COSPAR WORKING GROUP

# The future of Space Astronomy

## A Global Road Map for the Next Decades: the Report

*Pietro Ubertini, on behalf of the COSPAR WG:*

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*Vulcano Workshop 2012*

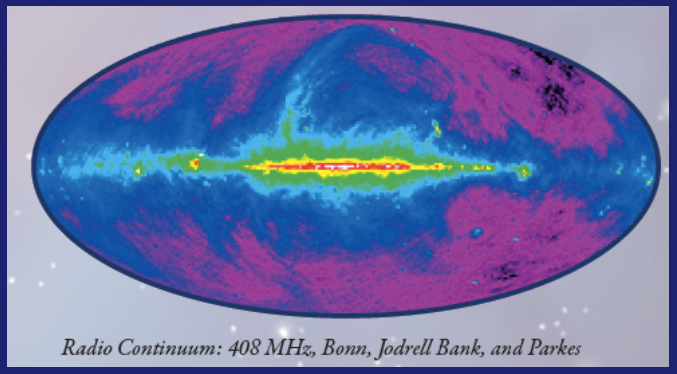
*Frontier Objects in Astrophysics and Particle Physics, 30 May 2012*

# Prologue

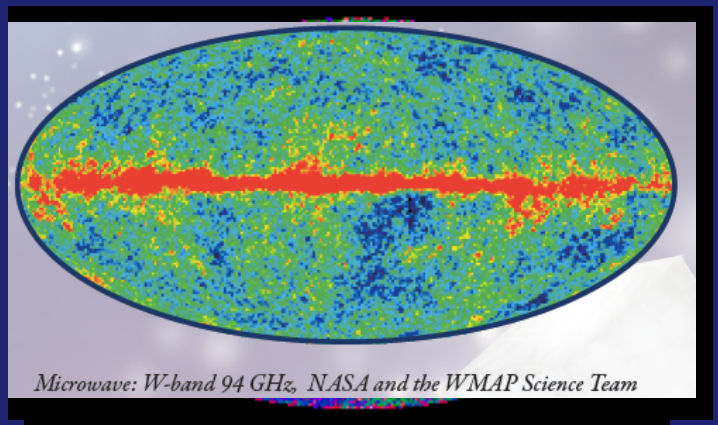
Space satellites have given astrophysicists a unique opportunity to explore the invisible part of the electromagnetic spectrum and drastically improve our knowledge of the Universe.

The increasing size, complexity and cost of large space observatories places a growing emphasis on large international collaboration.

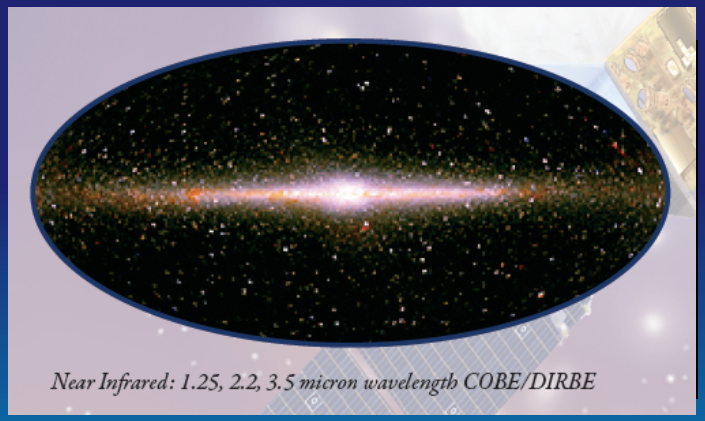
# The multicolor Universe as was known 20 years ago…..and nowdays..



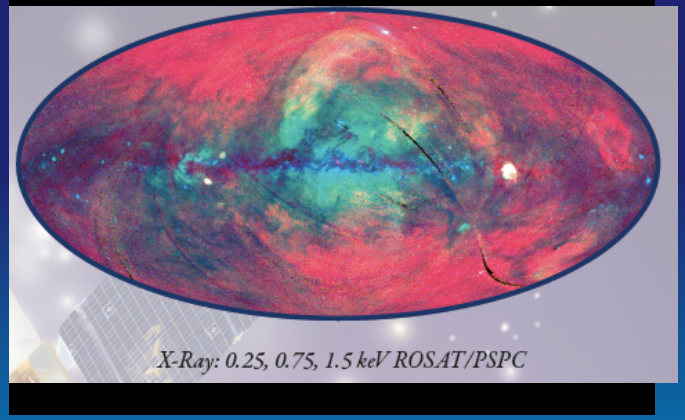
Radio Continuum: 408 MHz, Bonn, Jodrell Bank, and Parkes



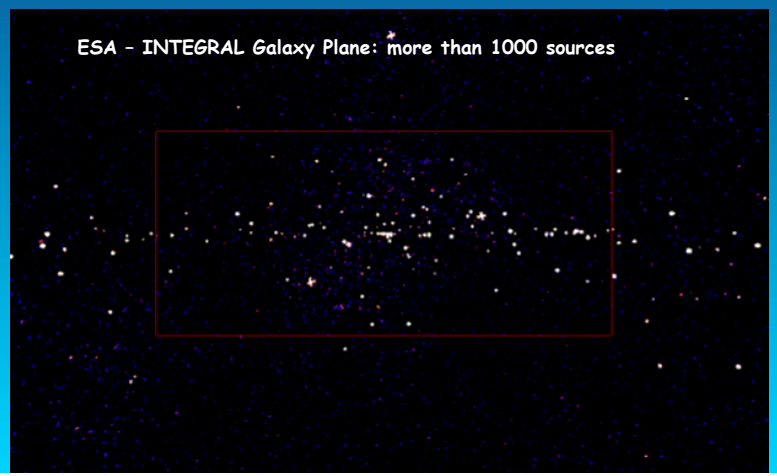
Microwave: W-band 94 GHz, NASA and the WMAP Science Team

