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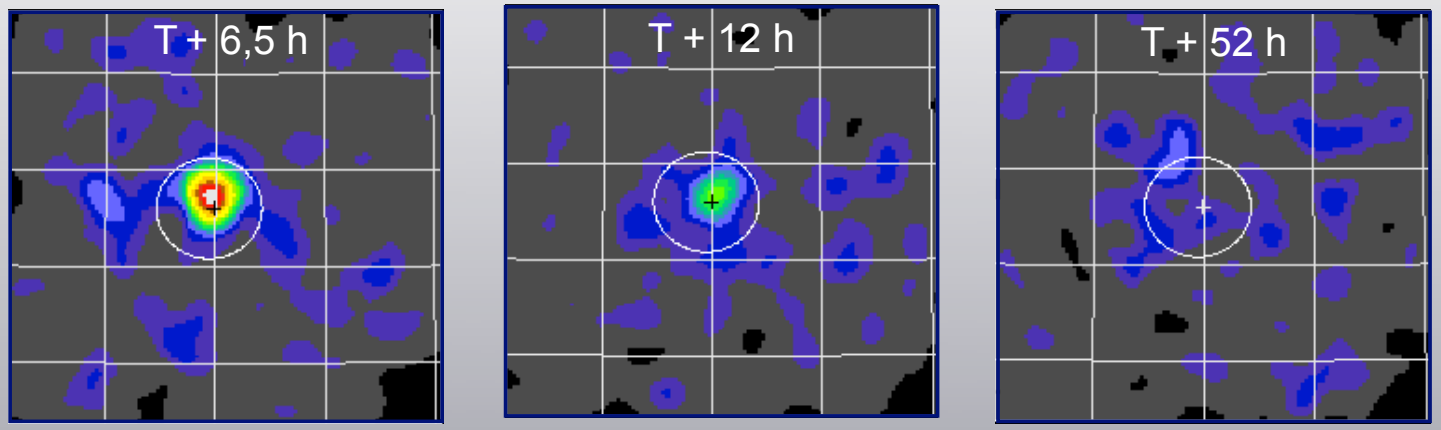
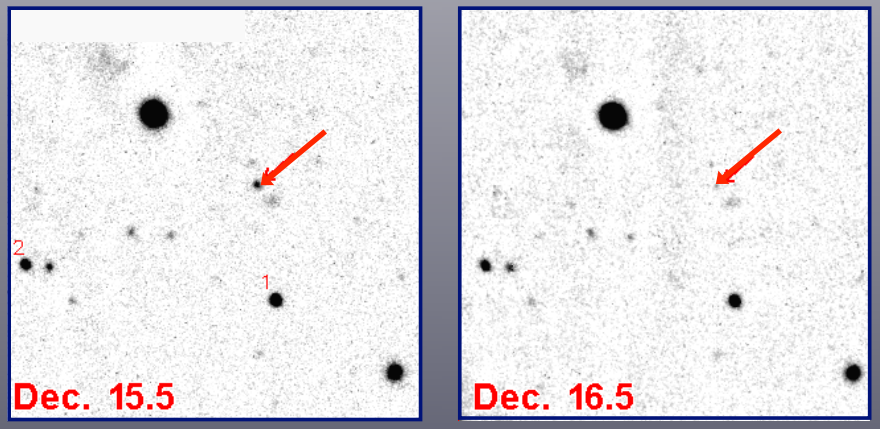
The first major discovery!

