

*Photonics, Space, Lasers: Designing the Future Society – Vision 2040*  
*Czech Pavilion EXPO Osaka*  
*Space Technologies and Instrumentation 10th of September 2025*

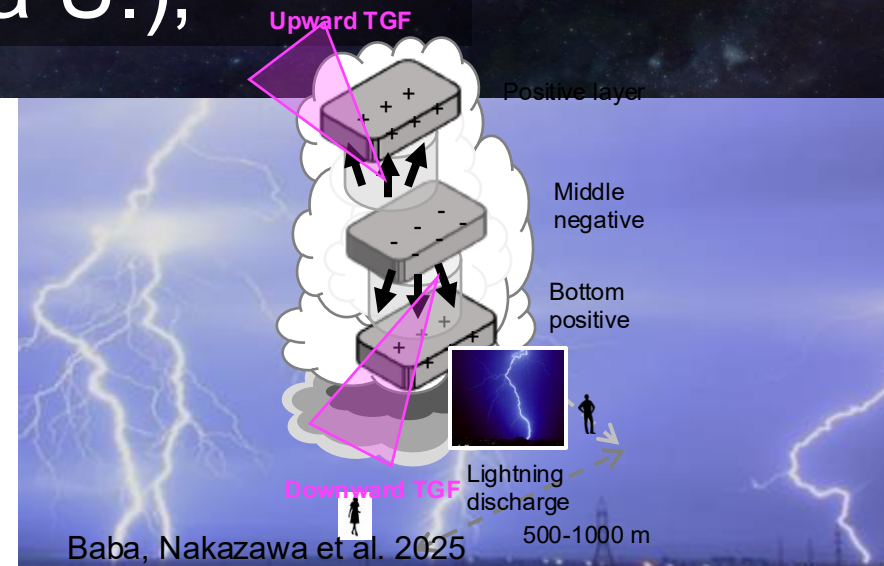
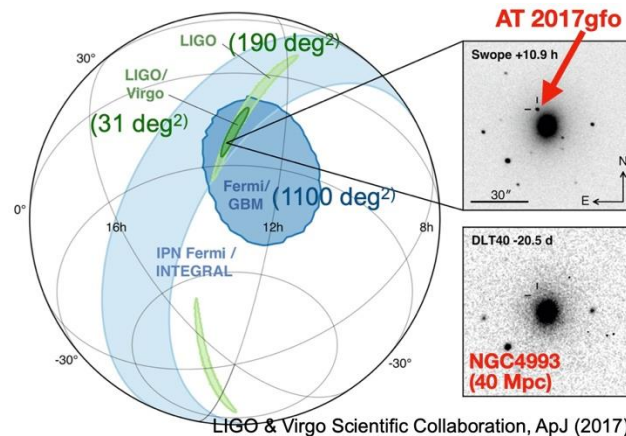
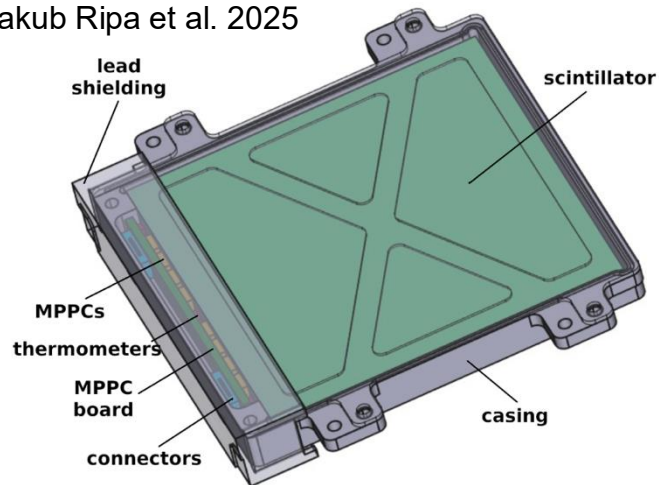


V. Dániel et al. 2022

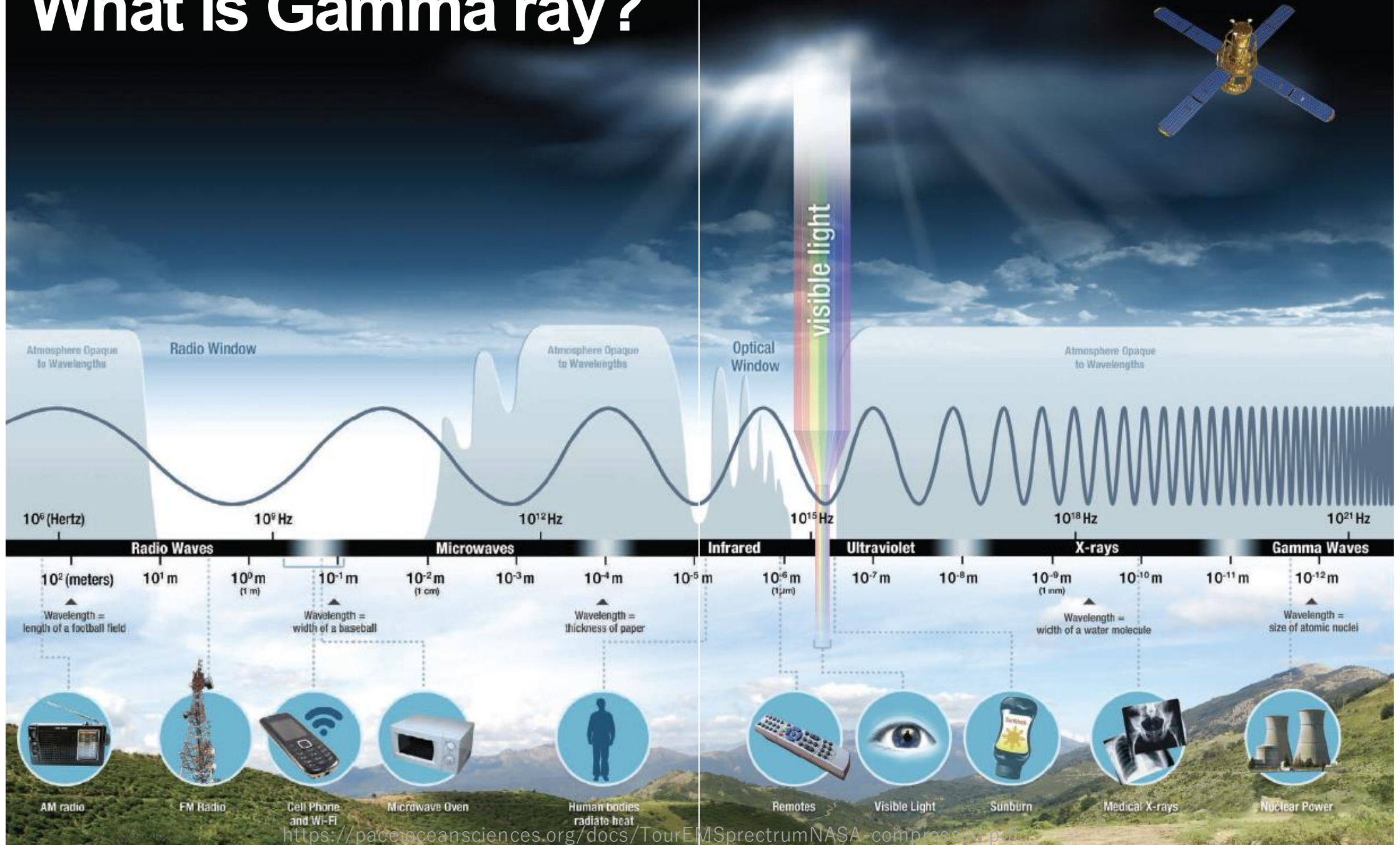
# Gamma-ray detector development in Japan-Czech collaborations: space and more

