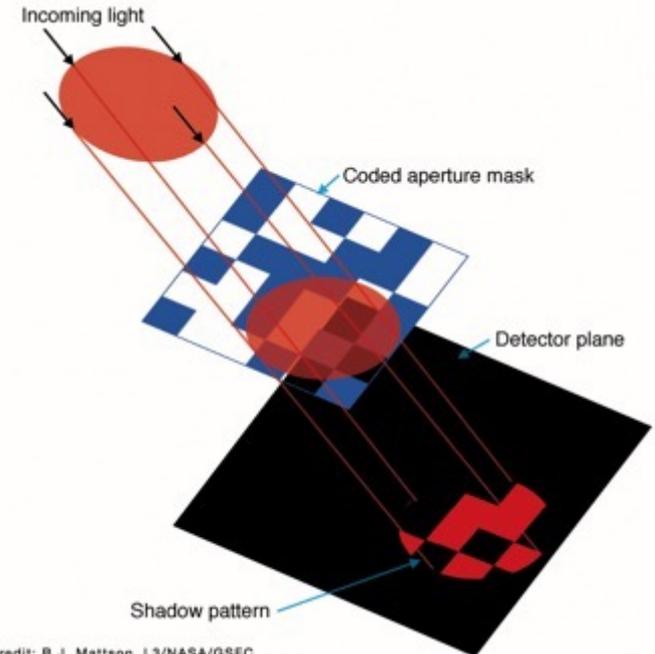
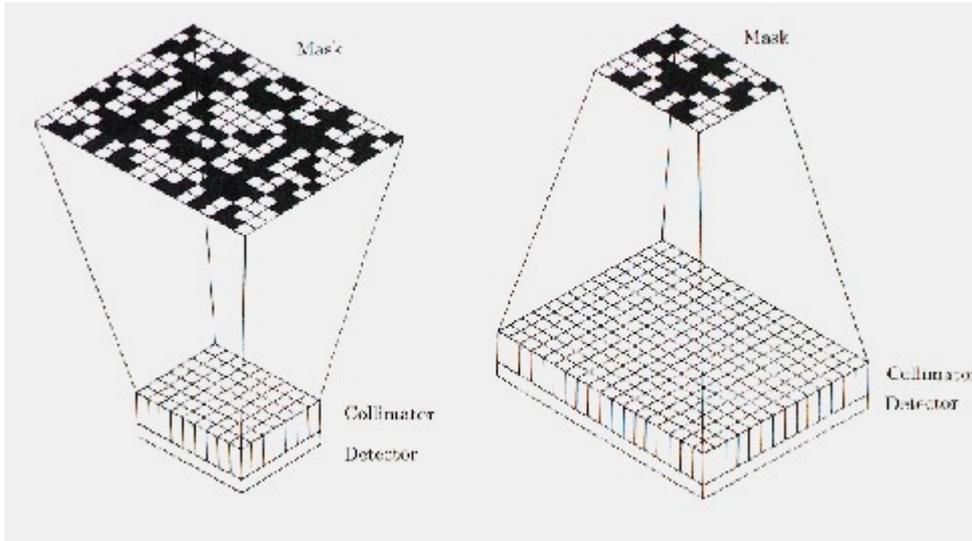
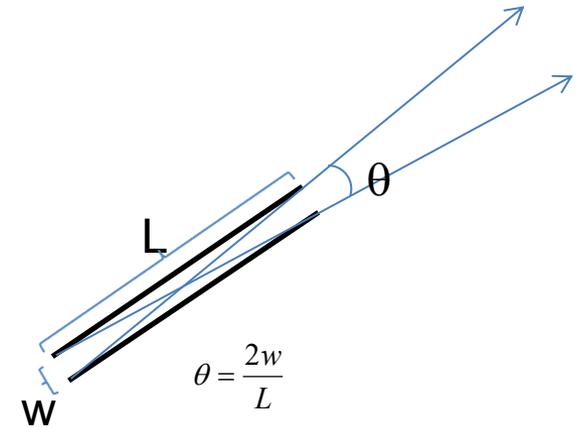


I telescopi a maschera codificata

I telescopi a maschera codificata sono l'evoluzione del concetto di collimatore, che dà una risposta triangolare al passaggio della sorgente.

L'idea della maschera codificata è la stessa della trasformata di Fourier bidimensionale: la maschera è la base di filtri con cui campionare l'immagine in cielo della sorgente. L'univocità (non periodicità) della maschera permette di ricostruire a posteriori la distribuzione di brillantezza della sorgente.



