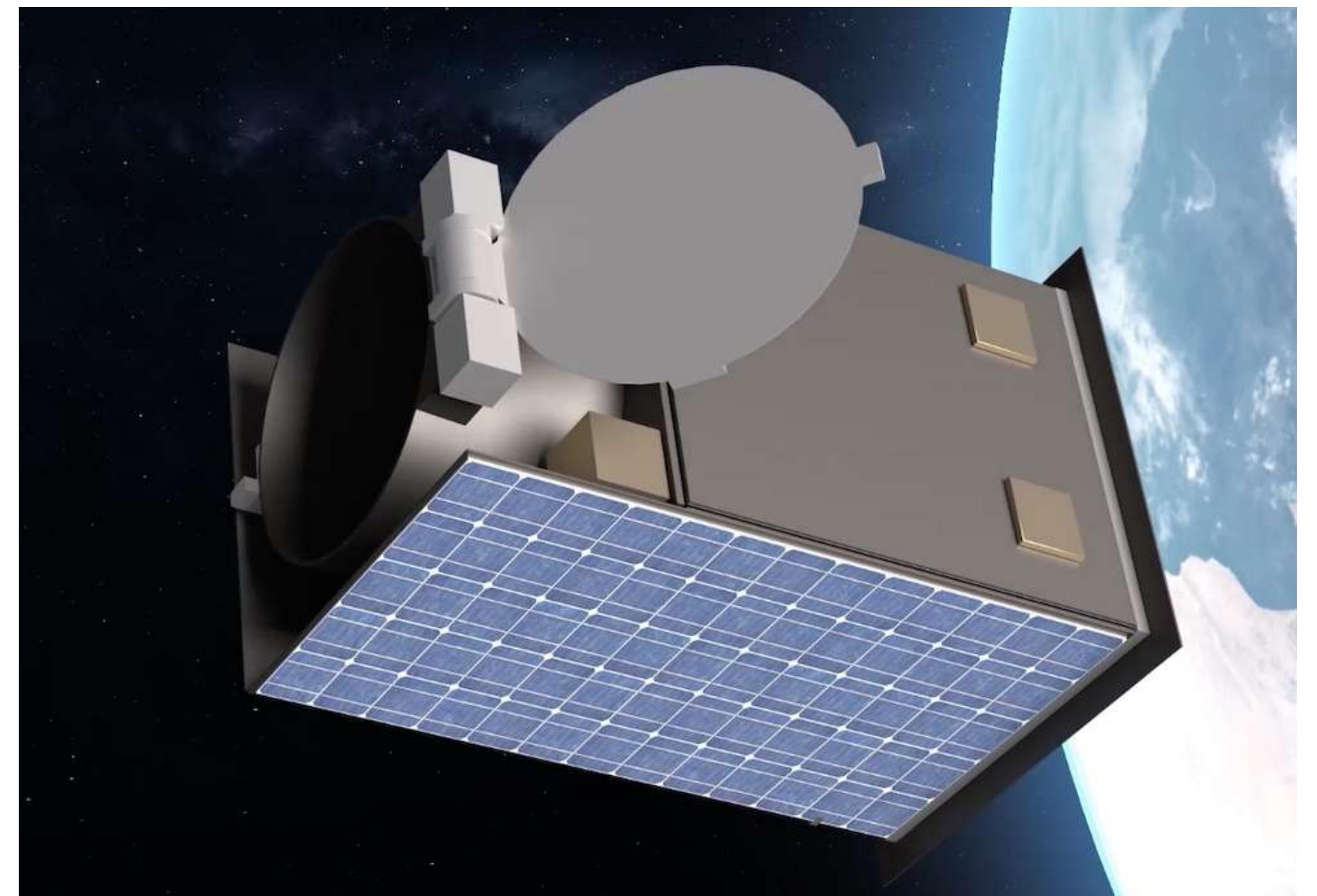
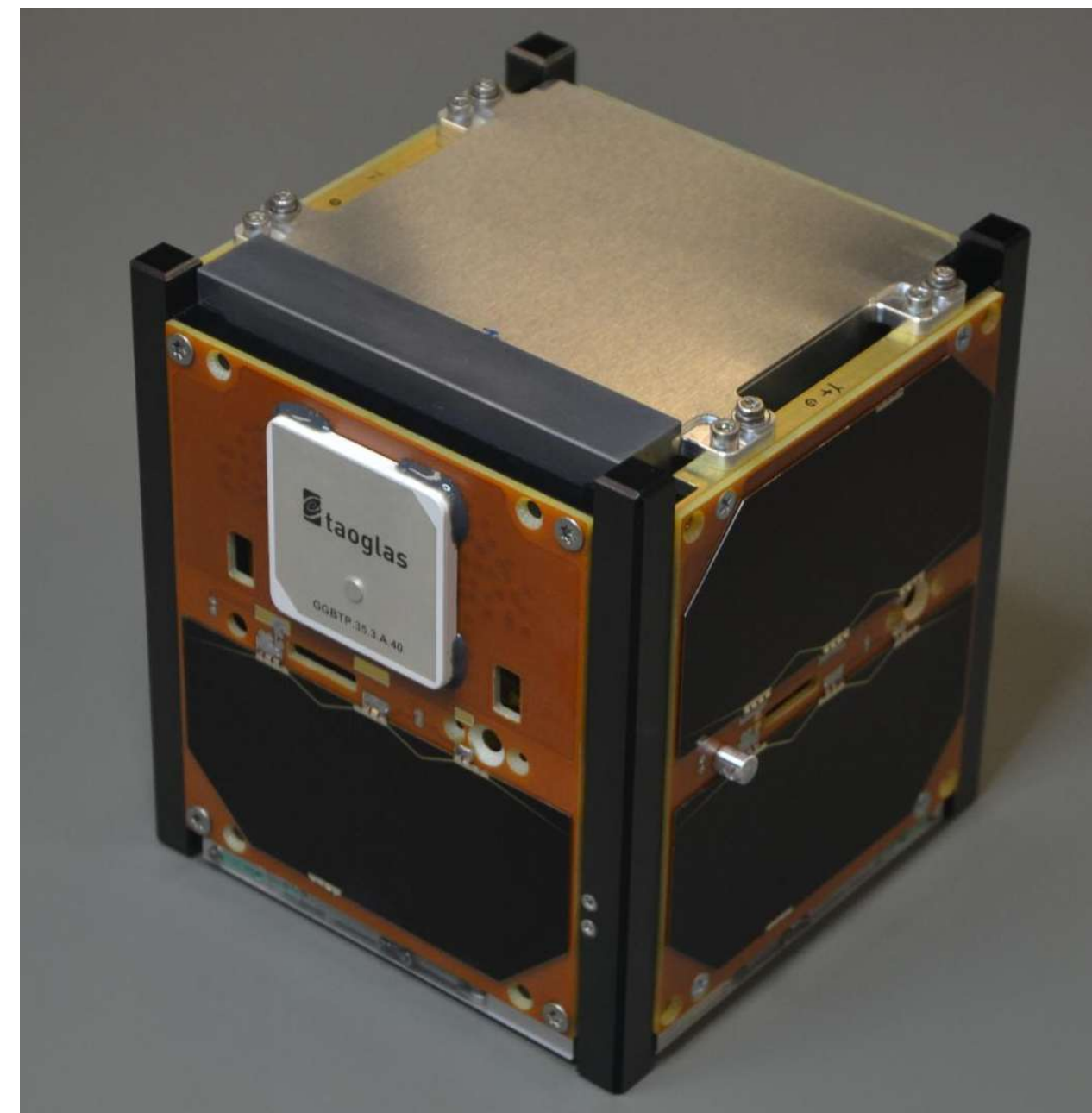
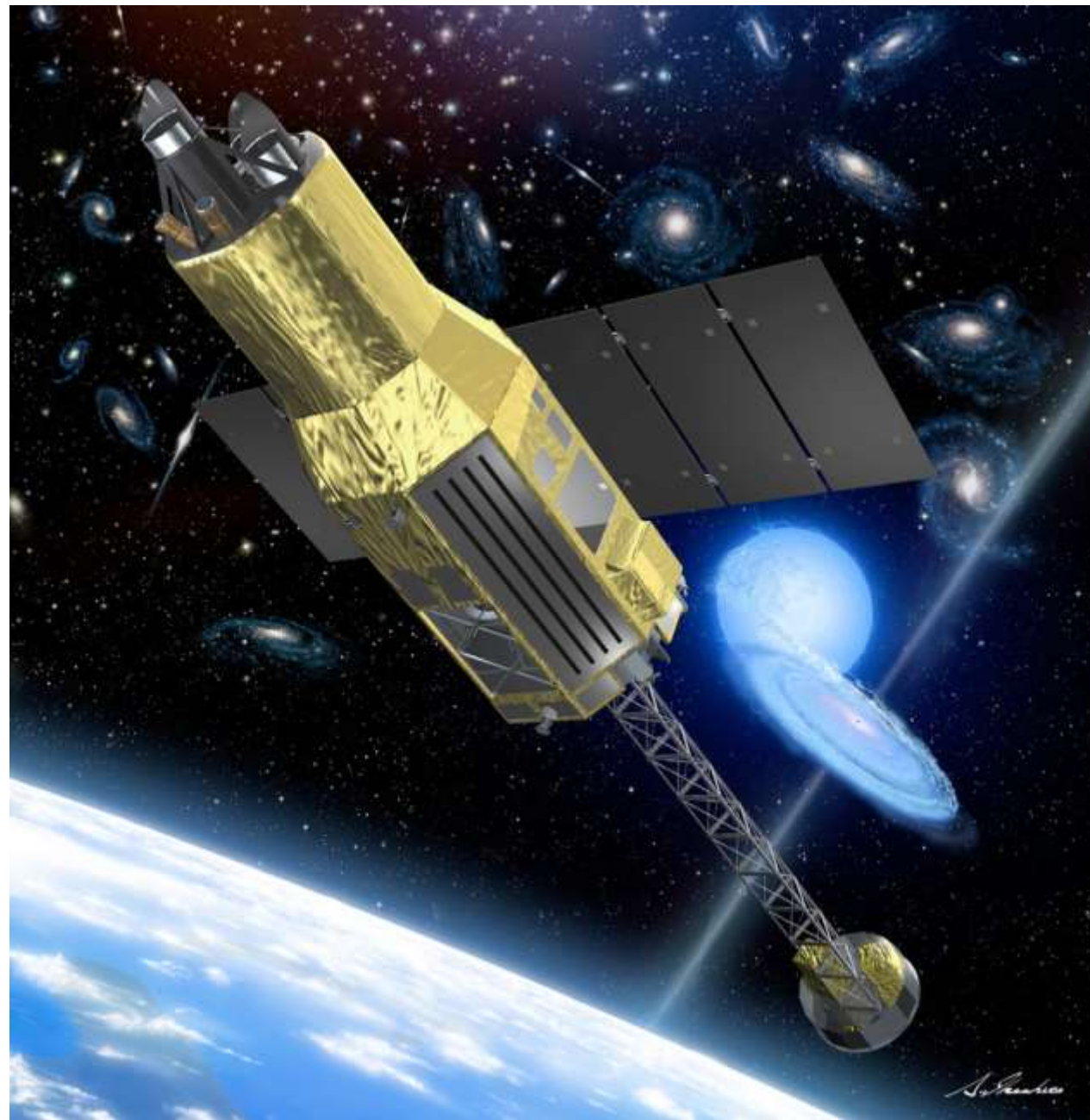


