The Chinese-French SVOM Mission for GRB Studies

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On behalf of the SVOM project.

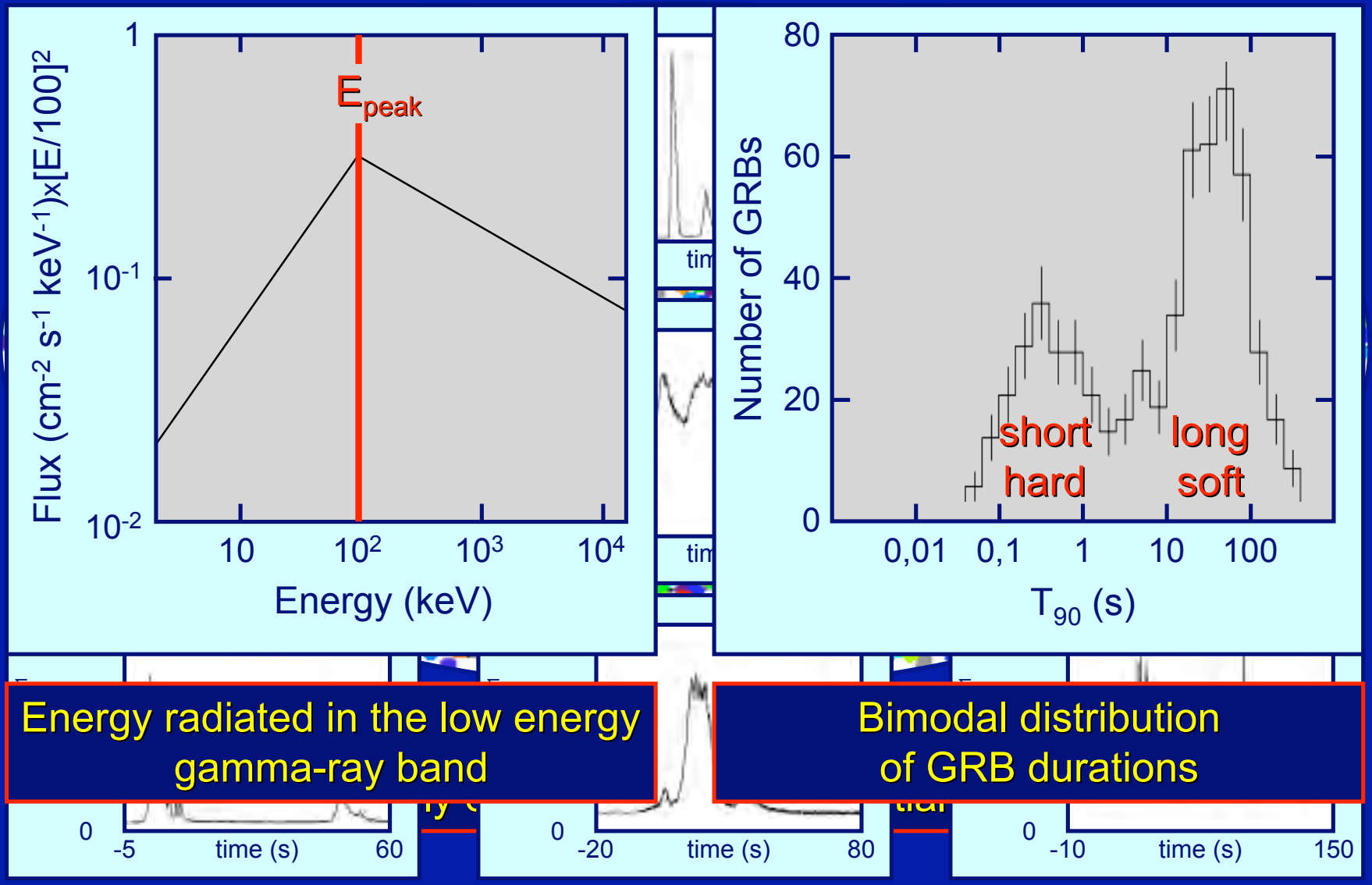
Some questions for the next decade

How black holes form relativistic outflows?	What was the first stellar population?	Which cosmic objects re-ionize the universe?
What is the nature of the dark energy?	Is the Lorentz invariance principle broken?	Where UHE cosmic-rays are accelerated?

