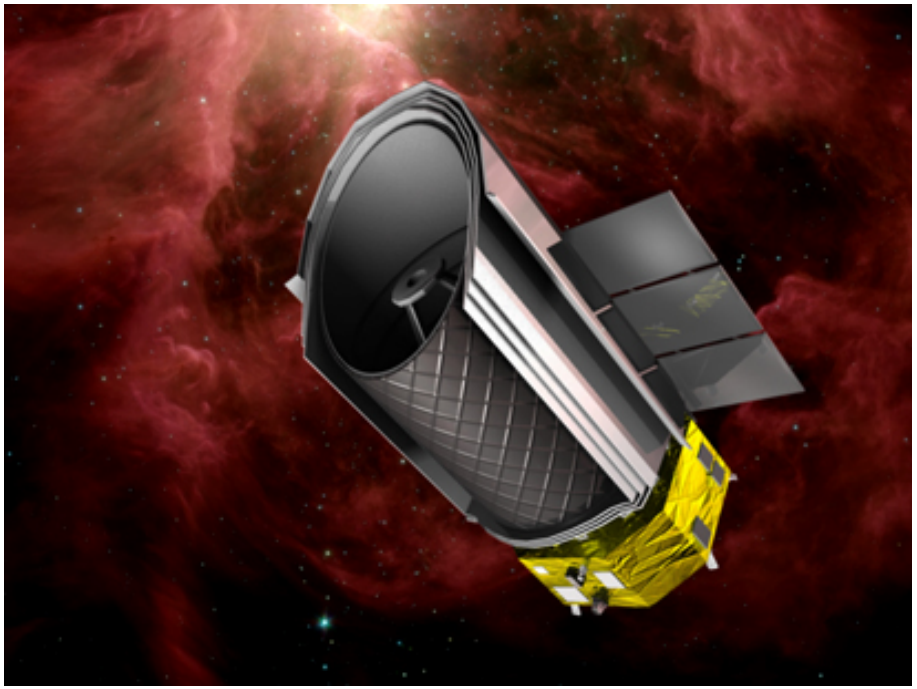
The Italian participation to SAFARI-SPICA is coordinated by IAPS - INAF

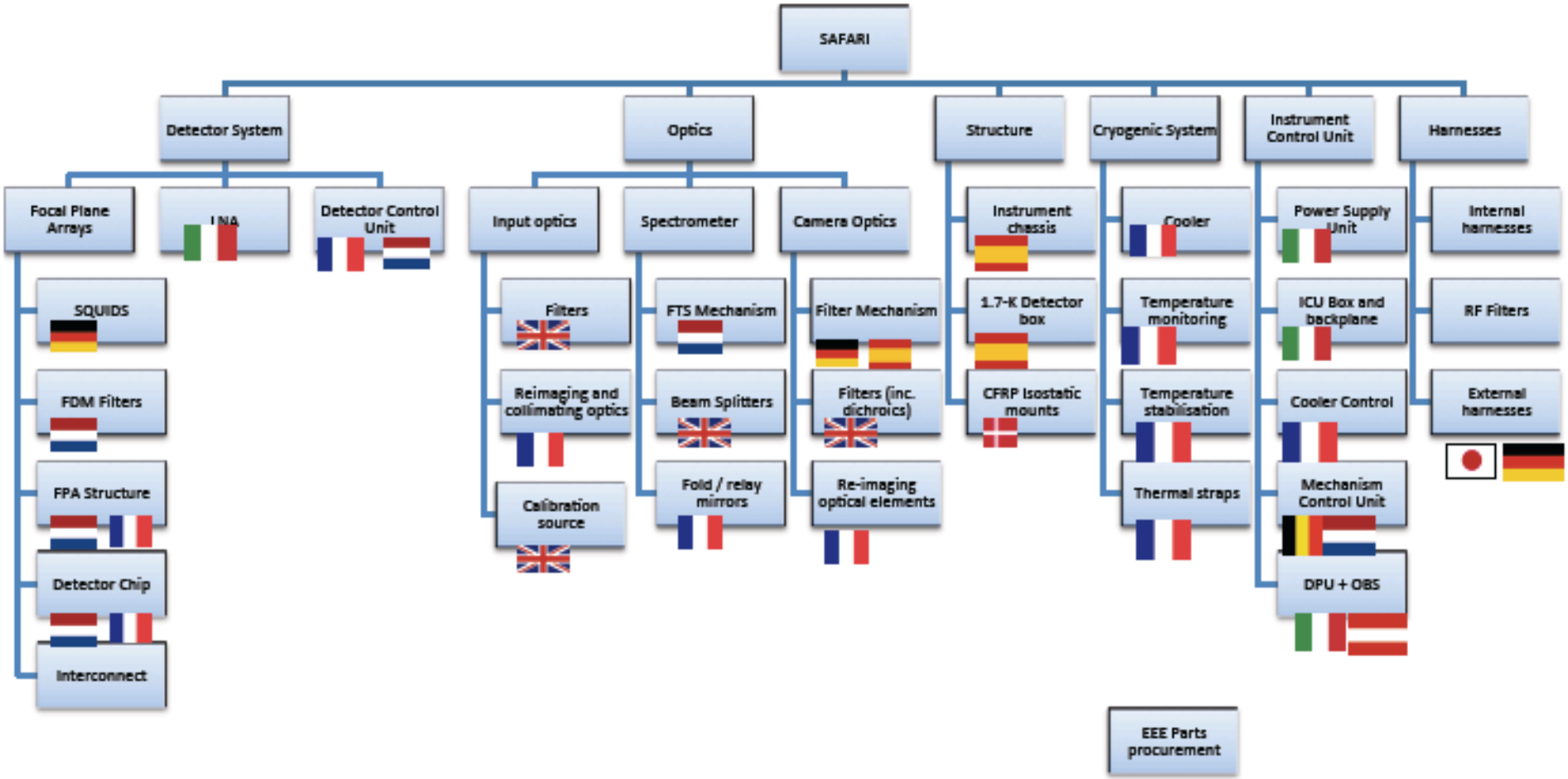


1. Instrument Control Unit:
   - DPU & OBS (IFSI)
   - ICU Box and backplane (national industry + IAPS)
   - Power Supply Unit (national industry + IAPS)
   - tests and integration of the ICU
     - MCU (Mechanisms Control Unit, NL+B), CCU (Cooler Control Unit, F) DPU (national industry + IAPS)

