



Space detection of gamma rays



COLD WAR

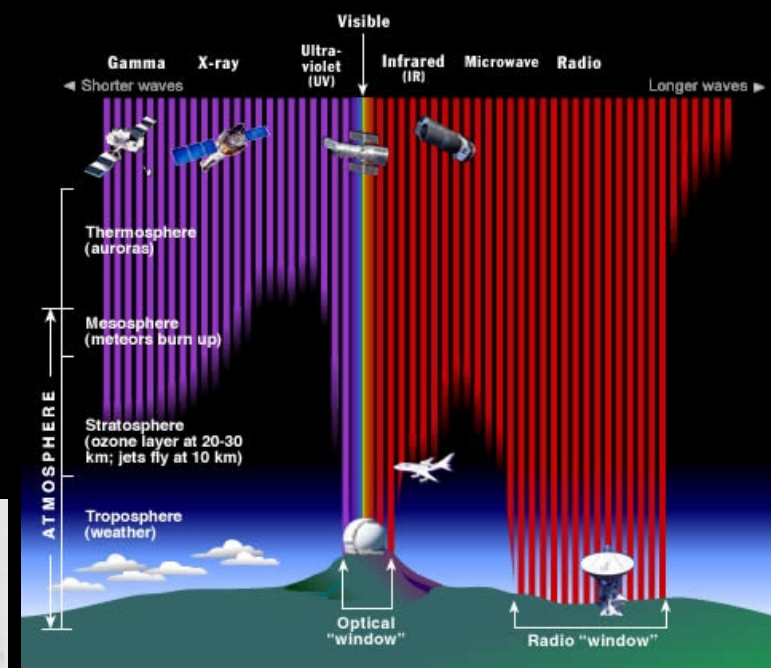
1952 - 53: US, USSR – thermonuclear weapon

1951- 1958 nuclear tests,

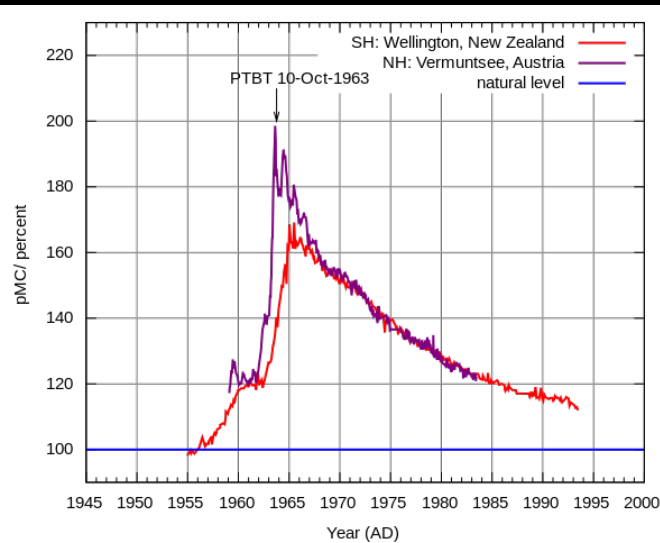
- 166 – US
- 82 – USSR,
- 21 – GB

Of which “only”

22 - underground



1963 Partial Test Ban Treaty



1959 VELA – research project

Oct 17, 1963: VELA I:

12 x-ray detectors

18 neutron and γ -ray detectors

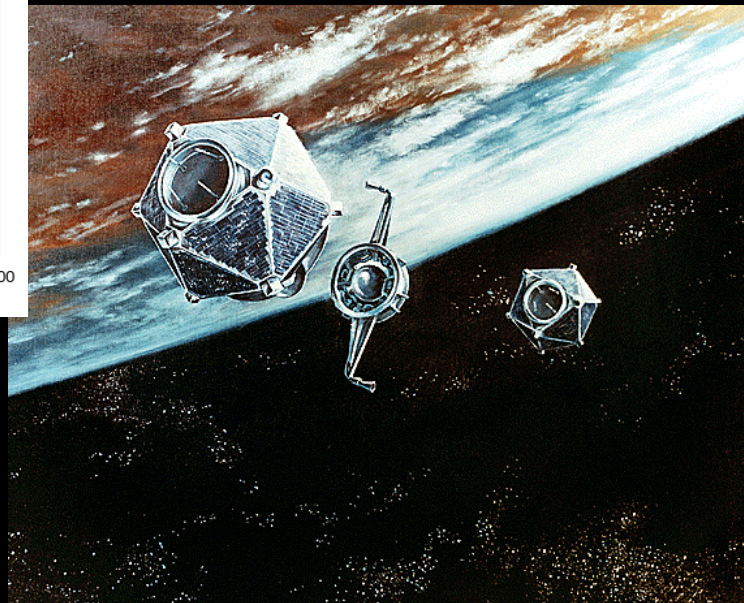
July 2, 1967, 14:19 UTC,

Vela 3 и Vela 4 – first detected γ -ray burst

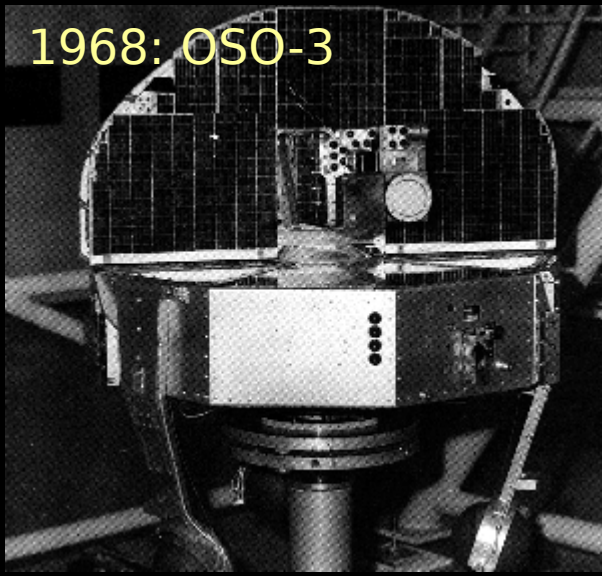
1973 discovery declassified and published

1970-80 Defense Support Program (DSP) – Star Wars

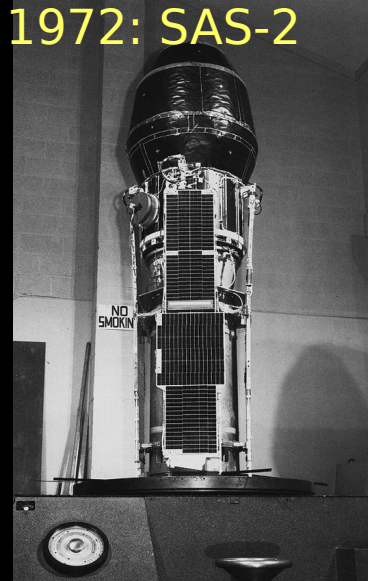
1980-90 Global Positioning System (GPS)



