

全天MeVガンマ線観測衛星 計画AMEGO-Xの現状

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AMEGO-X team



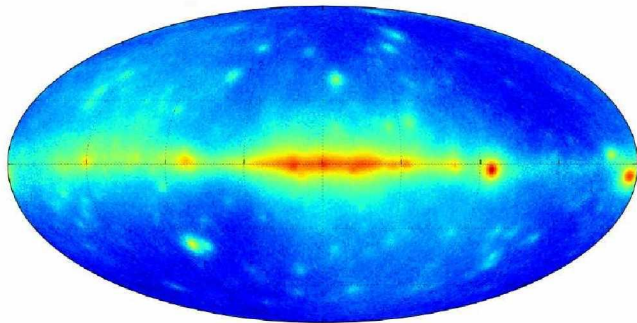
Progress of GeV/TeV Gamma-ray Astronomy

- 2000s TeV telescopes (>190 of TeV sources)
- 2008- Fermi/LAT >5999 GeV sources
- 2026- CTAO >1000 TeV sources

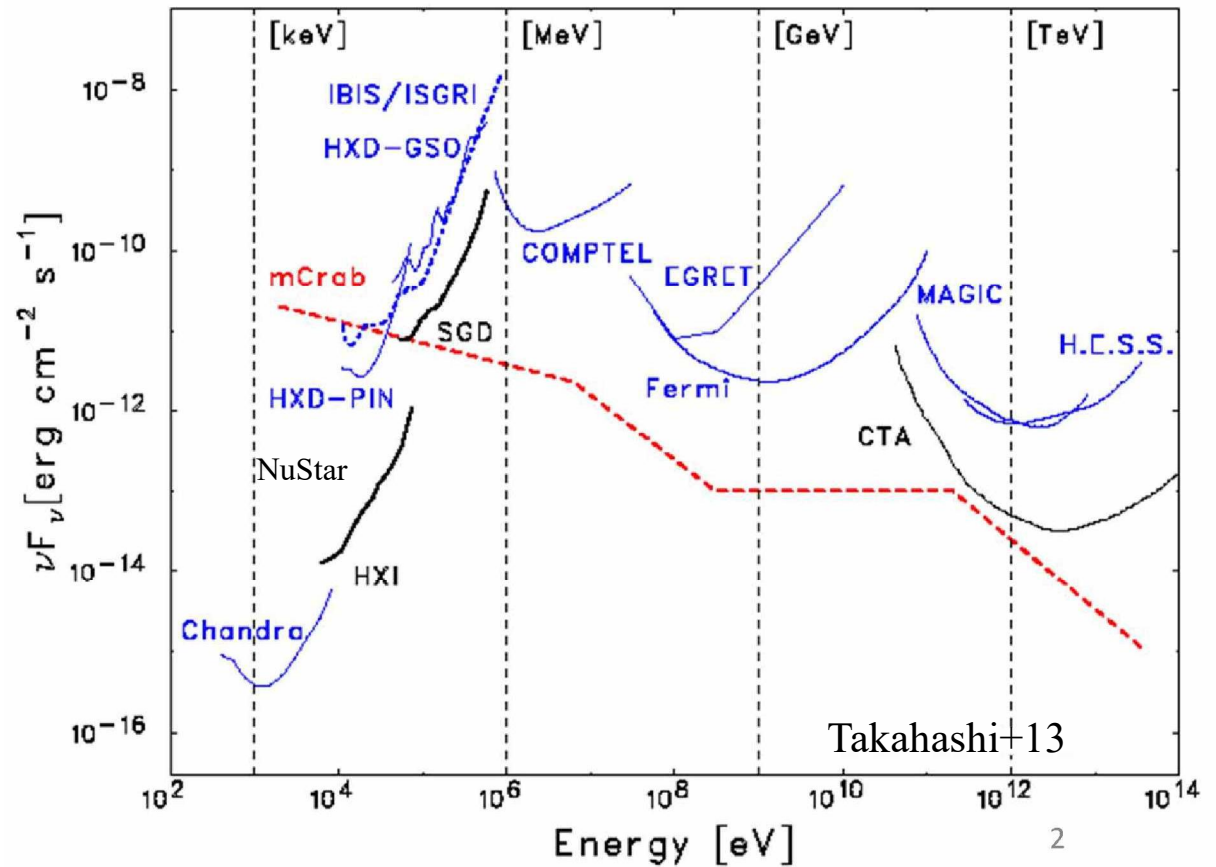
MeV gamma-ray Astronomy

- 1990s CGRO/COMPTEL 30 MeV sources
- 2027- COSI (line survey)