Credit: B.J. Mattson, L3/NASA/GSFC

PCFOV = Partially Coded Field of View

FCFOV = Fully Coded Field of View

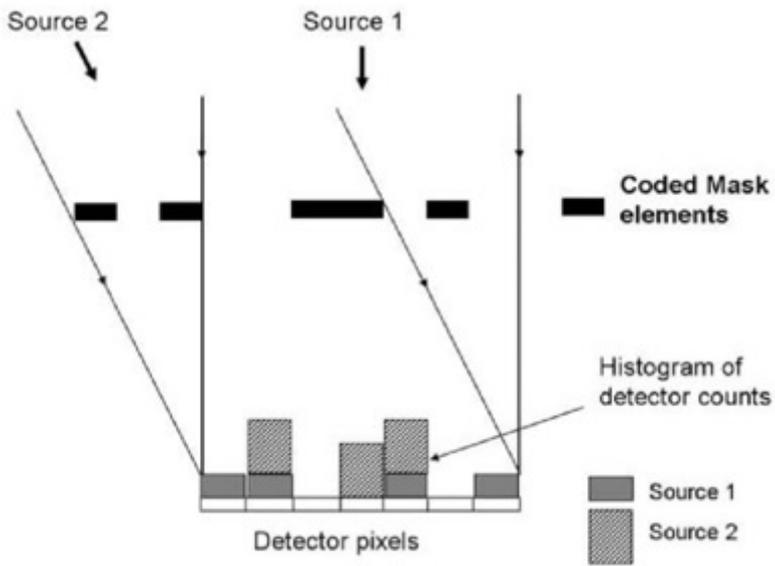
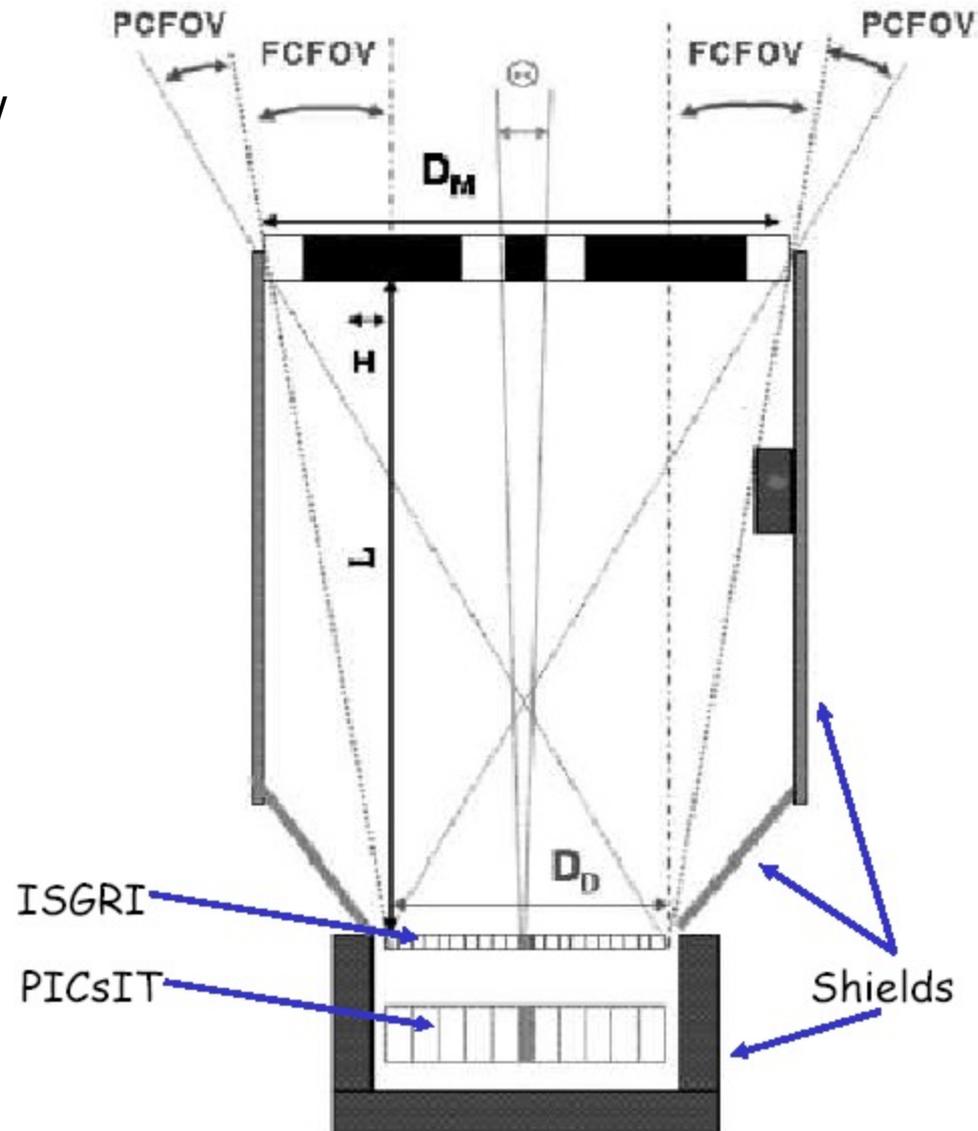
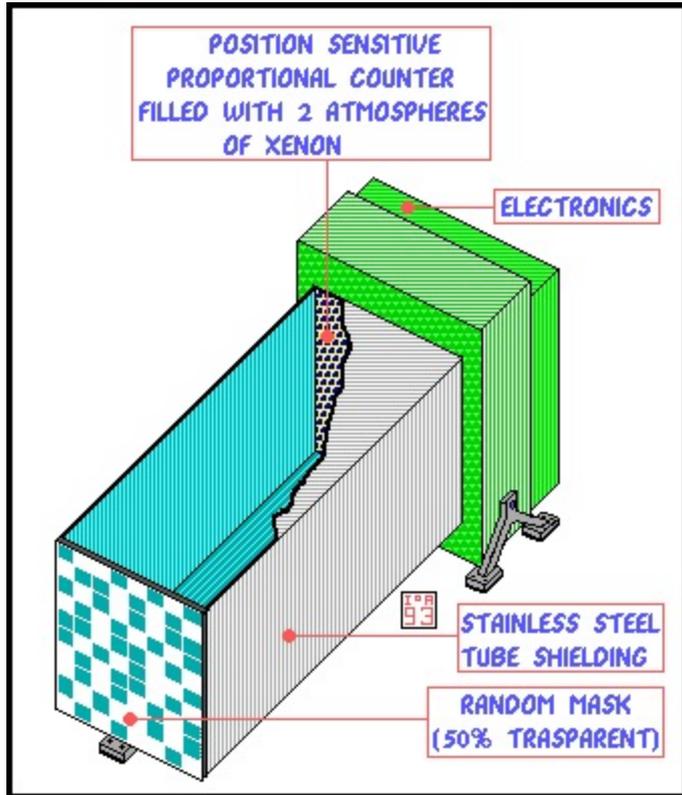


Figure 12.4. The basis of the coded mask technique.



I telescopi a maschera codificata



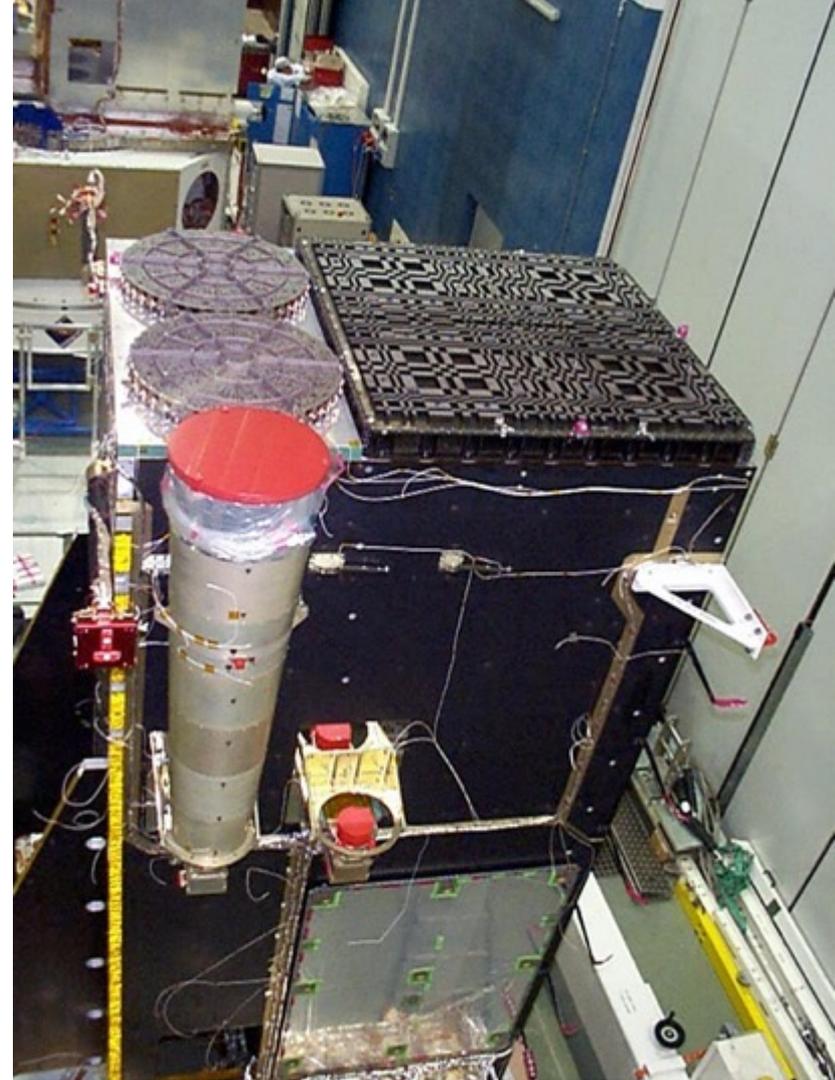
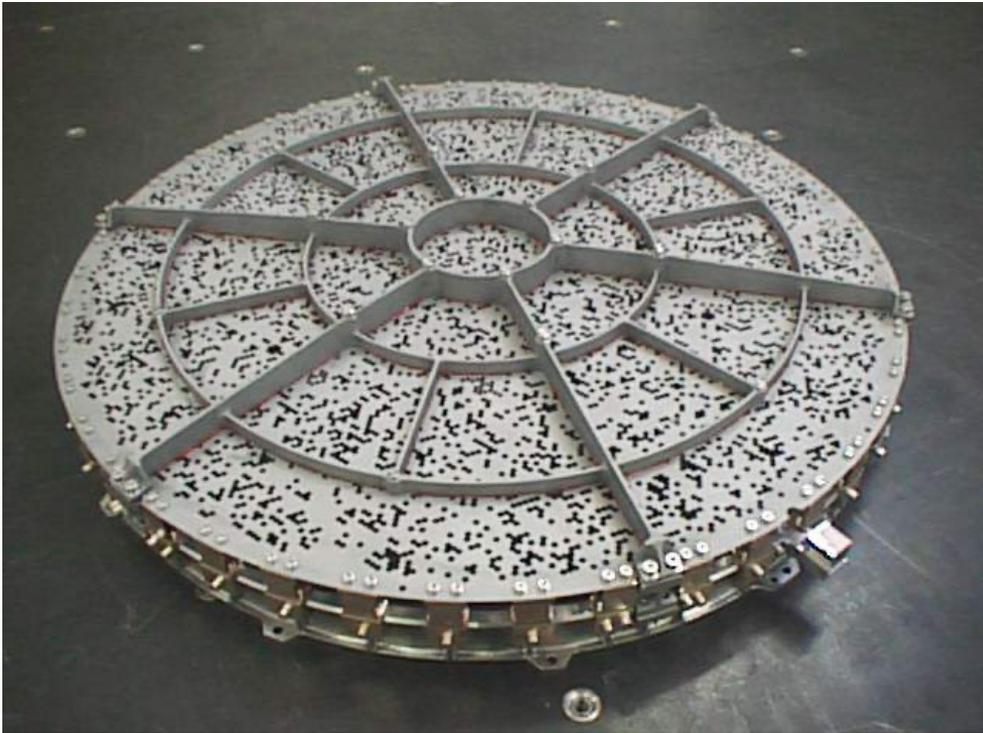
Wide Field Camera su SAX:
Campo di vista 20x20 gradi
Risoluzione 5 minuti d'arco



