



# Half a century 🤯 of gamma ray astronomy with Nanni and friends: a personal view

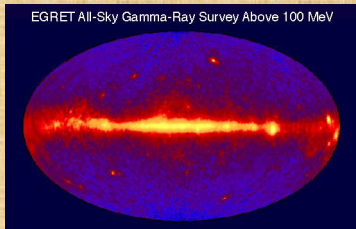


# The roaring 70': who is Nanni Bignami?



**Compton Gamma-Ray Observatory (CGRO)** was launched on April 1991. The 17 ton spacecraft had four instruments with unprecedented sensitivity and energy coverage, from 30 keV to 30 GeV. It operated for almost 9 years till 2000.

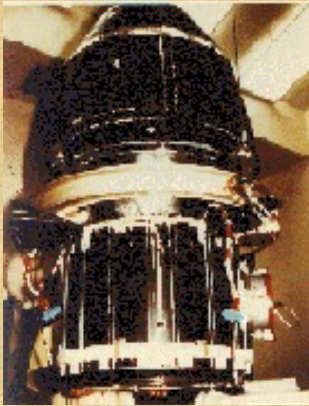
**At the end of the '70s NASA issued a call for the instruments to be on-board the satellite** and there was an UK-Italy-US proposal for a newly designed 'Drift Chamber', in competition with the more classical 'Spark Chamber' proposed by US scientist (Co-PI was Carl Fichtel, NASA GSFC, and Klaus Pinkau, Max Plank Institute for Plasma Physics)



**Livio Scarsi** was one of the leading person for the UK-Italy-US proposal (I was a sort of instrument scientist) and he mentioned to me several time the 'existence' of Giovanni Bignami, that, according to Livio, spent some time in US working on SAS-2, and that was interested in gamma ray astronomy, even though was not clear for Livio if Nanni wanted to the US or Europe proposal !?...).

So said, I was very curious to know or talk to Nanni Bignami as a well informed and renowned gamma-ray scientist....

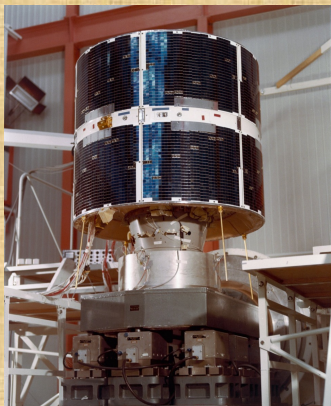
# The roaring 70': my first "weak interaction" with Nanni



## The Small Astronomy Satellite 2 (SAS-2)

The second NASA Small Astronomy Satellite (SAS-2), and was dedicated to gamma-ray astronomy in the energy range from 35 MeV- up to 1 GeV. SAS-2 **was launched on 1972 November 15** and began operations 4 day after. On 1973 June 8, a failure of the low voltage power supply ended the data collection.

**Nanni** was excited by the idea to have 'fresh' data in the gamma ray range and spent some time in US. **The almost immediate failure of the S/C power supply was for him a great disappointment → this fact diverted his interest from NASA to ESRO, I suspect.**



## COS-B, 1975-1982, the first ESA Satellite

*Europe's pioneer gamma-ray observatory*

The first ESA mission to study gamma-ray sources, operated for over six years, four years longer than planned.

The 2CG catalogue, included **25 gamma-ray sources** out of 30 observations made during the first three years and it also resulted in a complete gamma-ray map of the disc of our Galaxy, the Milky Way. (see G. Kanback presentation)

The next decade: end 70'-80', my first  
"strong interaction" with Nanni



### Unknown pages of the Gamma-1 observatory

Courtesy of Olga Dubrovina: "Looking For a Way Out. Soviet space program and international collaboration during *perestroika*", publication foreseen 2025.

Research fellow

Department of Political Science, Law and International Studies (SPGI)  
University of Padua

**Gamma-1**, the last Soviet period space observatory, was based on the Soyuz spacecraft and Progress cargo craft used to ferry equipment to the **Salyut, Mir and then ISS stations**. In **1965 Gamma** was originated as a free-flying module that could be docked to a large orbiting space complex. **The mission was redefined in 1972** as an observatory to study gamma-rays; France joined the project in **1974**, Poland later and Gamma was officially approved by the USSR government on the **17th February 1976**.