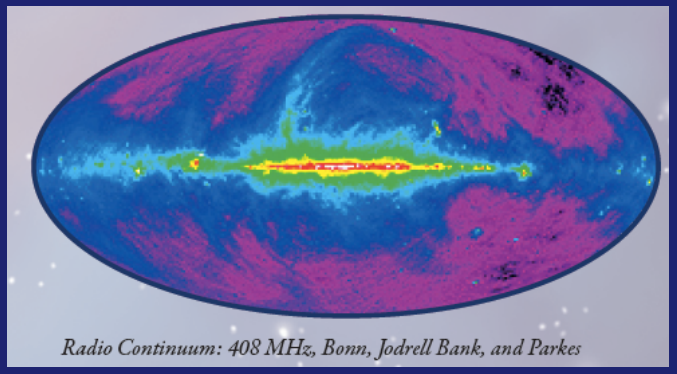
2. LNA (Low Noise Amplifiers) (national industry + IAPS)

3. Participation to the ICC (Instrument Control Center) IAPS-OABO-UniPD

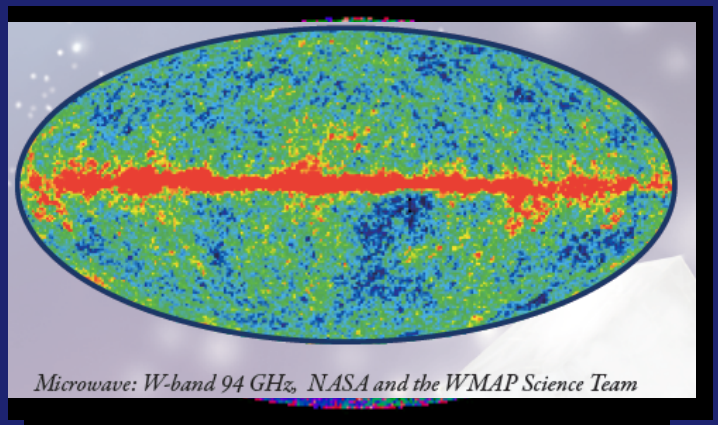
4. Participation to the Science Team IAPS-OABO-UniPD-UniBO
   - Two italian CoIs: L. Spinoglio & C. Gruppioni
   - Four associate scientists/CoI to be appointed


SAFARI
Detector System
Optics
Structure
Cryogenic System
Instrument Control Unit
Harnesses
Focal Plane Arrays
INA
Detector Control Unit
Input optics
Spectrometer
Camera Optics
Instrument chassis
Cooler
Power Supply Unit
Internal harnesses
SQUIDS
Filters
FTS Mechanism
Filter Mechanism
1.7-K Detector box
Temperature monitoring
ICU Box and backplane
RF Filters
FDM Filters
Reimaging and collimating optics
Beam Splitters
Filters (inc. dichroics)
CFRP Isostatic mounts
Temperature stabilisation
Cooler Control
External harnesses
FPA Structure
Calibration source
Fold / relay mirrors
Re-imaging optical elements
Thermal straps
Mechanism Control Unit
Detector Chip
DPU + OBS
Interconnect
EEE Parts procurement

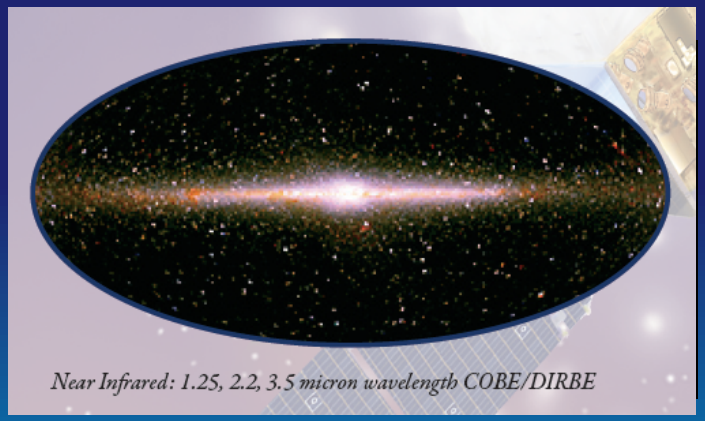
The multicolor Universe as was known 20 years ago…..and nowdays..



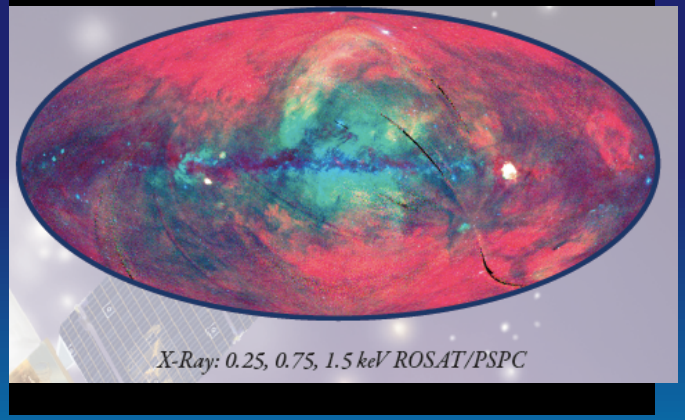
Radio Continuum: 408 MHz, Bonn, Jodrell Bank, and Parkes



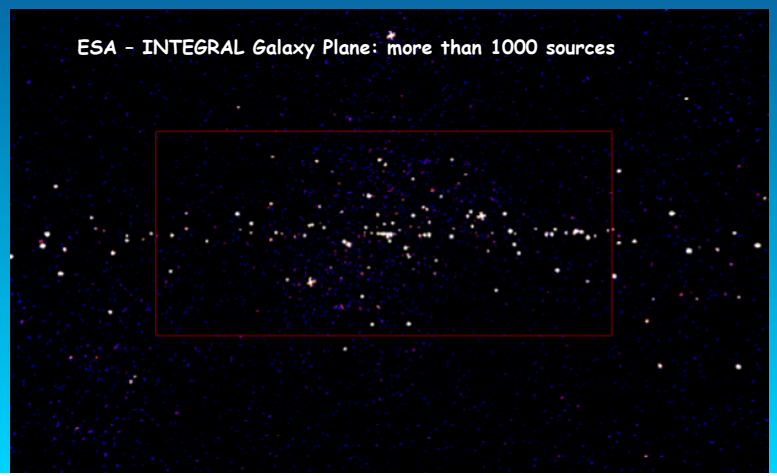
Microwave: W-band 94 GHz, NASA and the WMAP Science Team

