
# Long term follow-up and revisits

**Emeric Le Floc'h – CEA-Saclay & AIM**


# Follow-up of transient events : which time-scale ?

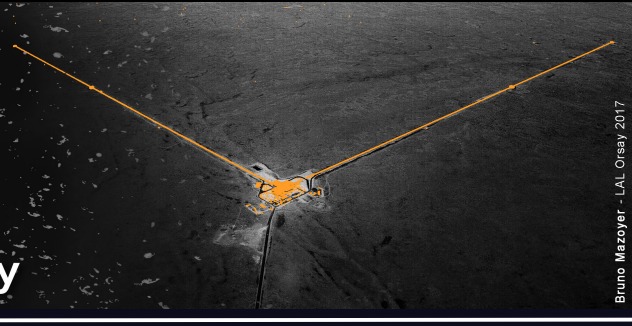
***Early time:***

(See Alain's talk)

- counterpart identification (if unknown location)
- "early" characterization of physical properties (if sensitive enough)

Transient Sky 2020

20 - 22 juin 2017, LAL-Orsay



Bruno Mazoyer - LAL Orsay 2017

# Follow-up of transient events : which time-scale ?

***Early time:***

(See Alain's talk)

- counterpart identification (if unknown location)
- "early" characterization of physical properties (if sensitive enough)

***Long term:***

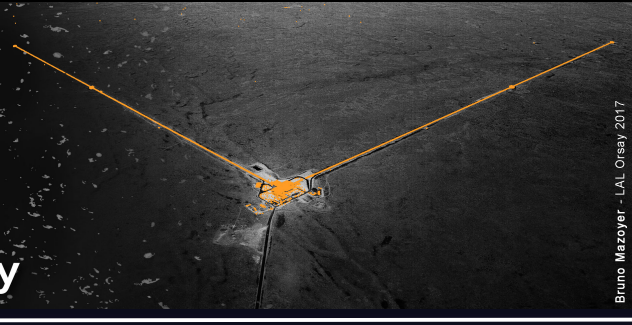
- in-depth analysis of the transient source
- characterization of its physical environment

***Revisits:***

- Hosting environment
- Transient source variations (if variability over long time scales, e.g., AGNs, repeaters, …)

# Transient Sky 2020

20 - 22 juin 2017, LAL-Orsay



Bruno Mazoyer - LAL Orsay 2017

## Follow-up of transient events : which time-scale ?

***Early time:***

(See Alain's talk)

- counterpart identification (if unknown location)
- "early" characterization of physical properties (if sensitive enough)

### This talk

***Long term:***

- in-depth analysis of the transient source
- characterization of its physical environment

***Revisits:***

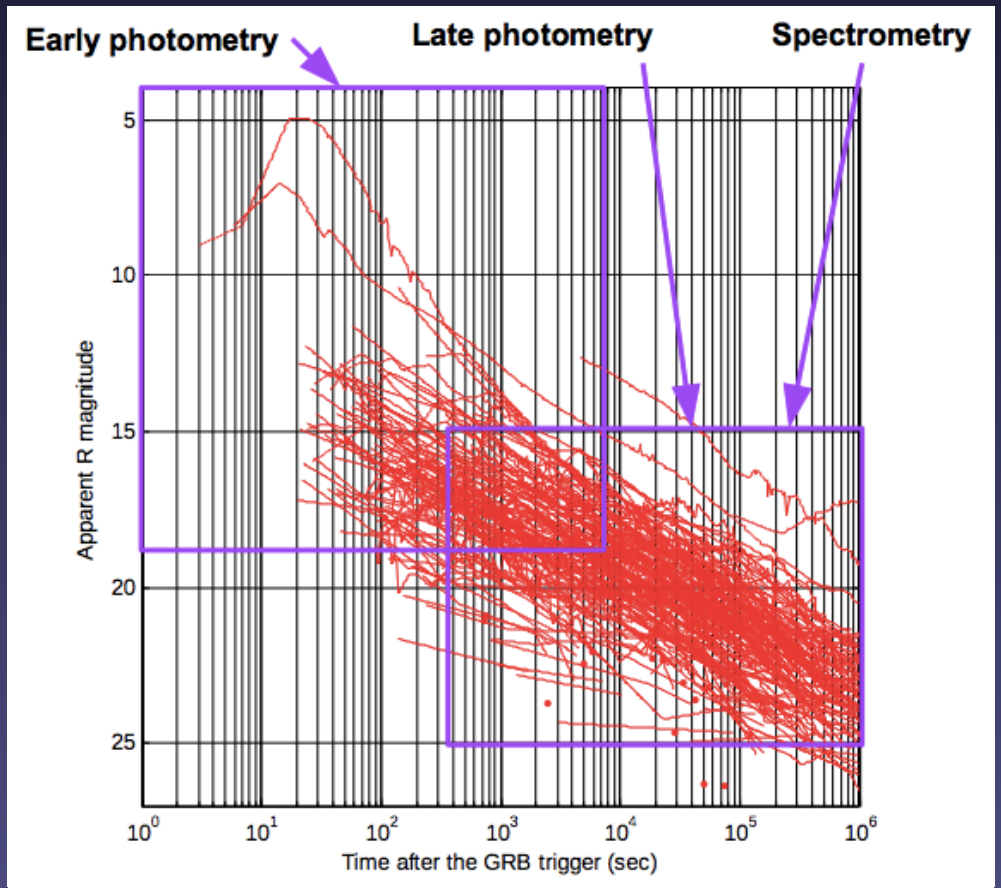
- Hosting environment
- Transient source variations (if variability over long time scales, e.g., AGNs, repeaters, …)

# The typical time-scales for long term follow-up are source- and wavelength-dependent :

- hours to weeks : e.g.,

  optical light-curve characterizations (galactic transients, SN/GRB, …)

  “Flaring-type” variabilities (accreting BHs, …)




***From slides of A.Klotz (GRB afterglows)***

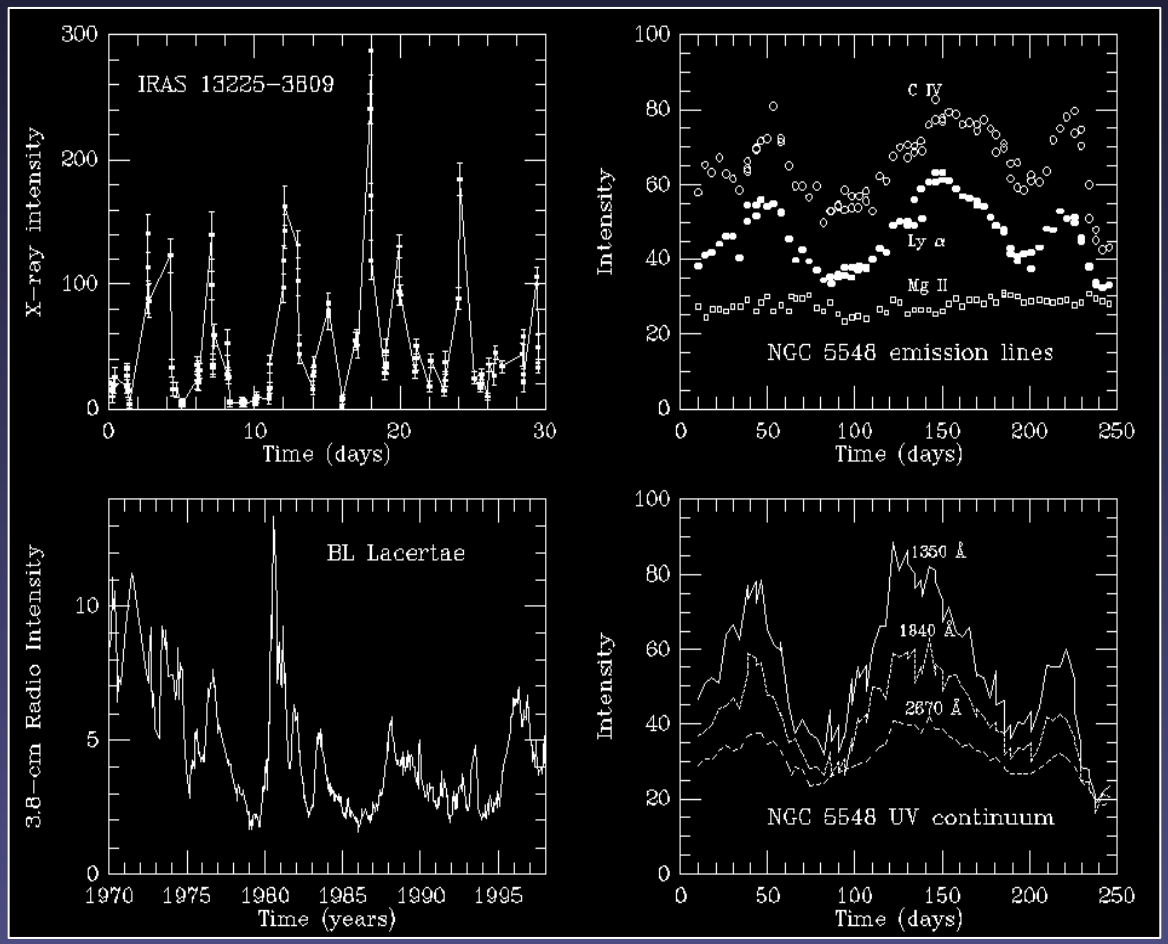
# The typical time-scales for long term follow-up are source- and wavelength-dependent :

- months to years: e.g.,

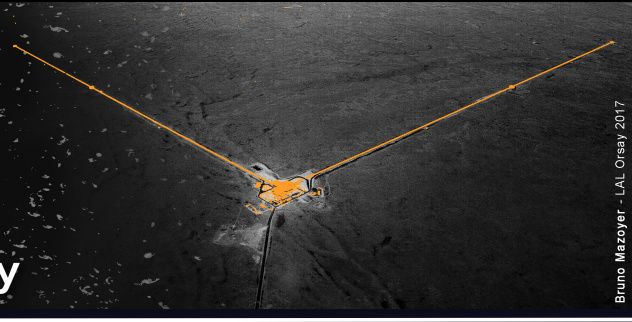
  radio GRB afterglows

  High-z SNe optical light curves

  AGN variability




Cr.: U.of Alabama





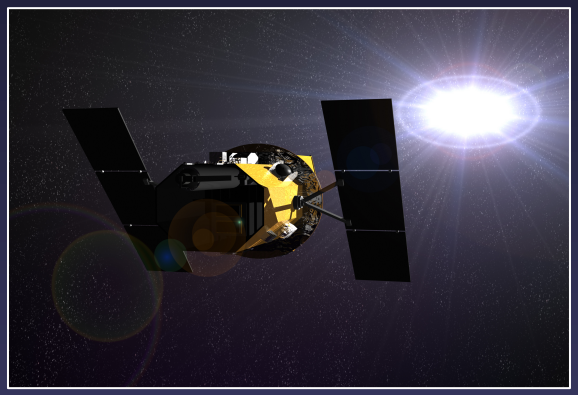
# Long term follow-up and revisits : Which telescopes & which programs ?