Maschera Codificata aperiodica di BAT SWIFT

I telescopi a maschera codificata

I telescopii JEM-X e IBIS a bordo di INTEGRAL



Strumentazione Astronomica: X-γ

$$D = S \otimes M + B$$



$$M \otimes G = \delta$$



Quindi si procede alla deconvoluzione

$$S' = D \otimes G = S \otimes M \otimes G + B \otimes G = S \otimes \delta + B \otimes G = S + B \otimes G$$

$$S' - S = B \otimes G$$

$$S = S' - B \otimes G$$

M matrice di 0 (pieni) e 1 (vuoti)

D = detector shadowgram

S = sky image

\otimes = convolution/correlation operator

M = mask array

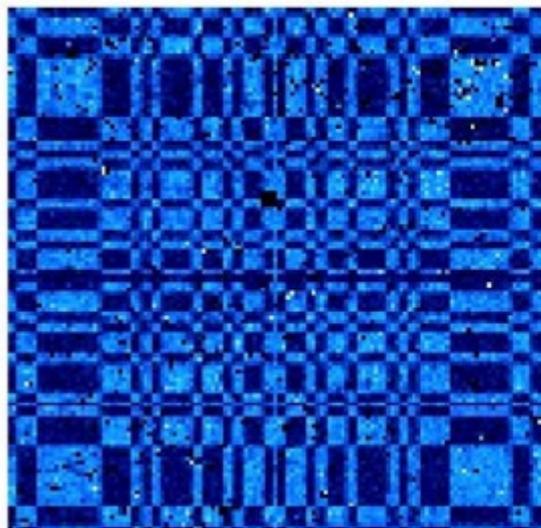
B = background

G = decoding array ($M \otimes G = \delta$)

