

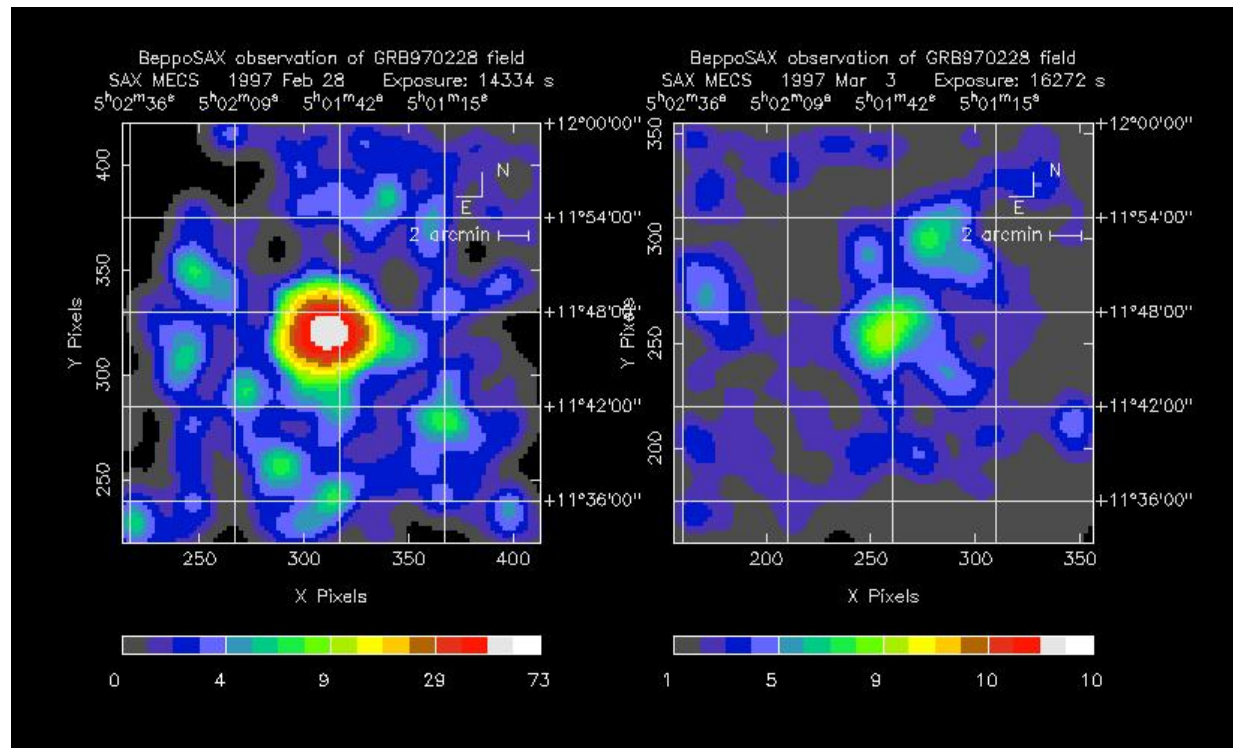
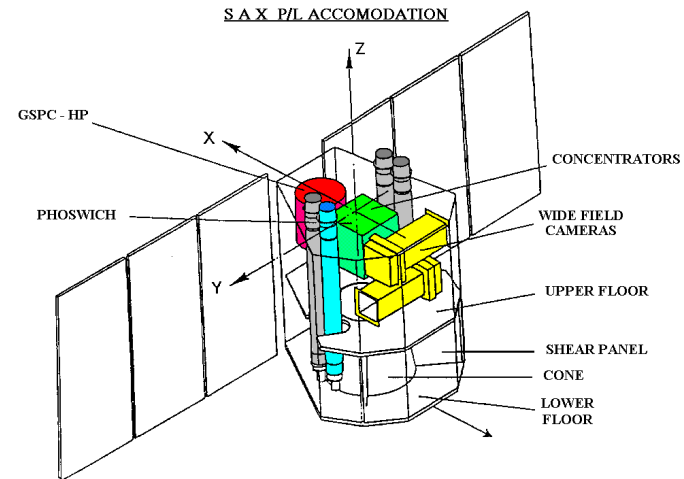


Organisation of the Italian community for the transient sky

Paolo D'Avanzo



The BeppoSAX heritage





Catching Gamma Ray Bursts on the Fly



Selected by NASA on October 1999
launched on November 2004

- Objectives
 - Determine origin of GRBs
 - Use GRBs to probe the early Universe
 - Perform hard X-ray survey
- International collaboration:
 - GSFC: lead institution
 - PSU: lead university partner
 - UK & Italy: key hardware collaborators
 - Spectrum Astro: spacecraft provider