Unlike the early time follow-up, which is more efficient with dedicated, fast-slewing (but small) automated telescopes, long term observations and revisits can be performed with any facility (private or opened to the community, small or large) :

- Target of Opportunity (ToO) observations for time-scales ranging from minutes to weeks
- Regular calls (or sometimes ToO !!) for much longer term follow-up + revisits

# Long term follow-up and revisits : Which telescopes & which programs ?

→ Goes from small apertures (e.g., LCOGT 1m, Swift, …) …

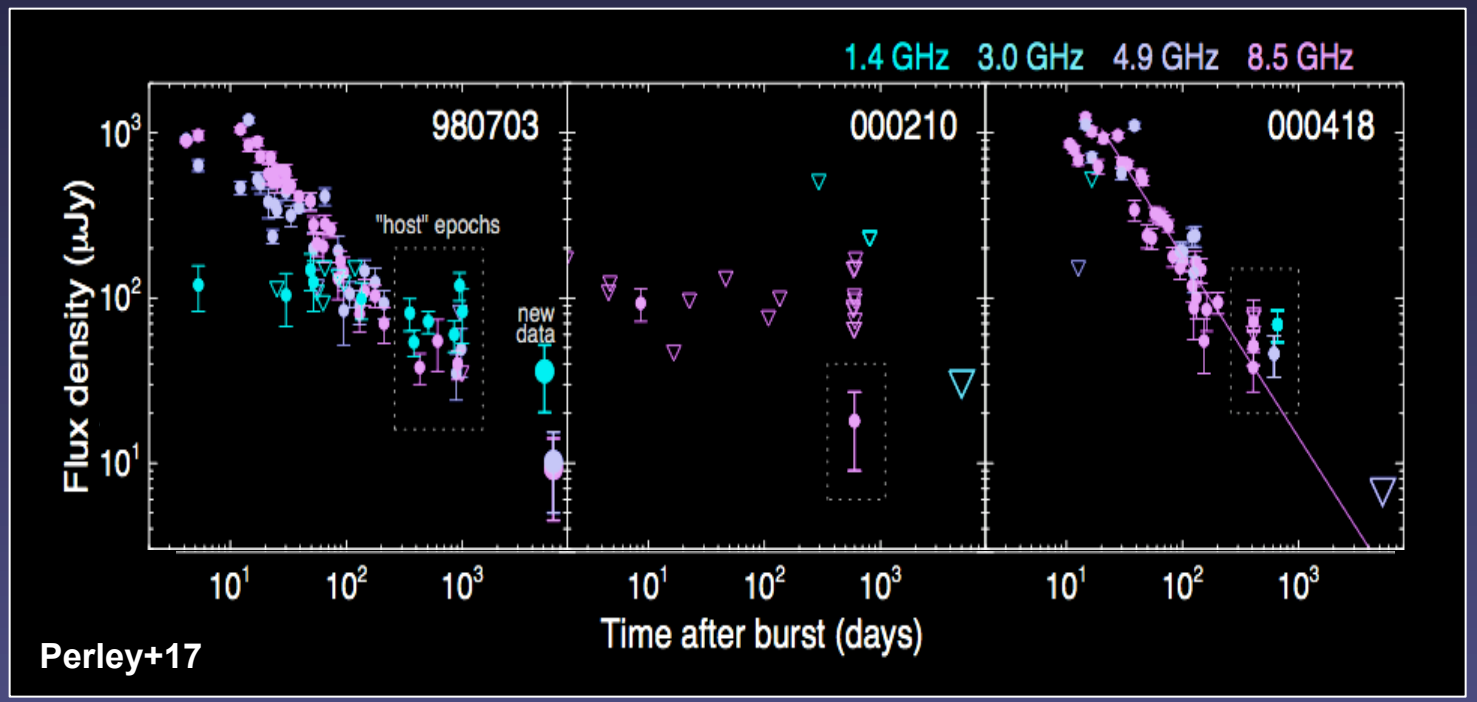


… to the largest facilities with rapid response modes (HST, 8m-class telescopes, ALMA, …)

# Long term follow-up and revisits : photometric issues

When the transient source fades to similar flux levels of its hosting environment, extra care has to be considered (not the case in the “early time” follow-up)

In this case, long-term radio emission from GRB afterglows had been misinterpreted as continuum from SF activity in the host…

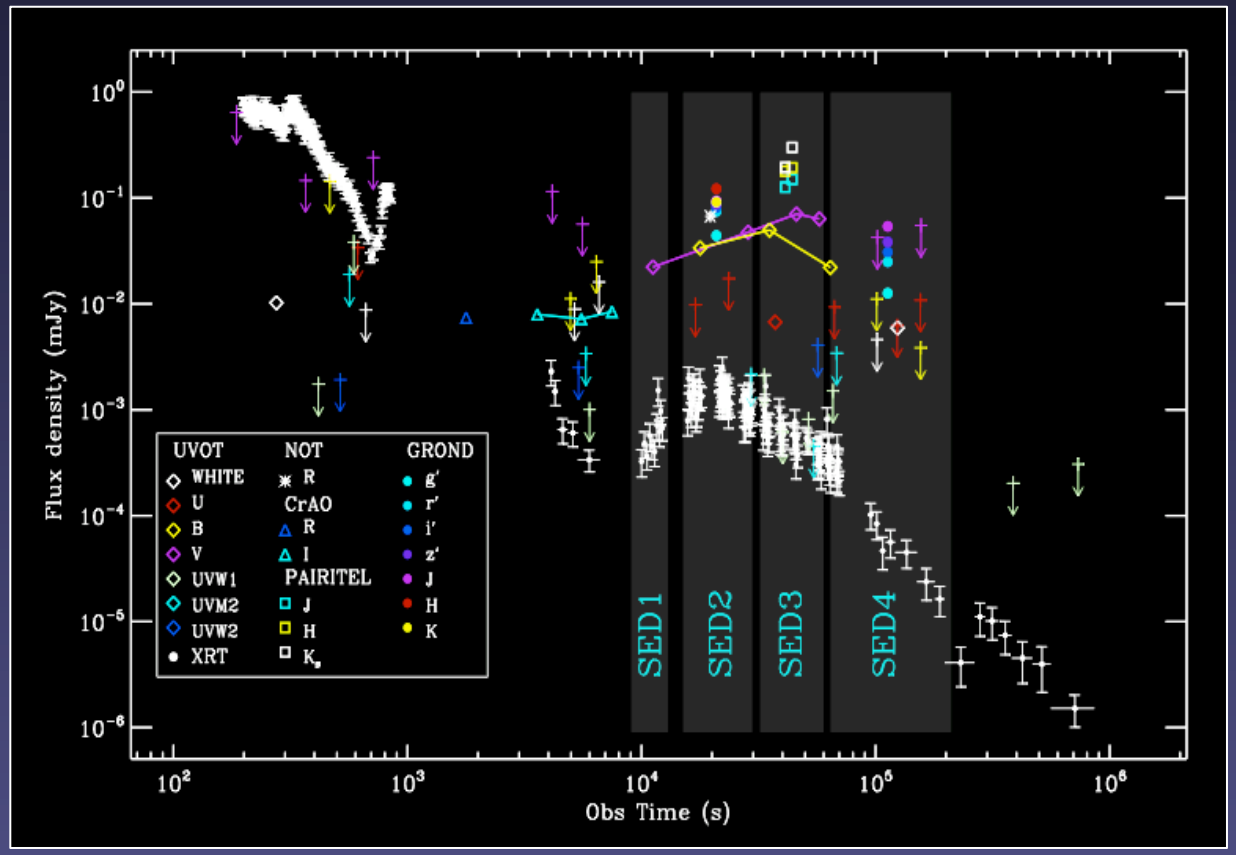


# Long term follow-up and revisits : for which science ?

## *GRBs (Long + Short) :*

- Characterization of the afterglow
  - Central engine
  - Geometry of the jet
  - Circum-burst properties…
  - Reverse shocks