K. Nakazawa (Nagoya U.),

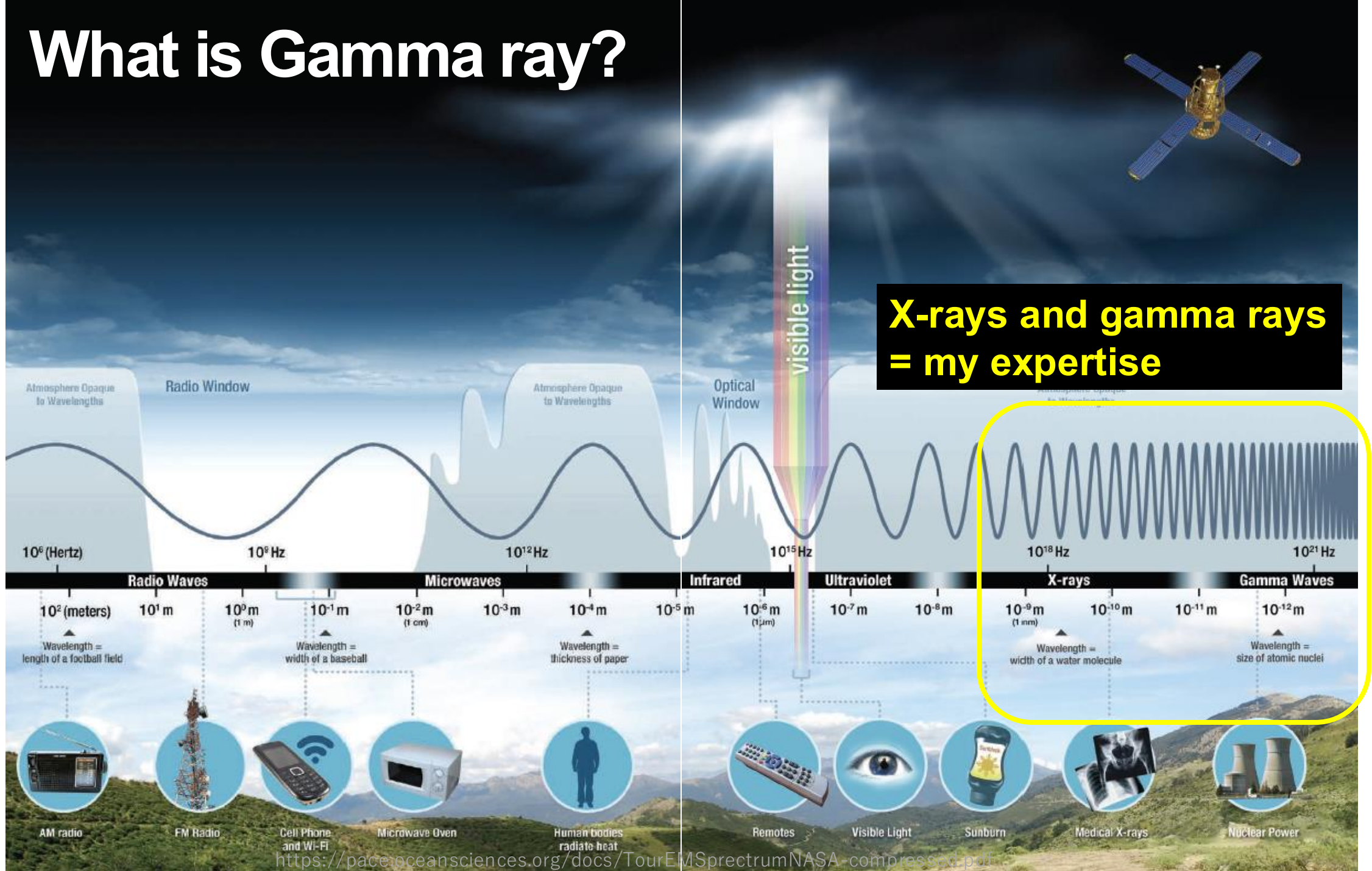
Jakub Ripa et al. 2025





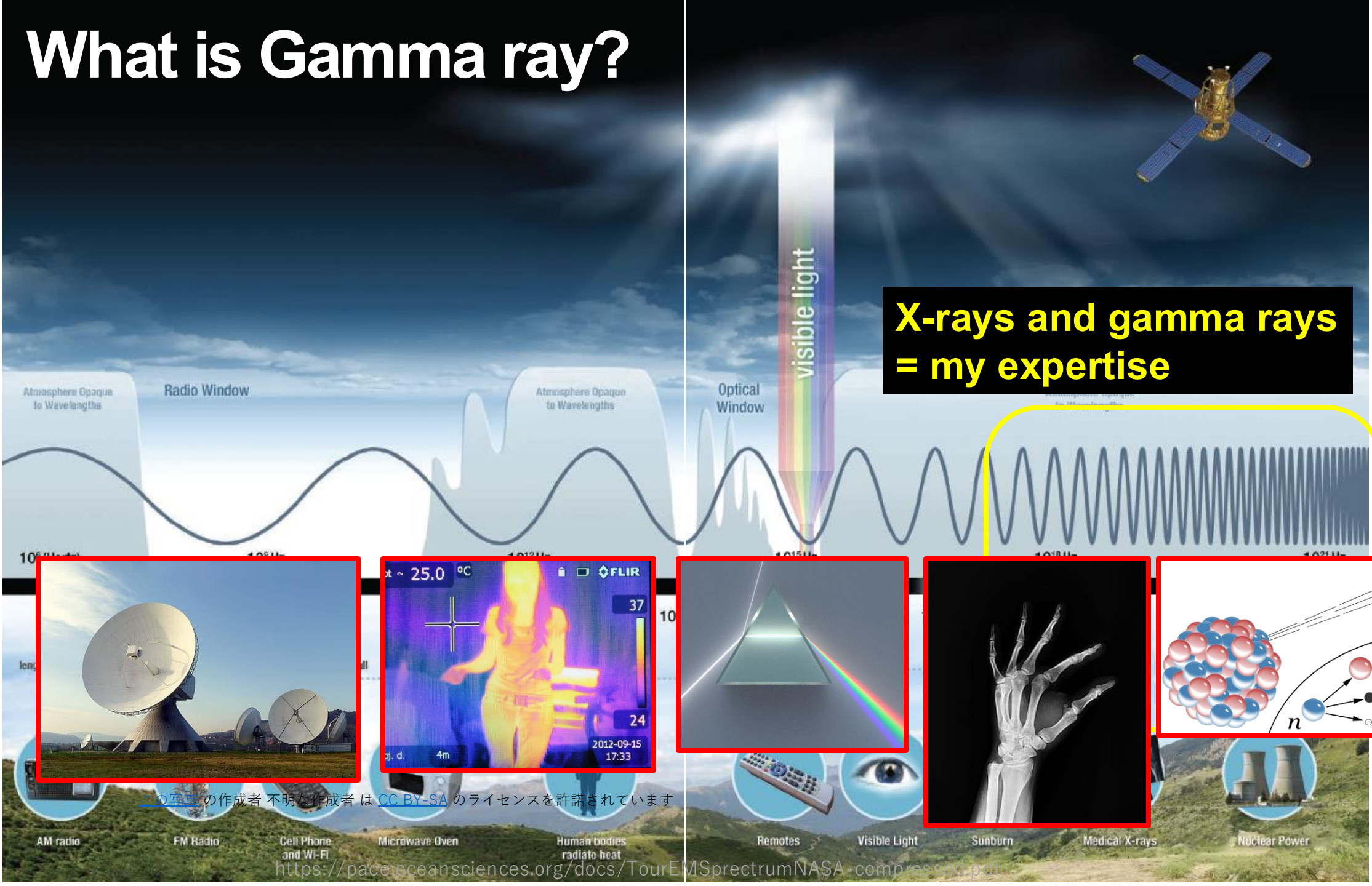


# What is Gamma ray?





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# What is Gamma ray?

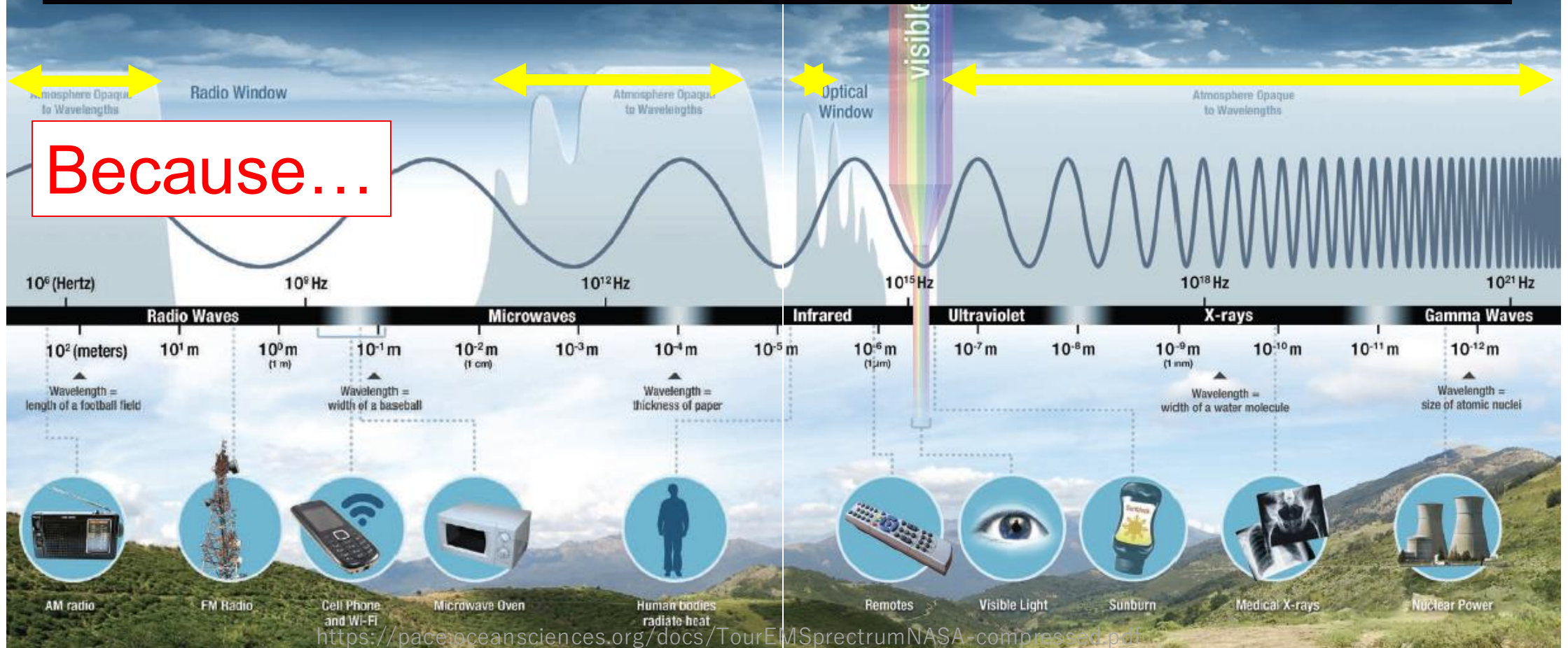
Satellites



Atmosphere is opaque in many wavelengths

→ Need to “go to space” to perform “multi-wavelength astronomy”