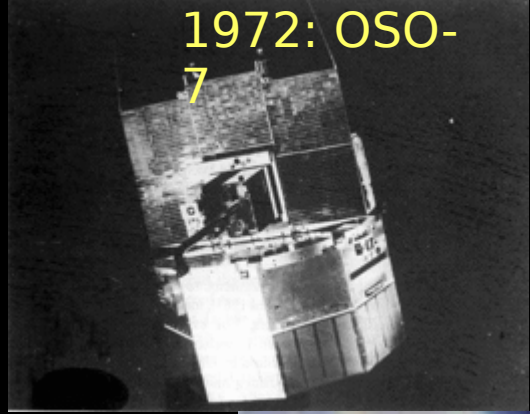
1968: OSO-3



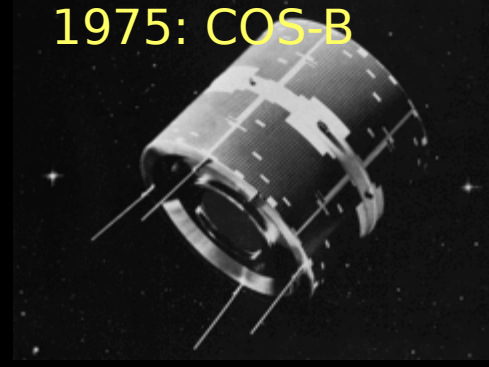
1972: SAS-2



1972: OSO-7



1975: COS-B

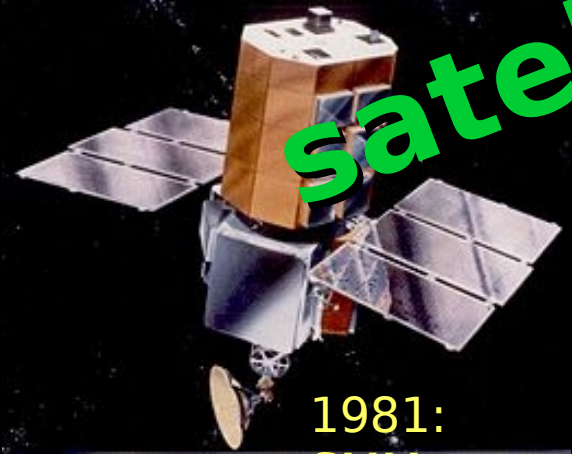


1991: CGRO

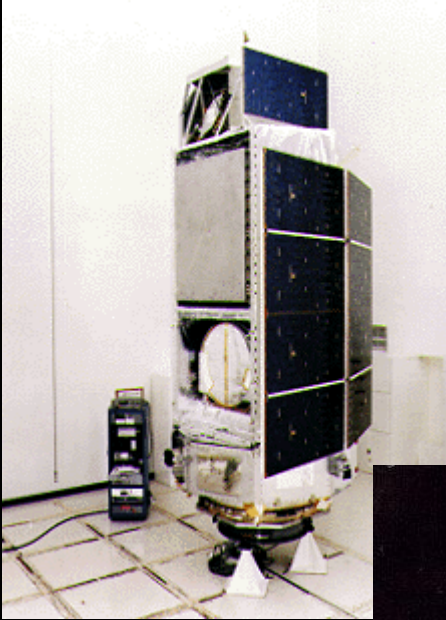


satellites

1981: CMM



1979: HEAO-3



1999: Chandra



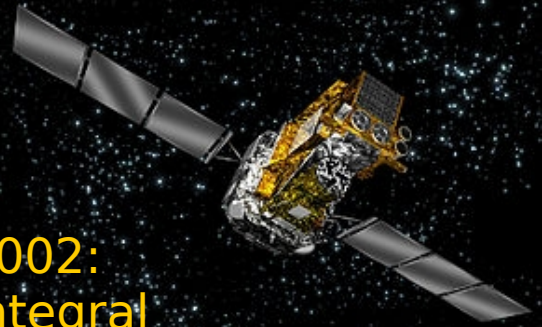
1995: RXTE



1996: BeppoSAX



2002: Integral



CGRO

Agency: ESA

Launched: 5.4.1991

Spacecraft: SS Atlantis

Orbit: Low Earth

Payload: 17 000 kg

Power: 2000 W

Manufacturer: TRW Inc.

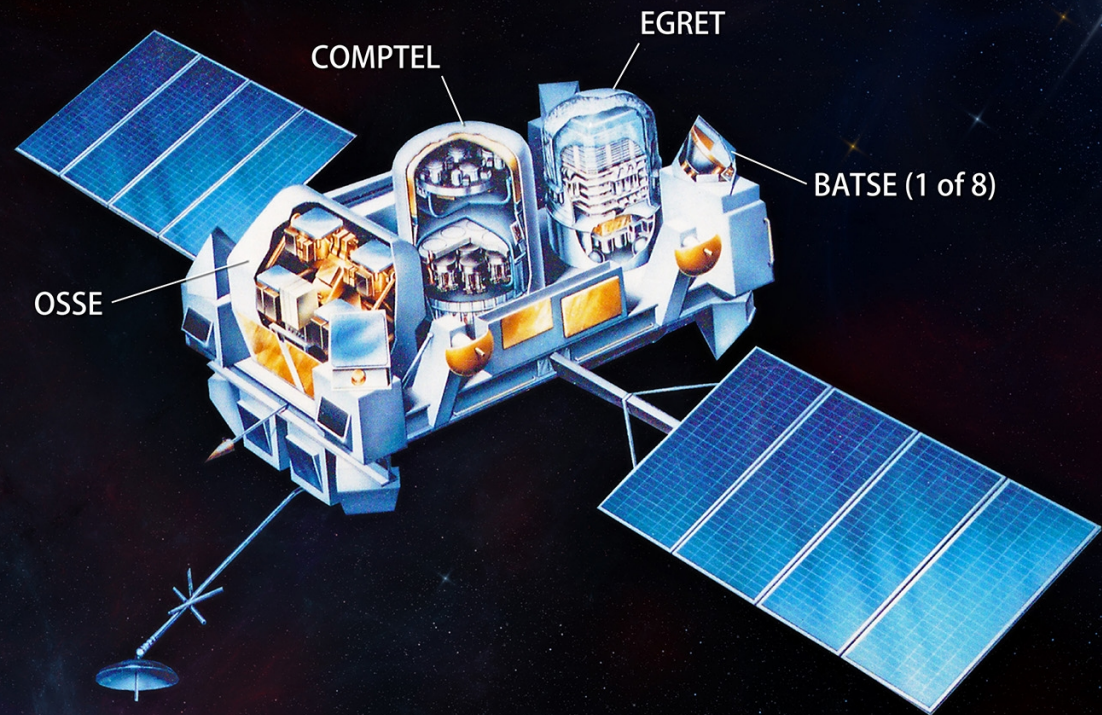
Planned duration:

Status: decayed
4 June 2000

Instruments: BATSE, OSSE,
COMPTEL, EGRET

Energy range: 20 keV – 30 GeV

NASA's Compton Gamma Ray Observatory



COMPTEL

Technology: Compton camera

Detectors: two layers

Scatterer (D1): 7 cyl. x NE 213A
 $\phi 27.6$ cm x h8.5 cm

Absorber (D2): 14 x NaI
 $\phi 28$ cm x h7.5 cm
8 PMTs/module

ACS: NE110, readout 24 PMTs

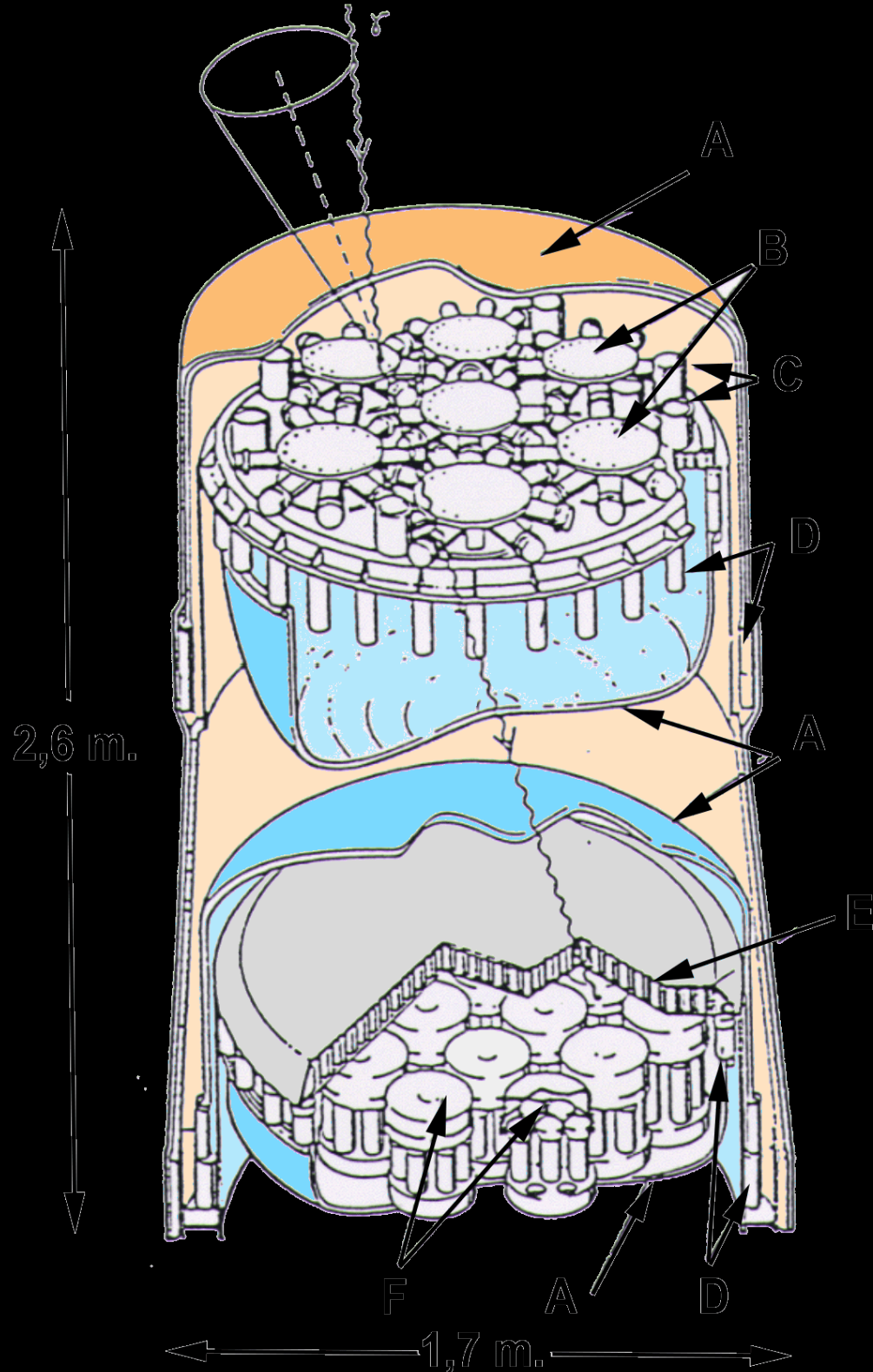
Energy range: 0.75 – 30 MeV

In flight calibration: ^{60}Co

Imaging capabilities:

D1-D2 distance: : 1.5 m

Angular resolution: 1-2 $^\circ$



Integral

The image shows a detailed illustration of the INTEGRAL satellite in space. The satellite has a central body covered in gold and silver thermal insulation. Two large, rectangular solar panel arrays are extended from the sides. The background is a dark field filled with numerous bright stars of varying sizes and colors.

Agency: ESA

Launched: 17.10.2002

Spacecraft: Proton

Mass: ~4000 kg

Payload: ~2000 kg

Size: 5m x 2.8m x 3.2m

Power: ~2000 W

Manufacturer: Thales Alenia
Space, France-Italy

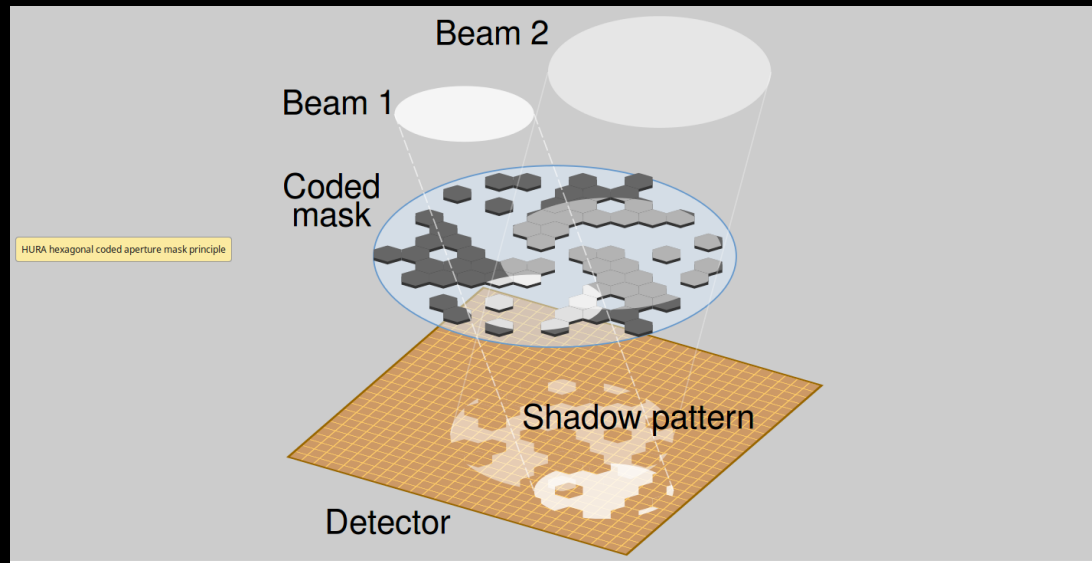
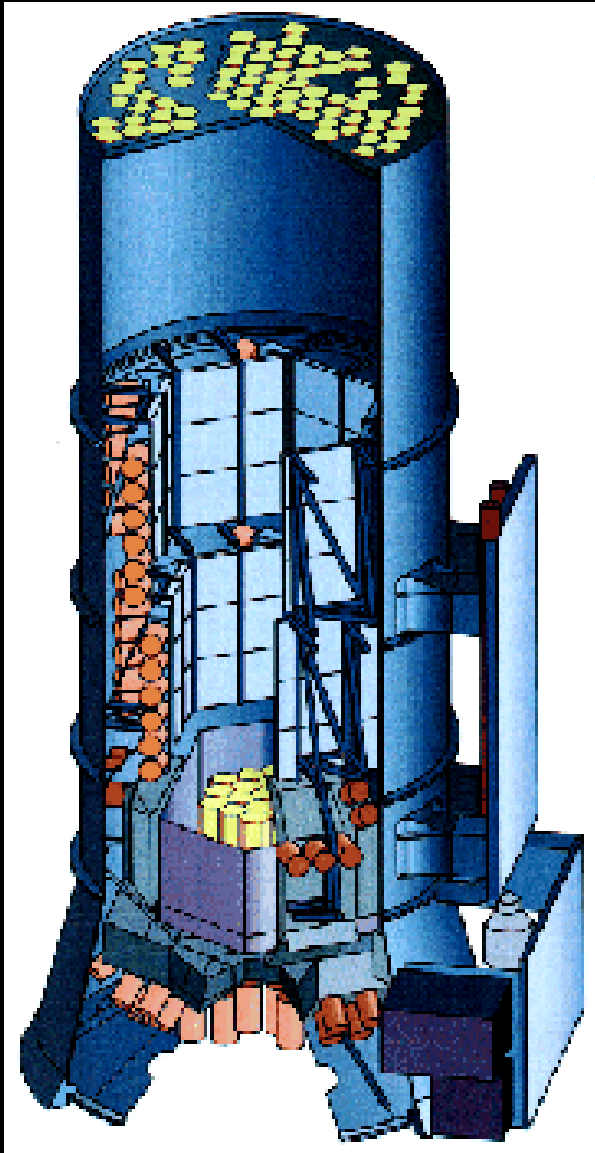
Operated by: European Space
Operation Center, Darmstadt,
Germany

Planned duration: 3+2 yrs

Status: still in operation till 2020

Instruments: SPI (among
others)

