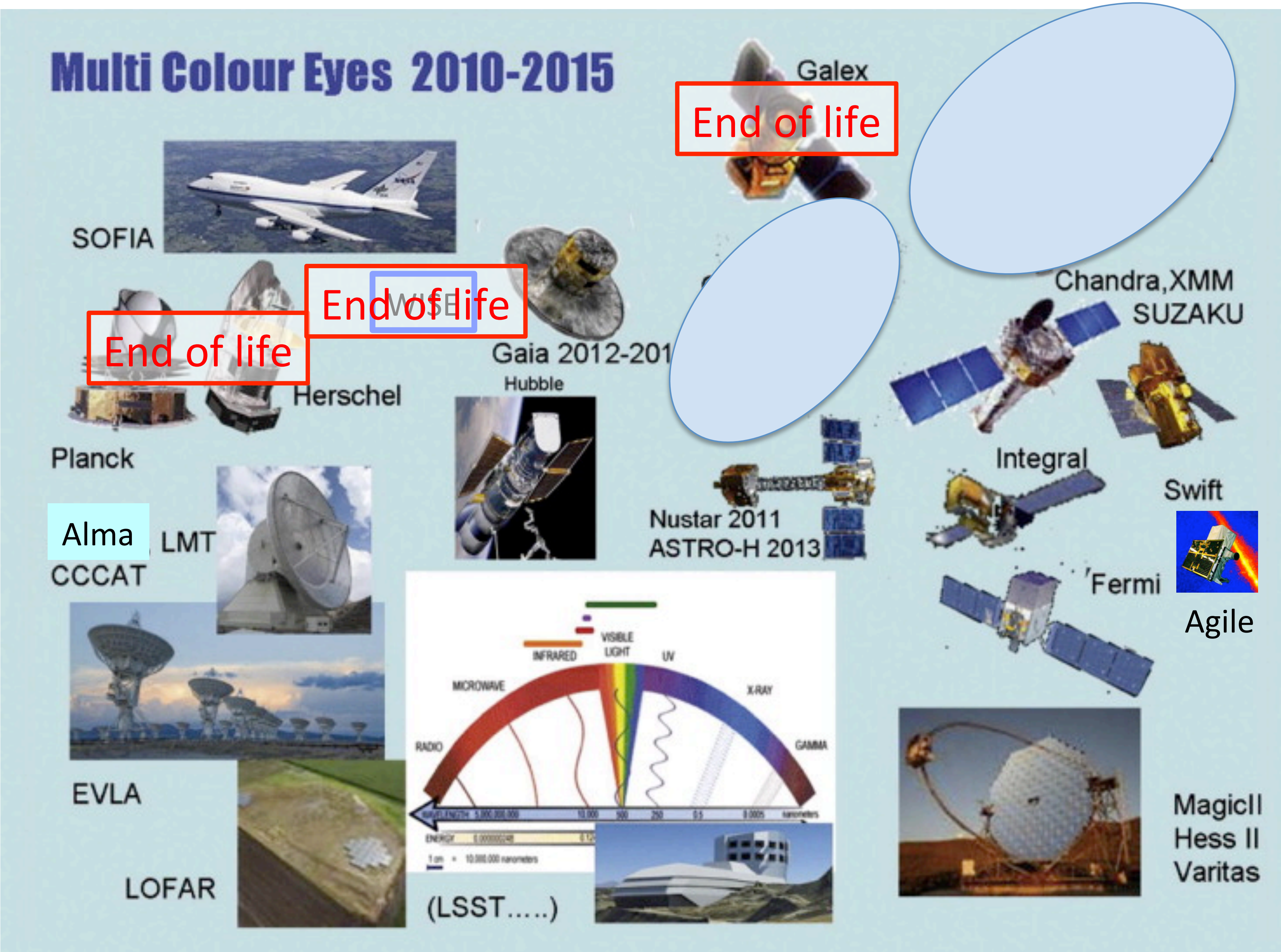

Multi Colour Eyes 2010-2015
Galex
End of life
SOFIA
End of life
WISE
End of life
Gaia 2012-201
Herschel
Hubble
Planck
Chandra,XMM
SUZAKU
Integral
Swift
Alma
LMT
CCCAT
Nustar 2011
ASTRO-H 2013
Fermi
Agile
EVLA
LOFAR
VISIBLE LIGHT
INFRARED
UV
MICROWAVE
X-RAY
RADIO
GAMMA
(LSST.....)
MagicII
Hess II
Varitas

Multi Colour Eyes > 2018
2024-2025
WFIRST
HST
JWST
2018-2020
2015-2016
Chandra
XMM??
e-Rosita
ASTROSAT
HXMT
SVOM
ATHENA
2021
2028
??
SPICA
2018-2021
Euclid
ESA M2
CHEOPS
Plato
ESA M3
ASTRO-H
??
??
ALMA
LMT
CCAT
INFRARED
VISIBLE LIGHT
UV
MICROWAVE
X-RAY
RADIO
GAMMA
SKA
GBT EVLA
LOFAR
CTA, ACIS
HAWC
ELT, TMT,LSST

Bilancio INAF

- Fondo Funzionamento Ordinario FFO
- Progetti speciali
- Progetti Internazionali

- Progetti Premiali & Premialità

- Progetti da altri enti : ASI Europa

- **Progetti Premiali 2011** (Nota MIUR prot. n. 1807 del 04/10/2012): **€ 10.600.000,00**
- Sensori strategici per LBT € 3.300.000,00
- Strumentazione ultrasensibile per il VLT € 3.400.000,00
- Progetto T-rex tecnologia italiana per E-ELT € 3.900.000,00

Progetti PREMIALI 2012 (Nota MIUR prot. n. 7213 del 28/03/2014): **€ 15.911.343,00**

- T-Rex per E-ELT € 2.800.121,00
- Sensori strategici per LBT € 3.214.060,00
- TECHE.it- Telescopi CHErenkov € 3.055.102,00
- iALMA € 3.536.203,00
- WOW € 3.305.857,00

PREMIALITA' 2013 (decreto MIUR 304 del 09/05/2014) **€ 13.292.958,95 + bando (mai uscito)**

Premialità e bando 2014 ??????????????

CTA

	2010	2011	2012	2013	2014	Totale
Progetto Bandiera "**ASTRI-Astrofisica con specchi a tecnologia replicante**"	€ 3.000.000	€ 2.000.000	€ 1.574.312	€ 1.430.412		€ 8.004.724
Progetto premiale **Teche**			€ 3.055.102			€ 3.055.102
Progetto straordinario MIUR					€852.489	€852.489

Gran Totale 11.900.000

- SKA

2011 € 1.000.000

2012 € 750.000

2013 € 1.250.000

2014 € 1.065.612

Fondi internazionali MIUR

totale 3.065.000

Altri fondi per ska negli anni antecedenti da Fondi Speciali Radioastronomia MIUR

Antenne Medicina Noto SRT

- 2010 2.000.000 manutenzione antenne
- 2011 2.060.000 idem + SRTstrumenti
- 2011 5.000.000 SRT straordinario compl.
- 2013 3.000.000 SRT
- 2014 2.500.000 SRT

- ELT

Contributo per la partecipazione italiana a ELT (fondi internazionali):

Circa 40 milioni di Euro in 10 anni + aumento del 2% annuo della quota di partecipazione per circa ulteriori 10-12 milioni (le quote varano in funzione pil)

2012 6.000.000

2013 3.200.000

2014 2.728.000 + 1.300. 000 (da premialità 2013)

Costo della costruzione strumenti (e predisposizione laboratori etc etc)

Premiale T Rex 2011 3.900.000

Premiale T Rex 2012 2.800.000

Il costo per Inaf (Maori + HIRES è soprattutto in FTE, ci si aspetta una cifra dell'ordine dei 6 - 8 milioni in 10 anni)

N.B: Il costo sostenuto è rimborsato in notti di osservazione

- TNG

Costo 2.400.000 € consolidati negli anni

DA FFO (per il solo 2015 contributo di 400k da Fondi MIUR staordinari)

Strumentazione da FFO e in parte da premiale VLT e Pianeti (WOW)

- LBT

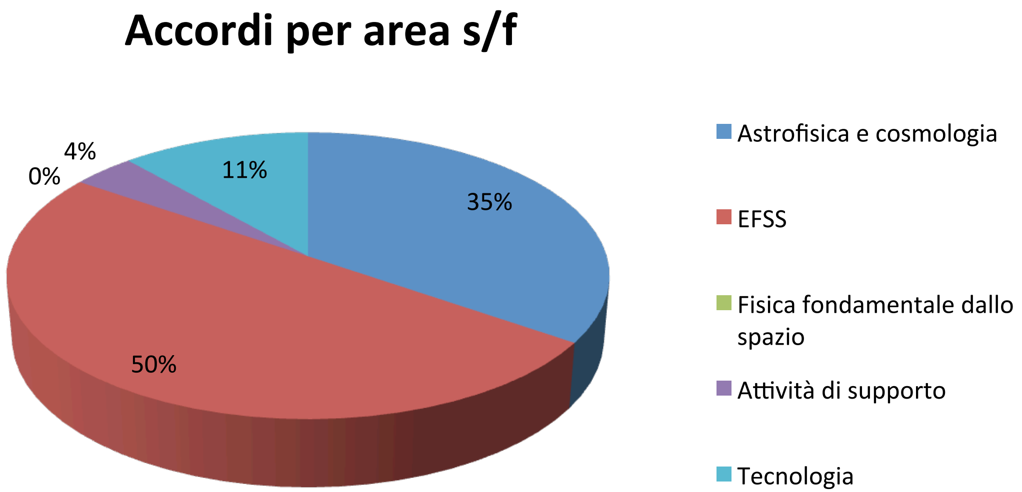
Costo 2.400.000 € consolidati negli anni

