

THESEUS

Transient High-Energy Sky and Early Universe Surveyor



L. Amati (INAF OAS), RSN4 meeting – 22 November 2022

- 2018-2021: ESA PHASE A STUDY (2018-2021) AS M5 CANDIDATE
- 2022: SELECTED FOR ESA PHASE-0 STUDY IN M7 SELECTION PROCESS
- M7 TIMELINE: PHASE-0/ A (2023-2025), LAUNCH 2037

Lead Proposer: L. Amati (INAF – OAS Bologna, Italy)

Coordinators: P. O'Brien (Un. Leicester, UK), D. Gotz (CEA-Paris, France), A. Santangelo (Un. Tuebingen, D), E. Bozzo (Un. Genève, CH)

Payload consortium: Italy, UK, France, Germany, Switzerland, Spain, Poland, Denmark, Belgium, Czech Republic, Slovenia, Ireland, The Netherlands, Norway

Amati et al. 2018 (Adv.Sp.Res., arXiv:1710.04638)
Stratta et al. 2018 (Adv.Sp.Res., arXiv:1712.08153)
Articles for SPIE 2020 and Exp..Astr. (all on arXiv)
<http://www.isdc.unige.ch/theseus>

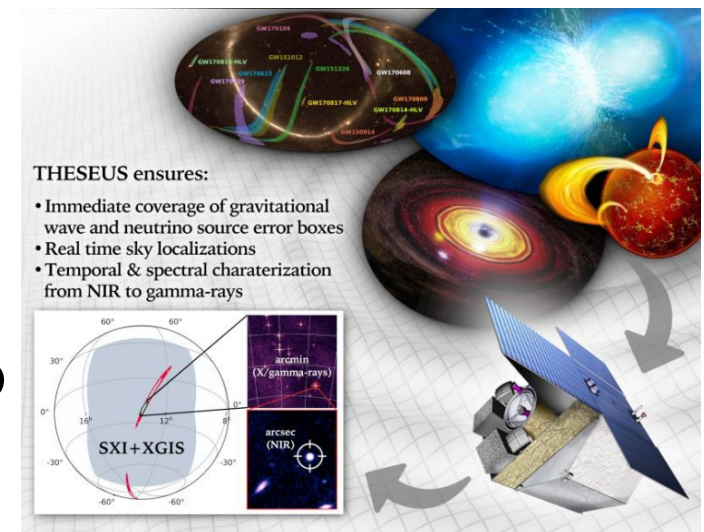
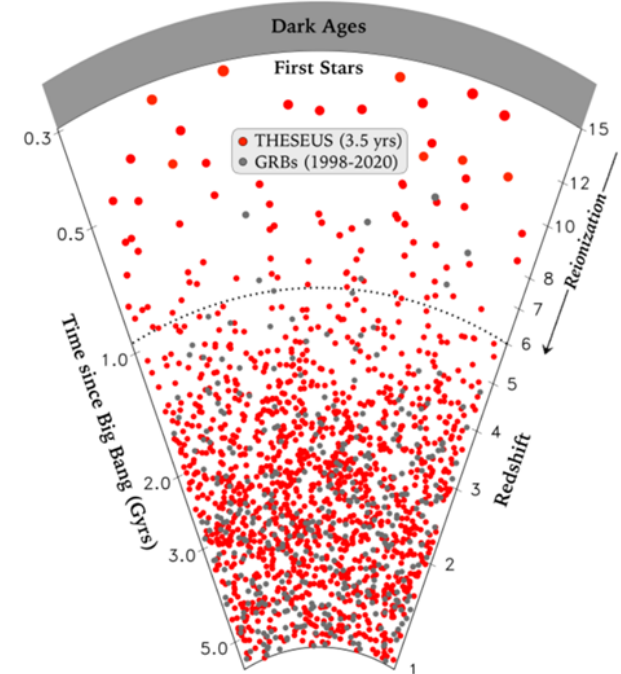


