HEAPnet
High Energy Astroparticle Physics network

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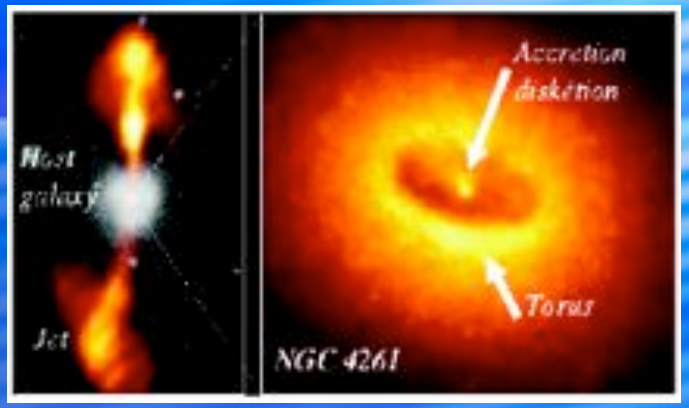
Study of Extreme Universe

- Understand cosmic ray origin and propagation
- Learn more about cosmic magnetic fields
- Understand relativistic winds, shock acceleration, jet formation, extreme electrodynamics
- Search for antimatter
- Indirect detection of dark matter
- Search for exotic particles and New Physics



Experiments:

High-energy gamma rays:

(Ground) HESS, MAGIC, VERITAS, ARGO

(Space) GLAST, AGILE, AMS

Charged particles:

(Ground) Pierre Auger Observatory, KASCADE-Grande, Pyhäsalmi mine

(Space) AMS, Pamela, BESS-Polar, CREAM, EUSO

High-energy neutrinos:

ANTARES, NEMO, NESTOR, KM3, AMANDA/ICECUBE, Pierre Auger Observatory

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HEAPnet Objectives

HEAP characteristics

- Global experiments
- Virtual infrastructure
- Most experiments currently taking data
- Site important part of experiment
- European scientists playing major role in planning and constructing experiments

Objectives

- Create synergy and coordination between different observations: from multi-wavelength to multi-messenger
- Maximize science output: public data
- Develop new detection techniques
- Evaluate new observation sites
- Great links to other science fields

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HEAPnet I3 Proposal in FP6

Ground and space experiments

130 laboratories, about 800 scientists

- Networking activities
  - Interconnect experiments
- JRAs
  - Photodetectors
  - Radiodetection
  - Spacedetectors
  - Atmospheric monitoring
- TA
  - Gamma observatories
  - Deep-Sea Platform for other scientists

Budget request (FP6)

- Networking: 1.4 M€
- TA1: 0.689 M€
- TA2: 0.345 M€
- JRA1: 2.86 M€
- JRA2: 0.998 M€
- JRA3: 1.654 Me
- JRA4: 1.033 M€
- TOTAL: 8.969 M€

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Evaluation results

- Strengths:
  - A very strong scientific case
  - A very good management structure
  - Outstanding JRAs
  - A very good outreach and educational plan
- Weaknesses:
  - NAs not convincing
  - TA weaknesses: satellites not yet launched, only small part of data goes to guest programs (HESS, MAGIC), access to multidisciplinary science not clear
  - ILIAS (already funded) covers related work

HEAPnet proposal for FP7

- HEAPnet meeting February 19-20 (Amsterdam)
- Coordination HEAPnet - ILIAS ?
- Strengthen the Transnational Access
  - Public data, data centers, guest programs
- JRAs are strong and transversal
  - Include acoustic detection
- TA
  - Gamma observatories
- Include other space experiments ?

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TRANSNATIONAL ACCESS ACTIVITIES

Discussion on access to observatories

Purpose:

Implementation of a Virtual Observatory with a collection of Cosmic Rays and High-Energy Gamma Rays data archives and software tools to form a scientific research environment in which multi-messenger astroparticle research programs can be conducted.