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2017 update

Satellite Instruments: OK

Fully funded until (at least) 2019

Orbit stable until (at least) 2025

Italian *Swift* team

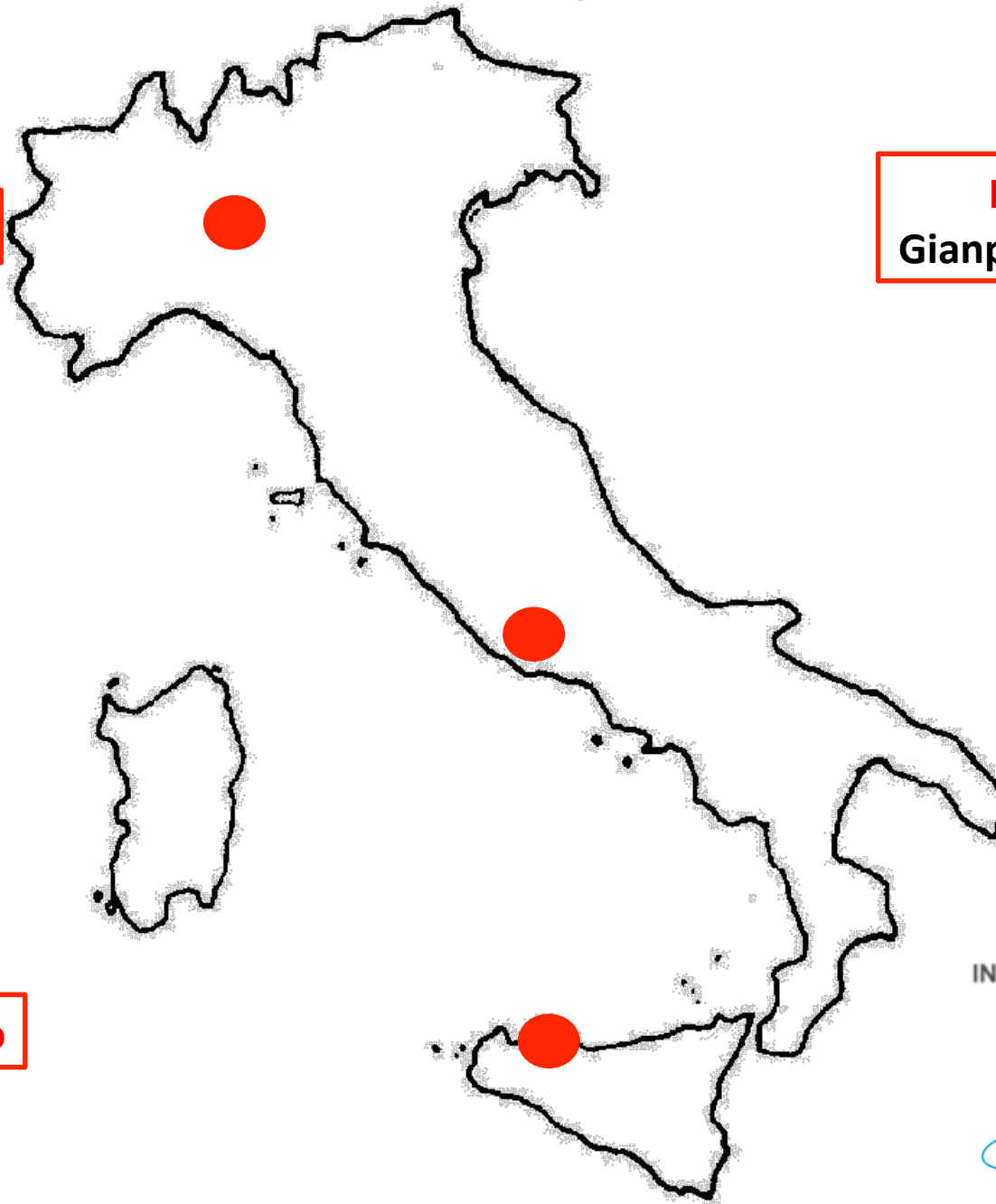
INAF-IASF Milano

INAF-OA Brera
Gianpiero Tagliaferri (PI)