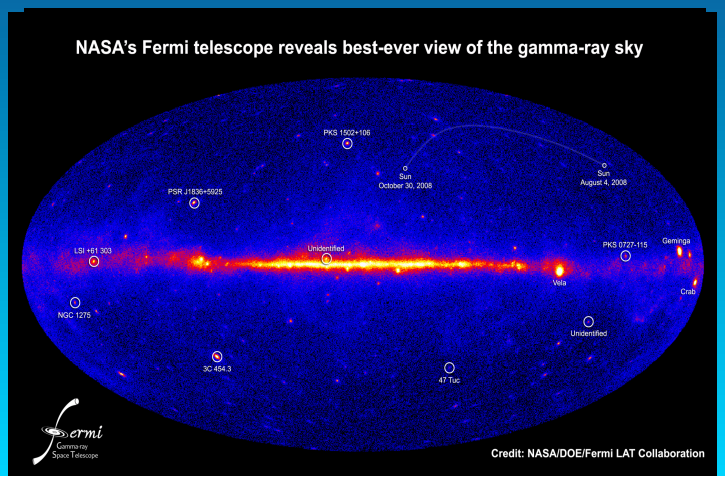


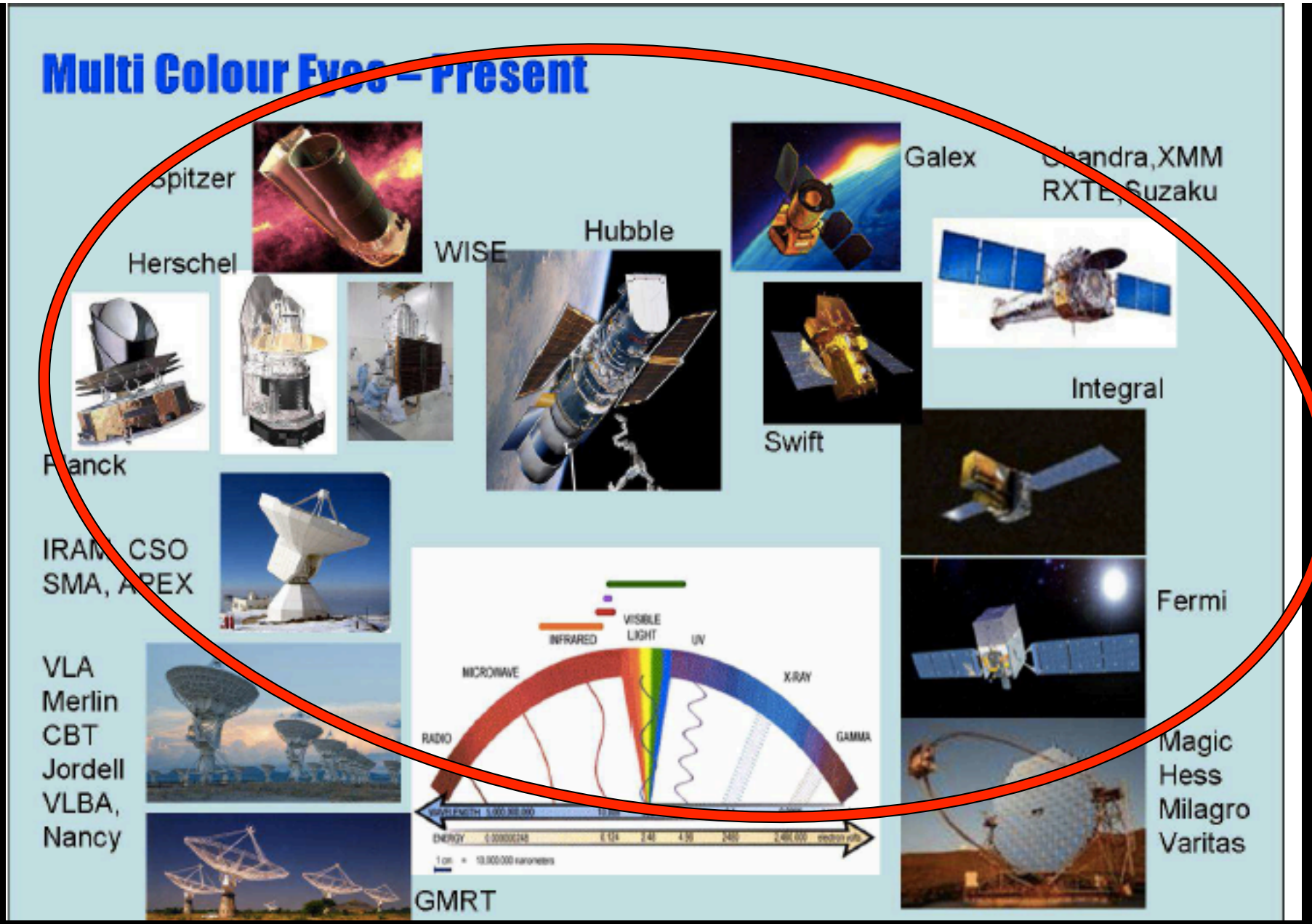
Near Infrared: 1.25, 2.2, 3.5 micron wavelength COBE/DIRBE



