

# SRON Overview and Outlook

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General and Scientific Director

*57th ESSC Plenary Meeting  
May 9, 2019*



Netherlands Institute for Space Research

Netherlands Organisation for Scientific Research (NWO)

## SRON Mission Statement

*“To enable breakthroughs in research from space by the definition, development, and scientific use of world-class instrumentation.”*



# Collaborations and New Locations



Leiden BioScience Park ~2021



Groningen nieuwbouw ~2022

- One Institute, two locations, ~190 staff (~140 Leiden, ~50 Groningen)
- Strong scientific and technical connections in both locations
- Six new staff positions to support collaboration with Leiden/TU Delft
- Process already underway to identify candidates and fill positions

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## Role of the Institute

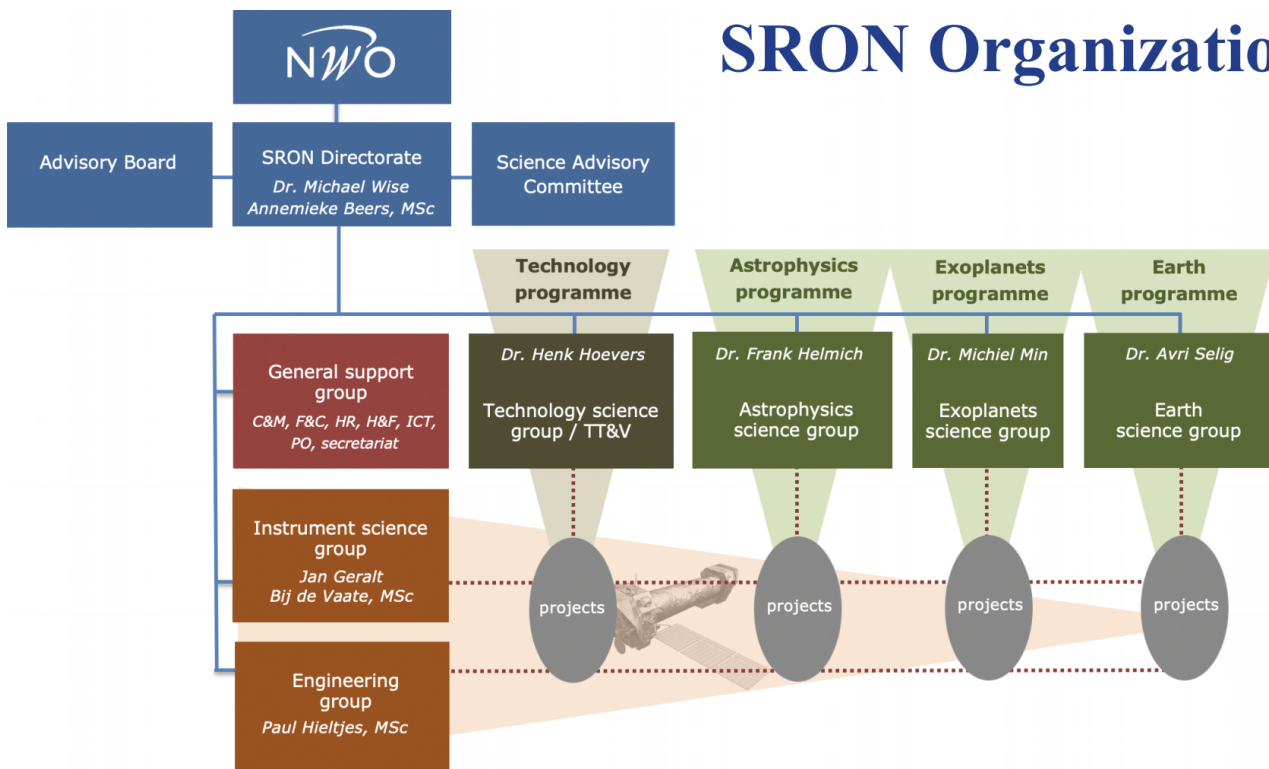
- Home base for NL instrumentation in the ESA science program
- National expertise institute for scientific space research
- Performs scientific research in astrophysics, Earth science, exoplanets, and new technology
- Develop pioneering technology for advanced space instruments
- Design and build instruments for scientific space research
- Advice to government on behalf of the space research community
- Provide community support for the scientific exploitation of space instruments and missions
- Promotes societal applications of space including valorization



