

Space Science at UK Space Agency - Challenge and Opportunity

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UK “Science & Space”

- First and foremost to carry out world class frontier science
- Exploit mandatory GDP funding through ESA
- Deliver strategic benefits — forcing-house for new technology and skills – drives innovation
- Showcase UK capabilities (academia and industry) on world stage
- Develop new international partnerships
- Public understanding of science and inspiration



UK Space Agency – Our Domains and “Science”

Astrophysics



Solar System



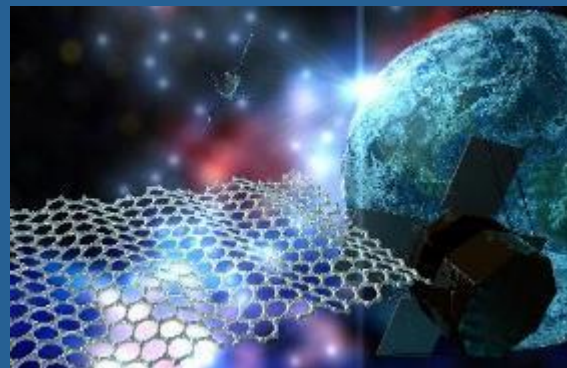
Space Situational Awareness



Exploration



Microgravity/Life Sciences



EO Science



Sustainable Devt



“Science” at UKSA - Approx 40% of our budget

£40M p.a. National

- science instruments
- data exploitation
- sustainable devt

£150M p.a. ESA

- technology
- satellite & ops
- science instruments
- applied research

(Few) bilateral missions

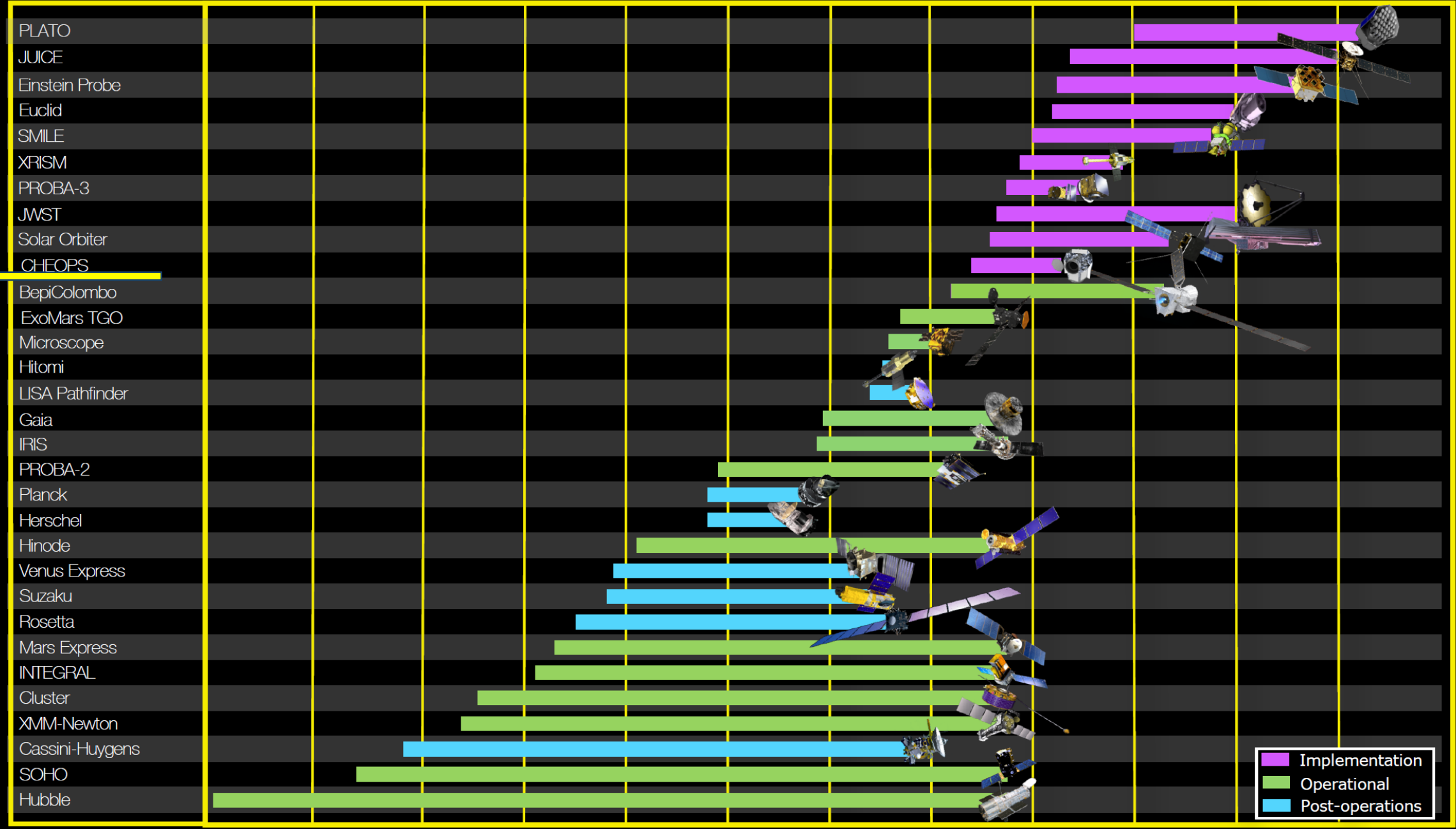


ESA Space Science Missions

New



Long tail of ops



Implementation
Operational
Post-operations

Solo- 2020

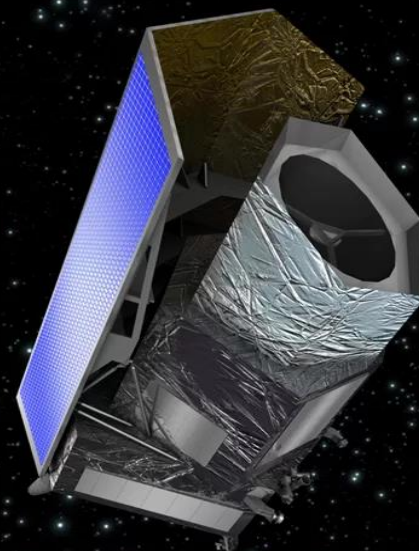
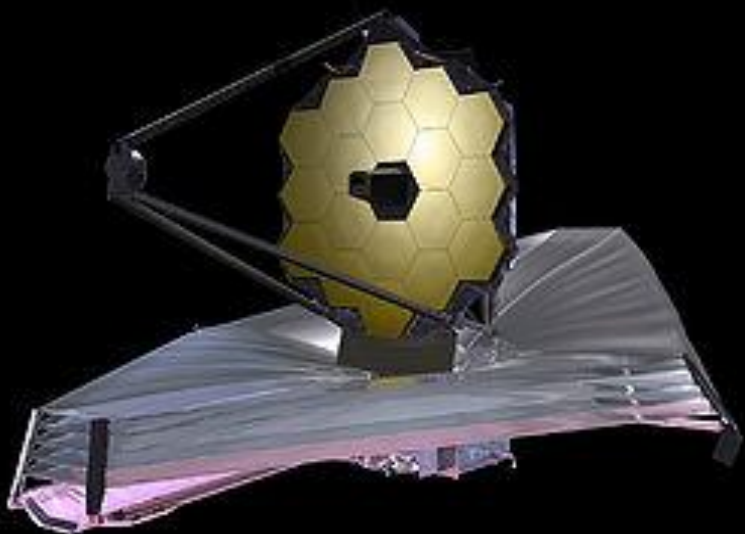


