FERMI – LA MISSIONE

WHY – WHEN – HOW - WHAT – WHERE -WHO

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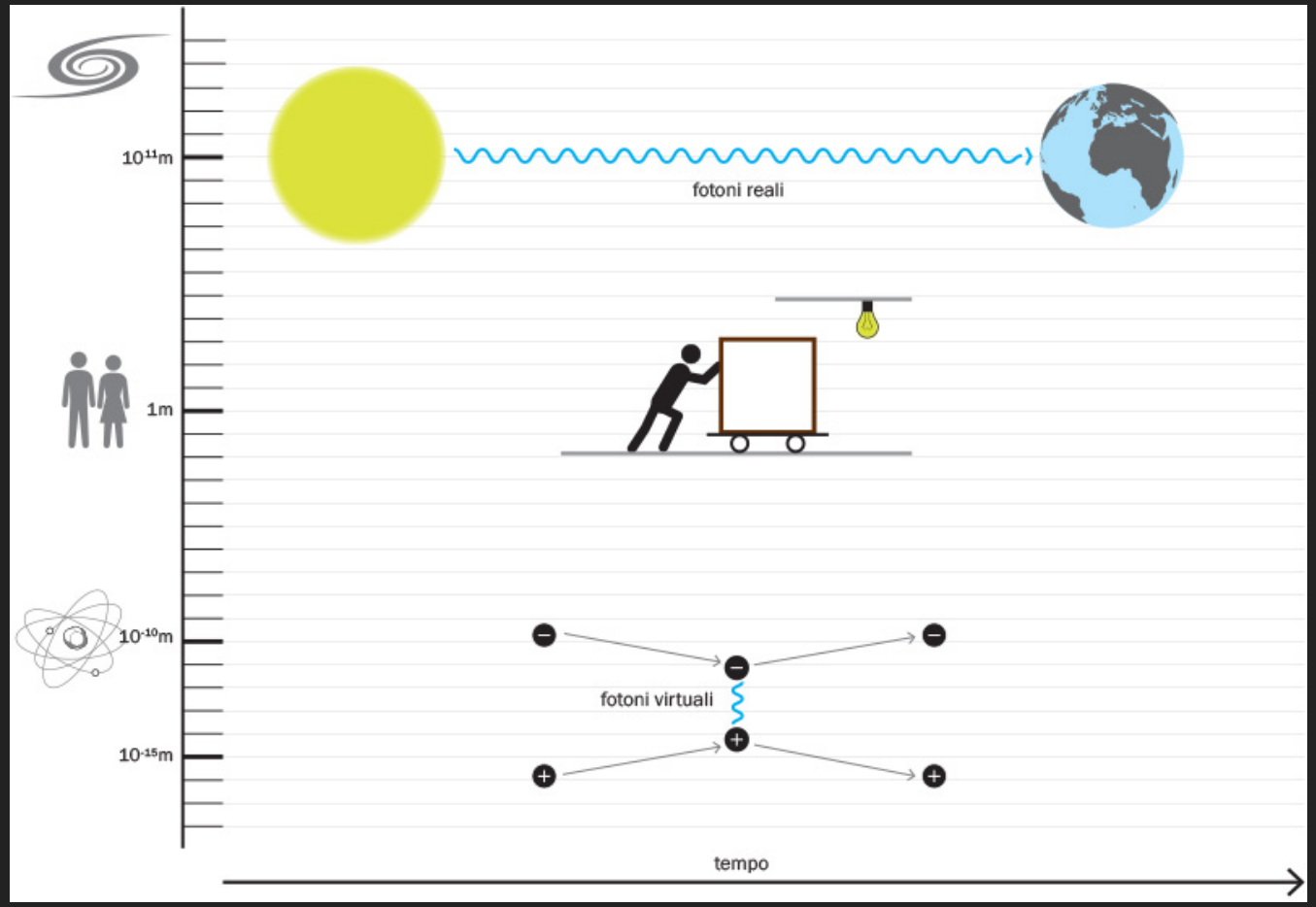
Istituto Nazionale di Fisica Nucleare
SEZIONE DI TORINO

Fermi Masterclass 2020

1. FERMI – WHY ?

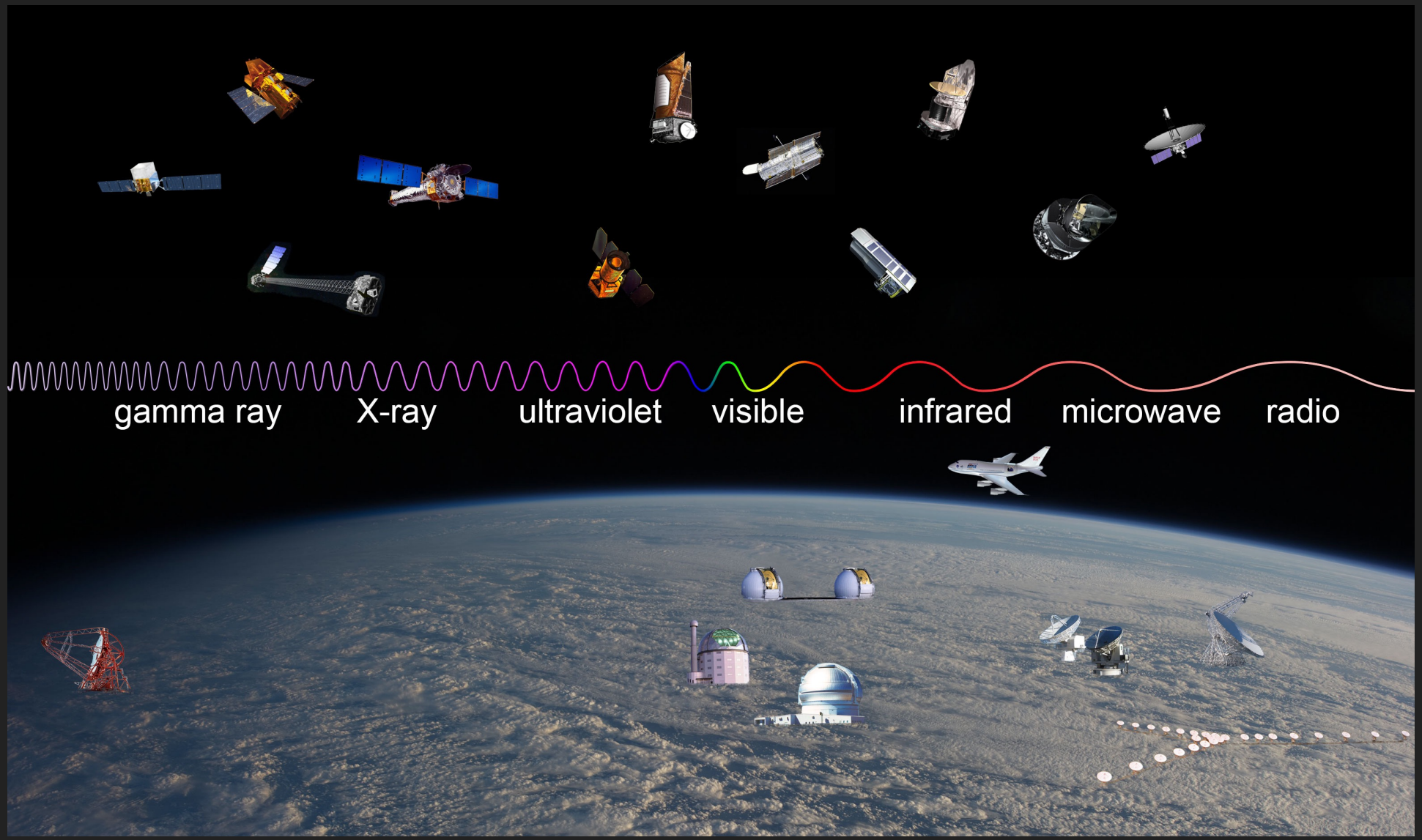
MESSAGGERI COSMICI

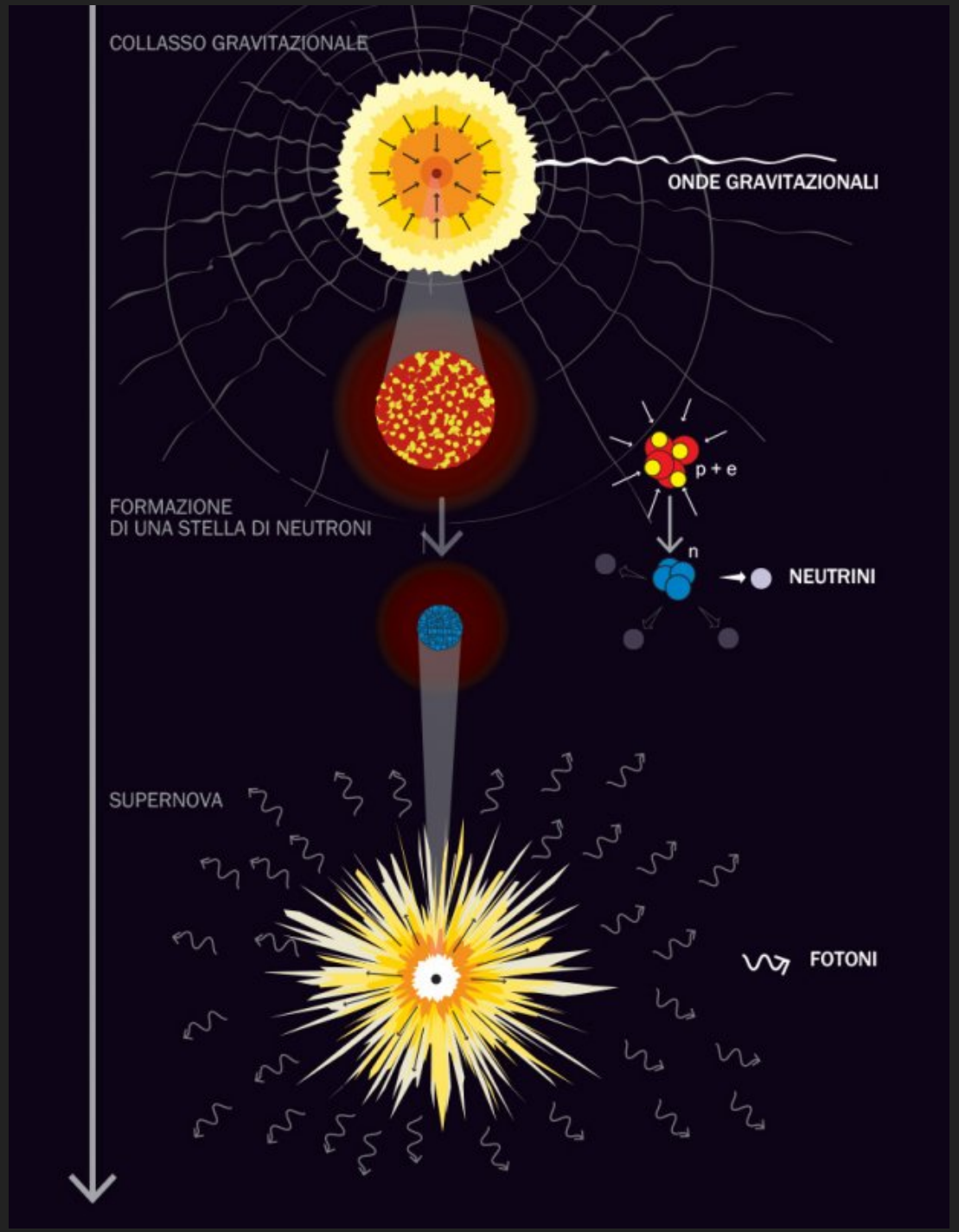
PORTANO INFORMAZIONI ATTRAVERSO L'UNIVERSO