INAF-OA Roma

ASI-ASDC

INAF-IASF Palermo



Italian
National
Institute for
Astrophysics

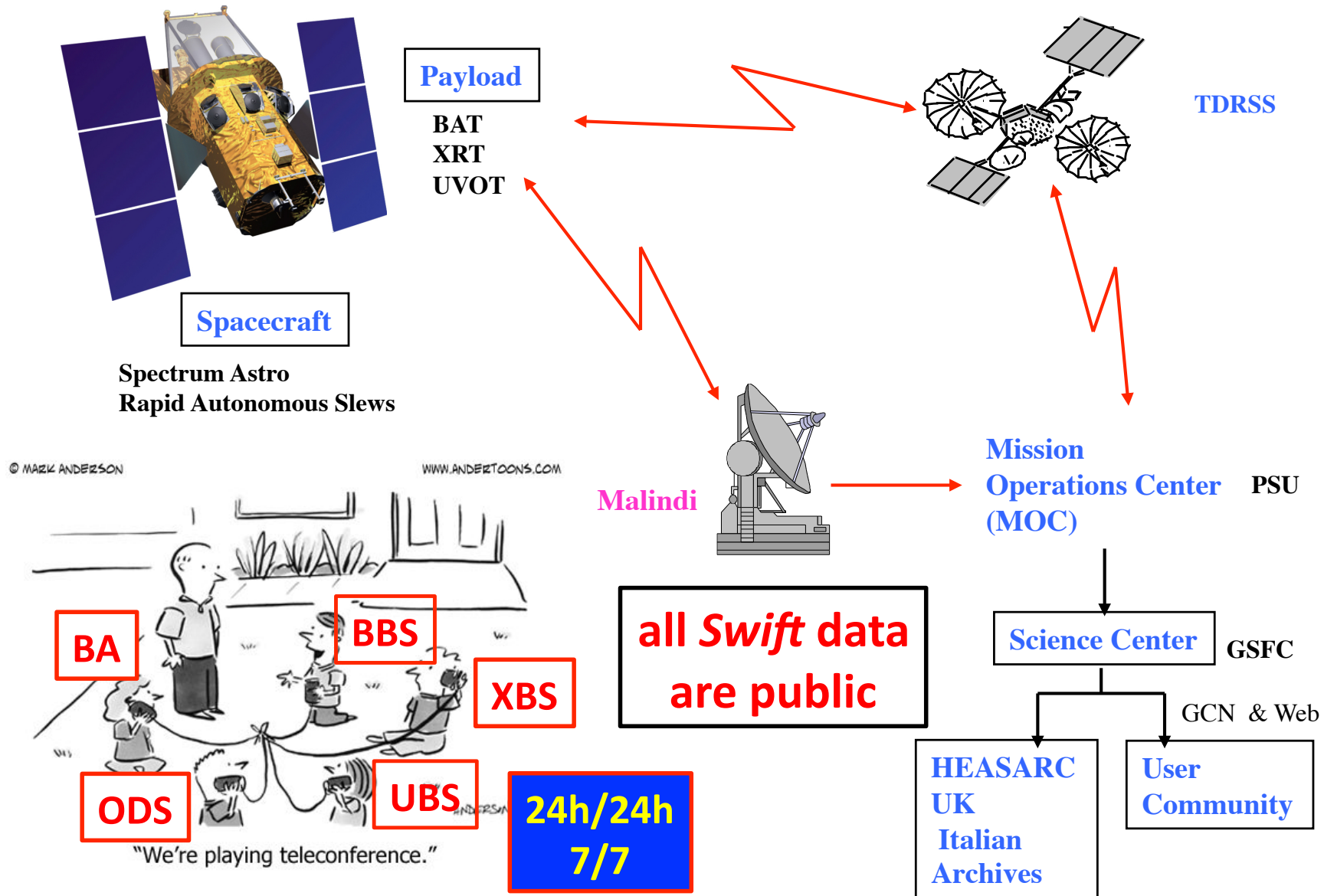


Italian Space
Agency

Swift: Italian Contribution & Responsibility

1. Mirror Module of the XRT Telescope (OA Brera)
2. Malindi Ground Station (ASI)
3. XRT Analysis software & Italian Swift archive (ASI/ASDC)
4. XRT calibration, & operation support (OA Brera + IASF Palermo + ASI/ASDC)
5. BA/XBS responsibility (Italian team), two weeks/month, 24/24 (OA Brera + IASF Palermo + ASI/ASDC)
 - 2004: 4 research staff + 7 postdocs (ASI contracts)
 - 2017: 1 research staff + 3 postdocs (ASI contracts)
6. ODS/BA/XBS support to the MOC
 - 1 postdoc @ PSU, USA (ASI contract + US) -> 2Ms/yr of XRT time granted to the Italian community

Swift



GRB follow up



GRB follow up



- Large involvement of the national GRB community (beyond the Swift team) for the GRB follow-up activities
- Healthy synergy with **theoretical** groups
- Collaboration with foreign groups (**DK, FR, ES, UK, SI, USA**)

GRB follow-up cover almost every science case

- Afterglow physics
- LGRBs & SNe
- High-z GRBs
- GRBs as cosmic probes
- Jet-breaks
- SGRBs & macronovae
- Host galaxies

- Italian PI or significant Italian participation as proposal co-Is
- Rotating Piship
- Typically “young” (> 3-5 yrs from PhD) postdocs as PIs

Main Follow-up Proposals

- Prompt emission and early afterglows of GRBs (A. Melandri et al., **REM**)
- Exploring the Universe with GRB afterglows (V. D'Elia et al., **TNG**)
- Probing the Epoch of reionization with GRBs (A. Rossi et al., **LBT**)
- Origin, progenitors and remnants of the powerful supernovae associated with GRBs (E. Pian et al., **VLT/FORS2**)
- The Swift GRB afterglow legacy survey: probing the hearts of star-forming galaxies through cosmic time (J. Fynbo et al., **VLT/X-shooter**)
- Radio follow-up of the brightest GRBs detected by Swift (G. Ghirlanda et al., **Medicina, EVN**)
- Studies of long GRB host-galaxies (S. Vergani et al., **OPTICON, TNG, VLT & GTC**)
- Studies of short GRB host galaxies (PI: Paolo D'Avanzo, **LBT**)
- Short GRBs & Macronovae (P. D'Avanzo, **VLT**)
- Hunting for jet-breaks in short GRBs (P. D'Avanzo, **XMM**)