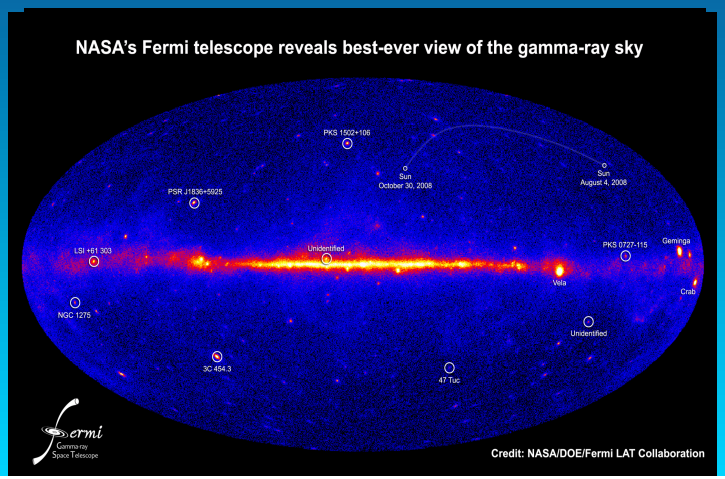


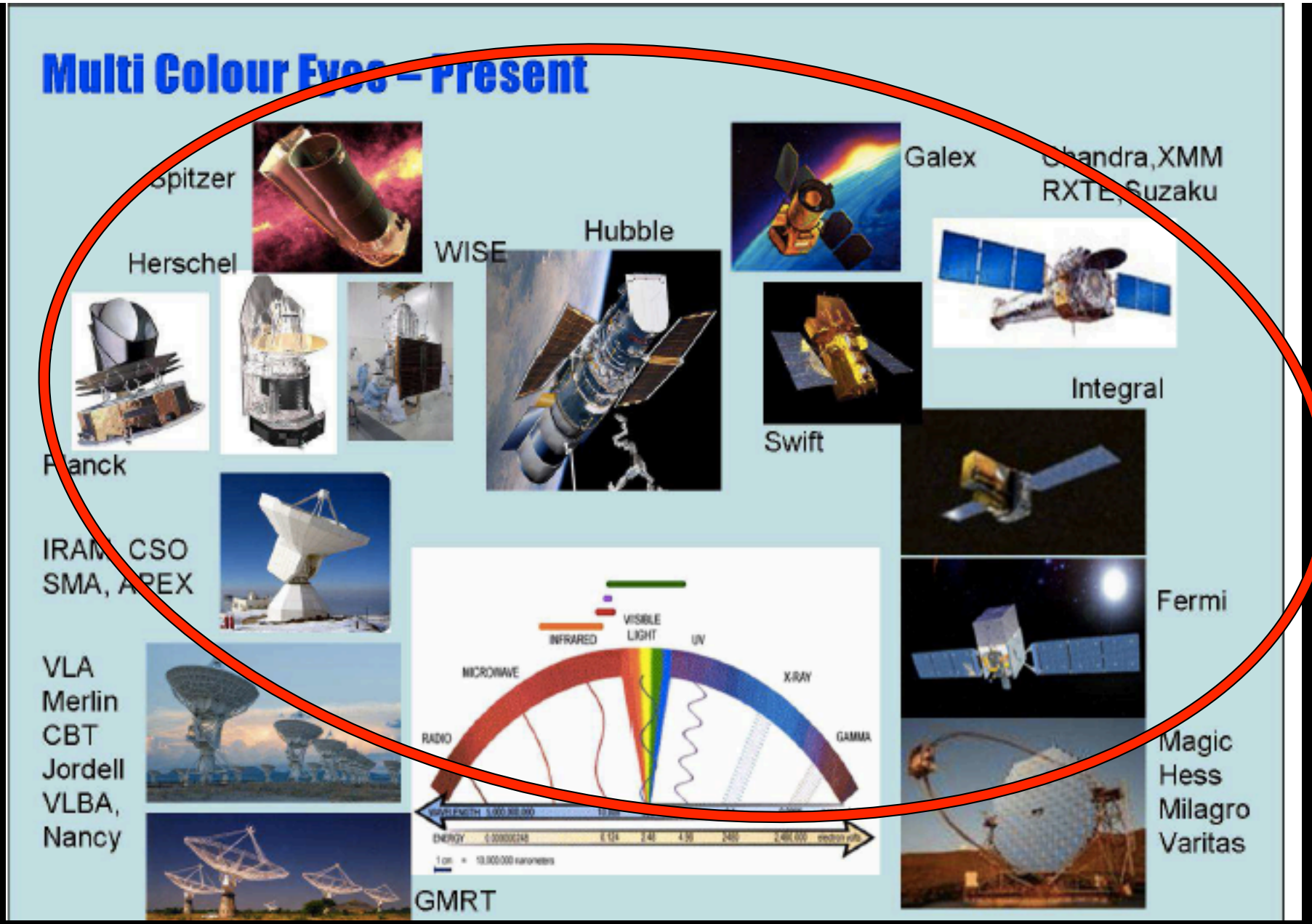
Near Infrared: 1.25, 2.2, 3.5 micron wavelength COBE/DIRBE