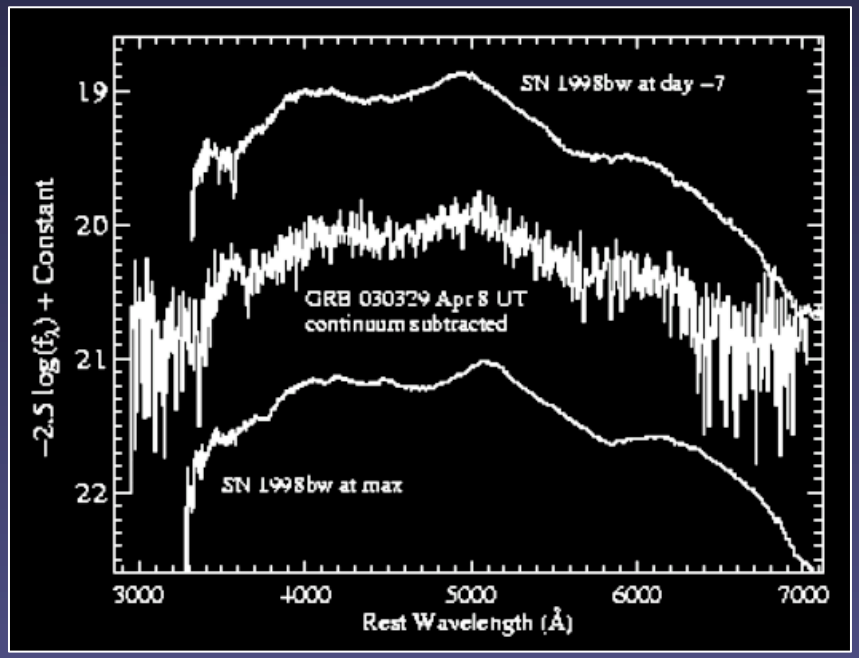
GRB081028, Margutti+10



# Long term follow-up and revisits : for which science ?

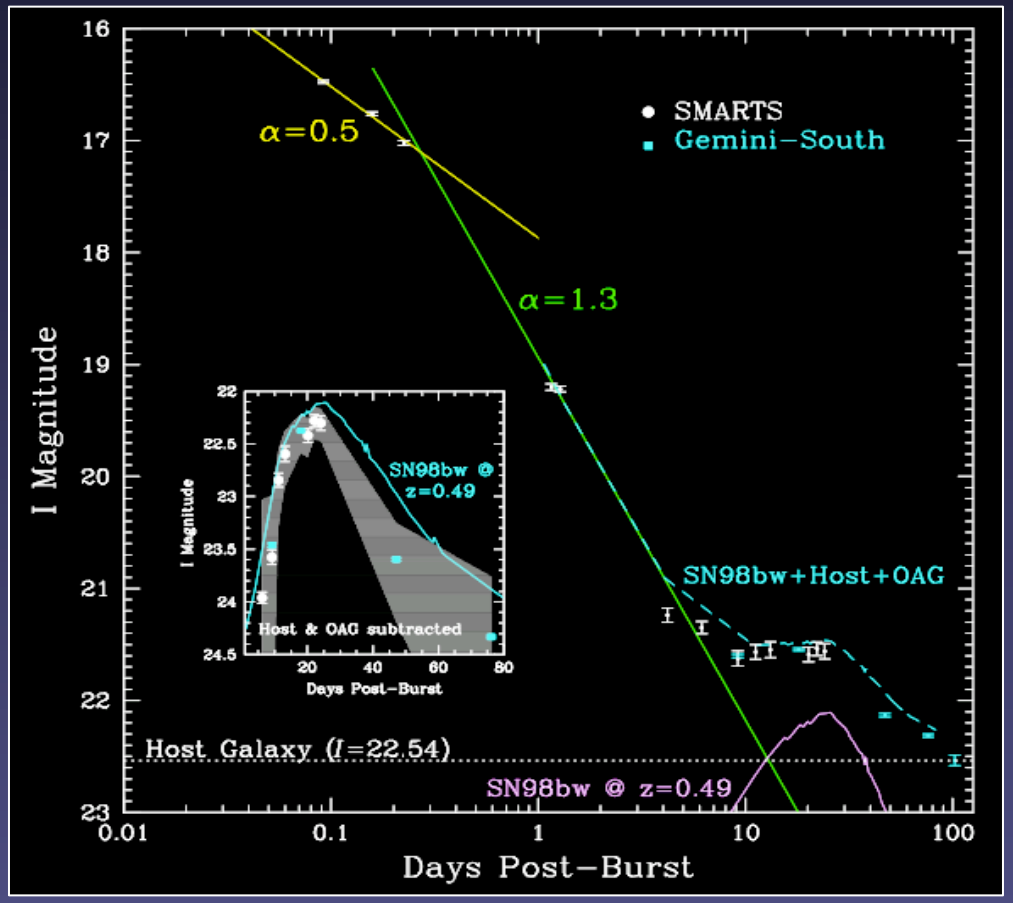
## *GRBs (Long + Short) :*

- Connection to SN Ibc




Hjorth+03

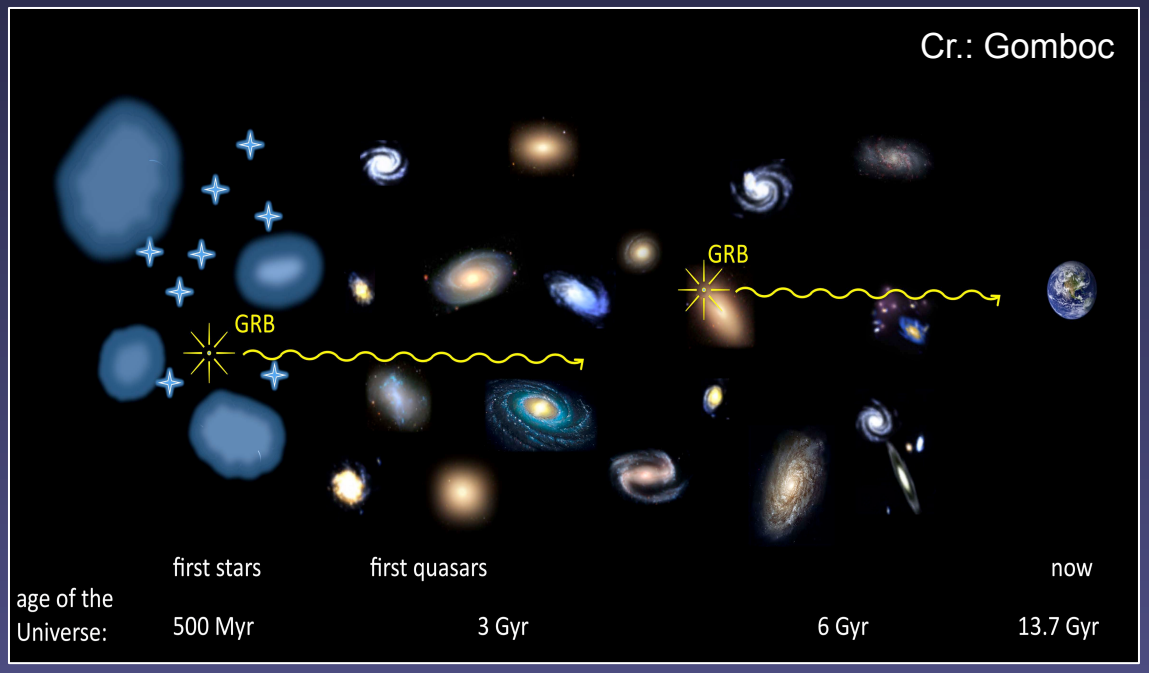
Cobb+10

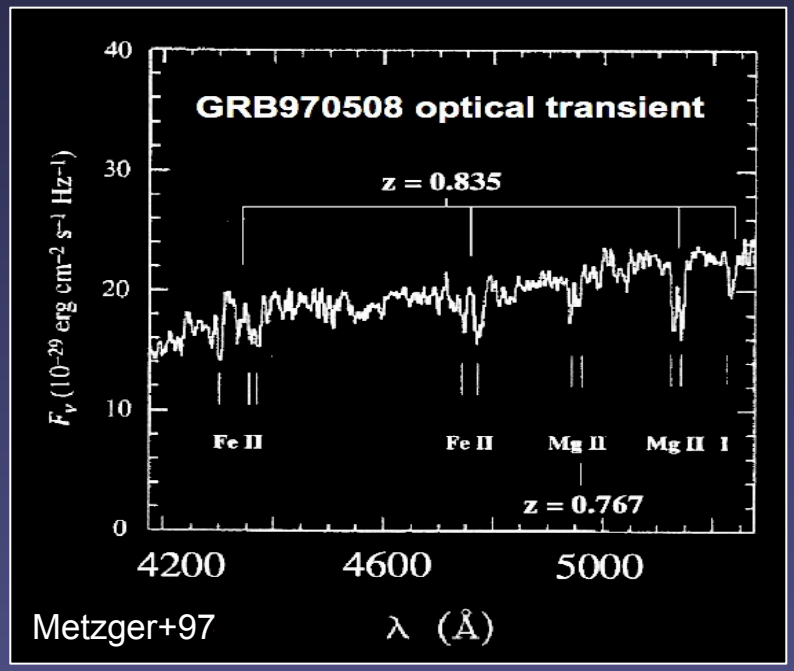


# Long term follow-up and revisits : for which science ?

## *GRBs (Long + Short) :*

- Spectroscopy in absorption: cosmological probes (host redshift, ISM, IGM, intervening systems, connection with e.g., quasar-DLAs)