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# SRON Organization

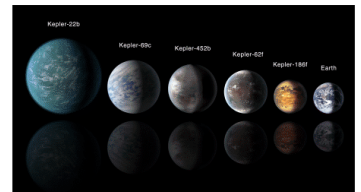
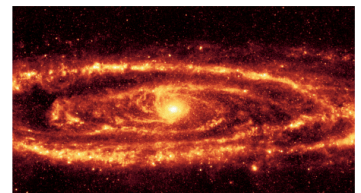


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## SRON Research Themes

- **Astrophysics**
  - High-energy astrophysics (the hot evolving Universe, properties and evolution of black holes, neutron stars, etc.)
  - Low-energy astrophysics (the cool obscured Universe, birth of stars, planets, evolution of stars and galaxies, etc.)
- **Earth science**
  - Atmospheric composition and chemistry (ozone, methane, CO<sub>2</sub>, aerosols, etc.)
- **Exoplanets**
  - Atmospheres of exoplanets (ultimately Earth-like exoplanets)
- **Technology development**
  - New technology for space instrumentation enabling future discoveries, ground-based, and balloon-borne demonstrators



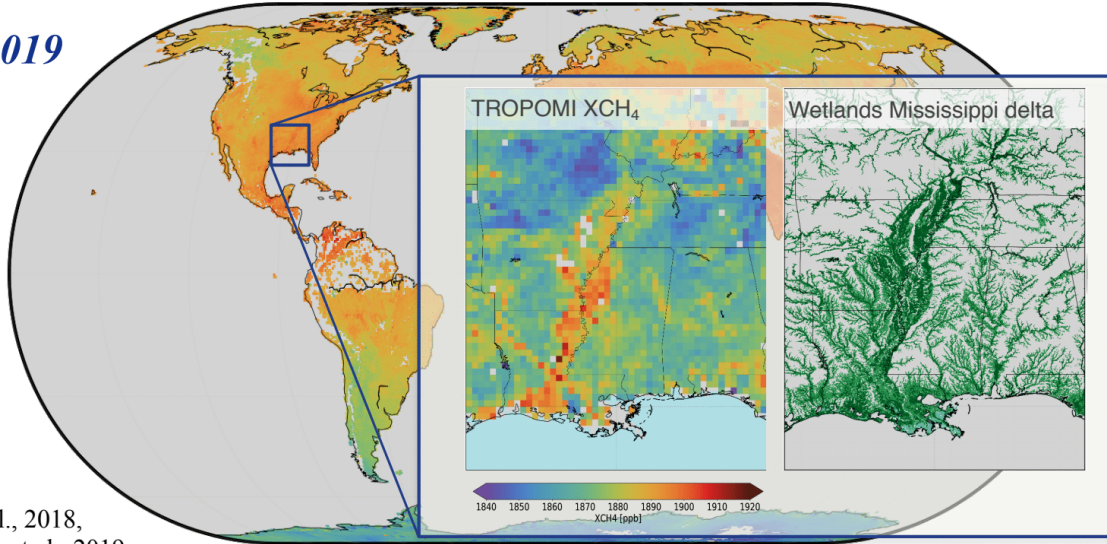
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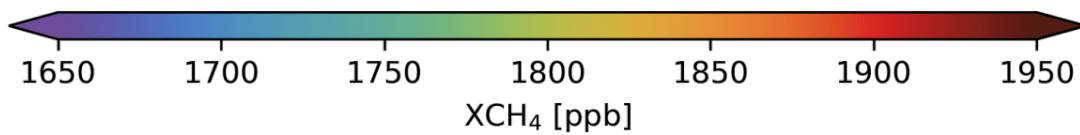