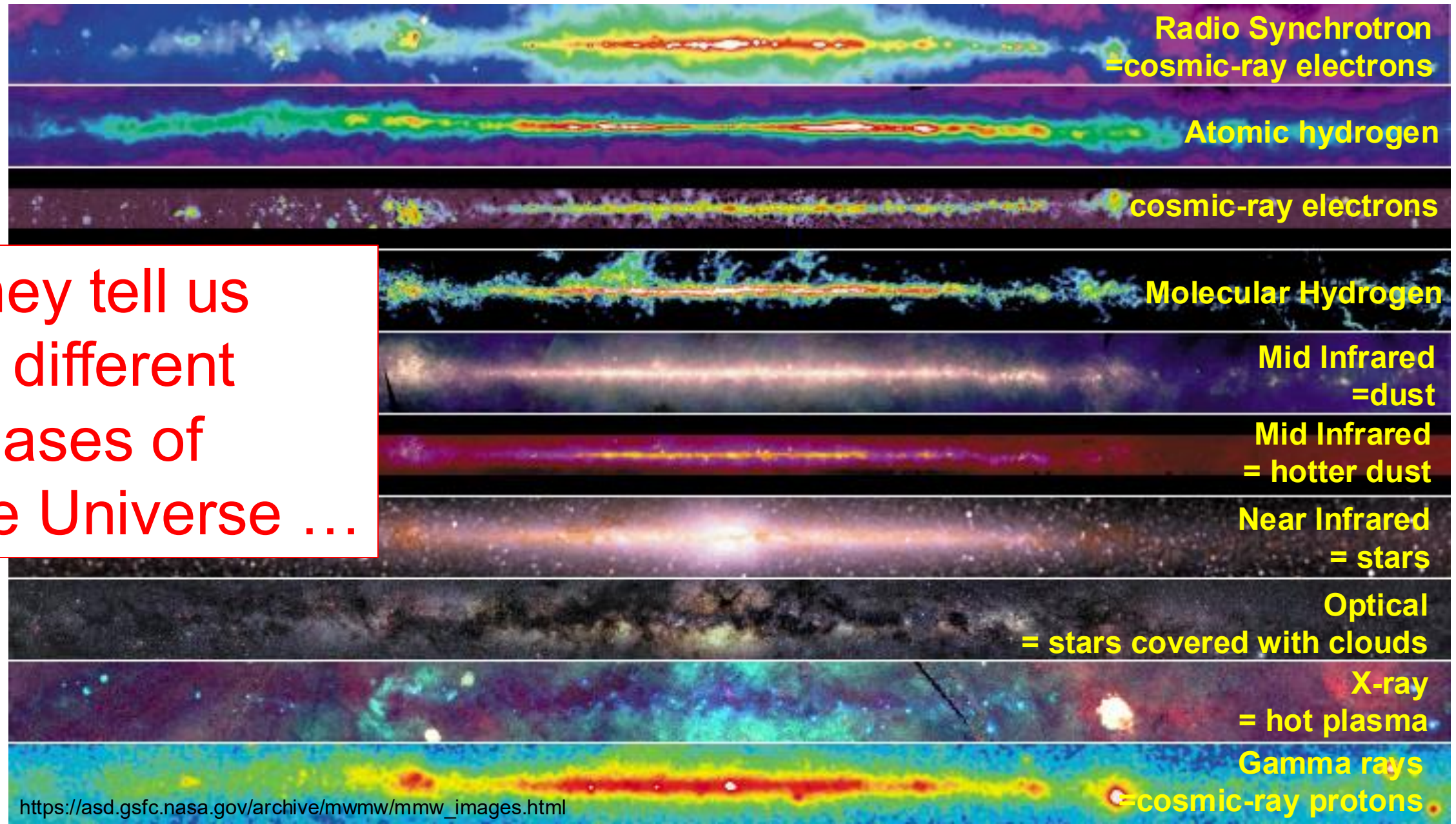
Because...





# Multi-wavelength sky = wider information of universe

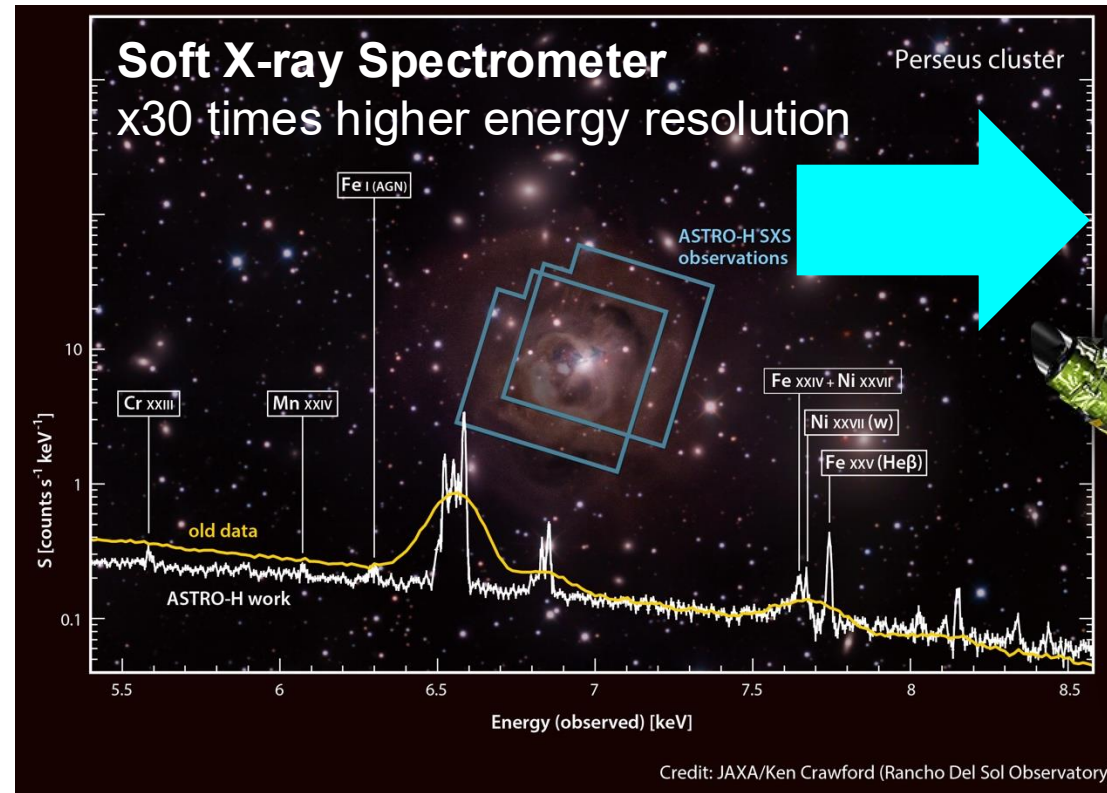
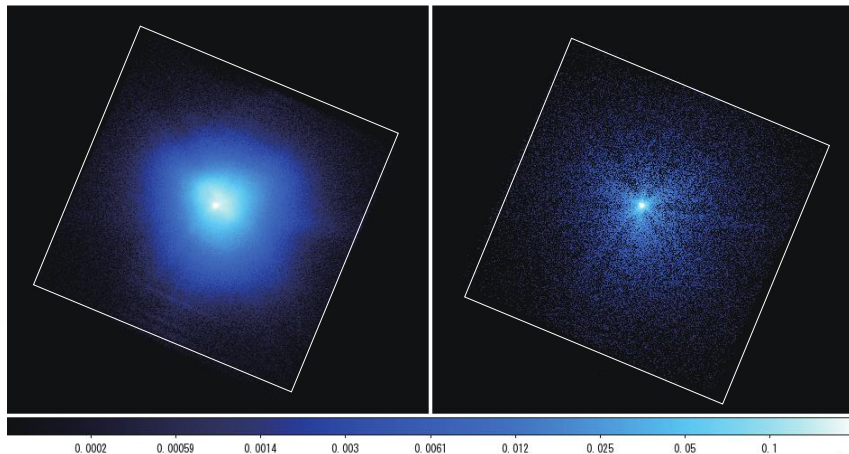
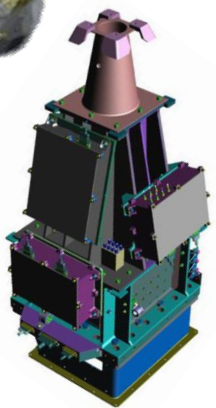
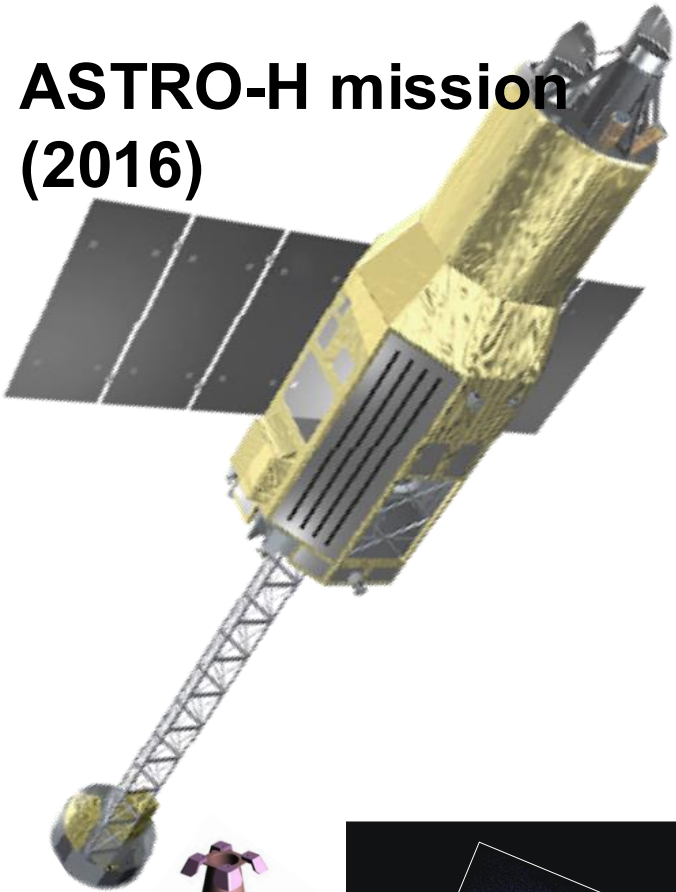
They tell us  
all different  
phases of  
the Universe ...