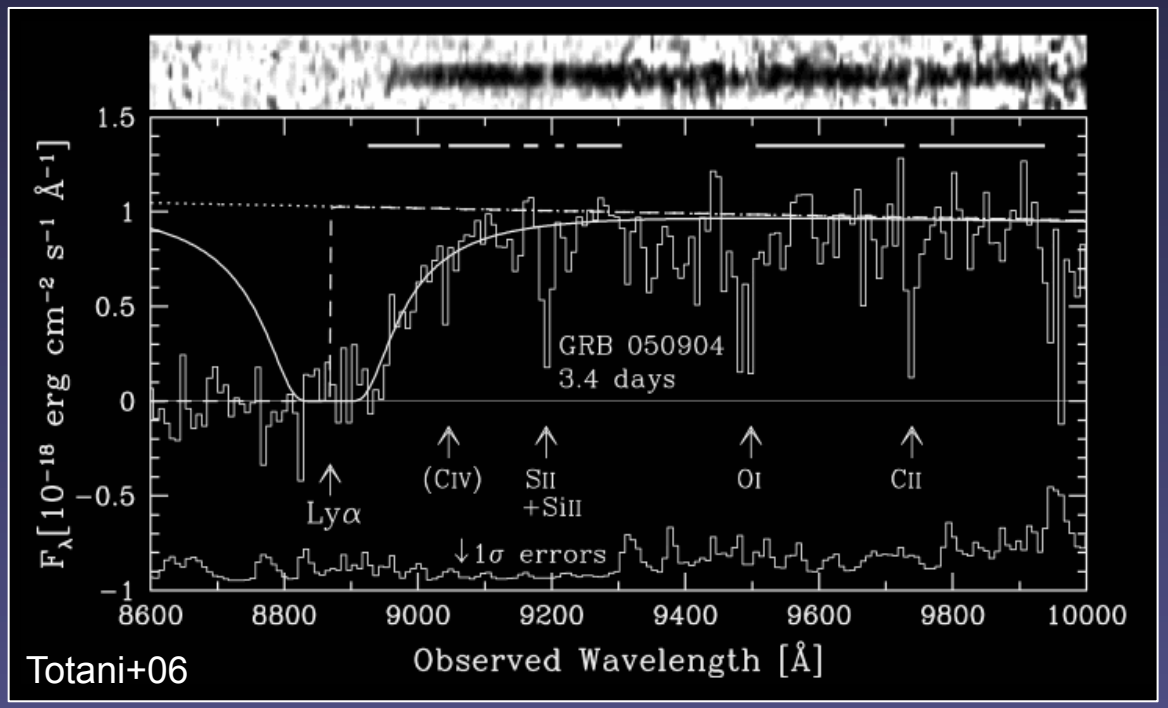


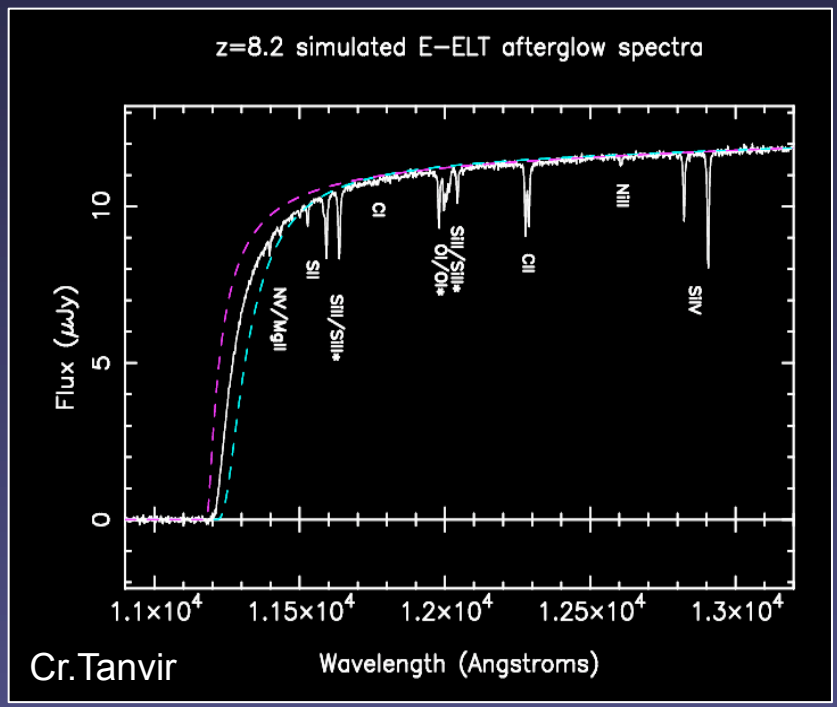



# Long term follow-up and revisits : for which science ?

## *GRBs (Long + Short) :*

- Spectroscopy in absorption: probing the re-ionization era (e.g., THESEUS proposed for M5-ESA)

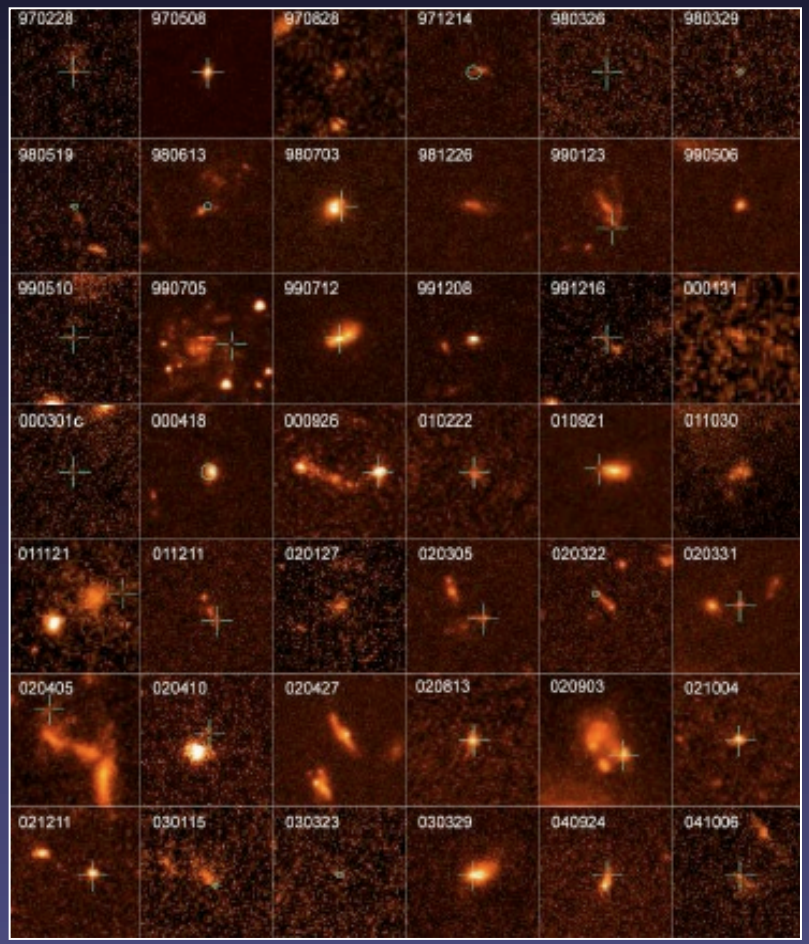


# Long term follow-up and revisits : for which science ?

## *GRBs (Long + Short) :*

- Host properties : luminosities, stellar mas, SFR, morphology, …, comparison with the field
- Location of GRBs in their host
- Redshift
- Emission properties compared to absorption




Fruchter+06

# Long term follow-up and revisits : for which science ?

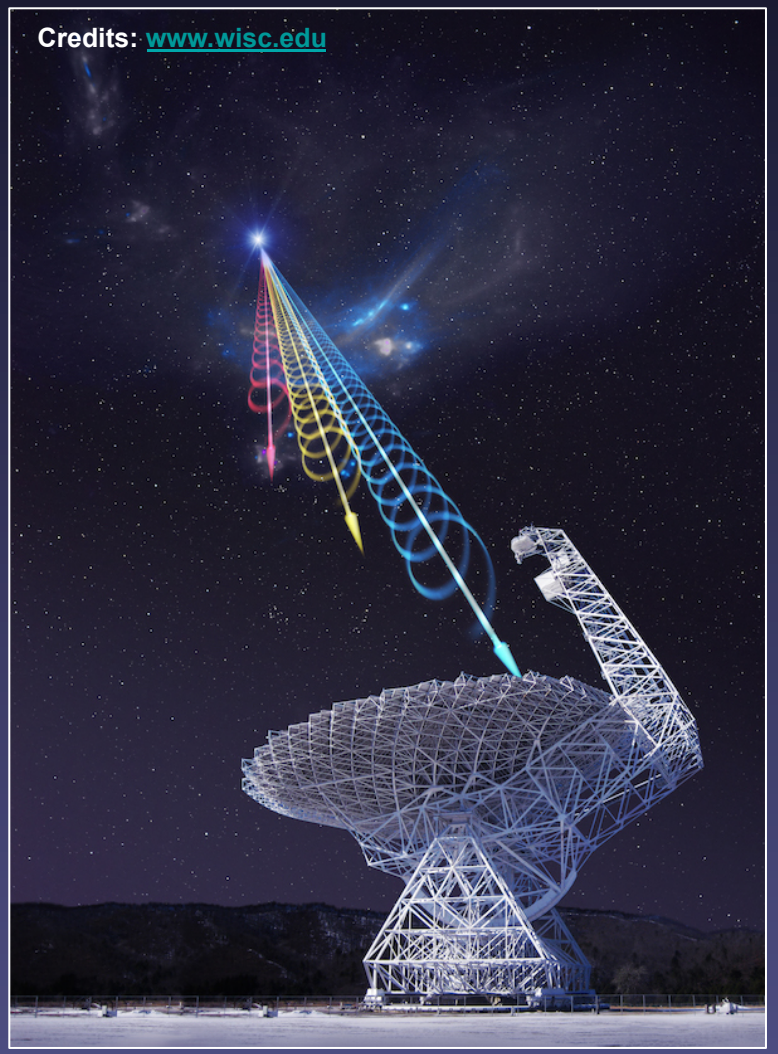
## *FRBs :*

- Extremely brief bursts of radio emission
- Detected with single dish facilities (Arecibo, Parkes, Nancay, …)

→ no accurate localization (for one-time events)

- No counterpart known at other wavelengths so far (but ToO's on-going)