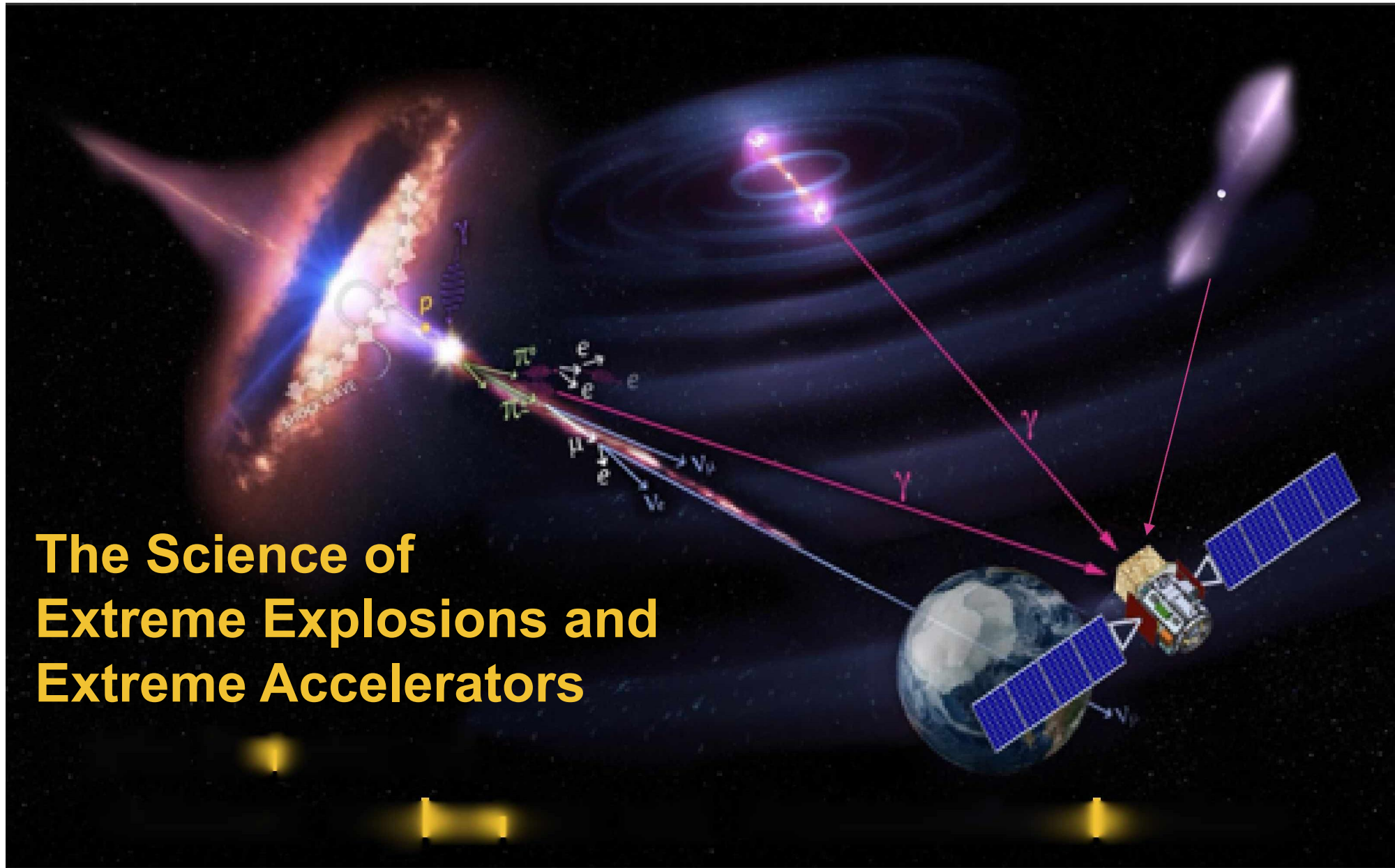
Fermi/LAT 30-100MeV



Principe+18



Multimessenger Astrophysics



**The Science of
Extreme Explosions and
Extreme Accelerators**

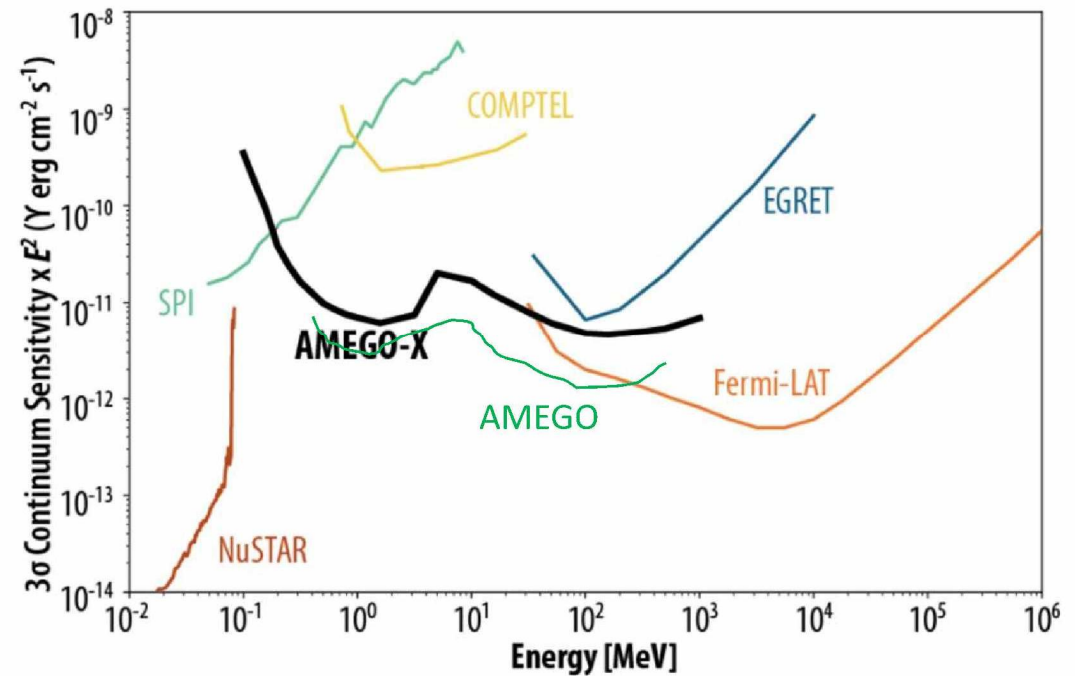
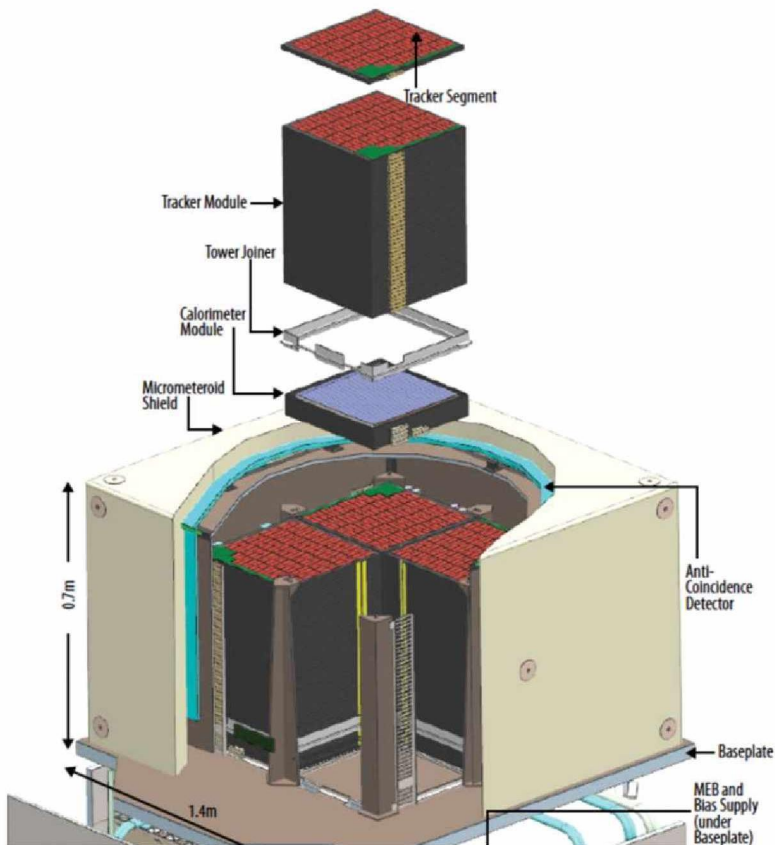
AMEGO-X

All-sky Medium Energy Gamma-ray Observatory Explorer

PI: Regina Caputo (GSFC/NASA)

International Collaboration : US, Japan, Italy

Si-stacked Compton Telescope

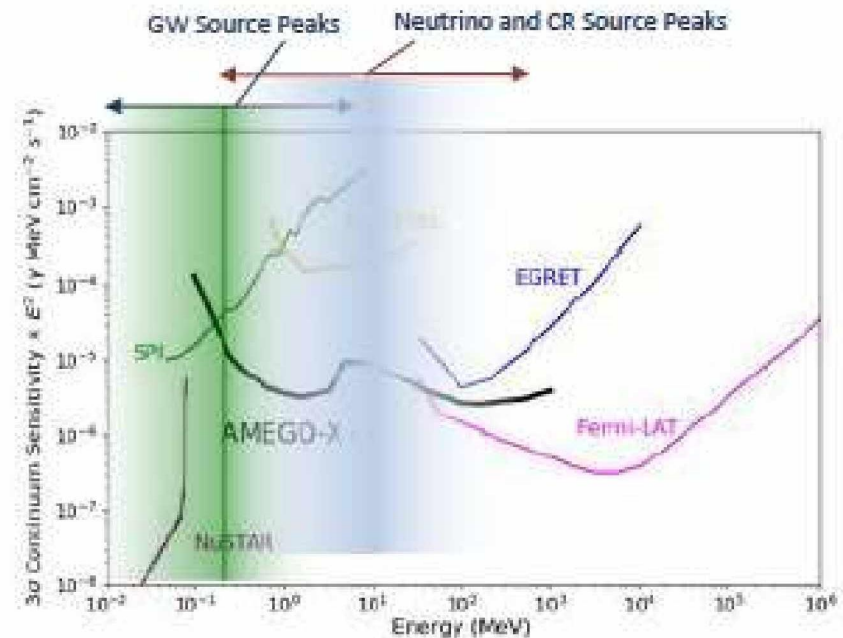


AMEGO-X Basic Performance

AMEGO-X will:

- Be at least 10x more sensitive than the previous MeV instrument COMPTEL
- Detect 1000x lower energies than *Fermi-LAT*
- Achieve >10x better localization than *Fermi-GBM*

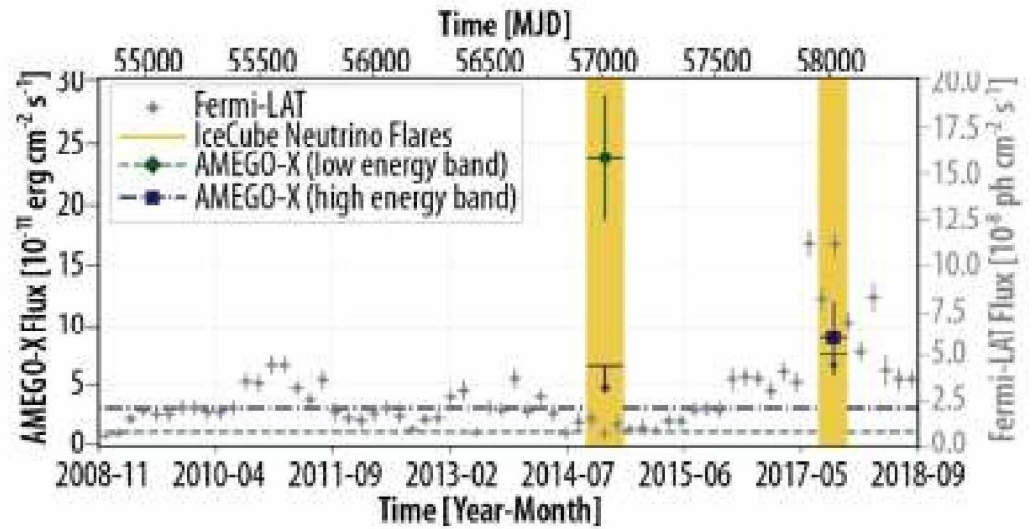
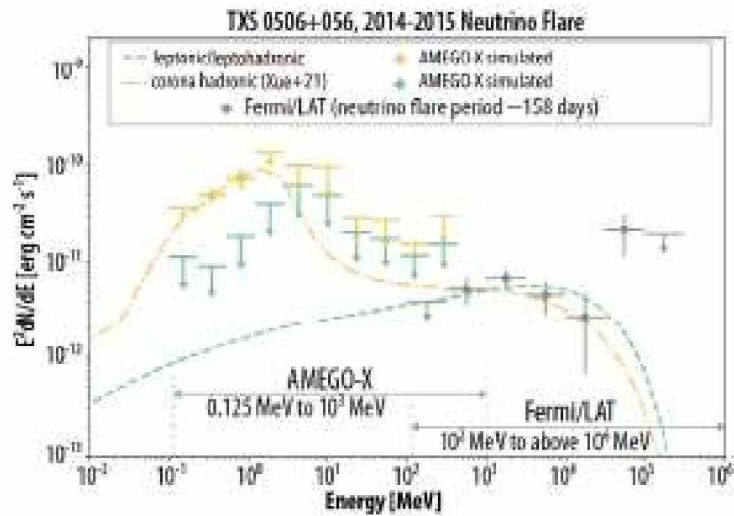
Energy Range	100 keV - 1 GeV
Angular Resolution	3° (1 MeV), 2° (100 MeV)
Field of View	2pi sr (50% of the sky)
Transient Sensitivity (ph cm ⁻²)	0.5 (100 keV-1 MeV) 1s
Continuum Sensitivity (MeV cm ⁻² s ⁻¹)	2x10 ⁻⁶ (100 MeV) 3 yr