Energy range: 15 keV-10 MeV



SPI

Technology: coded-mask

Total Mass: 1228 kg

Detectors: 19 HPGe /cooled/

Detector size: $\phi 5.7$ cm x h6 cm

Energy range: 20keV – 8MeV

FWHM: 2.35 keV @ 1.3 MeV

Imaging capabilities: 19 pixels

Distance: Mask-toDetector-surface: 171 cm

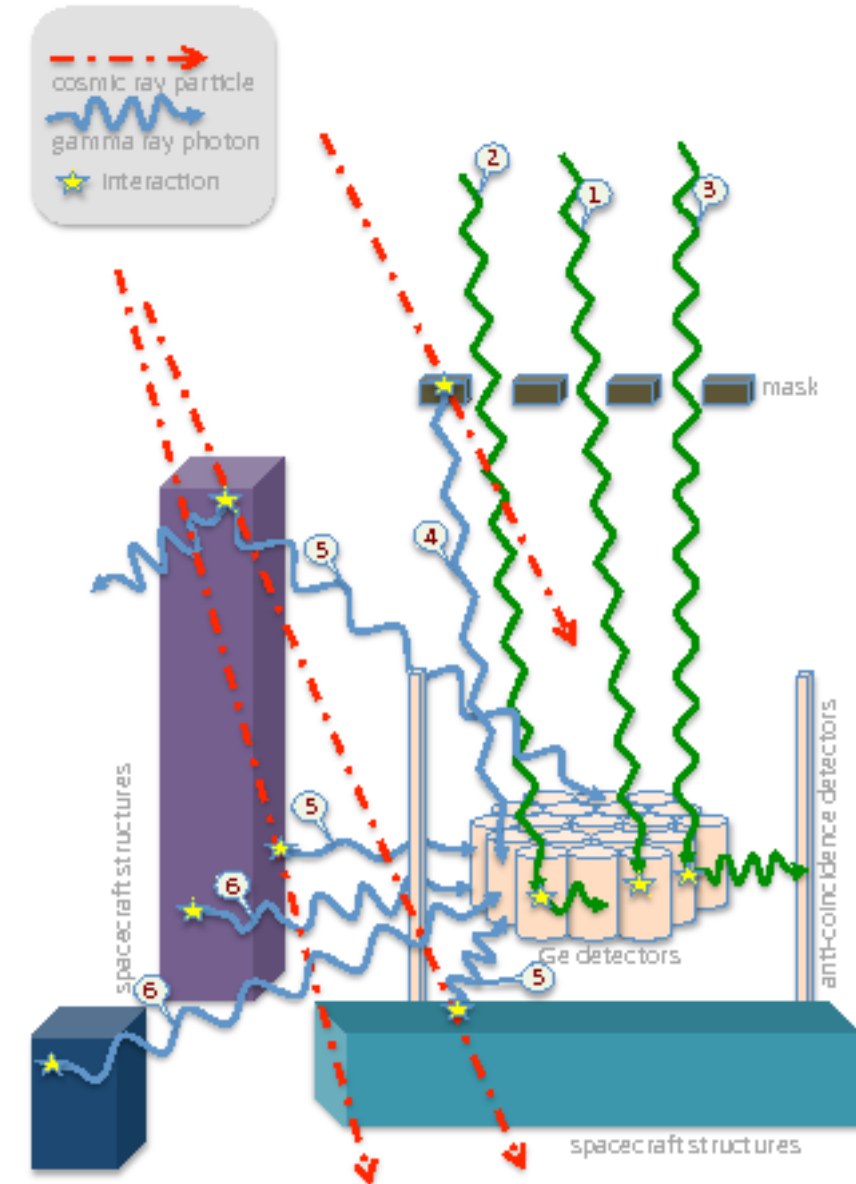
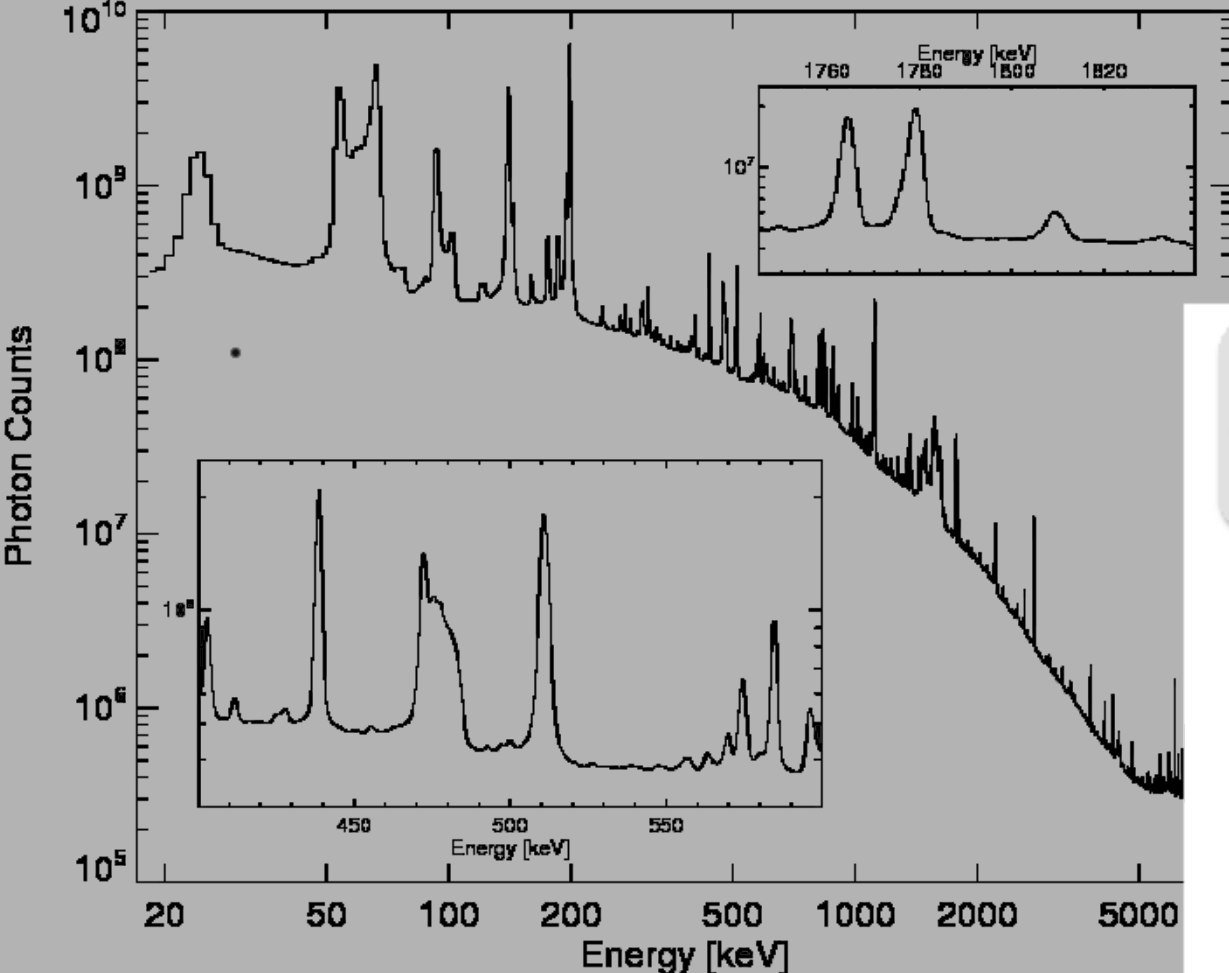
FOV: 16°