PARTICELLE COME MESSAGGERI

MEDIANO LE INTERAZIONI TRA LE FORZE FONDAMENTALI

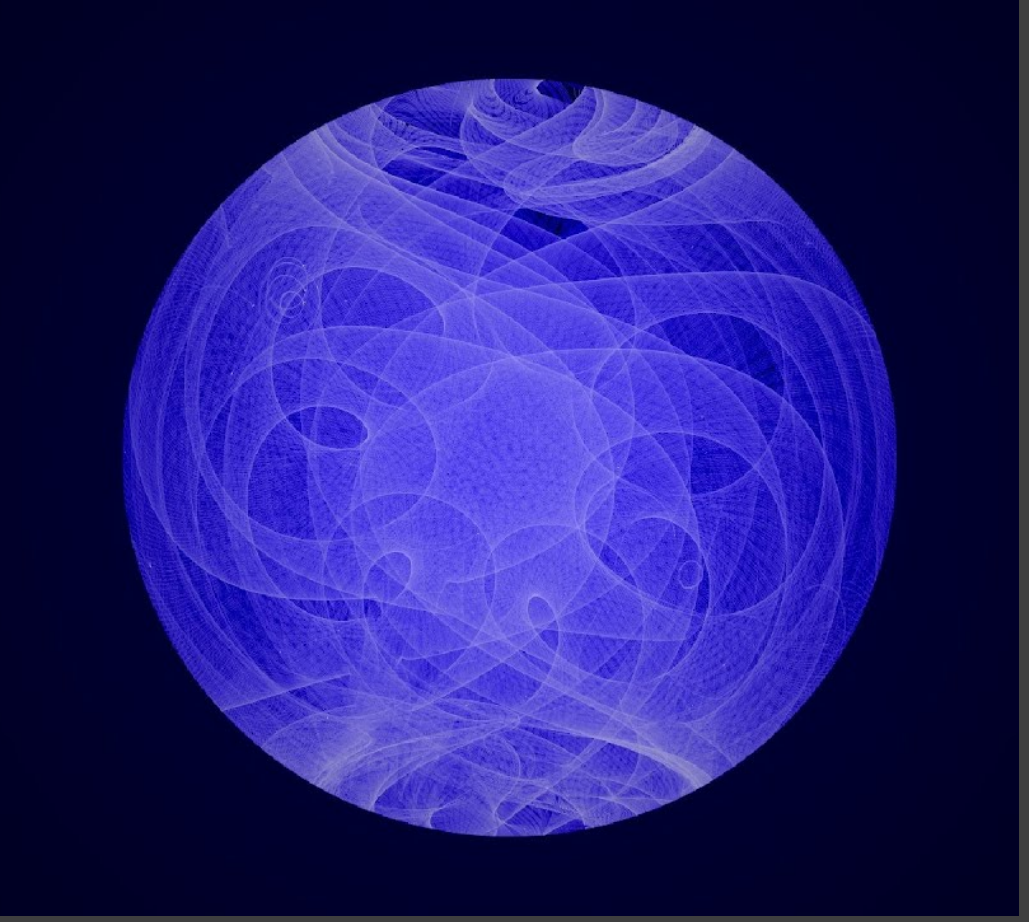

gamma ray
X-ray
ultraviolet
visible
infrared
microwave
radio

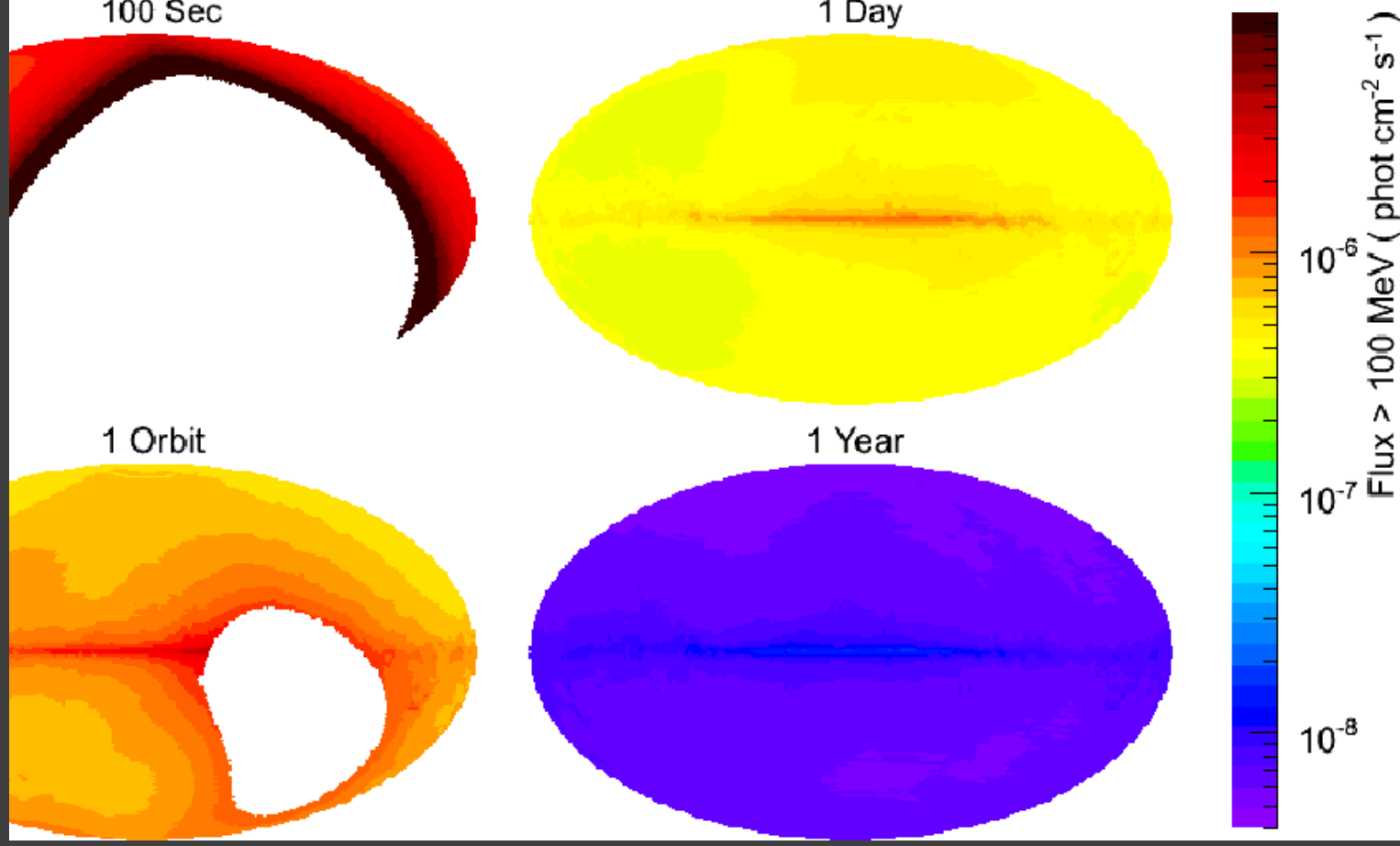


MESSAGGERI DALLA TRASFORMAZIONE DI UNA STELLA

2. FERMI – WHEN

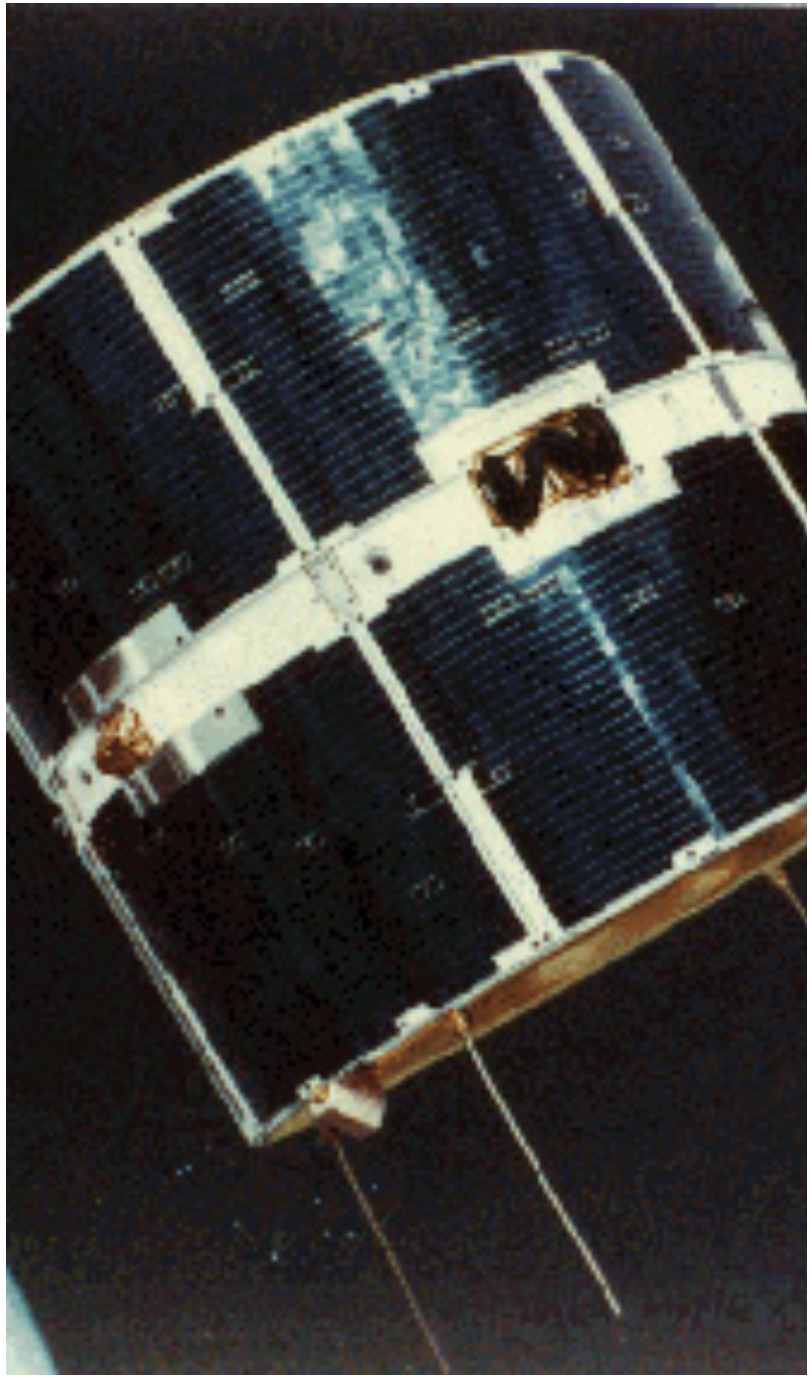
2008 – 11 GIUGNO - CAPE CANAVERAL

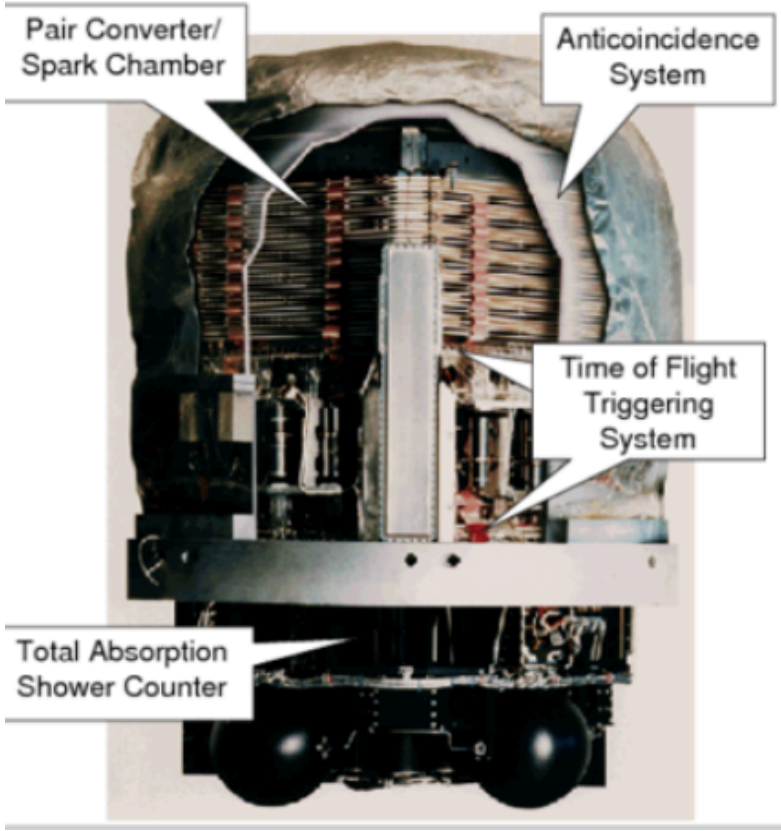


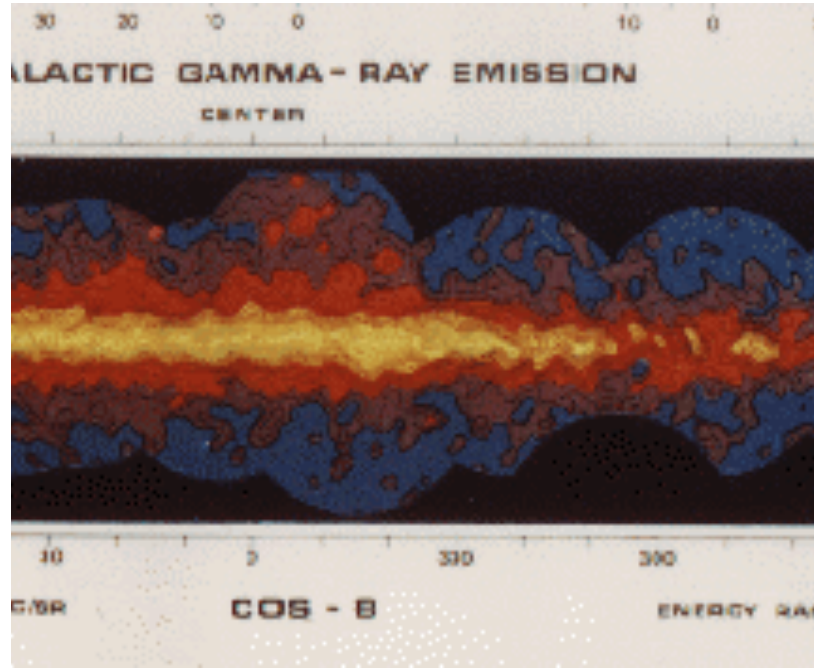


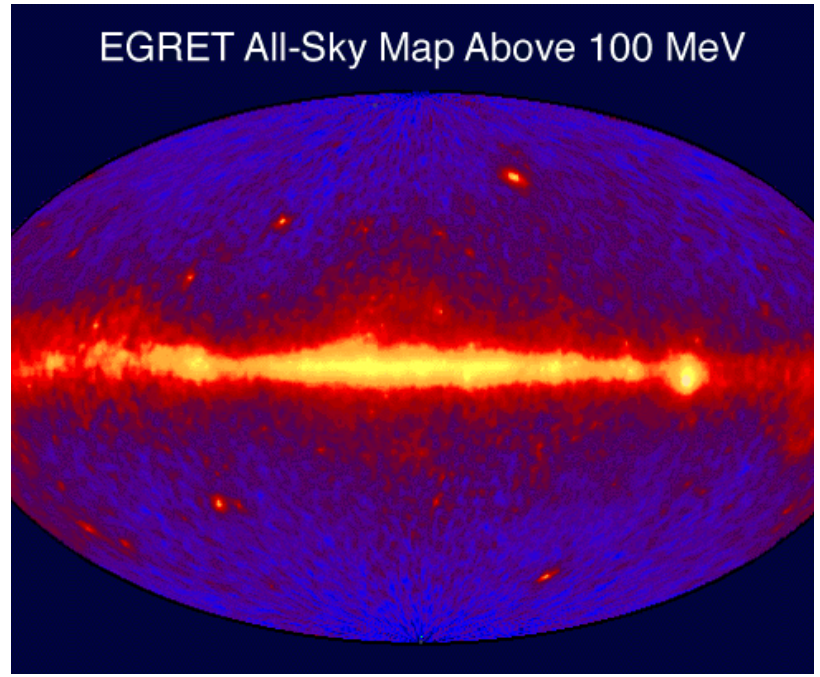
2008 – TODAY
FERMI ORBIT AT 565 KM ALTITUDE