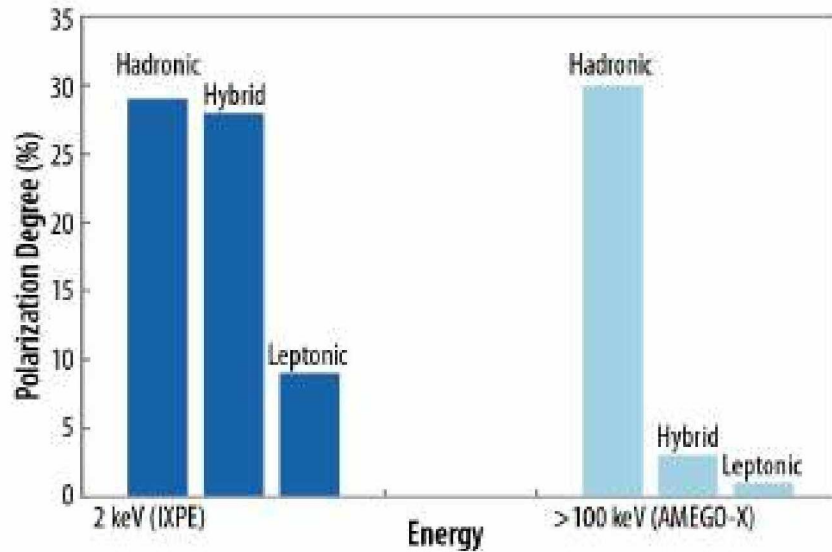
AMEGO-X will lead to major scientific discoveries and breakthroughs in the MeV gamma-ray band like Fermi-LAT in the GeV band

AGN Science

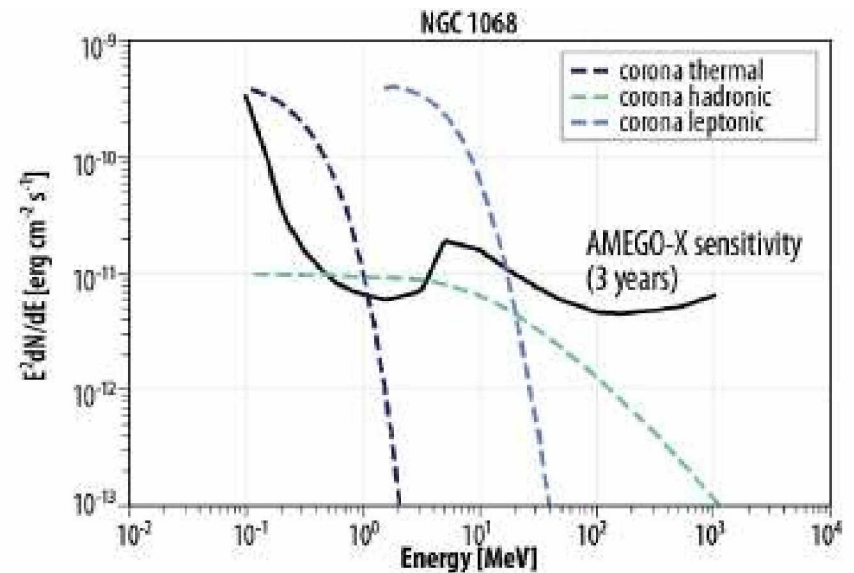
Objects associated with HE- ν (GeV band is optically thick)



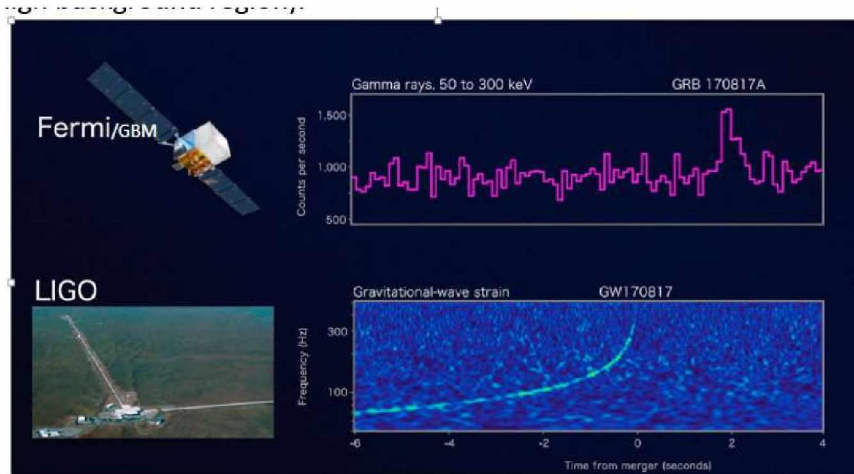
Distinguish emission mechanism by Polarization



Non-jetted AGNs (corona/UFO)