Angular resolution: 2.8°

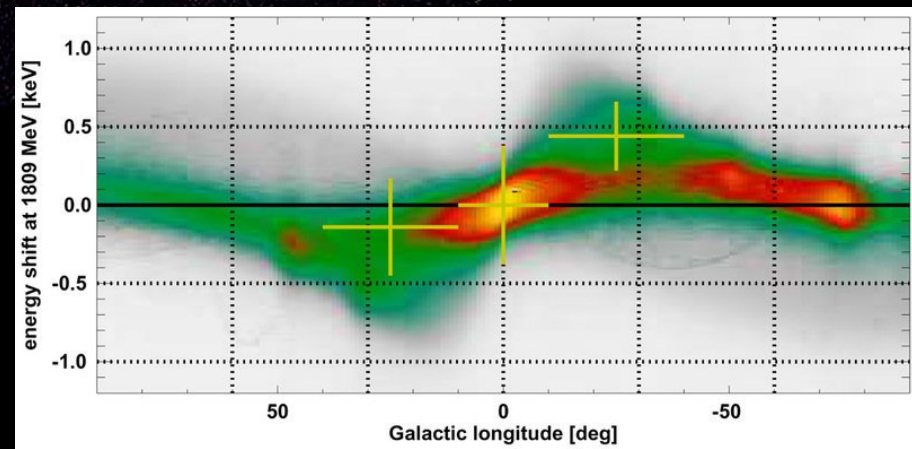
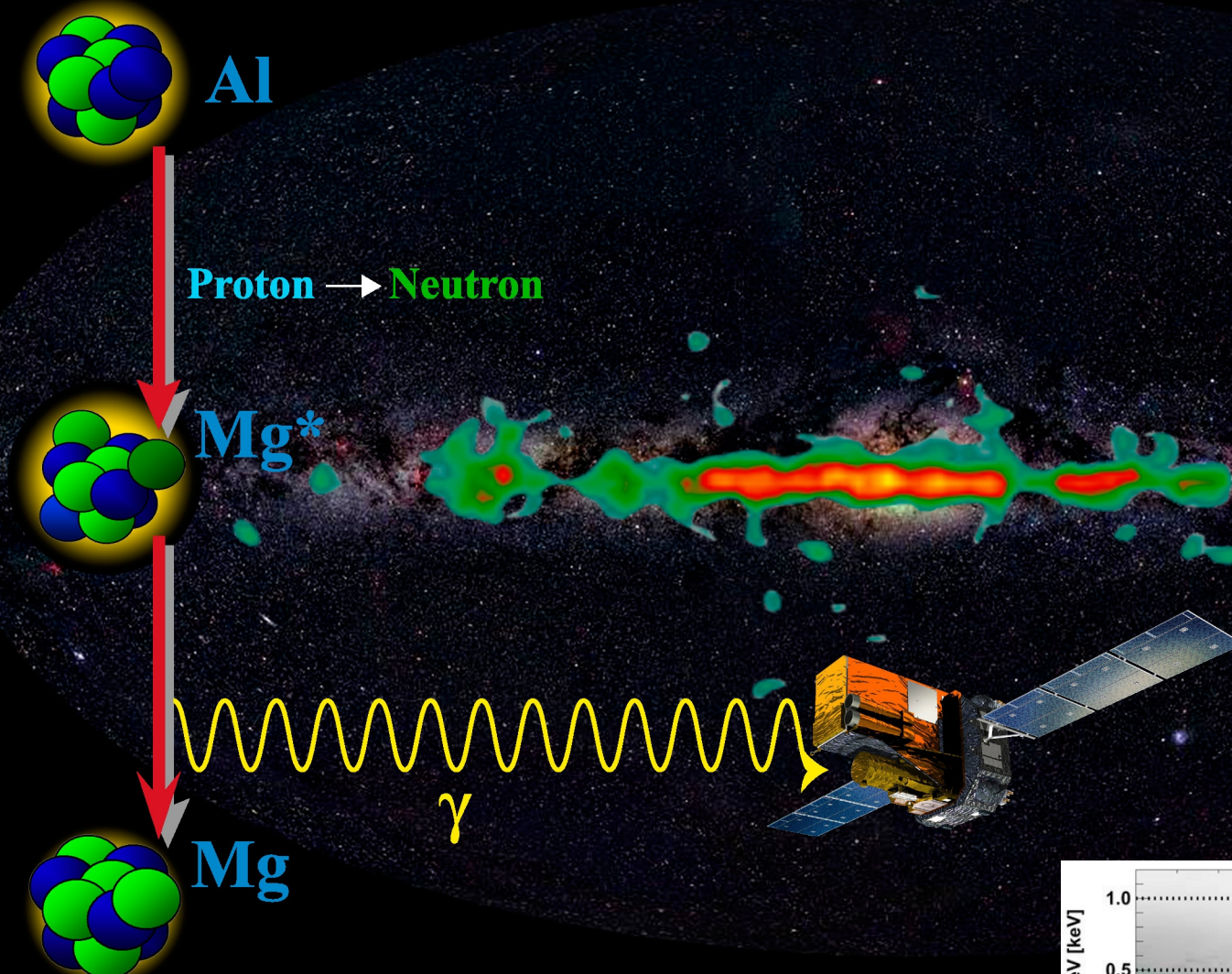
Cost: 105M Euro