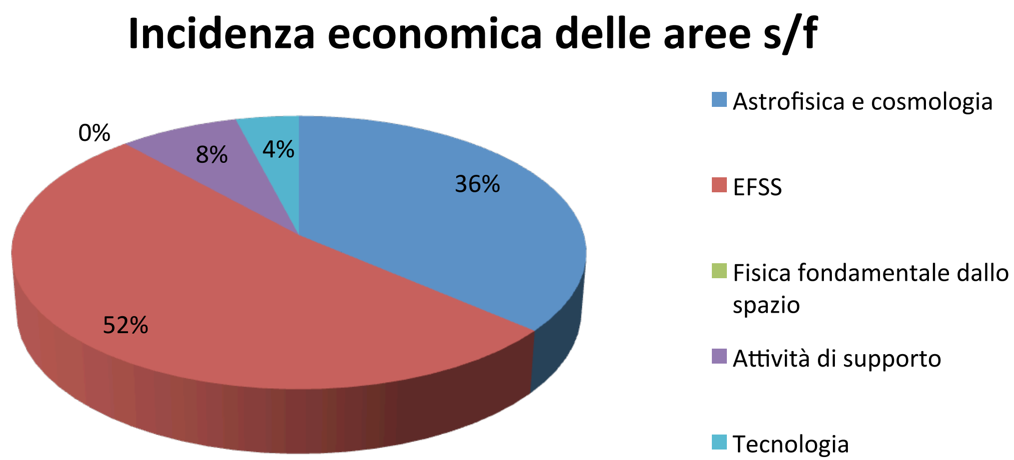
DA FFO (per 2012 2013 contributo del 50% circa da Premiale Sensori Strategici per LBT)

- PROGETTI SPAZIO

Accordi in corso: 26

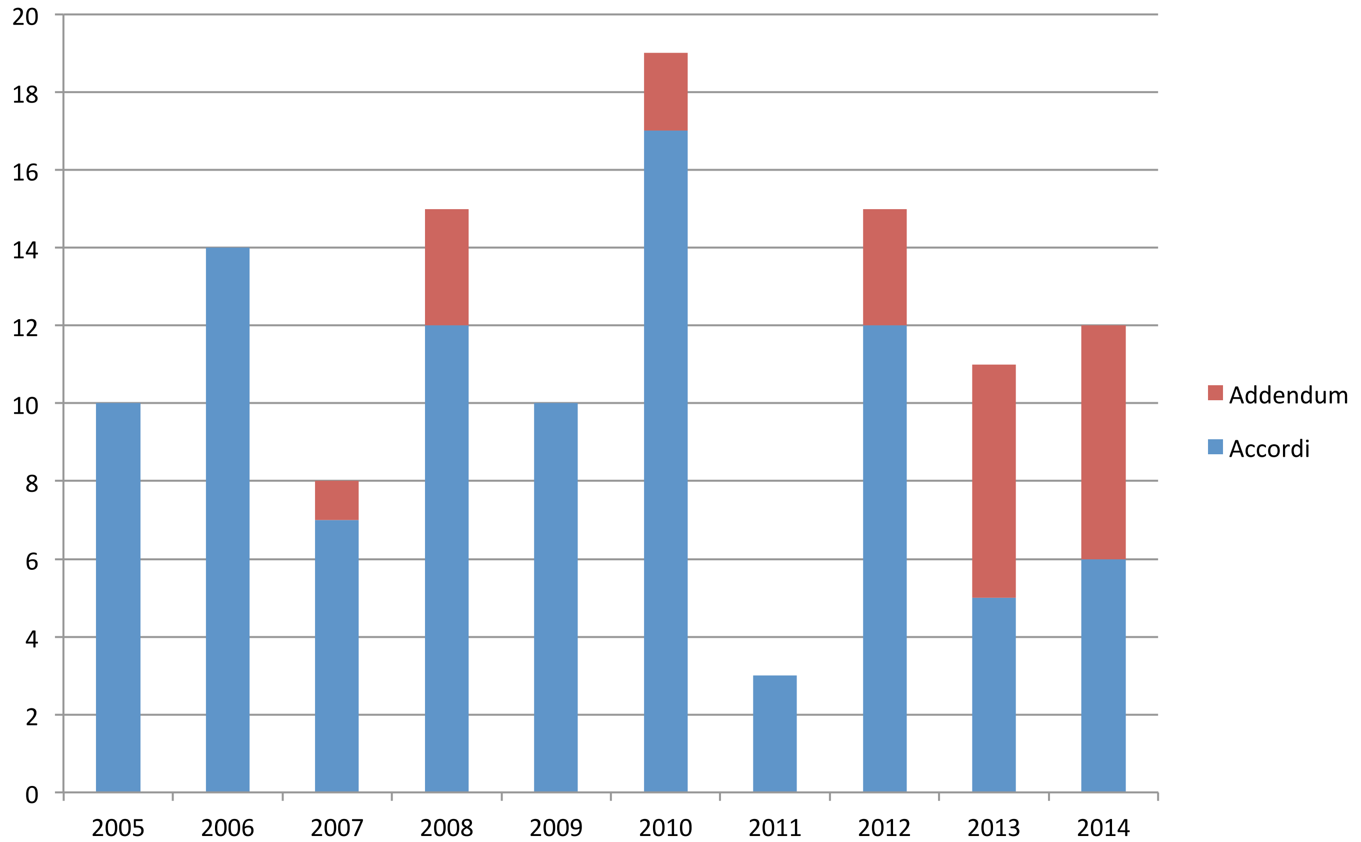
(dati aggiornati al 31/12/2014)





Contratti/accordi conclusi: 68

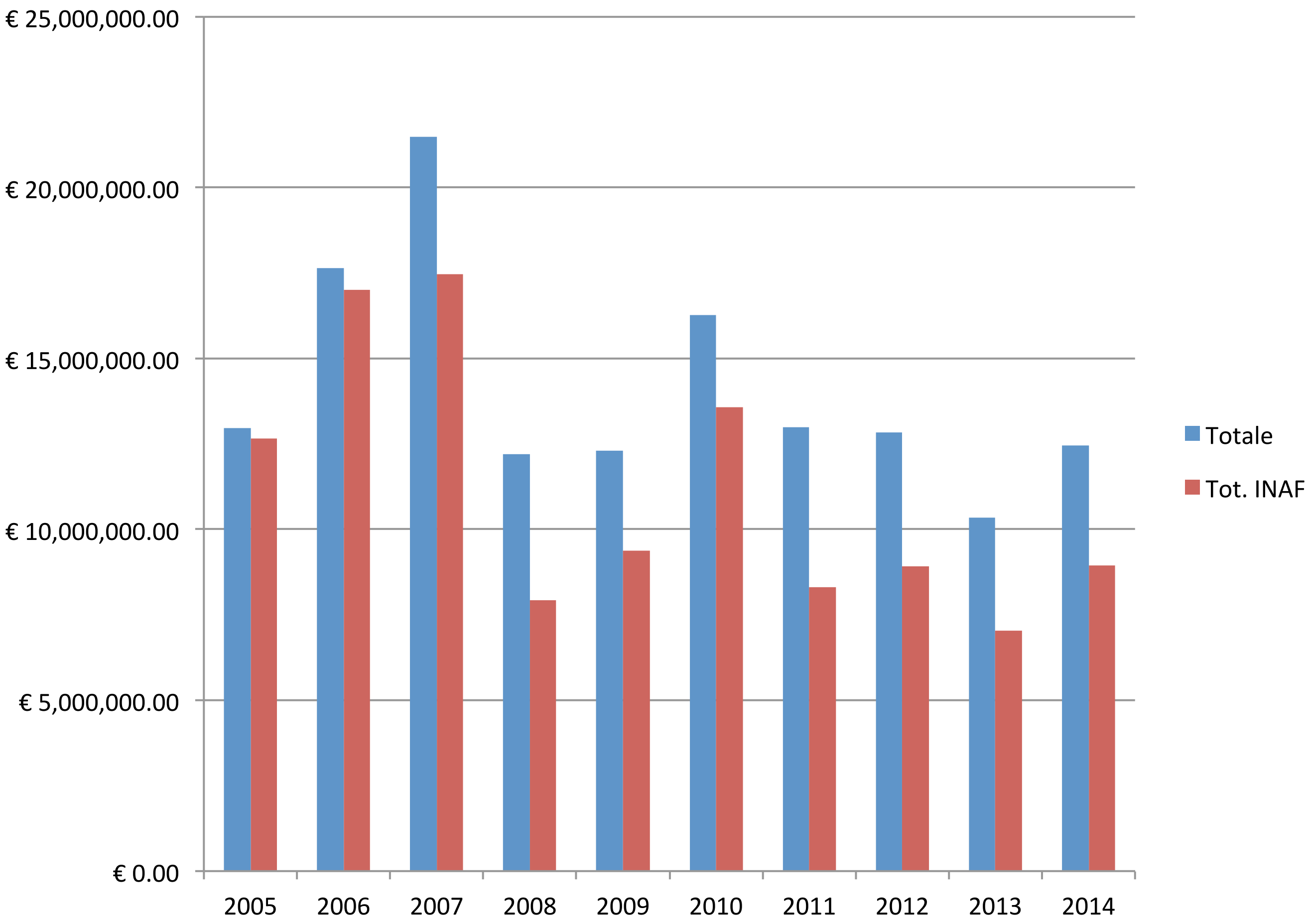
Analisi storica



Numero di accordi e di addendum stipulati in ciascun anno a partire da quando è stato creato l'Ufficio Spazio dell'INAF