JUICE- 2022



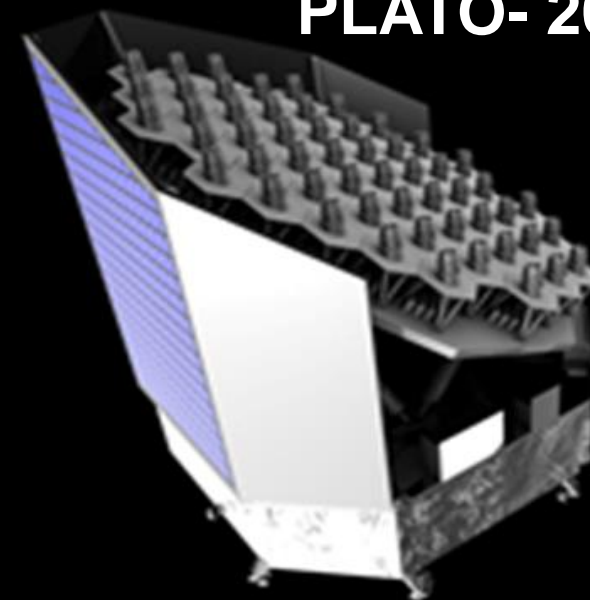
SMILE- 2023

JWST-2021



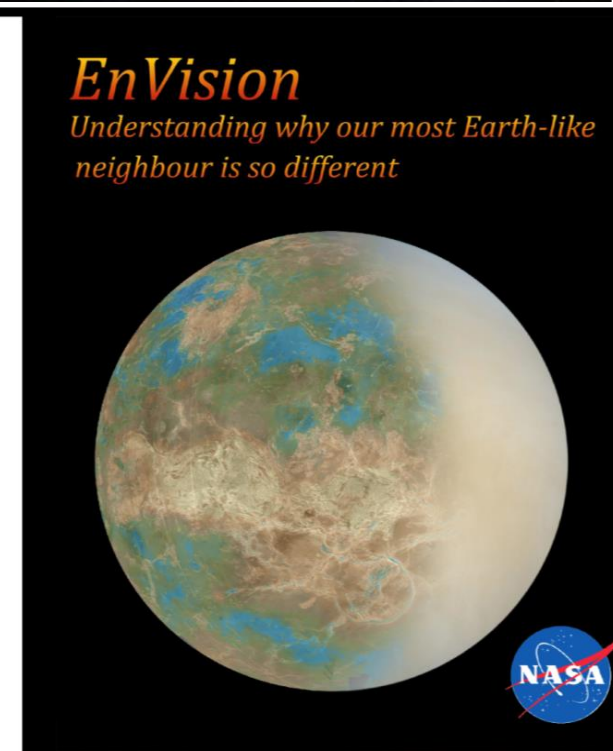
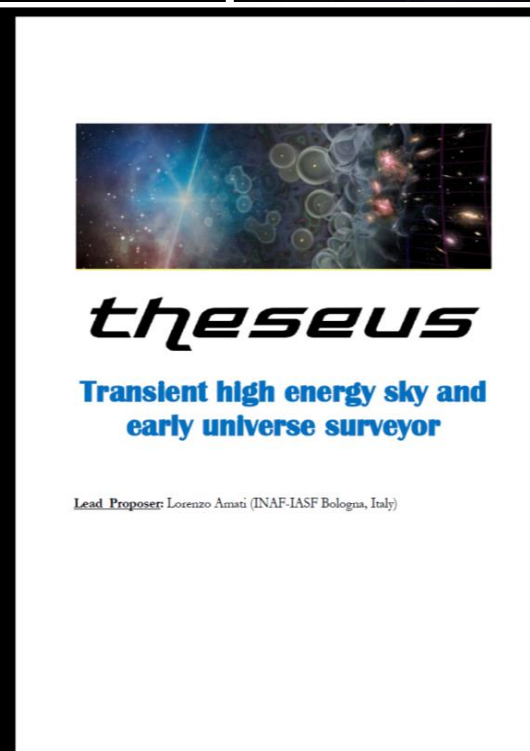
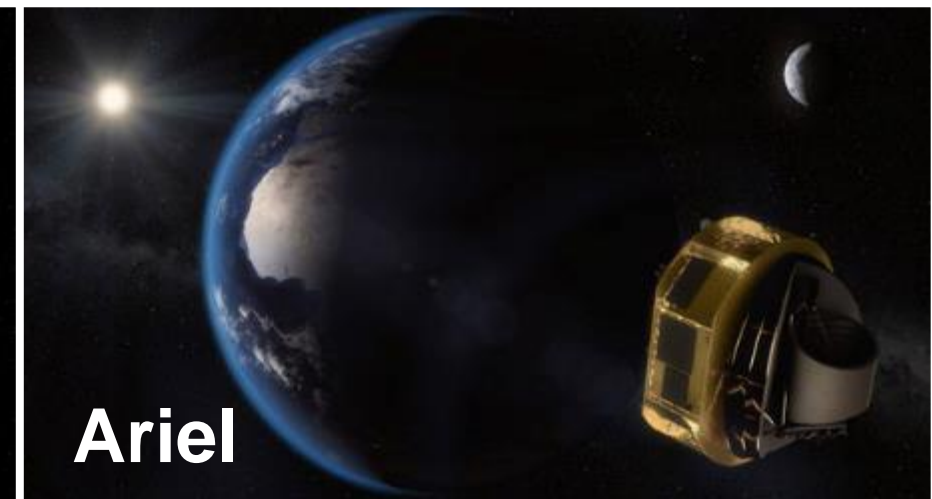
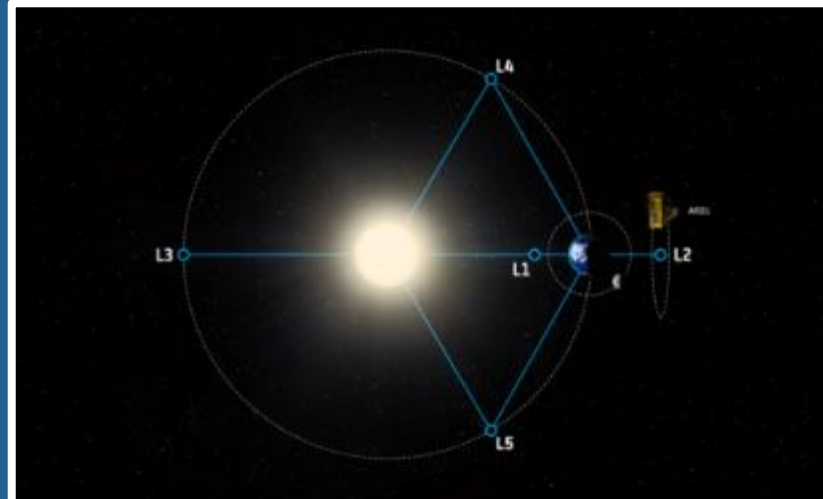
Euclid- 2022