Advanced GRB studies to provide many answers

What we believe we know about GRBs

CGRO/BATSE: unprecedented statistics

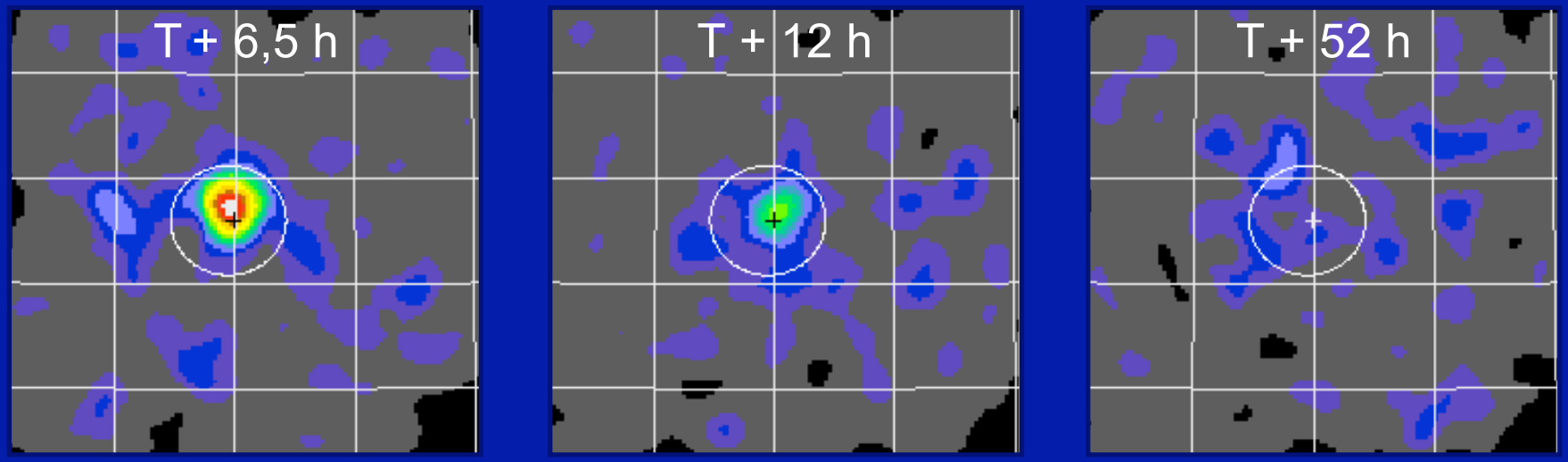


Energy radiated in the low energy gamma-ray band

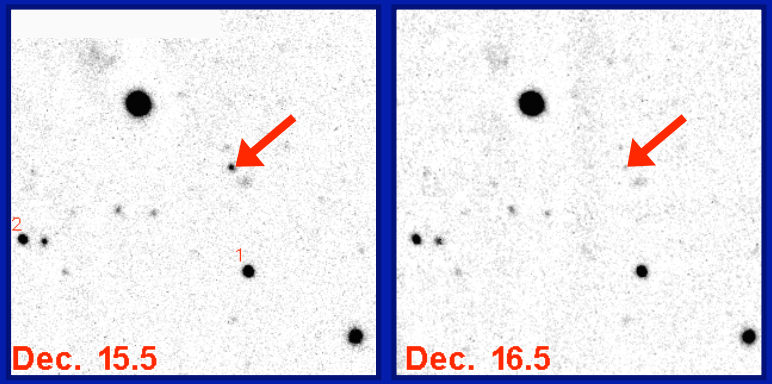
Bimodal distribution of GRB durations

BeppoSAX: long GRBs are cosmological

Afterglow of GRB 971214 detected by BeppoSAX in the X-ray band

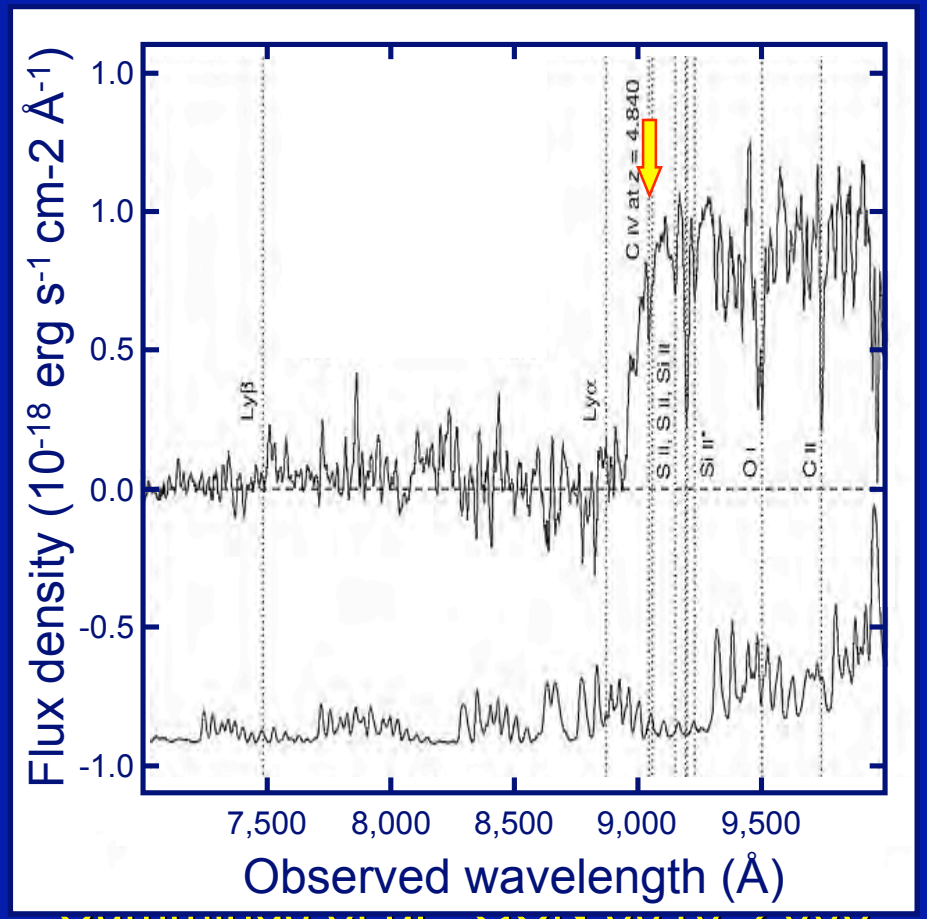


Afterglow in the visible band



- Detection of host galaxies
- Redshift measurements
- Cosmological distances
- Most energetic events
- 10^{44} J radiated in gamma rays