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

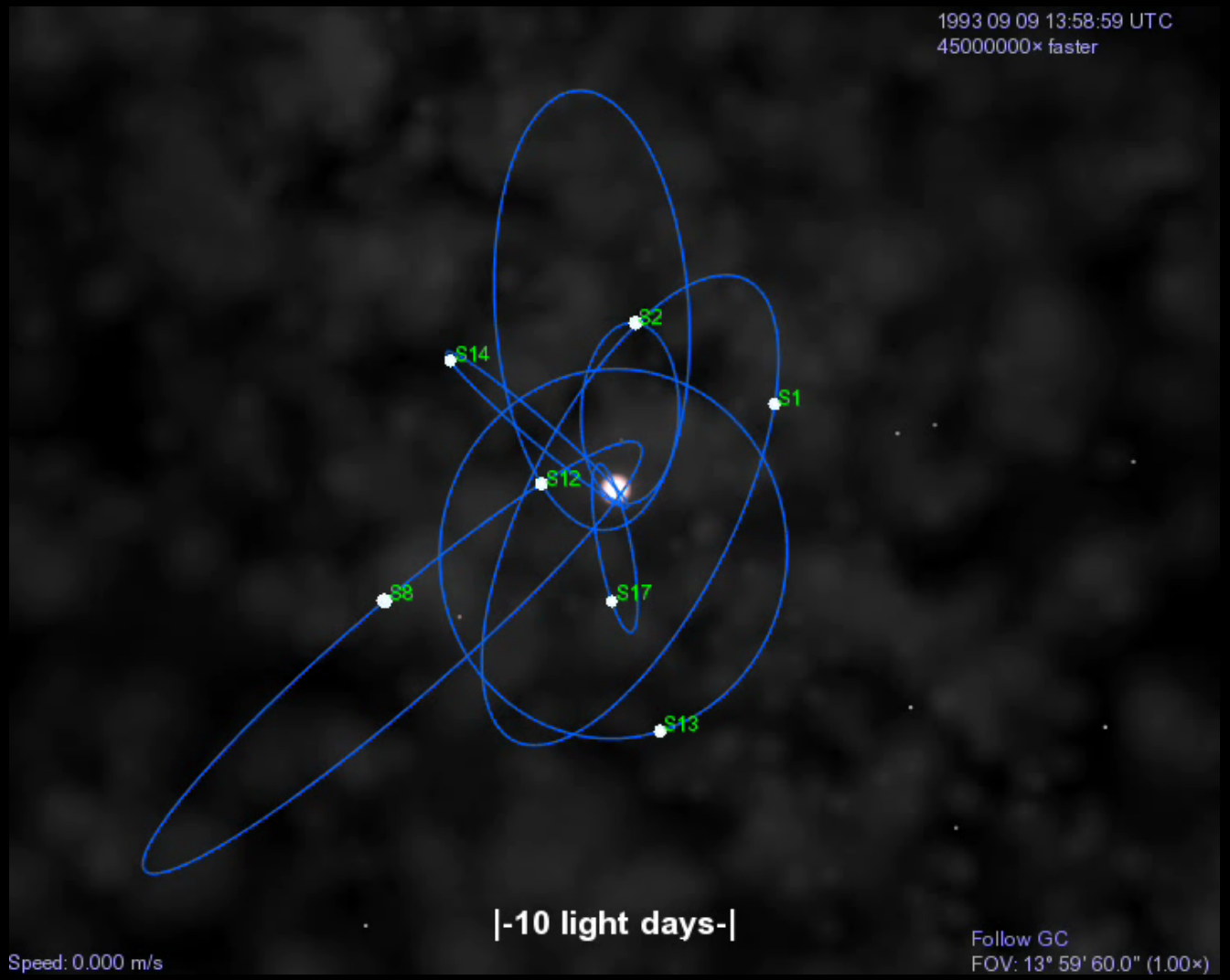


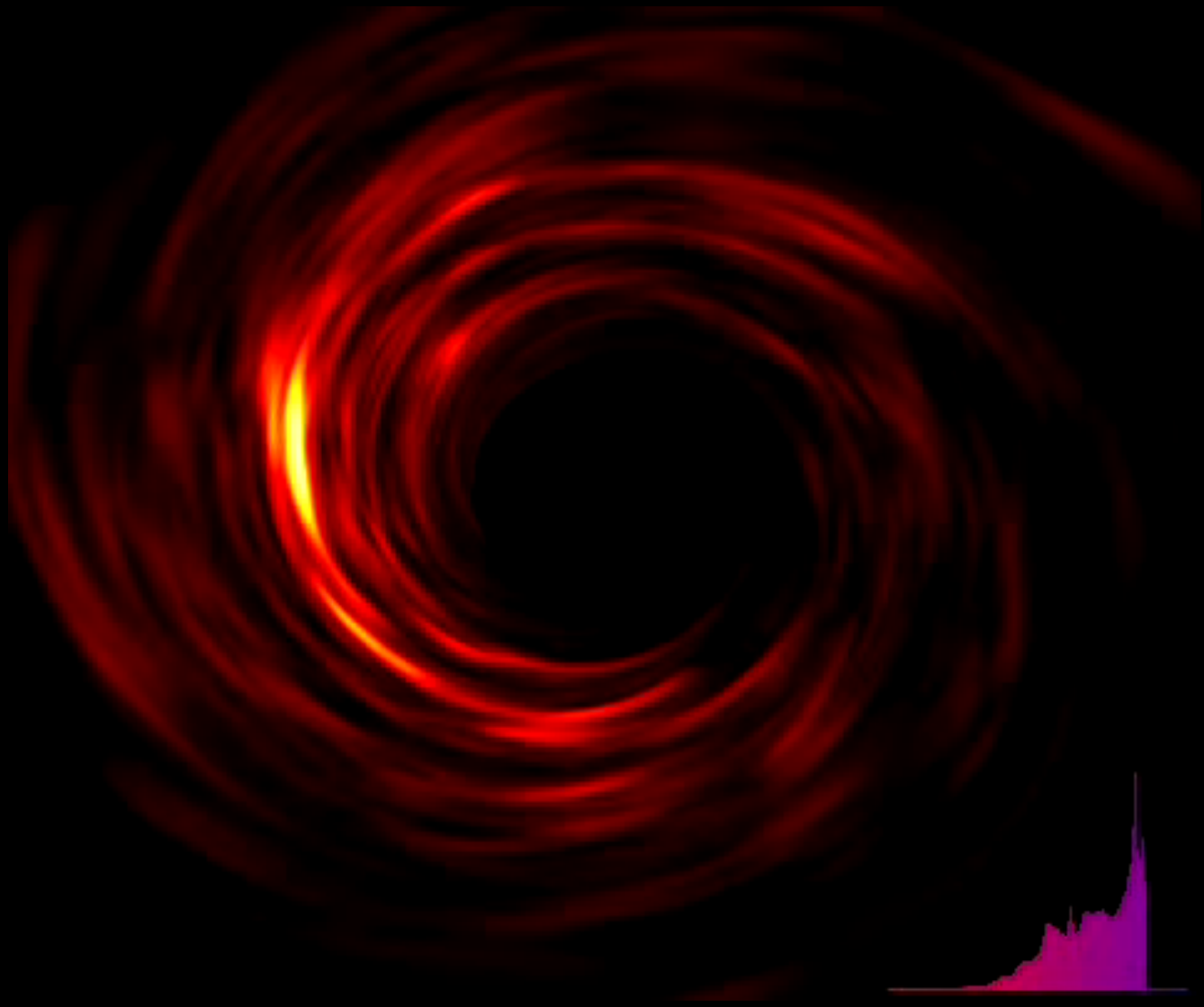



*a golden age for space astronomy..SPECTACULAR RESULTS FROM SPACE OBSERVATORIES*

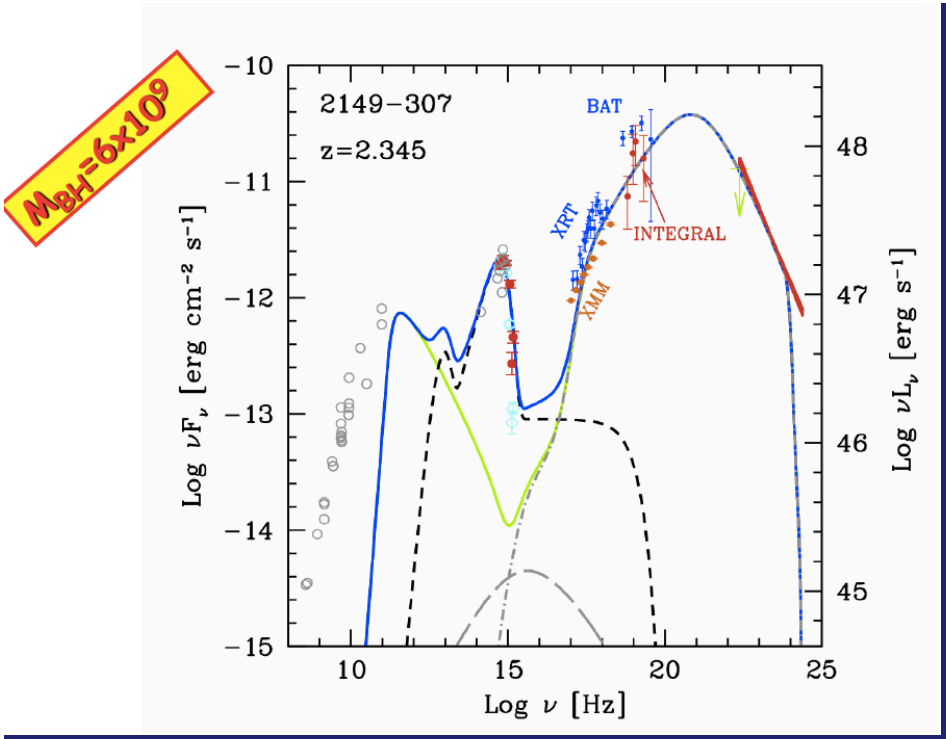
*Astronomers have now the proof of the existence of a SMBH (of about 3.7 million solar