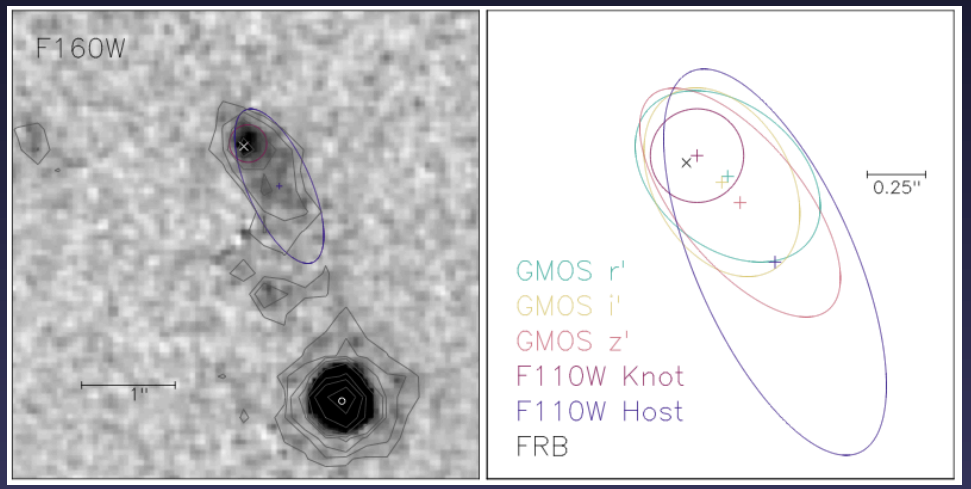
Ex. of cosmological use: magnetic field and turbulence of the cosmic web (Ravi+16)

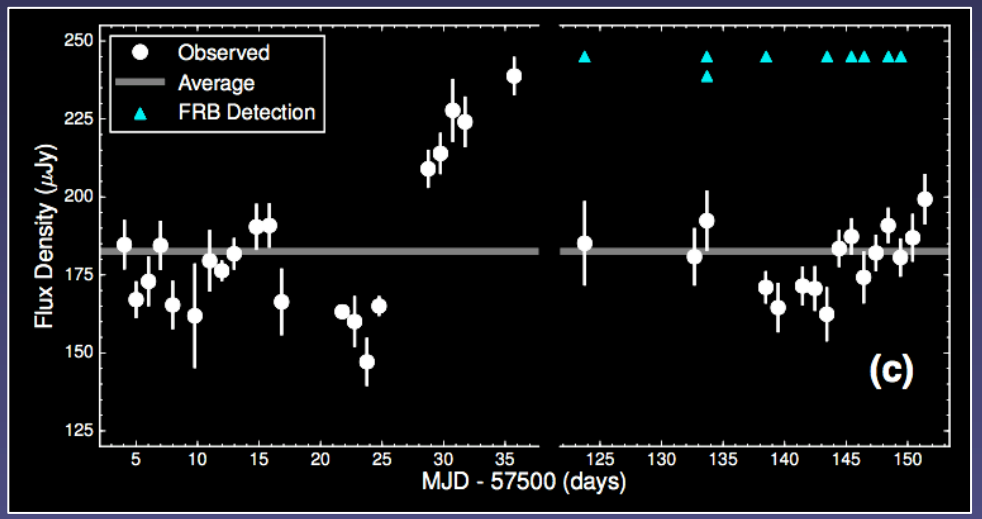


# Long term follow-up and revisits : for which science ?

## *FRBs :*

- 1 known repeater, localized with VLA, VLBI
- In a dwarf galaxy at z~0.2
- FRB coincident with a star-forming region (Halpha Subaru IFU + HST)
- Coincident with a compact & varying radio source




Bassa+17, Chatterjee+17

# Long term follow-up and revisits : for which science ?

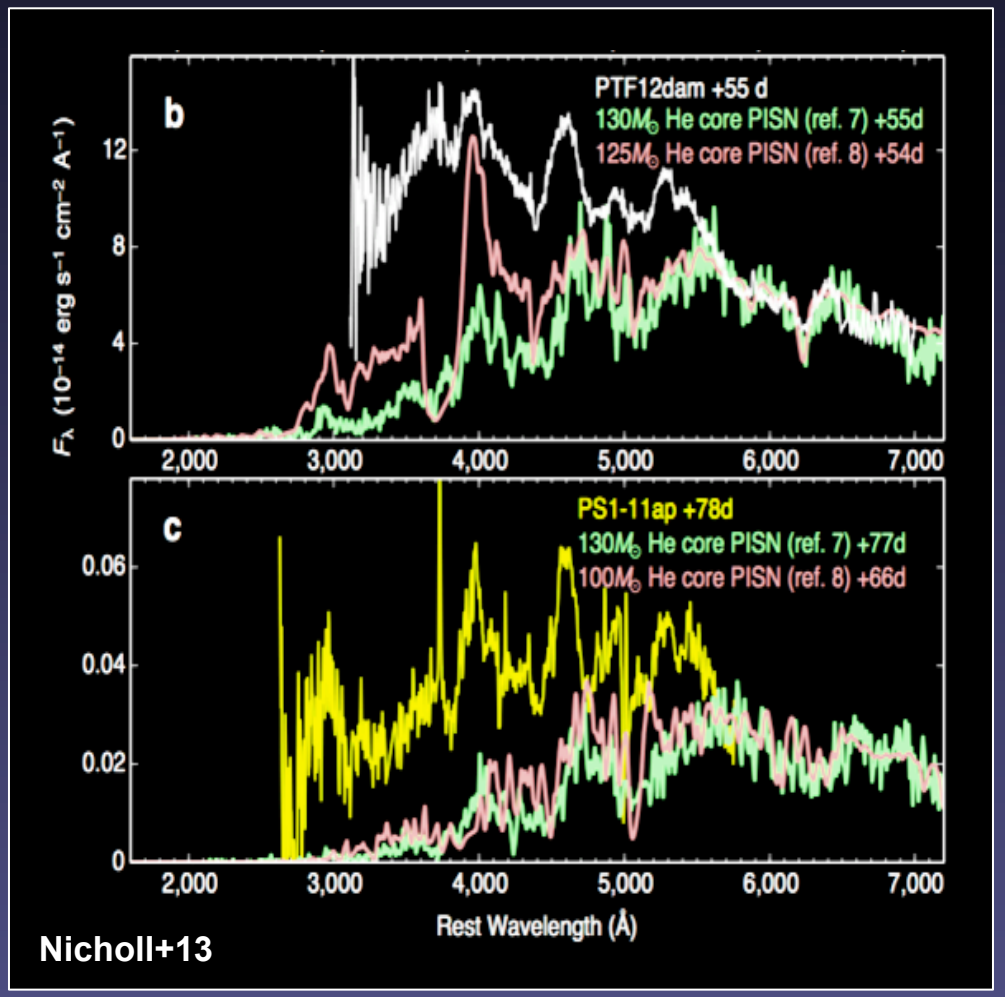
## *FRBs :*

→ Coordinated monitoring of FRB121102 planed for September 2017 (4 nights) with INTEGRAL (hard X-rays), optical (OHP), Nancay (radio) (+ possibly FAST, IRAM-30m, Arecibo, …) : C.Gouiffes et al.

# Long term follow-up and revisits : for which science ?

## *Superluminous SN:*

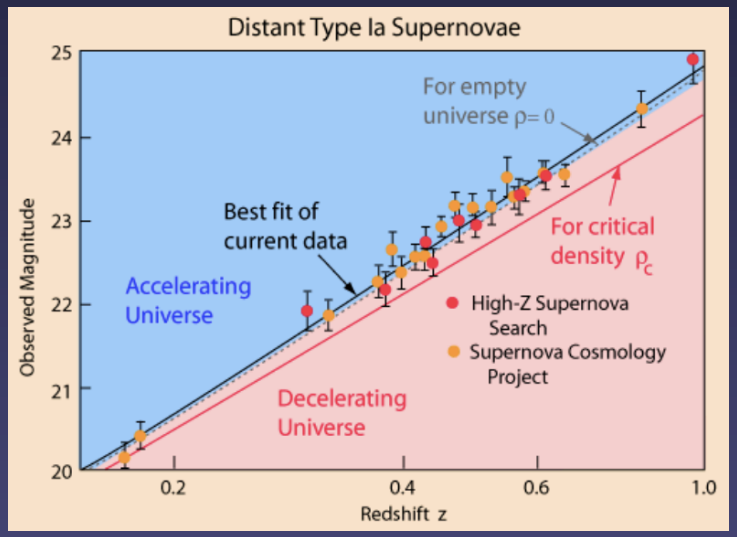
- Spectro-photometric characterization
- Physics of the central engine (pair-instabilitiy or magnetar driven ?, …)
- Distance, rate
- Hosting environment