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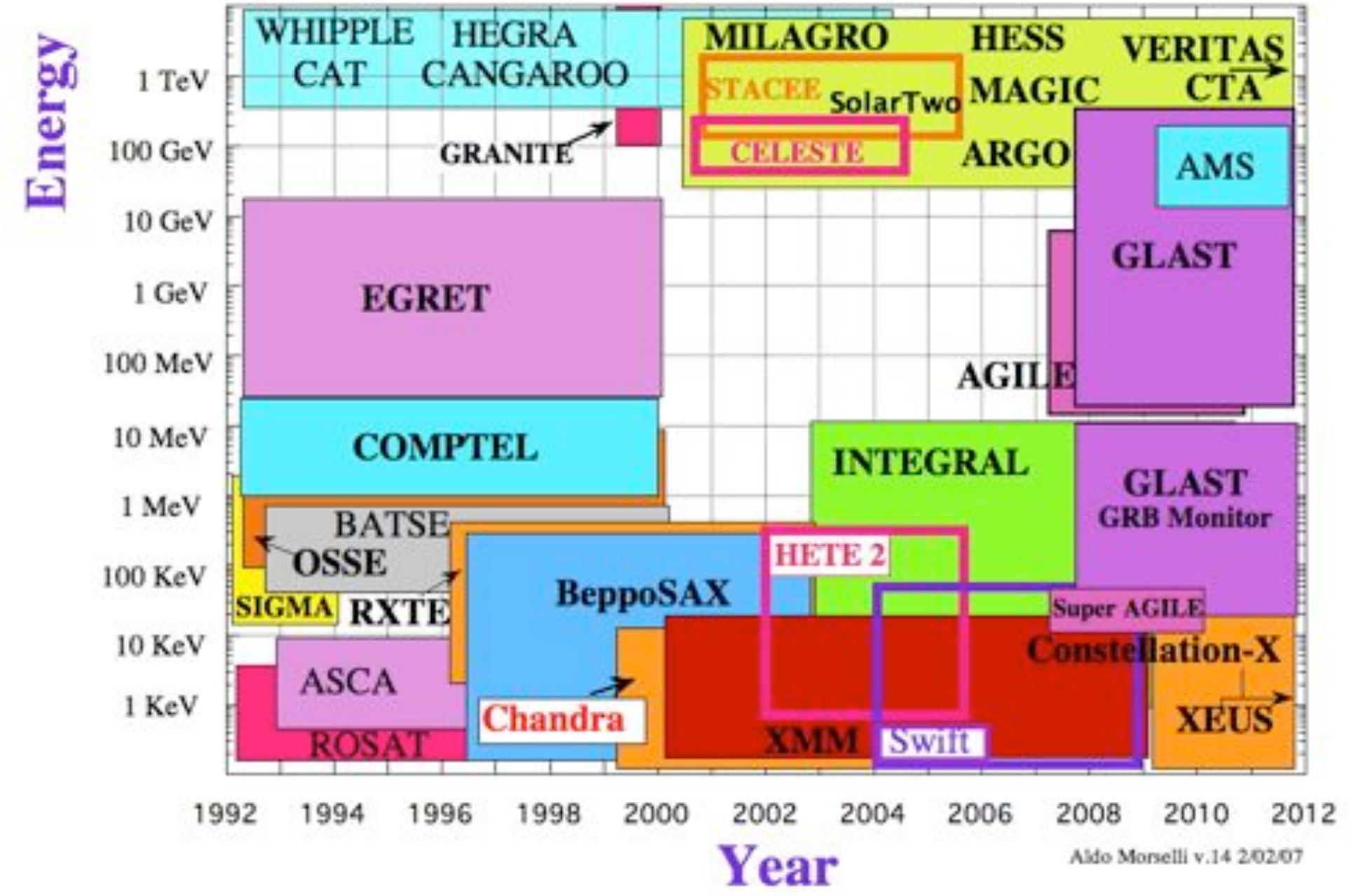
