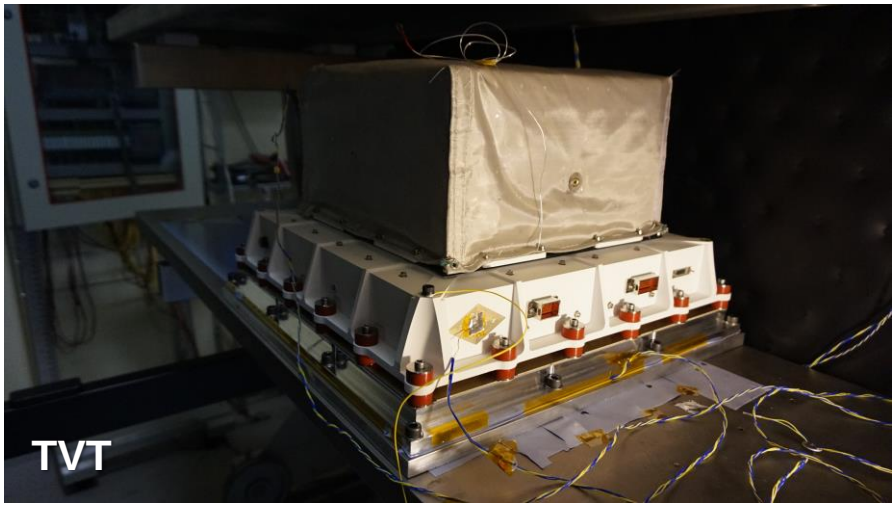
The POLAR Timeline

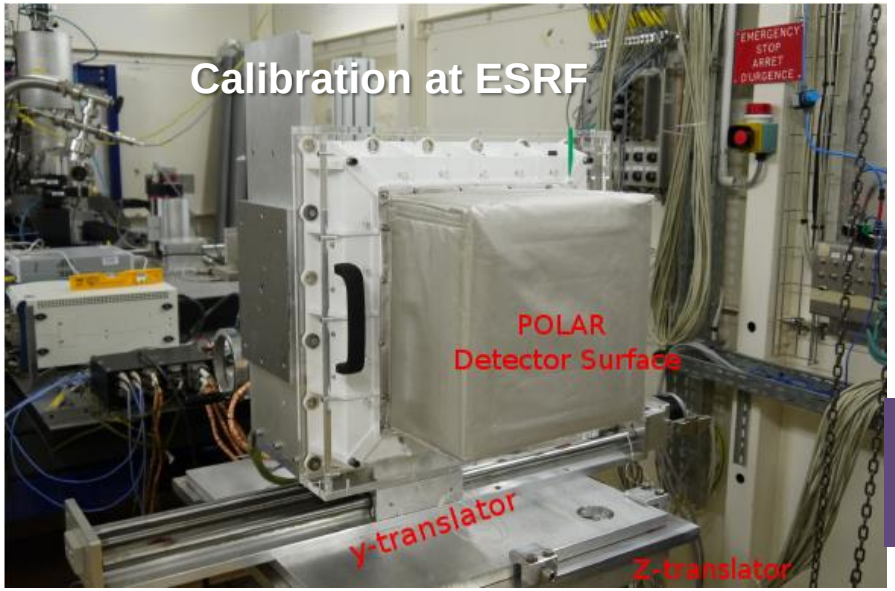
2005	Phase 0	NIM Publication
2007-2009	Phase A	DM, EQM I
2010-2011	Phase B	EQM II
2012-2016	Phase C/D	FM, FMS
2016–2020	Data analysis	Science publications

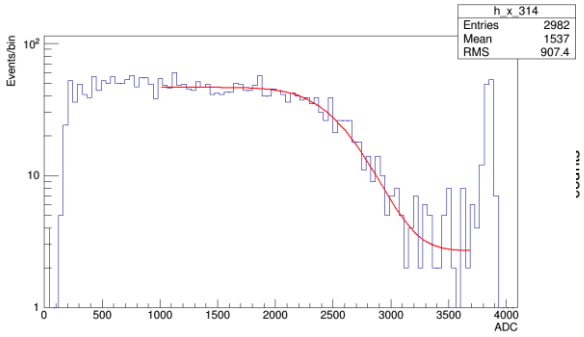





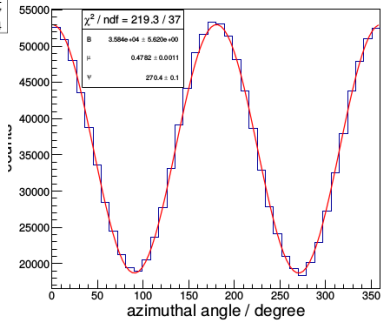
POLAR Constructed and Qualified







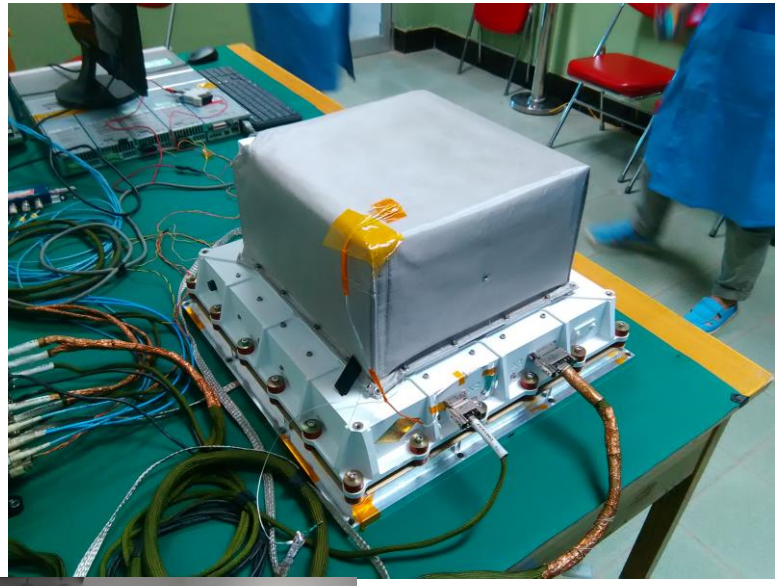




Full Flight Model calibrated on ground with polarized beams, performance confirmed!

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
  - t0 + 22.5h: INBOX turns on
  - t0 + 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!