# Sentinel-5P/TROPOMI results: CH<sub>4</sub> mapping

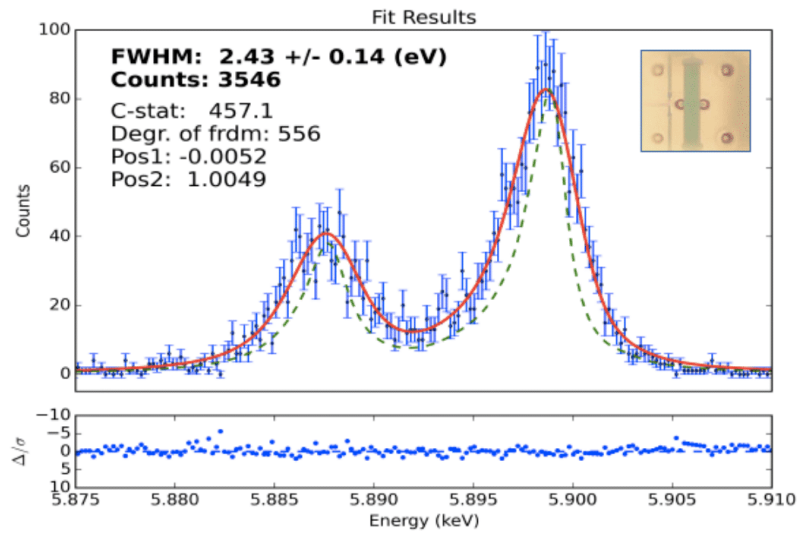
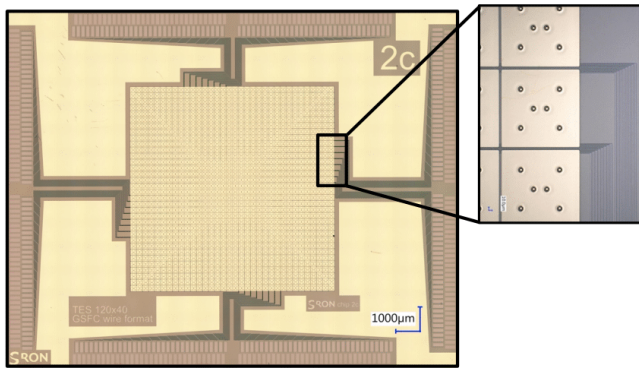
March 2019 release