INAF ISTITUTO NAZIONALE DI ASTROFISICA NATIONAL INSTITUTE FOR ASTROPHYSICS

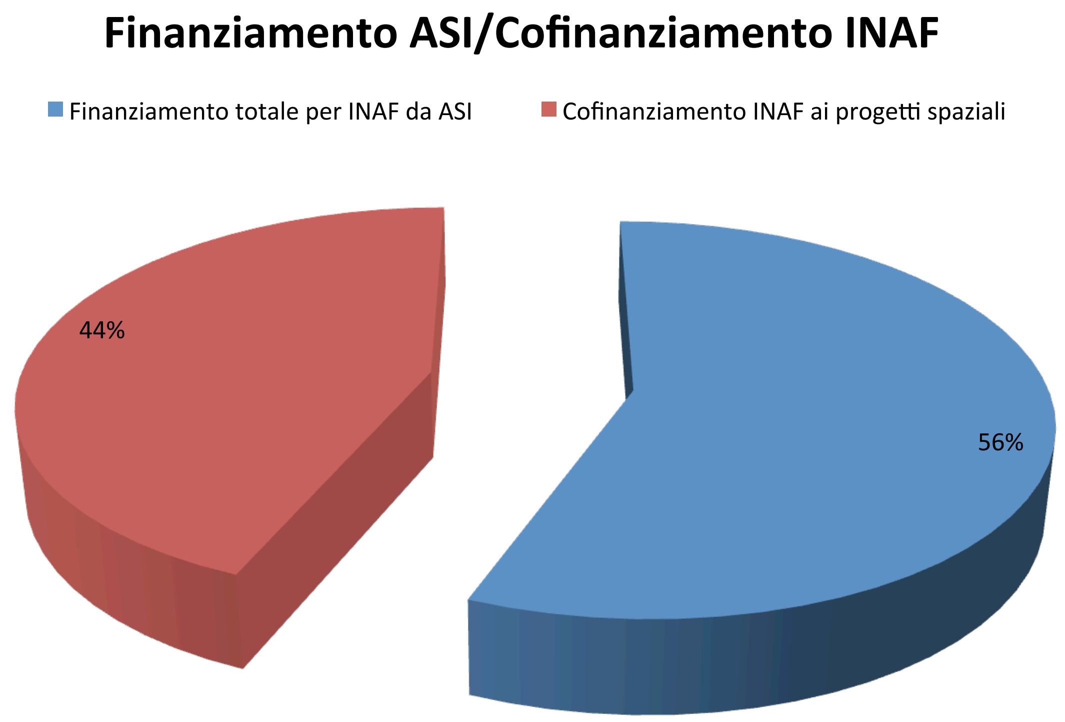
Analisi storica



Finanziamenti ASI

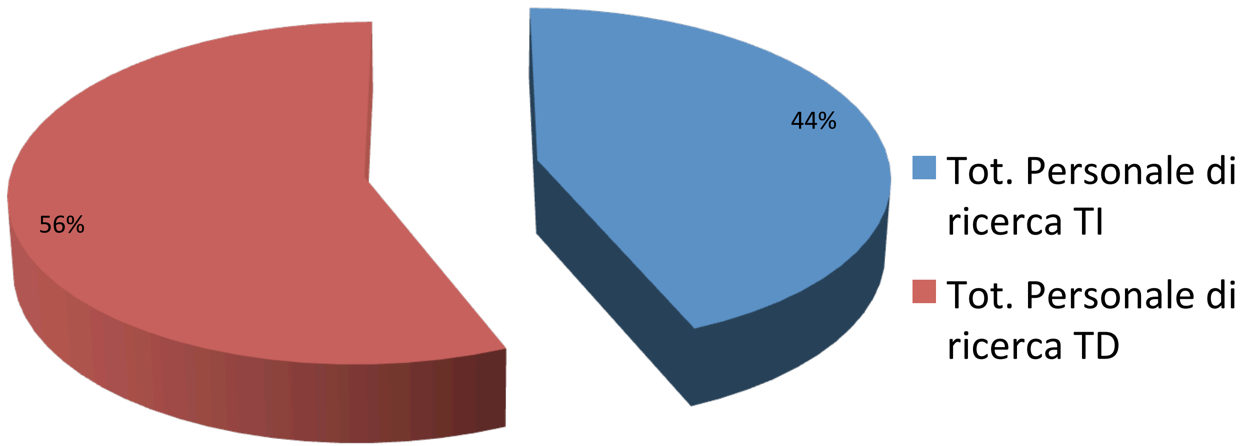
INAF ISTITUTO NAZIONALE DI ASTROFISICA NATIONAL INSTITUTE FOR ASTROPHYSICS

Co-finanziamento INAF



Rapporto medio tra finanziamento ASI e cofinanziamento INAF (principalmente man-power).

Personale



Personale di ricerca nei progetti di Astrofisica dallo Spazio

Nel personale TD vanno considerati non solo i lavoratori dipendenti con contratto a tempo determinato, ma anche i lavoratori para-subordinati (e.g. titolari di assegno di ricerca, borse di studio, co.co.co., ecc.)

Finanziamenti allocati dall'ASI all'Unità Esplorazione e Osservazione dell'Universo

	ANNI DI RIFERIMENTO							
	2009	2010	2011	2012	2013	2014	2015	2016
Budget ASI (in M€) FOE+Premiali+Altro	608	612	538	553	542	549	542?	542?
PTA 2008-2010	**88 (14,5%)**	70 (11,4%)						
PTA 2009-2011	**61 (10,0%)**	74 (12,1%)	79 (14,7%)					
PTA 2010-2012		**69 (11,3%)**	56 (10,4%)	49 (8,9%)				
PTA 2011-2013			n.a.	n.a.	n.a.			
PTA 2012-2014				n.a.	n.a.	n.a.		
PTA 2013-2015					**35 (6,5%)**	27 (4,9%)	27 (5,0%)	
PTA 2014-2016						**27 (4,9%)**	**24 (4,4%)**	**11 (2,0%)**

Settore	Mesi/uomo	%	Note
Astrofisica e Cosmologia	1294	65%	50% mesi uomo da personale TI
EFSS	710	35%	40% mesi uomo da personale TI

Fonte: Ricognizione Ufficio Spazio su accordi con ASI. Medie anni 2013-2014

Programmi di Astrofisica dallo spazio in cui l'Italia e' coinvolta

- **Programmi ESA**

  OBBLIGATORI

  Horizon 2000 (1986-2005) / Horizon 2000+ (2006-2015)

  e.g. ROSETTA, XMM, Integral, Herschel, Planck, Gaia, BepiColombo,

  Cosmic Vision 2015-2025

  a) missione Small selezionate → CHEOPS
  b) missioni Medium selezionate (slot M1, M2 ed M3) → Solar Orbiter, Euclid, Plato
  c) missione Large selezionate (slot L1, L2) → JUICE, Athena

  OPZIONALI, congiunti ESA-NASA, etc..

  e.g. ExoMars, Cassini/Huygens, MarsExpress, VenusExpress, LISA-PF

- **Programmi bilaterali con altre agenzie (NASA, JAXA, Roscosmos, etc..)**

  e.g. Swift, MRO, Dawn, Fermi, Juno, NuStar, CALET

- **Programmi nazionali**

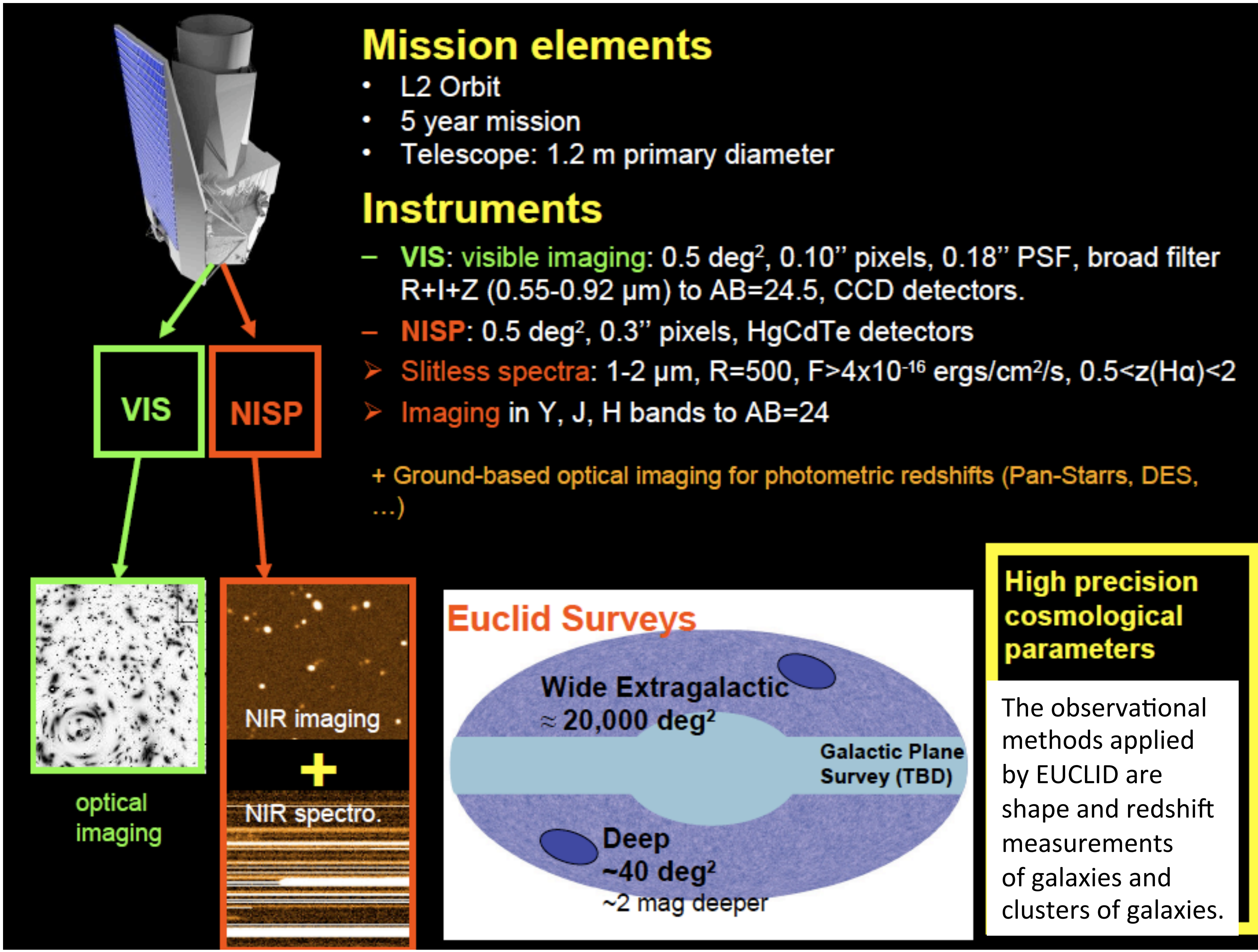
  AGILE, AMS, PAMELA, LARES

ESA M4 Call

Release of Call for M4 mission : August 19, 2014
Letter of Intent (LoI) deadline : September 16, 2014
Proposal submission deadline : January 15, 2015
Selection of Missions (<3) for study phase (2-3 years) : March 2015