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

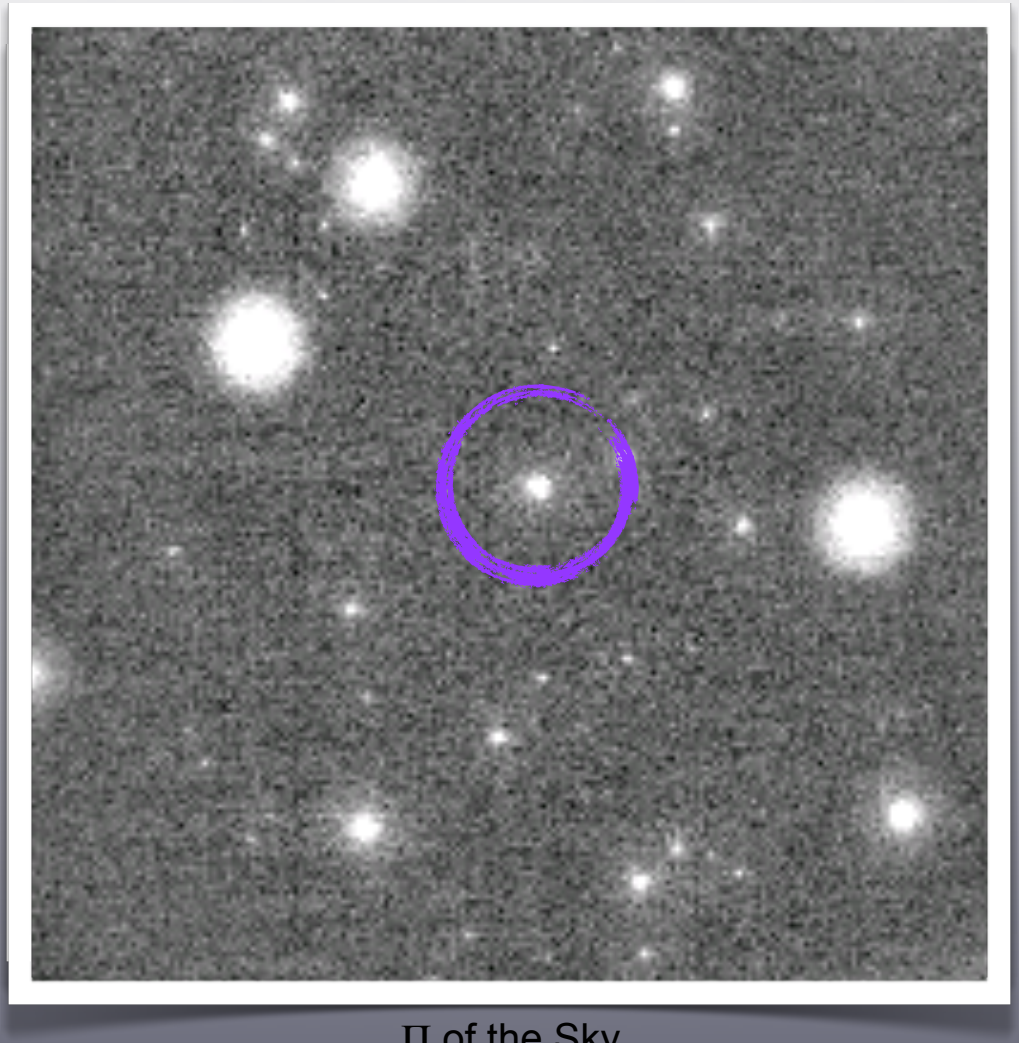


Afterglow in the visible band



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

The brightest objects in the Universe



Π of the Sky

- **On 03/19/08 at 06:12:49 Swift/BAT triggers on a long GRB (GRB 080319b)**

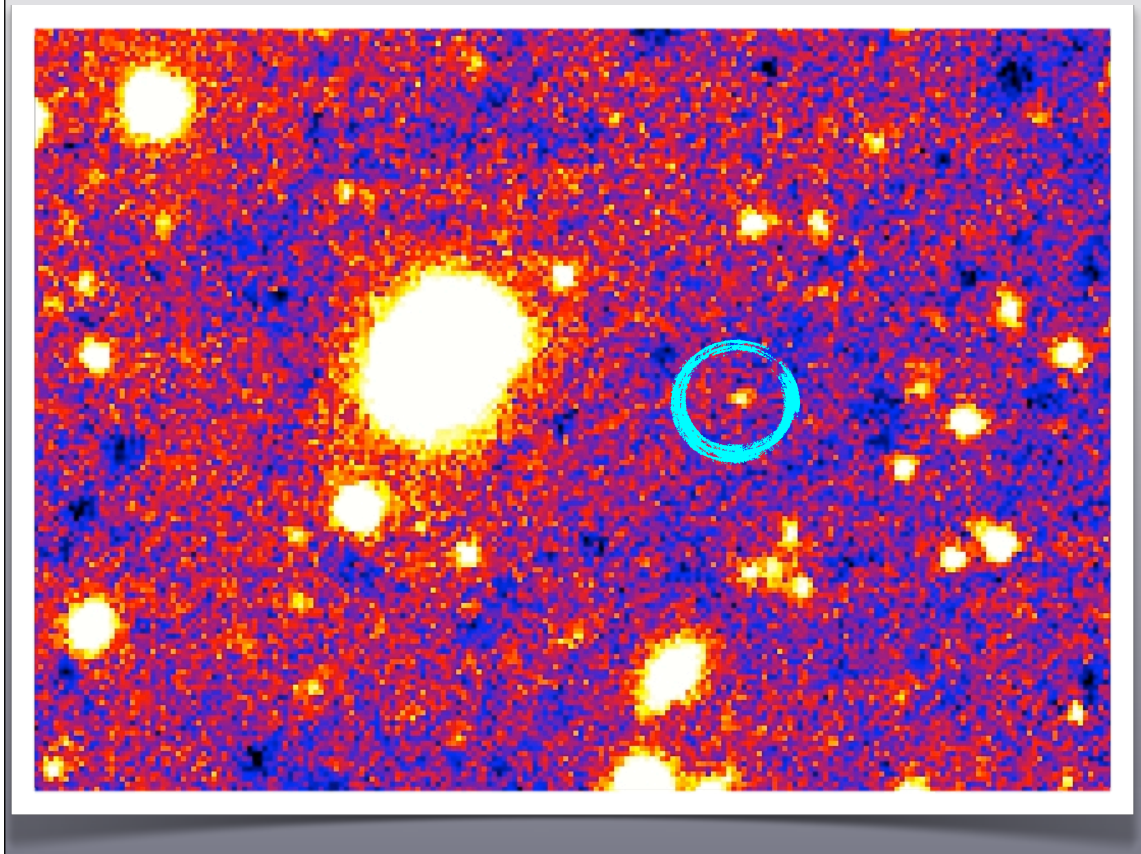
- **Simultaneous observations by many telescopes:**

$Mag_{Peak} = 5.8$

- **T + 1h: VLT measures the redshift in Rapid Response Mode:**

$z = 0.937$

The first galaxies



- **On 05/22/06: Swift/BAT triggers on a long GRB (GRB 060522)**

z = 5.11

- **T + 4 years!: discovery of the probable host galaxy with FORS2/VLT.**

But not so ideal!

GRBs and afterglow (AG) statistics (yearly sums of the table above)

Year	No of GRBs	No of X-ray AGs	No of optical AGs	No of radio AGs	No of redshifts
1997	10	9	5	2	4
1998	11	10	8	5	4
1999	21	12	7	5	7
2000	59	8	8	5	7
2001	26	4	4	4	4
2002	46	6	10	7	9
2003	37	8	15	3	7
2004	38	8	11	1	3
2005	110	84	47	14	32
2006	122	106	65	5	42
2007	109	76	46	6	30
2008	126	105	71	6	35
2009	114	84	48	9	32
Sum	**811**	**515**	**345**	**71**	**216**

< 30% !

Experience from the previous discoveries

The key of the success:

• A useful trigger: an alert in an equatorial field, during the night!

• A prompt response: < 12h.

• An excellent angular resolution: arcmin ↠ arcsec.

Observations of a transient phenomena has to organized:

A *great discovery* need a complete campaign !!!