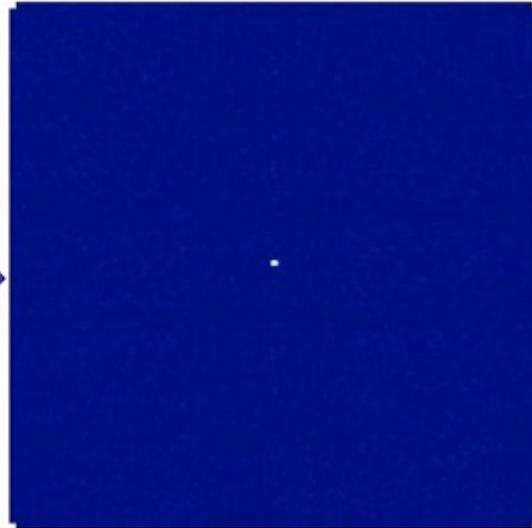
δ = Dirac's delta function

Strumentazione Astronomica: X-γ

Coding: $D = S \otimes M + B$

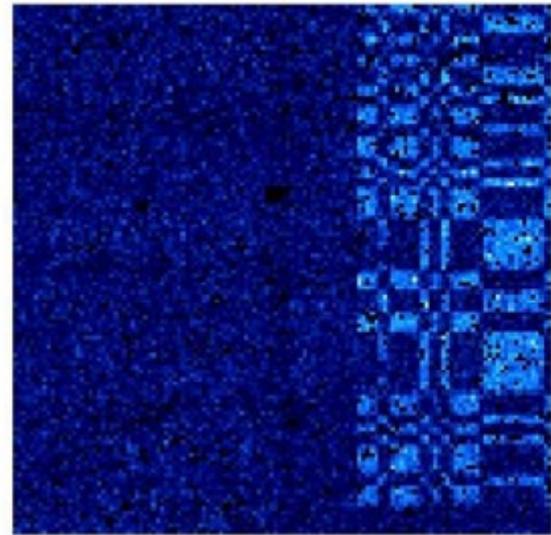


De-Coding: $S = D \otimes G + B \otimes G$

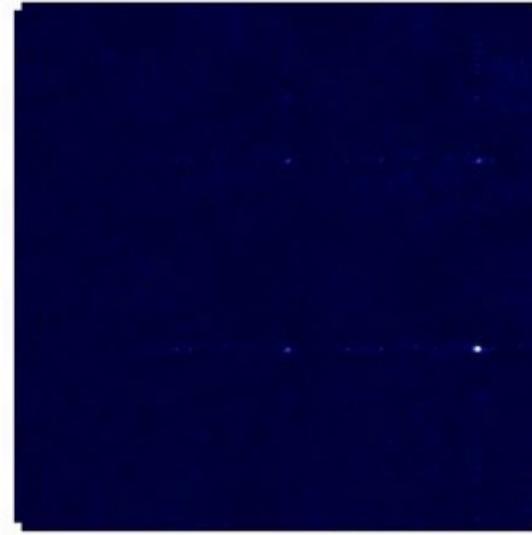


CRAB in asse

Coding: $D = S \otimes M + B$

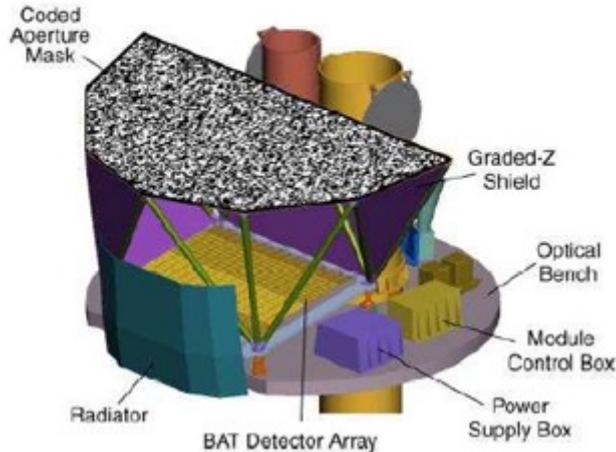


De-Coding: $S = D \otimes G + B \otimes G$



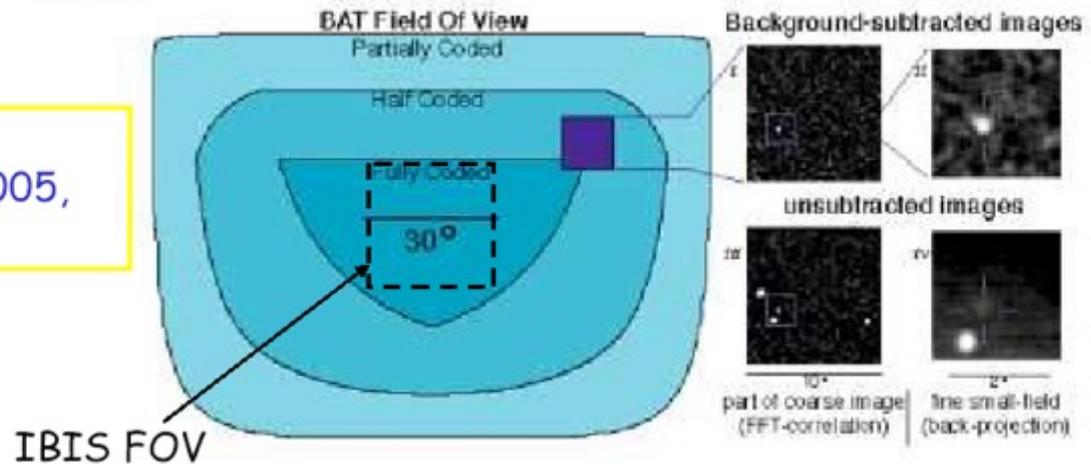
CRAB fuori asse

The BAT telescope onboard SWIFT

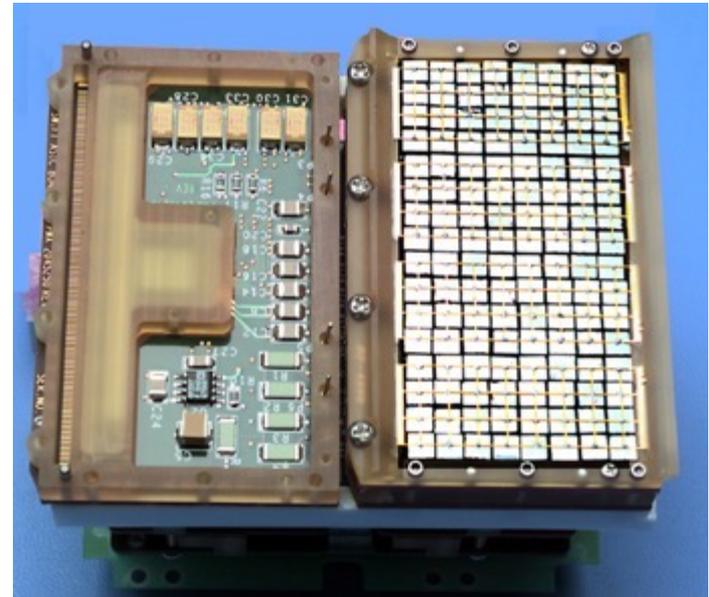
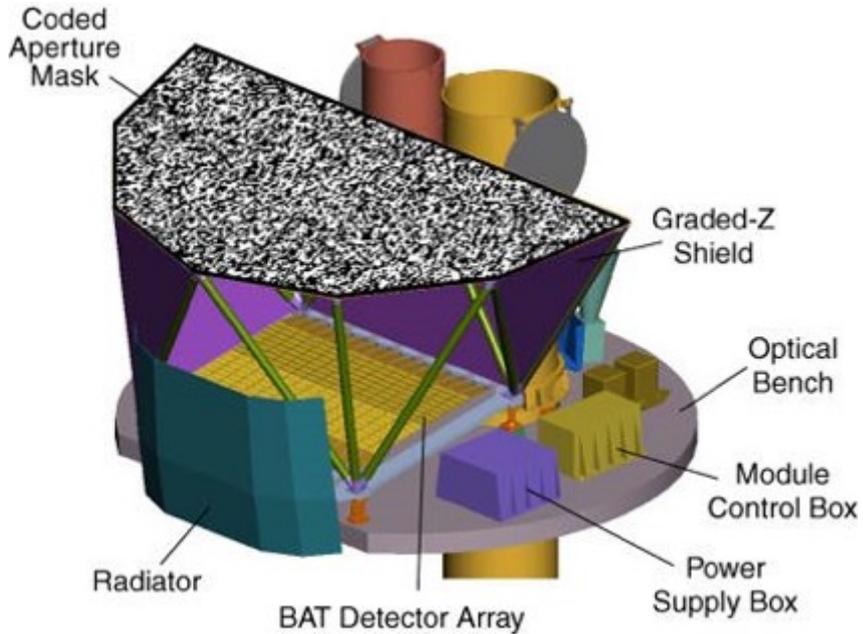


Burst Alert Telescope (BAT):
 Detector in CZT,
 Random mask pattern (50% open)
 FOV: $\approx 100^\circ \times 60^\circ$ (half coded)
 $\approx 160^\circ \times 80^\circ$ (PCFOV)
 Energy band: 15-200 keV
 Angular resolution: 17'
 PSLA: $< 4'$ for GRB

To know more, see:
 S. Barthelmy et al., 2005,
 SSRv 120, 143



Strumentazione Astronomica: X-γ



Aperture	Coded mask
Detecting Area	5200 cm ²
Detector	CdZnTe
Detector Operation	Photon counting
Field of View	1.4 sr (partially-coded)
Detection Elements	256 modules of 128 elements
Detector Size	4 mm x 4 mm x 2mm
Telescope PSF	17 arcmin
Energy Range	15-150 keV