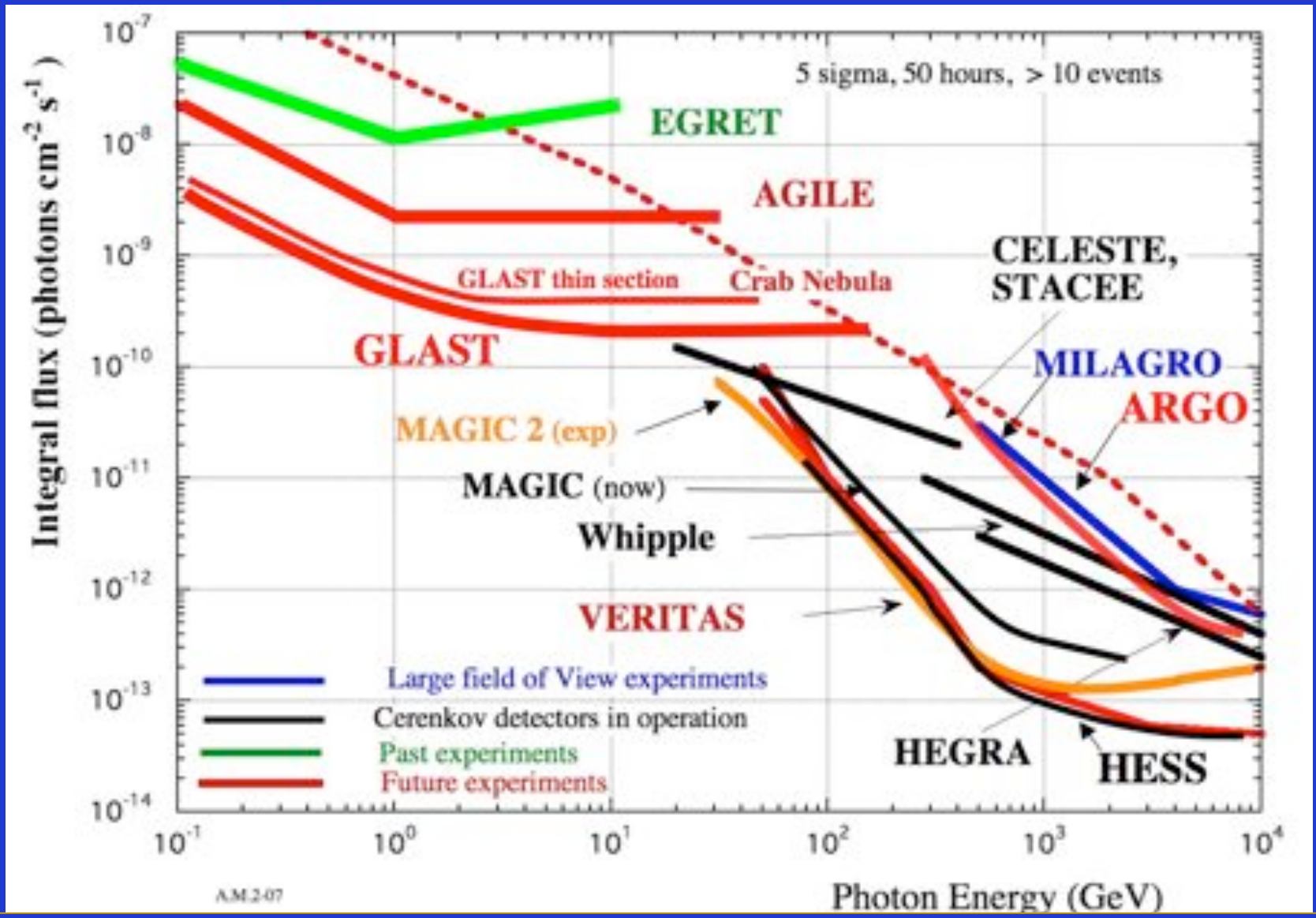
Energy versus time for X and Gamma ray detectors