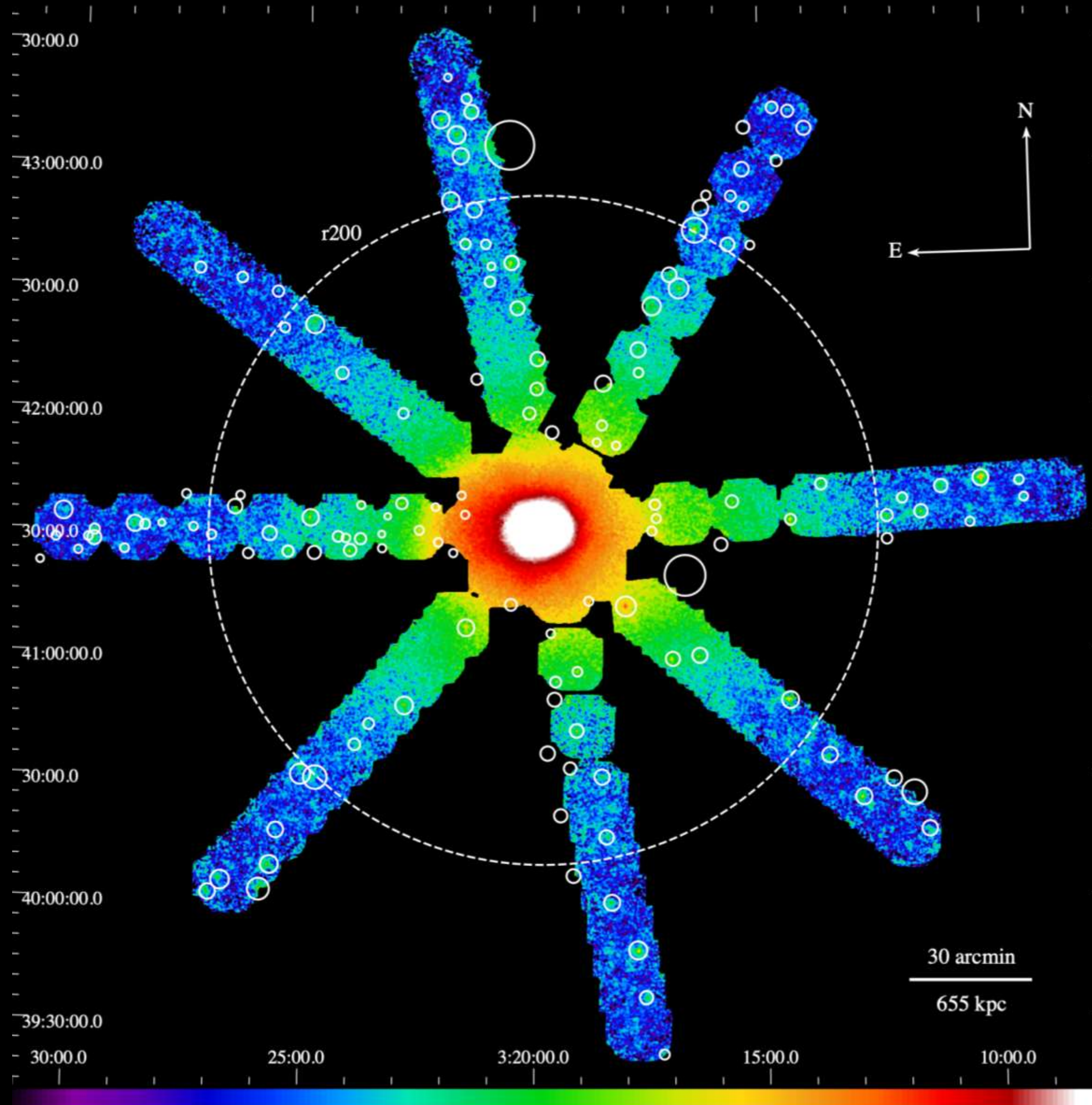
Czech-Japanese collaboration in studying the Hot and Energetic Universe:

From Hitomi/XRISM to future projects



Norbert Werner
Masaryk University

THE SUZAKU KEY PROJECT ON THE PERSEUS CLUSTER



85 Suzaku pointings

8 different directions

1Ms total exposure

AO 4-6 (July '09 -
Sept '11)

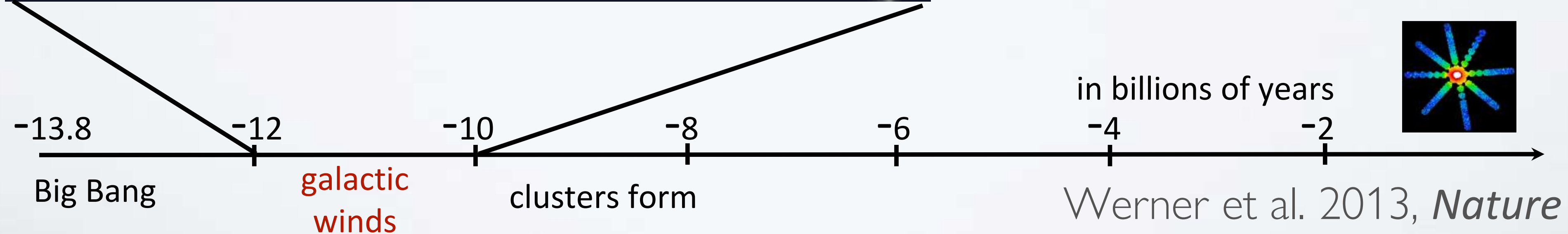
Urban et al. 2014

See also Simionescu et al. 2011,
2012, Werner et al. 2013

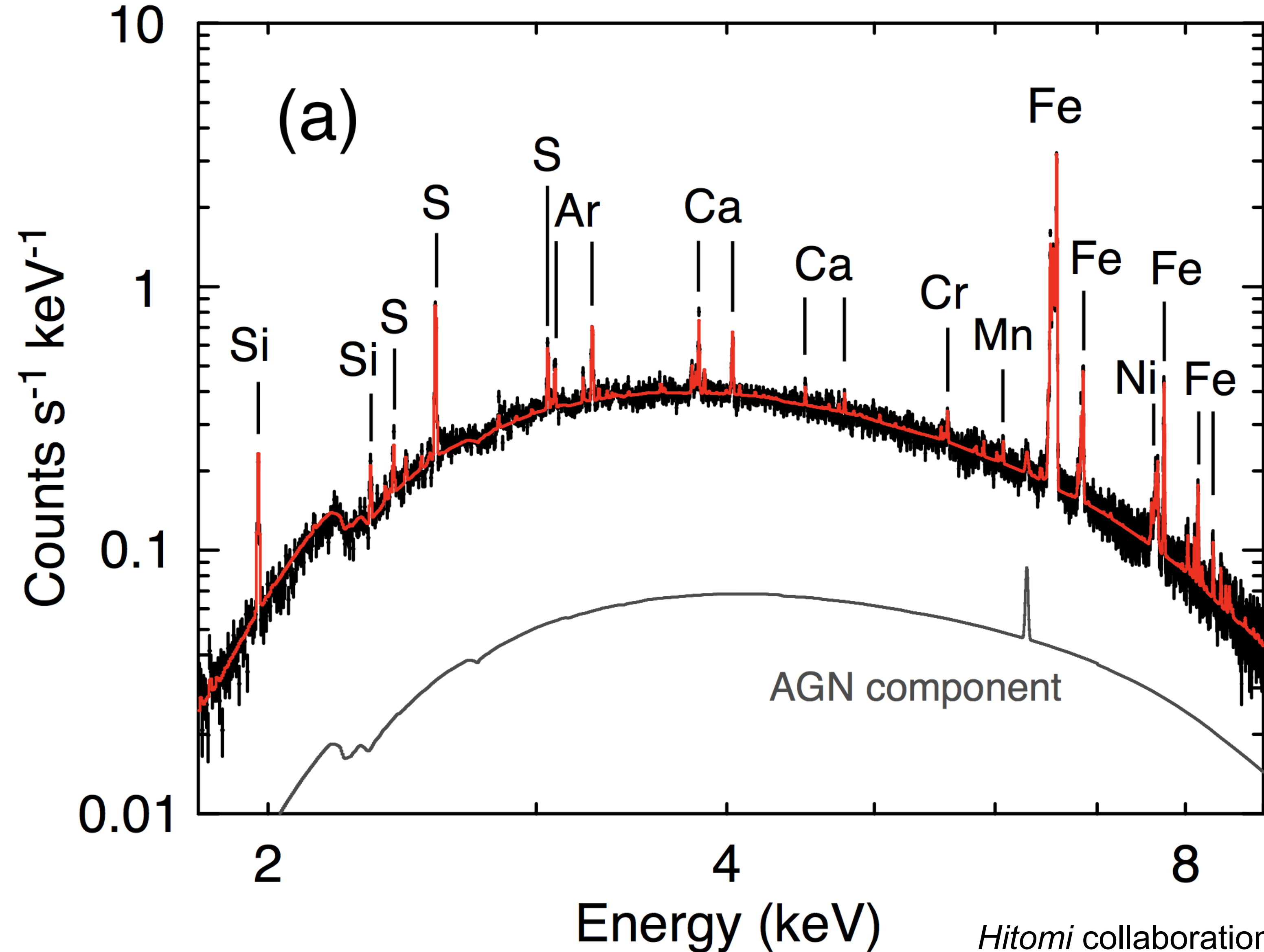
THE TURBULENT YOUNG UNIVERSE



- 10-12 billion years ago galaxies formed stars at very high rates, resulting in many supernova explosions
- at the same time, black holes grew fast by accreting matter
- combined energy of these processes produced winds blowing material out of galaxies