CCD utilizzati per rivelare i fotoni X

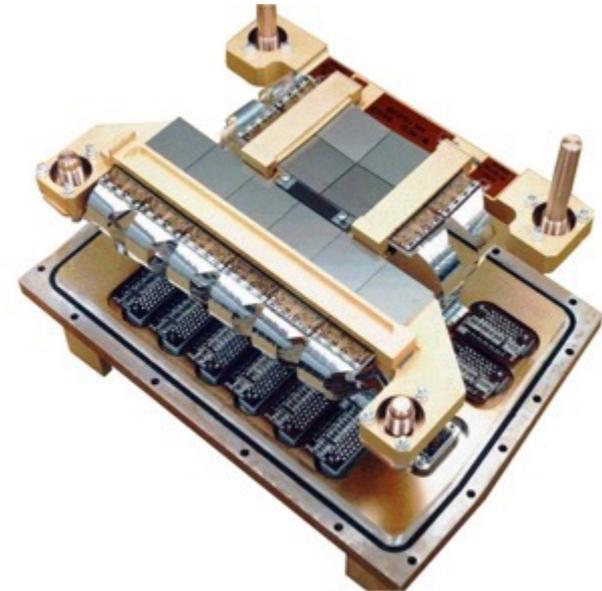
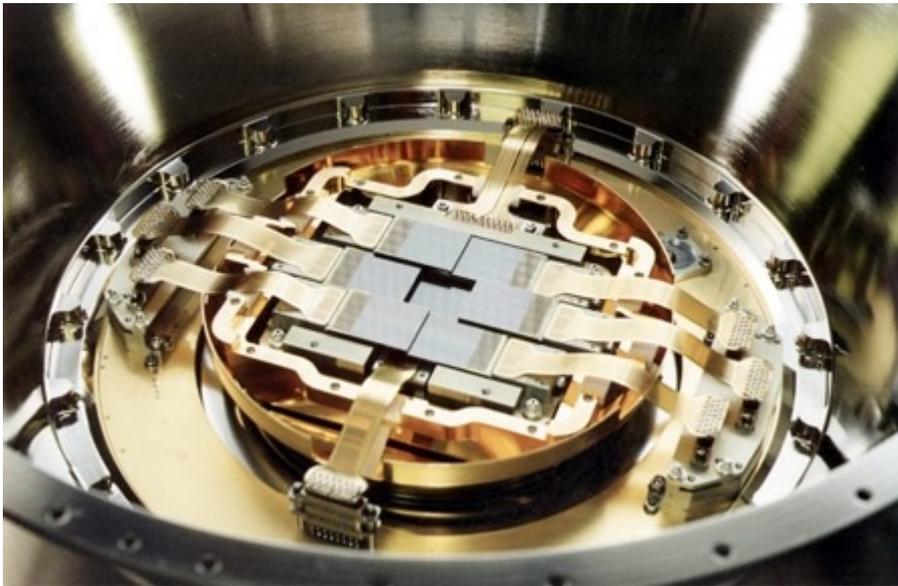
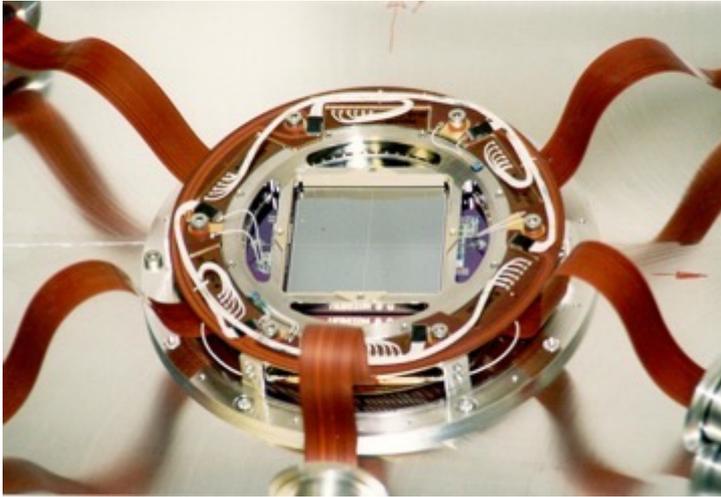
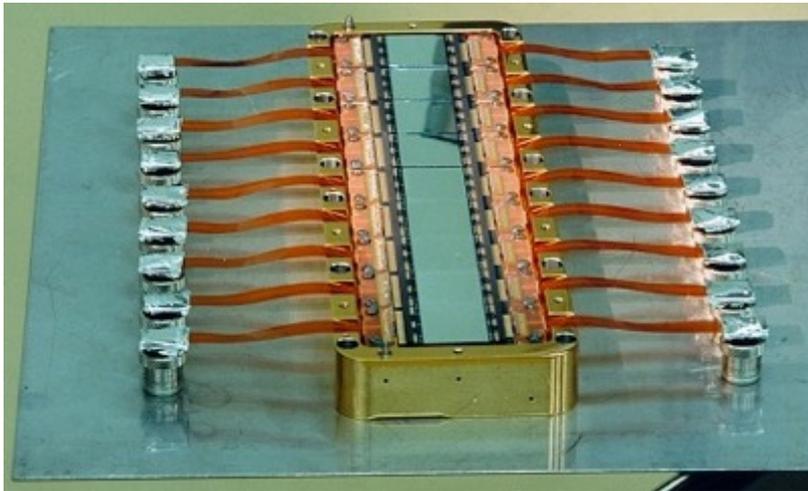
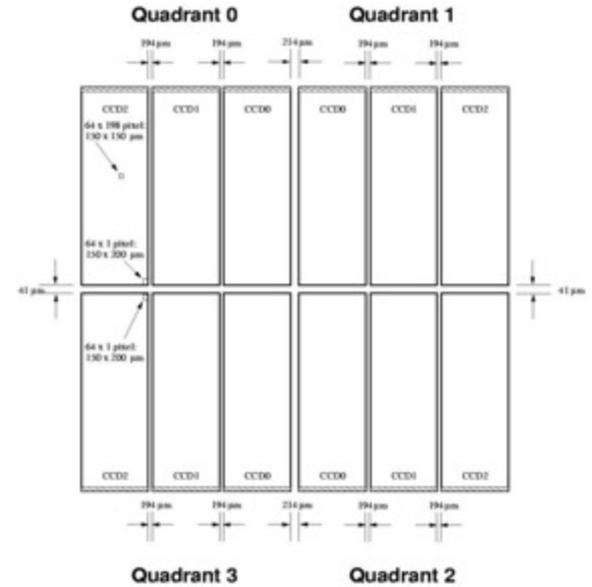


Figure 12.12. (Left) The EPICS CCD X-ray camera on XMM-Newton. (Right) The ACIS CCD X-ray camera on the Chandra X-ray Observatory. Credit: ESA and NASA.

Strumentazione Astronomica: X-γ



EPIC pnCCD camera



MOS sul piano focale (curvo) dello spettrometro

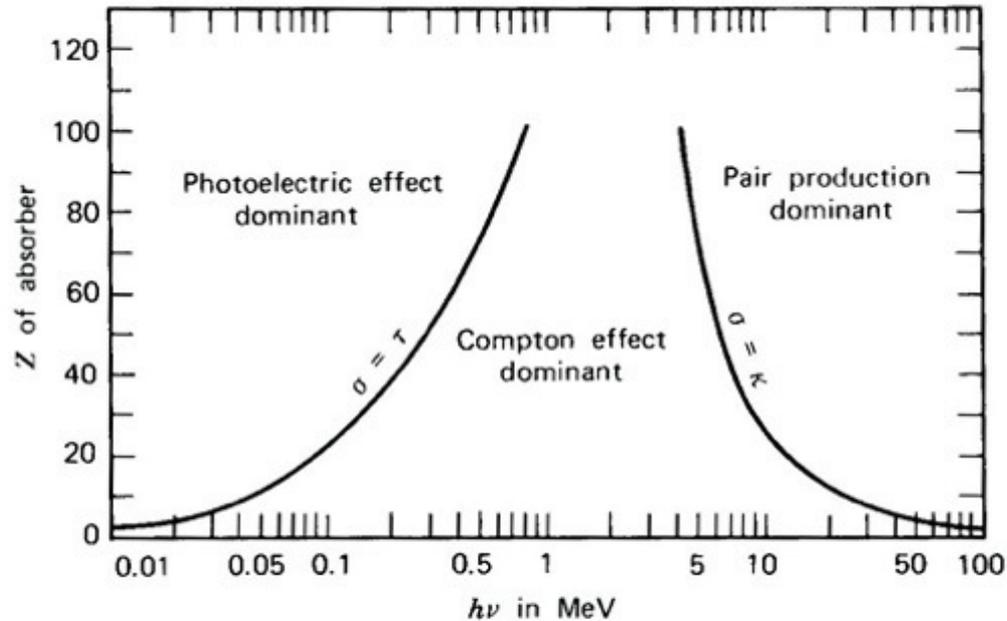
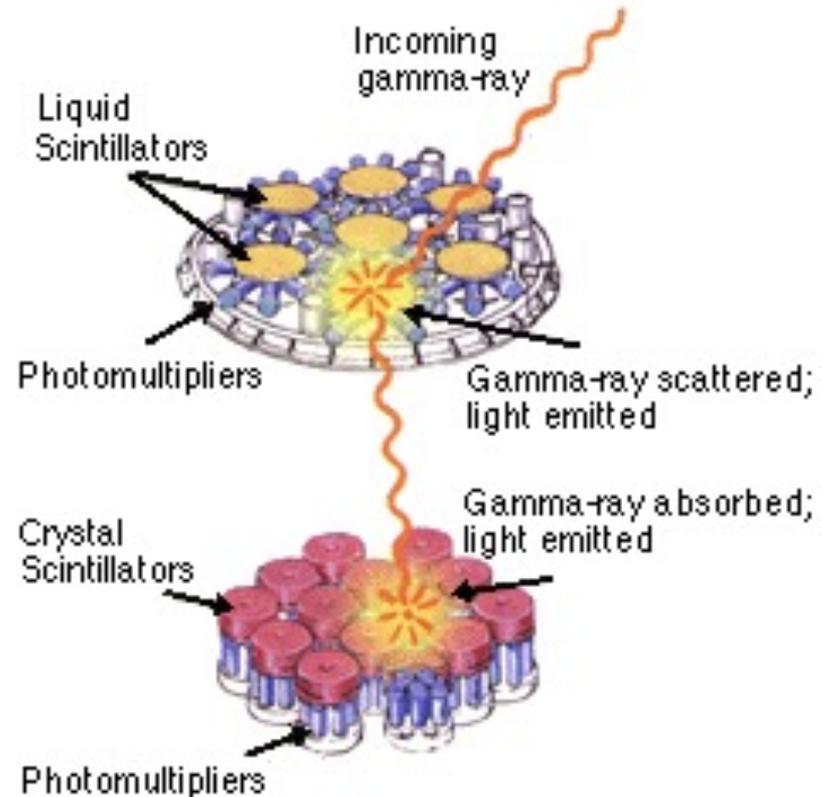