THESEUS **Core Science** pillars:

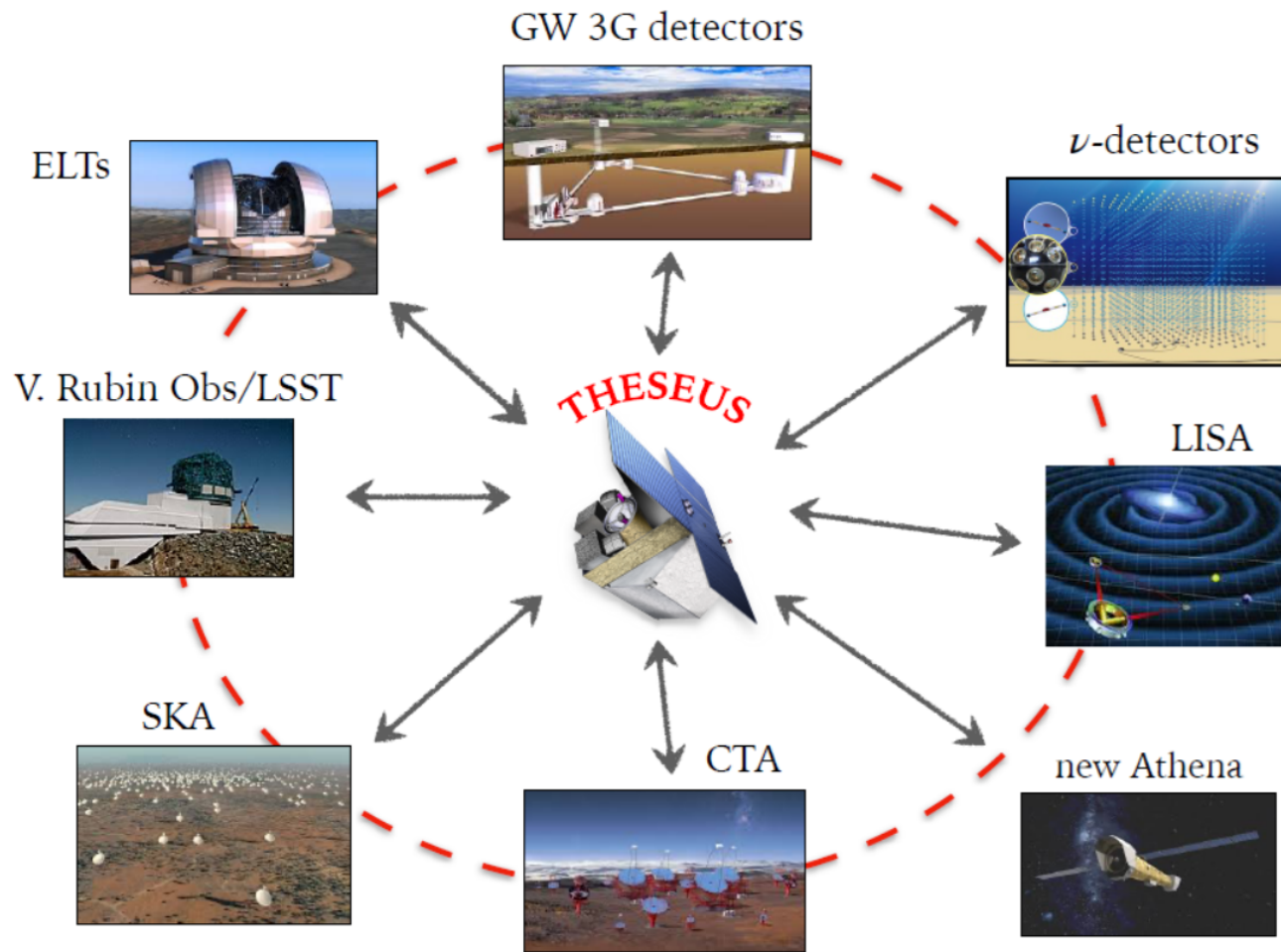
- Probe the **early Universe (first stars, first galaxies, cosmic reionization)**, by unveiling and exploiting the population of high redshift GRBs.
- Provide a **fundamental contribution to multi-messenger and time domain astrophysics** in the late 2030s