X-Ray: 0.25, 0.75, 1.5 keV ROSAT/PSPC

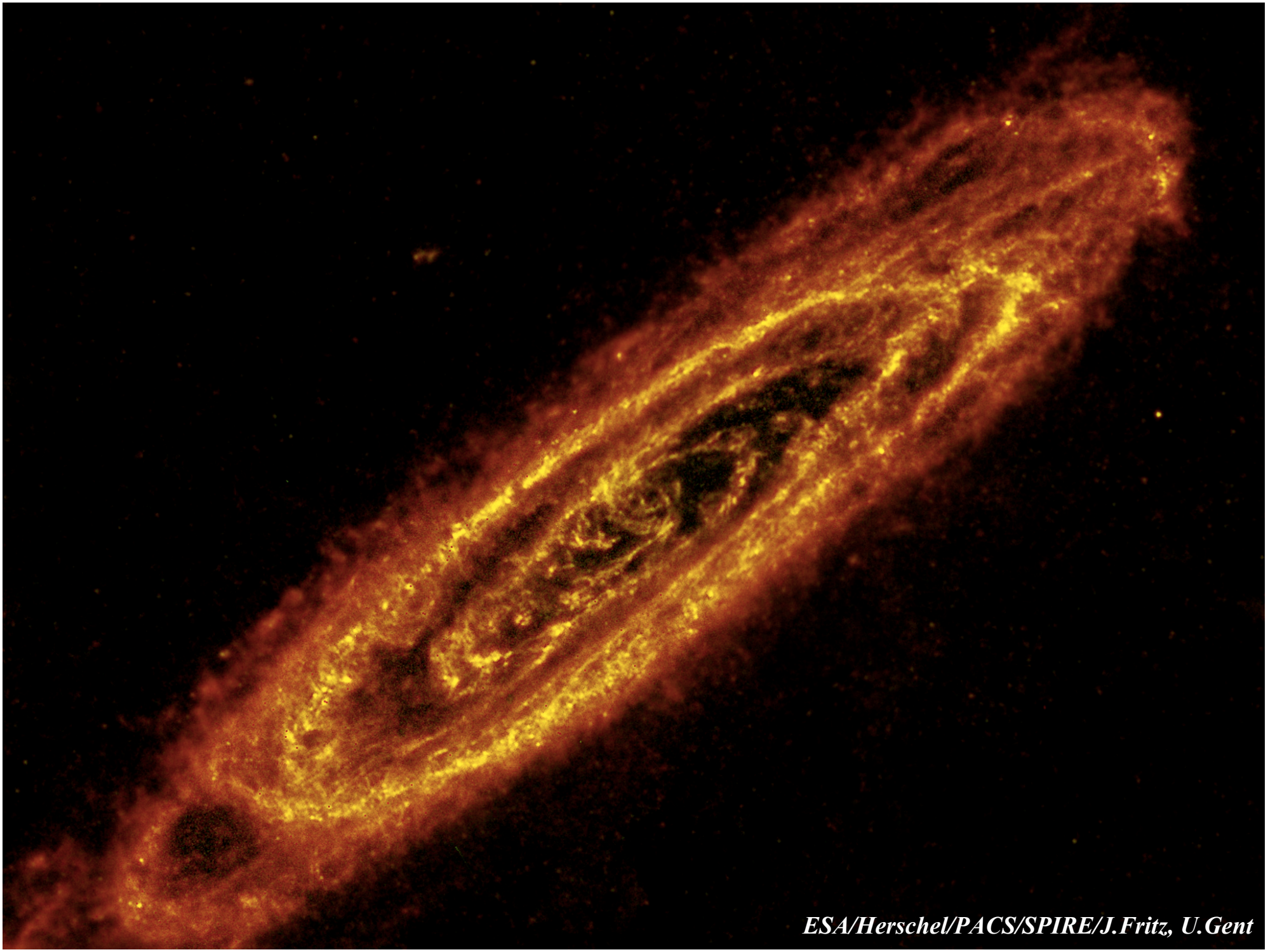


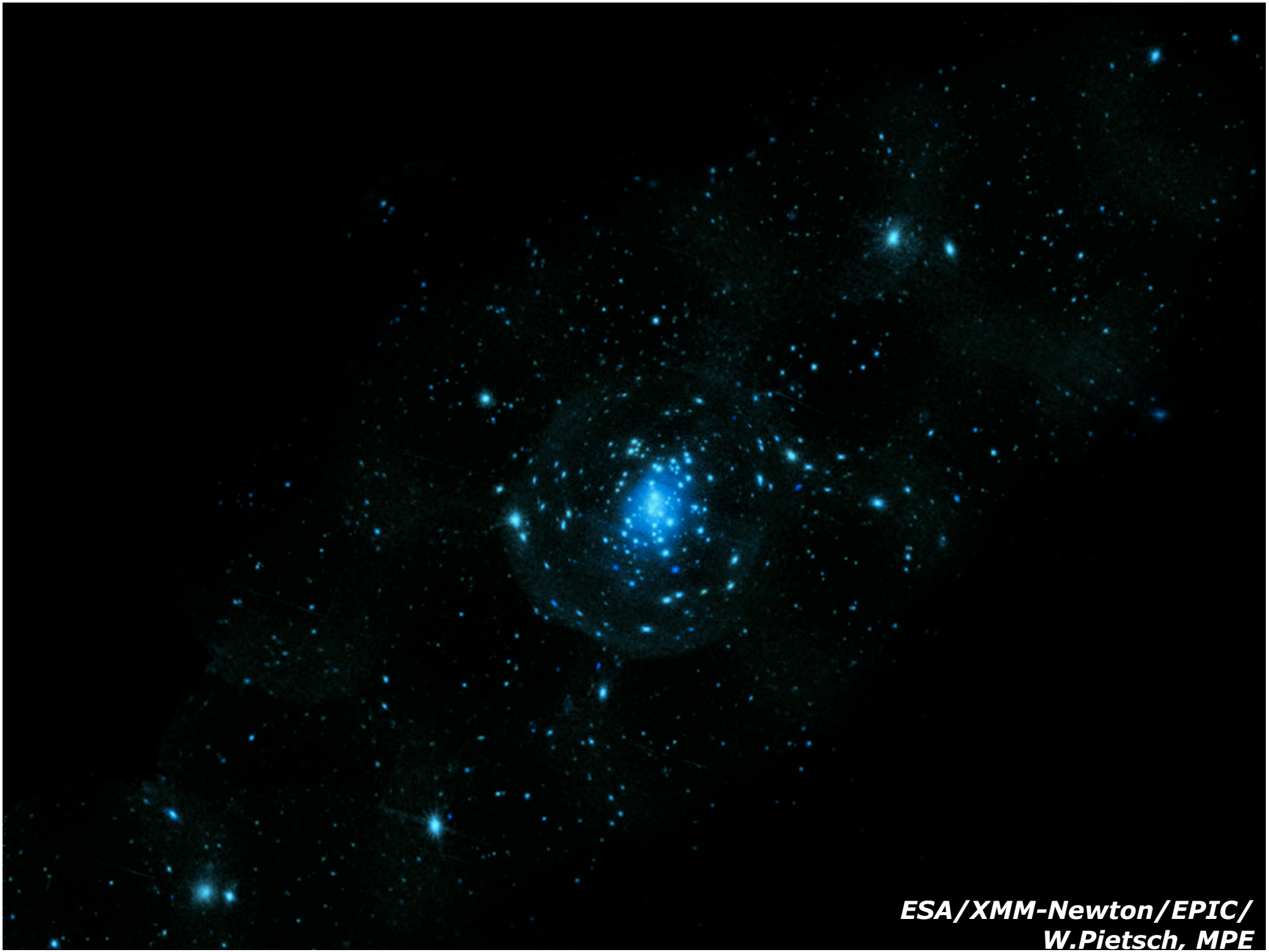




a golden age for space astronomy..SPECTACULAR RESULTS FROM SPACE OBSERVATORIES

Multicolor spectacular view of the Andromeda Galaxy seen at different wavelenghts, i.e. enhancing different states of its evolutionary hystory


ESA/Herschel/PACS/SPIRE/J.Fritz, U.Gent


ESA/XMM-Newton/EPIC/
W.Pietsch, MPE


Visible light: the living stars
Infrared: the 'birth' of the stars
X-Rays: the final stage of stars
..in a picture the whole story of the galaxies

This is the state of art… and open questions?

We need to probe the very early stages of the Universe, to understand how it evolved from the Big Bang, i.e. from the pure hydrogen in form of gas, to the 'monster' and 'mini' BHs.

→ how and when the 'first stars' were built is one of the fundamental question.

- Need for more powerful Space Observatories

→ there is a need to maintain a FULL ACCESS to the whole electromagnetic spectrum

- There is a solid plan for Ground Based facilities (SKA-½ Australia, ½ South Africa!, ELT, CTA) that must be complemented by the space-segment to get the full picture of how the Universe originated and what is it made off.