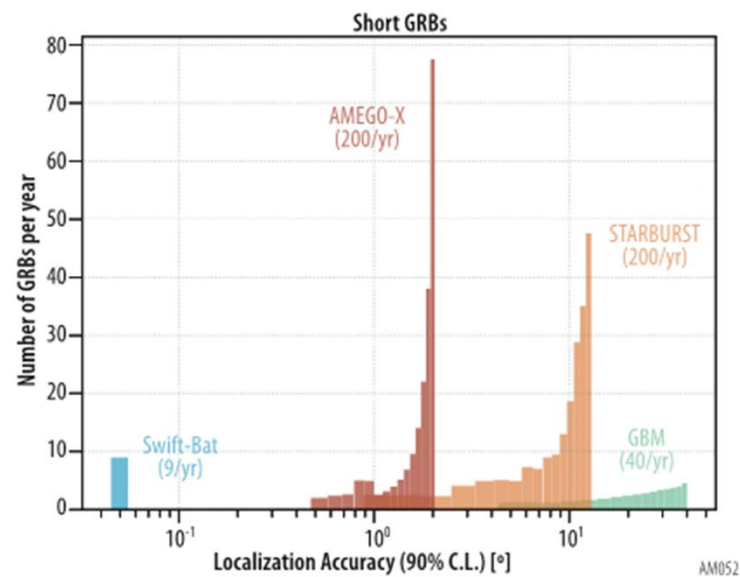


Gamma-ray burst with GW

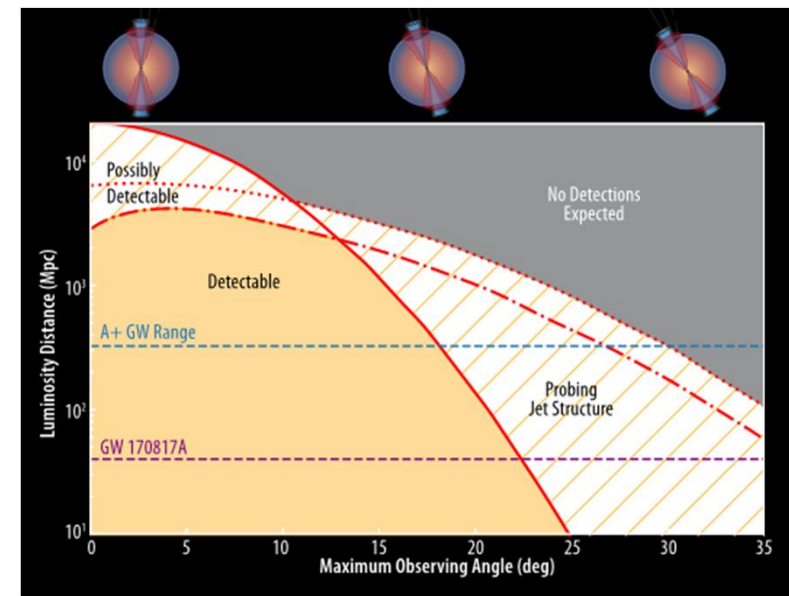


Detect faint gamma-ray bursts associated with GW

Search for GRB with GW with < 1 deg localization

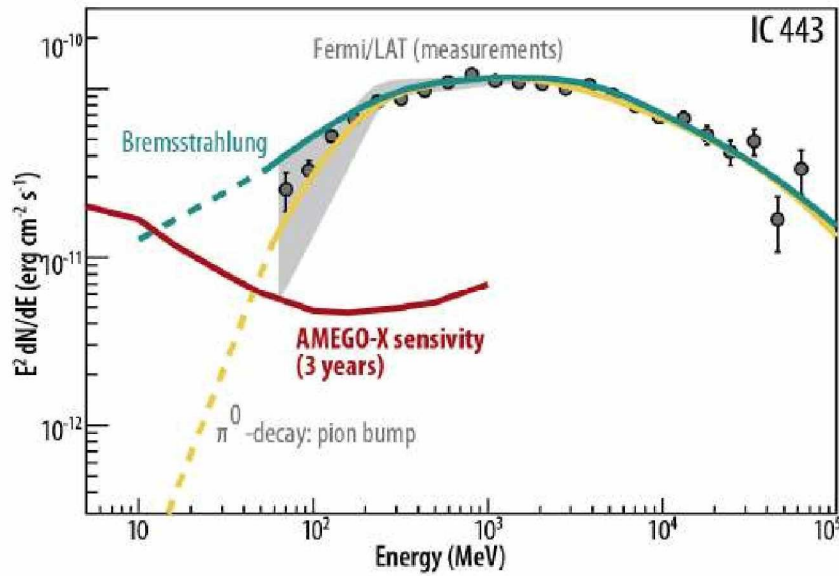


Viewing angle of GRB jet 布

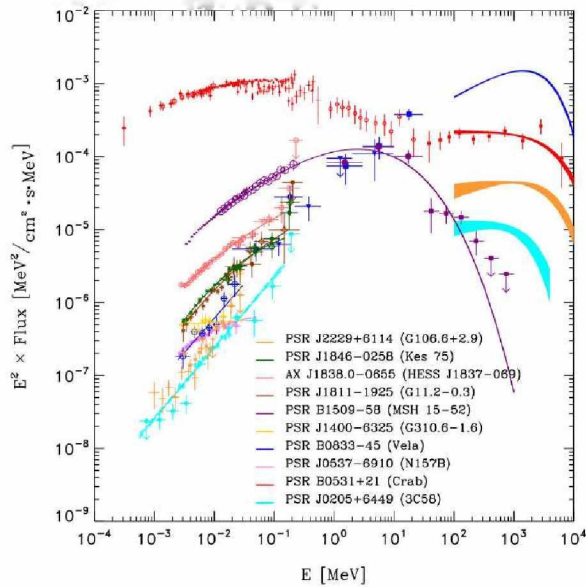


Galactic cosmic rays

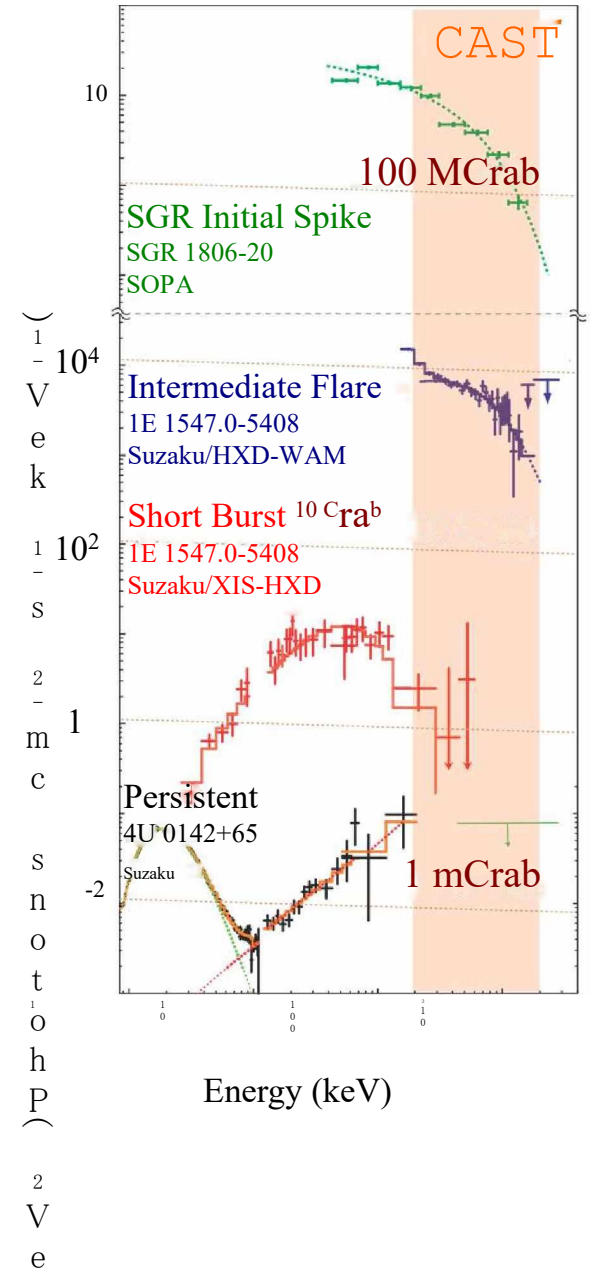
Search for Proton accelerators



Search for MeV Pulsars



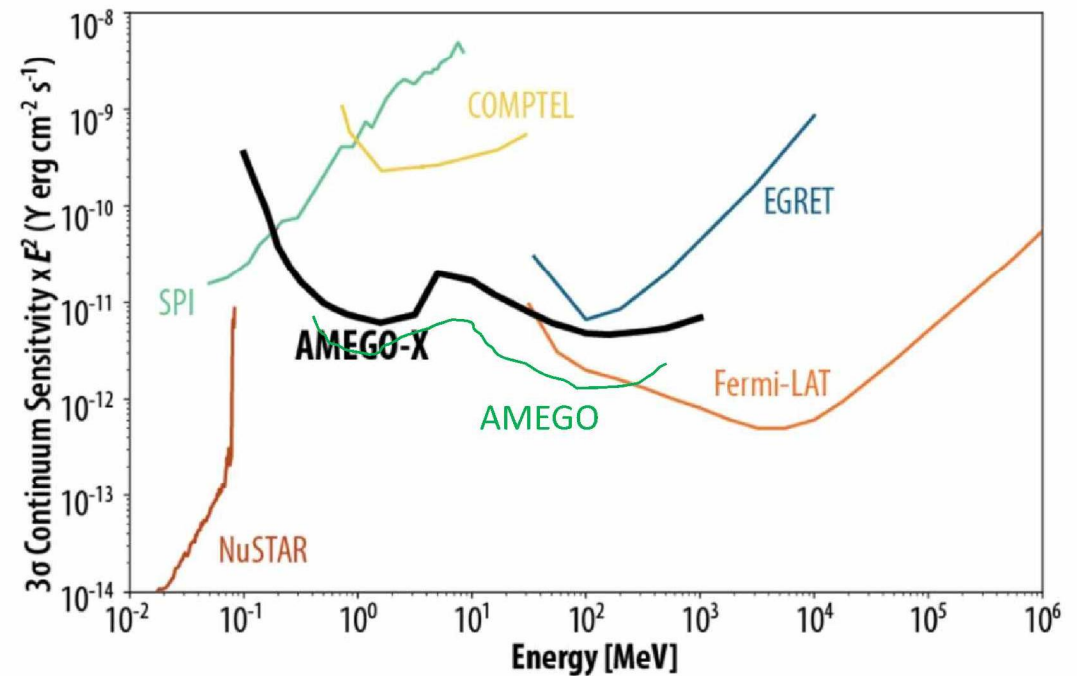
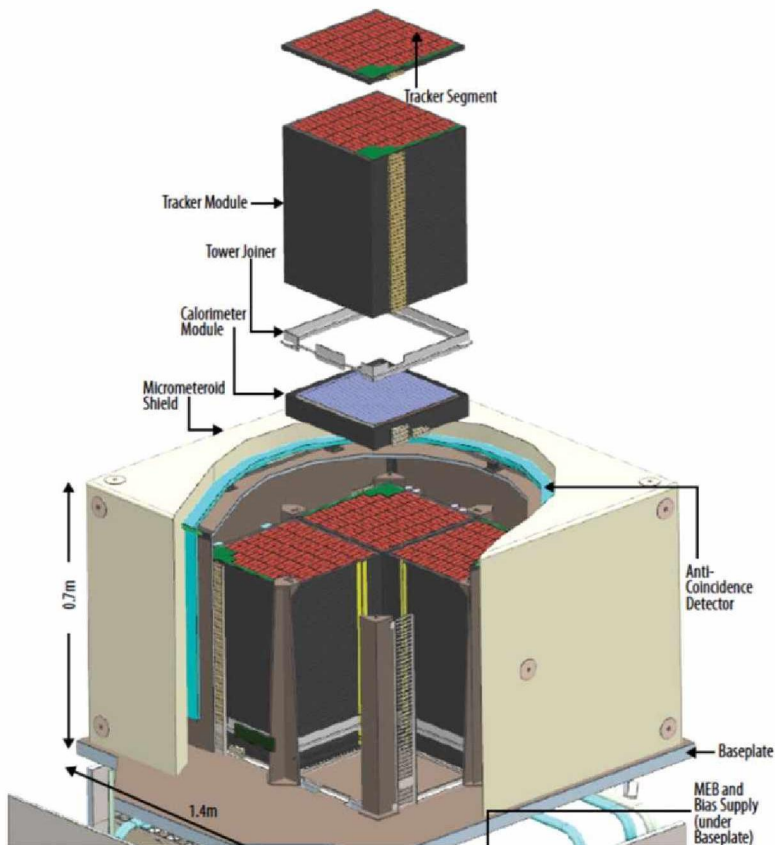
Magntor Flare



AMEGO-X detector concept

Utilize heritage from Fermi/LAT

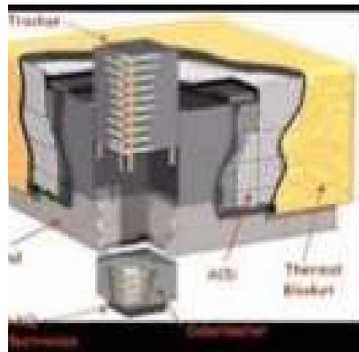
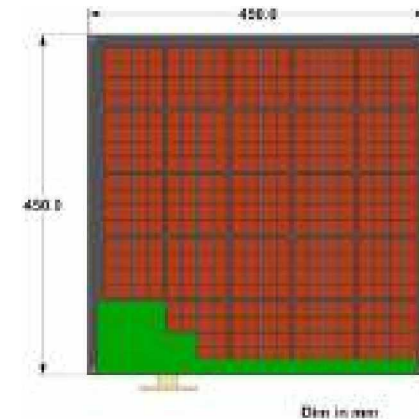
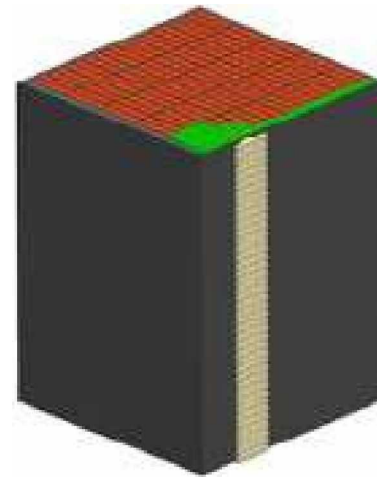
Si-stacked Compton telescope instead of Si e+e- tracker