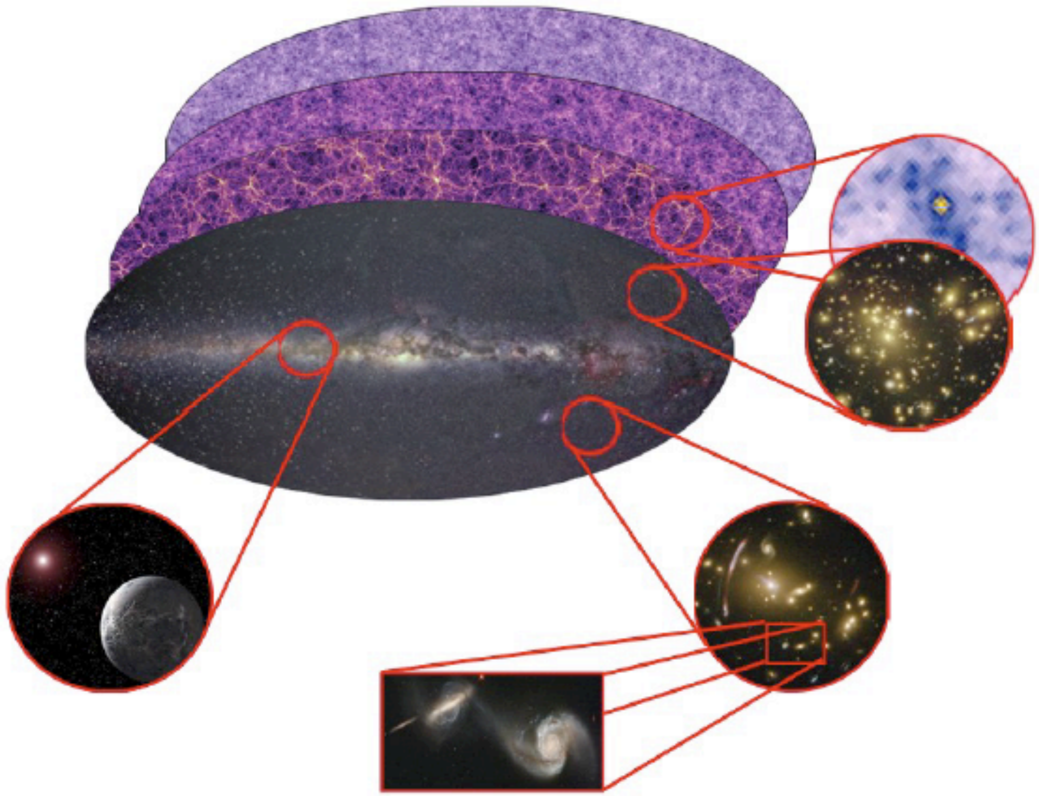
Field	N.Proposals	Italian PI	Endors. ASI
X-ray and Gamma Ray	4	4	4
Astrometry	2	1	1
Cosmology	1	1	1
Exoplanets	1		1
Fondamental Physics	2		2
Our Planets	8		5
The Sun	2		2
TOTAL	20	6	16

EUCLID



Courtesy of A. Cimatti

EUCLID



The immense Euclid legacy

- Unique legacy survey: 2 billion galaxies imaged in optical/NIR to mag=24, 70 million NIR galaxy spectra, full extragalactic sky coverage, Galactic sources
- Unique dataset for various fields in astronomy: galaxy evolution, search for high-z objects, clusters, strong lensing, brown dwarfs, exo-planets, etc
- Several synergies: JWST, Planck, eRosita, GAIA, Pan-STARSS, LSST, etc
- All data publicly available through the Euclid Legacy Archive

Courtesy of A. Cimatti

Euclid Mission Summary

Main Scientific Objectives

Understand the nature of Dark Energy and Dark Matter by:

- Reach a dark energy *FoM* > 400 using only weak lensing and galaxy clustering; this roughly corresponds to 1 sigma errors on w_p and w_a of 0.02 and 0.1, respectively.
- Measure γ, the exponent of the growth factor, with a 1 sigma precision of < 0.02, sufficient to distinguish General Relativity and a wide range of modified-gravity theories
- Test the Cold Dark Matter paradigm for hierarchical structure formation, and measure the sum of the neutrino masses with a 1 sigma precision better than 0.03eV.
- Constrain n_s, the spectral index of primordial power spectrum, to percent accuracy when combined with Planck, and to probe inflation models by measuring the non-Gaussianity of initial conditions parameterised by f_{NL} to a 1 sigma precision of ~2.

SURVEYS

	Area (deg2)	Description
Wide Survey	15,000 (required) 20,000 (goal)	Step and stare with 4 dither pointings per step.
Deep Survey	40	In at least 2 patches of > 10 deg^2 2 magnitudes deeper than wide survey

PAYLOAD

Telescope	1.2 m Korsch, 3 mirror anastigmat, f=24.5 m				
Instrument	VIS	NISP			
Field-of-View	0.787×0.709 deg^2	0.763×0.722 deg^2			
Capability	Visual Imaging	NIR Imaging Photometry			NIR Spectroscopy
Wavelength range	550– 900 nm	Y (920-1146nm),	J (1146-1372 nm)	H (1372-2000nm)	1100-2000 nm
Sensitivity	24.5 mag 10σ extended source	24 mag 5σ point source	24 mag 5σ point source	24 mag 5σ point source	3 10^{-16} erg cm-2 s-1 3.5σ unresolved line flux
Detector Technology	36 arrays 4k×4k CCD	16 arrays 2k×2k NIR sensitive HgCdTe detectors			
Pixel Size Spectral resolution	0.1 arcsec	0.3 arcsec			0.3 arcsec R=250

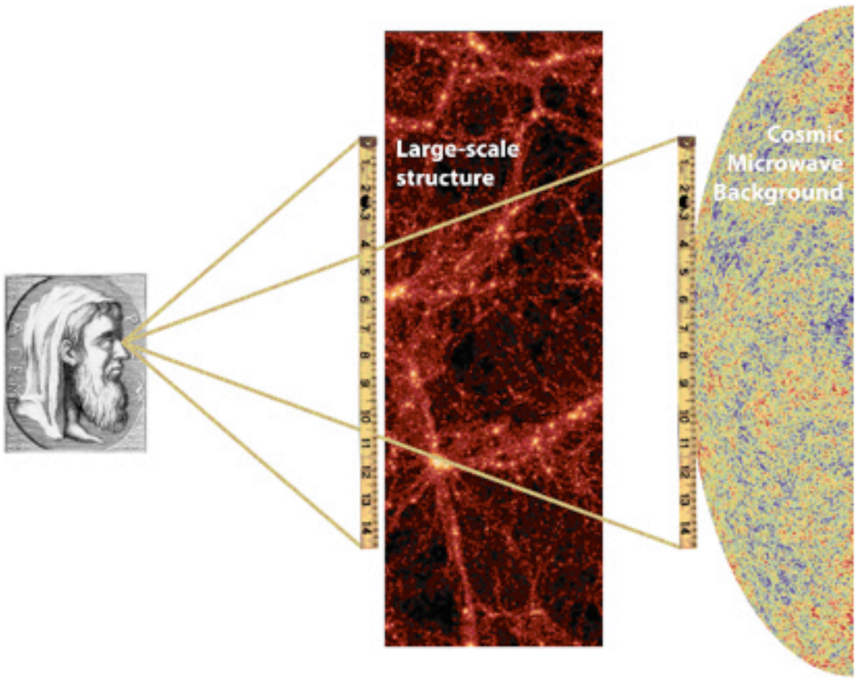
SPACECRAFT

Launcher	Soyuz ST-2.1 B from Kourou
Orbit	Large Sun-Earth Lagrange point 2 (SEL2), free insertion orbit
Pointing	25 mas relative pointing error over one dither duration 30 arcsec absolute pointing error
Observation mode	Step and stare, 4 dither frames per field, VIS and NISP common FoV = 0.54 deg^2
Lifetime	7 years
Operations	4 hours per day contact, more than one ground station to cope with seasonal visibility variations;
Communications	maximum science data rate of 850 Gbit/day downlink in K band (26GHz), steerable HGA

Budgets and Performance

	Mass (kg)		*Nominal Power (W)*	
industry	TAS	Astrium	TAS	Astrium
Payload Module	897	696	410	496
Service Module	786	835	647	692
Propellant	148	232		
Adapter mass/ Harness and PDCU losses power	70	90	65	108
Total (including margin)	**2160**		**1368**	**1690**

Baryonic acoustic oscillations (BAO)

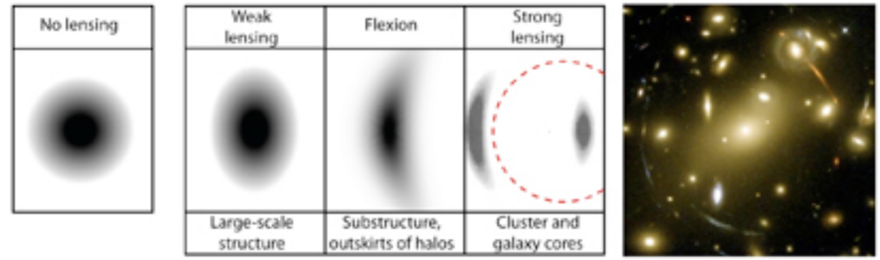


Date: 06 Mar 2010
Satellite: Euclid
Depicts: Baryonic acoustic oscillations
Copyright: ESA

Illustration of one of the two primary cosmological probes of Euclid: Baryonic Acoustic Oscillations.

Galaxy clustering as a probe of the geometry of the Universe. The same acoustic features (Baryonic Acoustic Oscillations) seen in the cosmic microwave background (CMB) can be observed in the spatial distribution of galaxies, providing a standard cosmological ruler.