“Active” volume mass: ~ 19 kg, i.e. 1.4% of the telescope's weight

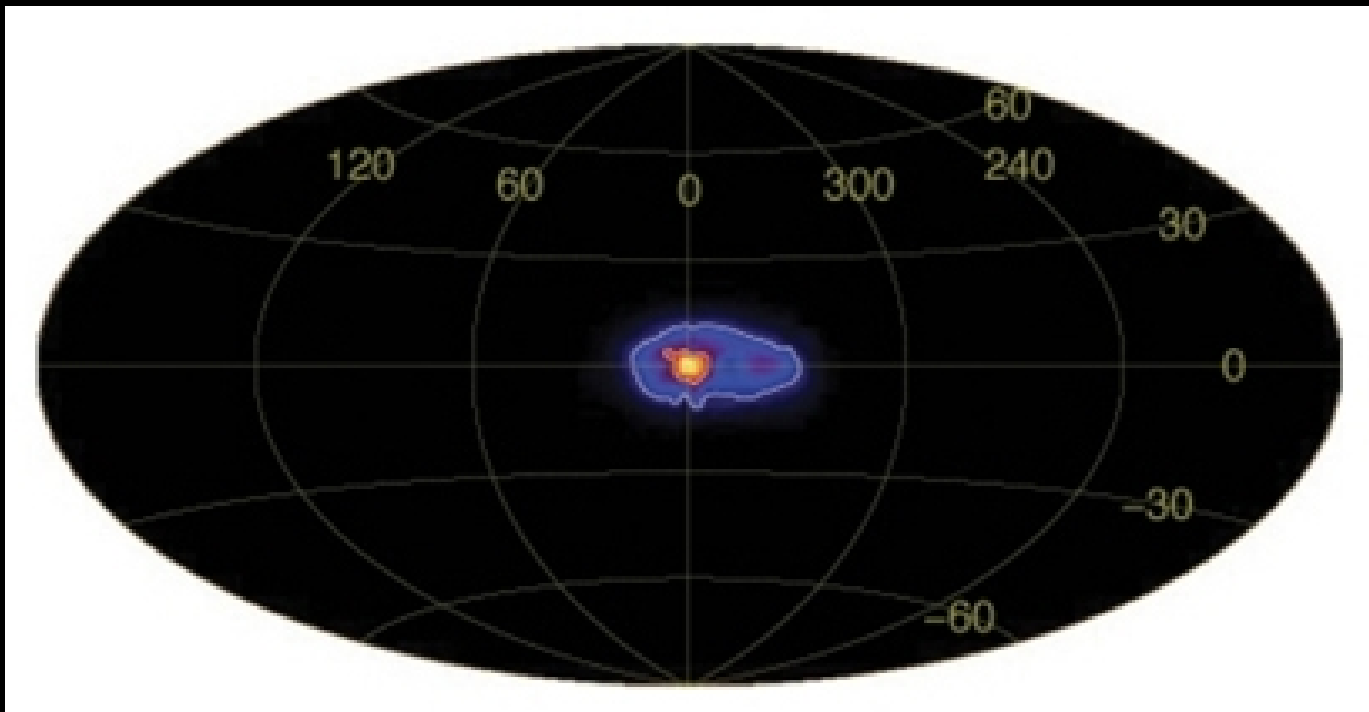
Background



Al-26



ANTIMATTER DISTRIBUTION



511 keV line intensity distribution

Scene: all-sky-ASTROGAM

Schedule for this call and important dates

Release of Call for a Fast (F) mission: 16 July 2018

Phase-1 proposal submission deadline: 25 October 2018 – 12:00 (noon) CEST

Phase-1 proposal assessment: November 2018

Workshop for Phase-2 proposers: 11 December 2018

Phase-2 proposal submission deadline: 20 March 2019 – 12:00 (noon) CET

Letters of Endorsement deadline: 10 April 2019 – 12:00 (noon) CEST

Proposal evaluation and scientific ranking: April – July 2019

Phase 0 study: July – December 2019

Selection of candidate mission: February 2020

Phase A/B industrial kick-off: September 2020

Mission adoption: November 2022

Mission CDR: June 2024

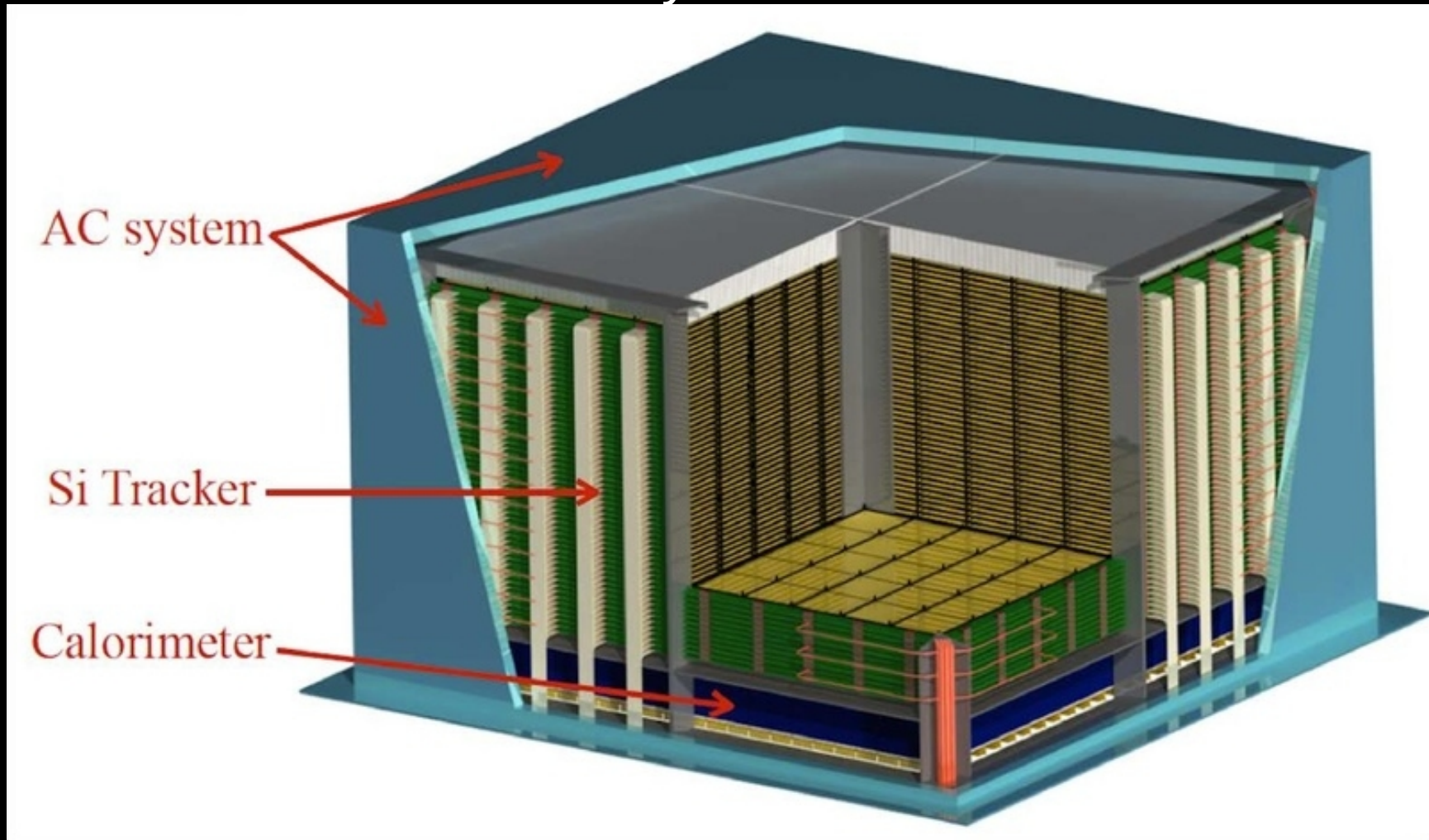
Spacecraft launch readiness: December 2027