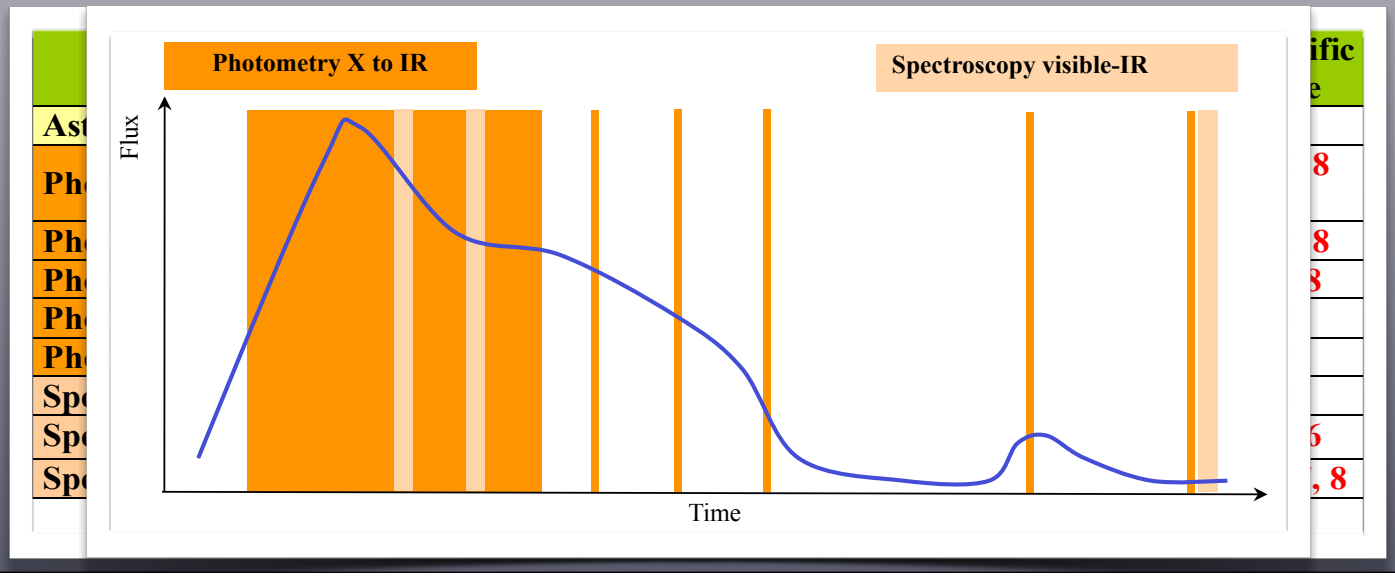
Different time sampling...

A complete campaign aims at addressing many questions:

1. Physics of the fireball
2. Circumburst medium
3. Properties of the progenitor and surrounding medium enrichment
4. Supernovae

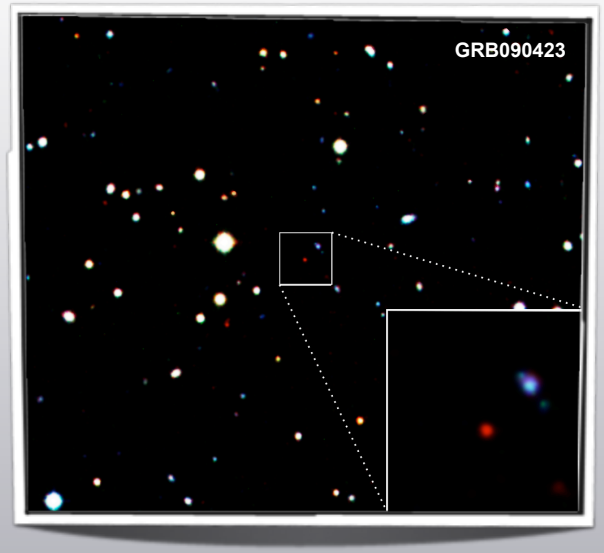
5. Properties of the host galaxy
6. Properties of the intergalactic medium
7. Study of the reionization epoch
8. Measuring the cosmological parameters