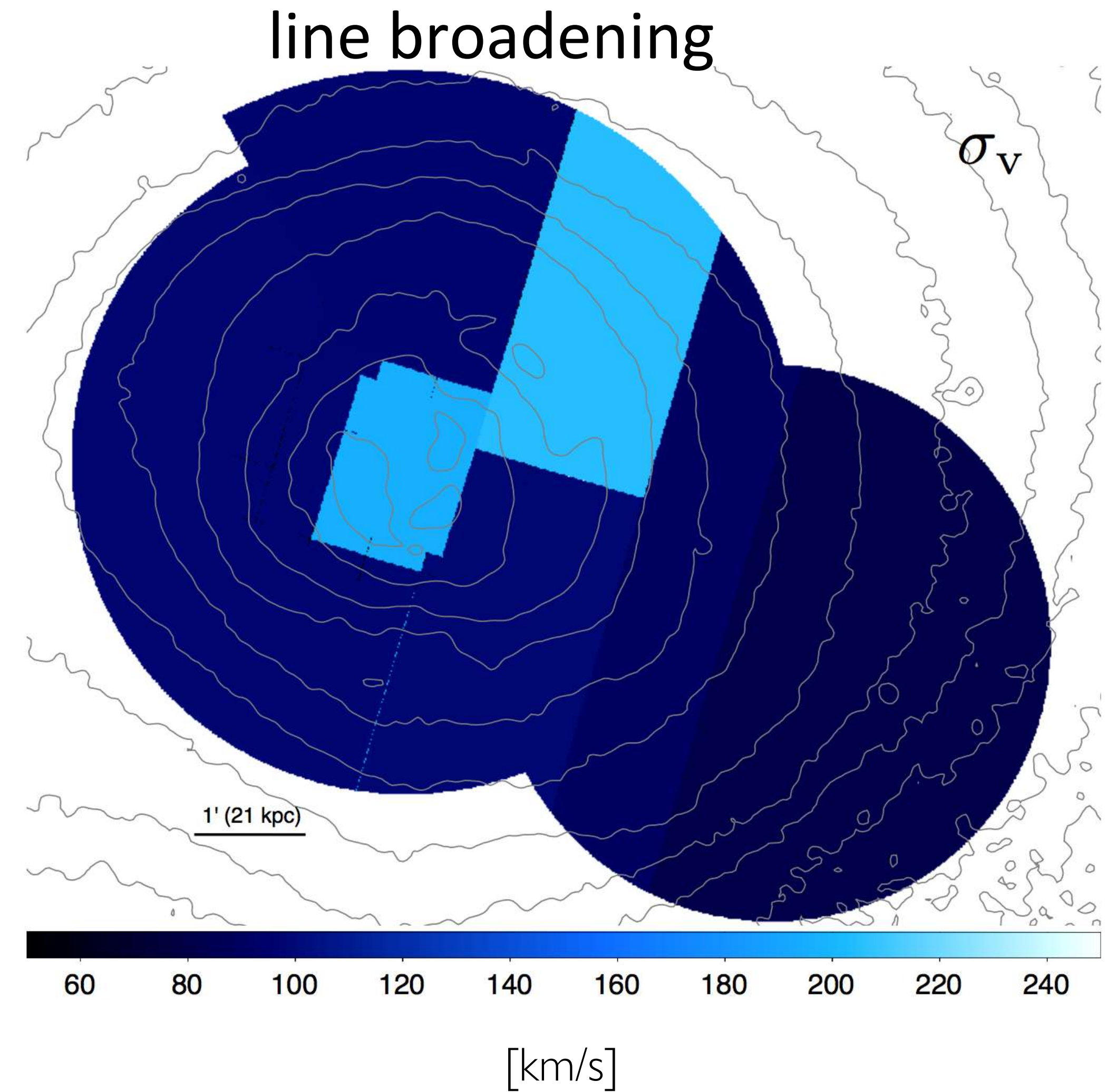
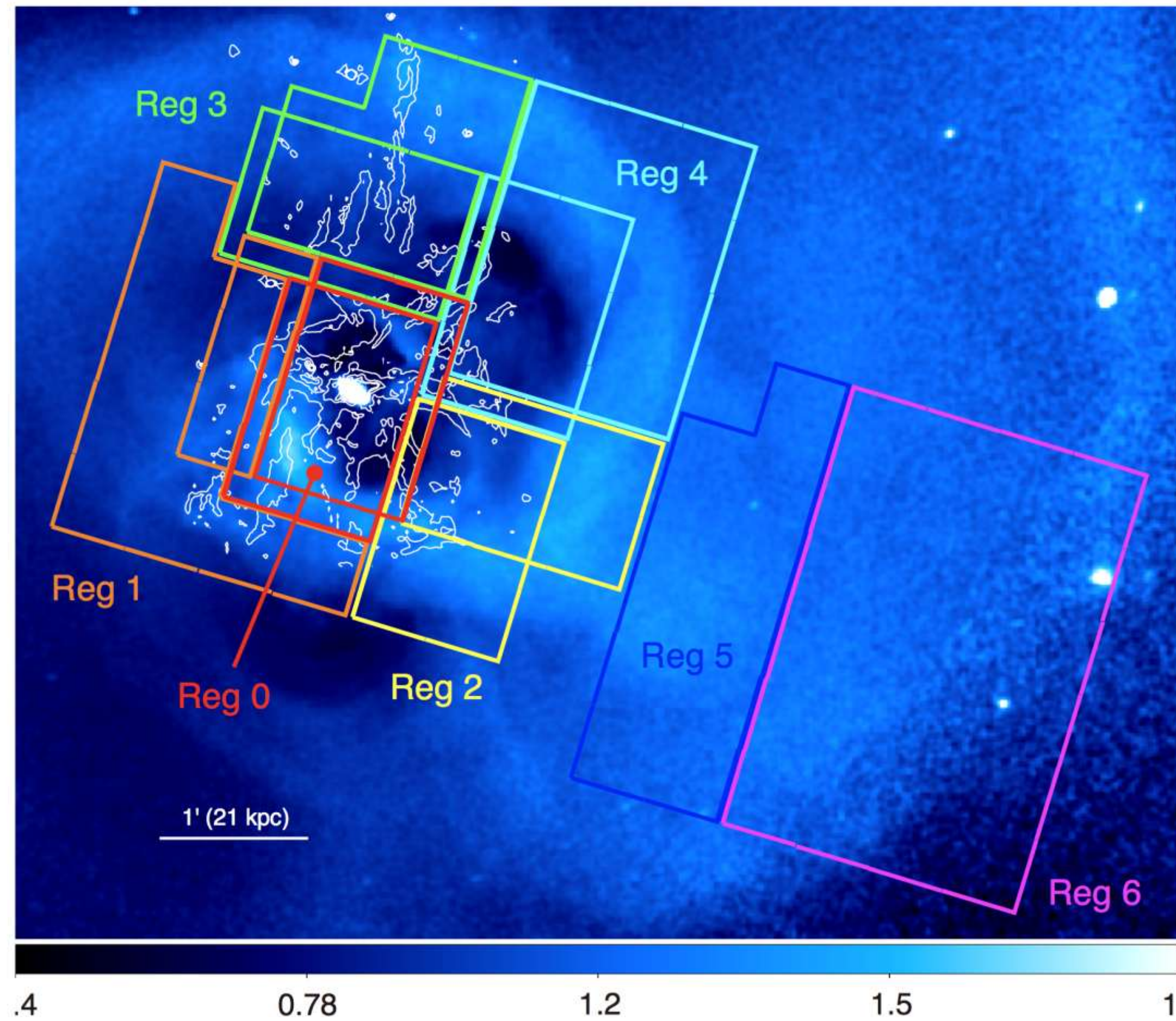