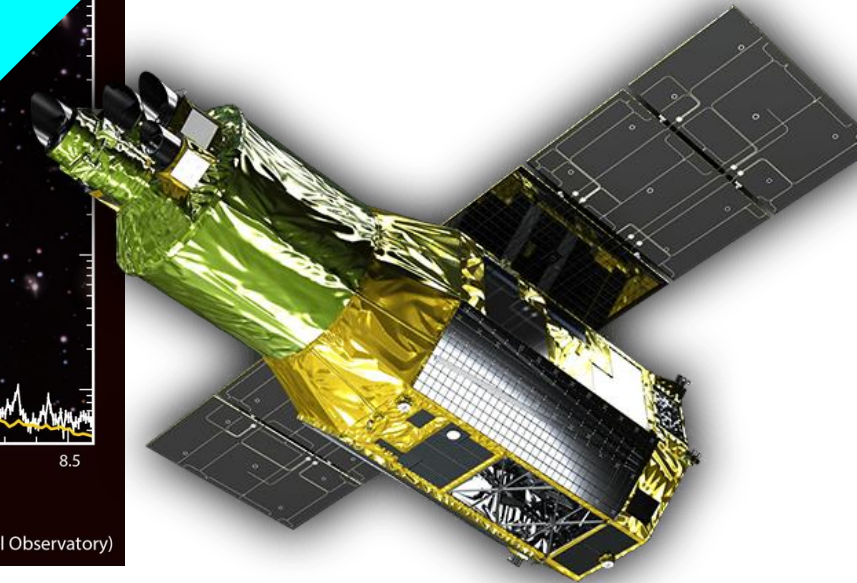


# Japan-lead Space X-ray/gamma ray missions

## ASTRO-H mission (2016)



## XRISM (2023-) See Noda-san's talk



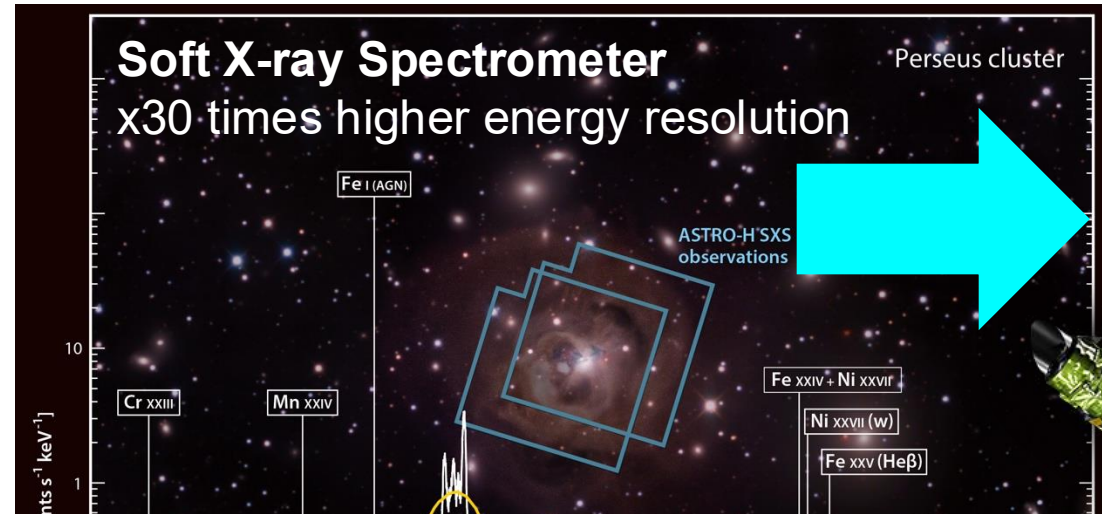
## Hard X-ray Imager (PI: Nakazawa)

Hard X-ray imaging spectroscopy with low noise and high sensitivity

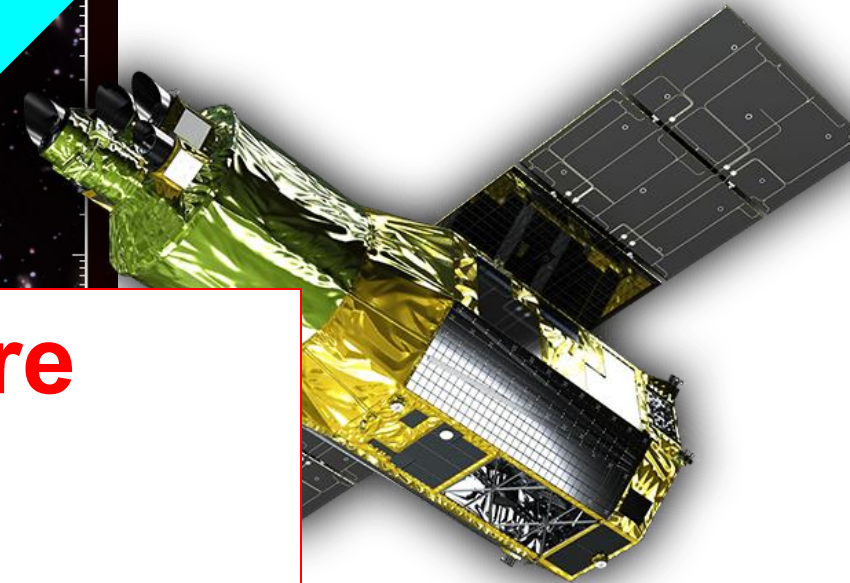
**Next generation  
FORCE/JEDI/HEROIX etc.  
Development works for  
even better sensitivity...**

# Japan-lead Space X-ray/gamma ray missions

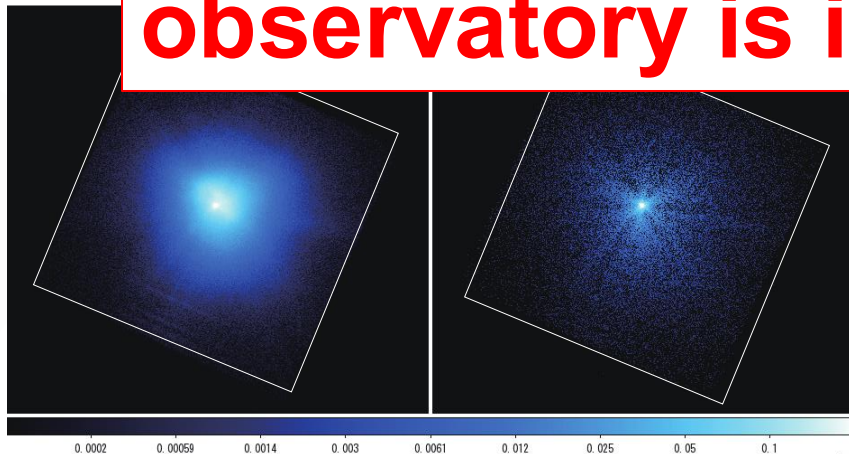
**ASTRO-H mission  
(2016)**



**XRISM (2023-)**  
See Noda-san's talk



**Development work for future  
hard X-ray and gamma-ray  
observatory is important**



**Nakazawa)**  
Hard X-ray imaging  
spectroscopy with low  
noise and high  
sensitivity

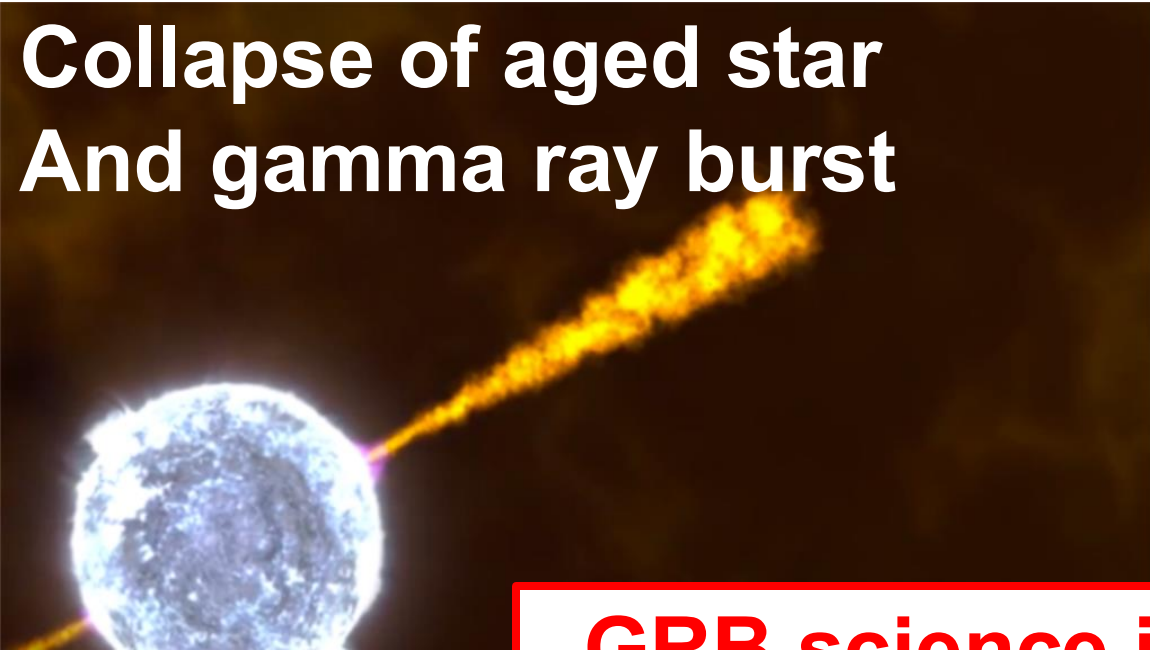


**Next generation  
FORCE/JEDI/HEROIX etc.**  
Development works for  
even better sensitivity...



# Science of Gamma ray bursts

**Collapse of aged star  
And gamma ray burst**



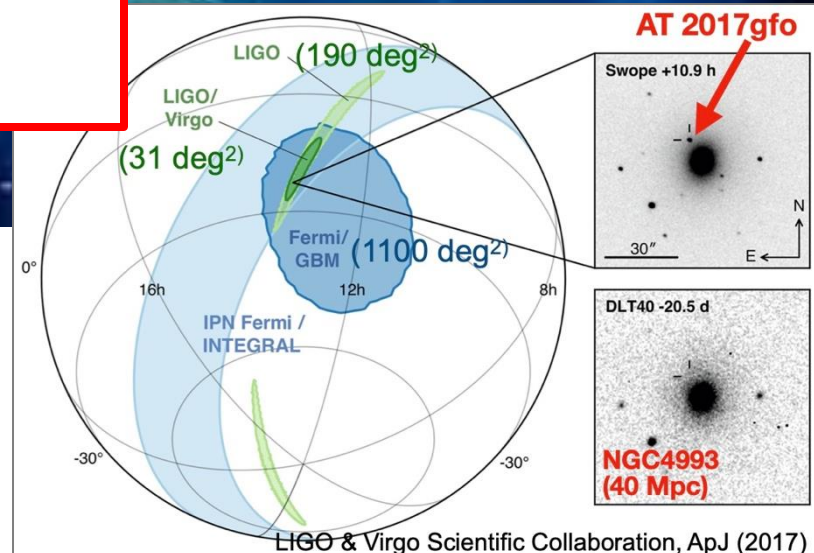
**Neutron Star merger**



**GRB science is hot, with new  
astronomy, such as GW**



Localization using  
GRB signal

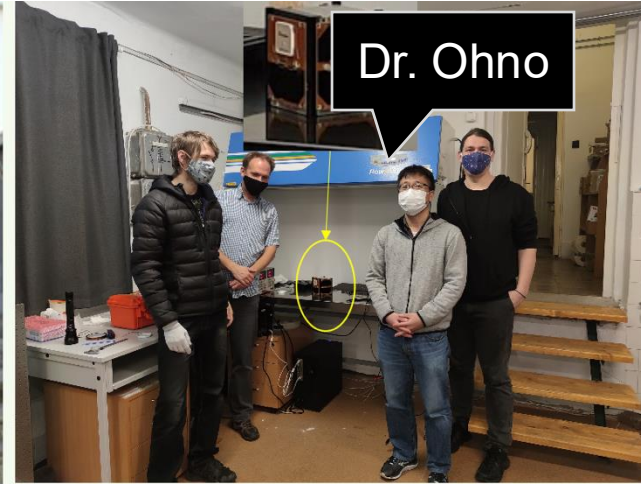




# Czech-Japan-Slovak-Hungary collaboration on cubesats for Gamma-ray Burst science



**VSZLUSAT-2 group photo just before the delivery of satellite to launcher**



**GRBAAlpha group photo after satellite integration**

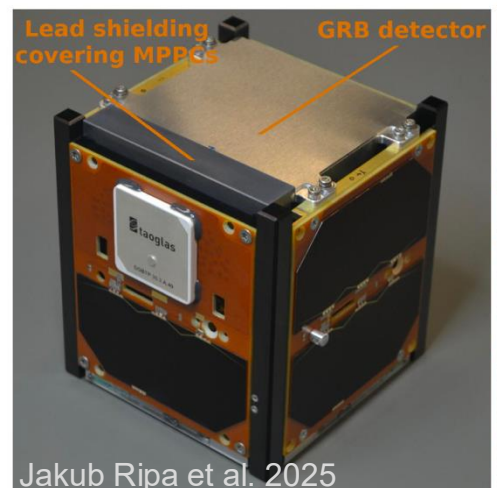
**See Norberto-san's talk**

Prof. Fukazawa

Prof. Mizuno

et al. (Hiroshima-University)