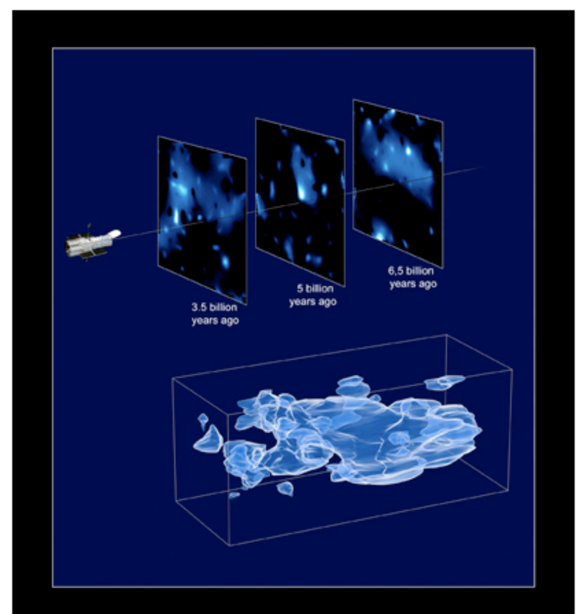
Weak lensing effects



Date: 05 Mar 2010
Satellite: Euclid
Depicts: Effects of lensing mass on an image
Copyright: Credit for Abell 1669: NASA, ESA, and Johan Richard (Caltech, USA)

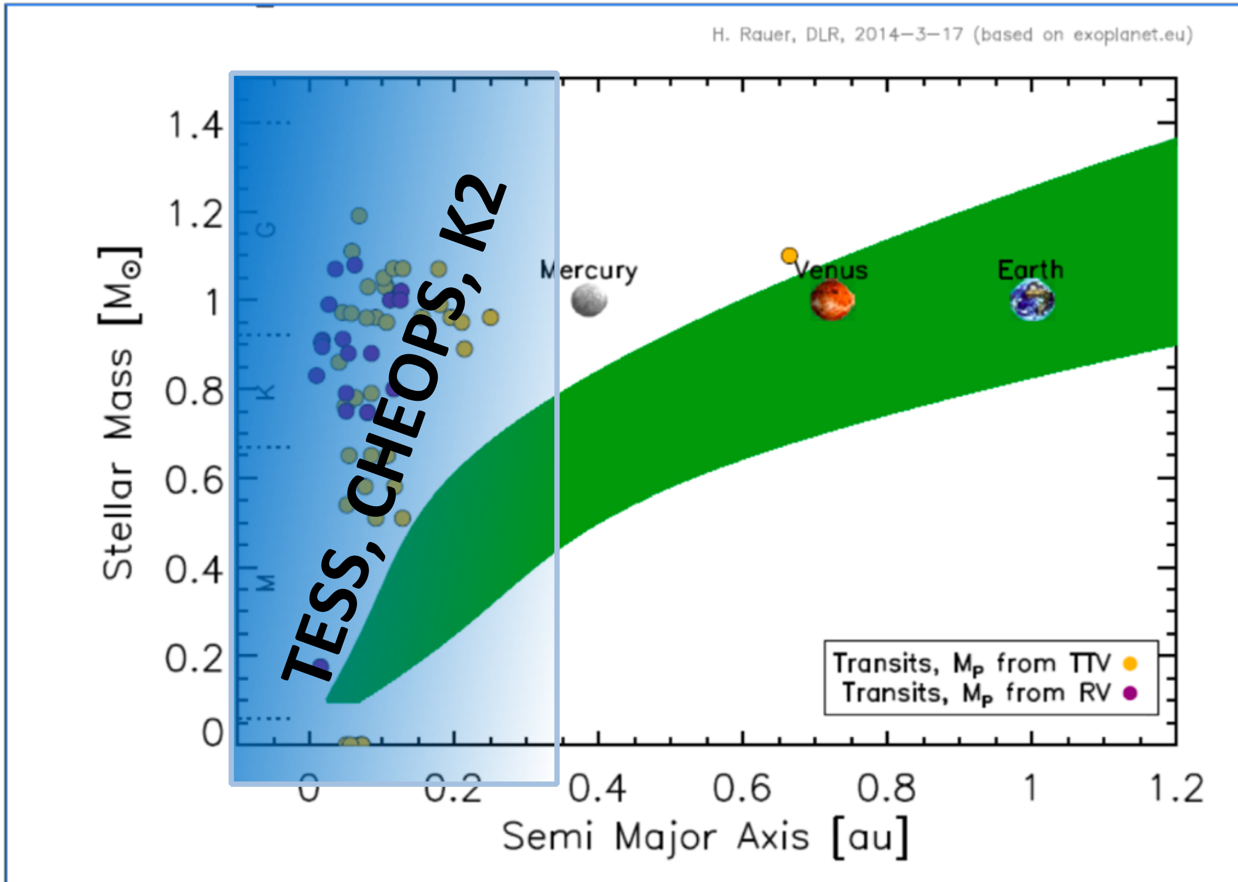
(Left) Illustrations of the effect of a lensing mass on a circularly symmetric image. Weak lensing elliptically distorts the image, flexion provides an arc-ness and strong lensing creates large arcs and multiple images. (Right) Galaxy cluster Abell 1689, strongly lensed arcs can be seen in around the cluster. Every background galaxy is weakly lensed.

Weak gravitational lensing



Prospects for characterized super-Earths in the habitable zone

„Super-Earths" with measured
radius and mass

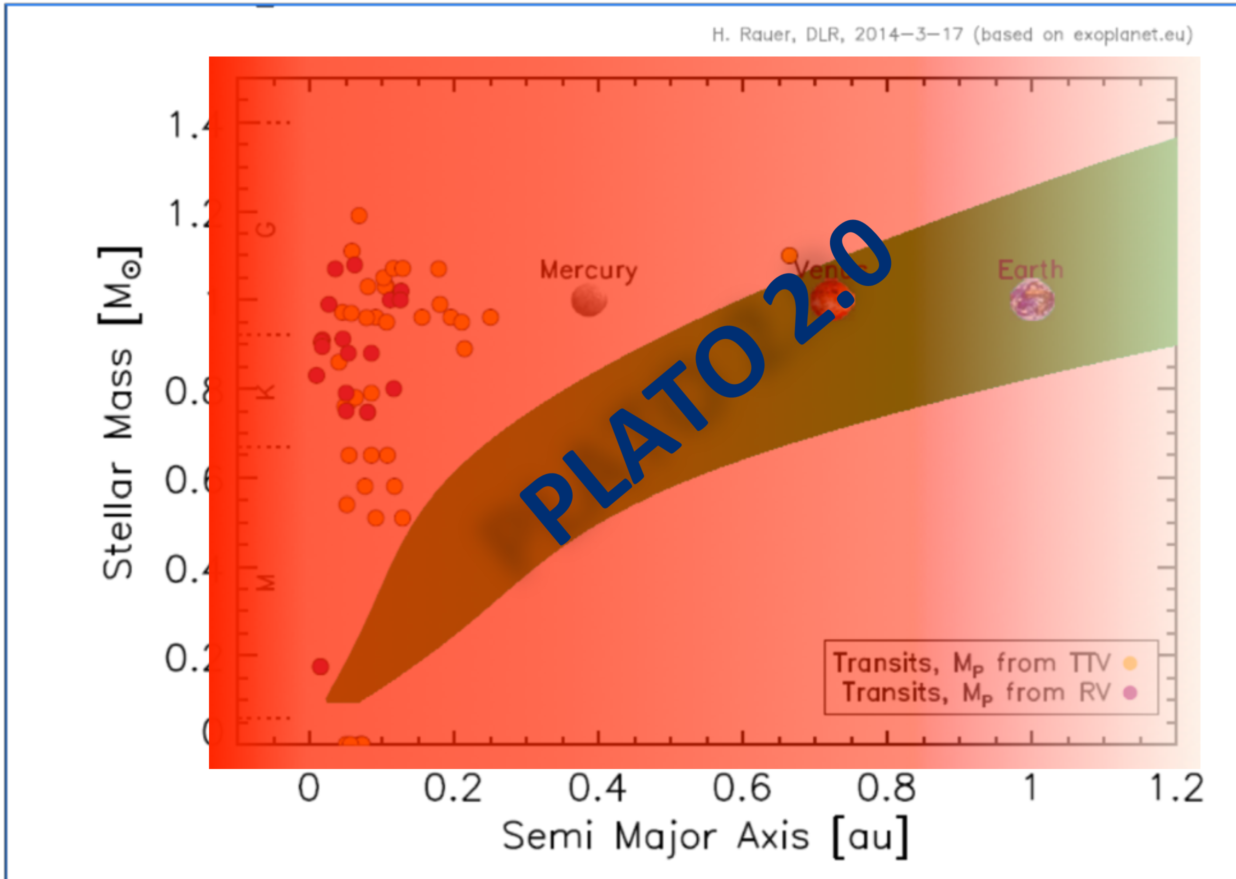


Courtesy of Isabella Pagano

- TESS, CHEOPS, K2 will mainly cover orbital periods up to ~80 days

Prospects for characterized super-Earths in the habitable zone

„Super-Earths“ with measured **radius and mass**



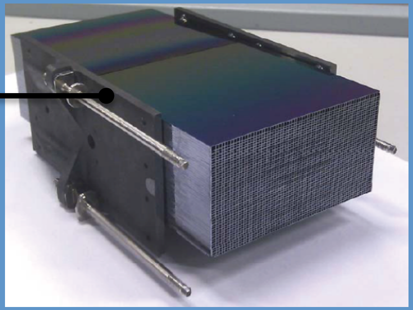
Courtesy of Isabella Pagano

- TESS, CHEOPS, K2 will mainly cover orbital periods up to ~80 days

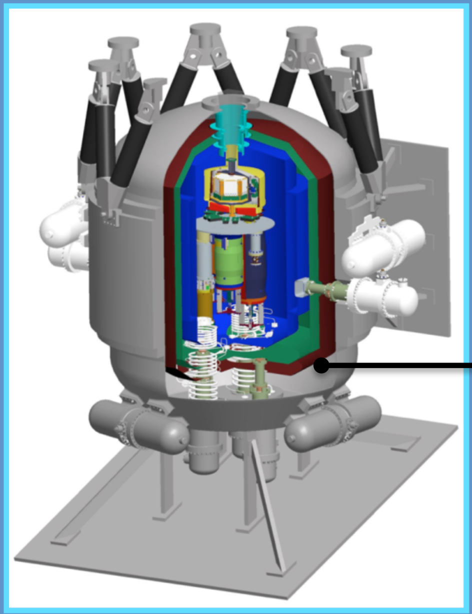
- PLATO 2.0: Detect and characterize planets up to the habitable zone of solar-like stars.

THE ATHENA OBSERVATORY: 1 TELESCOPE FOR 2 INSTRUMENTS!