Beyond GRBs

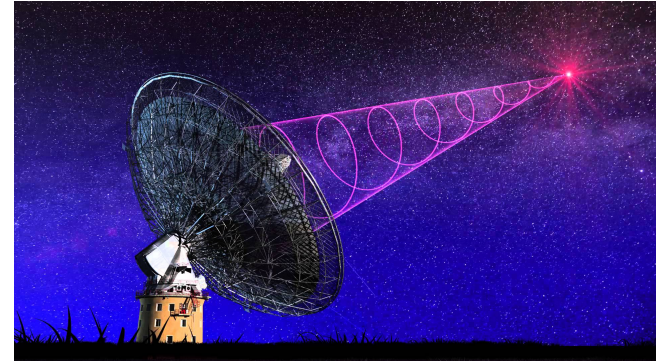
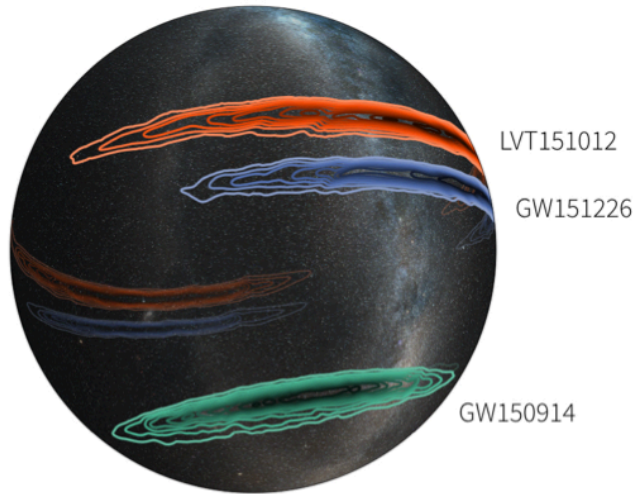
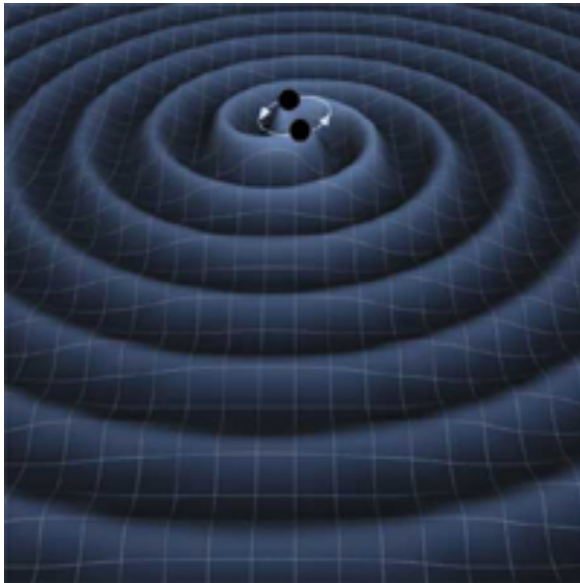
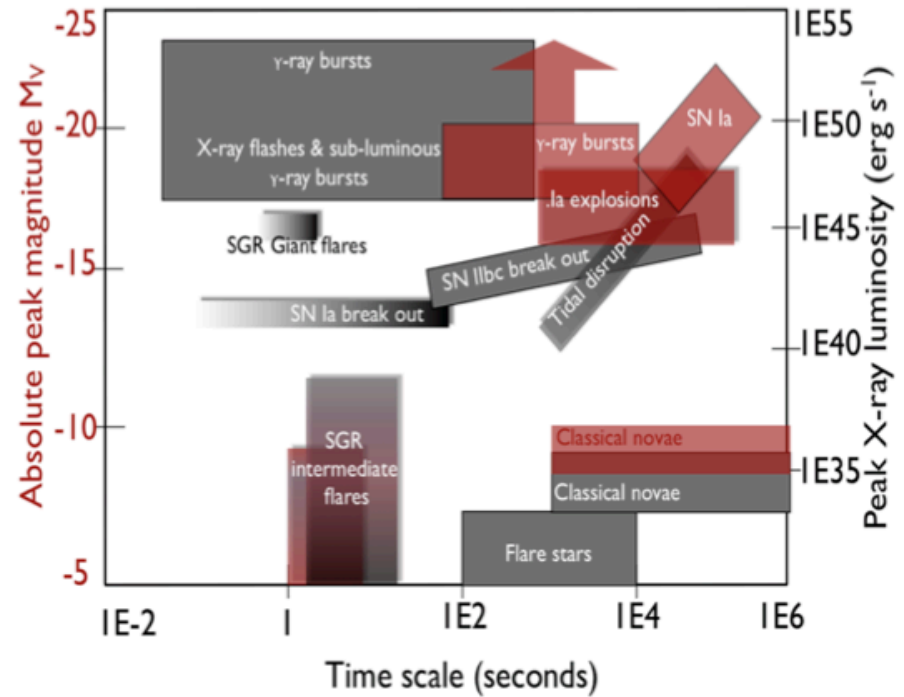
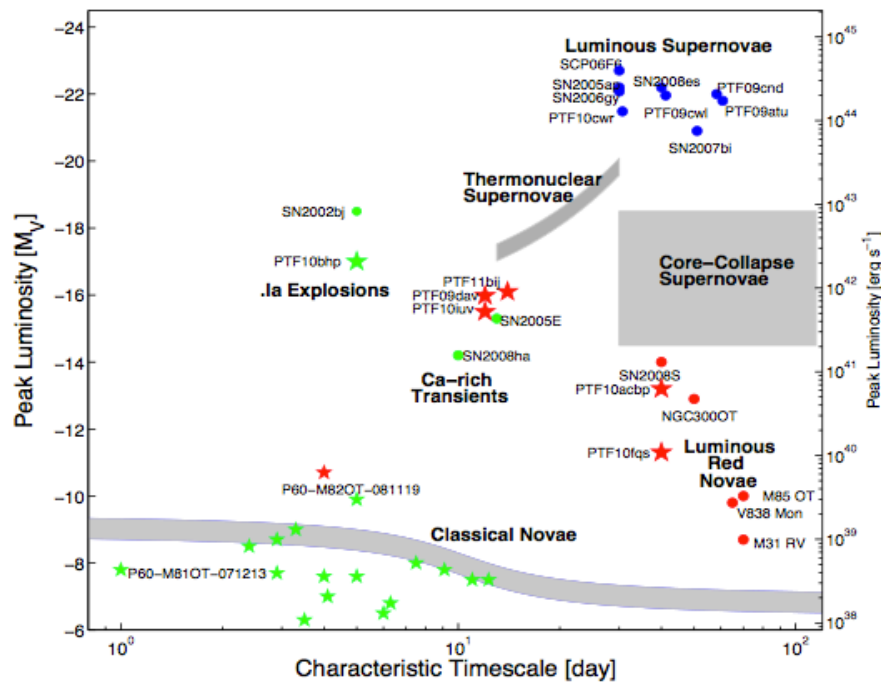
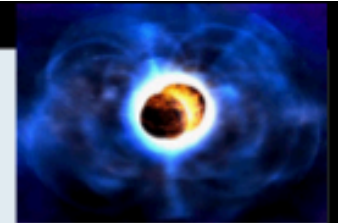