Swift: GRBs do exist at very high *z*



Kawai et al., Nature 440, 184, 2005

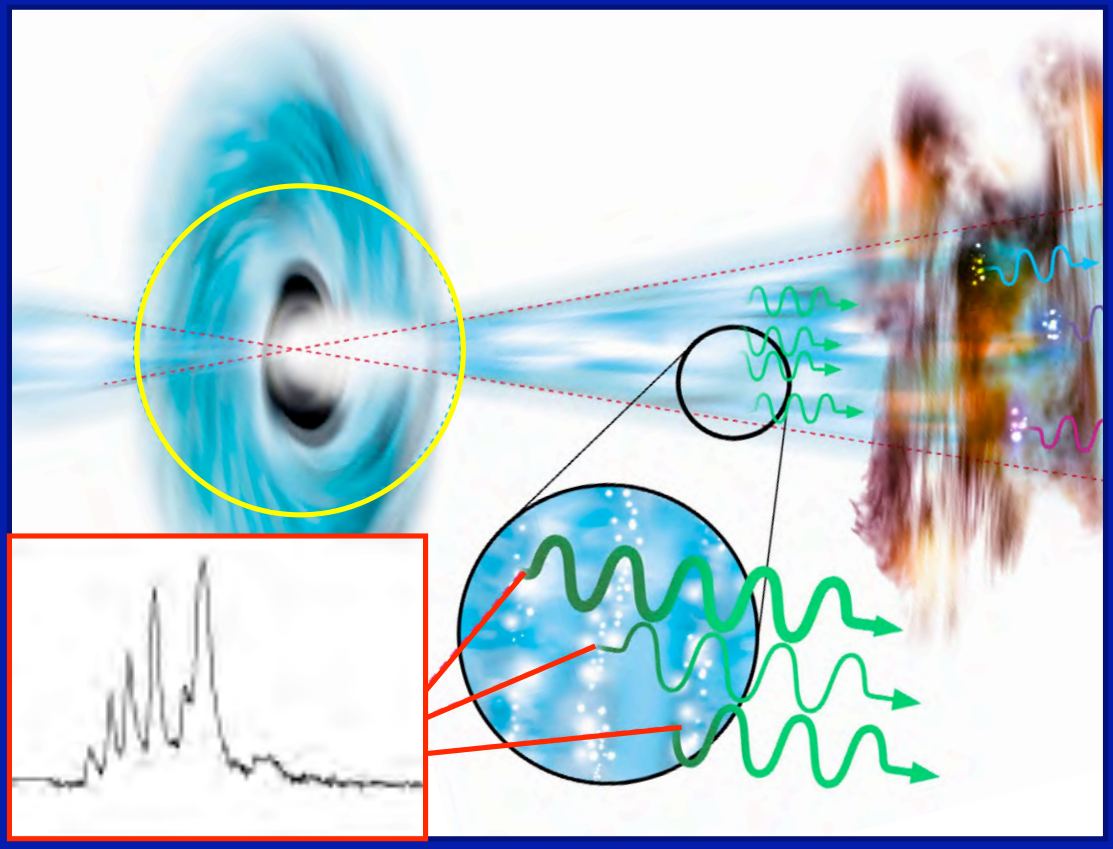
- On 05/09/04 at 01:51:44 Swift/BAT triggers on a long GRB (GRB 050904)
- T + 8 m: TAROT at CALERN observes the GRB field
- T + 27h: VLT measures the photometric redshift

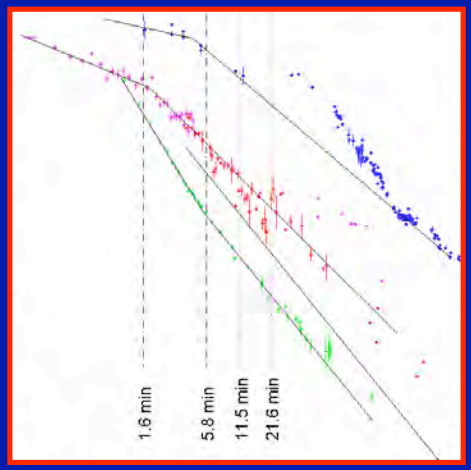
  z = 6.1 (+0.37 -0.12)