FERMI ZOOM COOLABORATION MEETING 2020



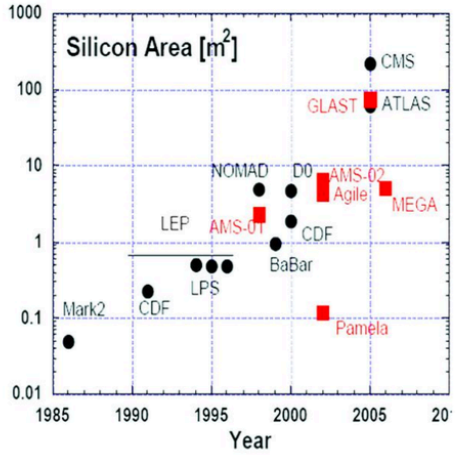

Pair Converter/
Spark Chamber
Anticoincidence
System
Time of Flight
Triggering
System
Total Absorption
Shower Counter


ACTIC GAMMA-RAY EMISSION
COS-B

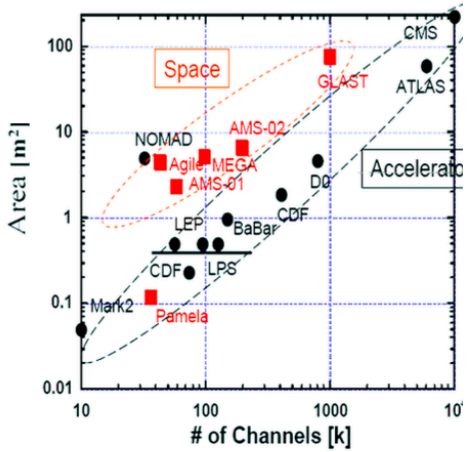

EGRET All-Sky Map Above 100 MeV

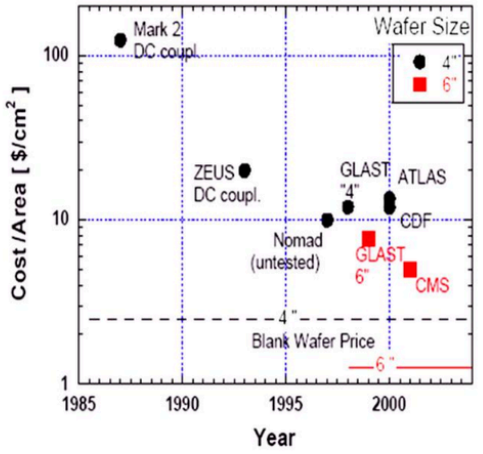
TKR Challenges - SSD

- **Cost at < 10$/cm²**
  - simple robust design
  - large scale production
- **Power at ~ 180 μW / channel**
  - digital readout
  - custom ASICs for Front-End and control