Sensitivity of γ-ray detectors



High galactic latitudes (background Φ_b=2 10^{-5} γ cm^{-2} s^{-1} sr^{-1} (100 MeV/E)$^{1.1}$). Cerenkov telescopes sensitivities (Veritas, MAGIC, Whipple, Hess, Celeste, Stacee, Hegra) are for 50 hours of observations. Large field of view detectors sensitivities (AGILE, GLAST, Milagro, ARGO) are for 1 year of observation.

TA1 : Access to *"Virtual Data"(TA-ViDa1)*

H.E.S.S.

PARIS

MUNICH

MAGIC

AGILE
PAMELA
GLAST

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Transnational Access

Access to and exchange of data

- A (web-based) database of astro-particle observations and the exchange of inter-disciplinary data

- Computer modelling and simulations

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expected impact:

- Correlate observations of space experiments (AGILE, GLAST) and ground observations (H.E.S.S., MAGIC, ARGO).
- Multi-wavelengths programs including x-rays, radio, IR, Optical ....
- Develop observation methods for transient sources: alert systems and combination of space and ground observations .
- Correlate γ observations with ν and CR observations.
- Evaluate potential discovery and physics outcome.

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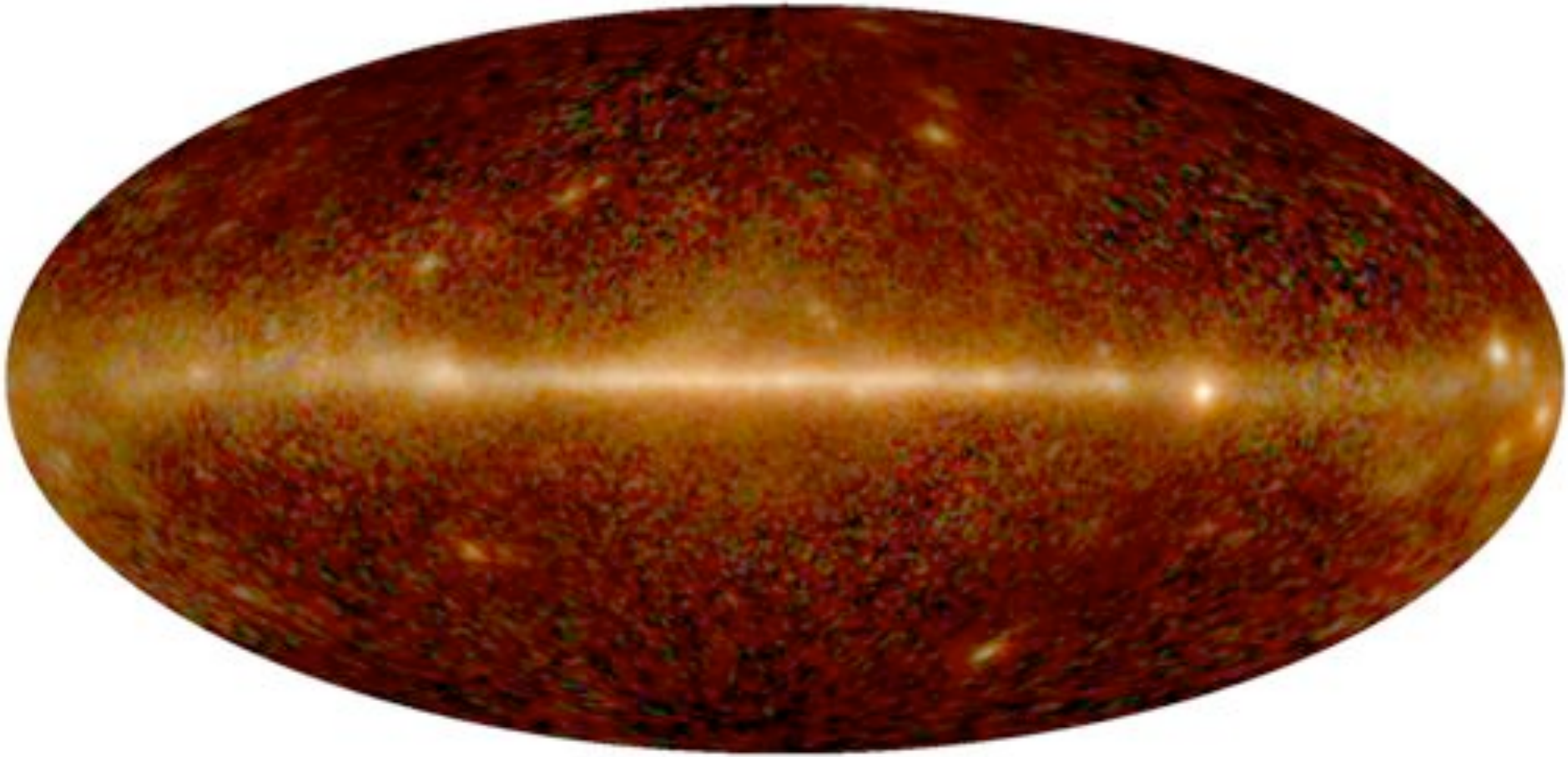
EGRET