J.High.E.Astrophys
19 (2018) 1



ASTROGAM

A gamma-ray space observatory for the multimessenger astronomy of the 2030s



NDeGRA PProject

Sensor: position-sensitive scintillator

Detector size: 4cm x 4cm x 0.5 cm

Readout: SiPM or pos.-sensitive PMT

Energy range: 20 keV - 1 MeV

FWHM: 3% @ 662 keV

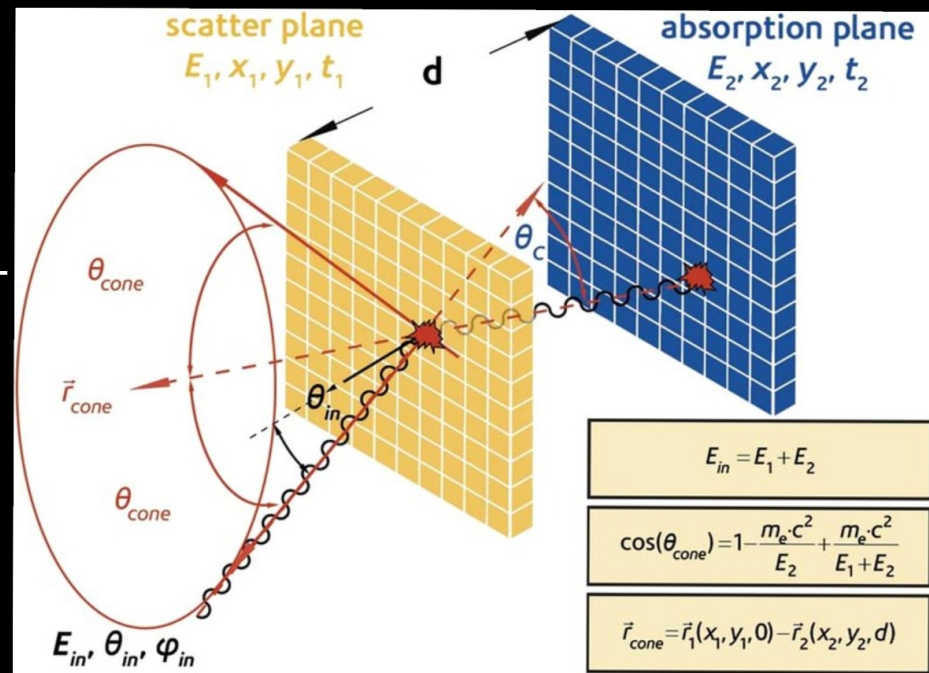
Position resolution: 0.5 cm

Power: 10 W

Payload: 3-5 kg

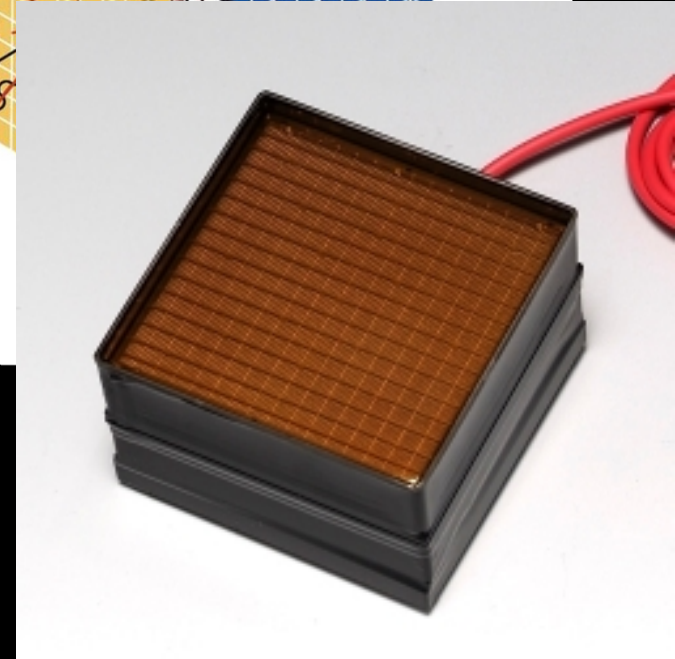
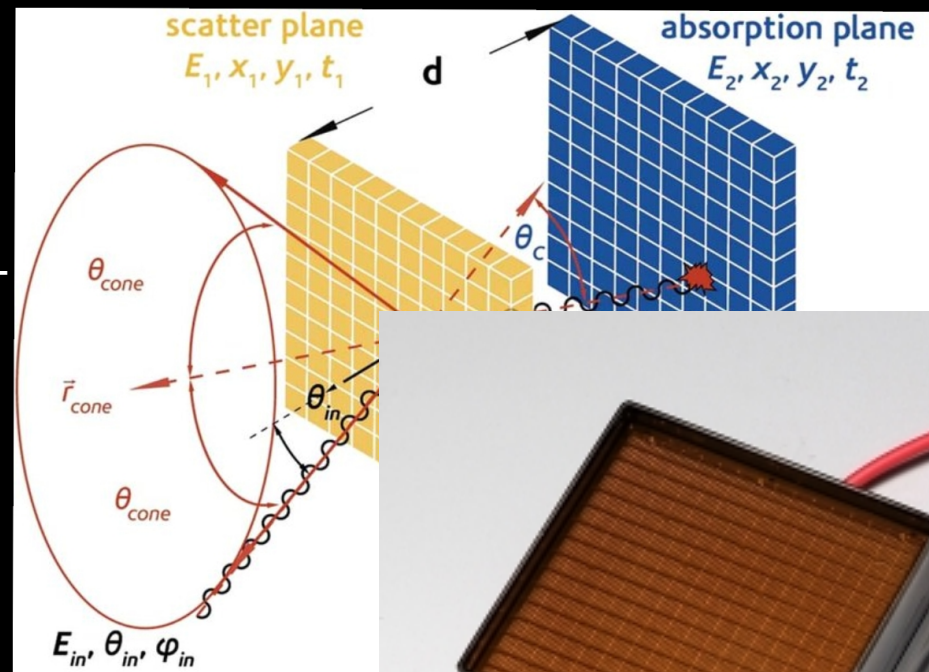
Satellite: 3U module