# Long term follow-up and revisits : for which science ?

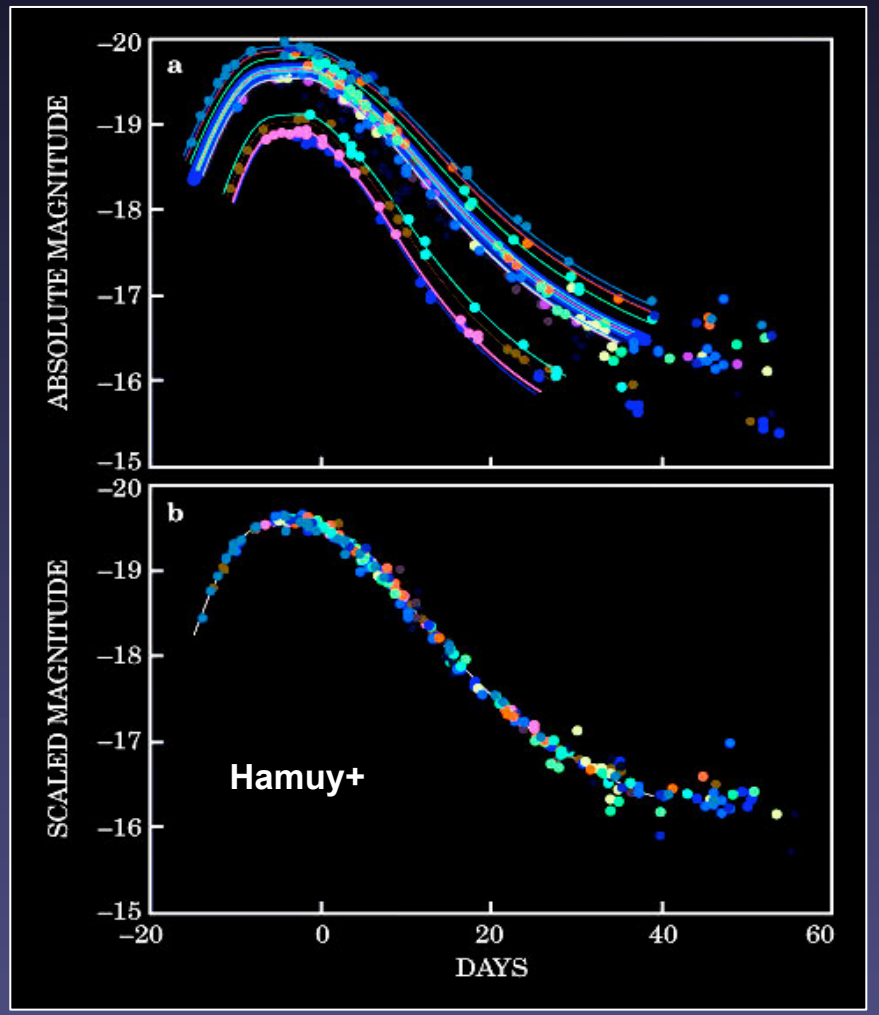
## *Type 1a SN:*

- Hubble diagram, cosmology




Cr.: Perlmutter

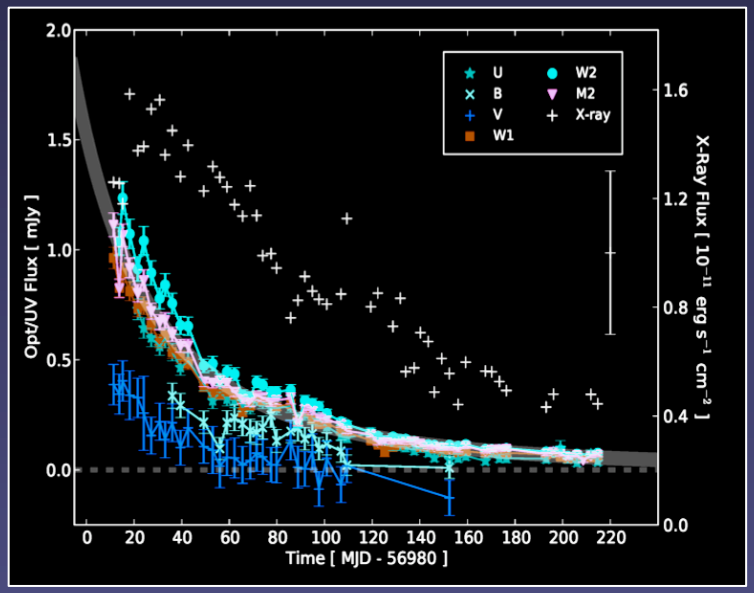
- Physical modelling of thermonuclear SN (e.g., Cobalt-56 detected with INTEGRAL)



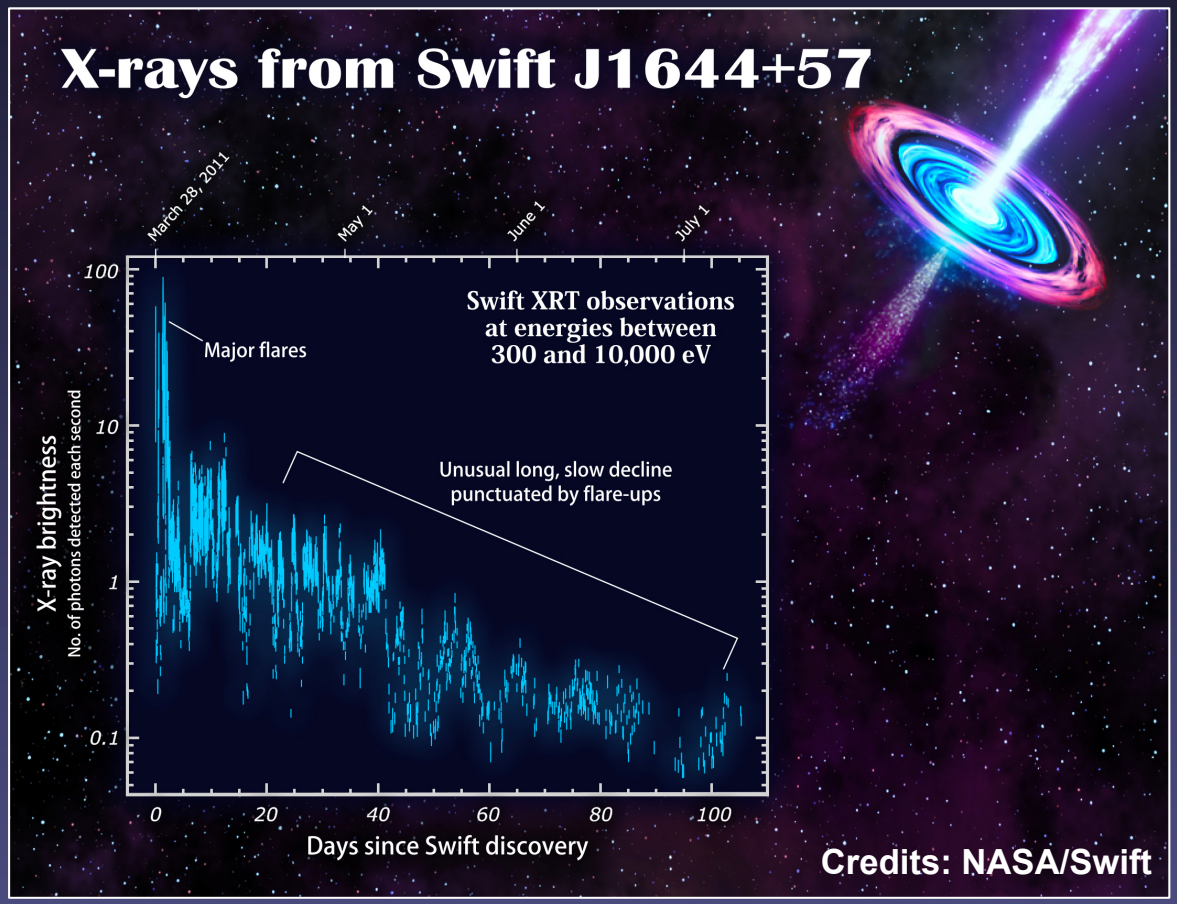
# Long term follow-up and revisits : for which science ?

## *TDEs :*

- Physics of accretion around massive BHs




Miller+15

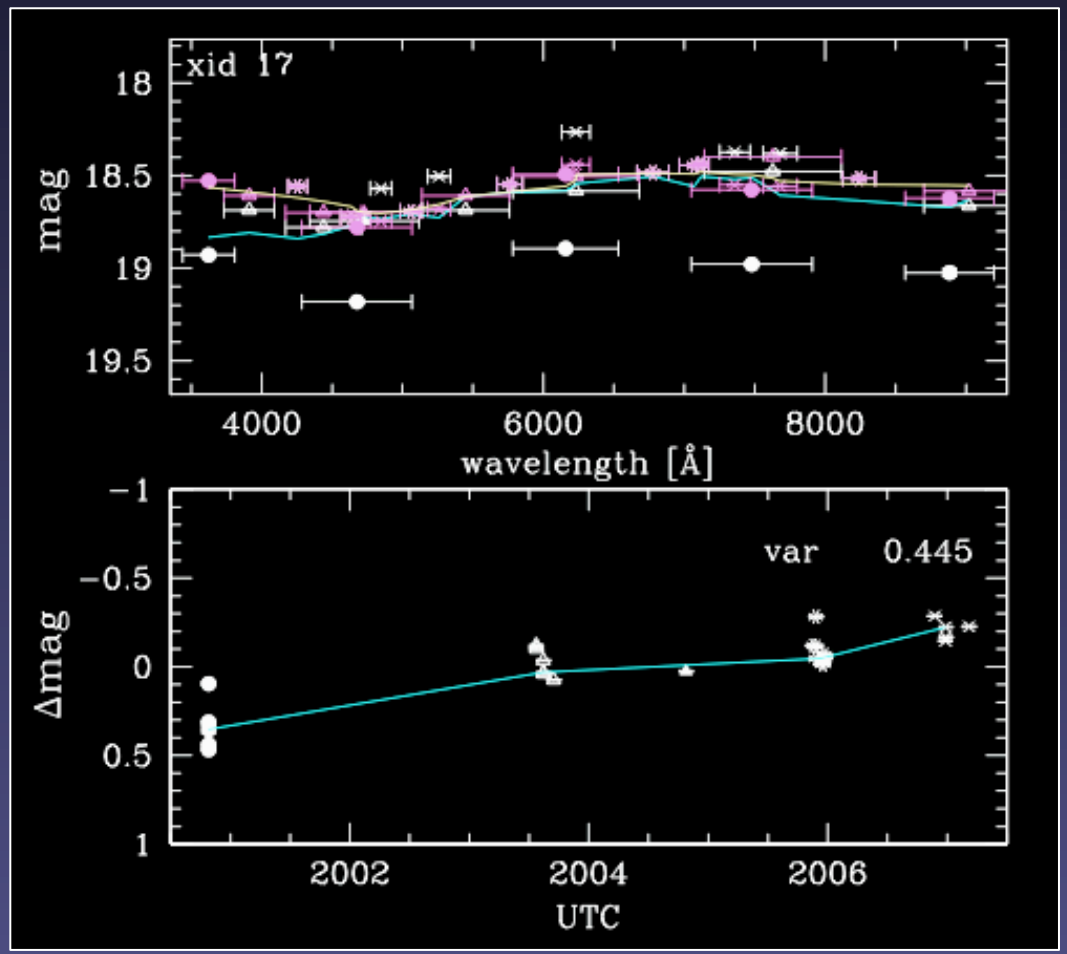


# Long term follow-up and revisits : for which science ?

## *AGNs :*

- Accretion disks around SMBHs
- Properties of the surrounding environment (torus, NLR, BLR, …)
- Radio jets
- Accurate sampling of the AGN spectral energy distributions