- T + 3.4 d: Subaru records a detailed NIR spectrum

  z = 6.295

The “standard” model





Afterglow emission

radio, infrared visible, X

Prompt emission

gamma, X, visible

High energy astrophysics

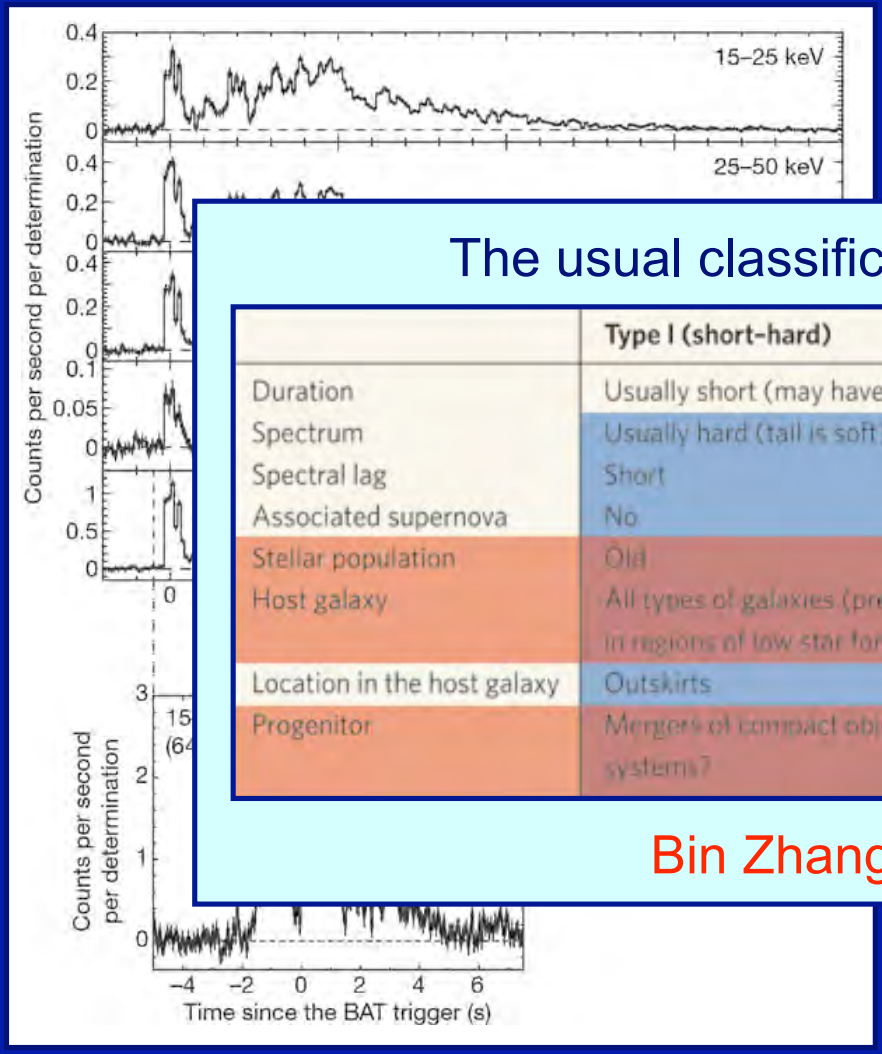
Early universe Cosmology

What we want to learn from a new GRBs space mission?

Scientific rationale of a new GRB mission

GRB phenomenon	Diversity and unity of GRBs
GRB physics	Acceleration and nature of the relativistic jet
	Radiation processes
	The early afterglow and the reverse shock
GRB progenitors	The GRB-supernova connection
	Short GRB progenitors
Cosmology	Cosmological lighthouses (absorption systems)
	Host galaxies
	Tracing star formation
	Re-ionization of the universe
	Cosmological parameters
Fundamental physics	Origin of high-energy cosmic rays
	Probing Lorentz invariance
	Short GRBs and gravitational waves

A recent burst of Nature papers



GRB 060614, a bright yet singular SWIFT GRB, subject of five papers in Nature (Vol 444, 20 Dec. 2006)

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The usual classification in question?

	Type I (short-hard)	Type II (long-soft)
Duration	Usually short (may have a long tail?)	Usually long
Spectrum	Usually hard (tail is soft)	Usually soft
Spectral lag	Short	Long
Associated supernova	No	Yes
Stellar population	Old	Young
Host galaxy	All types of galaxies (predominantly in regions of low star formation rate)	Late-type galaxies (predominantly in irregular, dwarf galaxies)
Location in the host galaxy	Outskirts	Central
Progenitor	Mergers of compact objects in binary systems?	Single-star systems? (Core collapse of massive stars)