THESEUS **Observatory Science** includes:


- Study of thousands of faint to bright X-ray sources by exploiting the **simultaneous broad band X-ray and NIR observations**
- Provide a **flexible follow-up observatory** for fast transient events with multi-wavelength ToO capabilities and **GO programmes**

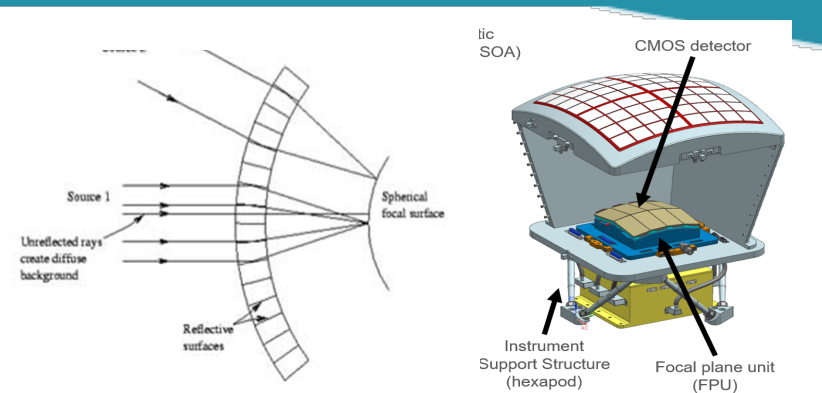



THESEUS CRUCIAL SYNERGIES IN THE LATE '30s

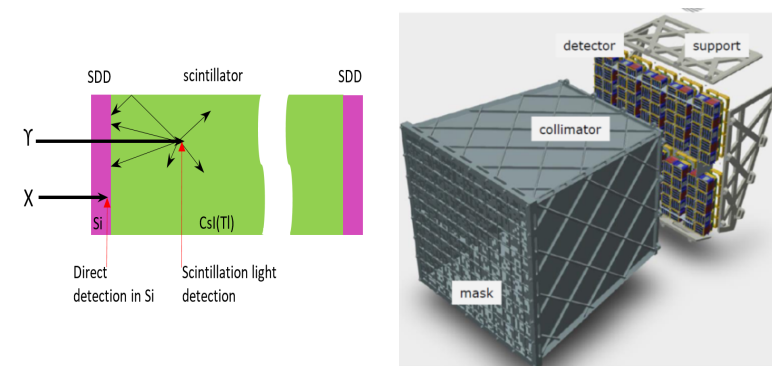



The «M7» timeline will allow to widely broaden the mission scientific impact by taking advantage of the perfectly matched synergies with major facilities coming fully operative in the 2030s (e.g., 3G GW detectors, Athena)

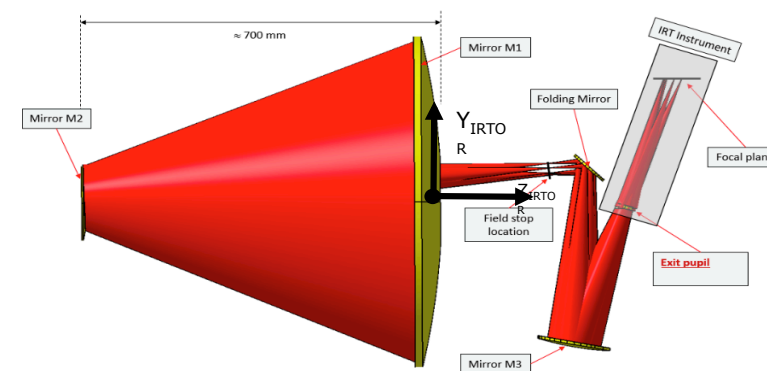
❑ **Soft X-ray Imager (SXI):** a set of two sensitive lobster-eye telescopes observing in 0.3 - 5 keV band, total FOV of ~ 0.5 sr with source location accuracy $< 2'$ 