+ Nagoya-U, U-Tokyo, RIKEN





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**VSZLUSAT-2 group photo just before the delivery of satellite to launcher**

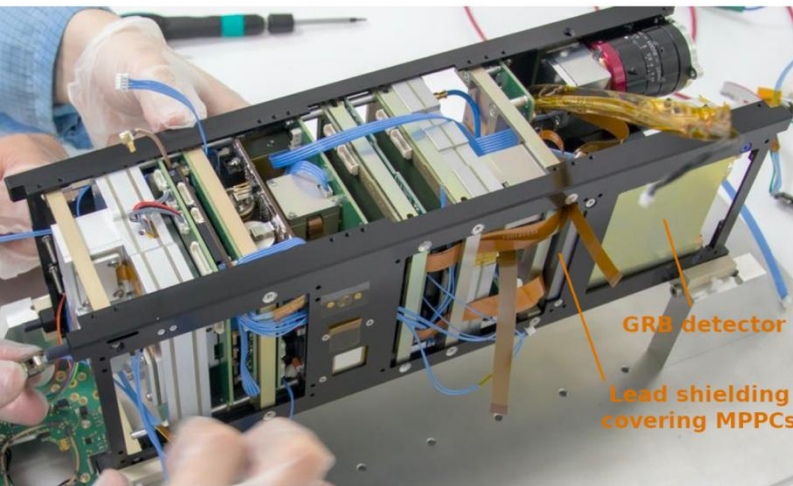
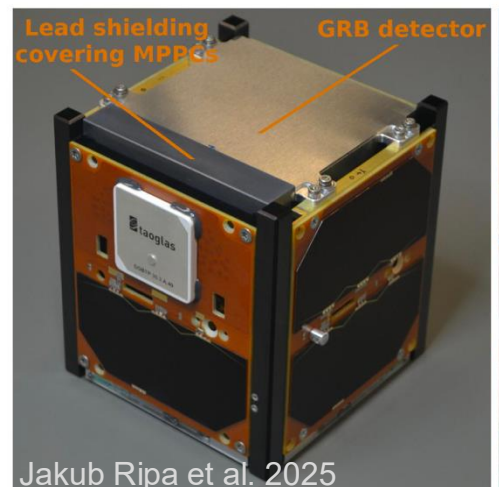


**GRBAAlpha group photo at integration**

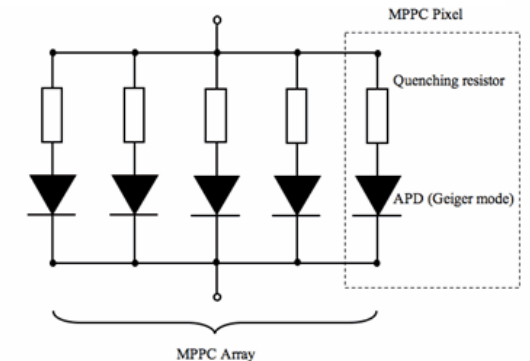
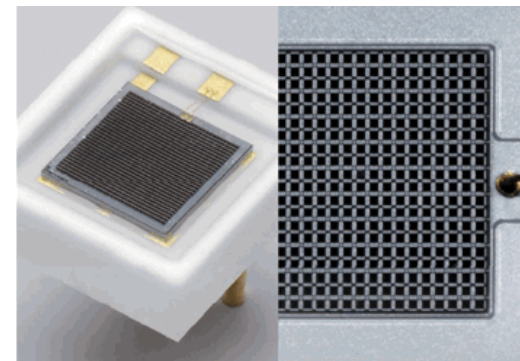
**See Norberto-san's talk**  
 Prof. Fukazawa  
 Prof. Mizuno  
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RIKEN

**New approach for GRB science + and ...**



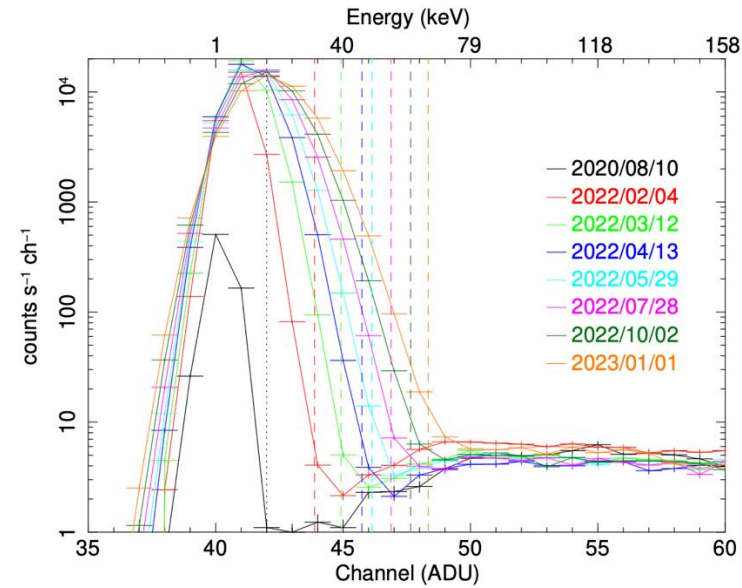
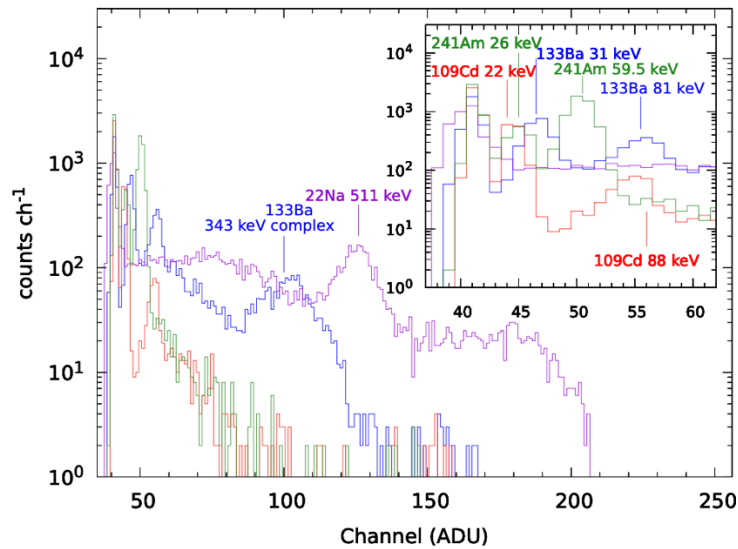
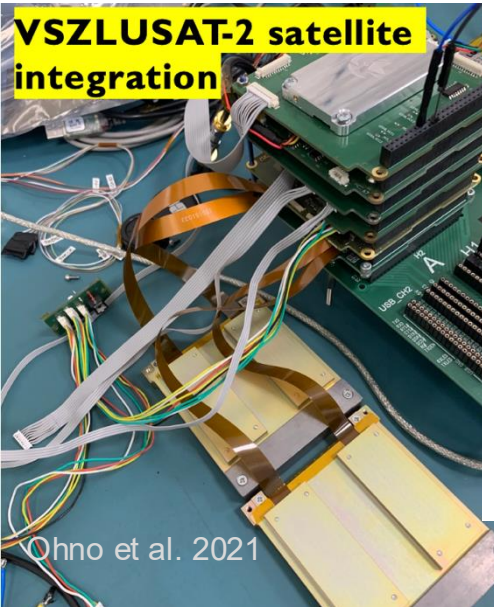
**Space verification of new Si-PM sensor**



Hamamatsu Photonics



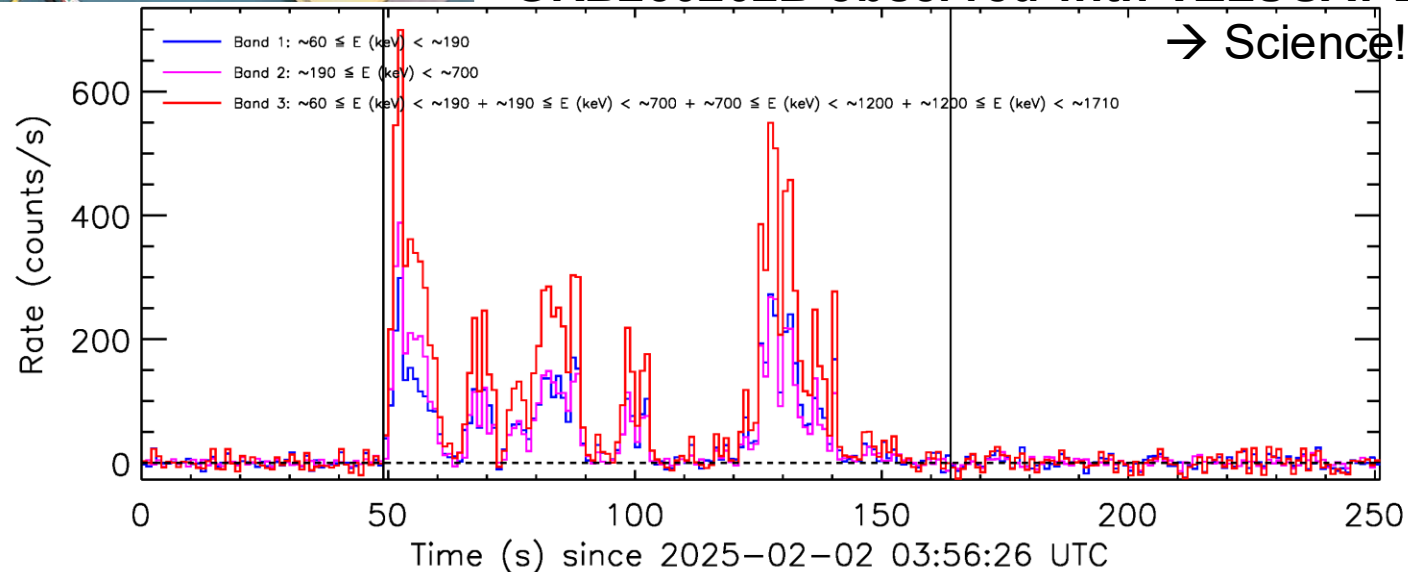
# Space Verification of new generation gamma ray detectors