Figure 2-20 The relative importance of the three major types of gamma-ray interaction. The lines show the values of Z and $h\nu$ for which the two neighboring effects are just equal. (From *The Atomic Nucleus* by R. D. Evans. Copyright 1955 by the McGraw-Hill Book Company. Used with permission.)

Gli strumenti per astronomia γ

Non ci sono possibilità di focalizzazione con ottiche tipo quelle X.
Il solo sistema che si può impiegare è quello della collimazione.
I rivelatori sono quelli tipici della spettroscopia nucleare: scintillatori inorganici e camere a scintilla.



Compton GRO

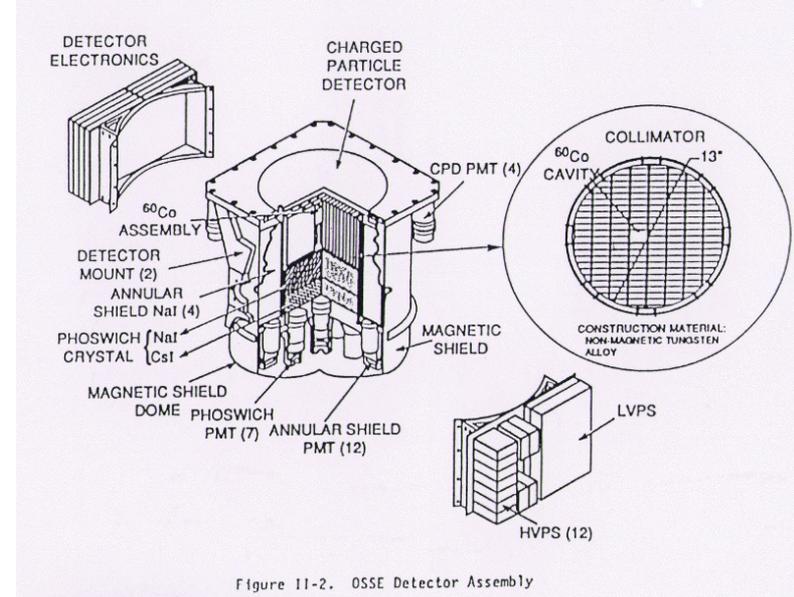
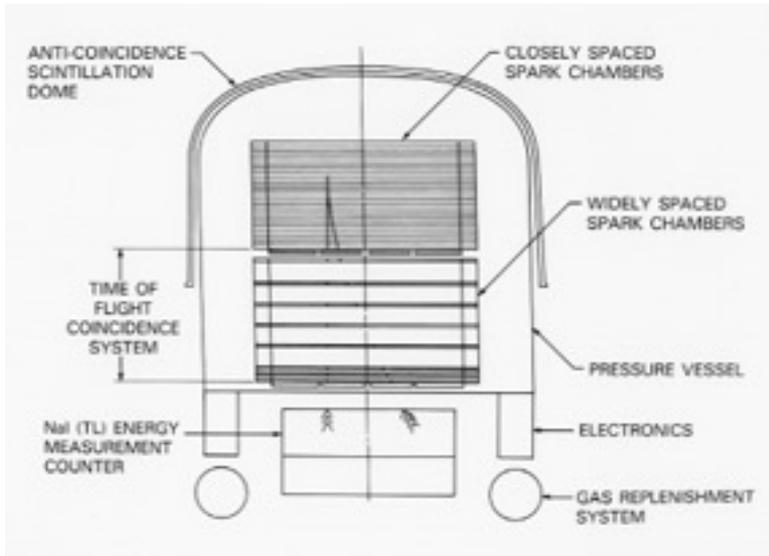
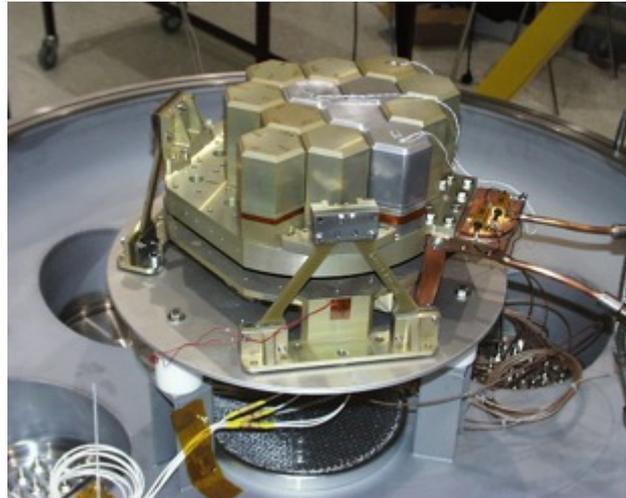
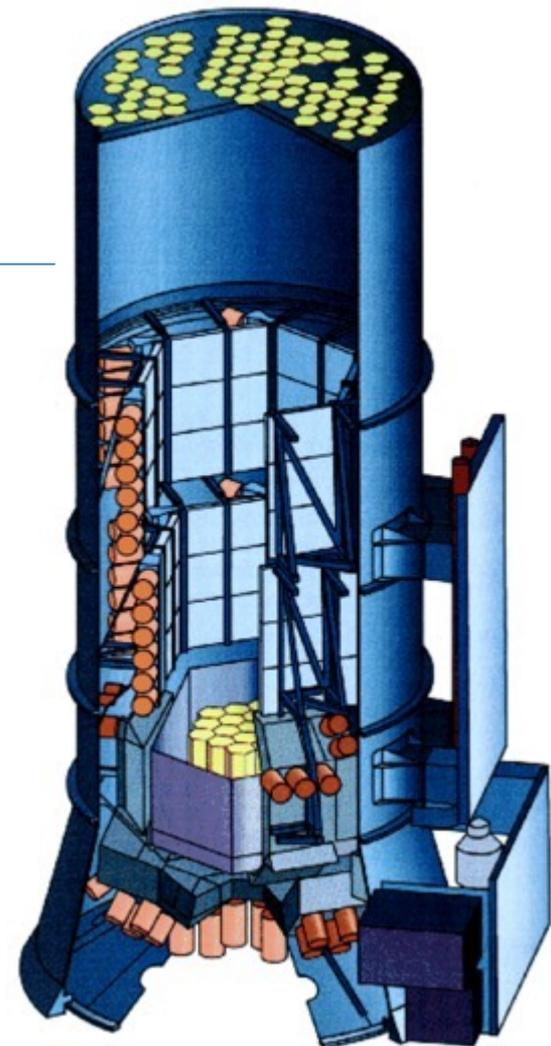
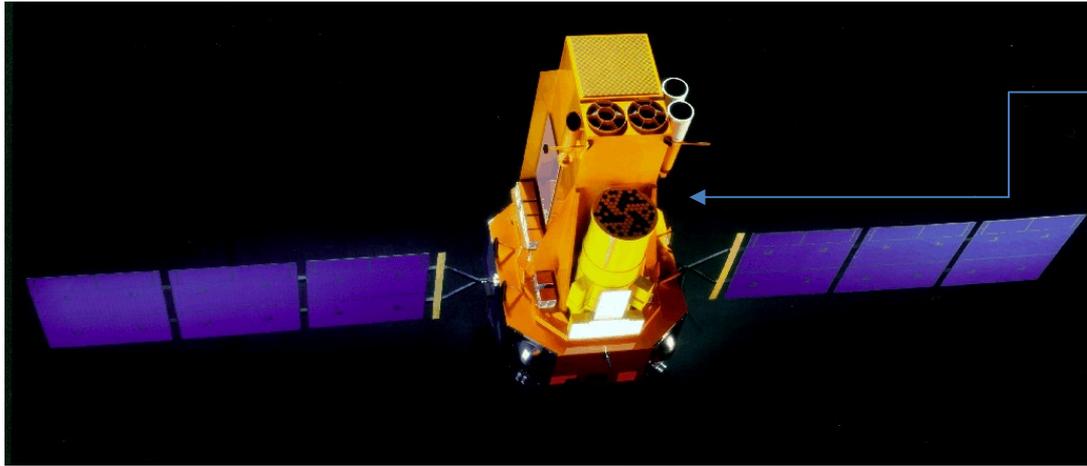