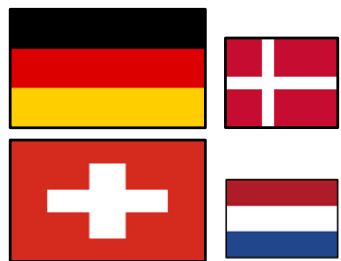
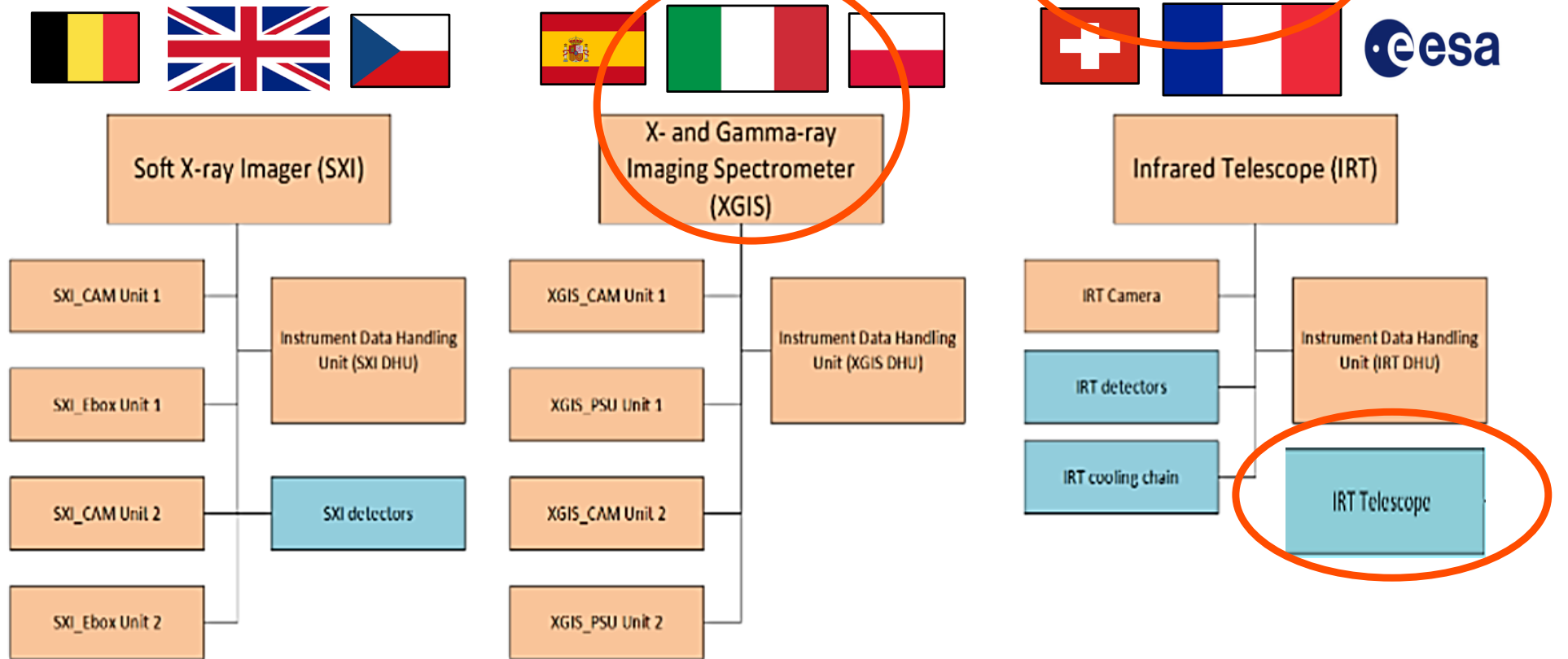
❑ **X-Gamma rays Imaging Spectrometer (XGIS):** 2 coded-mask X-gamma ray cameras using Silicon drift detectors coupled with CsI crystal scintillator bars observing in 2 keV - 10 MeV band, a FOV of > 2 sr, overlapping the SXI, with $< 15'$ GRB location accuracy 