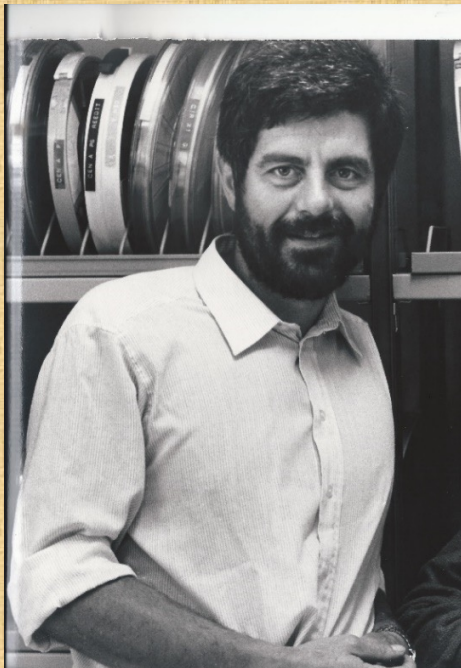
In **1982**, the design was finalized as a Soyuz with a French gamma-ray telescope, X-ray telescope, low-energy telescope. The satellite was launched in **1990** and soon after in orbit failed due to the power supply system of the gamma camera → remember SAS-2?

"The Italians played a significant role in the Soviet Gamma project, **contributing to a lesser-known chapter in the history of East-West scientific and technological exchanges during the last decade of the Cold War**"  
**The Italian involvement was to build a state of art star sensor to improve newly discovered Gamma-Ray sources identification → remember the Geminga story!**

# The next decade: end 70'-80', my first "strong interaction" with Nanni

"The Cosmic Physics and Relative Technologies Laboratory (Milan) initially led by Beppo Occhialini and after by Giuliano Boella, together with prominent Italian astrophysicist Giovanni Bignami, would also like to be associated with Gamma-1" (O. Dudrovina, "INTEGRAL Observatory: rescue at all costs", in Atti del LXIII Convegno annuale SISFA – Padova 2023. *Publication in progress*).

Nanni was the promoter of the Italian participation and this was the start of the future Italian (EU)-Soviet-Russian collaboration in the field of high energy astrophysics, and physics, still alive.



Nanni Bignami at the time of the Gamma-1-endeavour

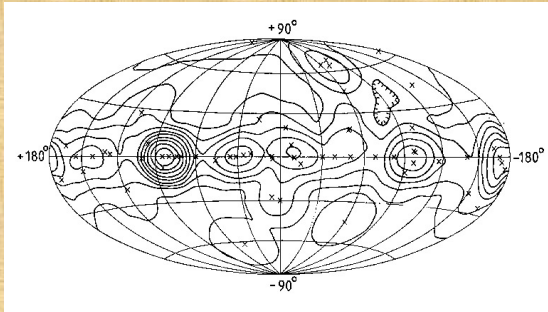
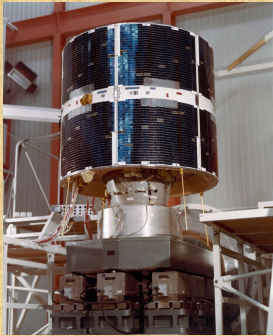
Nanni managed to give key input to the mission scientific objectives, also contributing to the source location accuracy with an Italian built Star Sensor, provided by Laben with a state of art 'American' image dissection phototube.

I was contacted by Nanni as a collaborator, having flown a sounding rocket with an Italian built Multiwire proportional counter coupled with a grazing incidence telescope in 1977 in collaboration with Riccardo Giacconi group.