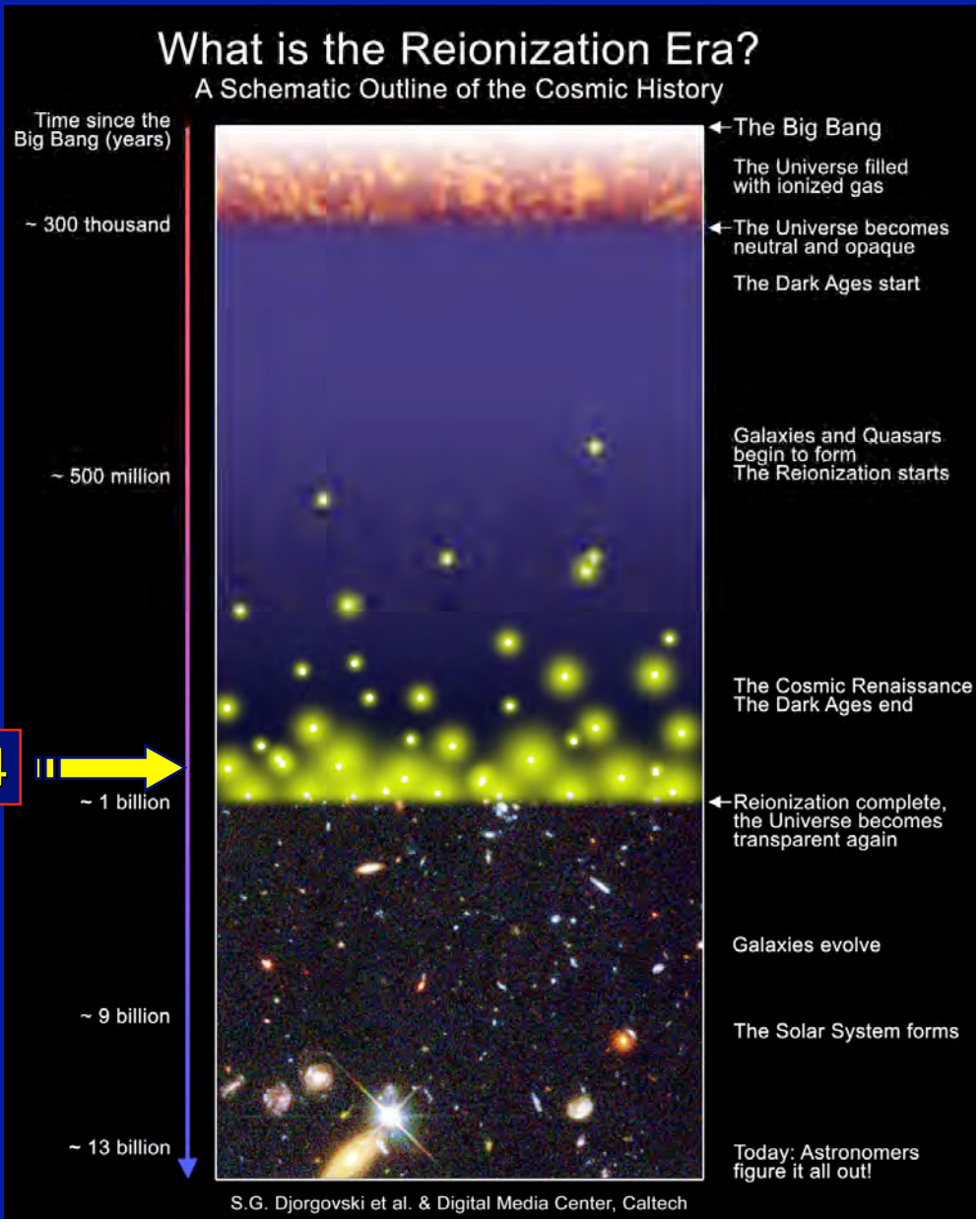
Bin Zhang, p. 1011

Fynbo et al., p. 1048

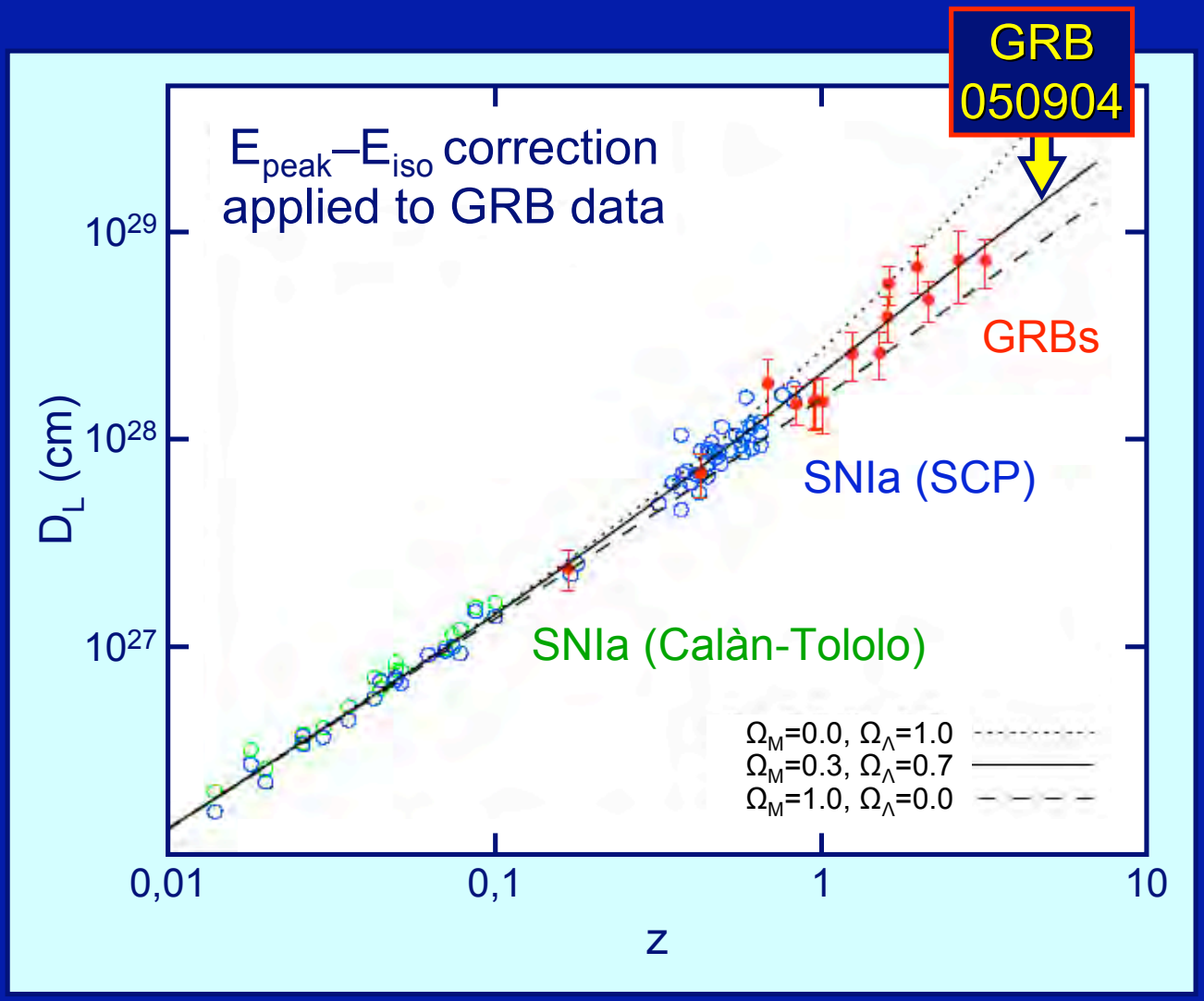
Della Valle et al., p. 1050

A brief history of the Universe

GRB 050904



GRBs on the SN Ia tracks?



Ghirlanda et al., ApJ 613, L13, 2004

“Maids of all works” of particle astrophysics

In the framework of the “standard” model of GRBs, many theoreticians anticipate that GRBs could be sources of:

- Ultra high energy cosmic rays
- High energy neutrinos
- Gravitational waves


SVOM,
the next GRB hunter!