masses) in the center of our Galaxy...combining IR data taken from ground with X and gamma-Rays from space observatories …to probe the proximity of the BH.*

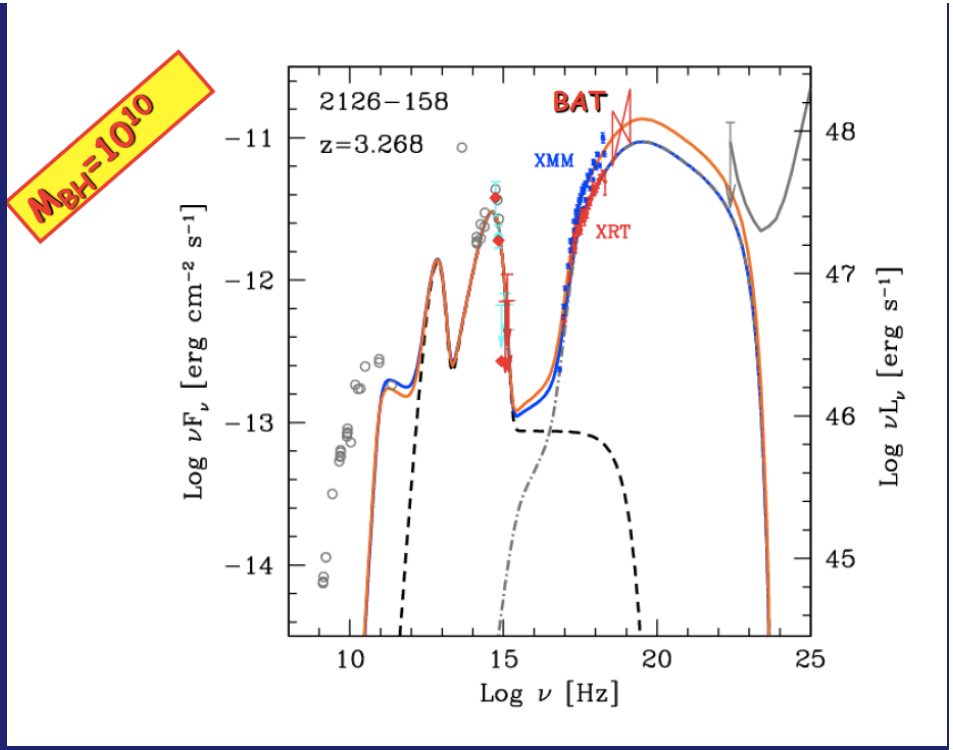


# Gravitational distorsion of the emission line profile close to the 'event horizon' of a BH give us the pictureof what happens close to the BH event horizon