Figure II-2. OSSE Detector Assembly

Strumentazione Astronomica: X-γ

International Gamma-Ray Astrophysics Laboratory

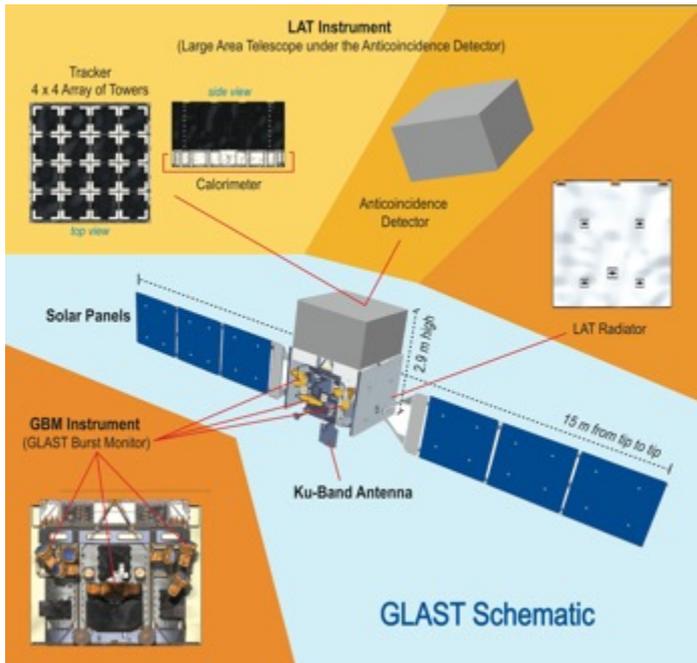


SPI (Spectrometer on INTEGRAL) 20 keV - 8 MeV

<http://sci.esa.int/integral/>

GLAST-FERMI

Gamma Ray Large Area Telescope



Large Area Telescope (LAT) Performance Summary

Energy Range	20 MeV - 300 GeV
Peak Effective Area (in range 1-10 GeV)	> 8,000 cm ² at 10 GeV
Energy Resolution 100 MeV-10 GeV on-axis	< 10%
Energy Resolution 10-300 GeV on-axis	< 20%
Angular Resolution 100 MeV on-axis	< 3.5
Angular Resolution 10 GeV on-axis	< 0.15
Field of View	> 2sr
Point Source Sensitivity (>100 MeV)	< 6x10 ⁻⁹ ph cm ⁻² s ⁻¹
Source Location Determination	< 0.5 arcmin

Burst Monitor Performance (GBM) Summary

Trigger Threshold	< 1 ph cm ⁻² s ⁻¹
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Low-Energy Detectors

Material	Sodium Iodide
Number	12
Area per detector	126 cm ²
Thickness	1.27 cm
Energy range	10 keV to 1 MeV

High-Energy Detectors

Material	Bismuth Germanate
Number	2
Volume per detector	1609 cm ³
Energy range	150 keV to 30 MeV