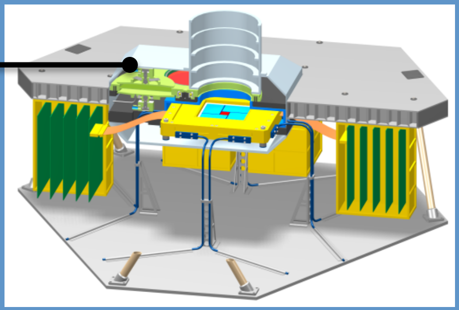
Ariane V (VI ?) class launcher
Satellite mass ~ 5500 kg
Power ~5600 W
Focal length: 12 m
Lifetime: 5 years (10 years)
Launch: 2028 th
Nandra et al. 2013 arXiv1306.2307



Silicon Pore Optics:
Effective area: $2m^2$ @ 1 keV
PSF (HEW): 5''
Willingale et al. 2013 arXiv1308.6785



X-IFU: X-ray Integral Field Unit
ΔE: 2.5 eV
0.3-12 keV
Field of view: 5 arcmin
Large array of TES cooled at 50 mK
Barret et al. 2013 arXiv:1308.6784



WFI: Wide Field Imager
ΔE: 125 eV
0.1-15 keV
Field of view: 40' x 40'
Rau et al. 2013 arXiv1307.1709

THE HOT AND ENERGETIC UNIVERSE AND THE X-IFU

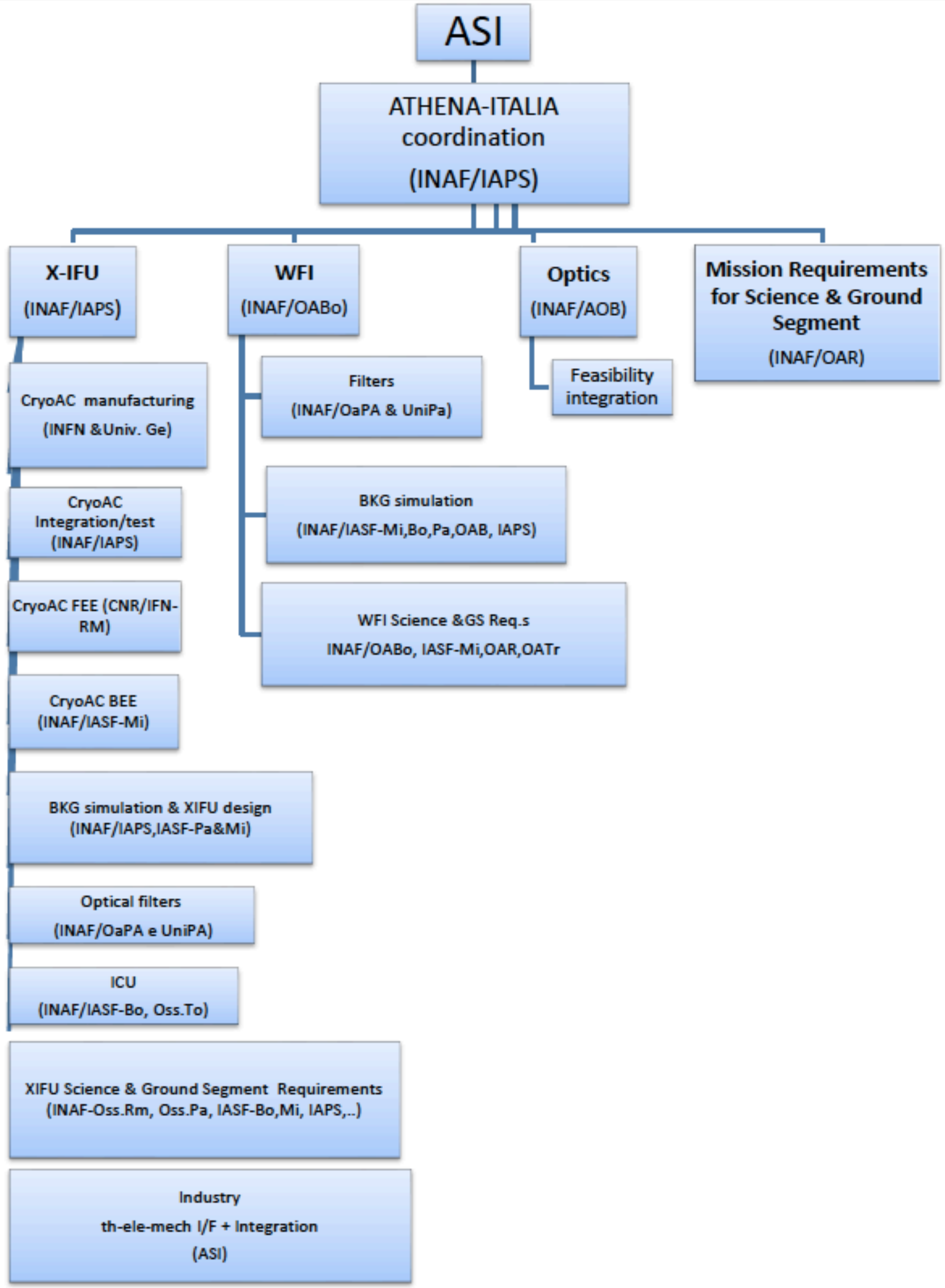
- To address the HEU theme, the X-IFU must provide breakthrough capabilities for:
  - Mapping in 3D the hot cosmic gas to measure motions and turbulence: e.g. to study matter assembly in clusters, AGN feedback on galaxy and cluster scales, …
  - Detecting weak lines to characterise metals in clusters, the missing baryons in the WHIM, features from progenitors in distant GRBs, …
  - Characterizing hot cosmic plasmas, using line ratios (e.g., line multiplets), AGN reverberation and spins, AGN outflows, massive stellar outflows, Solar wind, …

THE HOT AND ENERGETIC UNIVERSE AND THE WFI

- To address the HEU theme, the WFI must provide breakthrough capabilities for:
  - The formation and evolution of clusters and groups of galaxies
  - Feedback mechanisms
  - Black hole growth in the early Universe

Italy in ATHENA

- Italy is a leading member of Athena
- Science, Mission and Instruments defined with a leading role of Italian scientists and industry.
- XIFU CoPI + synergical participation to WFI
- Representatives in all key bodies
- Large community: ~ 90 Italian coI (out of 400) and 200 science supporters (out of 1500) with an increasing n.
- Italian institutes presently involved:
  - INAF: IAPS(RM), IASF-MI, IASF-Bo, IASF-Pa, OABrera, OABo, OATo, OAPa, OaTs, OAArcetri, OARM, OANa
  - Univ. &INFN Genova, Univ Rm1,Rm2Rm3, Univ. Bo, Univ. Pa, Un.Mi
  - CNR, IFN-RM
- Industrial role possible from mission prime-ship, subsystems, instrument cutting-edge technologies



XIFU Items with Italian responsibility

- Crucial for science (Bkg. reduction, Area at low E=> filters)
- Critical technology items to be integrated in the Demonstration Model by 2018
- Key role in Instrument Design and Control (Bkg. Simulation, ICU)
  - Cryogenic Anticoincidence, front end electronics, digital and Data processing (IAPS/INAF, Uni.Ge, CNR/IFN,IASF-Mi)
  - Background simulations and instrument design (IAPS/INAF,IASF-Pa/INAF+)
  - Optical/IR blocking filters (Univ.Pa &Oss.Pa/INAF)
  - Instrument Control Unit (IASF/Bo, Oss.To, IAPS)
  - Contribution to instrument calibrations on ground and in-flight (IAPS/INAF+) under assessment
  - Ground Segment (Innovation center)
  - Science teams/Working Groups

WFI Items with Italian responsibility

- Optical/IR blocking filters (Univ.Pa &Oss.Pa/INAF)
- Background and environmental simulation activities
- Science teams/Working Groups

Fisica Fondamentale dallo spazio

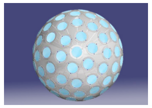
Fase Operativa

PAMELA
2006

Paylod for Antimatter Exploration and light-nuclei Astrophysics. Misura flusso RC e loro tipologia, ricerca di anti-materia e materia oscura.

AMS
2011

Alpha Magnetic Spectrometer. Misura flusso RC e loro tipologia, ricerca di anti-materia e materia oscura. Su ISS



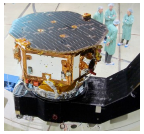
LARES
2012

Laser Relativity Satellite Misura effetto Lense-Thirring. Trascinamento rotazionale previsto relativita' generale

Fase Realizzazione

CALET
2015

Calorimeter Electron Telescope. Studio origine e propagazione RC e ricerca materia oscura



LISA-PF
2015

Validare le tecnologie abilitanti per LISA/NGO. Due masse di prova + interferometro

Fisica Fondamentale dallo spazio

Fase Operativa

PAMELA
2006

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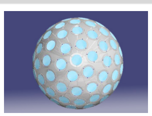
2011

Alpha Magnetic Spectrometer. Misura flusso RC e loro tipologia, ricerca di anti-materia e materia oscura. Su ISS



LARES
2012

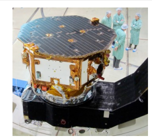
Laser Relativity Satellite Misura effetto Lense-Thirring. Trascinamento rotazionale previsto relativita' generale

Al momento non c'è un grosso coinvolgimento di personale INAF

Fase Realizzazione

CALET
2015

Calorimeter Electron Telescope. Studio origine e propagazione RC e ricerca materia oscura



LISA-PF
2015

Validare le tecnologie abilitanti per LISA/NGO. Due masse di prova + interferometro


Eliofisica e Fisica del Sistema Solare
TODAY
Fase Operativa
Fase Realizzazione
Solar Orbiter
ESA M1
2017
OSIRIS-Rex
NASA (2016)
Sample Ret.
Rosetta
ESA
2004 (2014)
Lander (Philae)
Cometa 67P/CG
Dawn
NASA
2007(2015)
Vesta -2011
Cerere-2015
Exomars
ESA-ROSCOSM.
2016:Orbi+Land
2018:Rover
Mercury
Venus
Earth
Mars
Jupiter
Saturn
Uranus
Neptune
Bepi-Colombo
ESA-JAXA
2017 (2024)
Orbiter+Lander
VenusEx
ESA
2005(2006)
MarsEx
ESA
2003 (2004)
MRO
NASA
(2005)
Juno
NASA
2011(2016)
Cass-Huyg
NASA-ESA-ASI
1997 (2004)
Orbiter+Lander
Titano 2005
Juice
ESA L1
Ganimede
Europa
2022(2031)