Courtesy of Kirpal Nandra



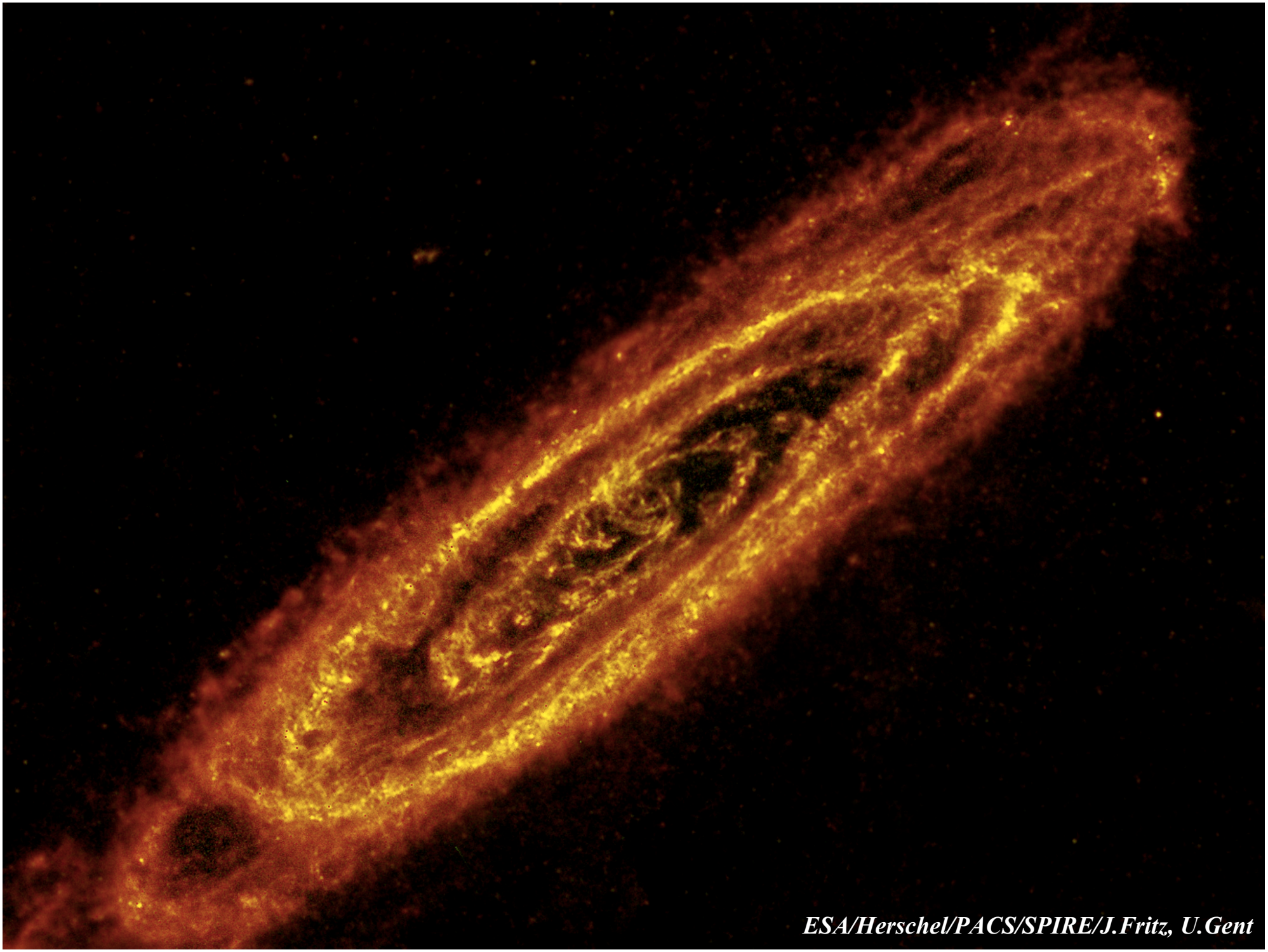

The most luminous blazars

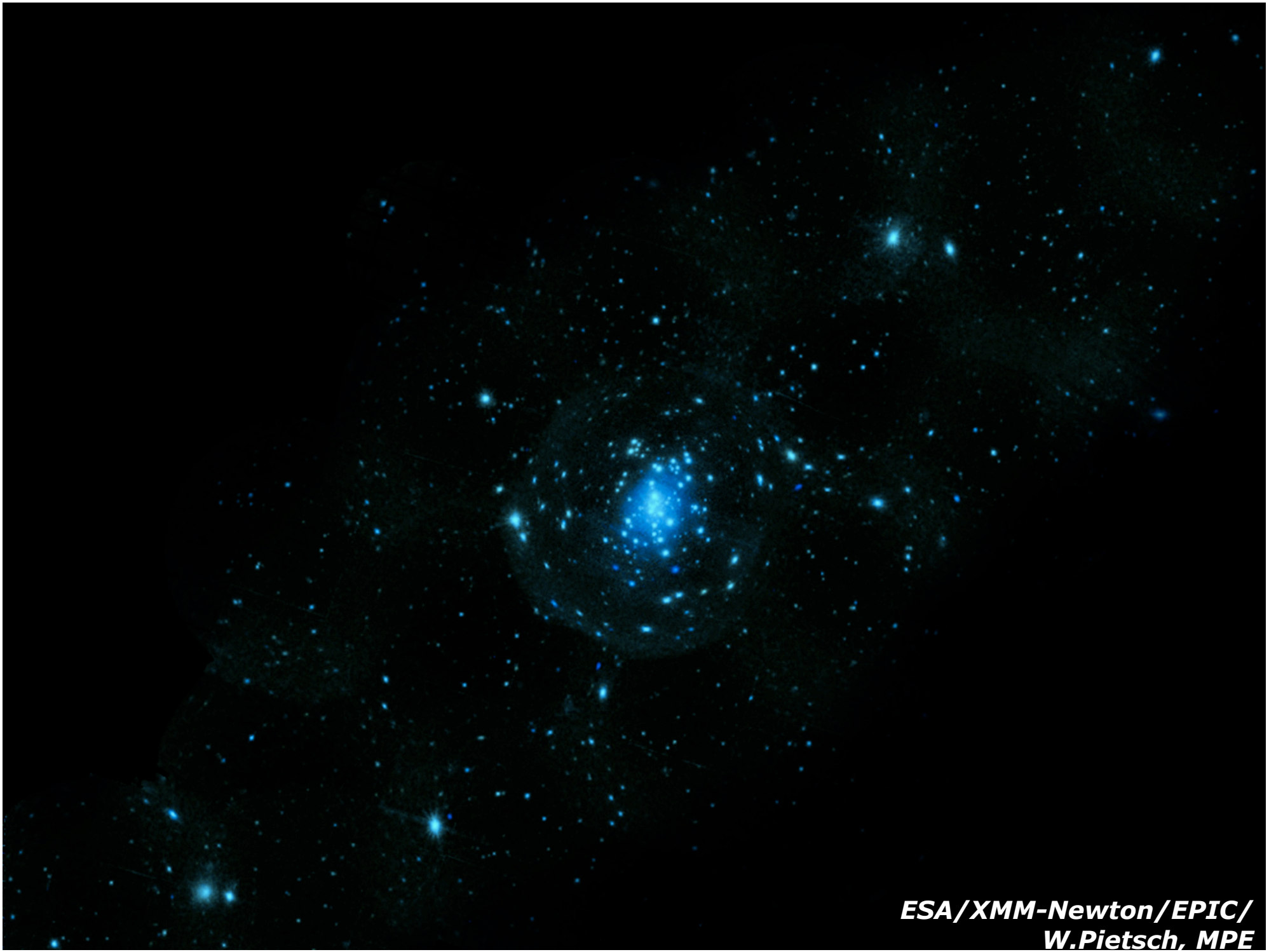
BAT and INTEGRAL even bigger blazars: z up to ~4

- *When and how the first star has been generated?*
- *Why the more massive QSOs have gigantic BH in the centre?..stars and BHs grow in parallel???*
- *How back into the reionization period we can see?.. z>15-20*