GLAST Mission Website:
<http://www.nasa.gov/glast>

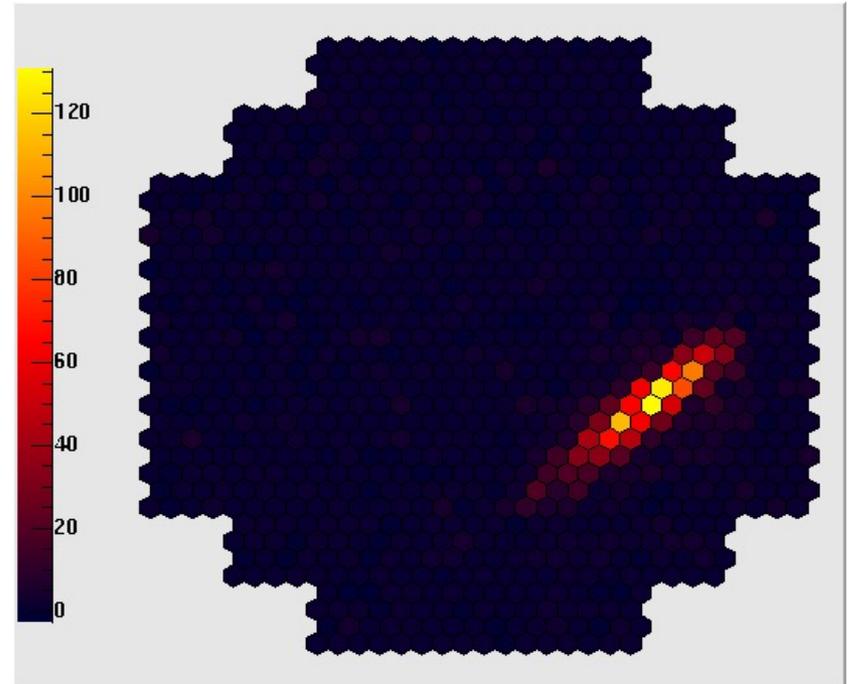
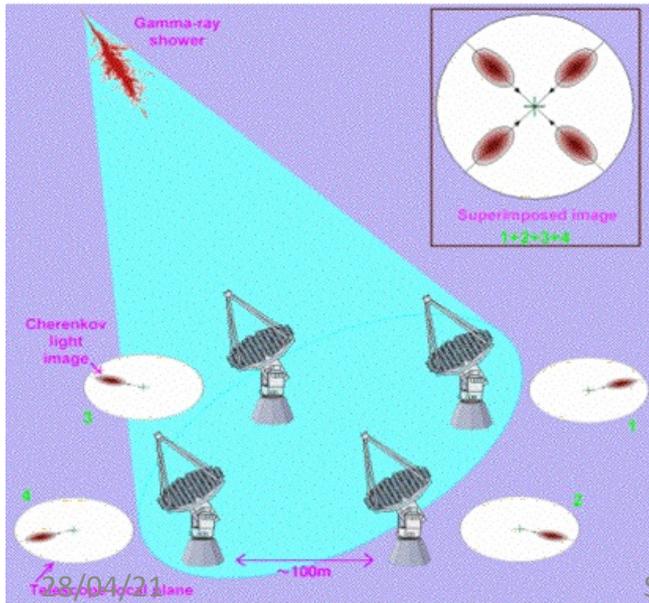
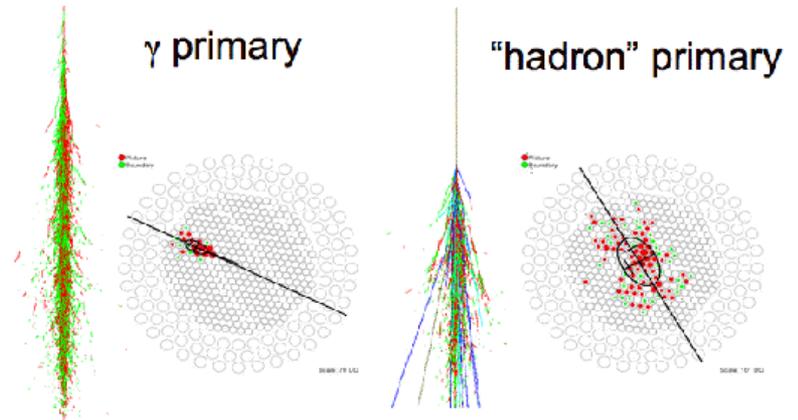
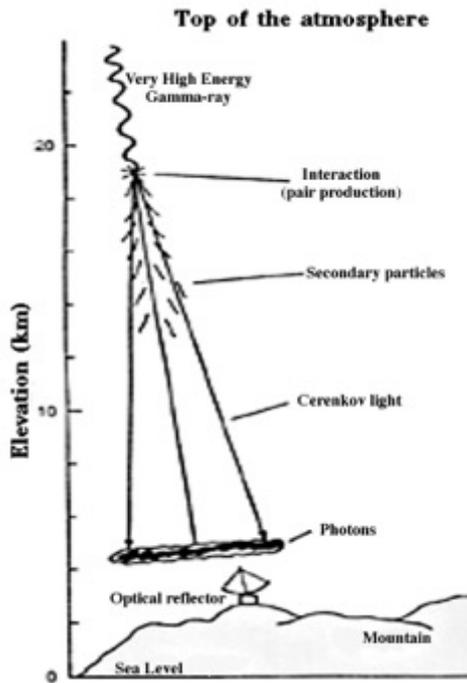
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<http://agile.asdc.asi.it>

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Astronomia Gamma da terra





Magic

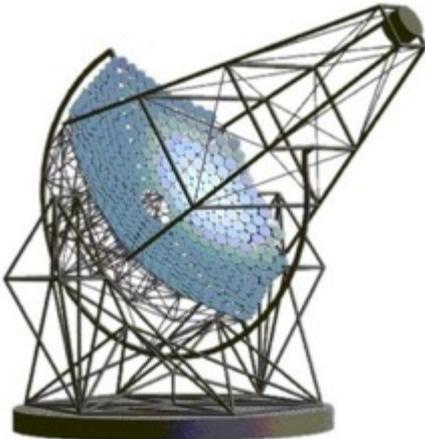
Sito osservativo: isola di La Palma (canarie) dove si trova TNG e Gran TeCan (sullo sfondo)

Dettaglio della struttura e della camera al primo (e unico) fuoco.



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VERITAS

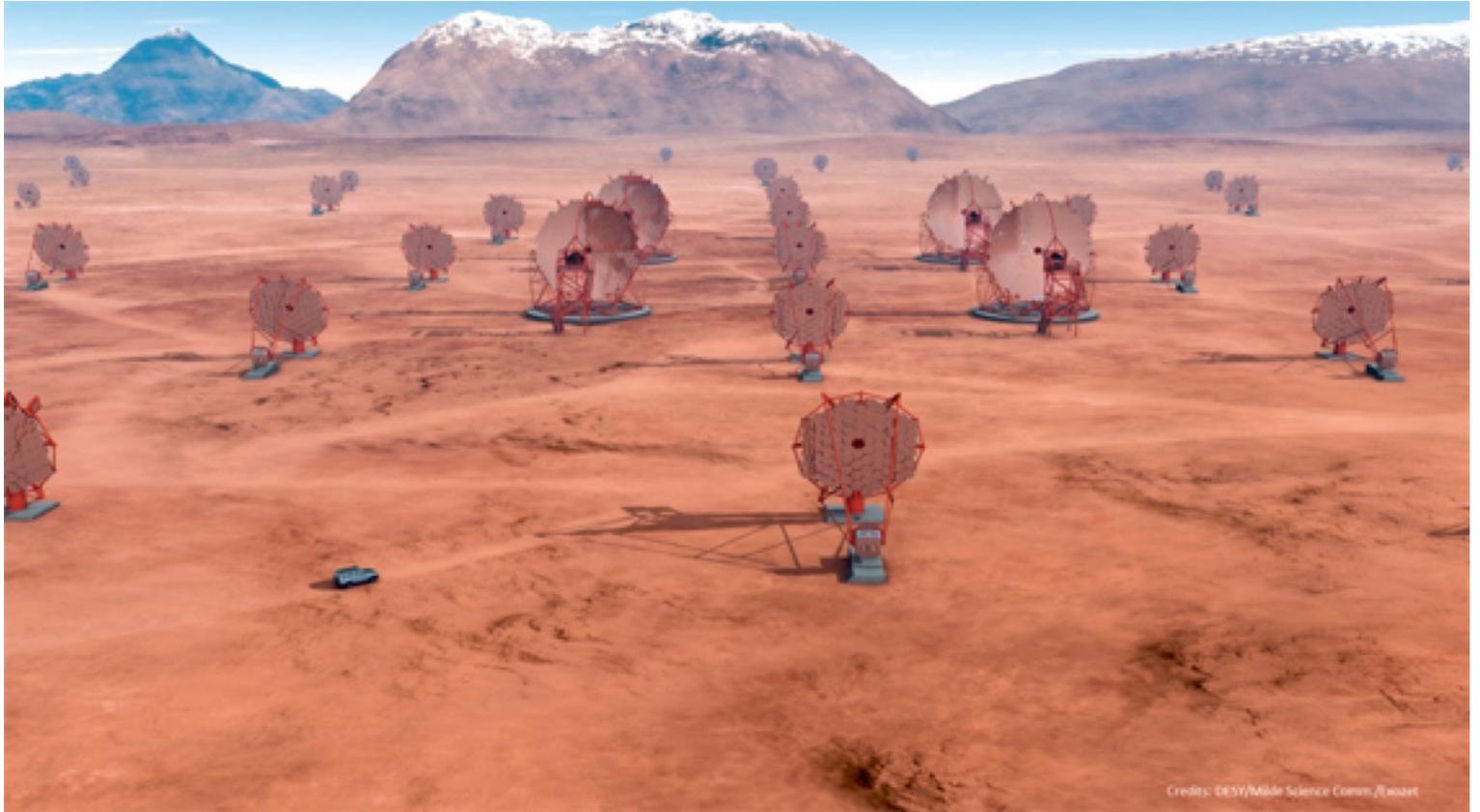


HESS



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CTA



www.cta-observatory.org