Hu et al., 2018,  
Lorente et al., 2019



## Athena XIFU Detector Performance

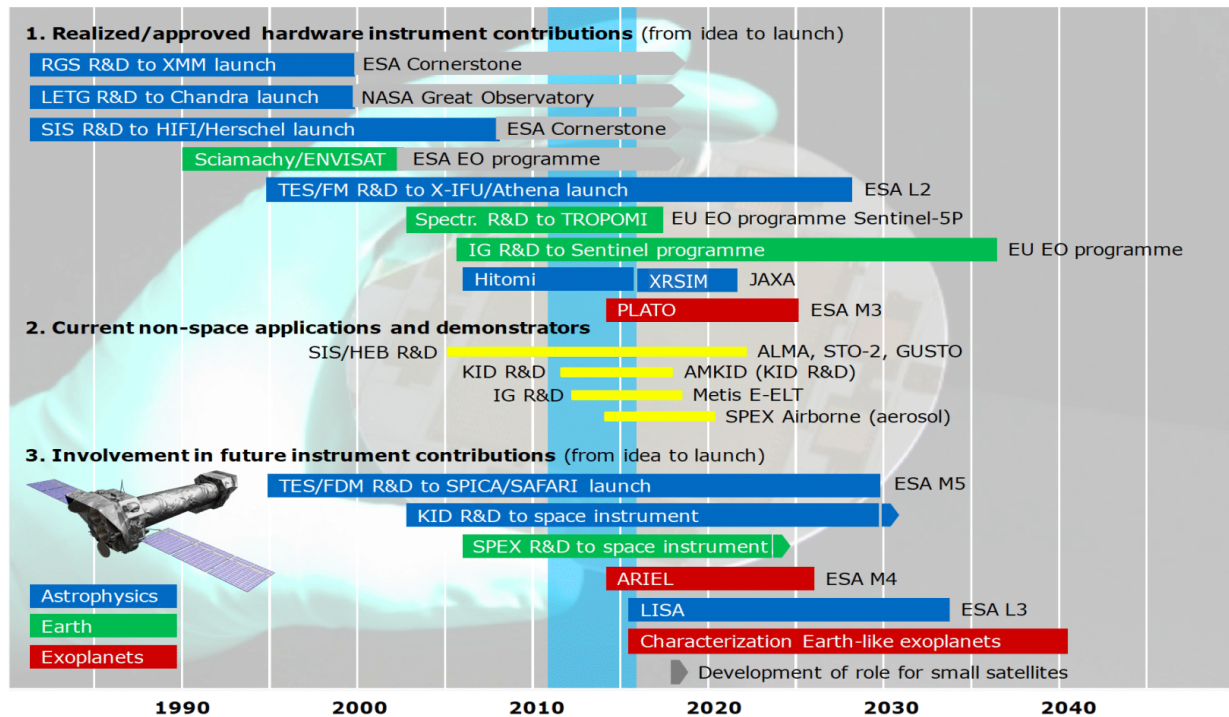


*SRON TES calorimeter performance close to XIFU requirements*

*Comparable to performance of world leading NASA-GSFC detectors*



# Current SRON ESA Mission Roadmap



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## Current Project Portfolio

Mission/instrument	Programme SRON	Launch date	Agency	Contribution SRON
Sentinel-5P/TROPOMI	Earth	2017	ESA (approved)	co-leading
Sentinel-5	Earth	2022	ESA (approved)	intermediate
XRSIM	Astrophysics	2021	JAXA/ESA	small
PACE/SPEXone	Earth	2022	NASA (approved)	leading
PLATO	Exoplanets	2026	ESA (M3, adopted)	small
ARIEL	Exoplanets	2028	ESA/M4 (selected)	small
Athena/XIFU	Astrophysics	2031	ESA (L2, selected)	co-leading
SPICA/SAFARI	Astrophysics	2031	ESA/JAXA (M5, candidate)	(co-)leading
LISA	Astrophysics	2034	ESA (L3, selected)	intermediate
Demonstrators	All	–	Ground, aircraft, balloon	(co-)leading
CO2M/SPEX5	Earth	2025	ESA/EC (in competition)	co-leading

Additional opportunities: eXTP (X-ray timing), HUBS (X-ray imaging surveys), NCLE followup mission, small satellite platform, etc.

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# XRISM - X-Ray Imaging Spectroscopy Mission

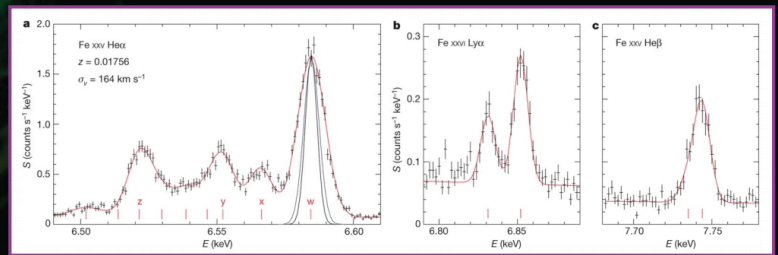
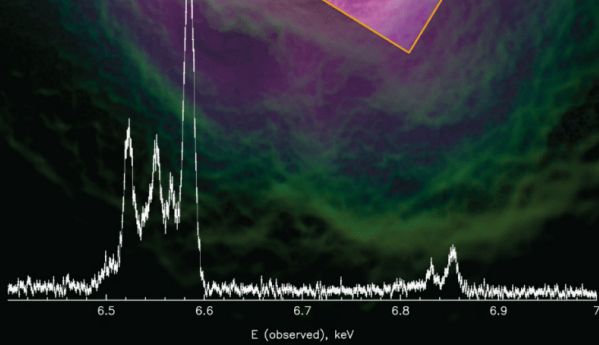
*High spectral resolution calorimeter and moderate spatial resolution*

*Followup to failed Hitomi mission (Feb 2016)*

*Joint JAXA, ESA, NASA mission*

*SRON providing filter wheel assembly and onboard X-ray calibration source*

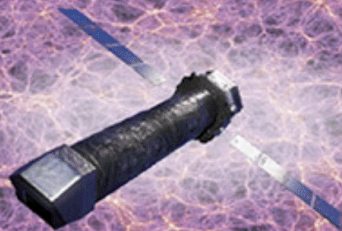
*Planned launch in 2021*



(Nature, Fabian et al. 2016)

## ATHENA

THE ASTROPHYSICS OF THE  
HOT AND ENERGETIC  
UNIVERSE



HOW DID ORDINARY MATTER  
ASSEMBLE INTO THE LARGE SCALE  
STRUCTURES WE SEE TODAY?