Eliofisica e Fisica del Sistema Solare

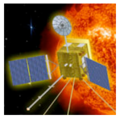
2020

Fase Operativa

Fase Realizzazione

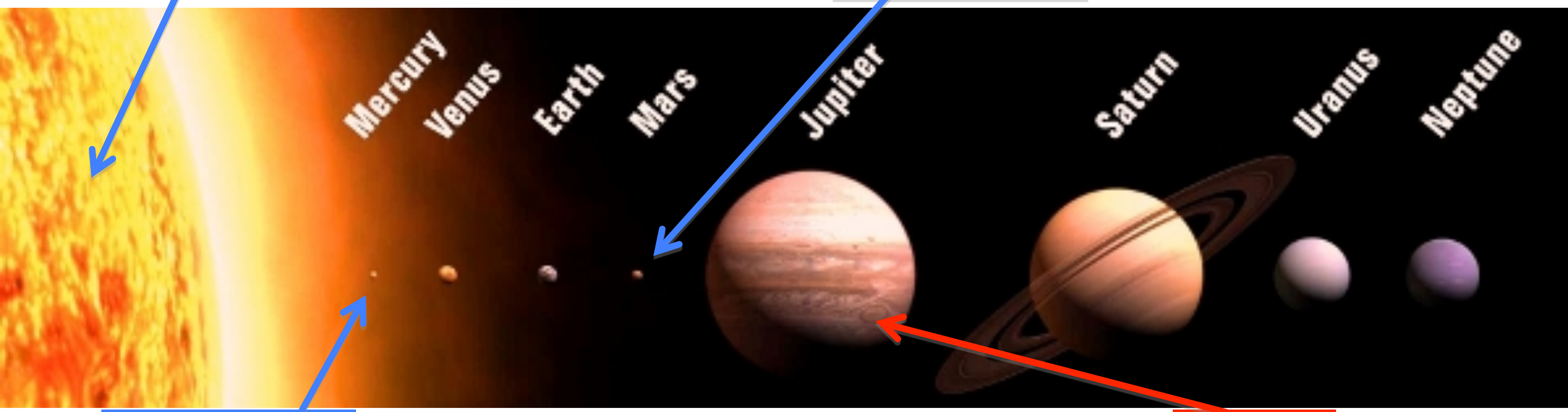
Solar Orbiter

ESA M1
2017



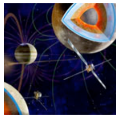
Exomars

ESA-ROSCOSM.
2016:Orbi+Land
2018:Rover



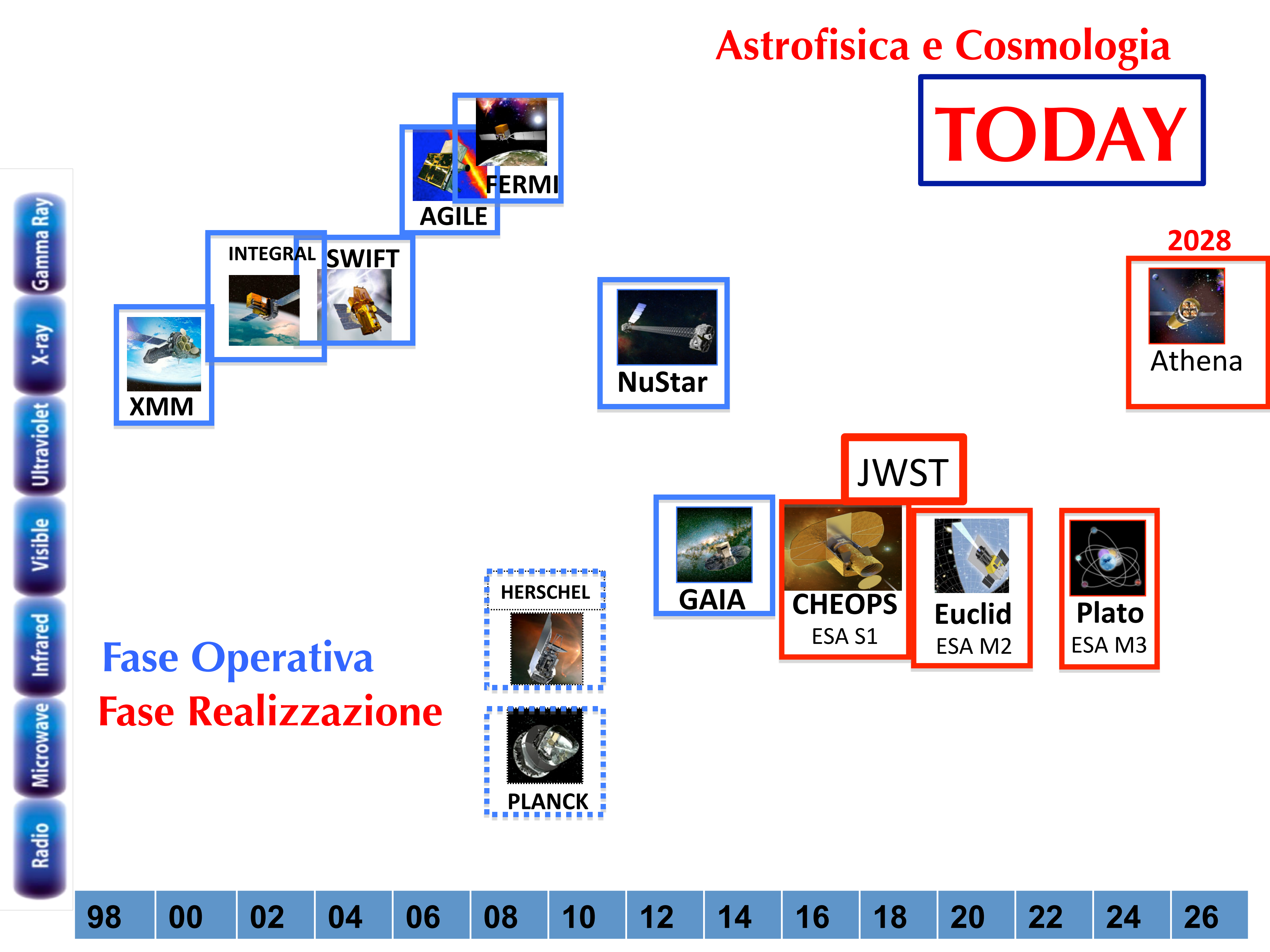
Bepi-Colombo

ESA-JAXA
2017 (2024)
Orbiter+Lander



Juice

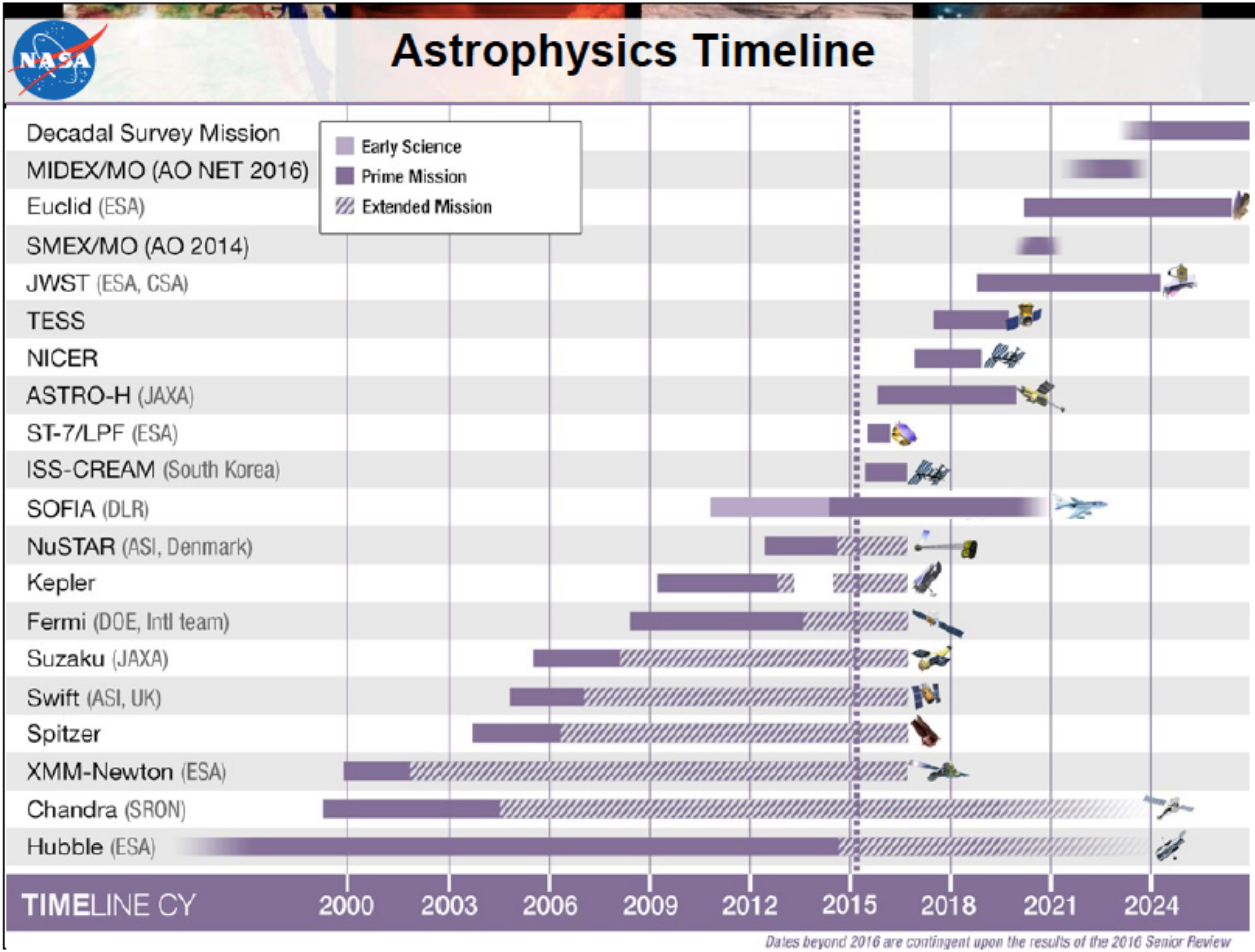
ESA L1
Ganimede
Europa
2022(2031)


Astrofisica e Cosmologia
TODAY
Gamma Ray
X-ray
Ultraviolet
Visible
Infrared
Microwave
Radio
XMM
INTEGRAL
SWIFT
AGILE
FERMI
NuStar
2028
Athena
JWST
GAIA
CHEOPS
ESA S1
Euclid
ESA M2
Plato
ESA M3
HERSCHEL
PLANCK
Fase Operativa
Fase Realizzazione
98
00
02
04
06
08
10
12
14
16
18
20
22
24
26