***These are among the more fundamental and open questions we could answer in the next decades***

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***

# 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.

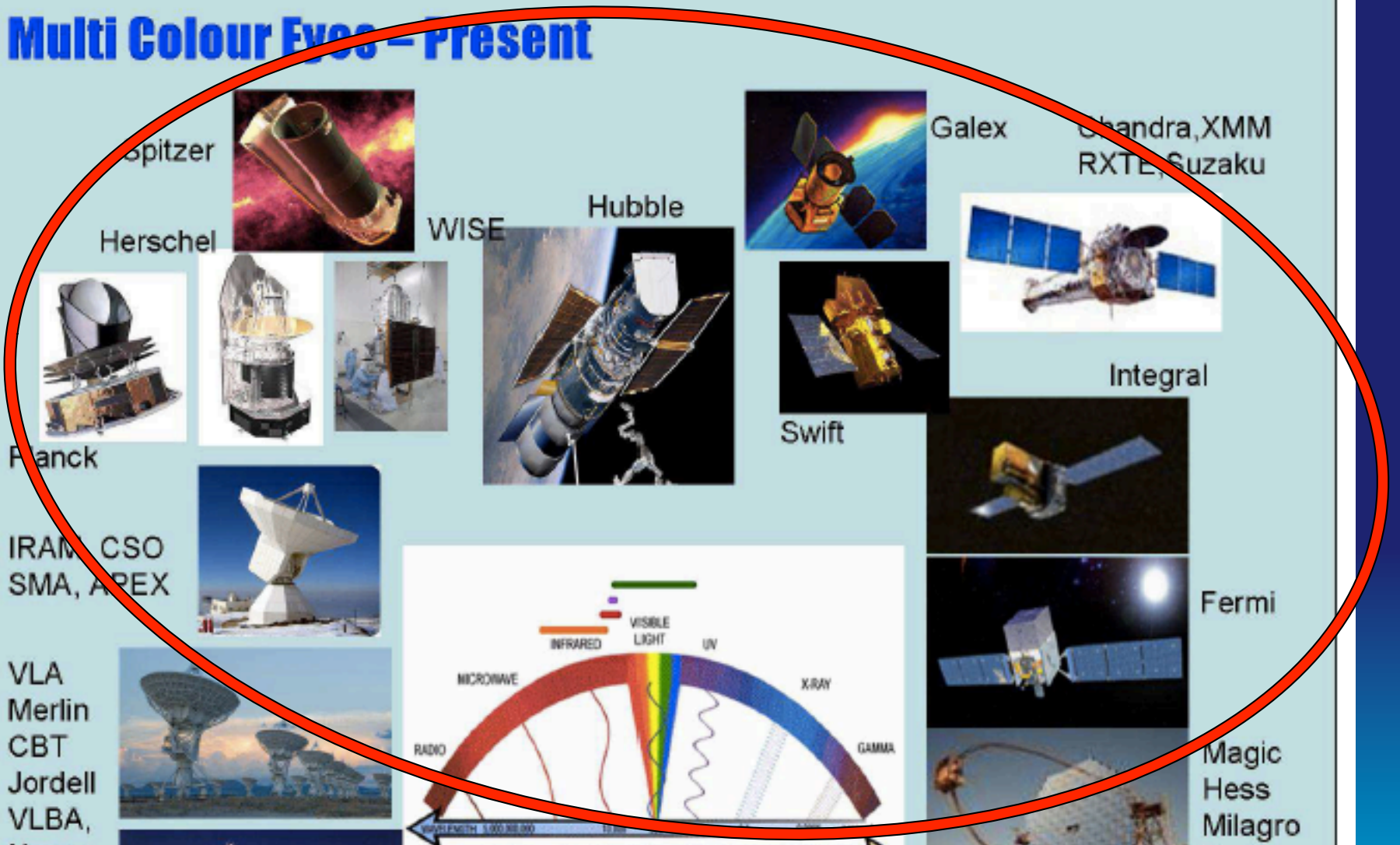
*Today operational space observatories cover the whole electromagnetic spectrum and complement ground based telescopes/arrays:*

*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 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*