Hitomi Observation of the Perseus Cluster



Hitomi collaboration 2016, *Nature*
Hitomi collaboration 2017, *Nature*

First Direct Velocity Measurements



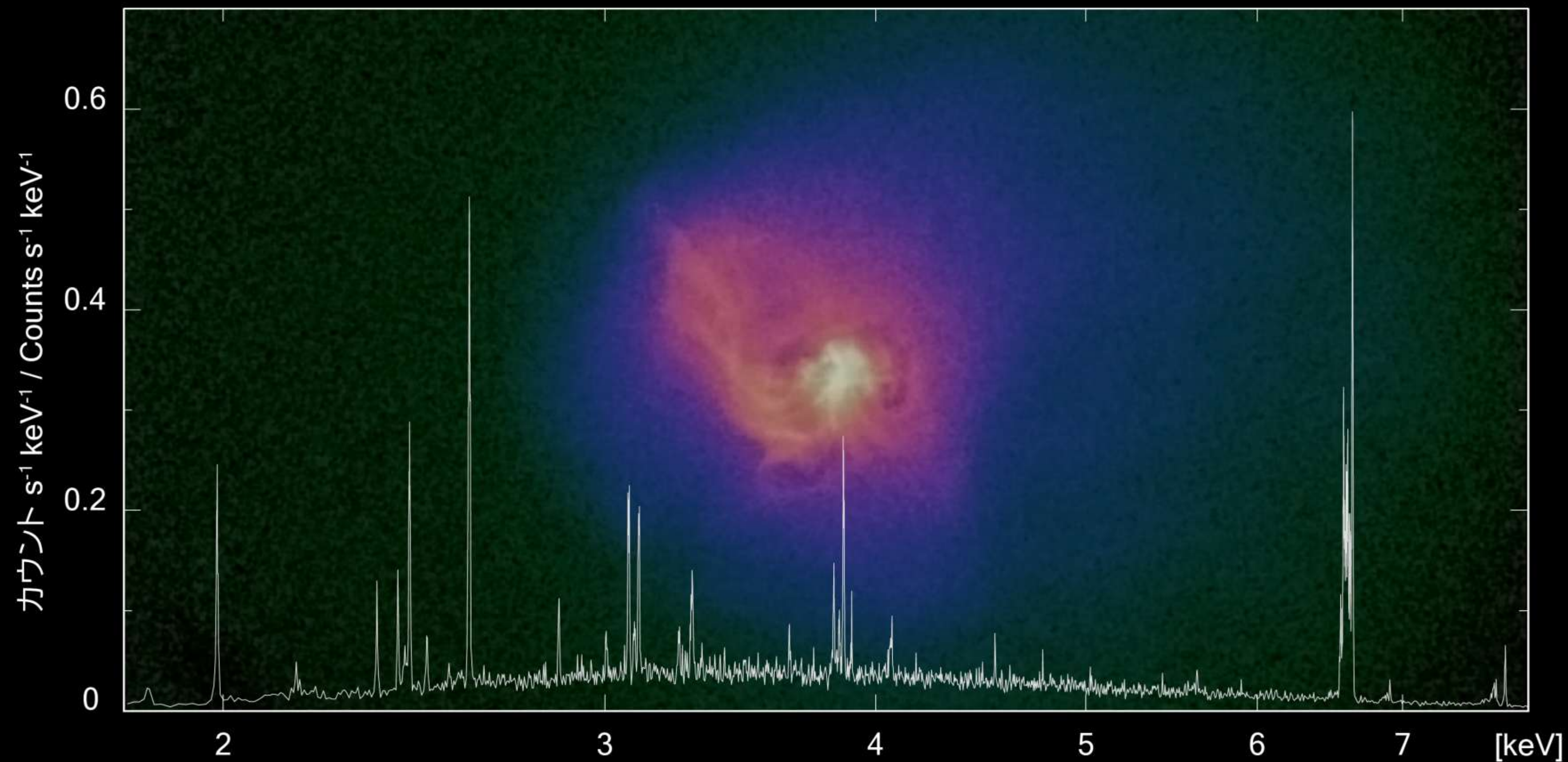
$$E_{\text{turb}}/E_{\text{therm}} \sim 2-6\%$$

ESA Guest Scientist in the XRISM Science Team

Centaurus Cluster Target Team



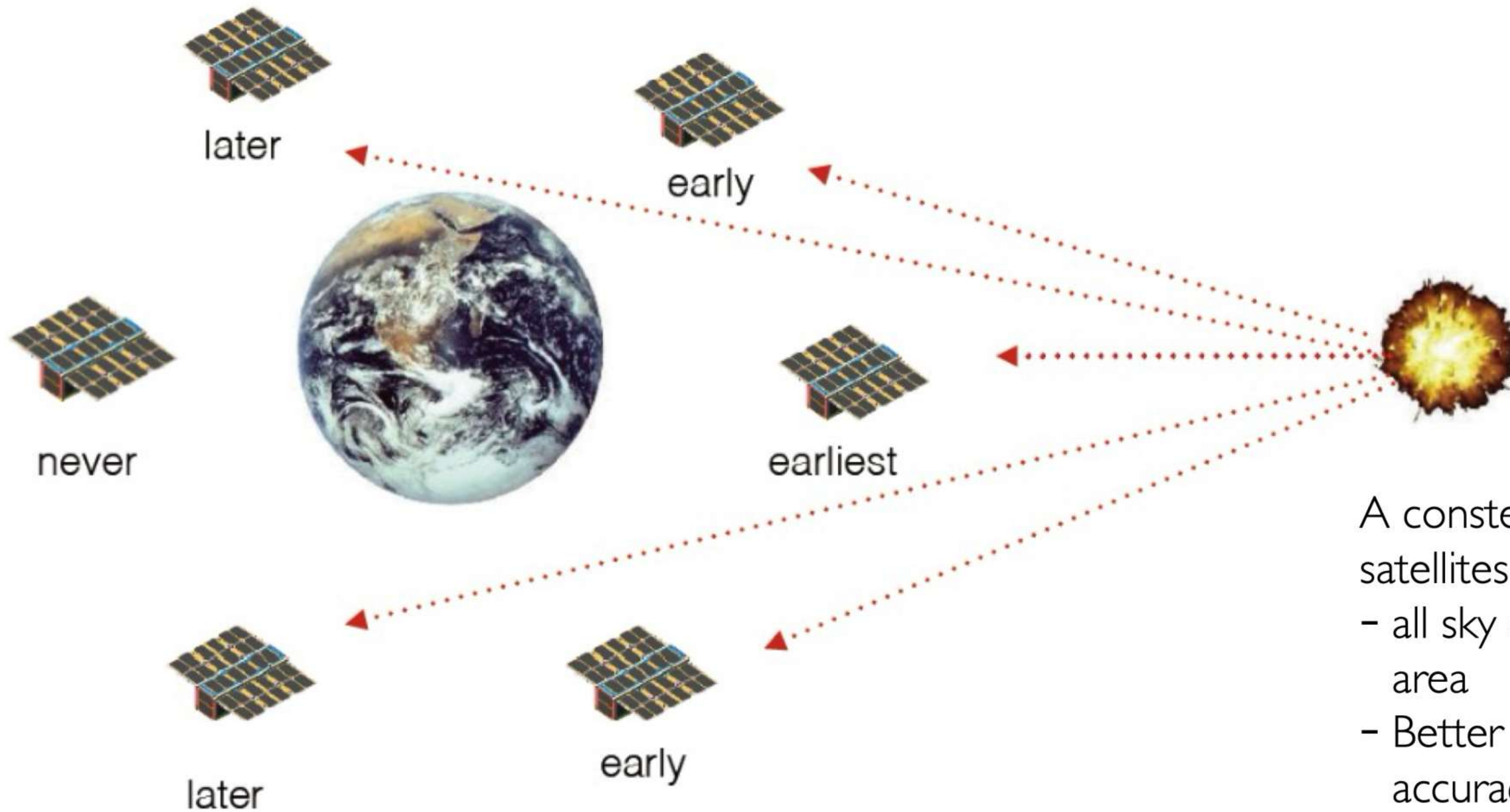
*X-ray Spectrum of Centaurus Galaxy Cluster Measured by **XRISM Resolve***