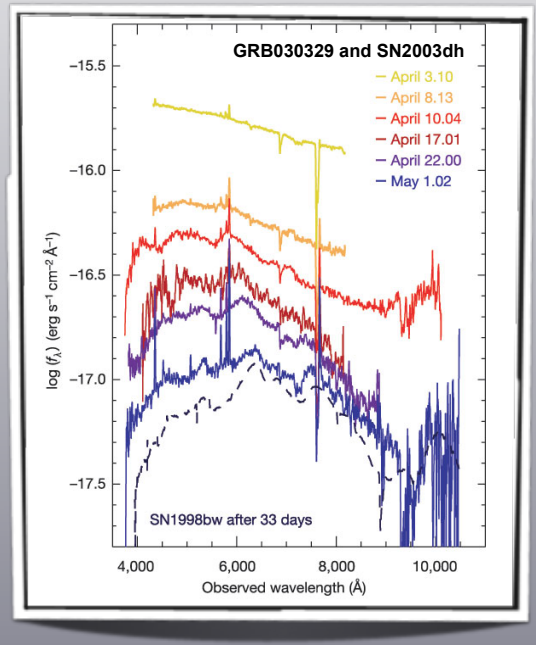
➡ **Early and regular observations.**

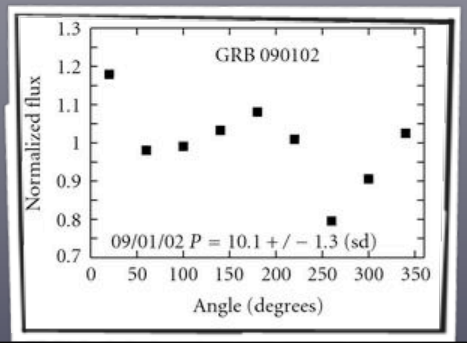


Different methods...

- Imagery
- Spectroscopy
- Polarimetry

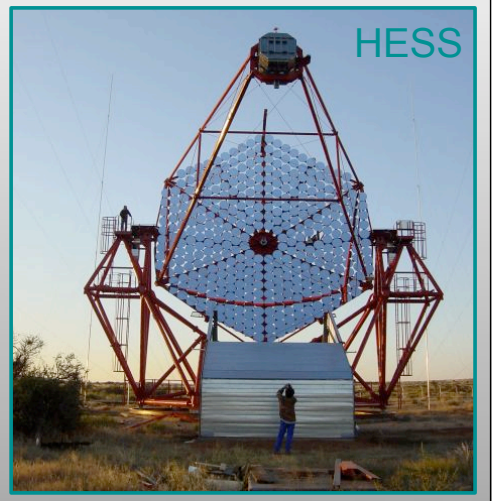






Different wavelengths, different messengers...

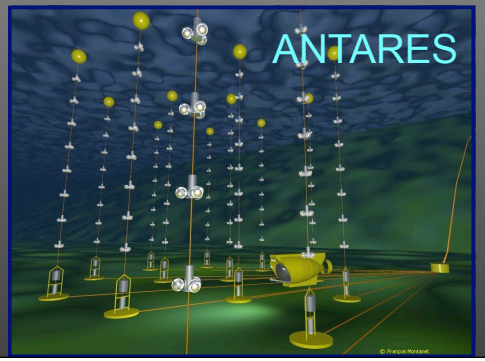
- **Radio astronomy**



Still to be proved

- Ultra high energy photons
- Ultra high energy cosmic rays

- Gravitational waves
- High energy neutrinos



Four types of facilities

- Automated telescopes: slew automatically within seconds to a GRB position whenever possible.

- Large, steerable, ground-based telescopes: VLT has for example a Rapid Response Mode (<1h) and a Target of Opportunity (<1 day) mode.

- Space-based telescopes (XMM, HST, ...): in principle, they can respond to GRB alerts on a ToO basis, but this may take a day or more.

- Non-steerable facilities, like Antares and Virgo: observe a large fraction of the sky more or less continuously.