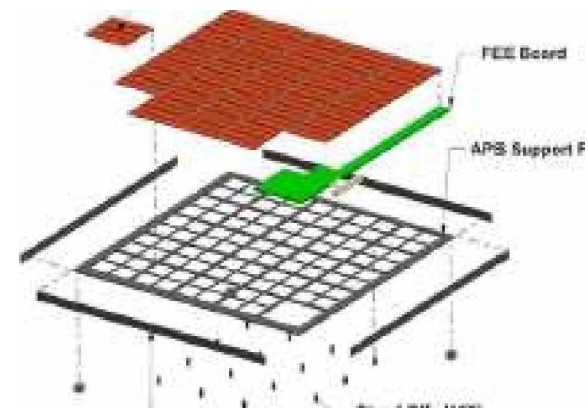
Tracker



- The Tracker Module is composed of 40 Tracker Segments
- The Tracker Segment is composed of 380 APS arrays, an FEE Board and a segment frame
- Draws on heritage from Fermi-LAT



APaduudAiup14Ki

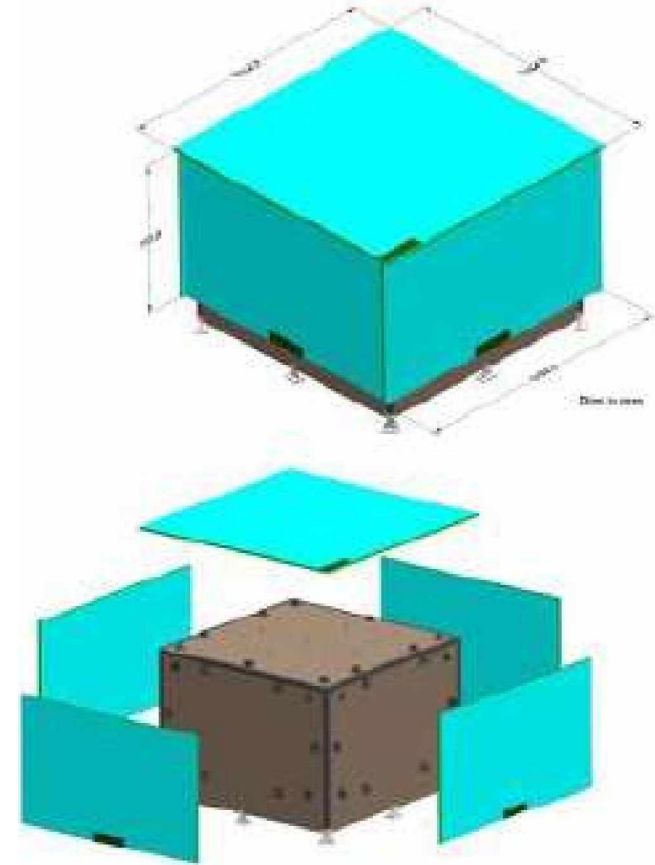


≡ V1S1 Eua CM.s-DILd



Anticoincidence Detector

- The Anti-coincidence Detector is composed of 5 Panels
- Each Panel is composed of scintillator tiles with WLS bars and SiPMs on the edge
- FEE cards are on bottom of side panels and in corner of top panel
- Each panel is mounted to the ACD structure
- Draws on Fermi-LAT Heritage

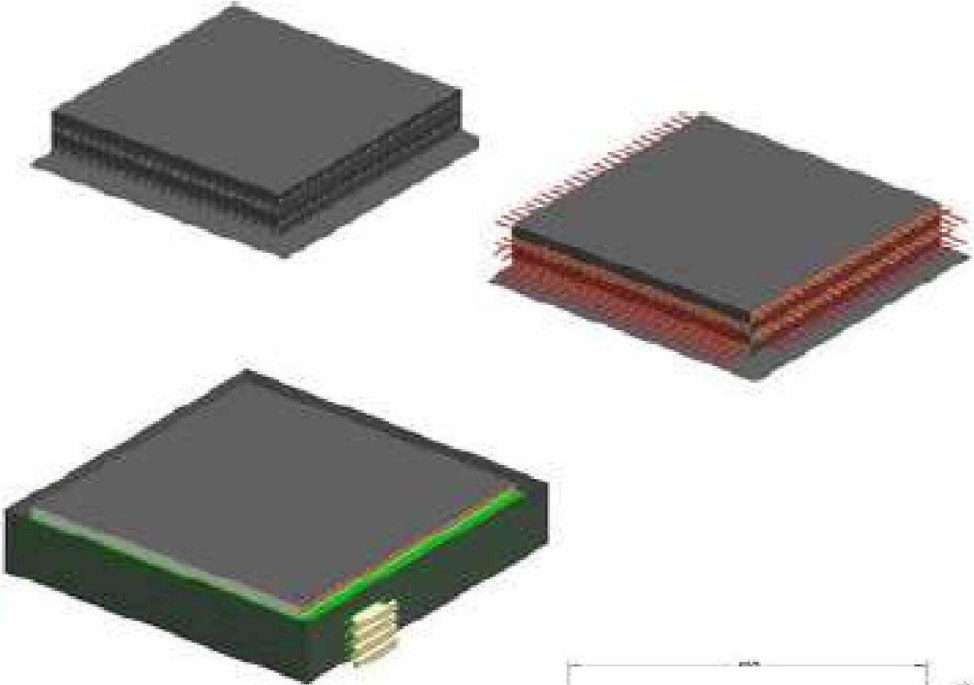


Calorimeter

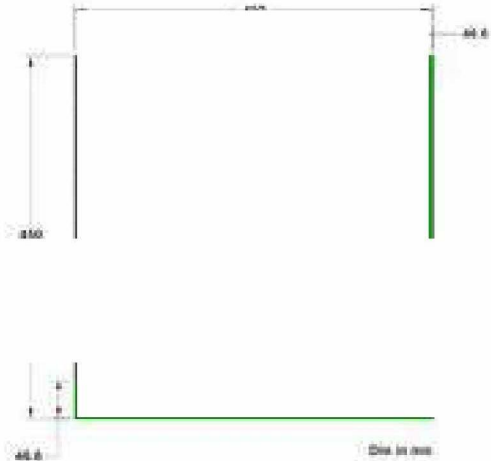
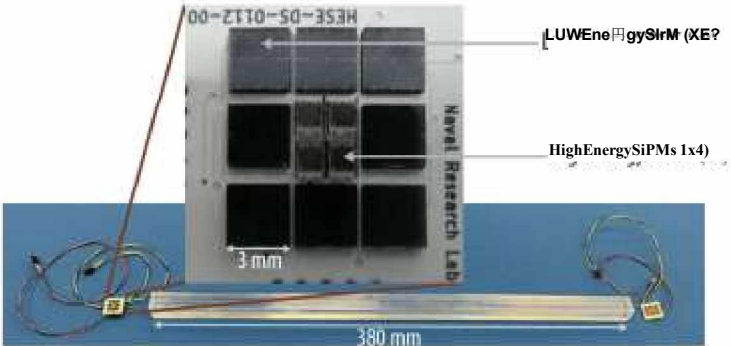
The Calorimeter is a 4 layer module

The 4 layers of CsI Crystals are installed in a unibody frame. Each Crystal has high and low energy SiPMs on each end. The SiPMs feed the FEE PCB.