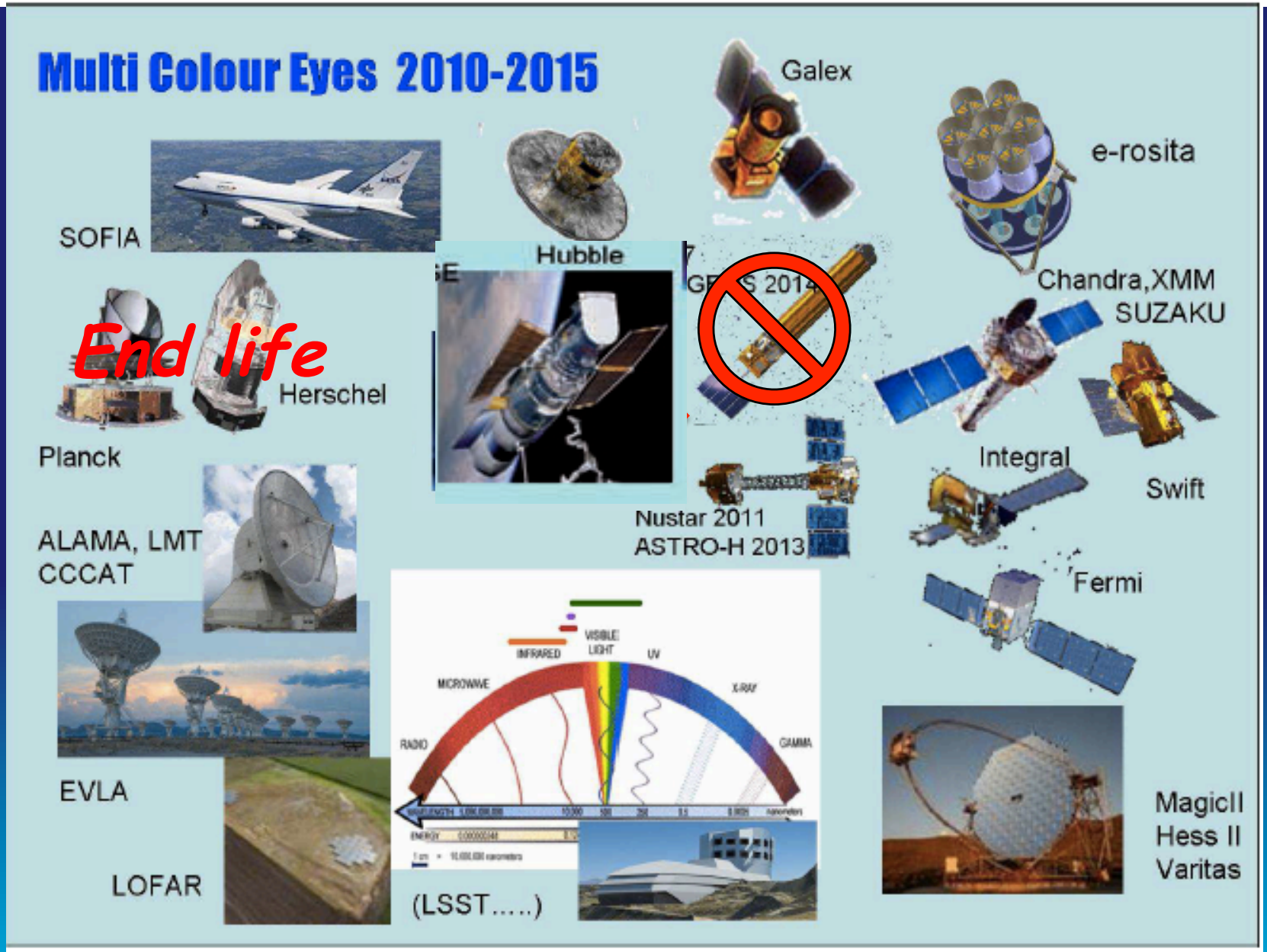



Figure 5: The best scenario. A few small/medium size missions are expected to be completed and placed in orbit. Current operative missions, like Chandra, XMM, INTEGRAL, SWIFT, etc. will hopefully be supported and in good hardware status in the future years. Few new entries are expected: Astrosat, Nustar,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

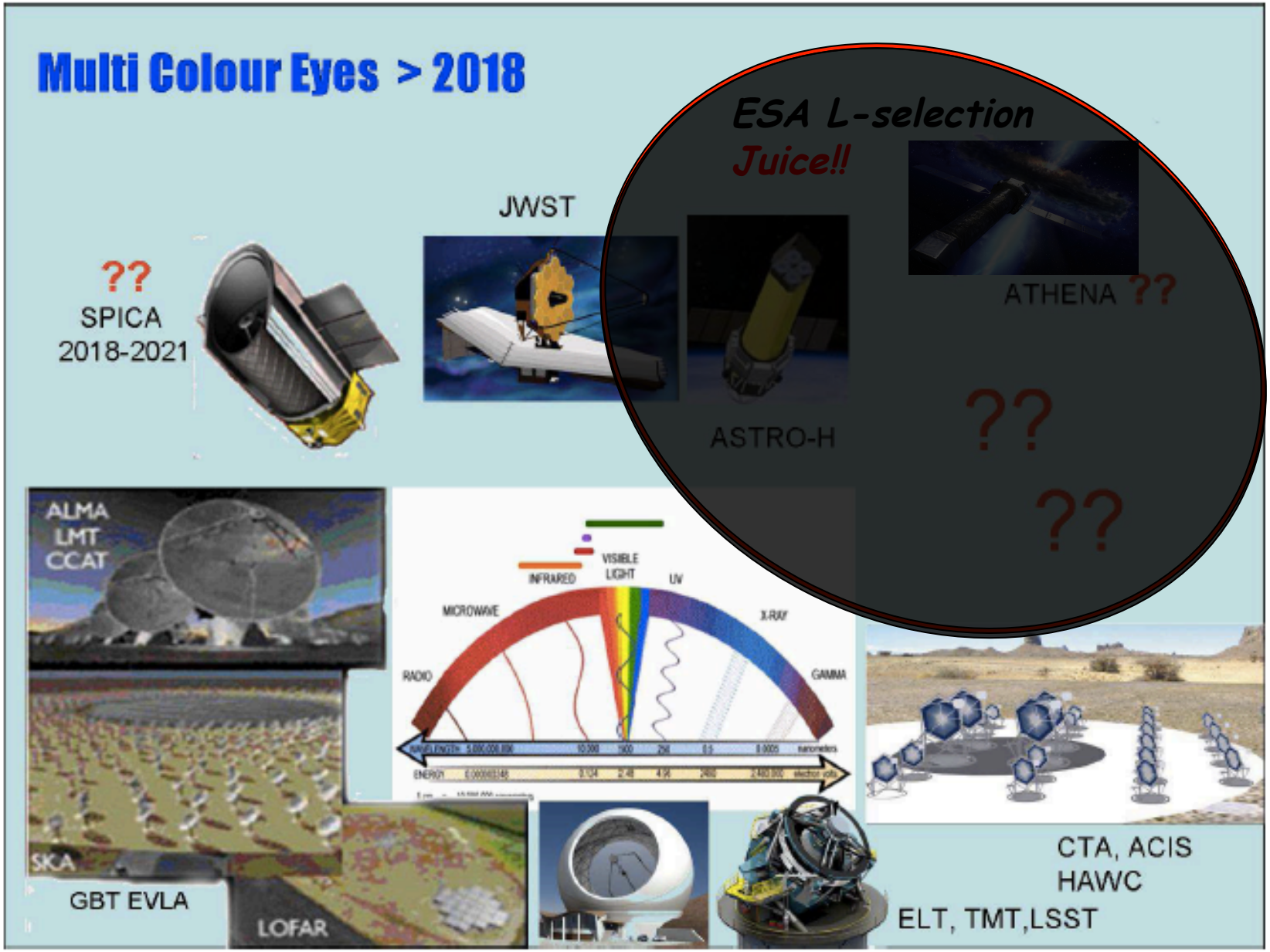
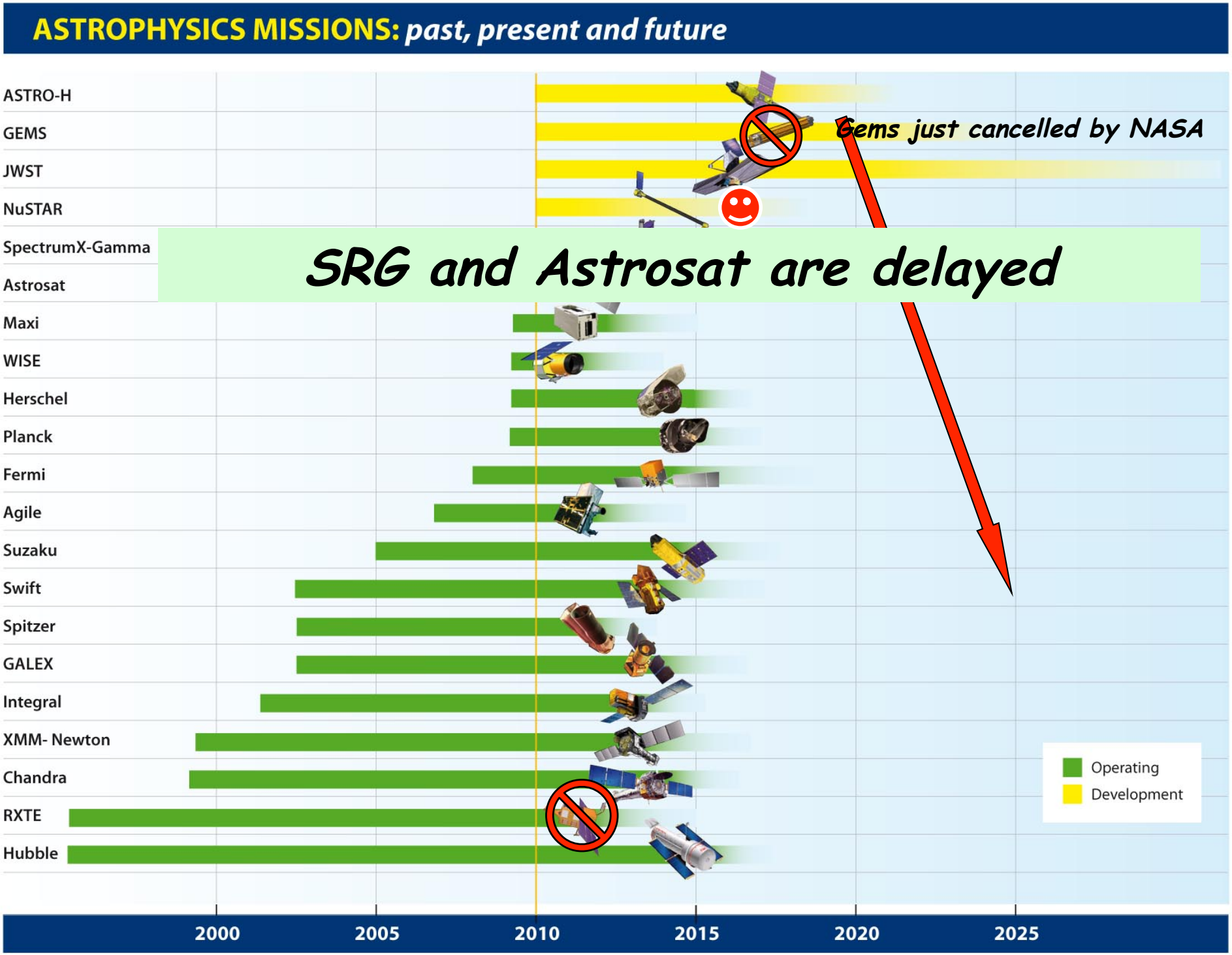