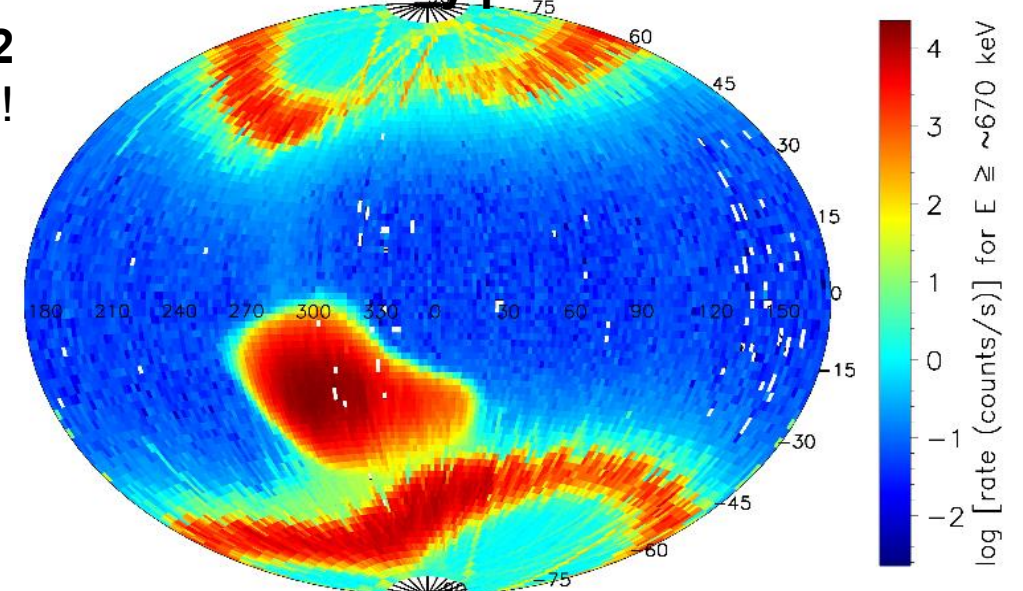
**Increasing leakage  
current noise**  
due to cosmic-ray  
bombardment  
Clearly recorded  
→ Precious data!

## GRB250202B observed with VZLUSAT-2

→ Science!!



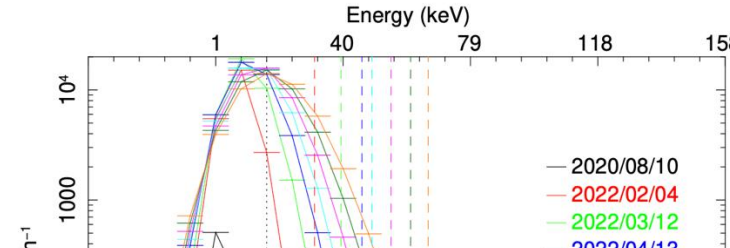
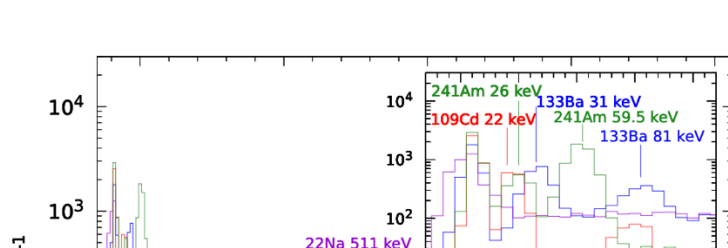
## Cosmic-ray proton distribution in orbit



Jakub Ripa et al. 2025

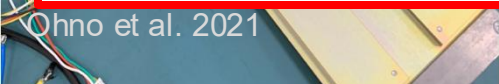


# Space Verification of new generation gamma ray detectors<sup>7</sup>



Increasing leakage  
current noise  
due to cosmic-ray  
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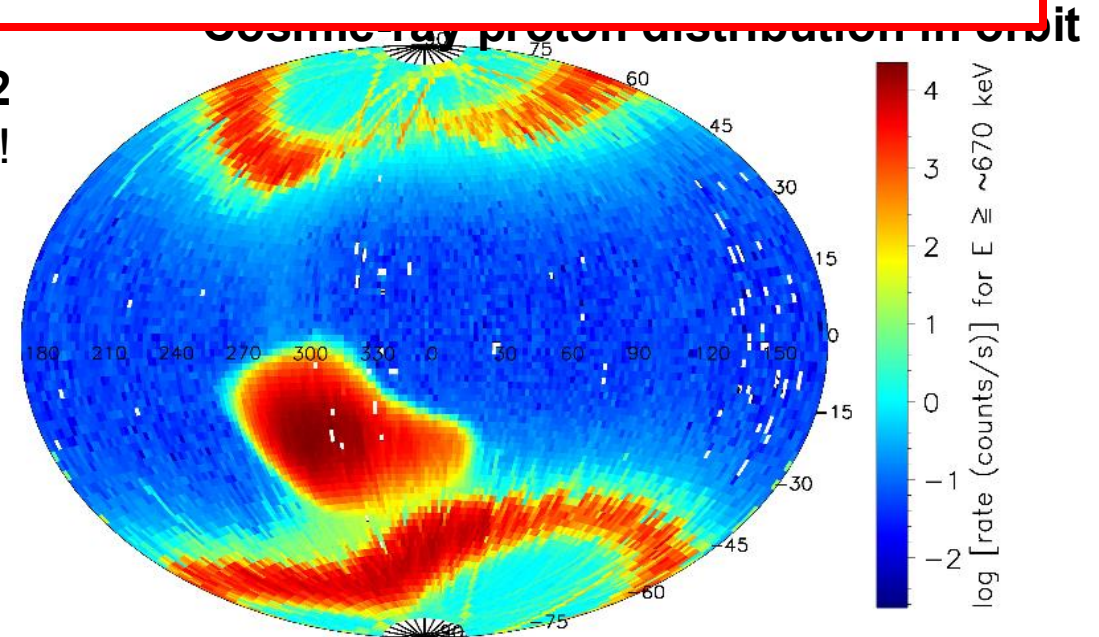
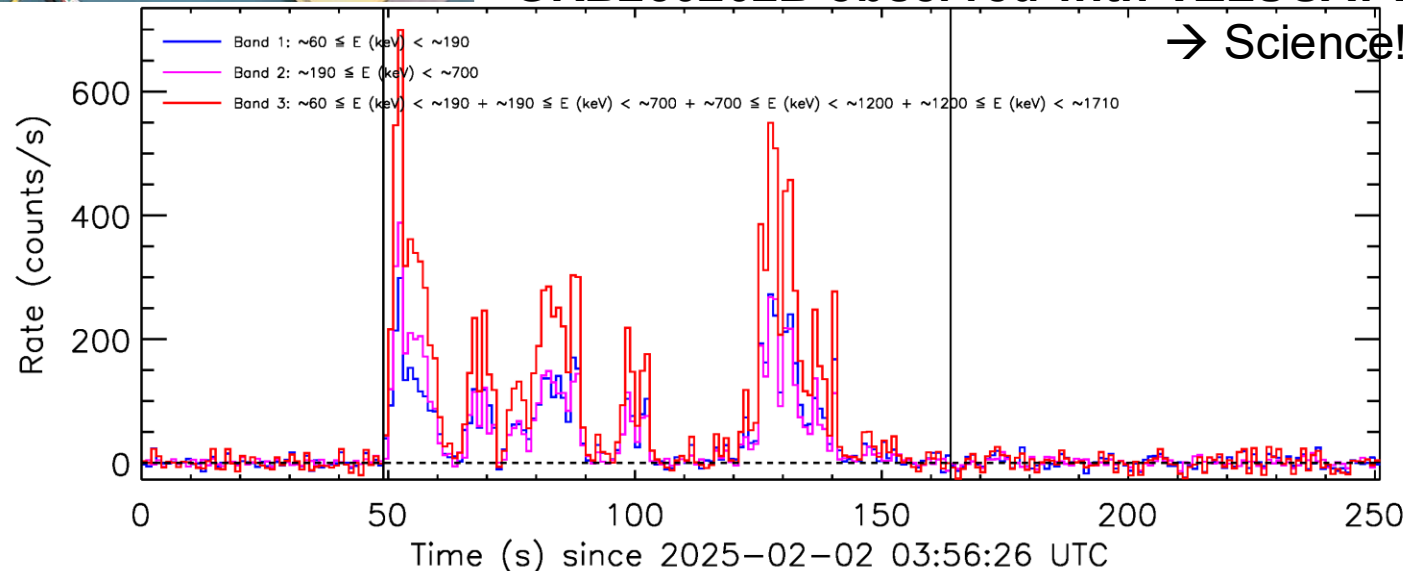
**New Si-PM sensor → Learning how to best use it  
+  
GRB science**



Jakub Ripa et al. 2025

**GRB250202B observed with VZLUSAT-2**

→ Science!!