X線エネルギー / X-ray energy

XRISM collaboration 2025, Nature

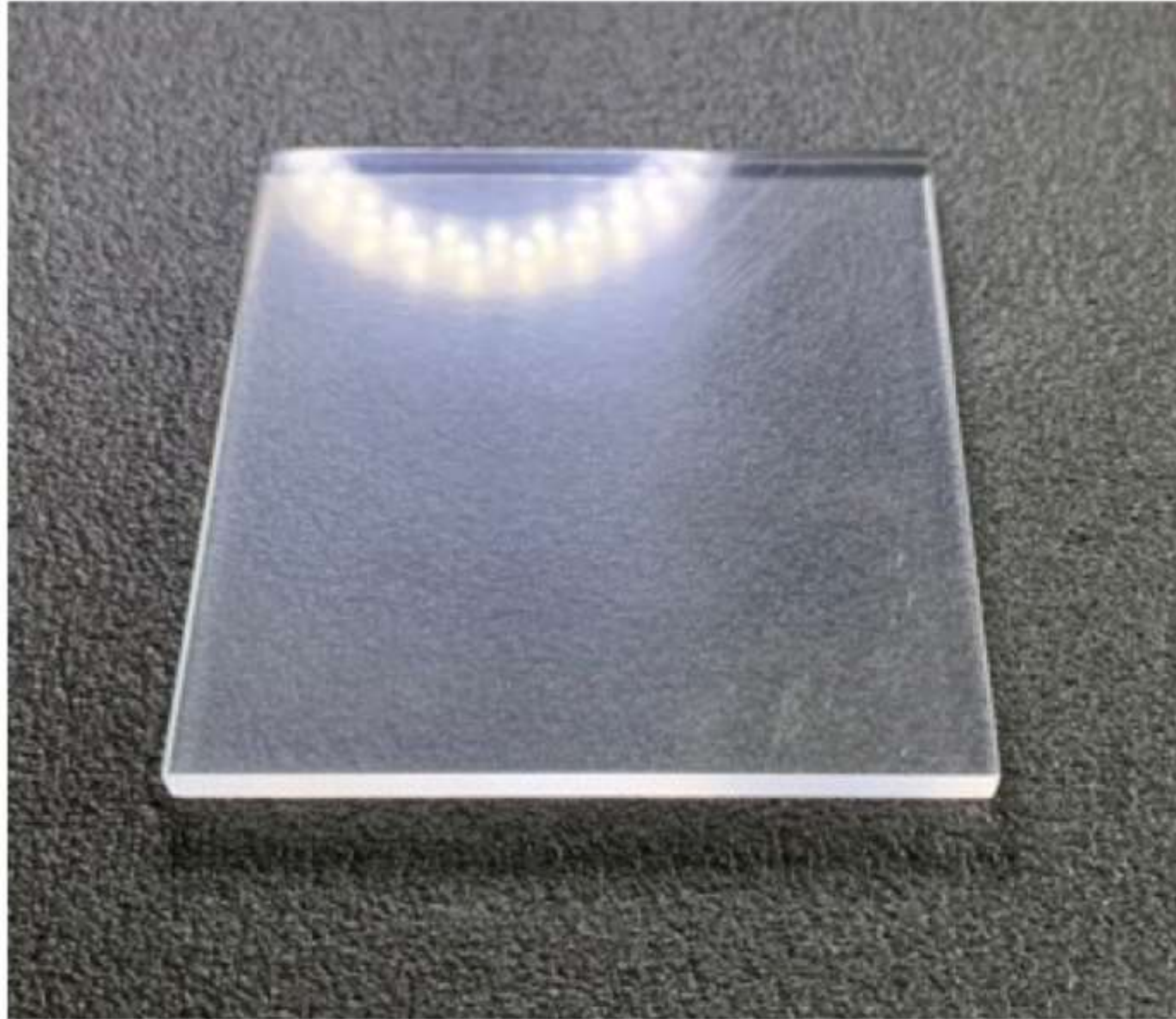
All sky monitoring and timing based localisation and *HERMES* and *CAMELOT* initiatives



- A constellation of at least 9 (18) satellites can provide:
- all sky coverage with a large effective area
 - Better than 0.1 millisecond timing accuracy
 - $\sim 1 \text{ deg}^2$ localisation accuracy using triangulation