- 271 sources

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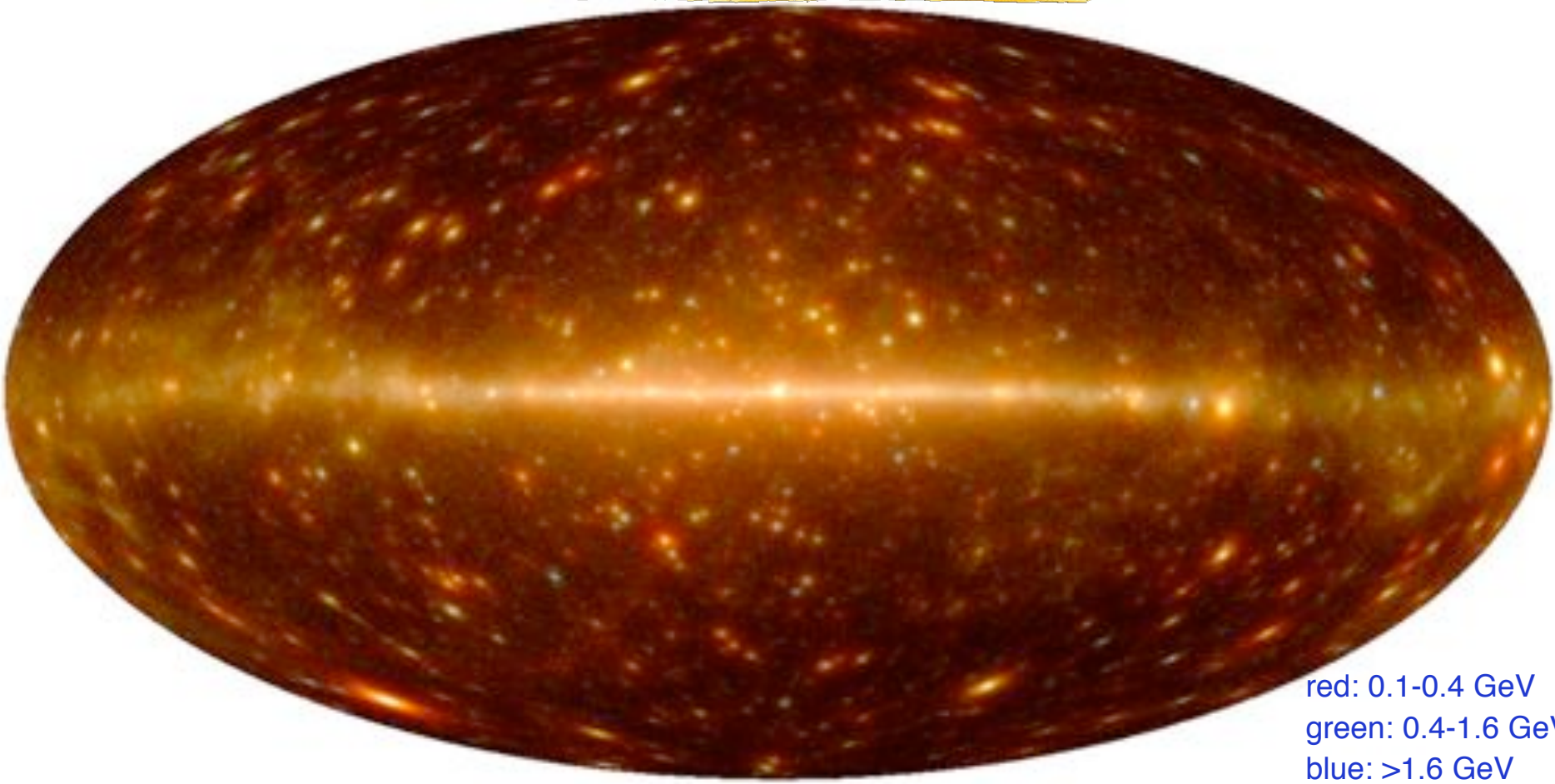
GLAST



red: 0.1-0.4 GeV
green: 0.4-1.6 GeV
blue: >1.6 GeV

> 9000 sources are foreseen

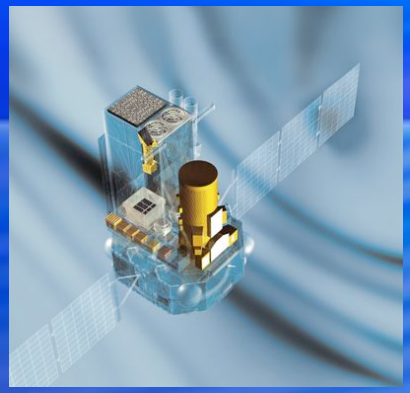
First GLAST Symposium Feb. 2007
http://glast.gsfc.nasa.gov/science/symposium/2007/

GLAST is ready to fly

Photons from Space (Europe)