Image credit: LIGO/L. Singer/A. Mellingner



LIGO/Virgo collaboration



In 2012, **LVC** agreed policy on releasing GW alerts

*“Initially, **triggers** (partially-validated event candidates) will be **shared promptly only with astronomy partners who have signed a Memorandum of Understanding (MoU)** with LVC involving an agreement on deliverables, publication policies, confidentiality, and reporting.*

***After four GW events have been published**, further event candidates with high confidence will be **shared immediately with the entire astronomy community**, while lower-significance candidates will continue to be shared promptly only with partners who have signed an MoU.”*

GRAWITA: GRAvitational Wave Inaf TeAm

05-12-2013...Monte Mario meeting INAF – LVC
2014.....MoU INAF-LVC signed / early Team submitted PRIN INAF
2014.....VST as ToO facility
2015.....Early activities Proposals / fund raising (Unsolicited / Premiale)
07-07-2015...Unsolicited project “Gravitational Wave Astronomy ...” approved
15-09-2015... First operational meeting
17-09-2015... VST observations of GW150914
01-2016..... PRIN MIUR 2015 (INAF-RU) *submitted*
03-2016..... Joint paper with LVC

INAF OA Roma: E.Brocato (P.I.), L. Pulone, V.Testa, G. Iannicola, L. Stella, M. Lisi, S. Piranomonte, S. Ascenzi, G. Israel, P. Casella

INAF OA Napoli: A. Grado, F. Getman, L. Limatola, M. della Valle, M Botticella, M. Capaccioli

INAF IASF Bologna: L. Nicastro, E. Palazzi, L. Amati, L. Masetti, D. Vergani, A. Bulgarelli, G. De Cesare, A. Rossi

INAF OA Milano: S. Campana, S. Covino, G. Tagliaferri, P. D’Avanzo, A. Melandri

INAF OA Padova: E. Cappellaro, L. Tomasella, S. Yang

University of Urbino: M. Branchesi, G. Stratta, G. Greco

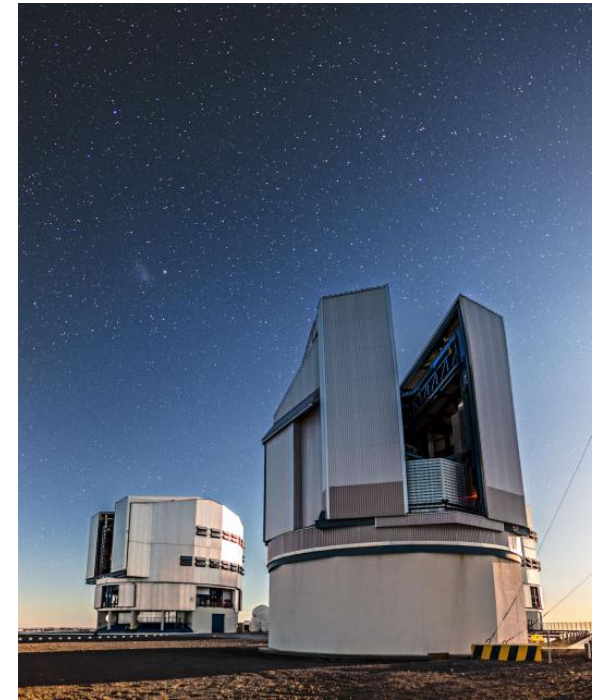
SNS Pisa: E. Pian, A. Stameria, F. Longo, M. Razzano, G. Pivato, B. Patricelli, G. Cella

ASI Science Data Center: L.A. Antonelli, G. Giuffrida, S. Marinoni, P. Marrese, V. D’Elia

Main facilities

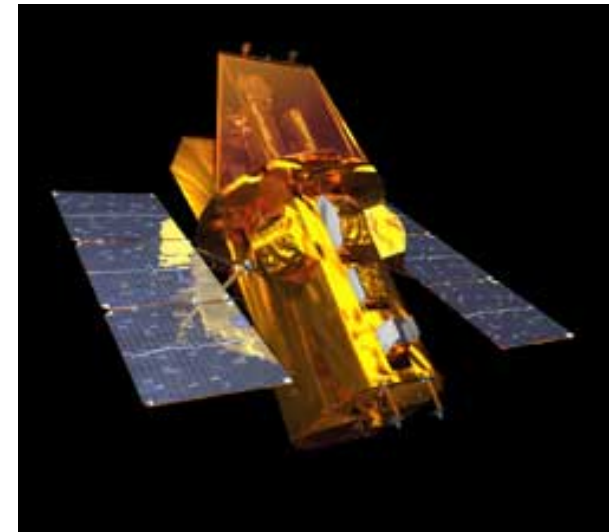
VLT Survey Telescope (VST)

- 2.6m
- 1 deg² FoV
- optical multiband imaging
- ToO mode



Swift

- BAT: 15-150 keV, 2 sr FoV
- XRT: 0.2-10 keV, 0.15 deg² FoV
- UVOT: UV/opt imaging; 0.08 deg² FoV
- ToO mode