GRBAlpha detector

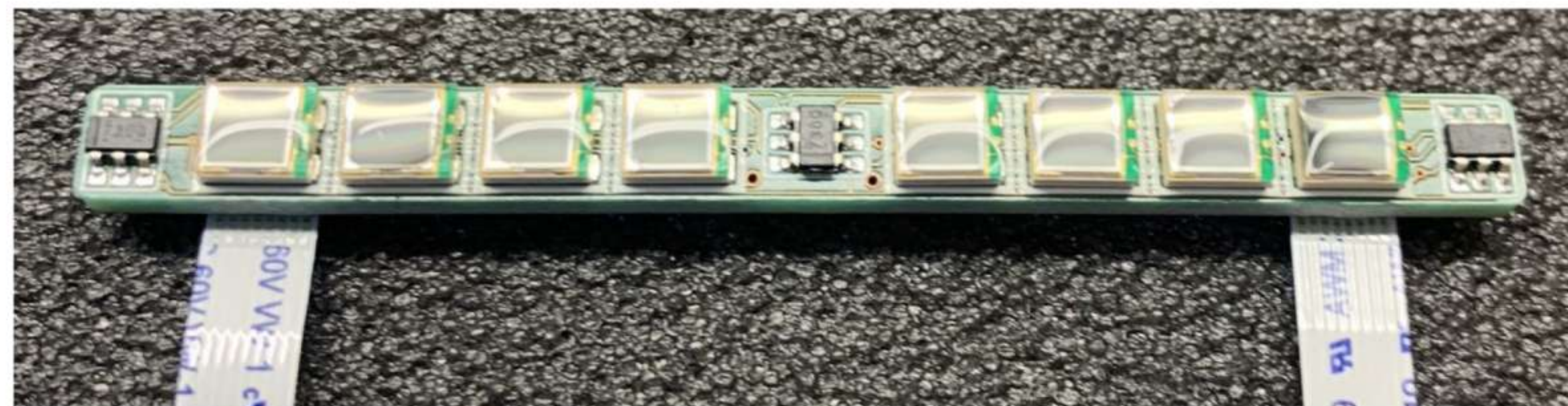
Pál+ 2020



CsI(Tl) scintillator

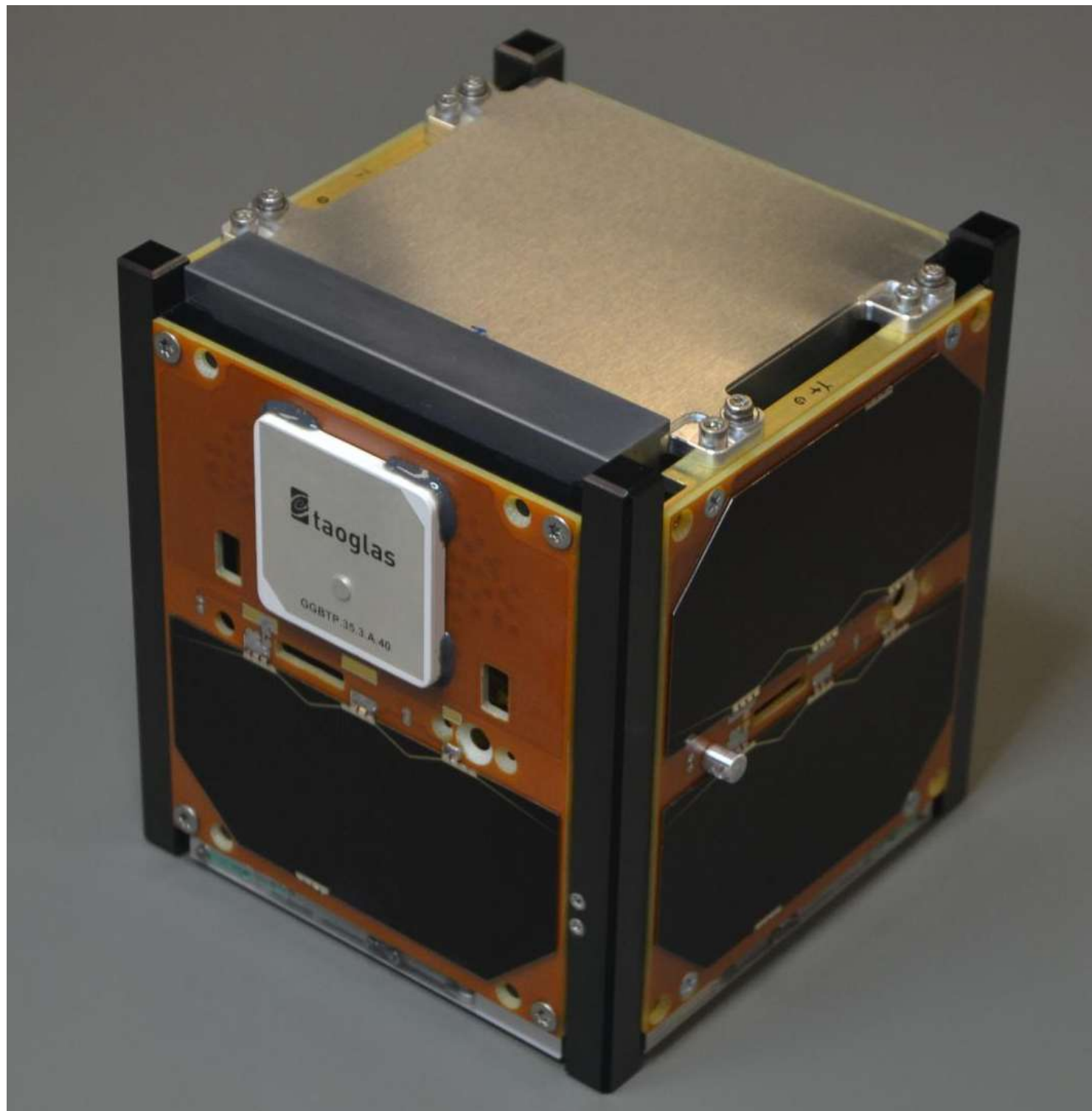


Wrapped in Enhanced
Specular Reflector (ESR)



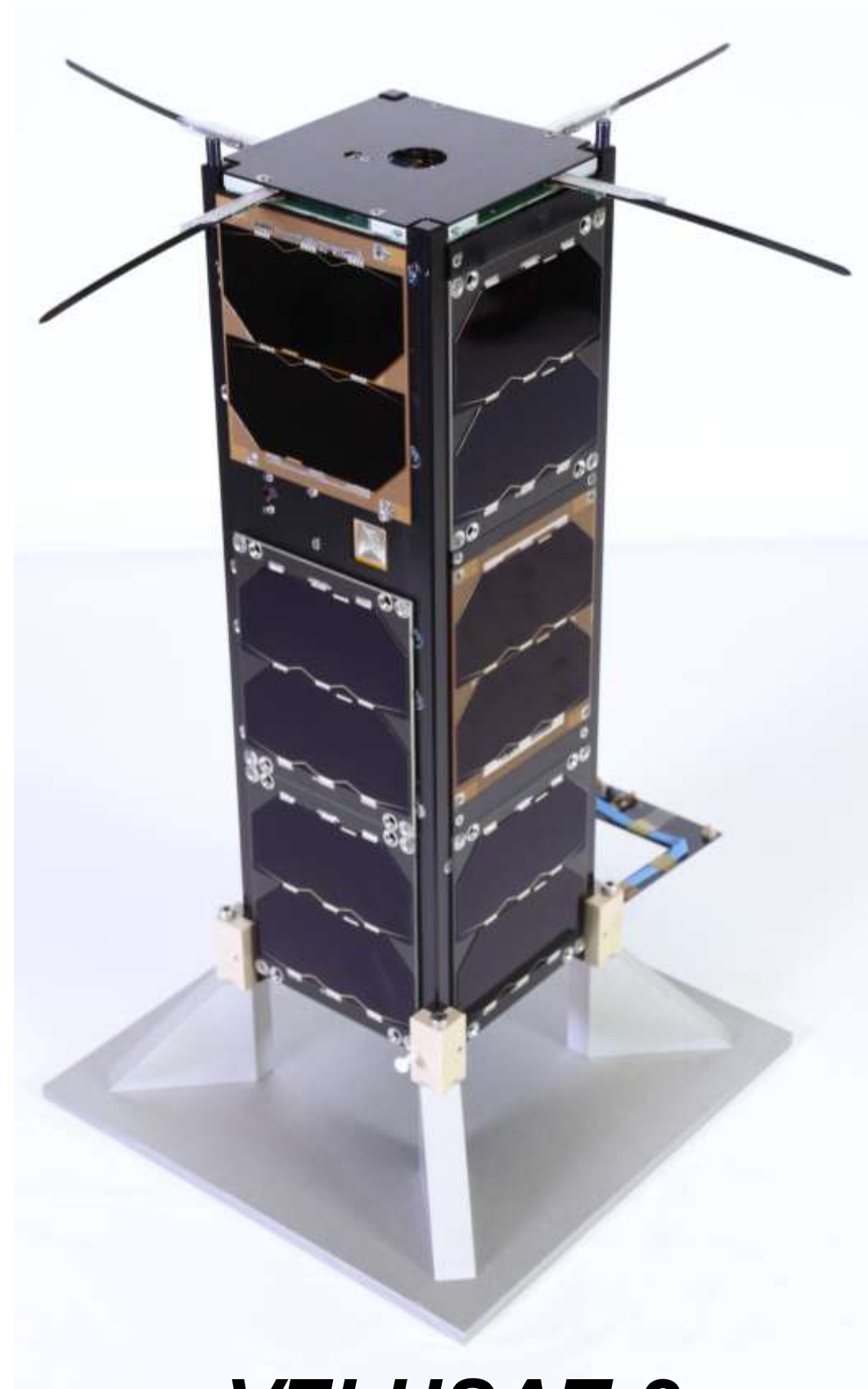
2 readout channels of 4 MPPCs (S13360-3050 PE) by Hamamatsu

CubeSats can monitor the high energy sky!