PLATO- 2026



M4 and M5

- ESA M4 Ariel selected
- Launch in 2028
- Chemical fingerprints of exoplanet atmospheres
- UK-led science (UCL) and RAL...
- ESA M5 Candidates – all teams include key UK capabilities



Challenges facing ESA Science Programme

- **A “Golden Age” for European Space Science but...**
- ESA missions combine ambitious science, technology risk and complex programmatic structures.
 - Are they still compatible with academic life-cycles?
- “Flat cash” over many years = declining purchase power.
- National instruments often over-budget and mission schedule driver
- Resource and skills imbalances?

Mission	Initial €	Final €	Launch delay (months)
LisaPF	160M (2004)	427M	75
BepiC	665M (2006)	1,356M	50
SolarO	499M (2009)	668M	37
Euclid	595M (2009)	800M	22?

2 “funding seeds” on the horizon...



SPACE SECTOR PRIORITIES FOR A NATIONAL SPACE PROGRAMME					
FOUNDATIONS OF INDUSTRIAL STRATEGY	Earth Information Services	Connectivity Services	In-space Robotics	Launch Services	Instruments & Science research
Ideas	Data access, fusion and analytics infrastructure, Manufacturing & In-orbit demo, Develop a UK commercial Earth, Observation satellite leading to a service, Deliver UK-GEOS & secure Copernicus access, Prepare data access roadmap for the UK	Connected mobility, Constellations manufacturing, In-orbit demonstration, Research into quantum and optical/photronics	R&D for low TRL and commercial initiatives, In-orbit demonstration, potentially using UK satellites, Develop UK manufacturing and supply chain	Launcher supply chain and manufacturing development	Develop UK leadership / PIs for future missions
Infrastructure & Place		Support broadband for rural communications by satellite	Space Robotics Centre	UK space port	Space clusters
Business environment	Market teams, cross sector R&D & business accelerators		Regulations for in-space activities	Promote FDI for launchers	
	Develop partnerships with other spacefaring nations				
	Improve access to finance				
People	Develop training & clusters for applications development	Remote learning in the UK and abroad	Develop new skill sets		
	Training for new communication technologies & applications		Promote STEM agenda via public excitement		

ESA
Council of Ministers Meeting 2019
“Space19+”