Draws on heritage from Fermi-LAT



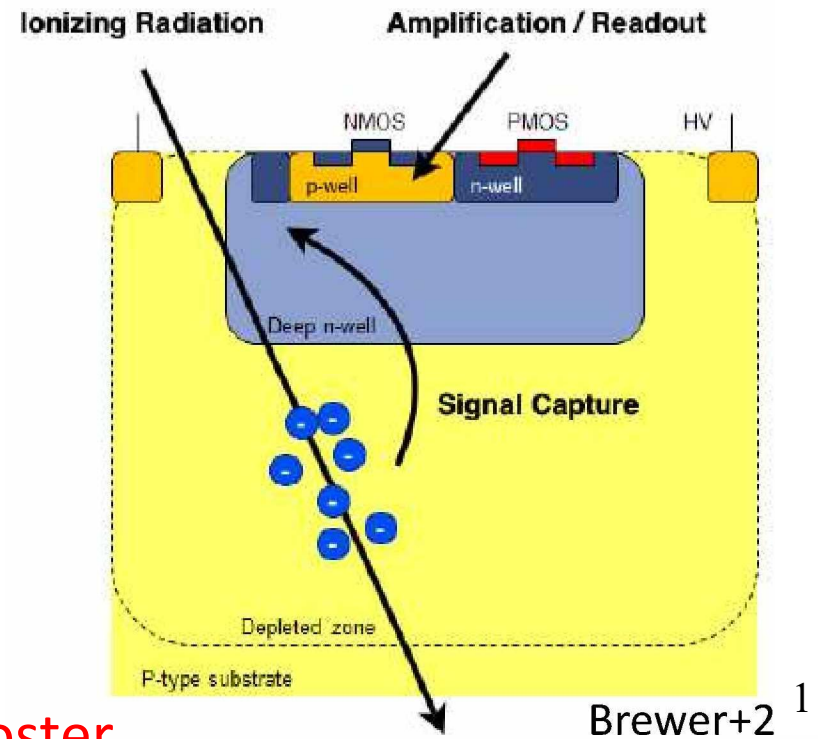
FERMI-LAT Calorimeter Structure Design



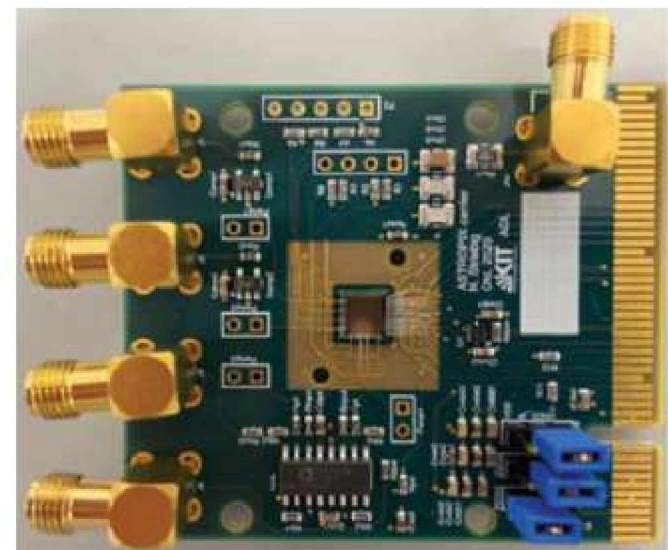
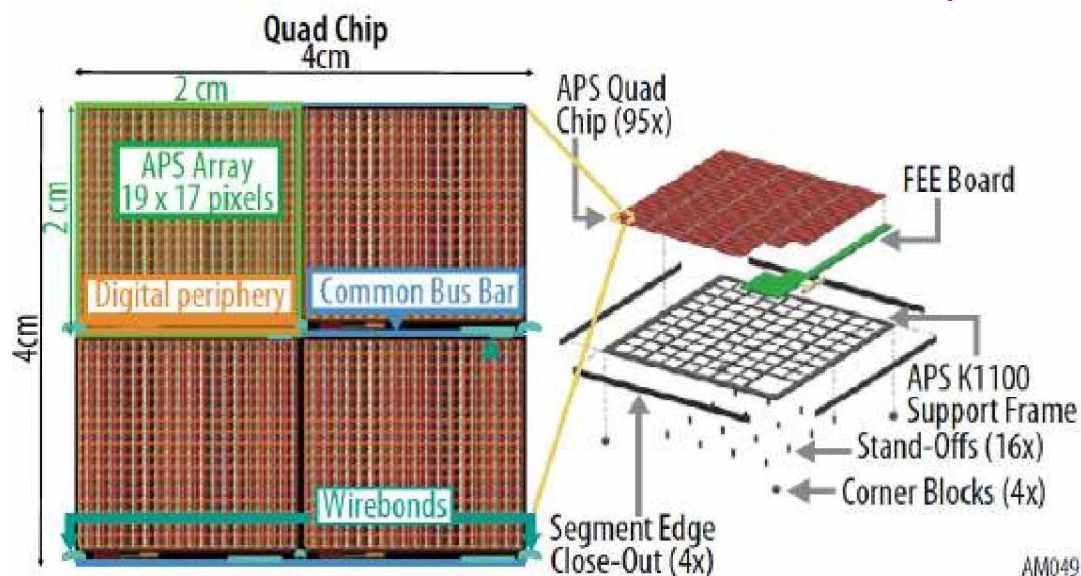
AstroPix

HV-CMOS from ATLASPix pix size:
0.5mm or 1mm

Give lower threshold than DSSD
60 keV \rightarrow 25 keV
Improve low-E performance
(below 1 MeV)
<1.5mW/cm²

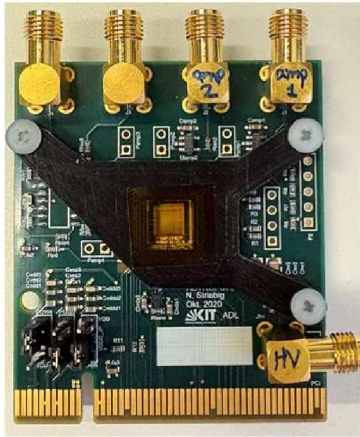


See Violette's poster



AstroPix Series

AstroPix1
2021



AstroPix2
2022



AstroPix3
2023

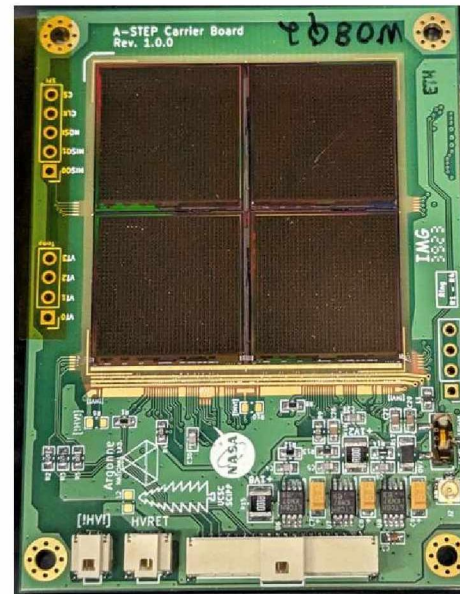


AstroPix4
2024



GSFC/NASA, ANL, KIT, UCSC,
Hiroshima U., Nagoya U.

AstroPix3 Quad-chip
(Flight prototype)



AstroPix5 will be
delivered. 2025

Evaluation of analog properties

Energy scale and linearity, dynamic range, gain, etc

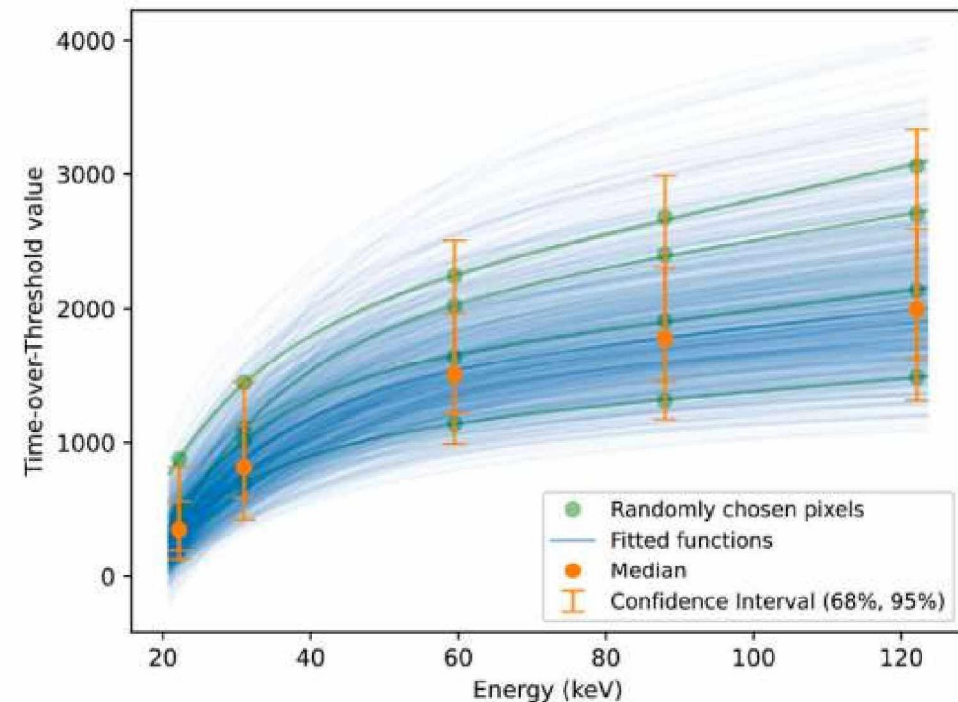
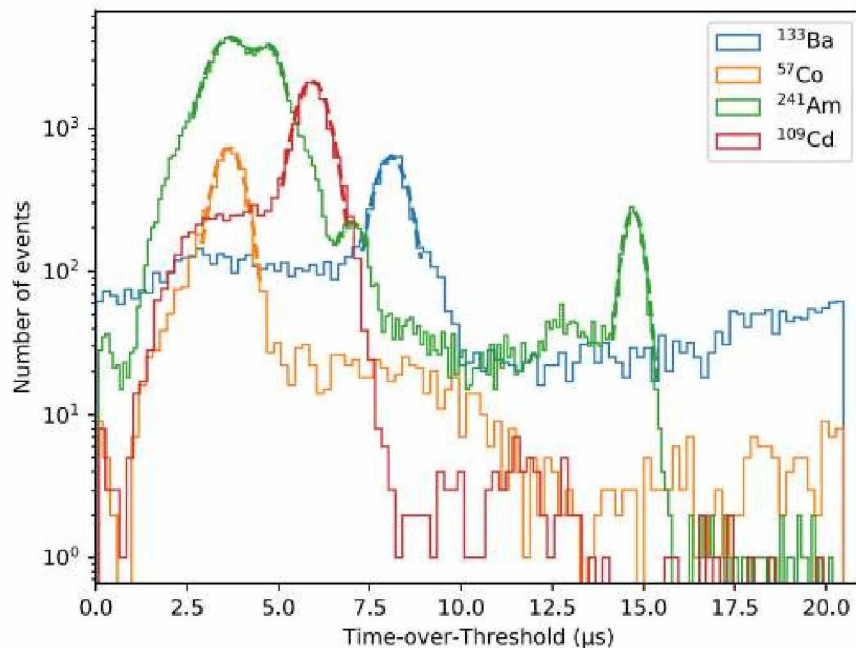
Measurement of depletion depth