HOW DO BLACK HOLES GROW  
AND SHAPE THE UNIVERSE?

Europe's next generation **X-RAY OBSERVATORY**

- Athena selected as L2 mission in ESA Science program (~1B€)
- Evolution of large-scale structure, growth of BHs, chemical enrichment, stars, exoplanets, pulsars, neutron stars, gamma ray bursts, GW followup, etc.
- SRON is co-PI of calorimeter instrument (X-IFU: spectroscopic X-ray camera)
- Supported by NWO Roadmap funding ~20 M€ (PI. J.W. den Herder)
- Successful recent Athena IPRR for XIFU and WFI, instruments now in phase B1
- Currently highest priority for the Astrophysics programme line

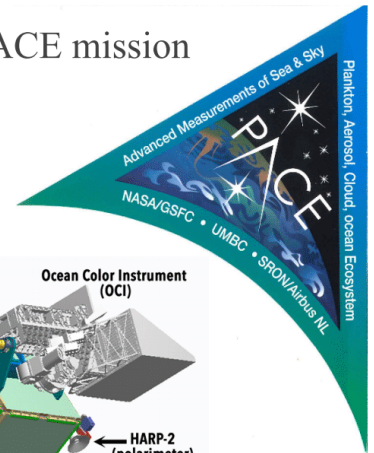
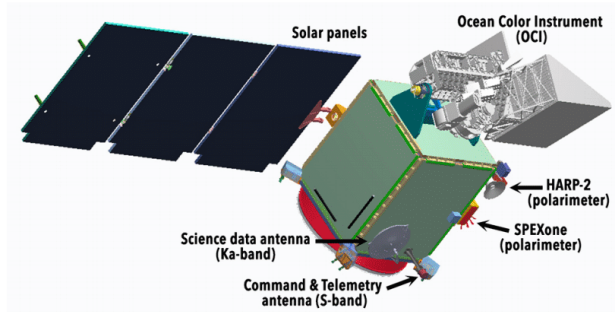
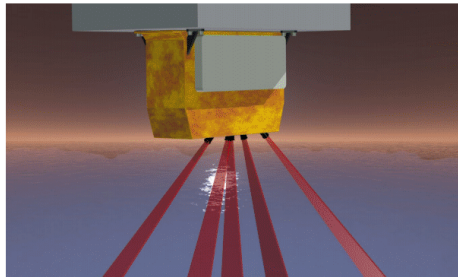
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# SPEXone – Spectro-Polarimeter for Planetary Exploration



Plankton, Aerosol, Cloud, ocean Ecosystem

- Synergetic payload for aerosol, cloud, and ocean science on NASA PACE mission
- Successful SPEXone Critical Design Review CDR (NASA, NSO, SRON, TNO, Leiden) - clearance to start manufacturing phase
- Supported by 7 M€ subsidy from NSO



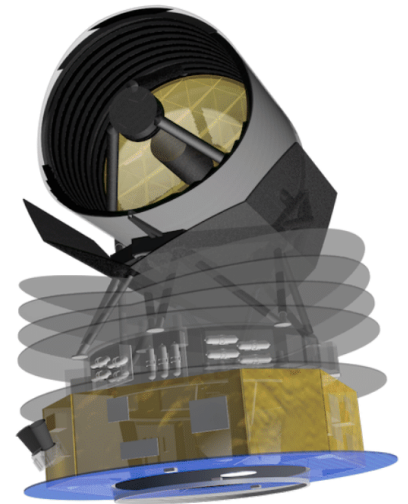
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# SPICA – Unveiling the Cold Obscured Universe