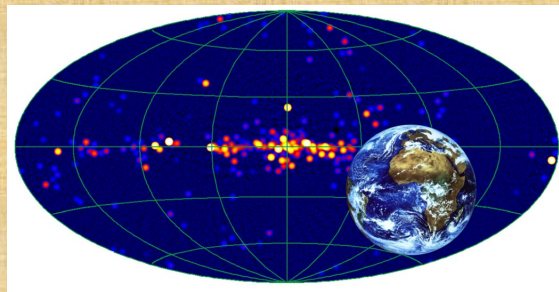
Patrizia Caraveo nowadays with the Star sensor

# End of the 80'-90' my second "strong interaction" with Nanni



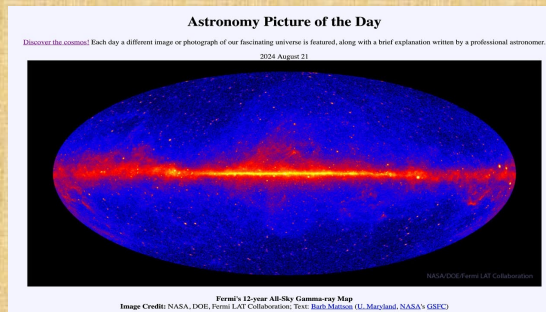
**COS-B**, was a forerunner of the current INTEGRAL mission, as stated in the ESA site.

Integral has then detected more than **1200 sources** (Bird et al, 2016) in a lower energy band most of which are new hard X-ray sources of transient nature.



**COS-B:** 25 sources  
**INTEGRAL:** 1220 sources  
**FERMI:** 7194 sources

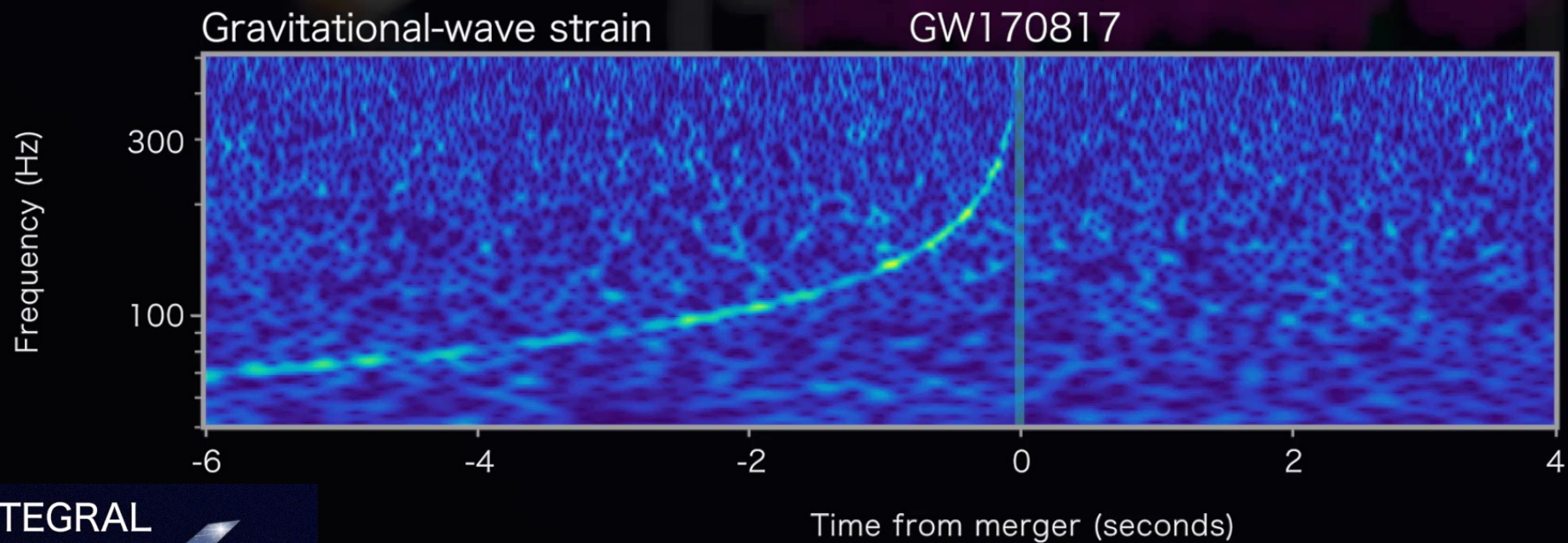
The Italian legacy...  
 Not to mention **AGILE**



AGILE (2007) and Fermi (2008) surveyed the entire sky each day. The fourth LAT catalog based on 14 years of survey data in the 50 MeV-1 TeV range, lists **7194 gamma-ray sources** (Ballet et al, 2024).