GRAWITA: GRAVitational Wave Inaf TeAm

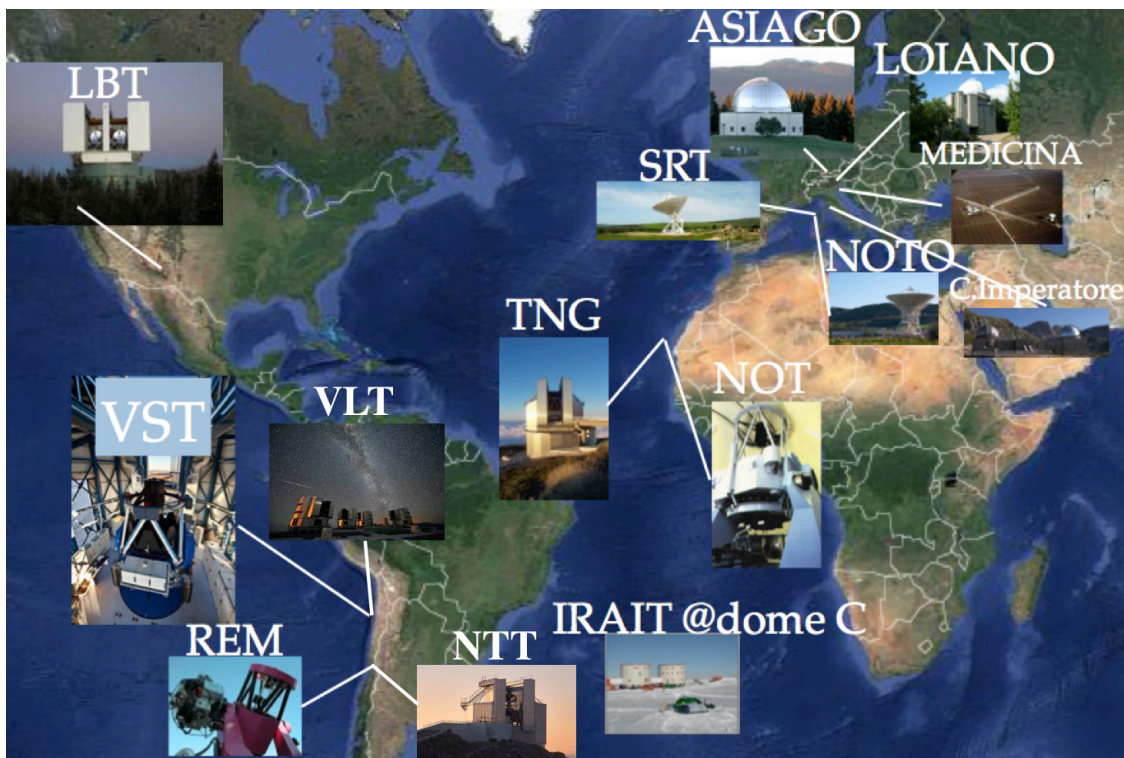
Multi-wavelength Observing Facilities:

Visible: VST, LBT, TNG, NOT, NTT, VLT + small telescopes [REM, 1.82m (Asiago, IT), 1.52m (Loiano, IT), 0.9m C. Imperatore, IT)] + HST (coll.)

Near-mid IR: 1.1m AZT-24 (C. Imperatore, IT), IRAIT (Antarctica)

Radio: 64m SRT (Cagliari, IT), 2x 32m (Medicina and Noto, IT)

High energy (coll.): space(coll. Swift, Chandra) + ground (coll. MAGIC, future ASTRI, CTA)

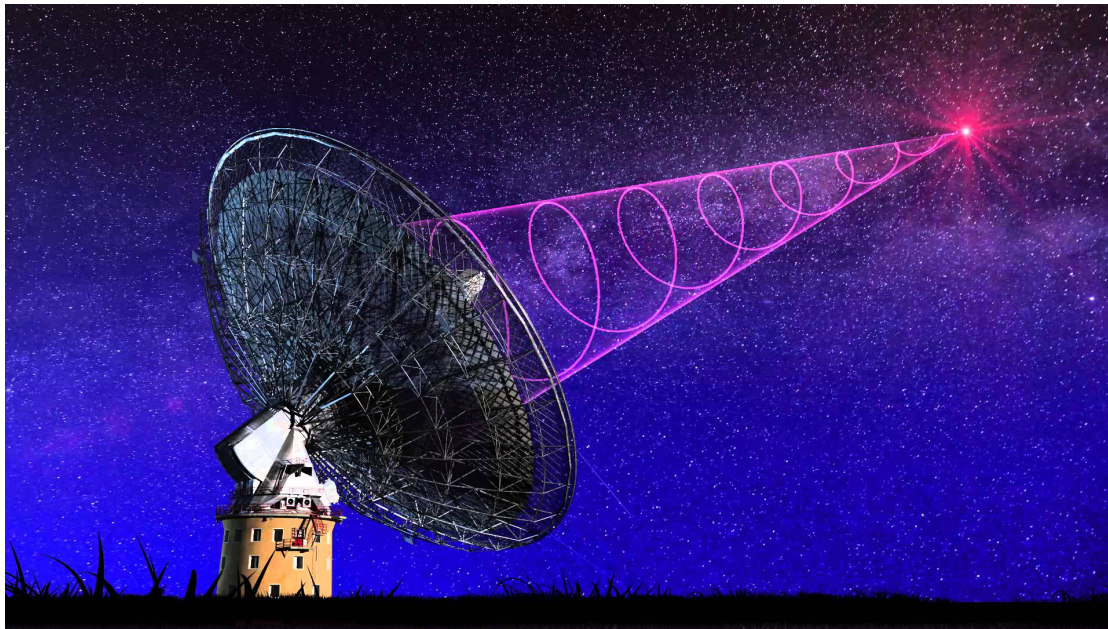


Telescope	Proposal approved	Proposal Submitted PI
VST	ToO 30h	Cappellaro \Grado
LBT	ToO 7h	Palazzi
TNG	ToO 12h	Piranomonte
NOT	ToO 8h	Pian
VLT	ToO 20h	Pian
SRT	ToO	Possenti
REM	ToO	Campana
It Antarctic Tel	yes	Col Brocato