We have a unsecured future for Large space missions

These was the basic motivation for the establishment of the COSPAR Working Group "Future of Space Astronomy" on April 2010

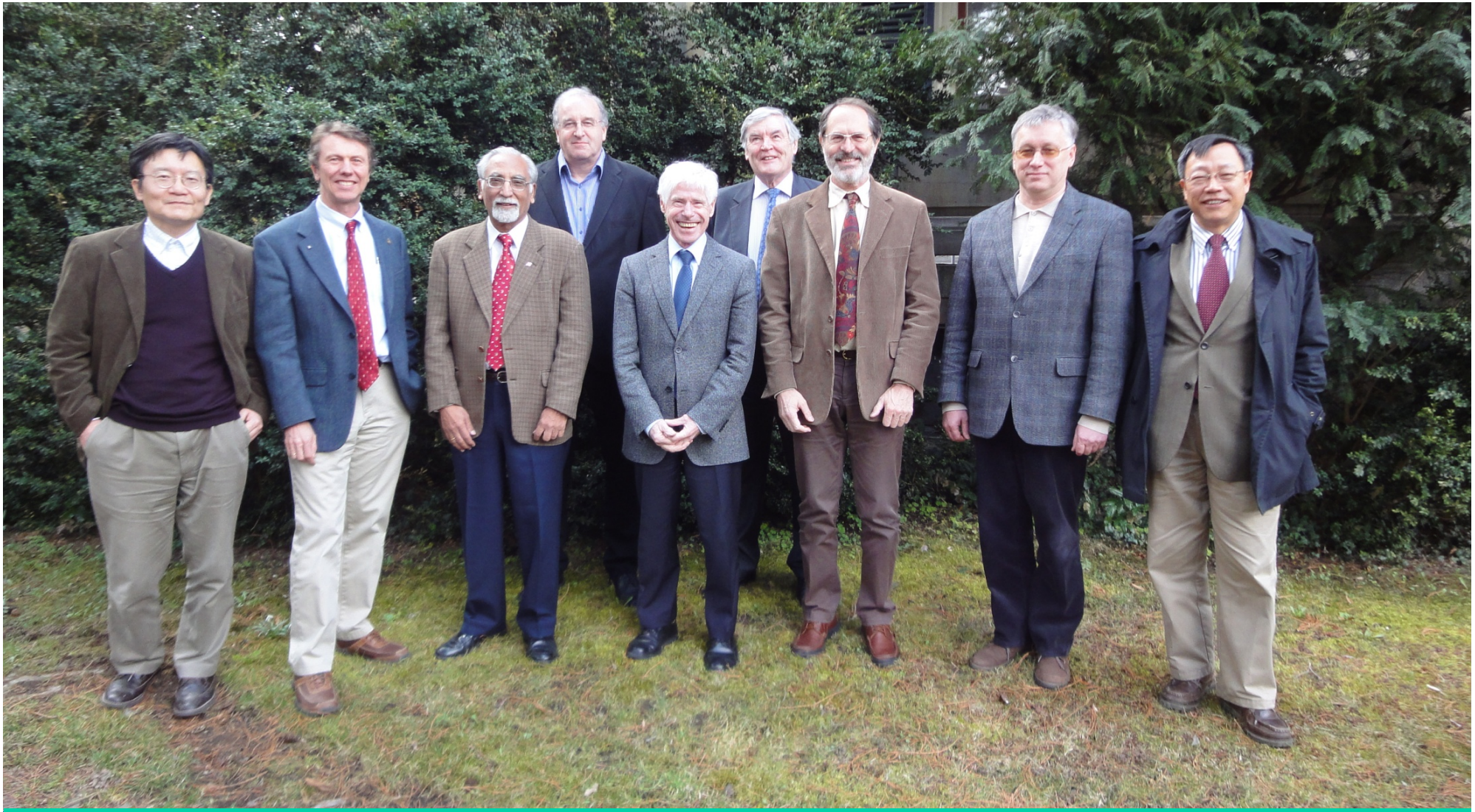
Prof. R. M. Bonnet,
former COSPAR President

Prof. G. F. Bignami,
COSPAR President

- ***Having assessed the scientific needs and the current plans of the main space agencies worldwide, the Working Group has now almost finished its work.***

- ***The basic outcome is going to be published as "Invited Revew Paper" on ASR…you have the Executive Summary***

- ***The WG has identified some major concerns about the lack of a secured future for Space Astronomy***



Matt Griffin, UK, Ian Corbett, UK,

Nobuyuki Kawai, Japan, Shuang-Nan Zhang, China,

Roger Bonnet, France,

Neil Gehrels, USA, Ravi Manchanda, India, Pietro Ubertini, Italy, Mikhail Pavlinsky, Russia,

Members not present at the Bern meeting: Paolo De Bernardis, Mike Hauser, Marcos Machado

Basic working Group considerations

- Astronomers need access to the complete electromagnetic spectrum which requires ambitious and powerful observatories as multi-national ground based projects as well as large space missions based on international cooperation and coordination.

- If international cooperation will not be implemented, new missions may not be as powerful as they could and may result in unnecessary duplication or not occur at all.

- The WG believes that the scientific community at large must find ways to provide the necessary encouragement and support to space agencies, and help create the conditions in which international cooperation can bring about a better scientific outcome for all.