Past milestones of the SVOM mission

2005 Sino-French discussions (CNES-CNSA) on a mini satellite mission

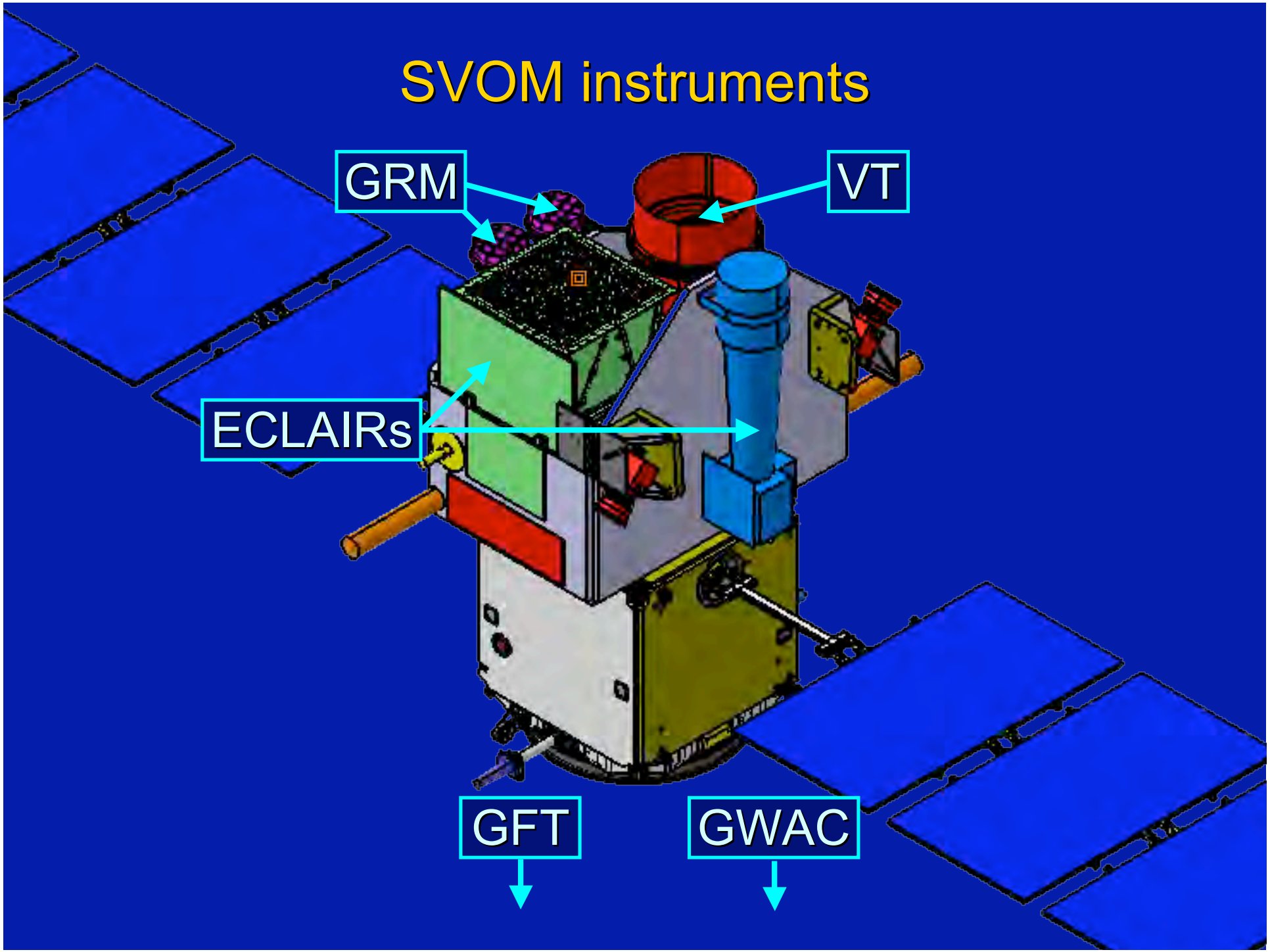
Scientific definition of the Space Variable Objects Monitor (SVOM)

CNES-CNSA decision to study the SVOM mission

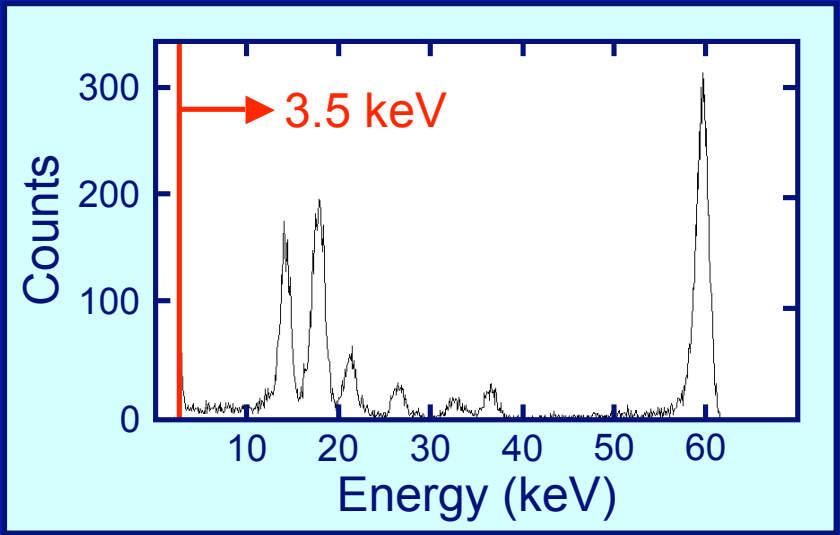
2006 SVOM Phase 0 kick-off meeting (March, Toulouse)