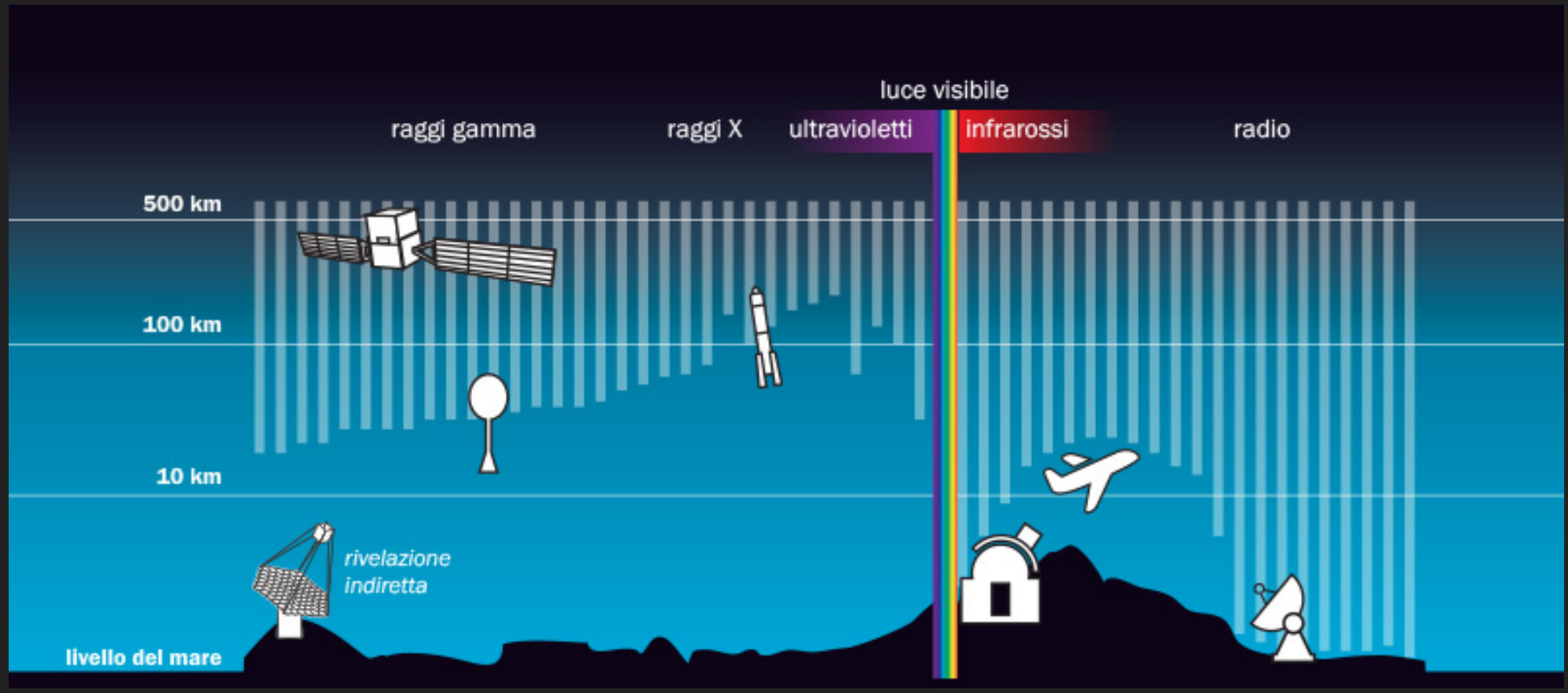


The fabrication of the GLAST-Fermi Silicon wafer paved the way to the Silicon Trackers of the CERN LHC Experiments