Astrofisica e Cosmologia

2020

Formulation
Implementation
Primary Ops
Extended Ops
XMM-Newton (ESA)
12/10/1999
Swift (ASI, UK)
11/20/2004
Suzaku (JAXA)
7/10/2005
Fermi
6/11/2008
SMEX
AO 2014
MIDEX
AO 2016
WFIRST
2024
Euclid (ESA)
2020
Hubble
4/24/1990
Kepler
3/6/2009
JWST
2018
Spitzer
8/25/2003
ASTRO-H (JAXA)
2015
Chandra
7/23/1999
NICER (on ISS)
2016
TESS
2017
NuSTAR (ASI)
6/13/2012
LISA Pathfinder (ESA)
2015
SOFIA
Full Ops 2014
NASA Astrophysics Strategy



Astrophysics Timeline
Early Science
Prime Mission
Extended Mission
Decadal Survey Mission
MIDEX/MO (AO NET 2016)
Euclid (ESA)
SMEX/MO (AO 2014)
JWST (ESA, CSA)
TESS
NICER
ASTRO-H (JAXA)
ST-7/LPF (ESA)
ISS-CREAM (South Korea)
SOFIA (DLR)
NuSTAR (ASI, Denmark)
Kepler
Fermi (DOE, Intl team)
Suzaku (JAXA)
Swift (ASI, UK)
Spitzer
XMM-Newton (ESA)
Chandra (SRON)
Hubble (ESA)
TIMELINE CY
2000
2003
2006
2009
2012
2015
2018
2021
2024
Dates beyond 2016 are contingent upon the results of the 2016 Senior Review

Other Space Agencies…

China

Hard X-ray Modulation Telescope (HXMT)

Broad-band (1-250 keV) survey and observations of Galactic BH and NS X-ray binaries.
Planned for launch between 2015 and 2016

China-France joint GRB mission: SVOM

Planned for launch 2021

India

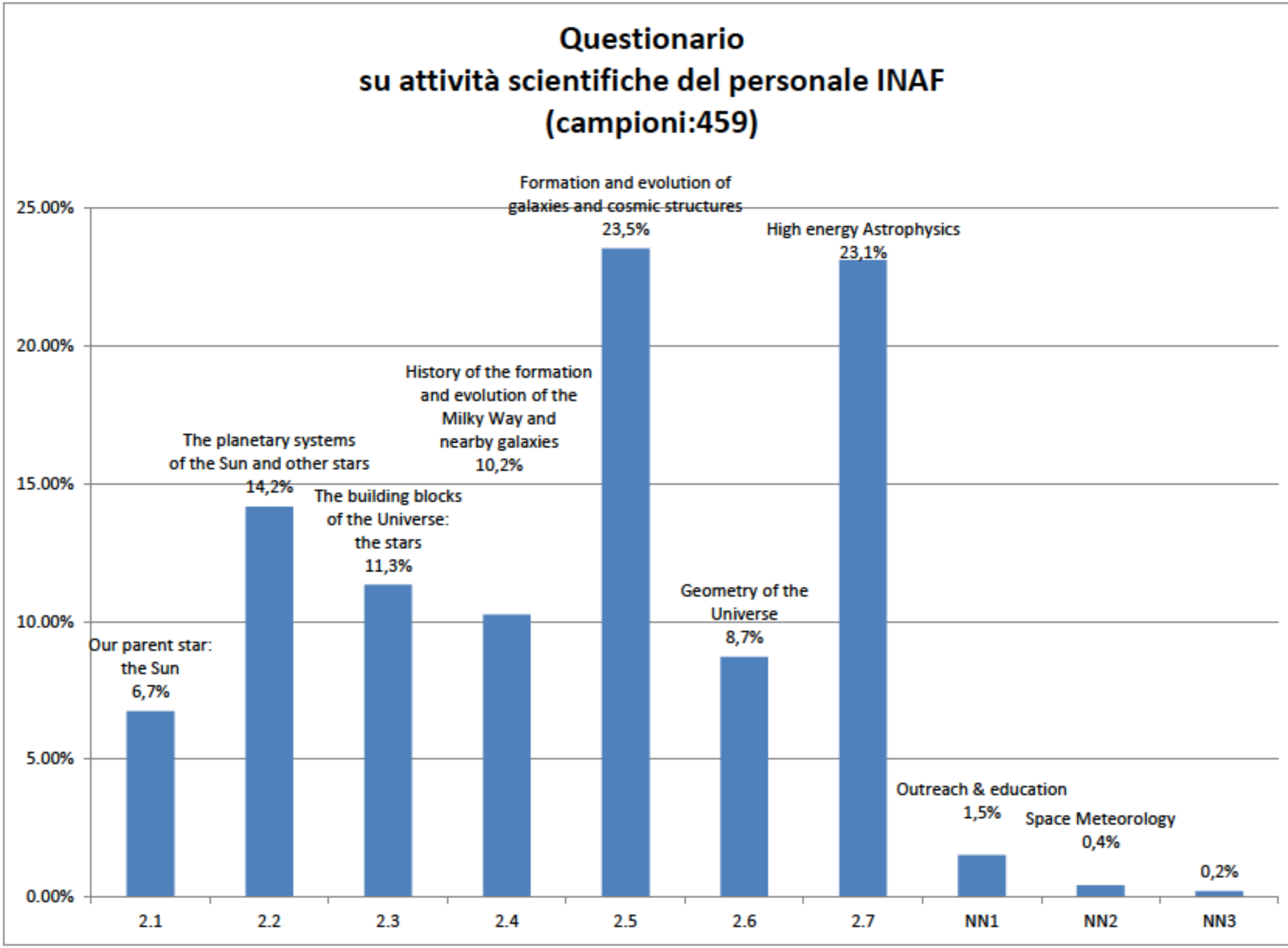
ASTROSAT

Multi-wavelength astronomy mission. The 5 instruments on-board cover the visible (320-530 nm), near UV (180-300 nm), far UV (130-180 nm), soft X-ray (0.3-8 keV and 2-10 keV) and hard X-ray (3-80 keV and 10-150 keV) regions.

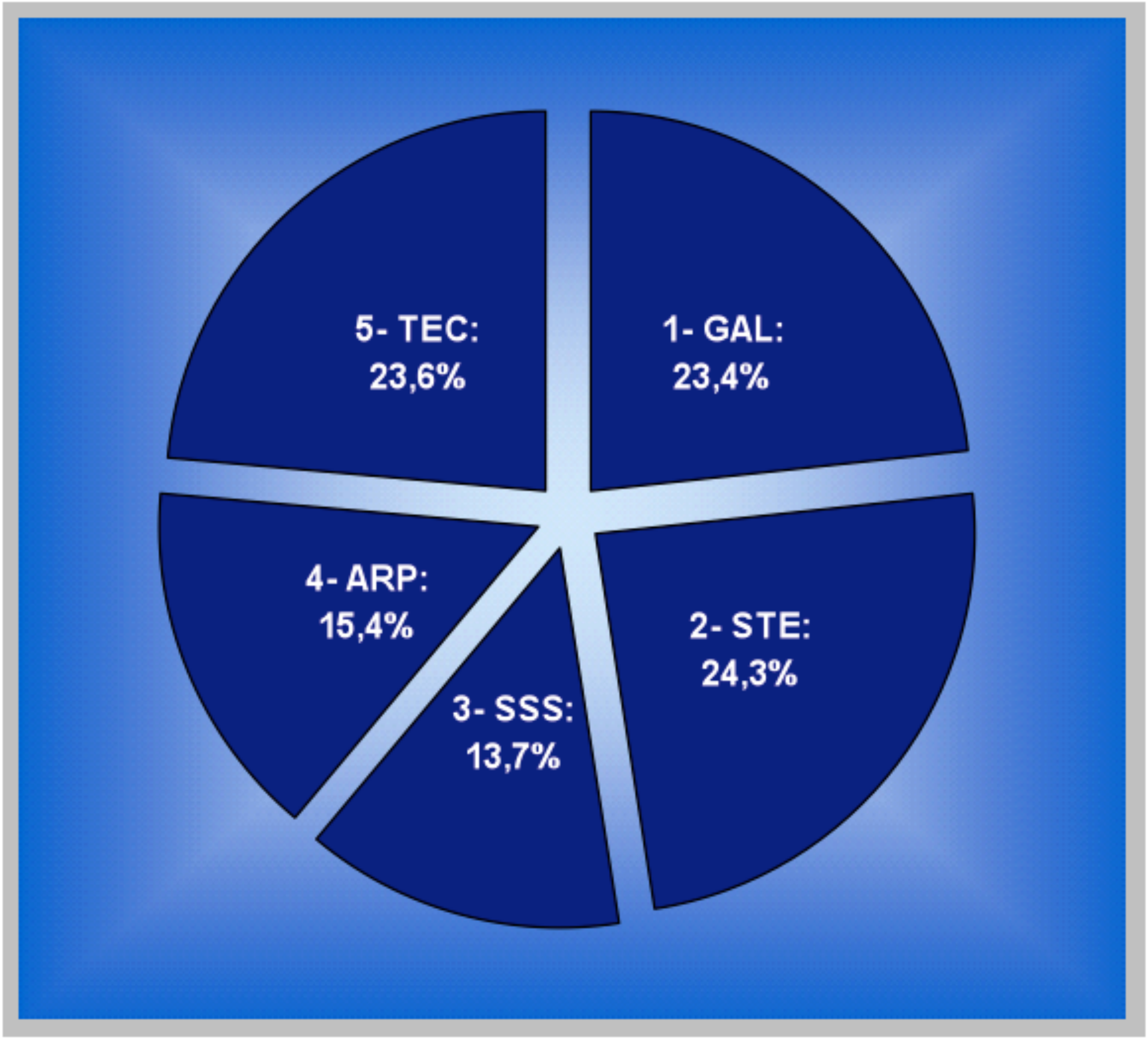
Germany-Russia

e-ROSITA

All sky survey in the 2-10 keV energy band.



Fonte: Consiglio Scientifico INAF - Gennaio 2014



Distribuzione personale INAF nelle diverse macroaree. Fonte: piano triennale INAF 2011