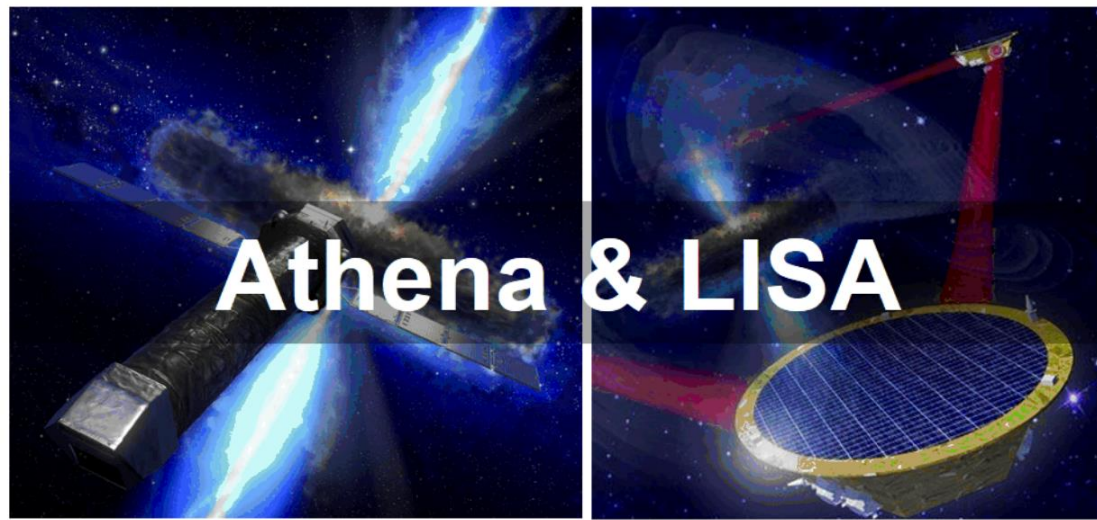
Underpinned by a detailed governance and delivery plan which has been developed by the Space Growth Partnership

1. ESA Space19+

At Interim Ministerial – Oct 2018: *“The most important decisions facing Member States at Space19+ will be: to restore **ESA’s (space) science programme** as the world leader in the physics of the Universe by reversing the long-standing decline in buying power of the Level of Resources ...”*

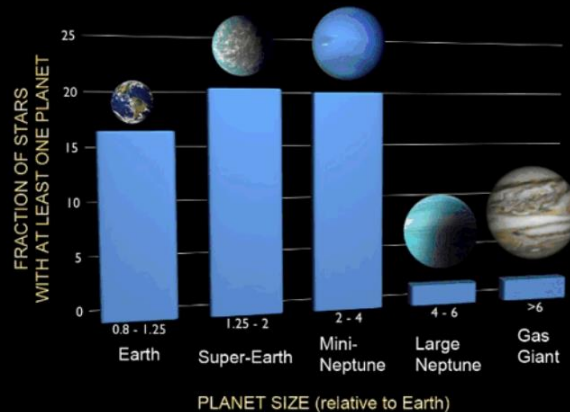


Proposal from ESA Directorate of Science: Uplift +20%?



F-missions in sync with M-missions (joint launch) → new line of opportunities with special emphasis on novel implementations

Unique celestial opportunity to explore Ice Giants



Payload system provision → alleviate/facilitate/support Member State provision

Preparation of Cosmic Vision in the 2050 time frame

2. Sector Deal... Science/Research?

“capture 10% of the global space market by 2030”



2010 - the sector sets out plans to gain a 10% share of global space economy by 2030



2017 - Government's Industrial Strategy - how UK can thrive in commercial space age



2018 - The space industry outlines a partnership strategy 'Prosperity from Space'



Today – Government, academia and industry are working towards a space sector deal.

“Government will continue to work closely with the space sector to build on our significant capability and maximise the benefits of space to life on Earth, creating jobs and opportunities across the country.”

*Science Minister
Sam Gyimah*

2018+ consider balance and influence...

- ESA Large, Medium, Small and Fast missions vs more ESA Missions of Opportunity?
- ESA vs non-ESA bilaterals for the UK?
- “Upstream” vs “downstream” focus?
- Grants vs contracts?
- University partnership with industry?
- Critical skills gap in project/engineering management?
- Mission opportunity vs mission timeliness for science (cadence)
- Space Science vs other science domains – **impact, impact, impact!**