Perspectives for *French* astronomers in 2015

Wavelength domain	On the major facilities in operation		
	Top interest	Less convenient	To be discussed
Radio domain	ALMA IRAM?		LOFAR
Optical domain	VLT/FORS2? VLT/XShooter	CFHT/MEGACAM	GTC/OSIRIS
Infra-red domain	VLT/HAWKI JWST/NIRCAM	CFHT/WIRCAM	GTC/CIRCE
High-Energy	Swift? Chanda/XMM? FERMI		
Astro-particule	Hess Virgo/Ligo Antares		

A very favorable situation...

➡ **But future of the smallest telescopes (<1m) not so clear: fundamental link between the triggers and these major facilities!**

SVOM follow-up: a perfect example???

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

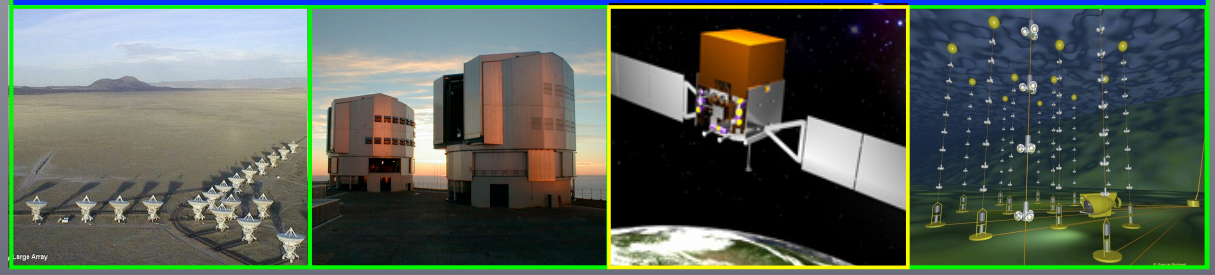
T_0 +1 min

GWAC (V)

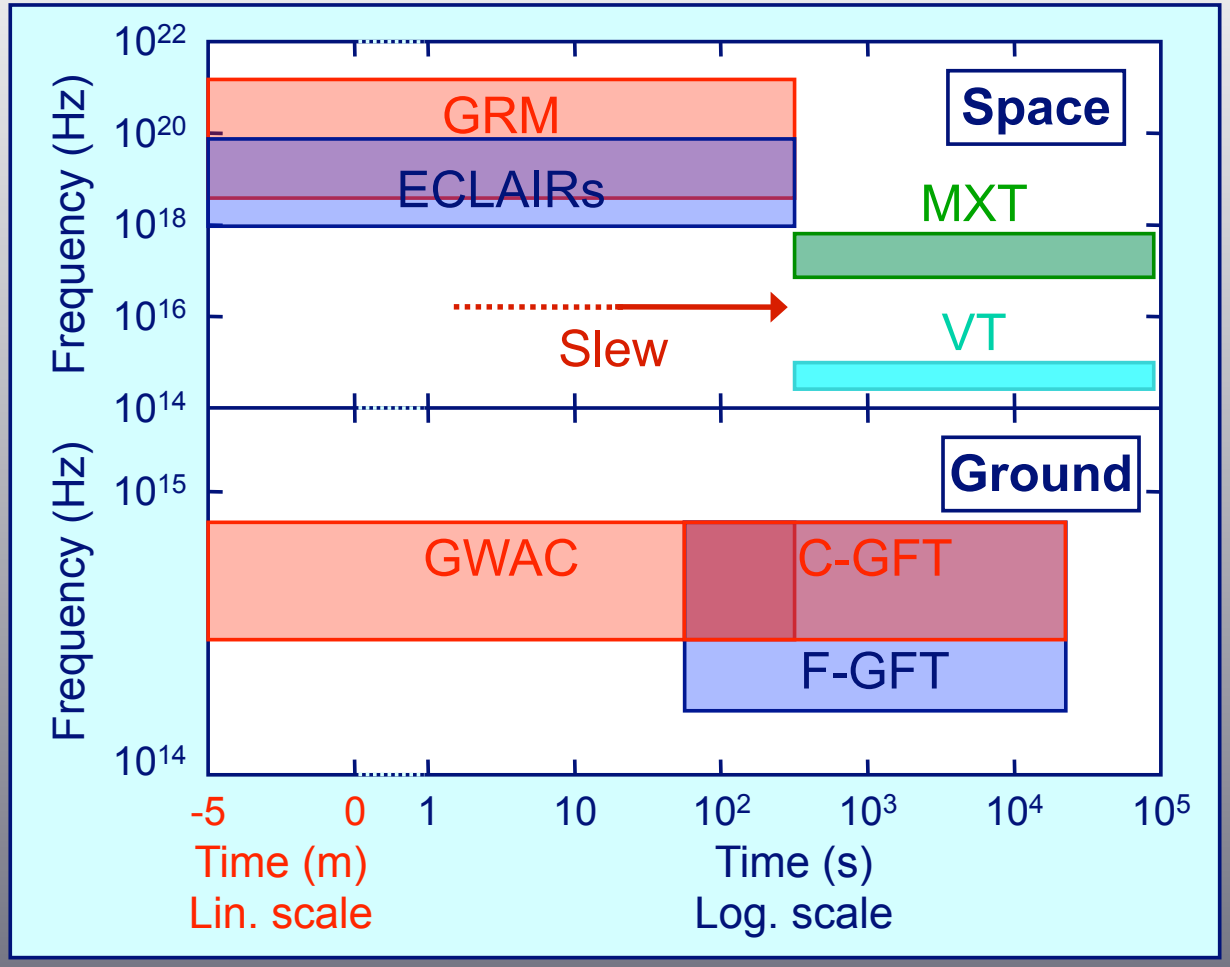
GFTs (B, V, R, I, J, H)