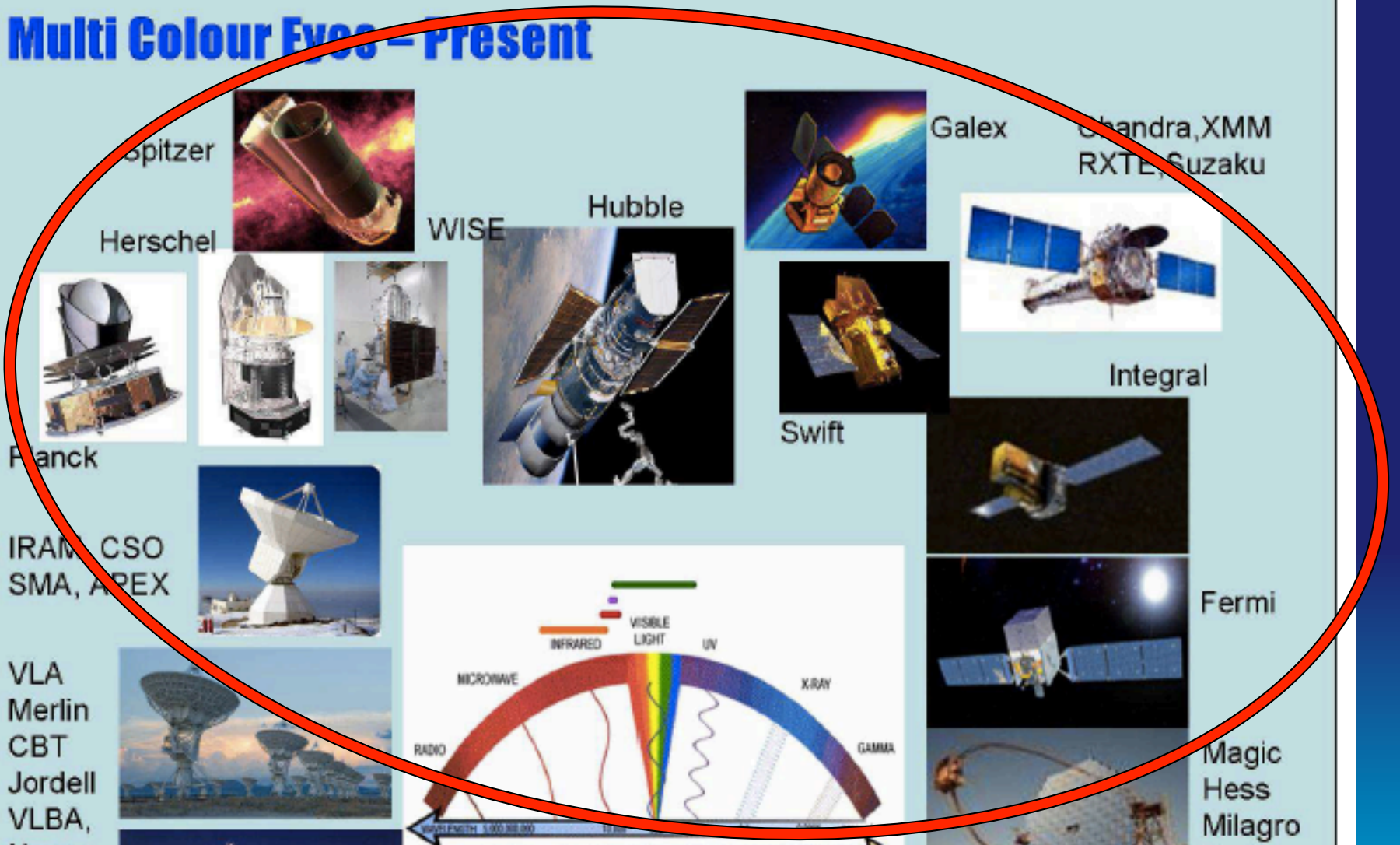
Today operational space observatories cover the whole electromagnetic spectrum and complement ground based telescopes/arrays:

from the IR, sub mm - Herschel & Planck - to the near UV, visible - Hubble – to the X-Rays –Chandra & XMM-Newton, Suzaku etc – to the soft γ-rays with INTEGRAL & SWIFT – to the higher energy – Agile & FERMI.

Some are operational since more than 10 years and may not be available in the next decade.

→ *the delay of the JWST launch to 2018→ and the extra cost (>1.5 M$/day) is a major concern for the COSPAR WG.*