SPAC: Science Programme Advisory Committee

SPAN: SPace Academic Network

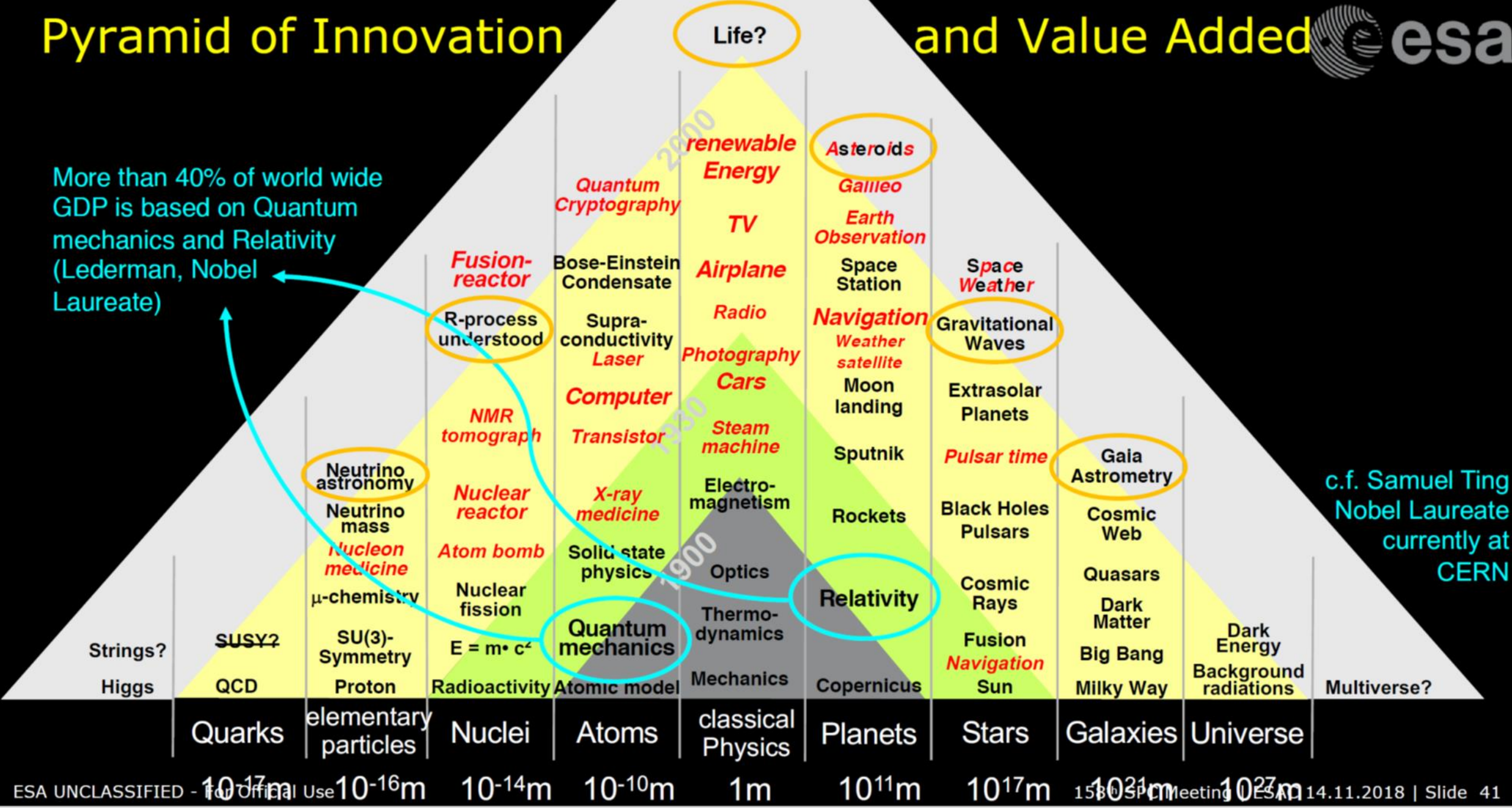
SSEC: Space Science and Exploration Committee

Pyramid of Innovation

and Value Added



More than 40% of world wide GDP is based on Quantum mechanics and Relativity (Lederman, Nobel Laureate)



c.f. Samuel Ting Nobel Laureate currently at CERN



“Bringing sound to the cosmic movies”



Athena
hot gas structures
supermassive black holes

LISA
gravitational wave observation



European
Space Science
as a force in
Sustainable
Devt and skills
agenda...



5 Key Sciences of NARIT



Optical Astronomy



Radio Astronomy



Solar Physics and
Space Weather

High Energy Astrophysics
and Cosmology



Astronomical
Instrumentation