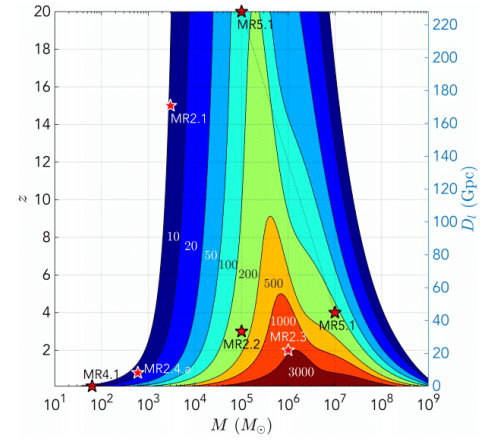
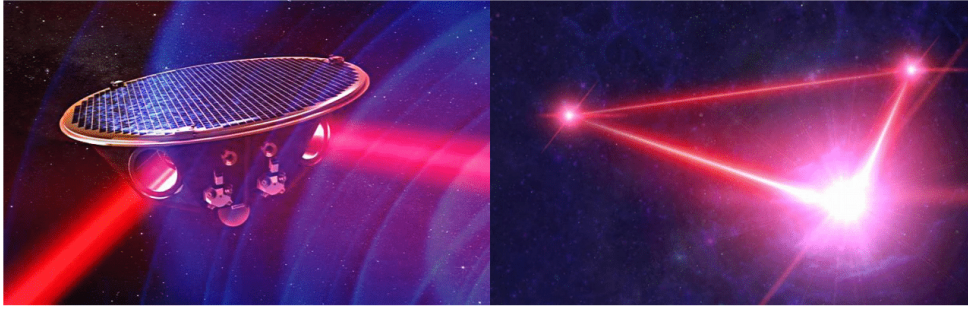
- SPICA - a large cryogenically cooled infrared telescope
- Evolution of galaxies in the early universe, planet formation, star formation, etc.
- ESA-JAXA collaboration with partners in Europe, Canada, US and Taiwan, M5 mission candidate (decision in ~2021)
- SRON is PI of SAFARI spectrograph
- Currently refining requirements and design to prepare for selection
- Still need to secure commitments for national funding from all partners



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# LISA – Gravitational Wave Astronomy in Space

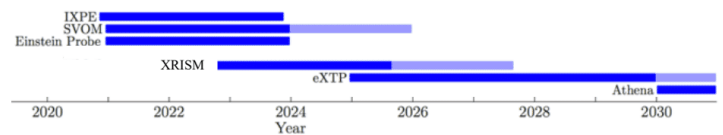
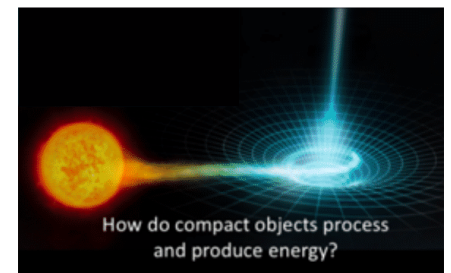
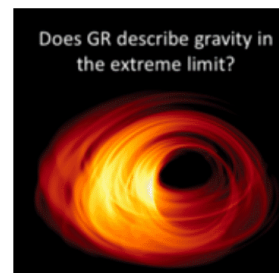
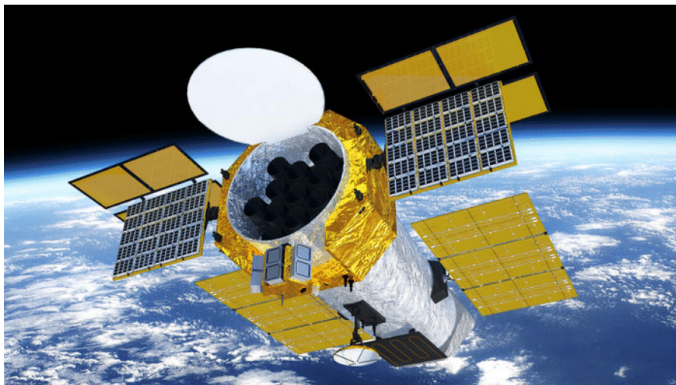


- LISA - Laser Interferometer Space Antenna
  - L3 mission candidate in ESA program (launch in ~2034)
  - SRON investigating potential hardware contributions (with TNO, Nikhef)
  - NSO subsidy of 1 M€ pending for TNO feasibility study
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- Strong NL science community, clear route to SRON flight hardware
  - Total cost likely to be large, but not currently on NL large-scale infrastructure roadmap

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## eXTP – enhanced X-ray Timing and Polarimetry