Measurement of sensitive area

Beam Test, Laser Scan

仲野講演

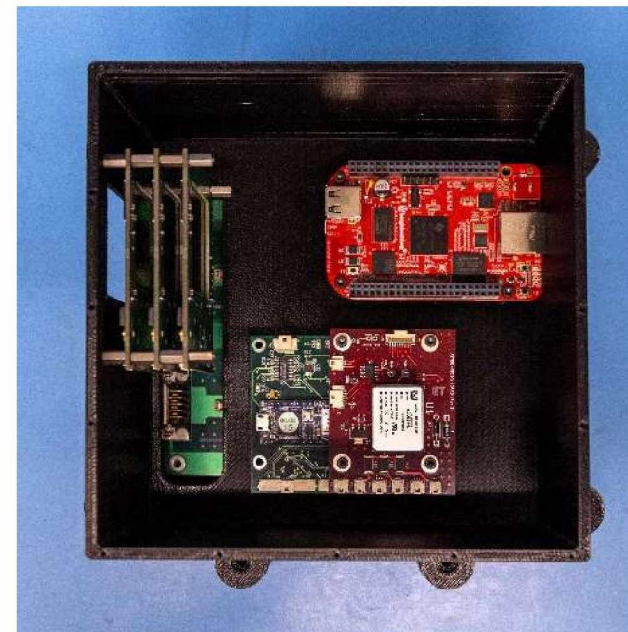
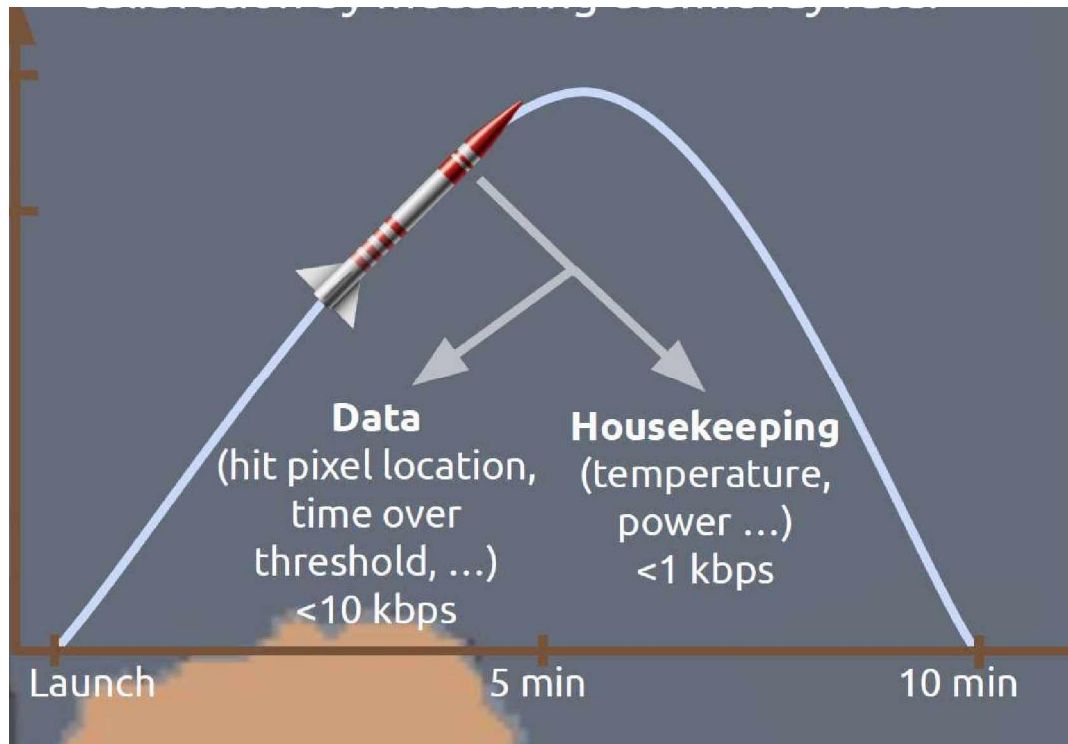
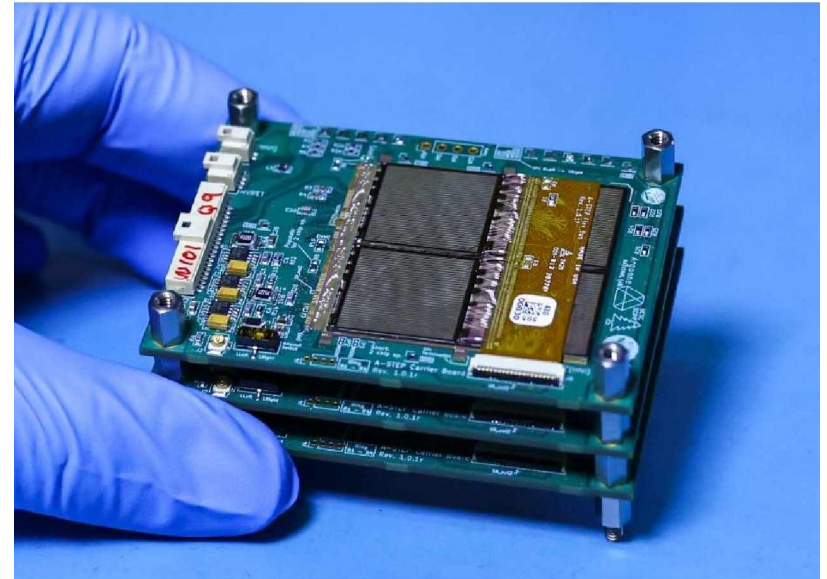
Suda + 24、NIM-A



A-STEP

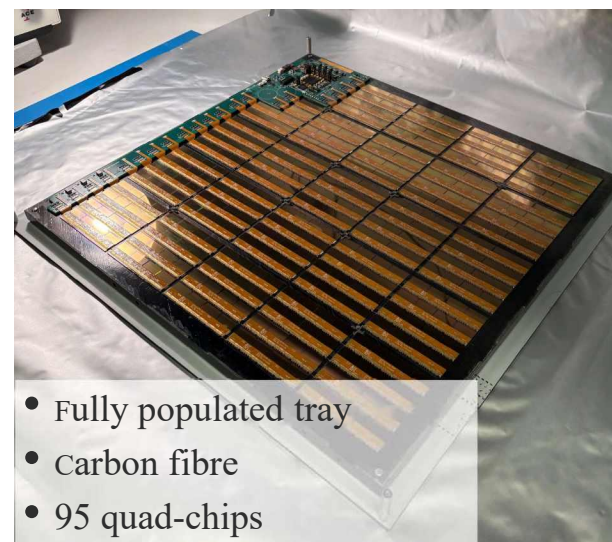
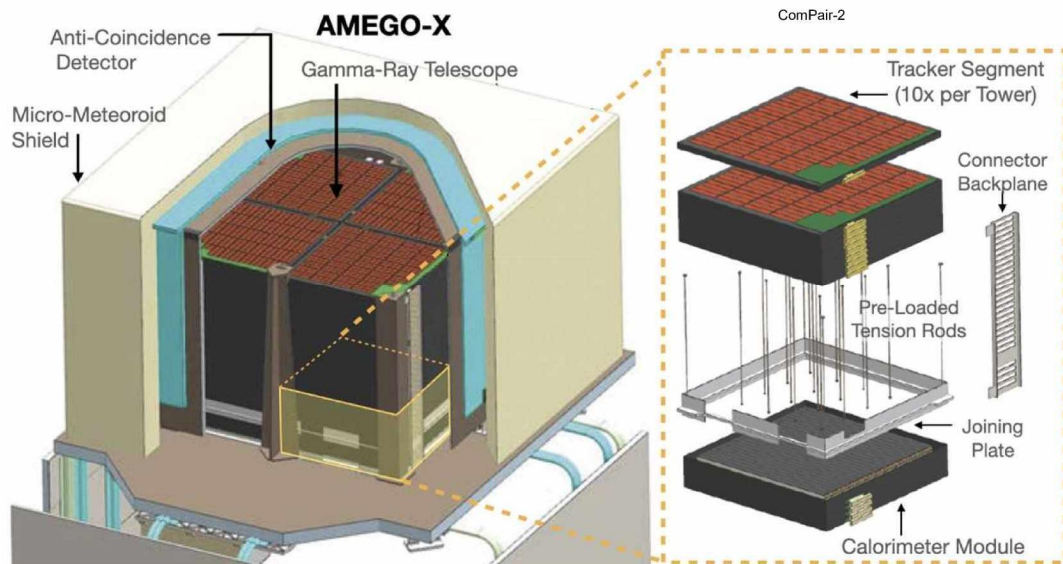
Sounding rocket 2026