Note: HST, VISTA, Swift - proposals accepted with GRAWITA Cols.

courtesy E. Brocato

Fast Radio Bursts follow-up

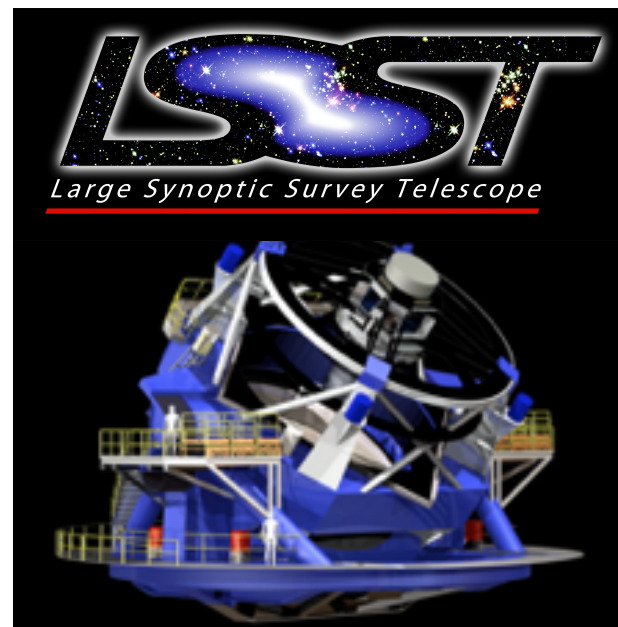


Programs for FRB follow-up @ REM, NOT, VLT
MoU with FRB teams

Towards the Time-Domain Astronomy Era



INAF participates in SKA, LSST and CTA
Involvement of the Italian community of transients (mainly GRB, GW)



Transients classification & characterization: need for optical spectroscopic follow-up

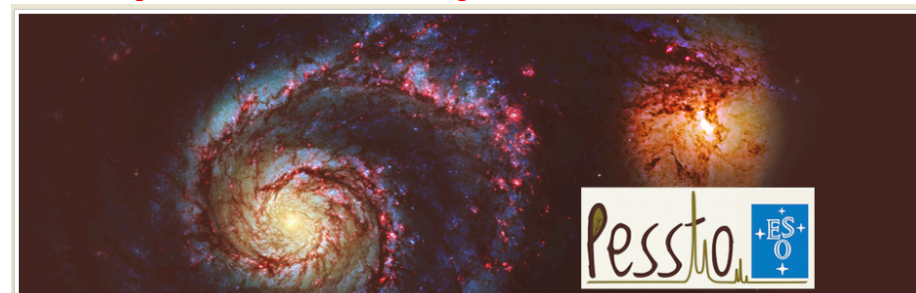
The Italian GRB & GW communities recently
joined ePESSTO :

the extended Public ESO Spectroscopic
Survey of Transient Objects

Spectroscopy and photometry
SOFOSC@NTT over the period **2017-19**
P.I.: S. Smartt (UK)

Scientific targets:

- Nuclear Transients
- Superluminous supernovae and the most massive stars
- Unexplained transients in remote locations
- Gamma-ray bursts
- Gravitational wave and neutrino sources



1160 transients classified by PESSTO so far
253 transients are being followed by
PESSTO



European Organisation for Astronomical Research in the Southern Hemisphere

OBSERVING PROGRAMMES OFFICE • Karl-Schwarzschild-Straße 2 • D-85748 Garching bei München • e-mail: ope@eso.org • Tel.: +49 89 320 06473

APPLICATION FOR OBSERVING TIME LARGE PROGRAMME PERIOD: **99A**

Important Notice:

By submitting this proposal, the PI takes full responsibility for the content of the proposal, in particular with regard to the names of CoIs and the agreement to act according to the ESO policy and regulations, should observing time be granted.

1. Title		Category: D-5							
ePESSTO: the extended Public ESO Spectroscopic Survey of Transient Objects									
2. Abstract / Total Time Requested									
Total Amount of Time: 200 nights VM, 0 hours SM		Total Number of Semesters: 4							
<p>Novel wide-field synoptic surveys of the sky, combined with multi-wavelength and multi-messenger experiments, mean we have now entered a golden age in transient astronomy. PESSTO has changed the way such transient science is carried out within ESO, and has prepared us for these new surveys by gathering the ESO supernova community into one coherent team, making the NTT a key global facility (50+ papers). We have provided legacy datasets for the most luminous supernovae, unusual tidal disruption flares, faint transients in remote halo locations, and quantified how interaction powers the fastest and most unusual supernovae. The SOXS spectrometer has now been selected by ESO to replace EFOSC2 and SOFI in 2020, dedicating the NTT to time-domain astronomy in the next decade. We now propose 'extended'-PESSTO (ePESSTO), building on the success of our PESSTO consortium and bridging the gap to SOXS. We will broaden the science to include of GRBs, gravitational wave sources, and high energy neutrinos, and will focus on the most exciting new transient populations now being discovered. The new all-sky surveys of Gaia, ASASSN, ATLAS and the upcoming Pan-STARRS2 and Zwicky Transient Facility demand extensive spectroscopic follow-up which we, the ESO community, are well placed to lead. We will continue to make all reduced data public as we do for PESSTO.</p>									
3. Run	Period	Instrument	Time	Month	Moon	Seeing	Sky	Mode	Type
A	99	SOFOSC	10n=2x3+4	apr	g	n	THN	v	
B	99	SOFOSC	10n=2x3+4	may	g	n	THN	v	