Jakub Ripa et al. 2025



## **And yet another science ...**

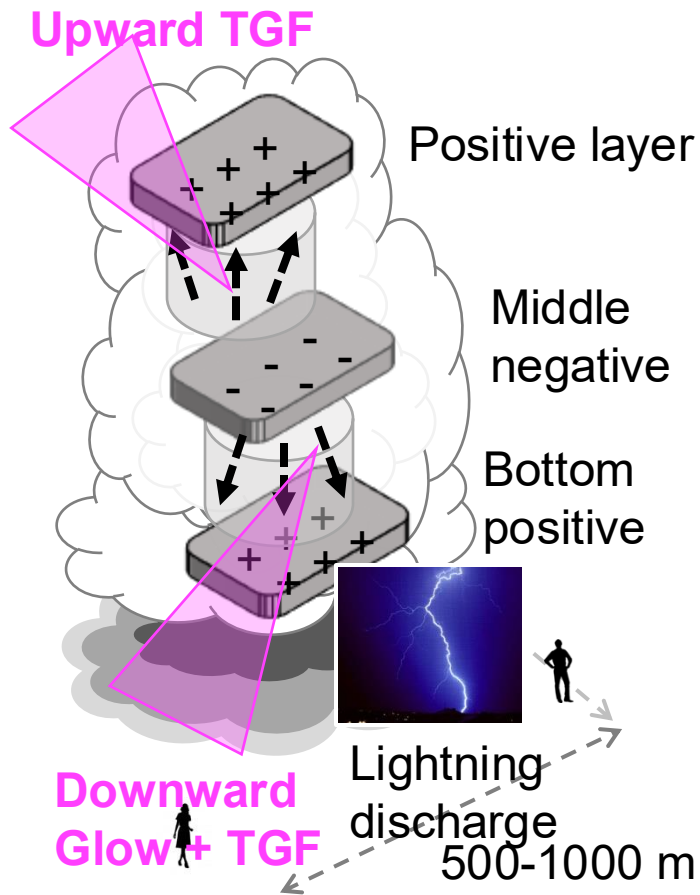




# Thunderstorm gamma rays : On ground measurements

**Enigmatic** (quasi)-static **electric-field acceleration** of ambient electrons **in the sky**

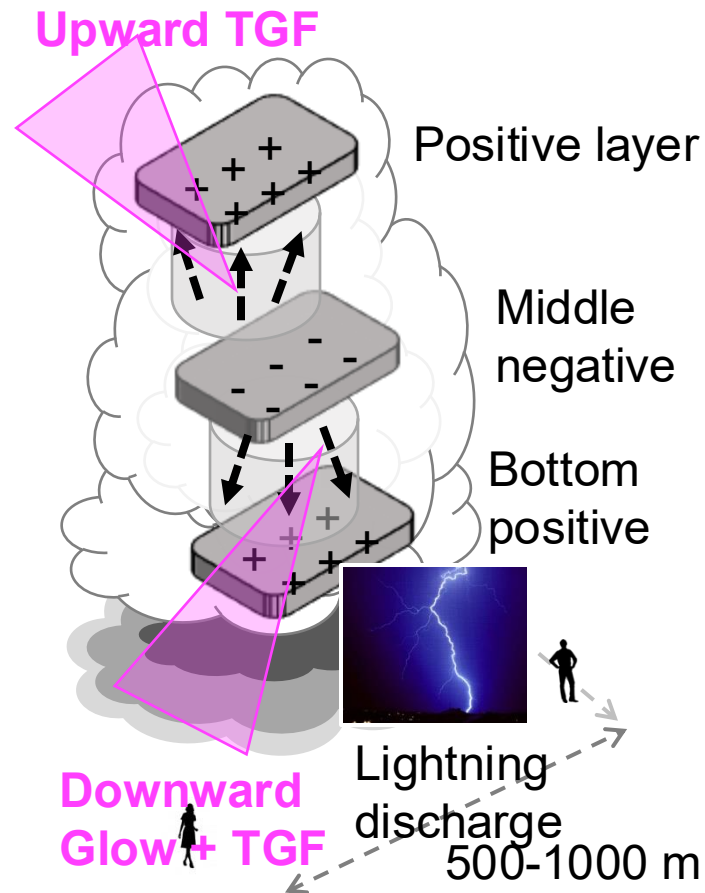
- **Newly** found “natural” particle acceleration phenomena (**physics**)
- **New** way of “remote sensing” the charge-up of thunderstorms (**meteorology**)



# Thunderstorm gamma rays : On ground measurements

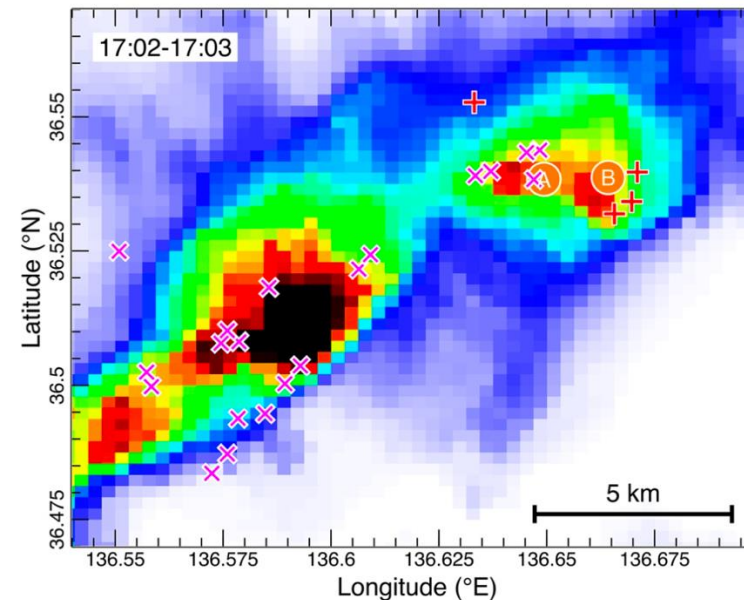
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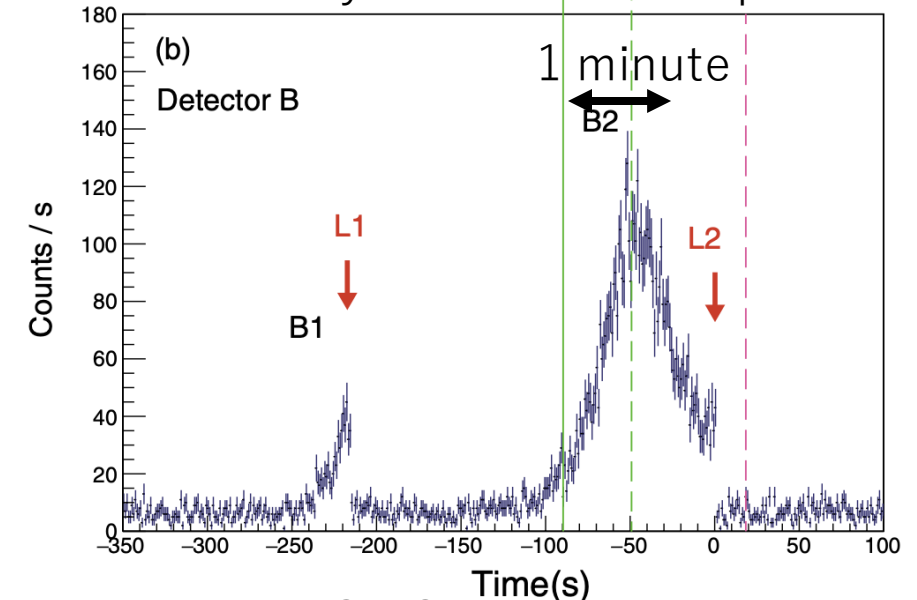


## Thunderstorm gamma ray glow in Japan Hokuriku-region

10 MeV gamma ray emitted from thunderstorm for a few minutes



## Gamma ray count-rate time profile



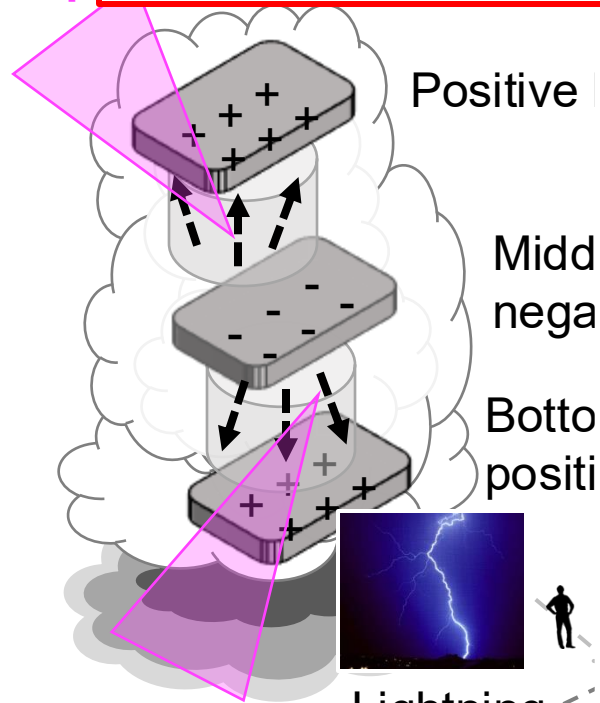
*“Multiple Gamma-Ray Glows and a Downward TGF Observed From Nearby Thunderclouds”* Hisadomi, Nakazawa, Enoto et al. 2021



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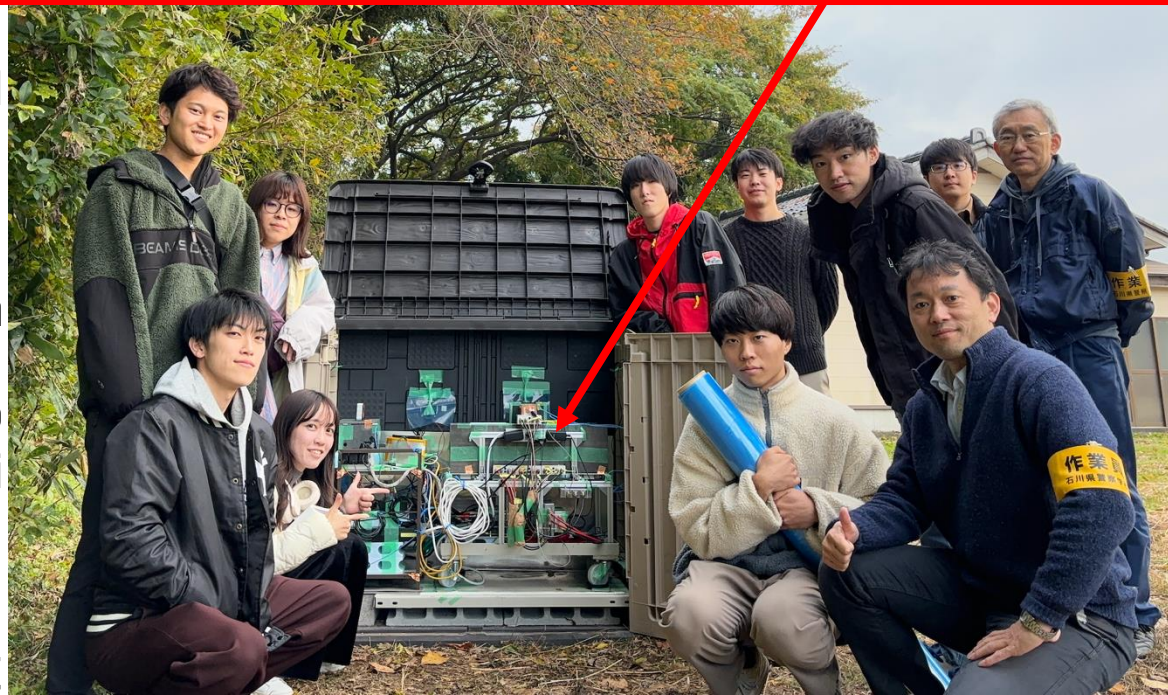
Enigmatic (quasi)-static electric-field acceleration of ambient electrons in the sky