Laviron's talk on Friday



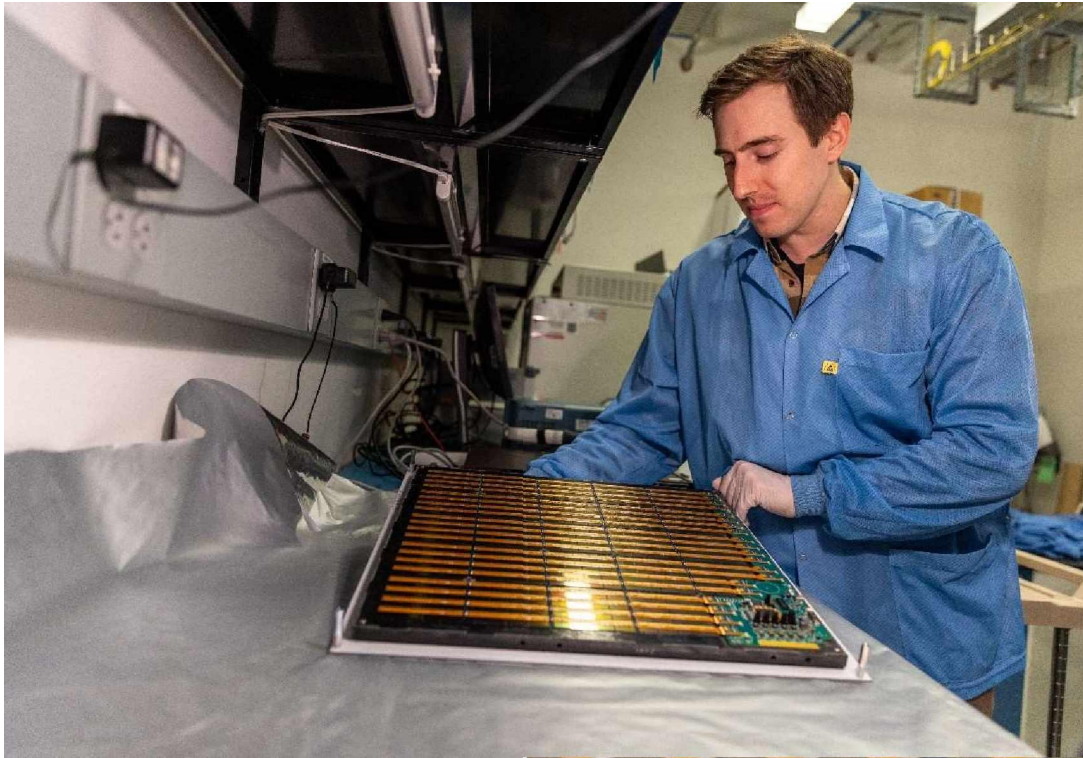
Prototype Telescope

ComPair_2 One tower with 10 layers

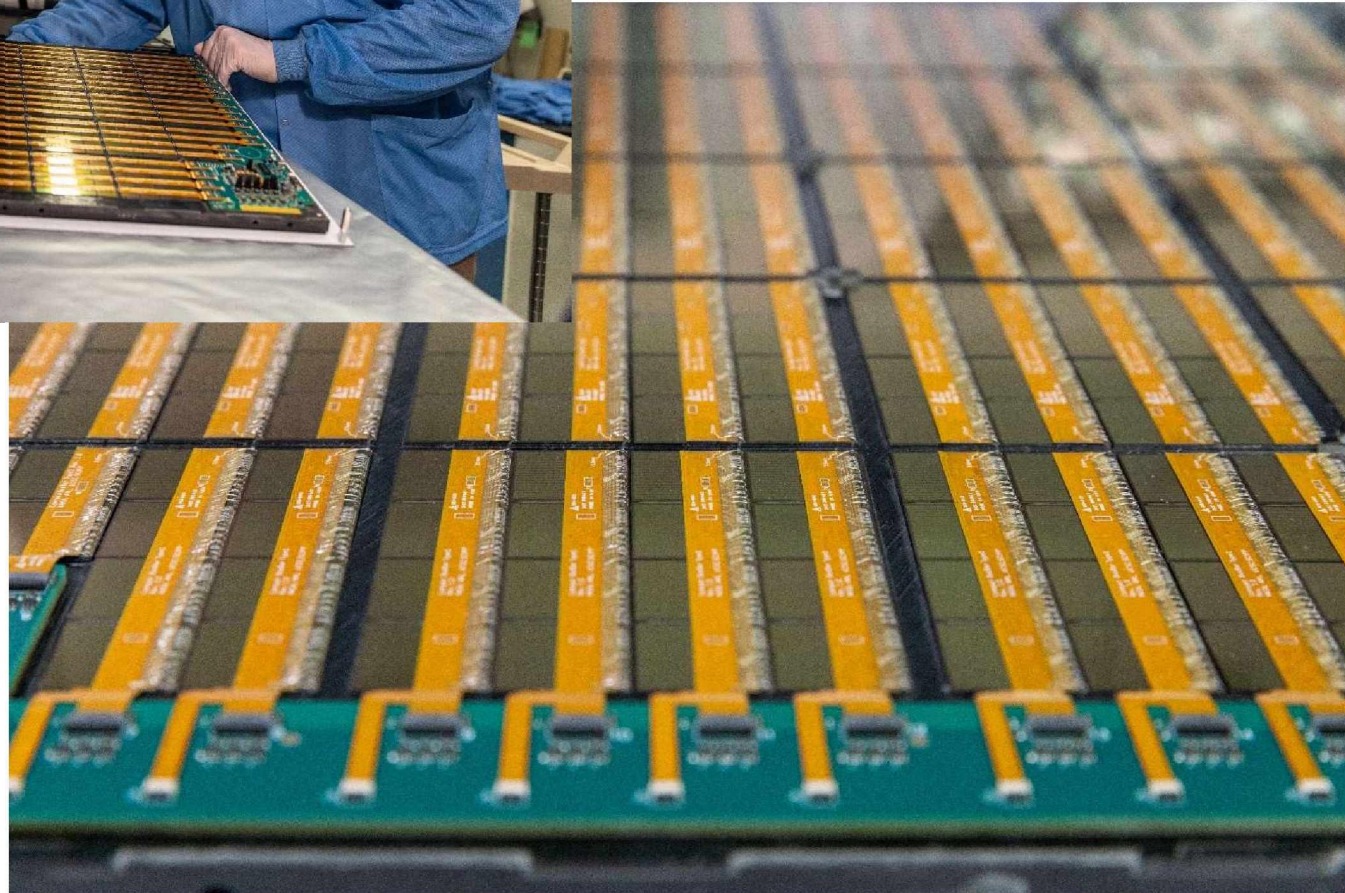


- ComPair-2 (PI: R. Caputo (GSFC/NASA)): AstroPix tracker + CsI calorimeter
 - Demonstration of Compton and Pair reconstructions
- Instrument integration, environmental test in 2026-2027 → Long duration balloon flight

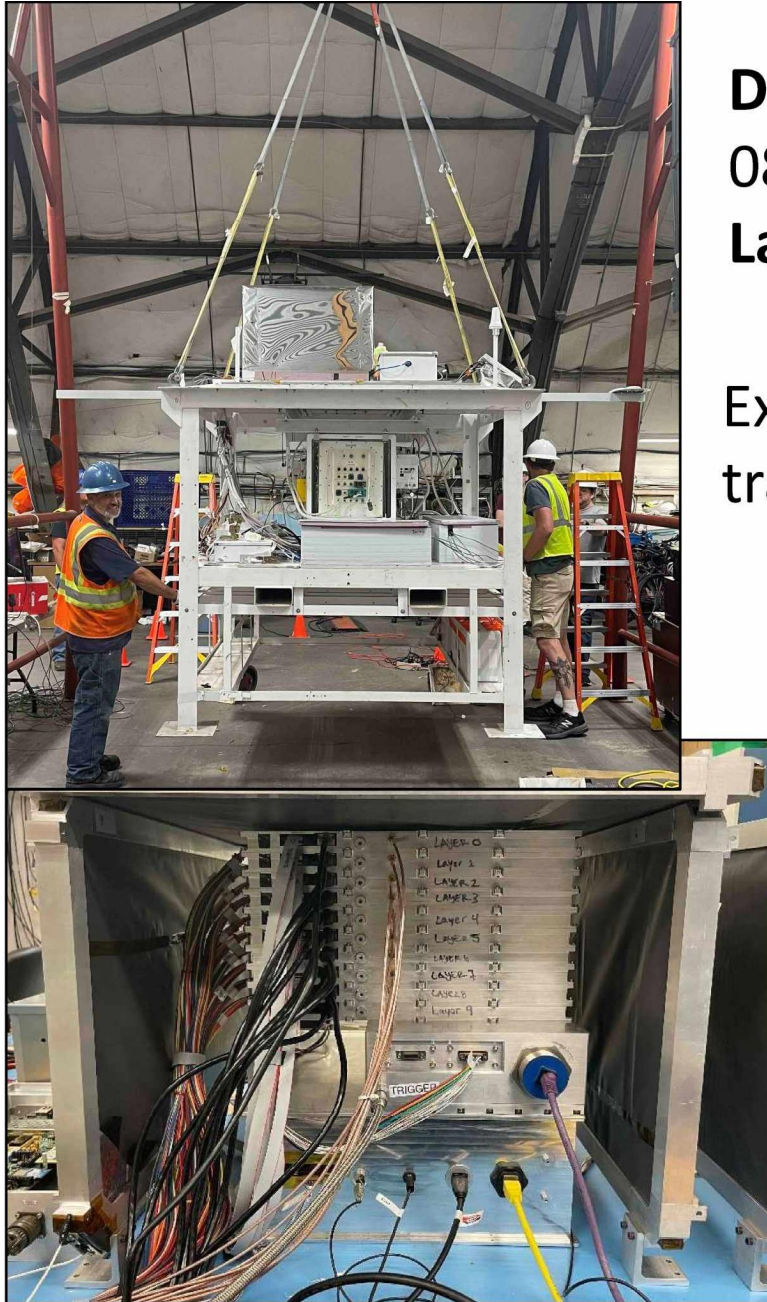
モンテカルロシミュレーション;
竹岡ポスター



AstroPix tracker tower one
tower with 10 layers IT and
V,TV test in 2026



Balloon flight experiments of Compare-1 (DSSD tracker)



Date/Time Launched: 27 August, 2023 /
08:57:20 MT

Launch Site: Ft Sumner, NM

Experience can be used for AstroPix
tracker Tower.

See Metzler's talk



2022 MIDEX proposal not accepted the highest rank among the dropped ones

2024kick-off meeting for next MIDEX proposal

2025-2027 toward MIDEX proposal

discussion for science matrix and hardware

2027 MIDEX proposal ...

Summary

AMEGO-X is planned to explore multimessenger astronomy.
AstroPix is developed for lowering the low-E threshold.
A-STEP and Compair-2 are being prepared for IT, design.