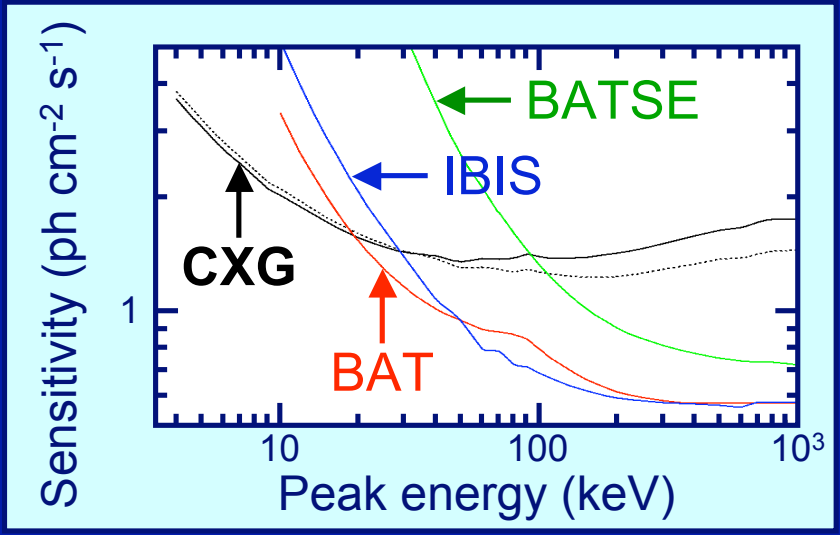
SVOM phase 0 review (Sept., Shanghai) – No critical issue

SVOM instruments



Anticipated GRB trigger performances



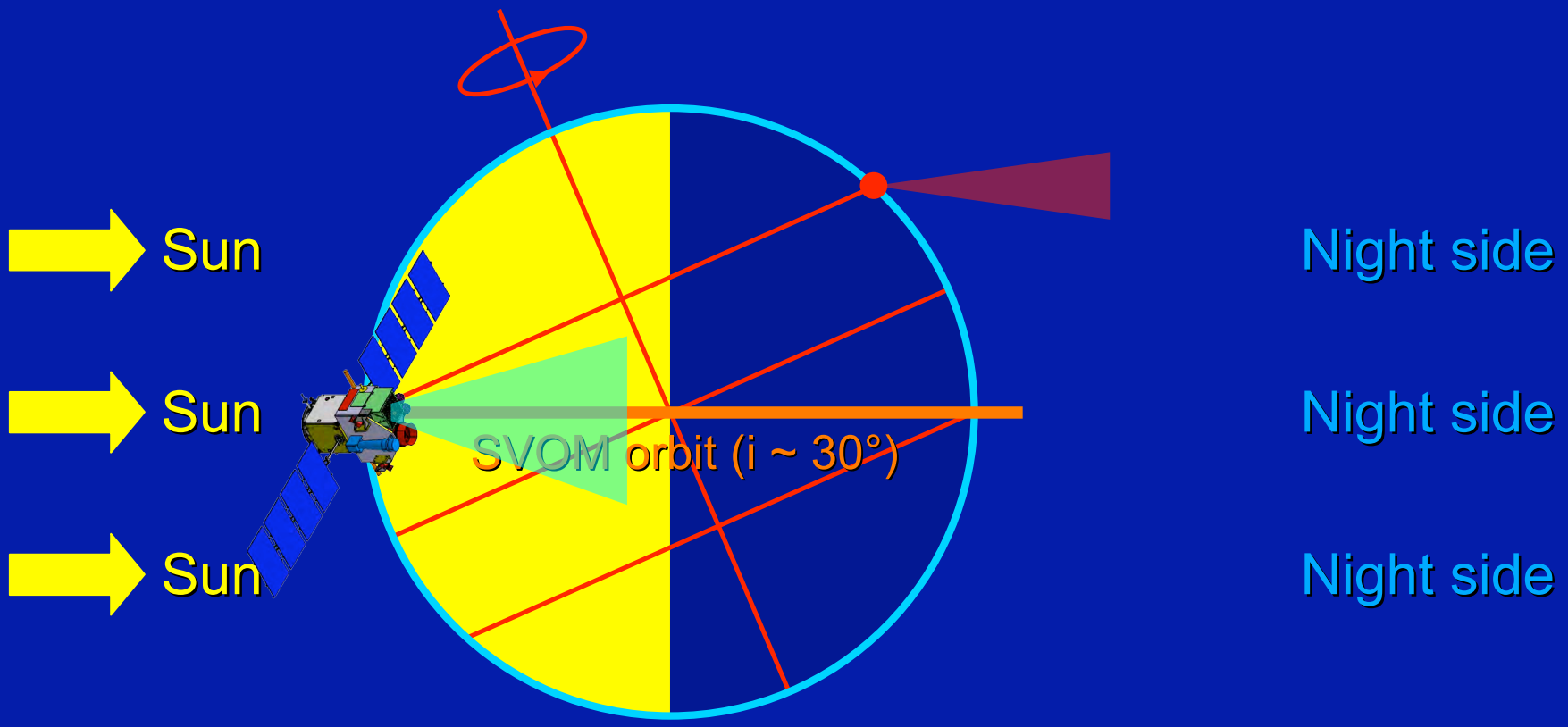


Instrument	Band (keV)	GRB/yr at z > 6
IBIS *INTEGRAL*	20-200	0.1-0.5
BAT *Swift*	15-150	1.3-4.0
CXG *SVOM*	4-50	2.0-4.0