# *INTEGRAL and FERMI search for GW counterpart: the GW170817 case*



INTEGRAL

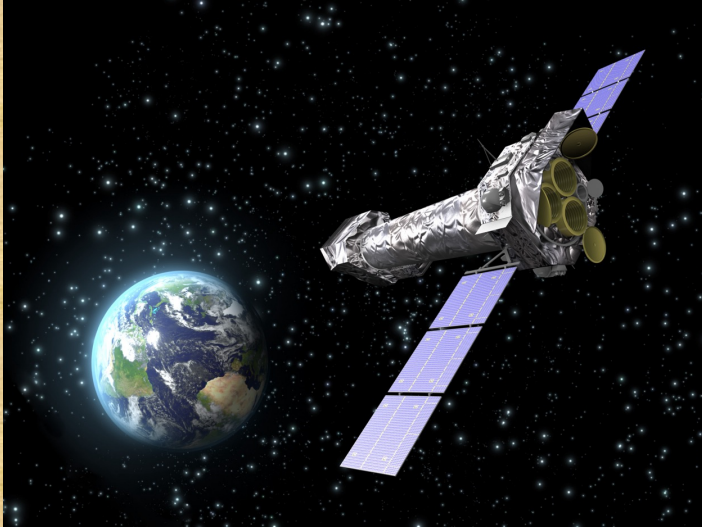


Patrizio Caraveo nowadays  
with the Fermi Gamma-ray  
with the Star sensor

Pietro Ubertini, IAPS-INAF

# 1990-2000: together during XMM and INTEGRAL turmoil

In the 90's we worked together on the EPIC X-Ray XMM focal plane detectors of which Nanni was the ESA PI.



In parallel ('80s till middle of the 90's) we proposed to build a  $\gamma$ -ray Observatory, materialized in the faulty proposal for a Italian-French-USSR satellite "a la Sigma" and after of the ESA GRASP M1 mission.

A few years after the collaboration tried again submitting an ESA-NASA-Roskosmos as M2. INTEGRAL, selected to completion in 1995, and launched 7 years later from Baikonur with a Proton.

*Just after the selection INTEGRAL was close to be cancelled due to the withdrawal of US and English Agencies, then rescued by Italy, France, and Germany collaboration with ASI, CNES and DLR financial support.*

*Nanni was key to rescue of the  $\gamma$ -ray Observatory*

**INTEGRAL is still providing outstanding science after 22 years in operation.**

**ESA management, in his infinite wisdom, as decided to terminate the observatory, costed 700M 30 years ago, and perfectly working**





IERI

Cos-b

Exosat

BEppo-SAX

XMM

Integral

Swift

OGGI

Agle

Glast

# The Nanni imprinting... and legacy..

DOMANI

Simbol X

Athena

DOPODOMANI



IERI

Cos-b

- Nanni ideas and activity span from the '70, with SAS2 initial work to 2030+ when Athena will fly.
- A great legacy for the relativistic astrophysics community, worldwide.
- A scientific link between Italy, France, Germany and Russia, an open window to better understand the Universe.

Agle

Glast

# The Nanni imprinting and legacy..

DOMANI

Simbol X

DOPODOMANI  
Athena →

COSPAR and INAF will organize the 2026 Scientific Assembly in Firenze, and I am sure Nanni would have been very happy.

In that occasion COSPAR, ASI and INAF plan to establish the 'Nanni Bighami Prize'.....

# COSPAR 2026 FIRENZE - ITALY

# COSPAR 2026

Florence  
1-9 August

46<sup>th</sup>  
General  
Assembly

Sustainable  
space research  
for the planet

**INAF**  
ISTITUTO NAZIONALE  
DI ASTROFISICA



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Thanks