Salvato+09

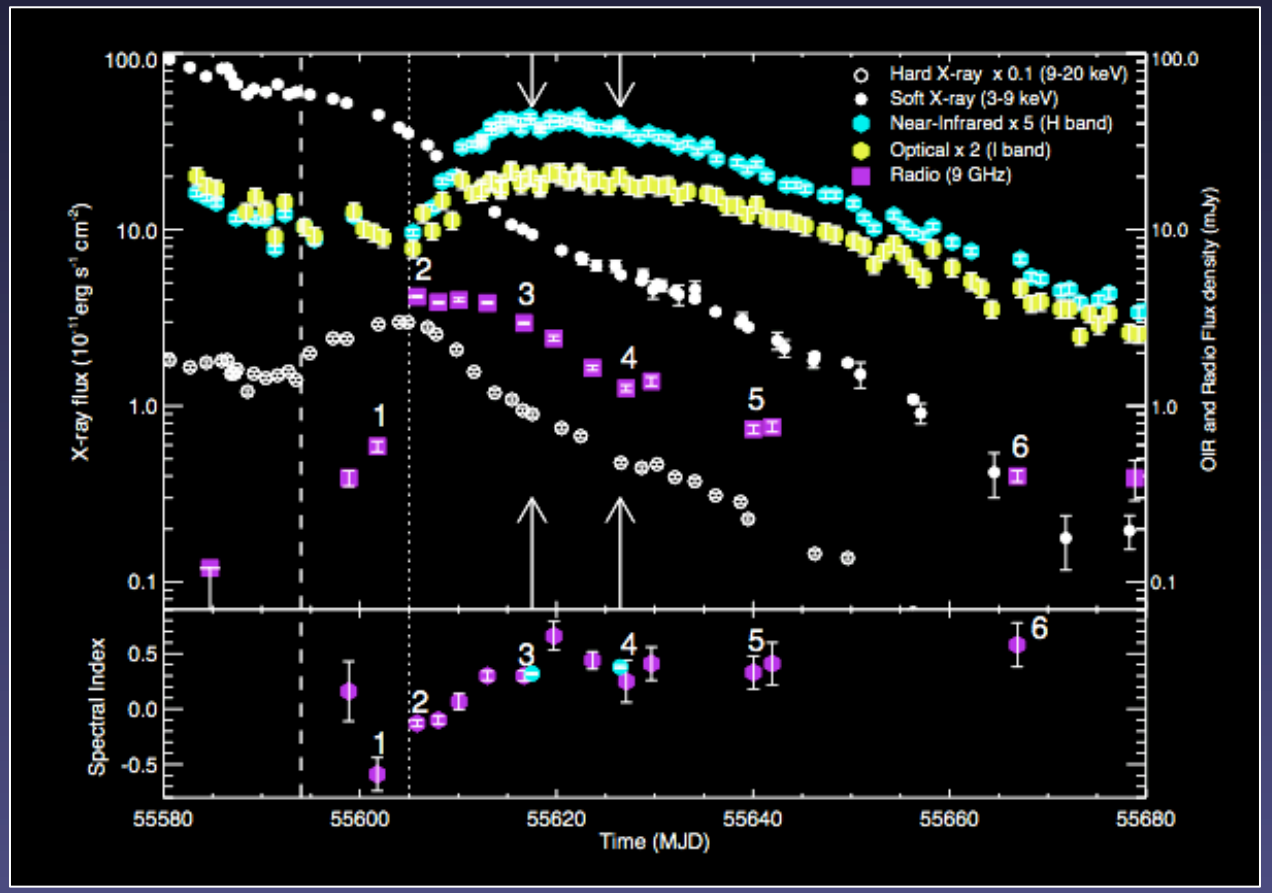


# Long term follow-up and revisits : for which science ?

## *Accreting BH, X-ray binaries*

- Outbursts, flares
- Compact jets ignition
- Accretion-ejection connection
- Composition of relativistic jets

Corbel+13

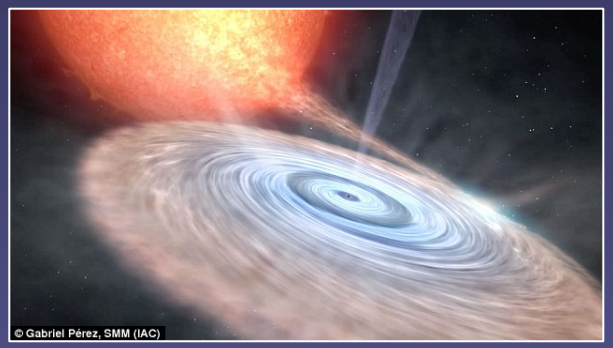


# Long term follow-up and revisits : for which science ?

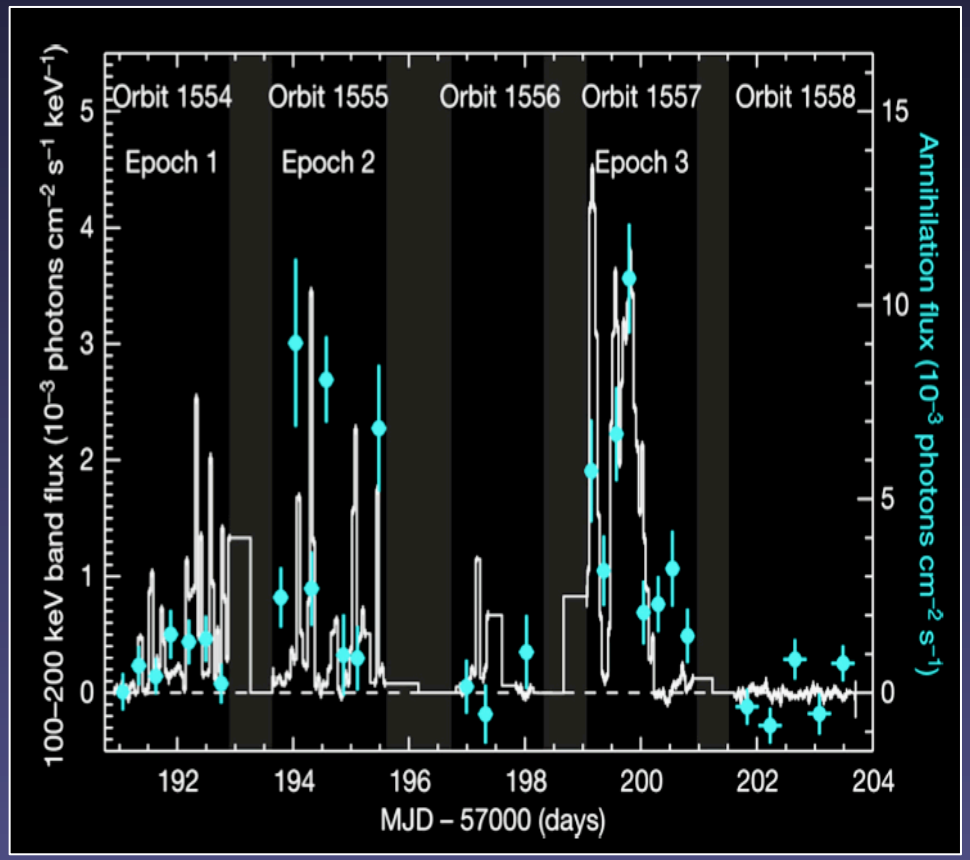
## *Accreting BH, X-ray binaries*

- E.g., Multi-lbda campaign toward V404 Cygni (2015 outburst)

  Positron annihilation at 511keV, with x1000 variations over ~1h time-scales !!




Siegert+16

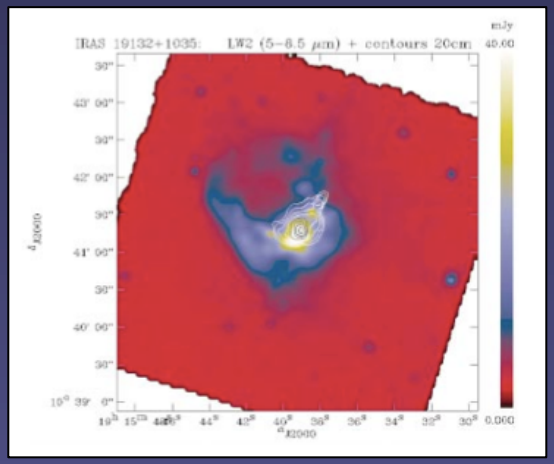


# Long term follow-up and revisits : for which science ?

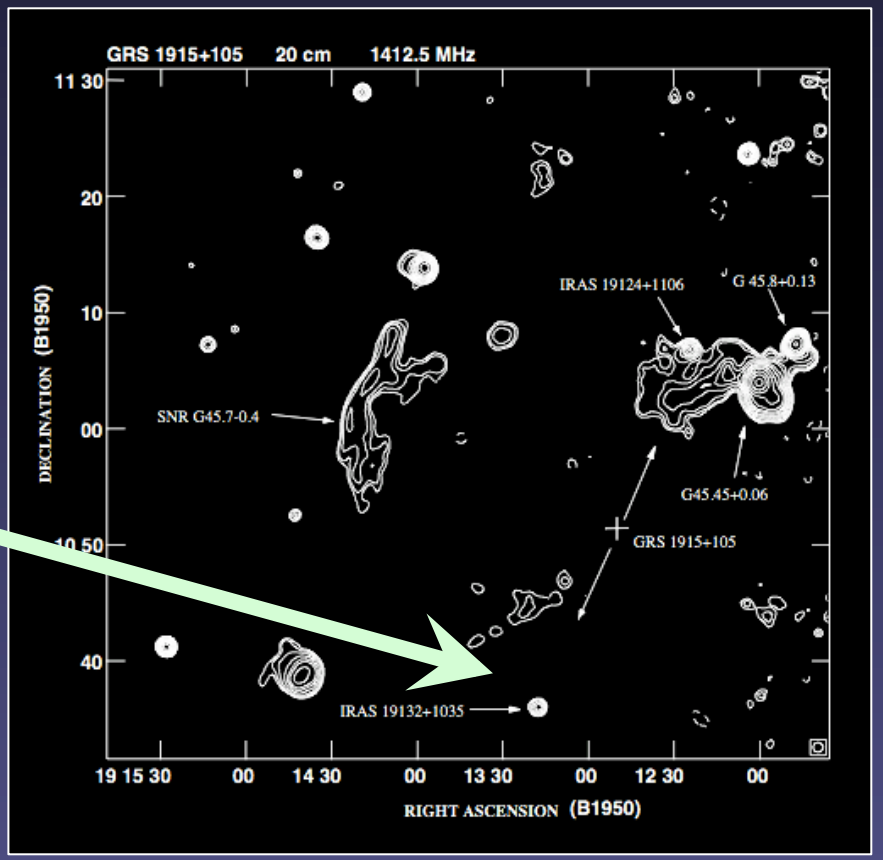
## *Accreting BH, X-ray binaries*

- Possible impact on local environment

  → jet induced star formation ??