Multi Colour Eyes – Present



a golden age for space astronomy..SPECTACULAR RESULTS FROM SPACE OBSERVATORIES

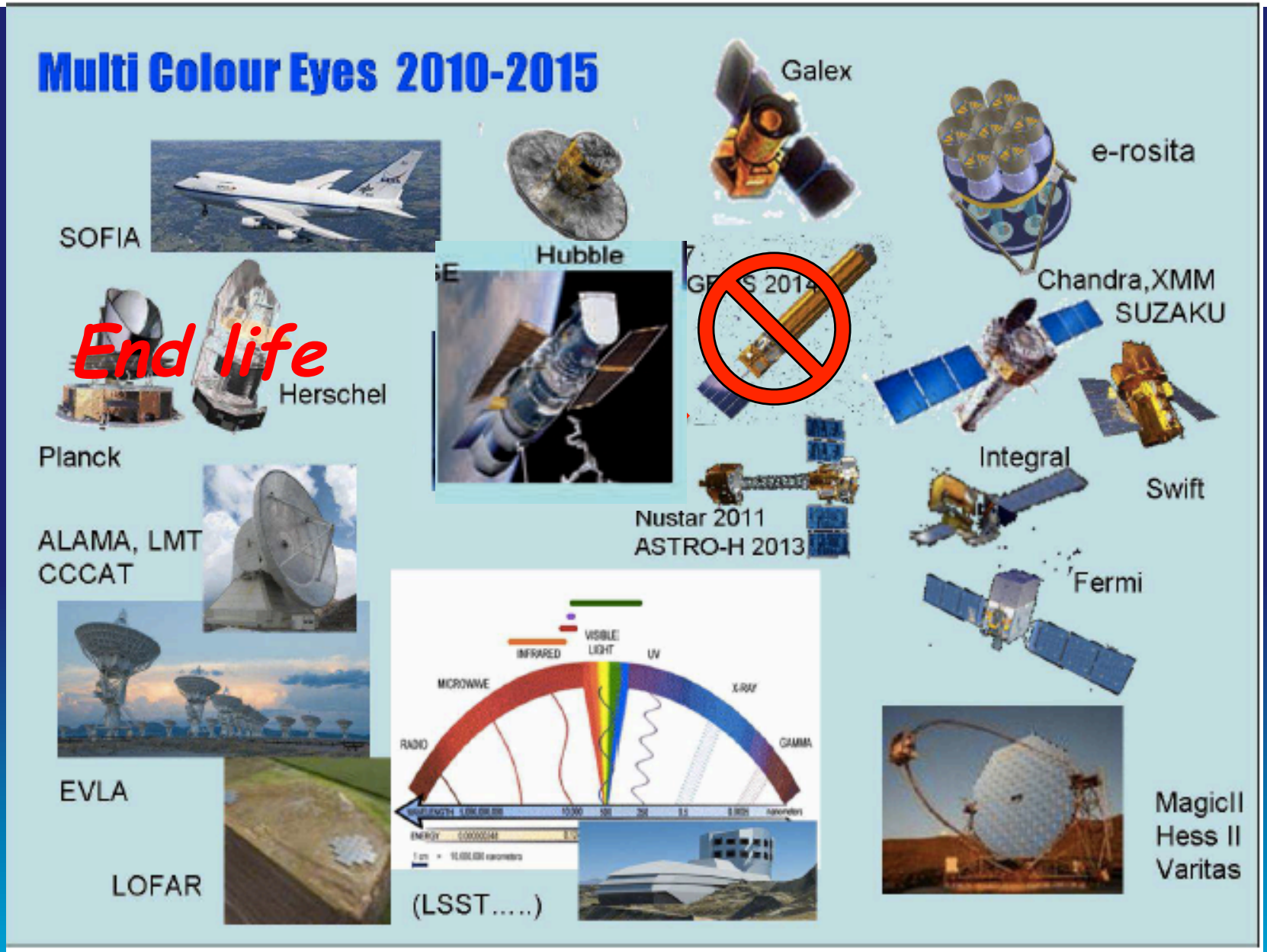
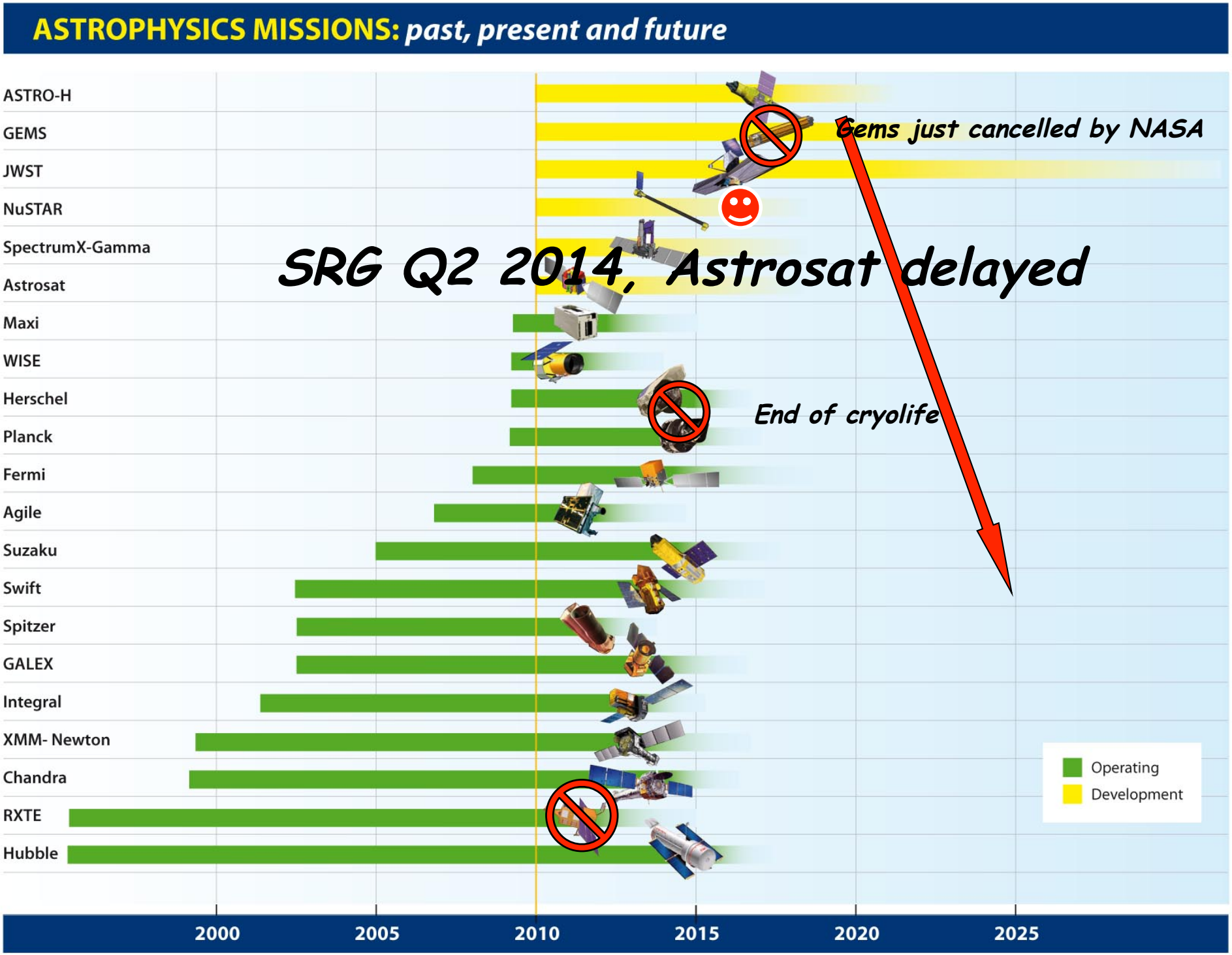
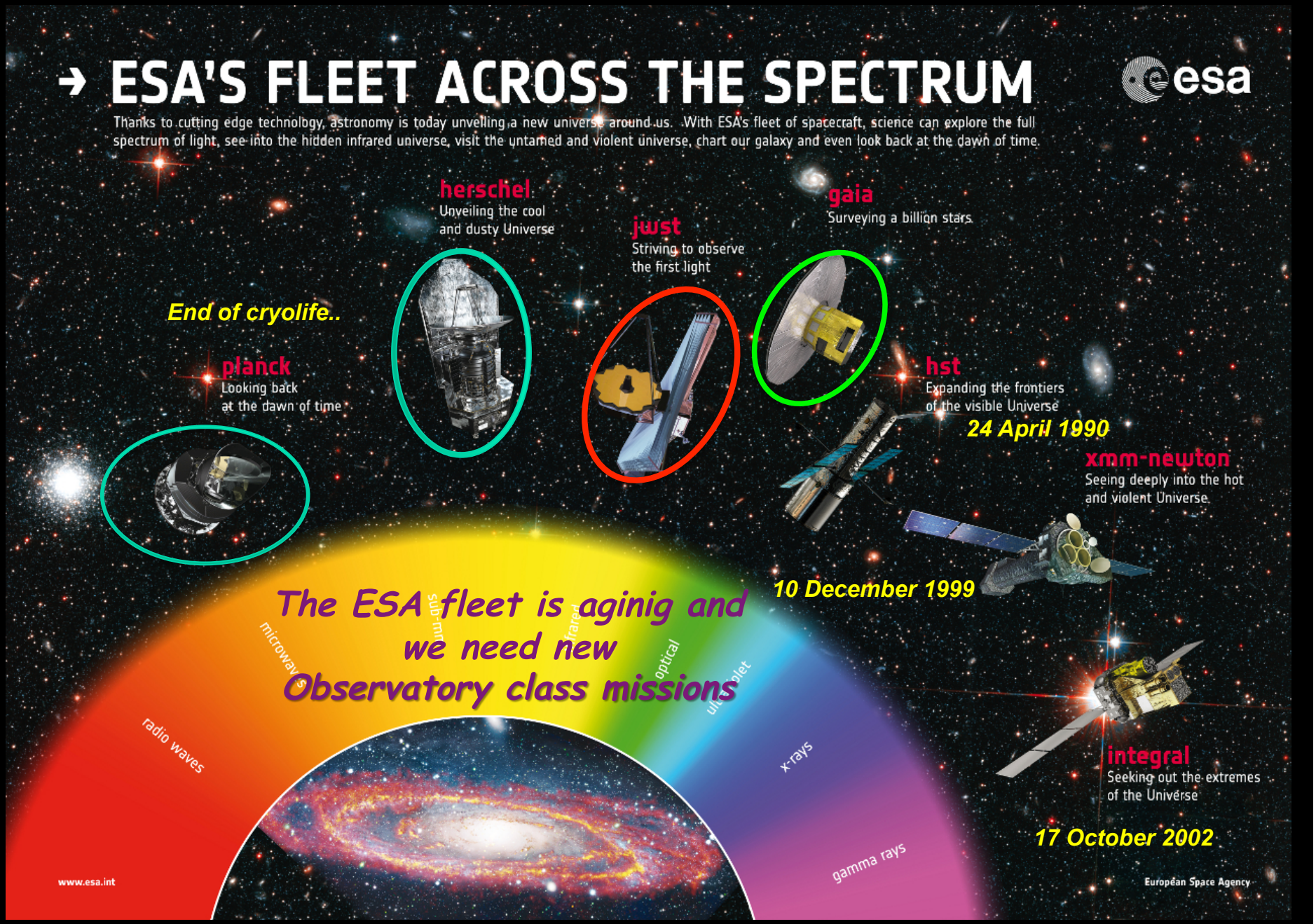


Figure 5: The best scenario. A few small/medium size missions are expected to be completed and placed in orbit. Current operative missions, like Chandra, XMM, INTEGRAL, SWIFT, etc. will hopefully be supported and in good hardware status in the future years. Few new entries are expected: Astrosat, Nustar, Astro-H, GEMS, e-Rosita etc.