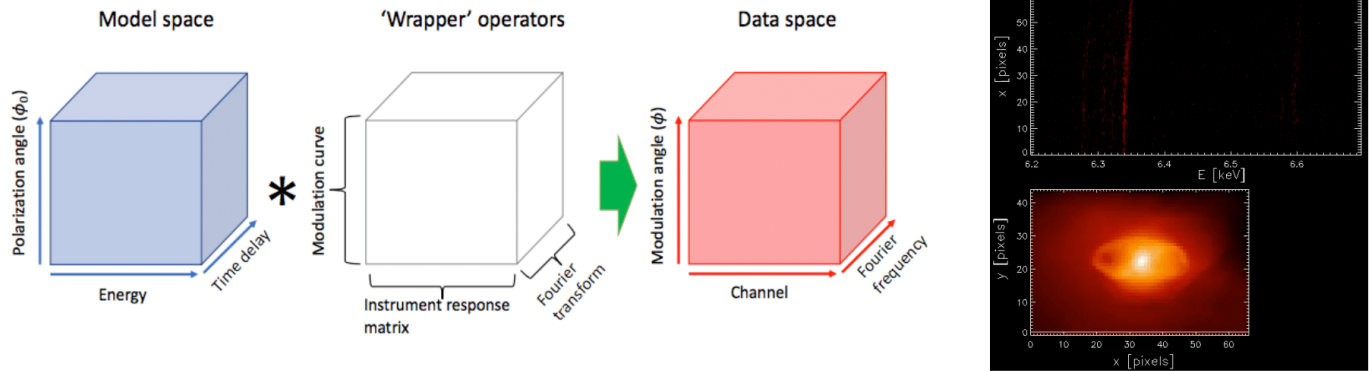
- Proposed ESA Mission of Opportunity with China with launch ~2025
- Simultaneous, high-throughput spectral, timing and polarimetry observations
- Strong European consortium, including significant NL community (UvA, RUG)
- Participation options - minimum (software), medium (hardware design), large (flight hardware)

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# NextSpec – Next Generation X-ray Analysis Software



- Modern software suite designed to support new X-ray spectral, spatial, and timing data
- Builds upon SPEX software and SRON expertise in high resolution X-ray spectral analysis
- Collaboration with UvA, Leiden, RUG, and SRON (basic NL contribution to eXTP)
- Specifically targeted at advanced analysis of XRSIM, eXTP, and Athena data

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## Small Satellite Science Platform

*Supports wide range of science cases  
(Earth, Planetary exploration, Exoplanets,  
Radio Astronomy, Space weather)*

*Low cost (<5 M€), fast development (3-5 yrs)*

*Broad NL research and industrial involvement*

*Community workshop  
planned for Oct 2019*

# Technology Research Program



The Technology research program supports SRON's strategic long-term plans, driven by the science goals of the Astro, Earth and Exo program lines. Activities usually are at low technology readiness levels ( $TRL \leq 5$ )

## Research themes $\Rightarrow$

- Cryogenic sensors (direct detector arrays and heterodyne)
- Read-out electronics
- Ultra-high contrast imaging and optics
- Focal plane assembly
- Instrument concepts and demonstrators to raise TRLs

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## Near term Priorities

### • Astrophysics

- Prepare for science with XRISM
- Focus on Athena XIFU development and schedule
- Prepare for SPICA/SAFARI mission selection in 2021
- Explore NL participation in LISA and eXTP

### • Earth science

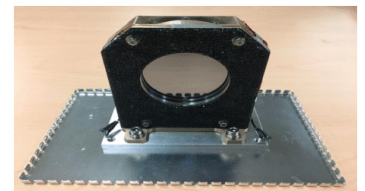
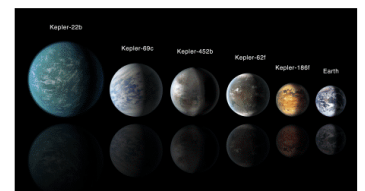
- Focus on construction phase of SPEXone instrument
- Prepare for phase B of MAP instrument on ESA/EC CO2M/Sentinel-7

### • Exoplanets

- Maintain science and calibration roles in ARIEL and PLATO
- Explore options for an expanded hardware role in PLATO

### • Technology development

- Advance current technologies in TES/FDM, KID/mu-wave
- Initiate optics development line in collaboration with TUD/Leiden



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# ESA Voyage 2050 Planning Process



→ **DISCOVERING OUR UNIVERSE**  
Share your views on future directions for space science  
March – June 2019



[sci.esa.int/discovering-our-universe](http://sci.esa.int/discovering-our-universe)



European Space Agency

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*Thanks for your attention!*

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