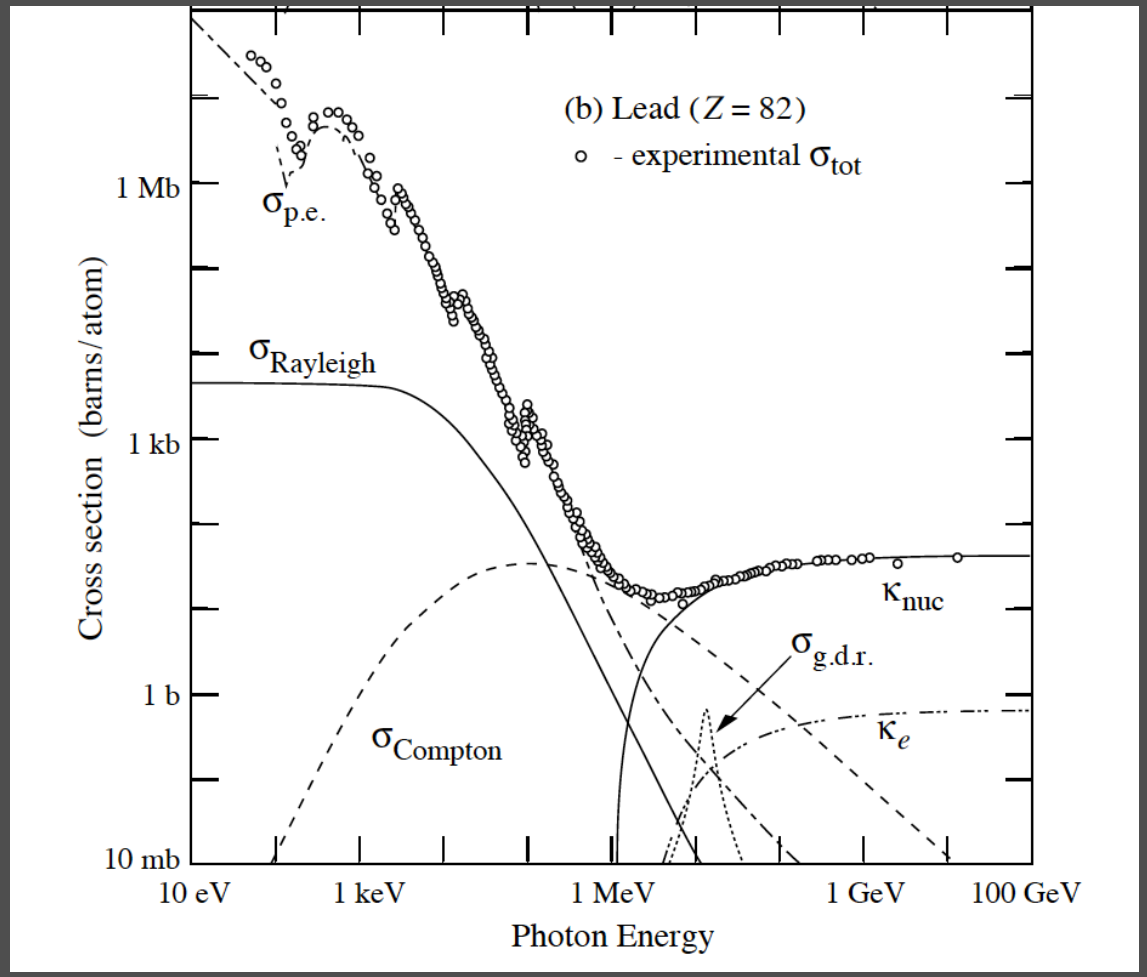


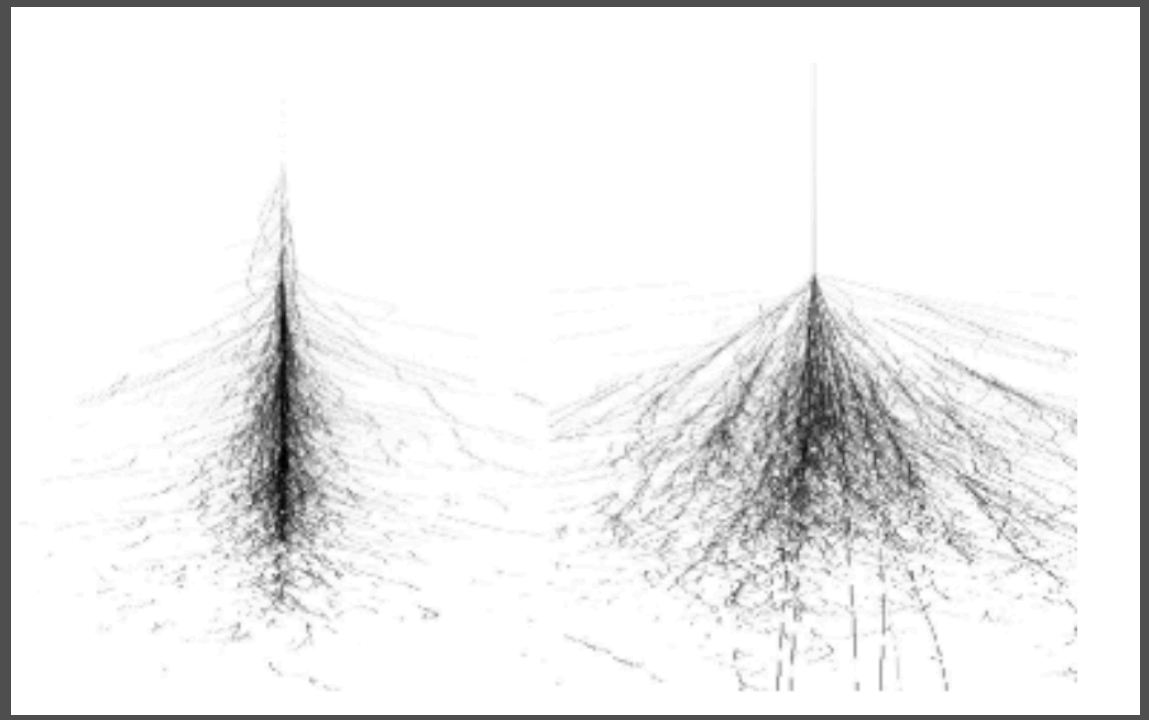
3. FERMI - HOW



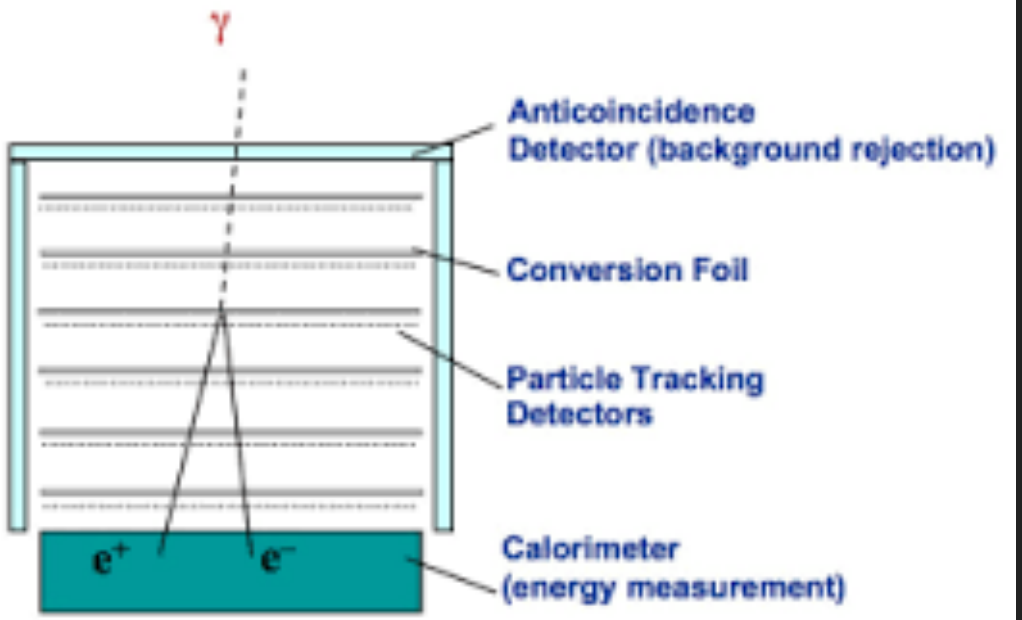
ASTRONOMIA ATTRAVERSO LO SPETTRO ELETTROMAGNETICO

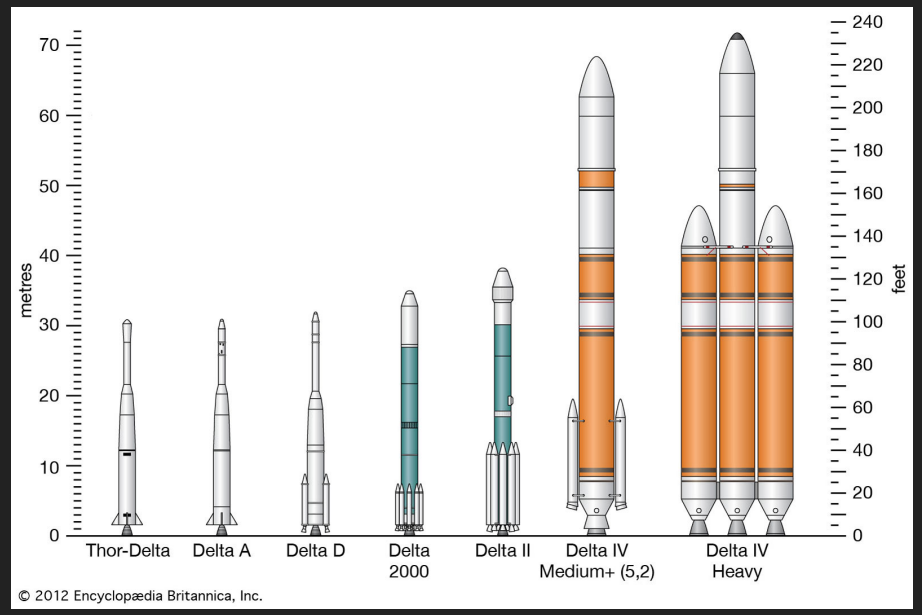
OSSERVIAMO L'UNIVERSO A DIVERSE DISTANZE
LA TECNOLOGICA E' FONDAMENTALE





INTERAZIONI DI UN FOTONE CON LA MATERIA

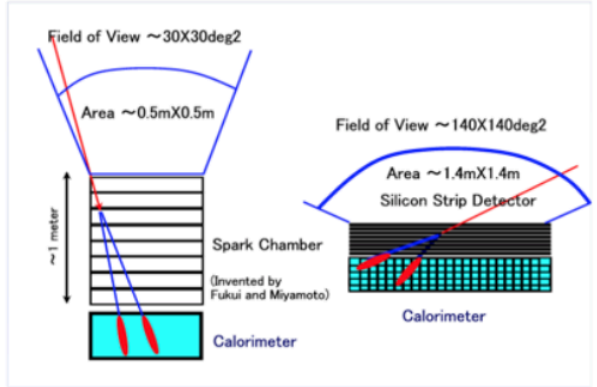




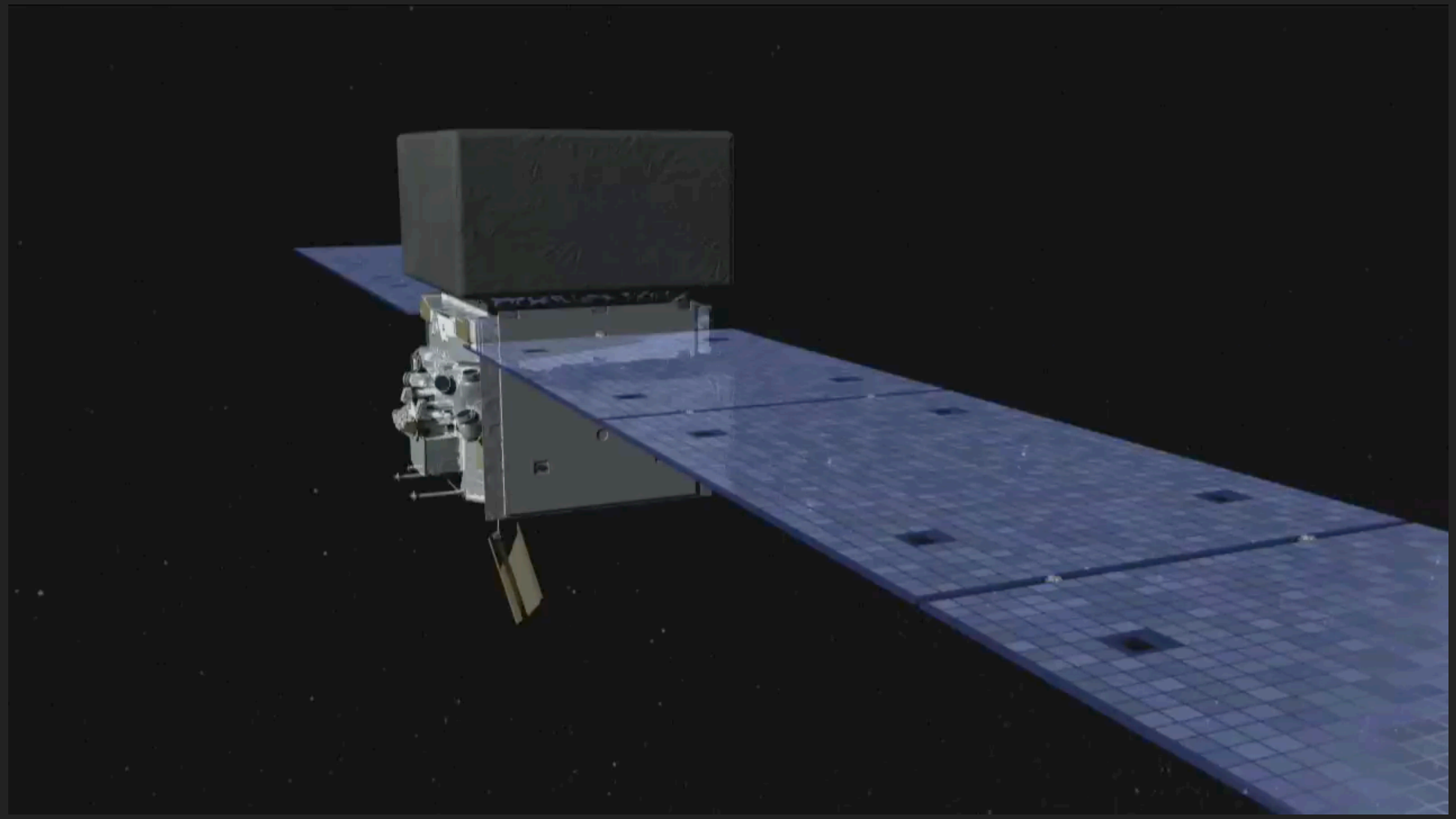
Gamma-ray Space Telescope

Design drivers

- ✦ Size to Delta II payload capacity
  - Instrument mass <3000 kg
  - Maximum transverse size ~1.8 m
- ✦ Module size
  - Maximum length of silicon strip detectors read out by single channel of electronics
    - ✦ Noise from strip capacitance
- ✦ Power < 1000 watts
  - Limit on silicon strip detector channel count, maximum number of tracking layers
- ✦ Mass < 3000 kg
  - Adjust depth of calorimeter
  - Minimum depth 10 radiation lengths



- ✦ Large field of view
  - Zenith-pointed, sky-survey instrument
  - Cover large fraction of sky each orbit
- ✦ Energy reach
  - 20 MeV to 300 GeV (and more)
- ✦ Event dead time
  - <100 us requirement