GRBA Alpha

Launched in March 2021
~240 transients



VZLUSAT-2

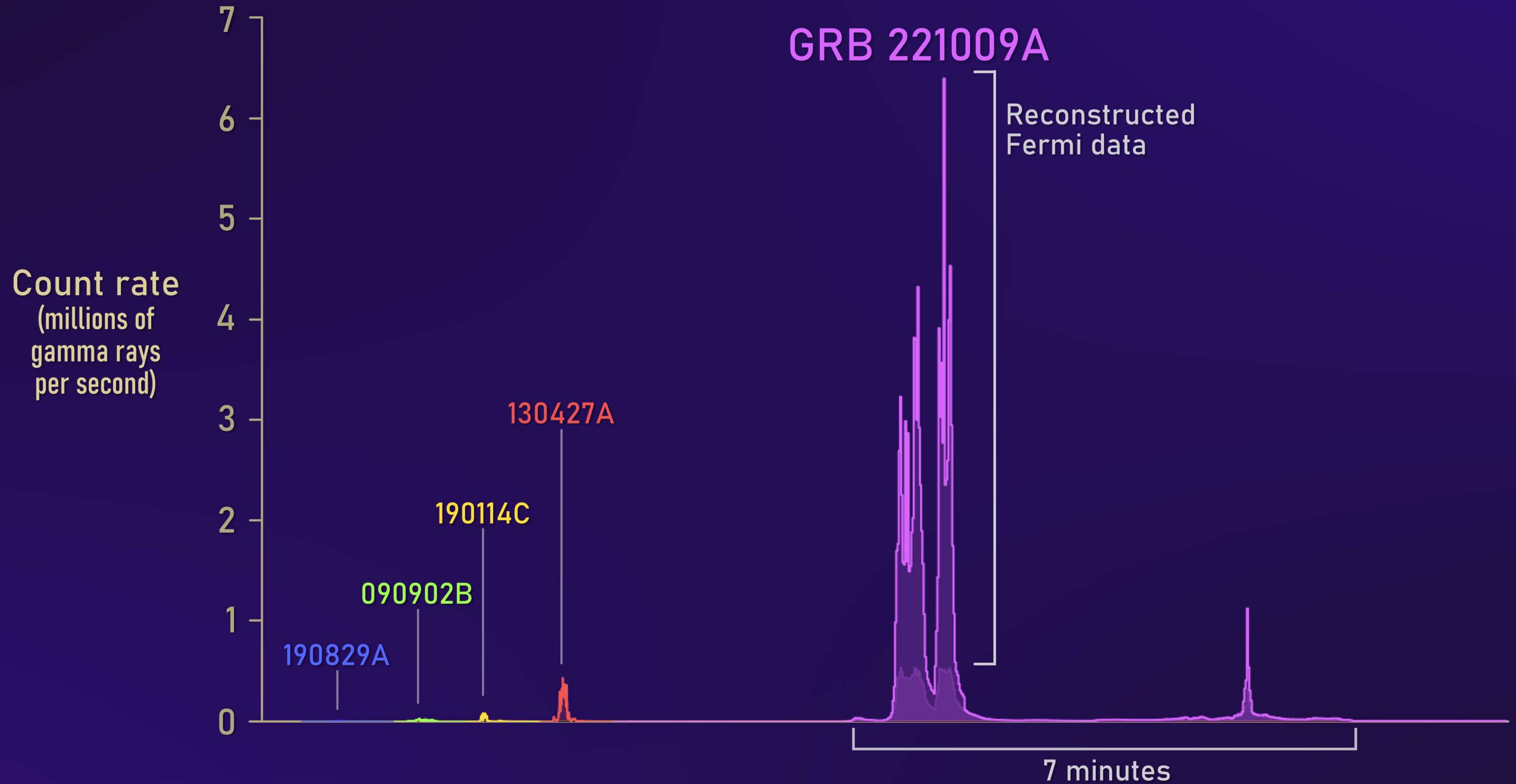
Launched in January 2022
~150 transients

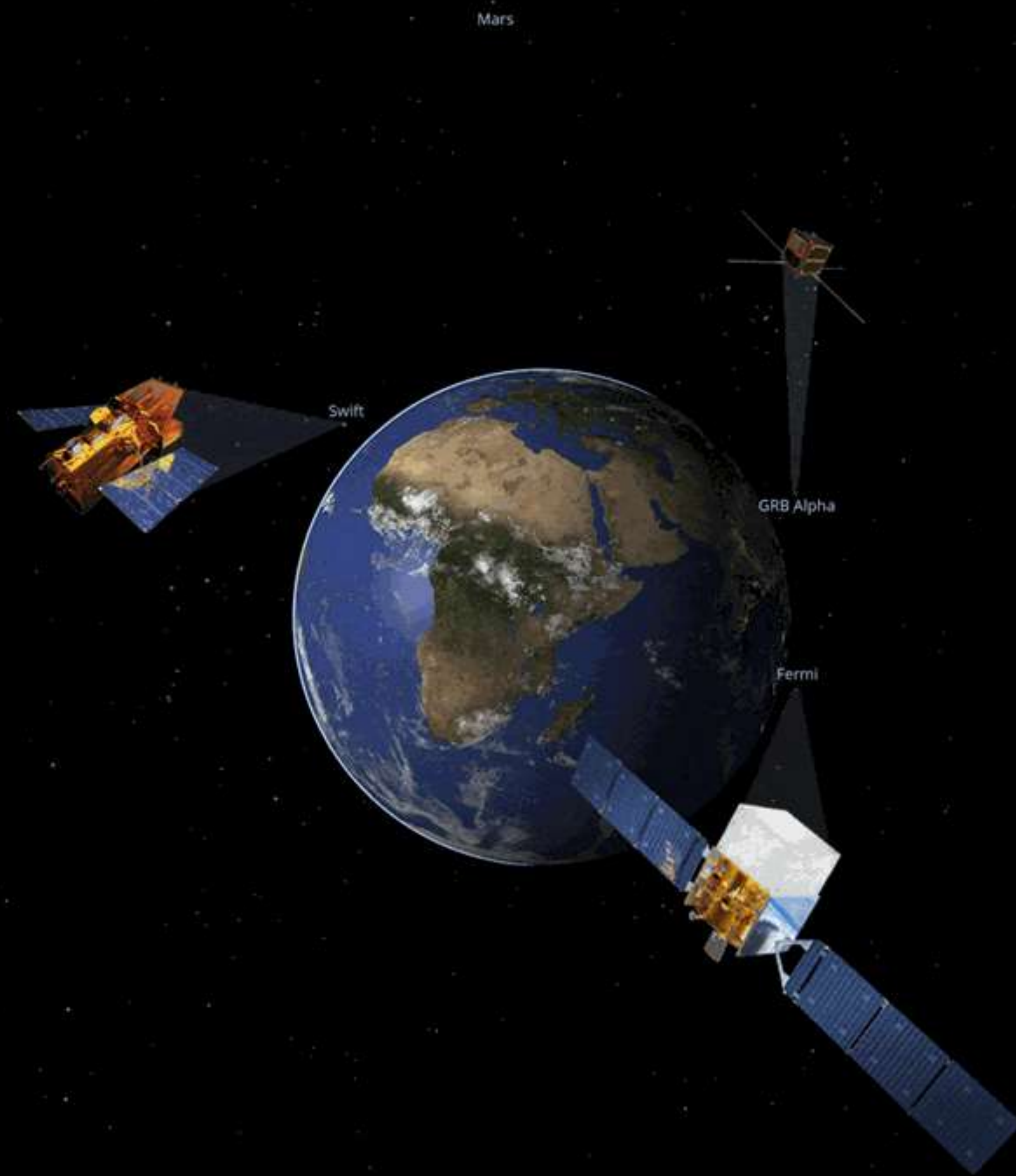


GRBBeta

Launched in July 2024
~1st two weeks after launch!

The BOAT GRB in Context





Mars

Swift

GRB Alpha

Fermi