1-2 m robotic telescopes

Multi messenger follow-up



SVOM, a multi-wavelength mission



Space and ground instruments joined to enable a unique coverage

The SVOM French Follow-up Group

The prime responsibilities of the French Follow-up Working Group (F-FWG) are to organize the SVOM follow-up by:

- **Defining the optimal follow-up strategy.**
- **Establishing strategic collaborations.**
- **Organizing the follow-up observations.**
- **Contributing to the development, improvement and maintenance of the follow-up software.**
- **Reducing, archiving and distributing the data.**

⇒ Minimize competition for time at any particular observatory, by carefully selecting team members

Collaboration with external facilities

Philosophy

- ***Collaborations with key partners required.***

- **Guideline in seeking collaborations and partnerships with individuals and/or organizations based on the maximization of the follow-up observations, both in photometry and in spectroscopy:**
  - **Good geographical coverage**
  - **Good mix of large telescopes and smaller robotic ones**
  - **Good wavelength coverage, in particular in the near IR (less facilities available).**
  - **Minimum duplication of effort and competition within team**
  - **…**

Collaboration with external facilities

Private facilities

• Strategic collaborations must be organized.

• *Modalities will be discussed between the F-FWG and the possible partners during the subsequent phases of the project*.

• Possible directions for further discussions and negotiations are indicated hereafter:

- **Formal access to the network formed by the F-FWG.**
- **Privileged access to the complete SVOM GRB alert datasets (beyond the public data).**
- **Sharing of the SVOM and facilities data: agree to collaborate with SVOM co-I in data analysis and publication, as appropriate.**
- **Fostering scientific collaborations in preparation of the mission, e.g. through for example studentship or fellowship exchange programs.**
- **…**

Collaboration with external facilities

Private facilities

Some of them are not open to the community, i.e. it is not possible to submit an external proposal.