Figure 6: In the post 2020 scenario only JWST is actually palnned and approved. In the high energy astrophysics domain the only foreseen Observatory Class Mission is IXO/Athena. This ESA lead-NASA-JAXA mission is now under final selection process (down selection between IXO, LISA and EJSM by 2012 and final selection to fly by 2014)


ASTROPHYSICS MISSIONS: past, present and future
ASTRO-H
GEMS
JWST
NuSTAR
SpectrumX-Gamma
Astrosat
Maxi
WISE
Herschel
Planck
Fermi
Agile
Suzaku
Swift
Spitzer
GALEX
Integral
XMM- Newton
Chandra
RXTE
Hubble
Gems just cancelled by NASA
SRG Q2 2014, Astrosat delayed
End of cryolife
Operating
Development
2000
2005
2010
2015
2020
2025

WE HAVE AN IMPRESSIVE FLEET OF ASTROPHYSICAL OBSERVATORIES



COMMITTE ON SPACE RESEARCH (COSPAR)

Expanding the knowledge frontier of space for the benefit of humankind

COSPAR Working Group: Future of Space Astronomy

A Global Road Map for the Next Decades

EXECUTIVE SUMMARY

COSPAR Secretariat
c/o CNES • 2 place Maurice Quentin • 75039 Paris Cedex 01, France
Tel. +39 1 44767510 (outside France), 01 44767510 (inside France)
Fax +39 1 44767437 (outside France), 01 44767437 (inside France)
cospar-at-cosparhq.cnes.fr - http://cosparhq.cnes.fr

9 March 2012

Recommended Space Astronomy Road Map

A select group of future space astronomy missions has been identified in major studies by national scientific committees to be of the highest priority. Critical technologies and instrumentation for these missions have been brought to a high level of technical readiness. Though these missions do not provide complete coverage of the electromagnetic spectrum, the WG considers these missions to be the most feasible core of the near-term major space astronomy missions, and recommends this list as a Road Map for the next few decades.

JWST. JWST is a collaborative mission of NASA, ESA and the Canadian Space Agency (CSA). It is the only future large space astronomy mission already approved for development, with a planned launch in 2018. It was the highest priority programme recommended in the US National Academy of Sciences decadal survey in 2000 ("Astronomy and Astrophysics for the New Millenium"), and its central importance to astronomy was reiterated in the 2010 survey ("New Worlds, New Horizons"). With a combination of near- and mid-infrared imagers and spectrometers, JWST will provide unprecedented capability to study systems from the first galaxies that formed in the early Universe, to newly forming stars and planetary systems, and to bodies in our solar system.
The WG recommends completion and launch of this major observatory as soon as possible. JWST is recognised to be the only new large space astronomy Observatory to be possibly operational in the next 10-20 years. It is an essential asset for space science investigations complementing "ground based".

Euclid/WFIRST. Both ESA and NASA are currently evaluating missions to study dark energy: Euclid (ESA; dark energy and dark matter) and Wide-Field Infrared Survey Telescope (NASA; dark energy, exoplanets and near-infrared sky survey). The scientific goals of these missions have been recommended as being of the highest importance by the worldwide astronomical community. Euclid has been selected as an ESA M-Class mission; NASA is conducting a definition study for WFIRST. Possible collaboration has been discussed by the national agencies, but the situation is unclear at the time of this study.
The WG believes it would best serve the interests of science and the community to have a single optimised mission or programme, combining the resources and technical capabilities of NASA and ESA. Canada, India, China, Russia and others could be added as partners.

International X-ray Observatory (IXO). IXO has been extensively studied and reviewed as a collaborative NASA/ESA/Japan mission, now re-scoped by ESA as an L-Class candidate for the 2020-2025 time-frame, Athena, without NASA collaboration. The proposed IXO/Athena satellite, or a similar large high energy observatory, would be able to exploit a broad scientific scenario, possibly including investigation of the 'first stars' via a high-z γ-rays burst detection capability.
The WG recommends development of a large X-ray space observatory, operative in the next decade.

Large Interferometer Space Antenna (LISA). LISA is a pioneering gravitational wave mission, designed to open a new window on the cosmos. LISA has been extensively studied as a collaborative NASA/ESA mission, but, though highly ranked in the 2010 US Decadal Survey, programmatic constraints are preventing NASA from proceeding. The LISA Pathfinder mission is in development in Europe. ESA has re-scoped LISA as NGO, an L-Class mission candidate.

The WG recommends that the agencies involved support, exploit and finalise the R&D programmes necessary to have in operation a gravitational wave mission [illegible] Even though the previous collaborative mission concepts for [illegible] and LISA are not feasible in the current ESA or NASA plans, the Working Group recommends that some multinational aspect of the missions be preserved to prevent significant loss of scientific capability.

Space Infrared Observatory for Cosmology and Astrophysics (SPICA). SPICA is large aperture, cryogenically cooled far-infrared observatory studied as a collaborative JAXA/ESA/Canada mission. Contribution of an additional instrument was recommended by the US 2010 Decadal Survey, but may not be possible due to US programmatic constraints.

The WG believes that a large aperture, cryogenically cooled far-infrared observatory is essential to bring about the major advance in sensitivity needed to continue investigation of the cold and dust obscured Universe.

In the longer term, it is to be expected that detailed characterisation of Earth-like exoplanets, a major scientific priority, will require the stability and sensitivity afforded by a large space [illegible] Numerous UV/optical and infrared mission concepts have been proposed and studied.

The WG recommends further technical development to bring the most promising approaches to readiness.

The WG also recommends that space-faring nations pursue robust cooperative programmes devoted to solving specific burning scientific questions via the implementation of multilateral medium and small size dedicated missions.

In addition to the specific high priority near-term missions listed above, the WG compiled a list of additional missions of interest around the globe, some of which might be accomplished by 2030. Such missions are listed, by approximate size class, in section 3 of the Ubertini at al., ASR paper in press (2012).