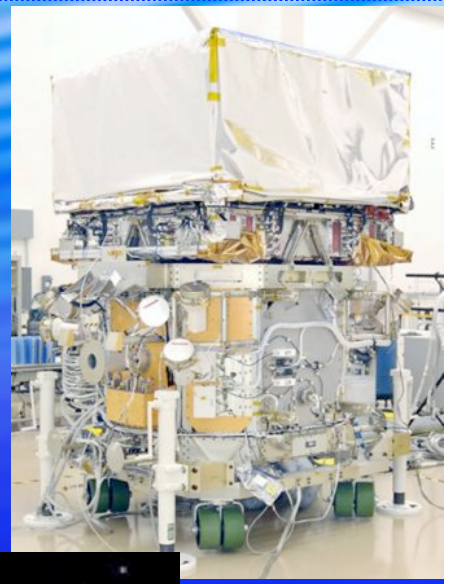
XMM, 0.2-15 keV

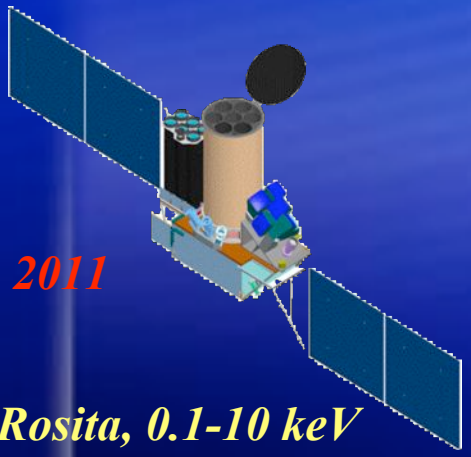
INTEGRAL, 6 keV-8 MeV



AGILE, 15 keV-50 GeV
March 2007

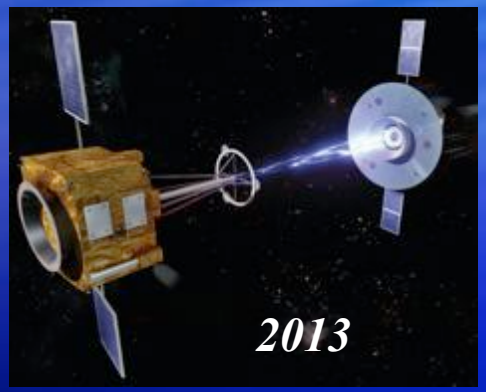
GLAST
LAT 20 MeV-300 GeV
GMB 10 keV- 25 MeV
November 2007





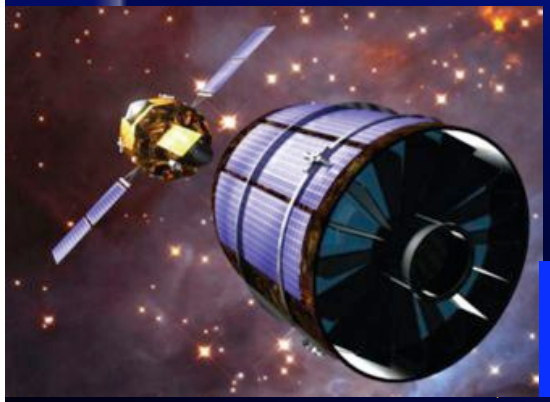
2011

eRosita, 0.1-10 keV



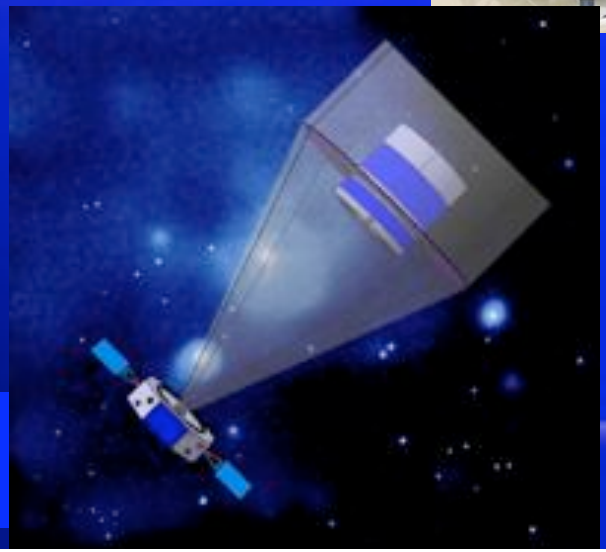
2013

SIMBOL X, 0.5-80 keV



XEUS

←2020 →



NG
Gamma
Telescope

VHE Gamma Rays from Ground (Europe)