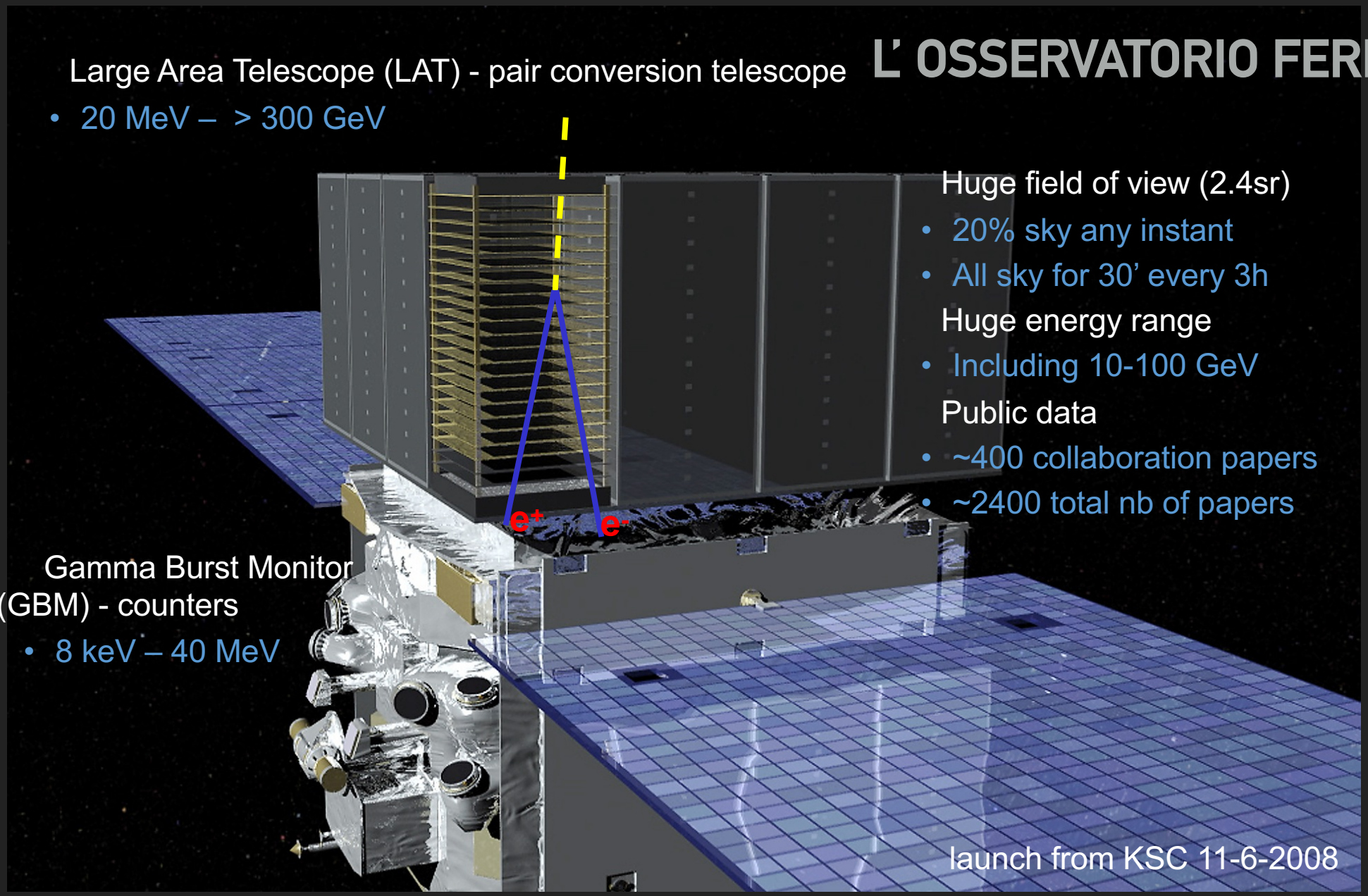


4. FERMI - WHAT

L' OSSERVATORIO FERMI

Large Area Telescope (LAT) - pair conversion telescope

- 20 MeV – > 300 GeV



Huge field of view (2.4sr)

- 20% sky any instant
- All sky for 30' every 3h

Huge energy range

- Including 10-100 GeV

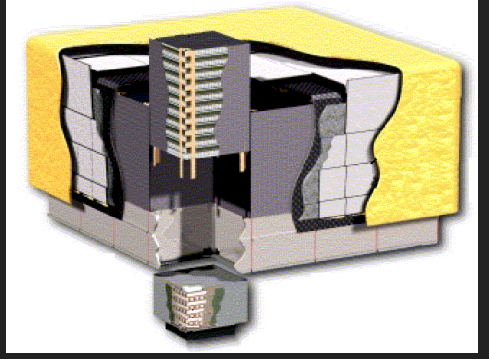
Public data

- ~400 collaboration papers
- ~2400 total nb of papers

Gamma Burst Monitor (GBM) - counters

- 8 keV – 40 MeV

launch from KSC 11-6-2008



LAT:

- modulare - 4x4 array
- 3ton – 650watts

Anti-Coincidence (ACD):

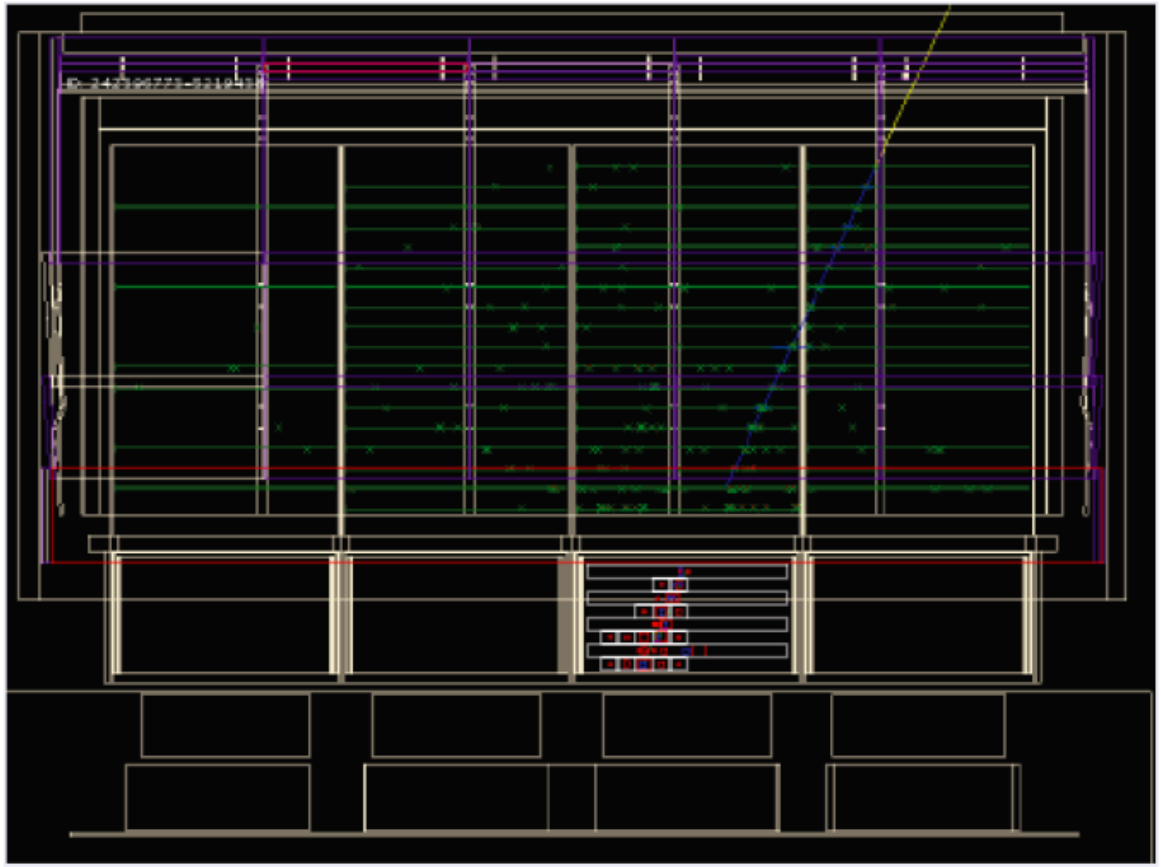
- ~100 scintillatori ad altissima efficienza

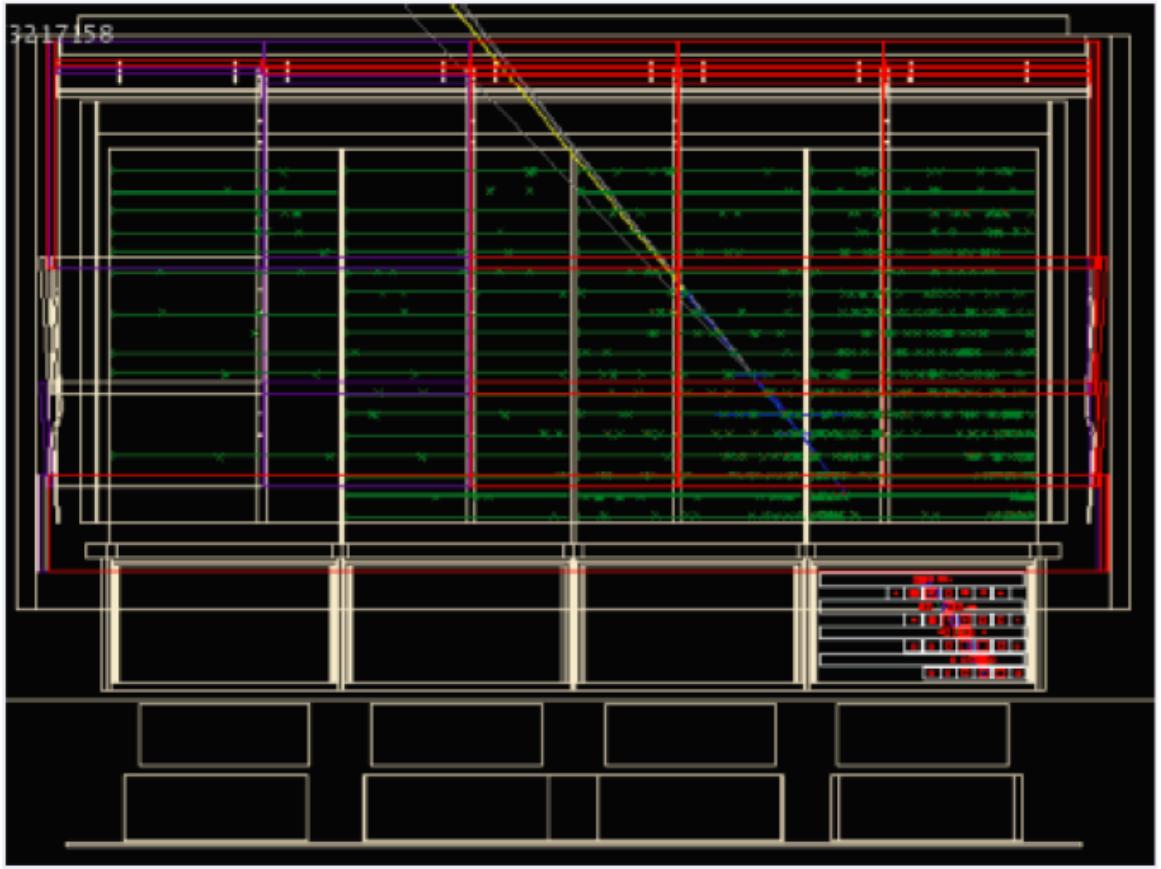
Tracker/Converter (TKR):