Cost: 0.5% Integral cost



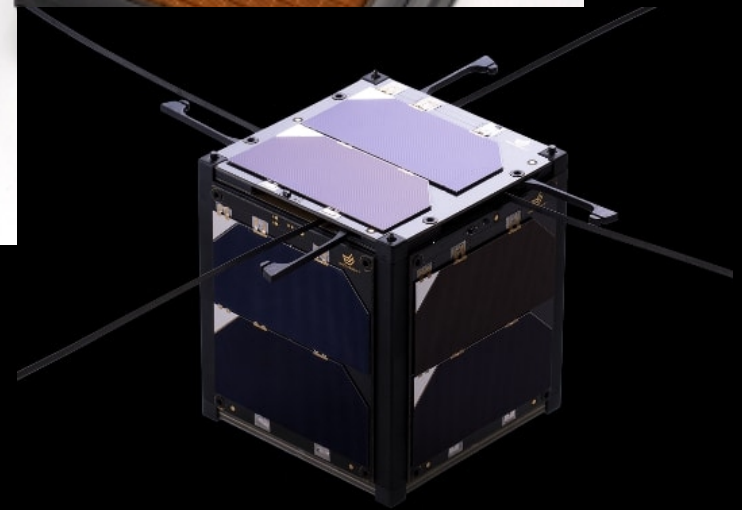
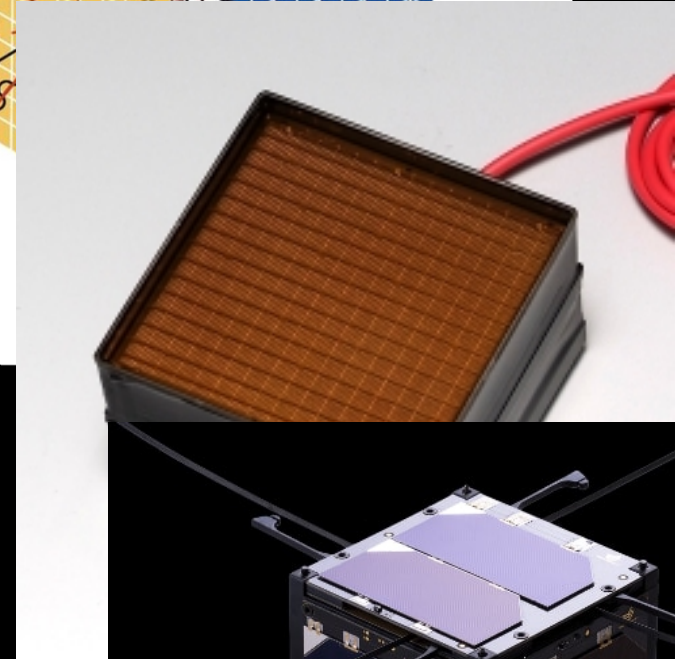
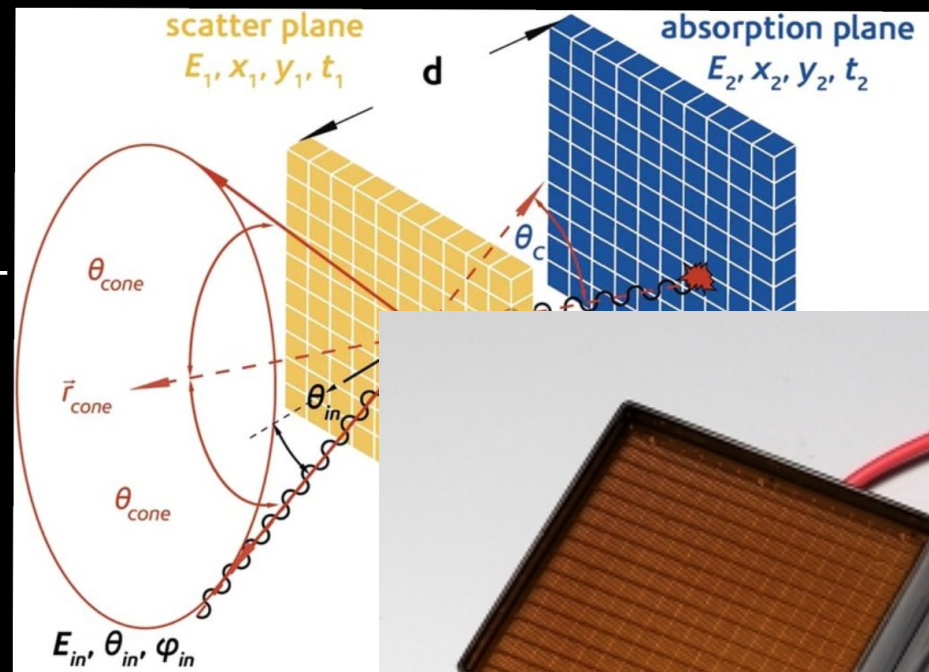
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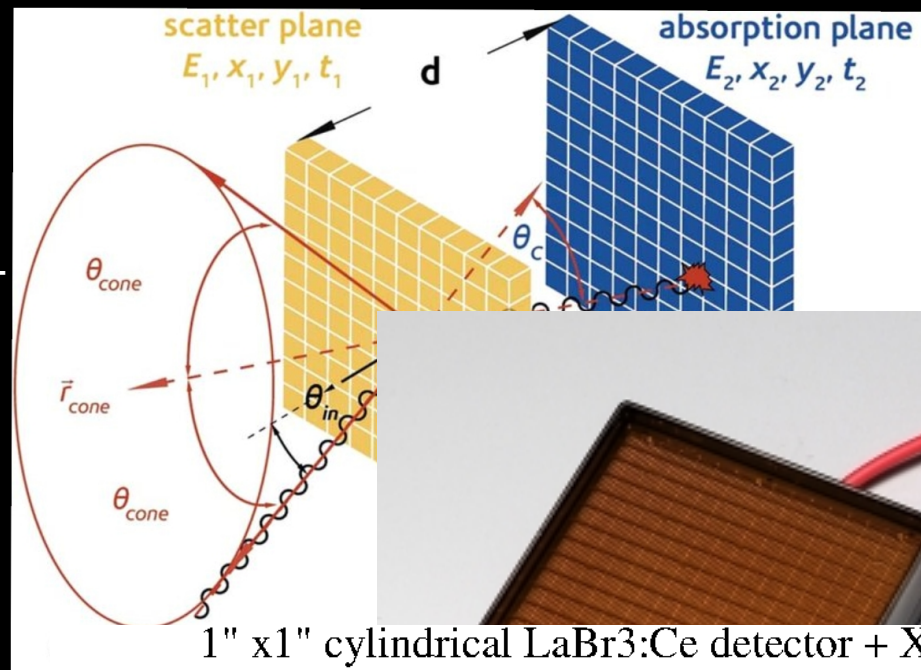
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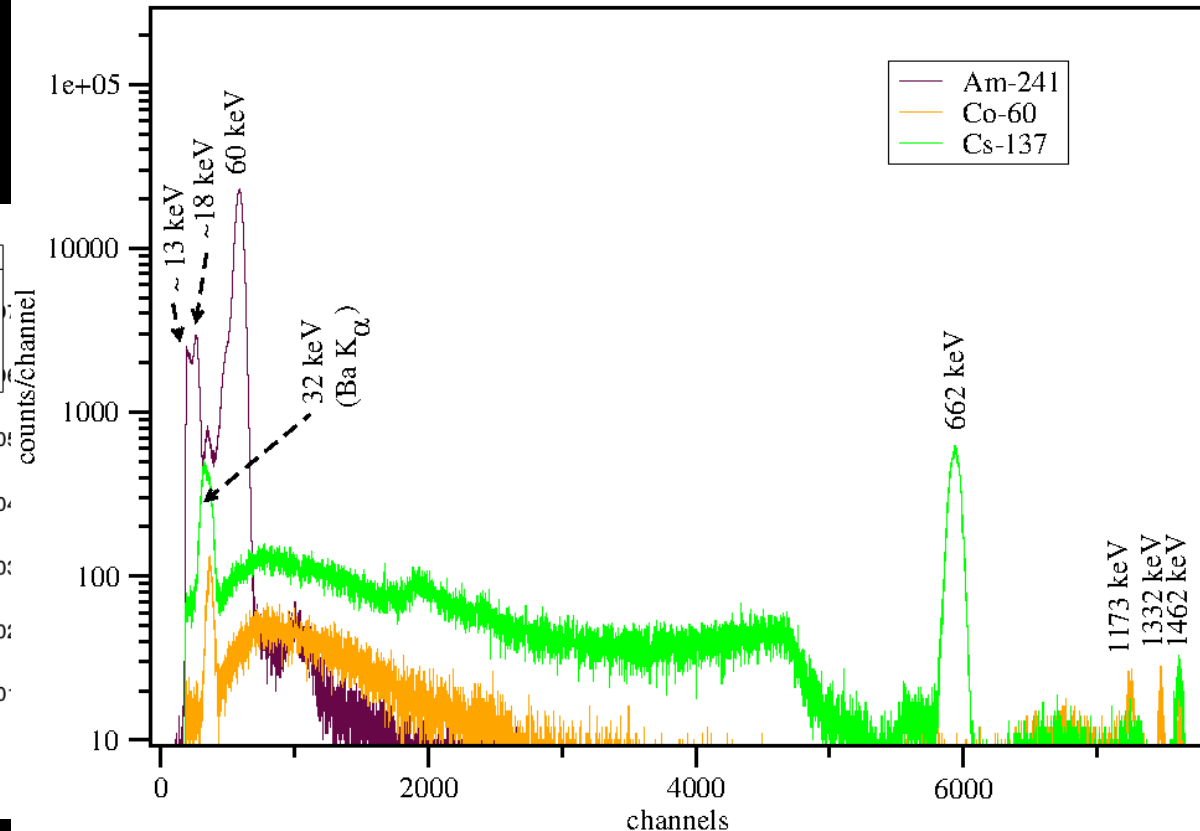
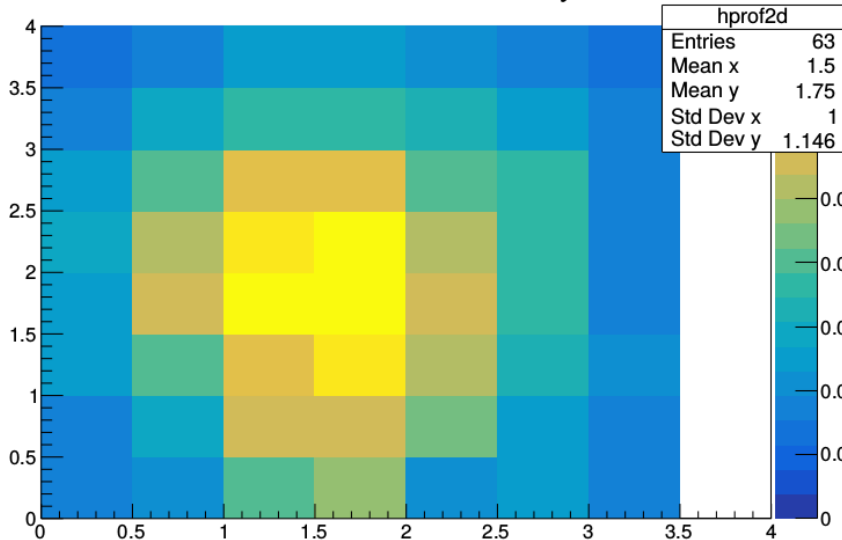


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Profile of Qmax versus x and y Ch 5



**НАЦИОНАЛНА НАУЧНА ПРОГРАМА
“КОСМИЧЕСКИ ИЗСЛЕДВАНИЯ, ТЕХНОЛОГИИ И
ПРИЛОЖЕНИЯ”**

Дата: 29/03/2019

Версия: 07

Страница: 1 от 68

**НАЦИОНАЛНА НАУЧНА ПРОГРАМА
„Космически изследвания, технологии и
приложения“**

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