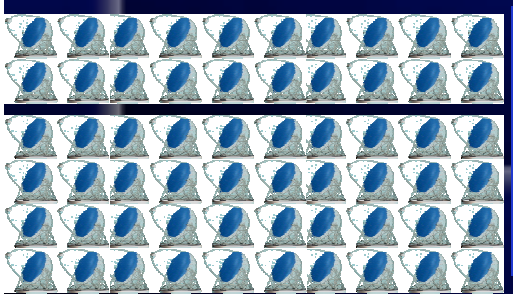
HESS 100 GeV-50 TeV

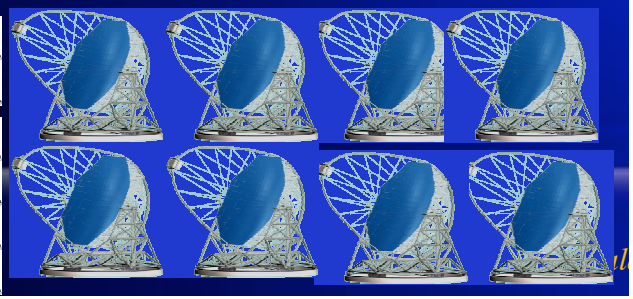
MAGIC 50 GeV- 10 TeV

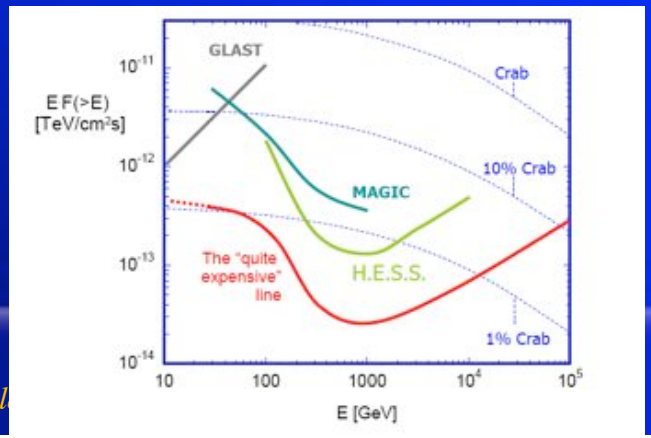
HESS II 20 GeV-50 TeV, 2008

MAGIC II 20 GeV- 10 TeV, 2007

CTA, 2012 (?)







Milestones:

- Definition of a Coordination between ground and space gamma ray observatories
- ii) Definition of a Coordination between existing MW programs such as:

Whole Earth Blazar Telescope [WEBT]

(http://www.to.astro.it/blazars/webt/homepage.html).

and/or

European Network for the Investigation of Galactic Nuclei through Multifrequency Analysis [ENIGMA] (http://www.lsw.uni heidelberg.de/users/swagner/enigma.html).

and space and ground gamma-ray observation

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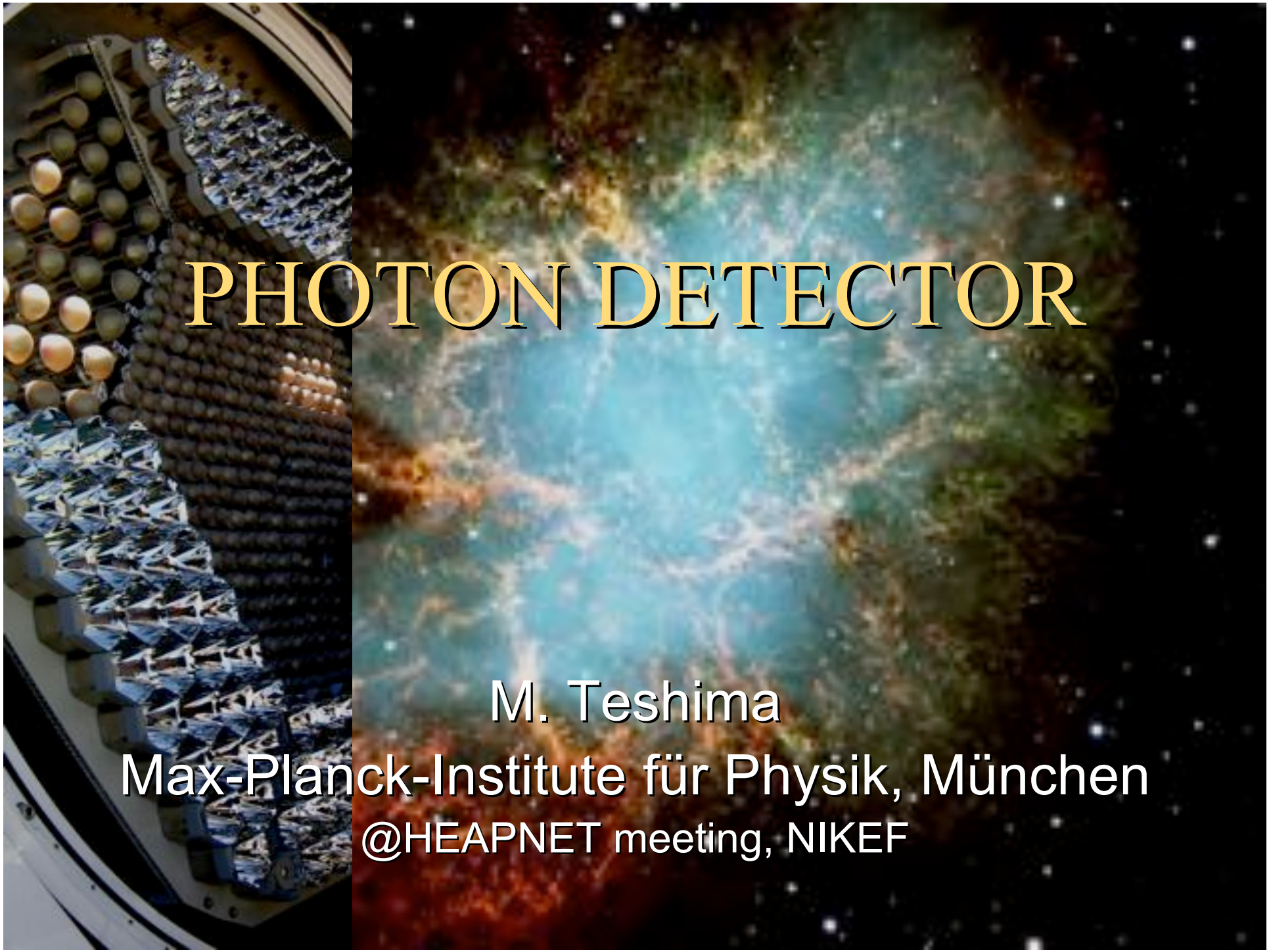