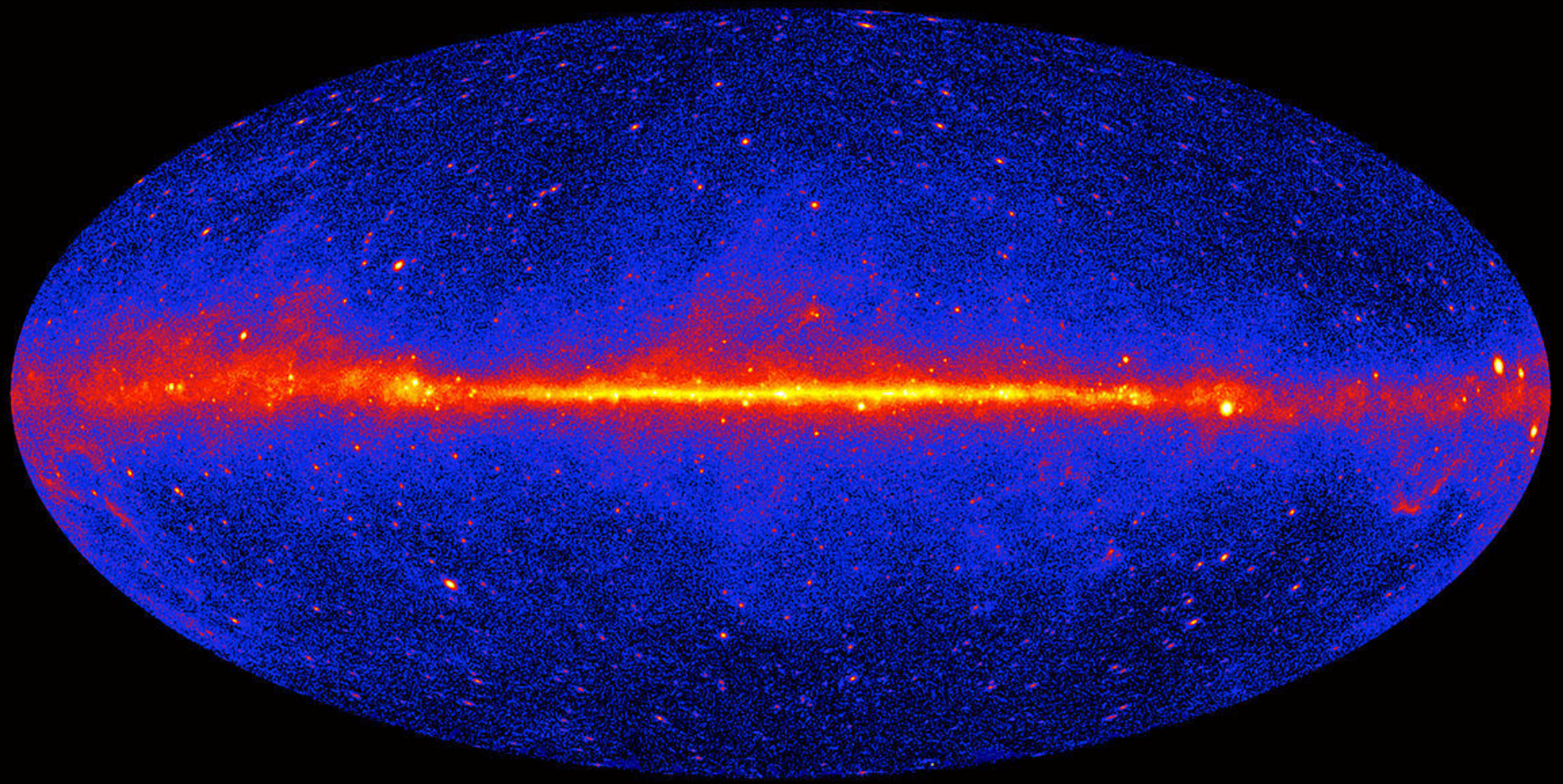
- Strip al silicio
- ~80 m^2 , 1M canali
- convertitori tungsteno

Calorimeter (CAL):

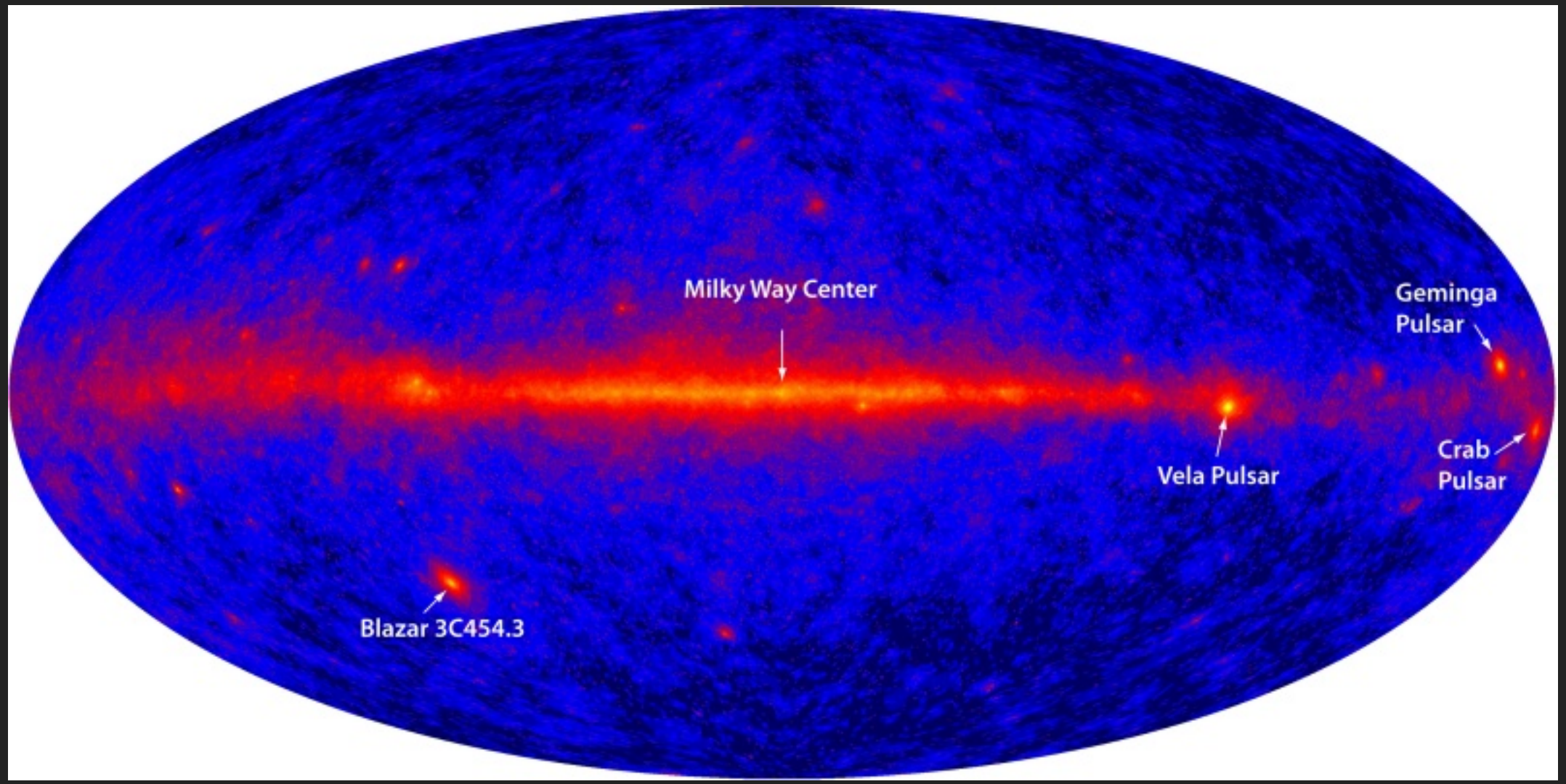
- 1536 CsI(Tl) crystals
- ~10k canali







IL CIELO DI FERMI - 11 ANNI

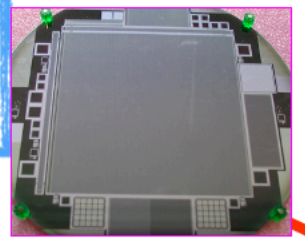


IL CIELO DI FERMI – PRIMA LUCE - 4 GIORNI

5. FERMI – WHERE –
IL TRACCIATORE

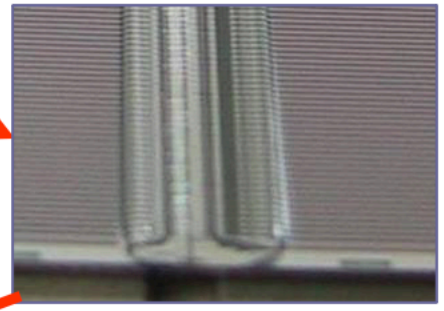
Module Structure Components
SLAC: Ti parts, thermal straps, fasteners.
Italy (Plyform): Sidewalls

SSD Procurement, Testing
SLAC,Japan, Italy (HPK)



10,368

SSD Ladder Assembly
Italy (G&A, Mipot)