- **Our Detector system in Kanazawa is based on technologies similar to that of the GRB cubesat**



Downward  
Glow + TGF

Lightning  
discharge  
500-1000 m



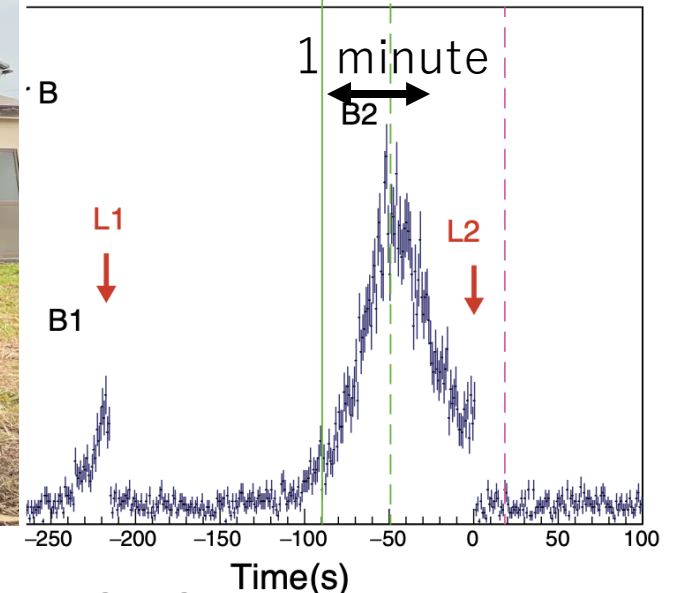
Longitude ( $^{\circ}$ E)

-350 -300

an Hokuriku-region

m for a few minutes

a ray count-rate time profile

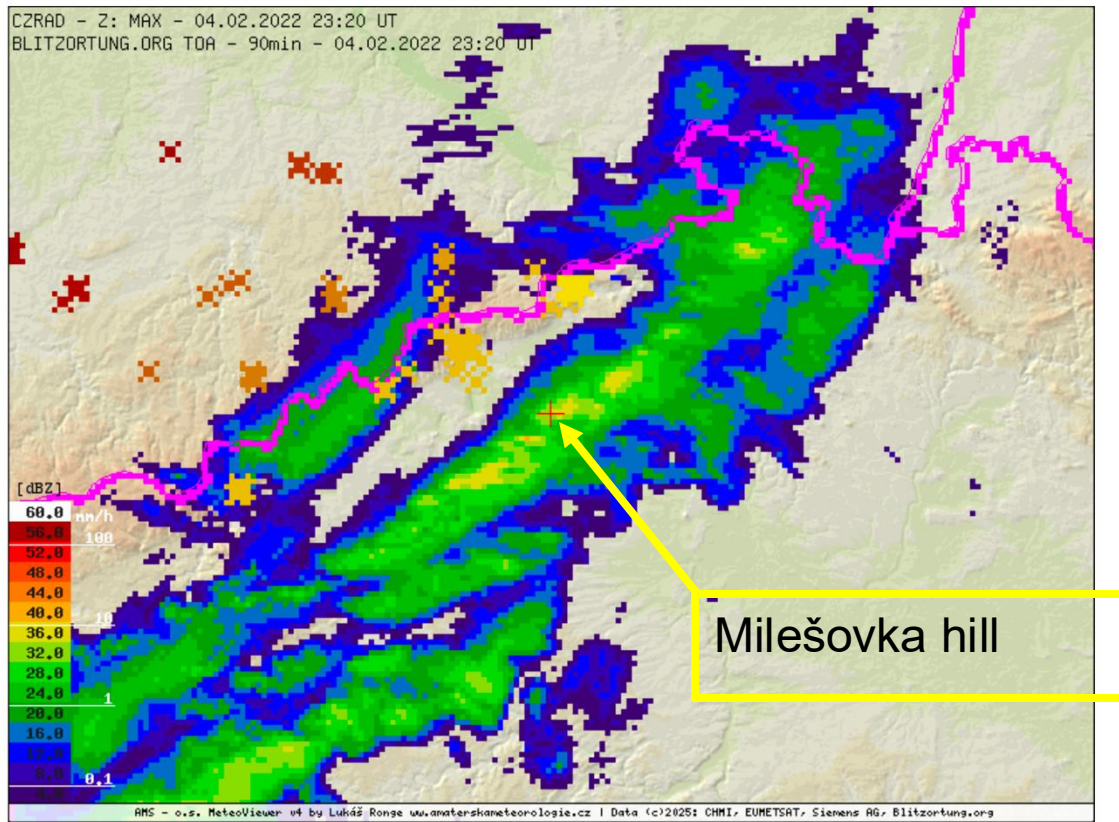


*"Multiple Gamma-Ray Glows and a Downward TGF Observed From Nearby Thunderclouds"* Hisadomi, Nakazawa, Enoto et al. 2021

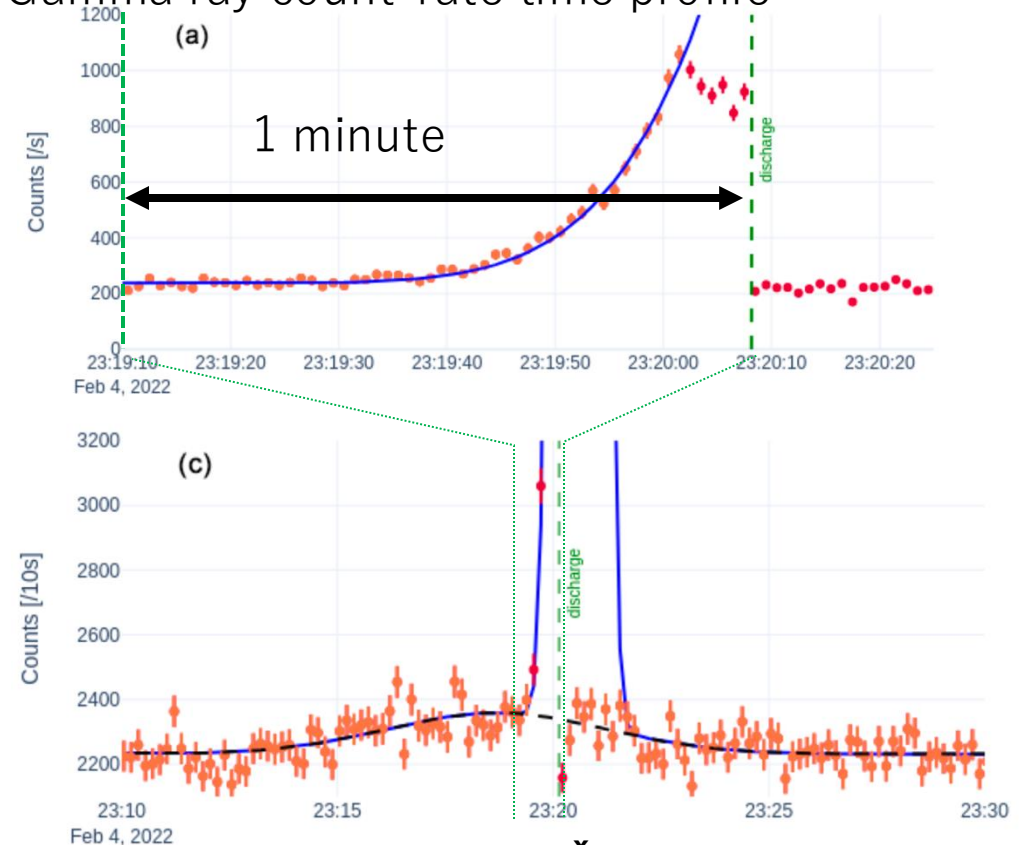
# Phenomena is also observed in Czech

## Thunderstorm gamma ray glow in **Czech Milešovka hill**

10 MeV gamma ray emitted from thunderstorm for a few minutes



Gamma ray count-rate time profile



*“First reported detection of a winter continental gamma-ray glow in Europe”* Jakub Šlegl et al. 2025

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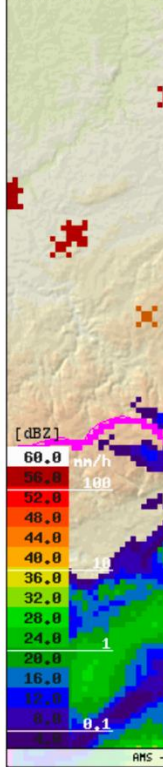
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Gamma ray count-rate time profile

CZRAD - Z: MAX - 04.02.2022 23:20 UT  
BLITZORTUNG.ORG TDA - 90min - 04.02.2022 23:20 UT



**Czech is “yet another” precious location  
thunderstorm gamma rays can be observed  
on-ground  
(Japan, Armenia, + **Czech**)**

*Ref: Czech-Japan CAS-JSPS Bilateral Collaborations  
2020-2021 Ondrej Ploc, Teru Enoto, Yuki Wada +*

“First re

EGU AC&P **RECENTLY REPORTED!!**

# Thanks a lot

- Czech and Japan has good history of gamma-ray detector development work on space science.
  - For future observatories
  - For GRB science
- And maybe more on thundercloud gamma ray observations.
  - For new electron acceleration physics
  - For meteorology, how clouds evolves.