PHOTON DETECTOR

M. Teshima
Max-Planck-Institute für Physik, München
@HEAPNET meeting, NIKEF

Photon detectors in HEAP

- Photon detectors → Key element for high energy astroparticle physics
- Limited flux / rare events → Large area / Large Volume → Transparent Material (Air, Water, ICE) → Photon detectors
- For example
  - Ground based Gamma Ray Astronomy
    - Imaging Air Cherenkov Telescopes
  - High Energy Neutrino Astronomy
    - Water / ICE Cherenkov detectors
  - Ultra High Energy Cosmic Rays
    - Water tanks, Scintillation detectors
    - Ground-based air fluorescence detectors
    - Space-born air Fluorescence detectors

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Improvements and Developments of photon detectors

- Improvements and developments of photo sensors have a big impact on physics and detector designs in HEAP

- Higher quantum efficiency / High photo-detection efficiency
  - Lower threshold energy (wider energy range)
  - Equivalent to enlarge telescope
- Very Fast response
  - Better angular / position resolution
  - Better noise reduction
- Pixel detectors and direction sensitive detectors
  - Imaging
  - Better signal to noise ratio
- Associated development
  - Fast, High Integrated Readout Electronics
  - Analogue signal fiber transmission
  - High reflective material
- Service facilities
  - Photodetector measurement/characterization labo in EU
  - PHOTODAC workshop

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HEAPNET Amsterdam: February 20, 2007

Space-Based Detection for High-Energy AstroParticle Physics experimental studies: innovative developments.

Alessandro Petrolini

Physics Department University of Genova and INFN, Italy.

SPADET

innovative developments for Space-Based Experiments
in High-Energy AstroParticle physics experimental studies.

A report on the SPADET FP6/HEAPNET/JRA4 proposal...
science was already described...
no time to talk in detail about all technical issues...

SPADET: objectives.

- To carry on R&D on a few specific and critical items
  required for next-generation space-based experiments in HEAP,
  by facing the specific challenges of space-based experiments.
- To create a network of knowledge and exchange of competence,
  exploiting the large amount of knowledge disseminated in Europe
  in the field of HEAP from space.
- To unify the European HEAP community establishing useful and stable links,
  getting rid of fragmentation of projects and infrastructures.
- To promote research activities according to the EU policy on Space,
  improving the links among Scientific Institutions, Industrial Companies and ESA.
- To establish a number of European reference facilities and infrastructures
  for the benefit of community engaged in the development of Space Missions.

EU Acoustic Detection Activities

Lee Thompson
University of Sheffield

HEAPNET Particle Astrophysics Meeting
NIKHEF, Amsterdam
19th February 2007

HEAPnet FP6 Networking Activities

- Multimessenger Investigations
- Cosmic Accelerators and Point Sources
- Search for Exotic Particles and Phenomena
- Coordination of Engineering and Exchange of Expertise