For example:

Photometry						
Liverpool Telescope	2 m	Visible Near-IR in 2013 (TBC)	4.6'x4.6'	*Yes (robotic)*	Canaria Islands	Private
Falkes Telescopes	2 m	Visible Near-IR in 2013 (TBC	4.6'x4.6'	*Yes (robotic)*	Hawaii and Australia	Private
MPE	2.2 m	Visible to near-IR (g' to K bands)	10'x10'	*Automatic*	Chile	Private

Collaboration with external facilities

Open time facilities

The other facilities are open to the community, i.e. telescope time is obtained by submitting a proposal to the time allocation committee (typically once or twice per year).

It is the F-FWG responsibility to promote, coordinate and validate all the time proposals submitted to the different facilities on behalf of the SVOM project. Only the proposals, which is validated by the FWG can be officially supported by the SVOM collaboration.

Collaboration with external facilities

Open time facilities

For example:

Photometry						
CFHT/Megacam	3.6 m	Visible	57'x57'	No (but ToO accepted)	Hawaii	Open
CFHT/Wircam	3.6 m	Near-IR (J to K bands)	21'x21'	No (but ToO accepted)	Hawaii	Open
VLT/HAWK-I	8 m	Near-IR (J to K bands)	7.5'x7.5'	Yes (ToO and RRM)	Chile	Open
VLT/FORS1-2	8 m	Visible	6.8'x6.8'	Yes (ToO and RRM)	Chile	Open (operational in 2013 ?)

Spectroscopy					
VLT/X-Shooter	8 m	300-2500 nm	Yes (ToO and RRM)	Chile	Open
VLT/FORS1-2	8 m	380-950 nm	Yes (ToO and RRM)	Chile	Open (still operational in 2013 ?)
VLT/UVES	8 m	300-1100 nm	Yes (ToO and RRM)	Chile	Open

SVOM Follow-up Science Plan

- **Part 1: High Level Requirements**
  - **For each science case:**
    - **Instrument mode (imaging, spectroscopy, etc.), Wavelength / band, Integration time, Time constraints, Parallel and/or simultaneous observations, Repeat time**
  - **Summary, priorities**

- **Part 2: Observational scenarios**
  - **Run simulations of observations, taking into account:**
    - **All facilities and instrumental capabilities potentially available for the follow-up**
    - **Fraction of time potentially available to SVOM follow-up (including instrument changeover, estimates of TAC allocations)**
  - **Analysis. Optimization of the scientific return. Identify hard points, amount of observing time needed, requirements for specific capabilities, etc.**

- **Prepare and release version 1 at end of phase B**
- **New releases in subsequent phases with updated list of facilities and capabilities**

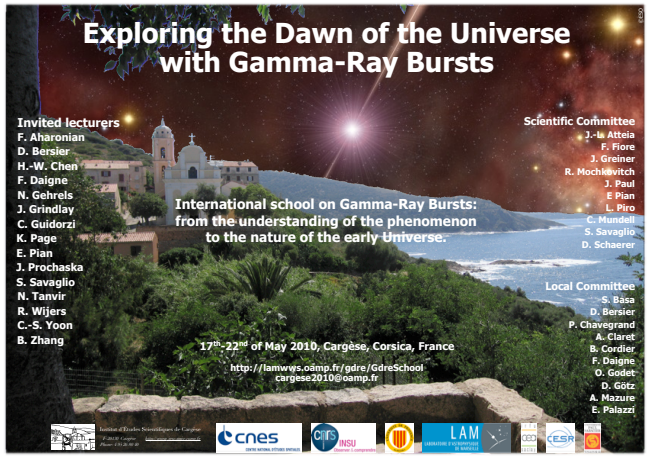
Conclusion from Cargese's School conclusion!

We are still doing our research on an exciting, challenging field. And many colleagues are not aware of the powerfulness of GRBs for our understanding of the Universe.

- Multiwavelength observations (photometry, spectroscopy, polarimetry) and other sources of information (neutrinos, gravitational waves) are most essential.

- We are dealing with Stellar Astrophysics as well as Observational Cosmology, coupled with theoretical research in all these fields.

- Technological developments are also a must, at both ground-based facilities (instruments, robotic and rapid reacting systems) and space- borned mission (SVOM and hopefully JANUS and EXIST).




SVOM