Figure 6: In the post 2020 scenario only JWST is actually palnned and approved. In the high energy astrophysics domain the only foreseen Observatory Class Mission is IXO/Athena. This ESA lead-NASA-JAXA mission is now under final selection process (down selection between IXO, LISA and EJSM by 2012 and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



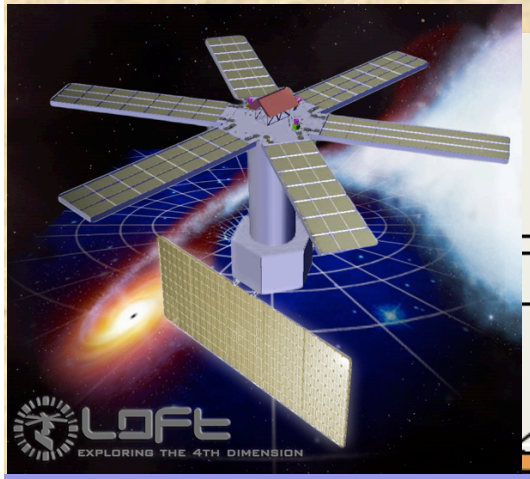

# ASTROPHYSICS MISSIONS: *past, present and future*

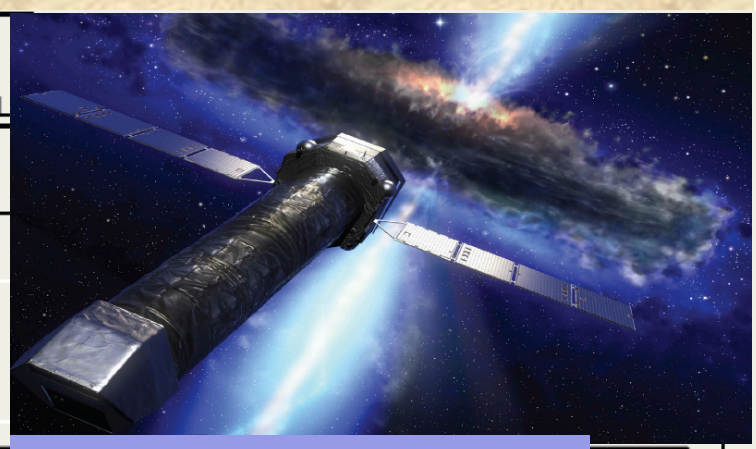
*Gems just cancelled by NASA*

## SRG and Astrosat are delayed

# …and the future for relativistic Astrophysics?

## The ESA (tentative?) decadal program..NASA no L programmes!



**Loft** 2024
*(1 of 4 M)*

**Athena** 2028
*(1 of 2 L)*

# Conclusions 1/2

Are we entering "A dark Age for Space Astronomy?" (Bonnet and Bleeker, Science 2011),…yes, indeed! After the ESA choice to not select Athena as the next "cornerstone" of the Cosmic Vision program..

Of particular interest are the conclusions about the (lack of common) planning & management control by space agencies in the last decade:

- At a time of worldwide restricted financial capabilities, the lack of common strategy at international level is becoming a major stumbling block.
- Each national road map has its own planning of missions that may introduce useless duplications and/or prevent collaboration on required global observatories.
- This is exemplified by the ESA, NASA, JAXA, etc road maps for Large missions (IXO, LISA and EJSM), which result in a downscaling of these major observatories for the worldwide community →ESA alone scheme

# Conclusions 2/2

- **As a conclusion, strategic long term planning (e.g. two decades) is essential in order to establish a single road map based on global cooperation with clearly identified scientific priorities with the required technological development.**

- **This can be implemented through an interagency coordination group on large space astronomy facilities.**

- Examples of such an approach exist without the necessity for intergovernmental agreements on budgets

- At planetary level COSPAR-IAU common action?

→ ***If all the above happens we will have a revolutionised view of the Universe in two decades timeframe…but..***

# → What we do next..?

COSPAR-IAU common action → Mysore, July-Beijing-August?..

EAS has a similar WG chaired by Mike Watson → find sinergies, common actions, proselitism!?...

Thanks for your attention