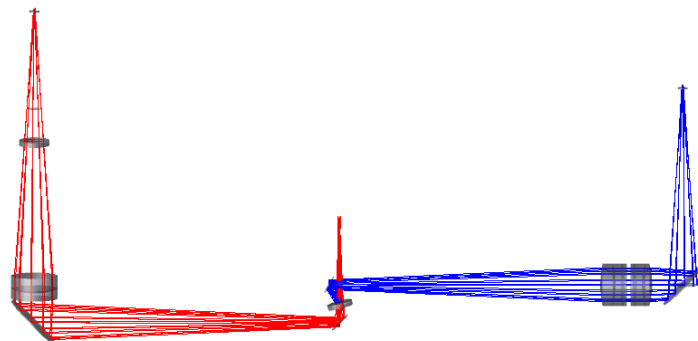
courtesy E. Brocato

Transients classification & characterization: SOXS



What is SOXS?

- ESO call for new instruments at NTT (06/2014)
- Proposal submission by our consortium (02/2015)
- SOXS selected by ESO (05/2015) out of 19
- SOXS -> Son Of X-Shooter
- **A spectroscopic machine for the transient sky**



SOXS@NTT in a nutshell

- Broad band echelle spectrograph 350-1750 nm
- $R \sim 4500$ (3500-6000)
- Two arms (VIS + NIR)
- $S/N \sim 10$ spectrum – 1 h exposure for $R \sim 20.5$ mag
- Acquisition camera to perform ugrizY photometry (3'x3')

Consortium

PI: Sergio Campana (INAF-OAB)



Timeline

- PDR July 2017
- FDR July 2018
- End of Procurement April 2019
- AIT & Test in Europe June 2020
- Instrument in Chile August 2020
- End of Commissioning December 2020

180n/yr for (at least) 5 years

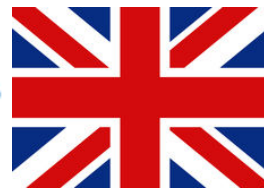
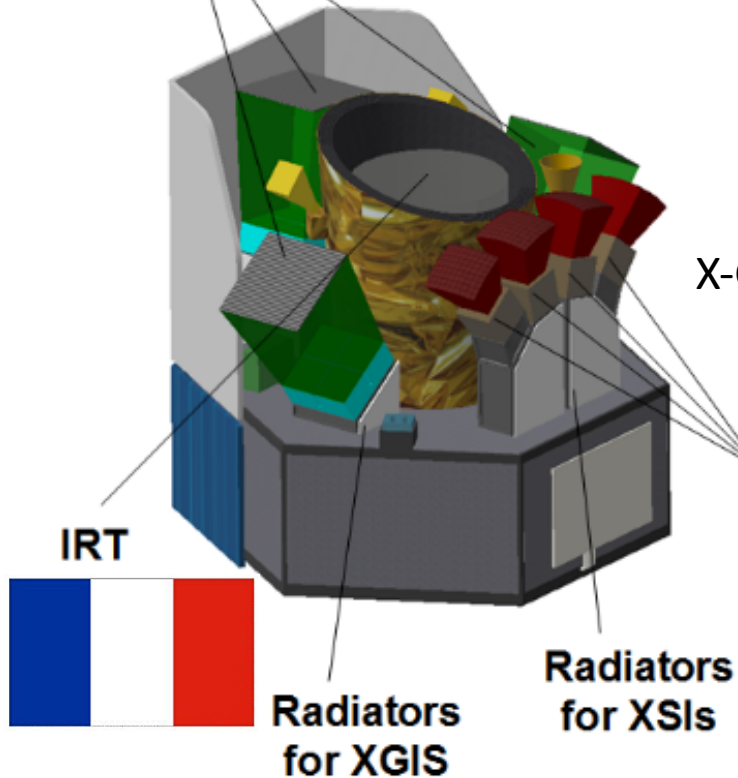
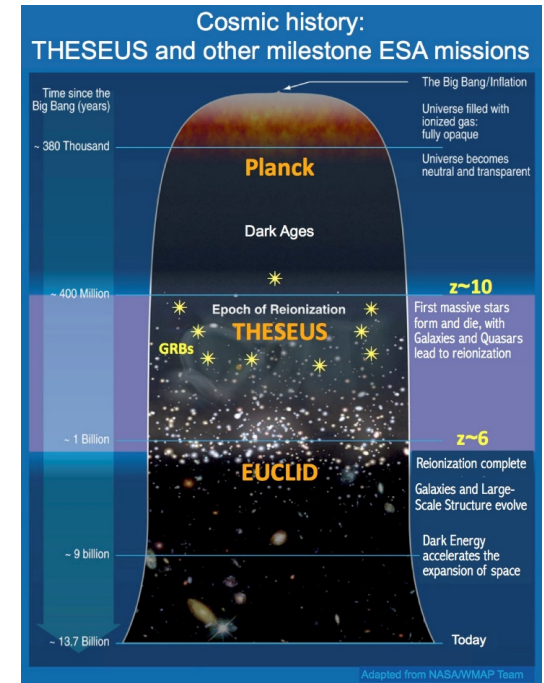
theseus

TRANSIENT HIGH ENERGY SKY AND EARLY UNIVERSE SURVEYOR



XGISs

ESA M5 call (2028)
PI: Lorenzo Amati (INAF)



Soft X-ray Imager (SXI, 0.3-6 keV)
Infrared Telescope (IRT, 0.7 – 1.8 μm)
X-Gamma rays Imaging Spectrometer (XGIS, 2 keV – 20 MeV)