❑ **InfraRed Telescope (IRT):** a 0.7m class IR telescope observing in the 0.7 - 1.8 μ m band, providing a $15' \times 15'$ FOV, with both imaging and moderate resolution spectroscopy capabilities 



THESEUS consortium responsibilities (Lead: ITALY)



Instruments Data Handling Units



Science Data Centre



Main ground station (ASI/Malindi)



The Leading Italian contribution to THESEUS

M5 Phase A supported by ASI & INAF (+ AHEAD2020, ESA/NPMC)

- **Consortium coordination:** INAF/ASI (Lead Proposer, project office)
- **XGIS PI:** INAF (PI; OAS, IASF-MI, IAPS, IASF-PA, ...), **Universities** (Politecnico Milano, Univ. Pavia, Univ. Ferrara, Univ. Udine), **FBK** Trento
- **Trigger Broadcasting Unit (M5):** INAF, **GPAP** Brescia
- **IRT optical assembly (M7):** INAF (Brera, OAS, ...), **Media Lario**, ...
- **Malindi ground station:** ASI (in-kind contribution)
- **Industries involved:** **OHB-I**, **GPAP** (contrib. XGIS and TBU studies); **TAS-I** (M5 ESA prime), **Media Lario** (interest in IRT optics for M7)
- **Science:** INAF (Lead Scientist; OAS, IASF-MI, Oss. Brera, IAPS, IASF-PA, Oss. Napoli, Oss. Roma, ...), **Universities** (e.g., Univ. Ferrara, Pol. Milano, SNS Pisa, Univ. Federico II Napoli, Univ. Urbino, ...), **INFN** (Fe, Ts, Na, ...)

Great heritage and leadership in the main scientific fields and key enabling technologies



Team Summary

15. Personale INAF coinvolto

Numero di partecipanti INAF al progetto: 73

Struttura	Nfte	N0	TI 21	TI 22	TI 23	TD 21	TD 22	TD 23	Nex	Extra
IAPS ROMA	1	5	0.10	0.10	0.10	0.00	0.00	0.00	1	0.20
IASF MILANO	5	5	0.60	0.70	0.70	0.00	0.00	0.00	2	0.40
O.A. BRERA	4	4	0.30	0.20	0.20	0.05	0.05	0.05	1	0.10
OAS BOLOGNA	14	11	2.30	2.35	2.30	0.30	0.60	0.60	2	0.30
O.A. CAGLIARI	0	1	0.00	0.00	0.00	0	0	0	1	0.10
O.A. PADOVA	2	0	0.30	0.30	0.30	0	0	0	0	0.00
IASF PALERMO	7	1	0.60	0.30	0.30	0.00	0.00	0.00	0	0.00
O.A. CAPODIMONTE	2	2	0.20	0.20	0.20	0	0	0	0	0.00
O.A. TRIESTE	1	2	0.20	0.20	0.20	0	0	0	0	0.00
O.A. ROMA	2	2	0.20	0.20	0.20	0	0	0	0	0.00
IRA BOLOGNA	0	1	0.00	0.00	0.00	0	0	0	0	0.00
O.A. ARCETRI	0	1	0.00	0.00	0.00	0	0	0	1	0.20
Totali	38	35	4.80	4.55	4.50	0.35	0.65	0.65	8	1.30

16. Personale Associato INAF coinvolto

Numero di partecipanti Associati INAF: 9