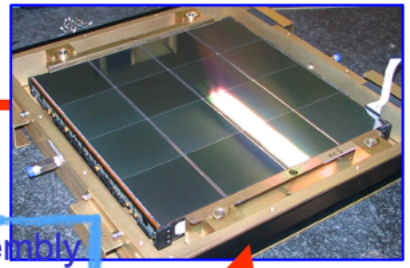


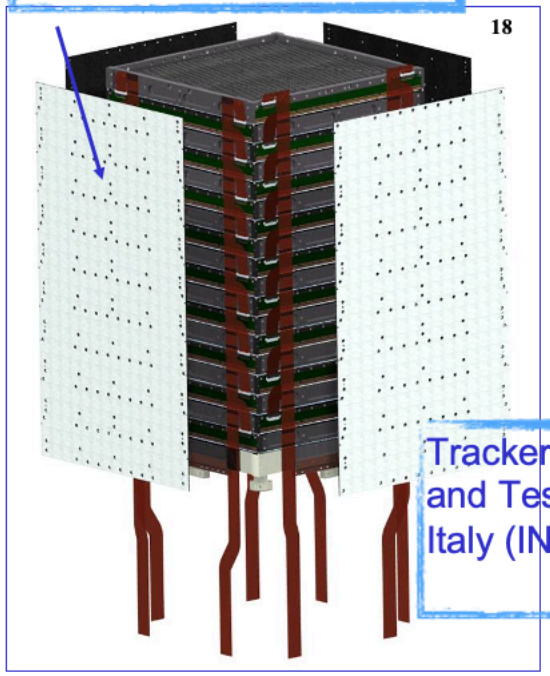
2592

Tray Assembly and Test
Italy (G&A)

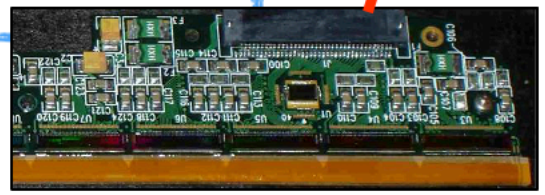
342

inter-ladder // 100μm





Tracker Module Assembly and Test
Italy (INFN, Alenia Spazio)



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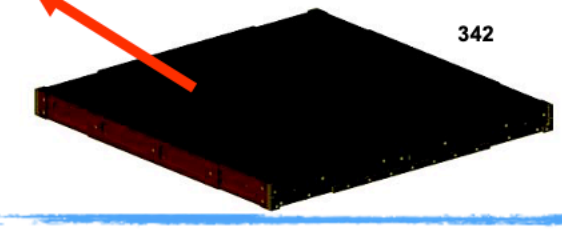

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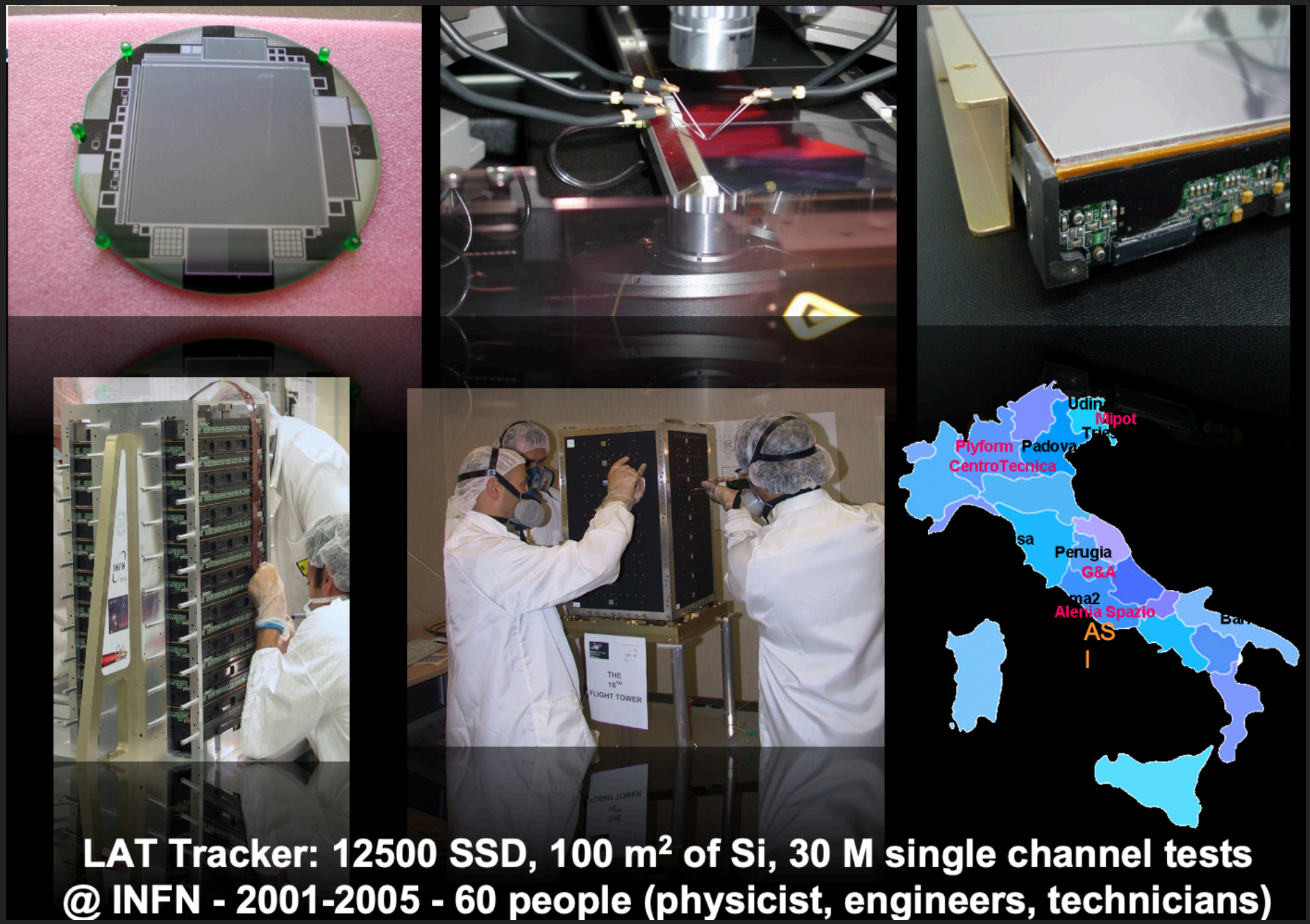
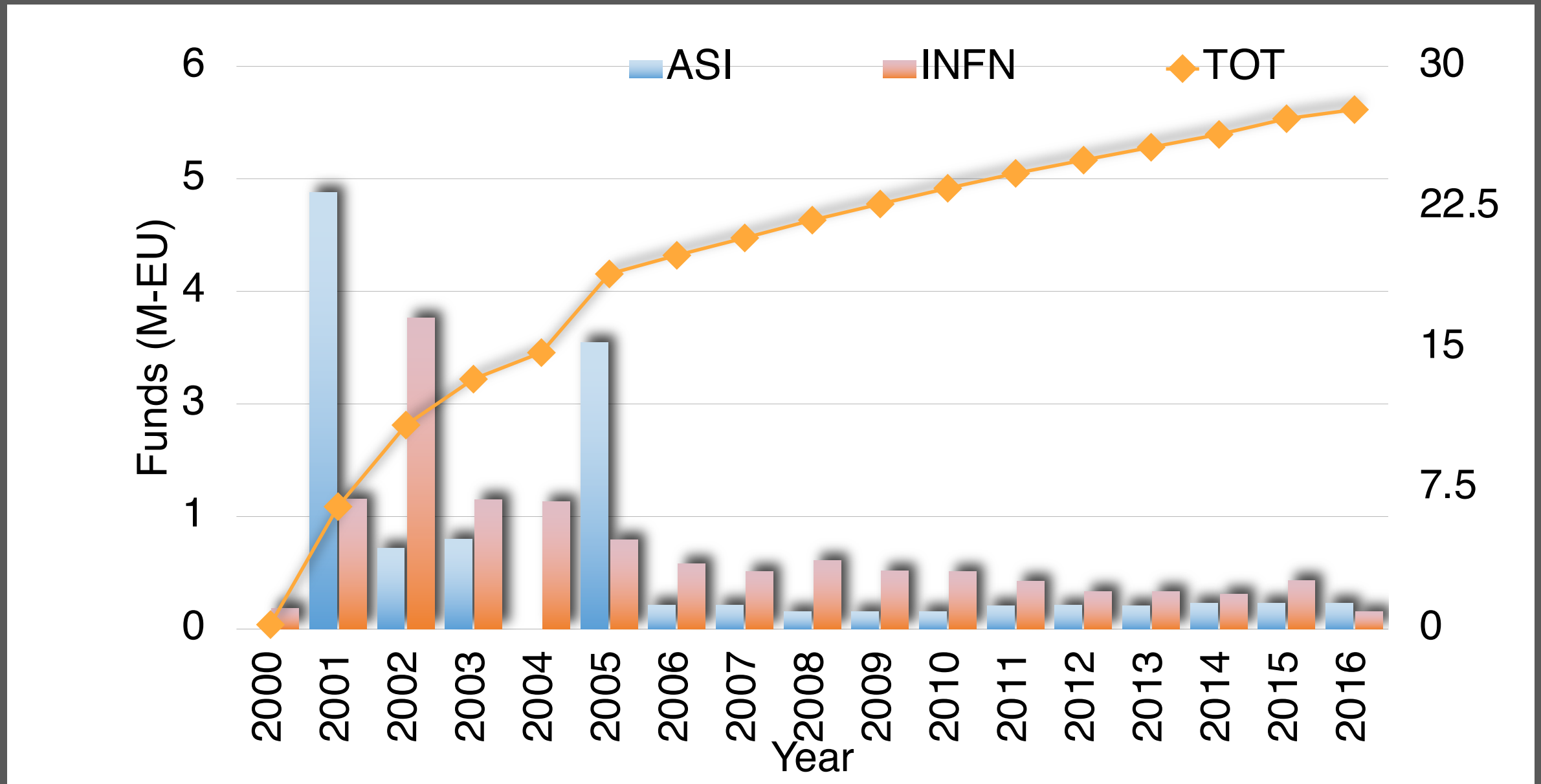
Composite Panel, Converters, and Bias Circuits
Italy (Plyform): fabrication
SLAC: CC, bias circuits, thick W, Al cores

Readout Cables
UCSC, SLAC
(Parlex)

Electronics Fabrication, burn-in, & Test
UCSC, SLAC (Teledyne)



LAT Tracker: 12500 SSD, 100 m² of Si, 30 M single channel tests @ INFN - 2001-2005 - 60 people (physicist, engineers, technicians)


ASI
INFN
TOT
Funds (M-EU)
6
5
4
3
1
0
30
22.5
15
7.5
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Year

6. FERMI - WHO

WE WANT YOU!