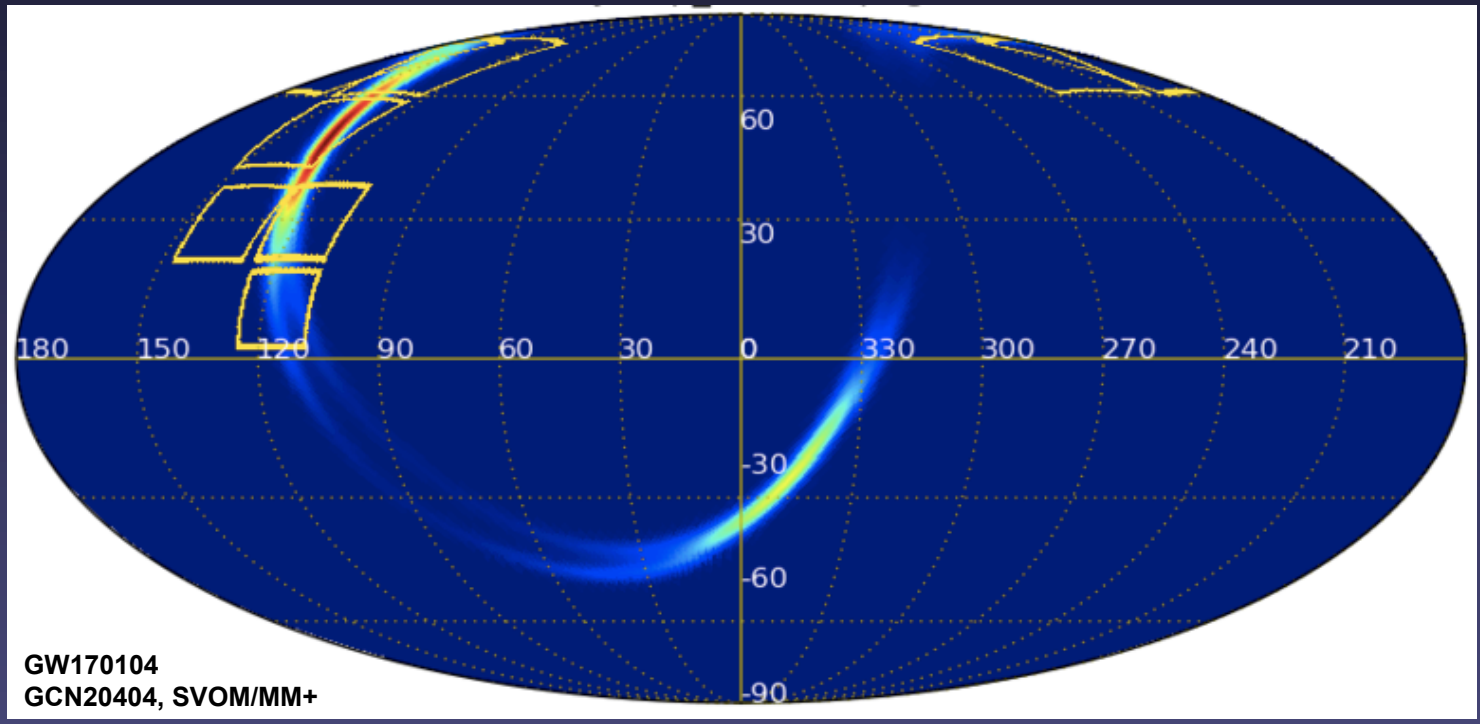



Chaty+01



# Long term follow-up and revisits : for which science ?

***GWs, Neutrinos :*** Early-time follow-up not successful yet ...




**GW170104**
**GCN20404, SVOM/MM+**

- TAToO (Telescope Antares ToO) on-going : TAROT, ROTSE, Swift, ..
- GW ToO programs on 8m-class telescopes already approved !!!!!

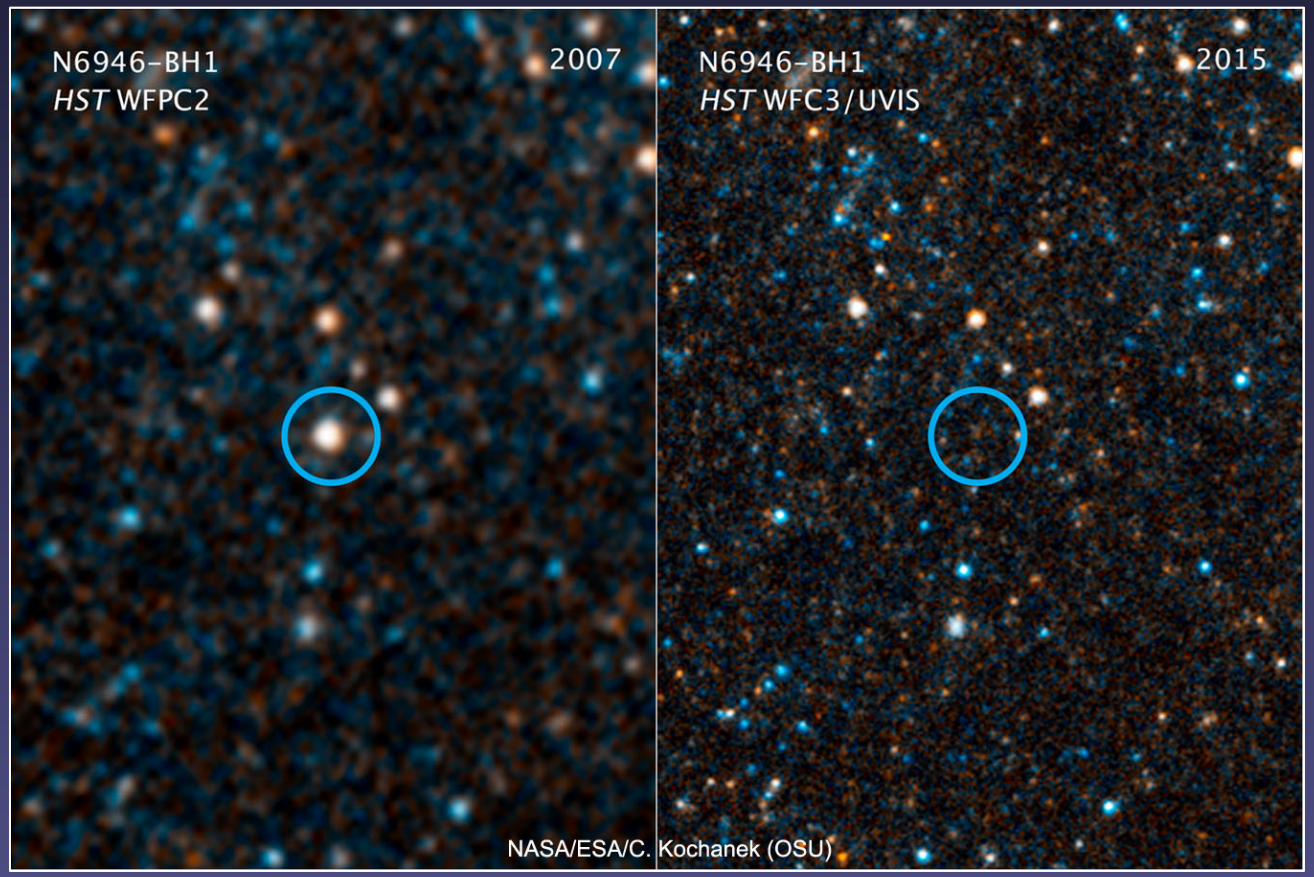
# Long term follow-up and revisits : for which science ?

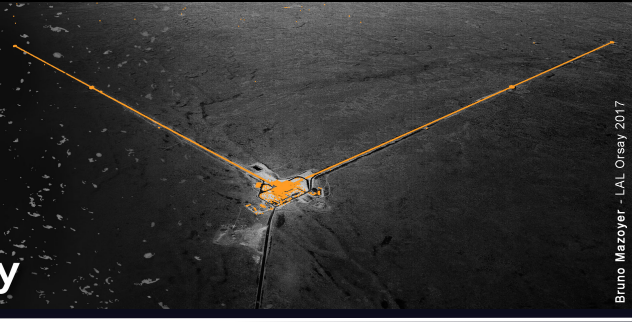
## *Forming BHs in the dark:*

- Search for possible signatures of the recently formed accreting BH

→ Requires X-ray & radio ToOs

(e.g., Mirabel+)







# Long term follow-up and revisits : conclusions

- A large variety of science themes to be covered with the transient sky at ~H2020
- French community highly active in some of them (both galactic and extragal.), but less represented in some key others
- Still some time before next generation of TS survey facilities, but need to react quickly