Predicted detection rate of high *z* GRBs

Salvatera et al. Astro-ph 2007

Pointing strategy: anti solar



Most of the GRBs detected by SVOM to be well above the horizon of large ground based telescopes all located at tropical latitudes

GRB observation strategy

Space

GRB trigger provided by ECLAIRs at time T_0

T_0 + 5 min

VT (V & R band photometry)
SXT (Soft X-ray photometry)

Ground

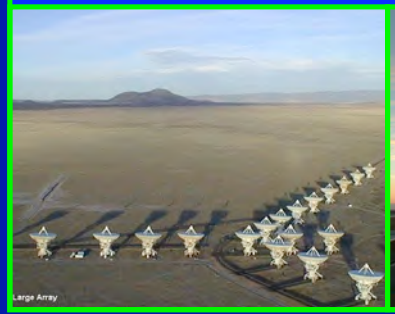
T_0 +1 min

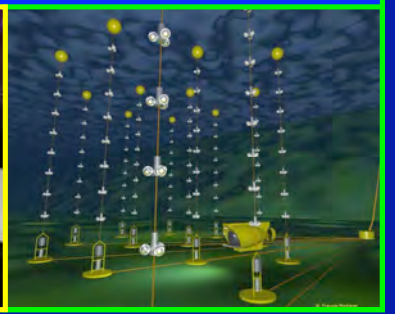
GWAC (V)

GFT (B, V, R, I, J, H)

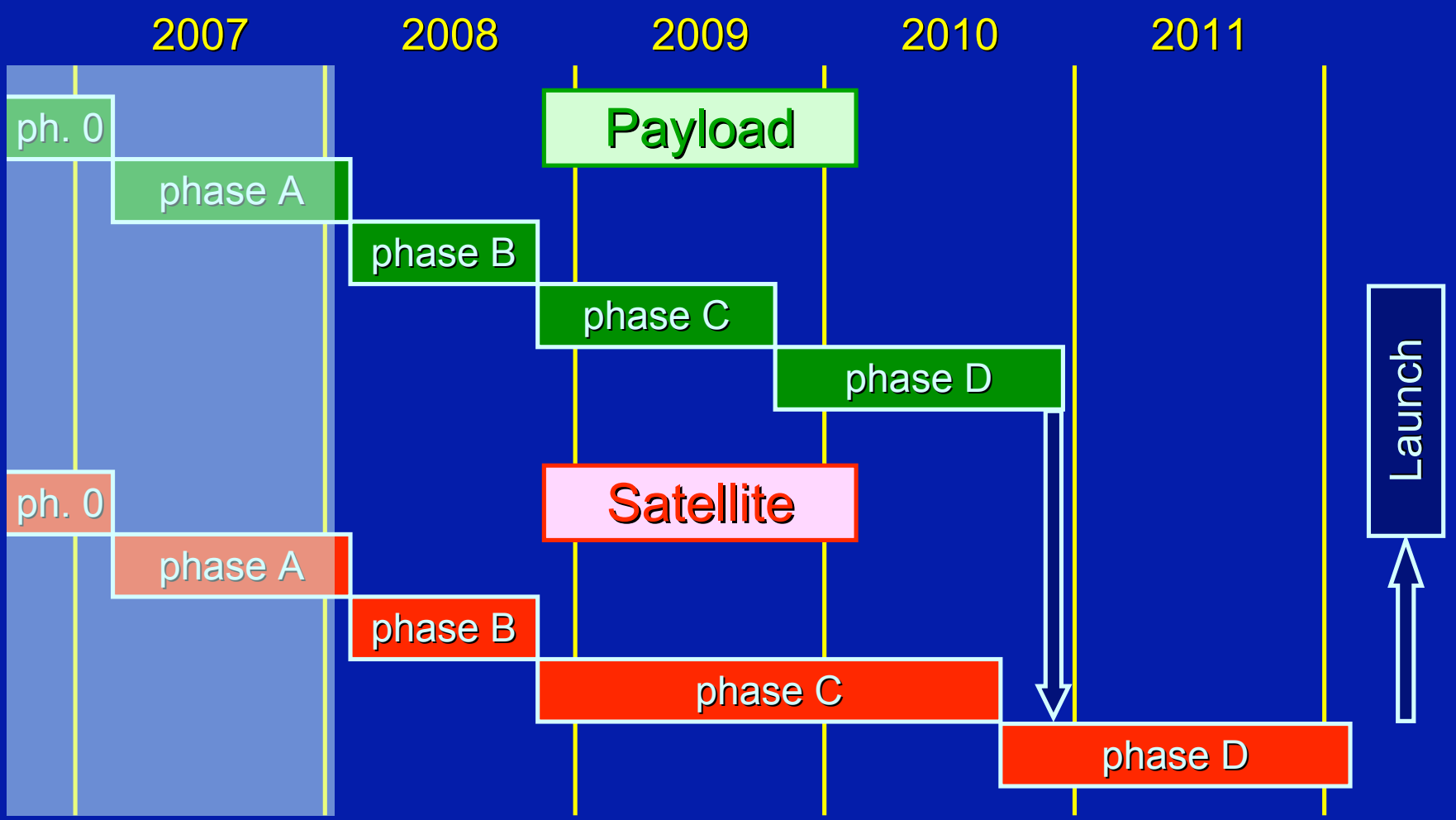
1-2 m robotic telescopes

Multi messenger follow-up





Development plan



To Conclude…

A strong scientific case

- Understand the most energetic events in the Universe.
- Study the infancy of the Universe.

Participants

- China: CAS, CNSA, NAOC, SECM, XIOPM, …
- France: APC, CEA, CESR, CNES, IAP, LAM, LATT, OHP, …

Rendez-vous in 2012 for the very first events …