

David Hobbs
Lund Observatory
Sweden

# A GaiaNIR Consortium

- The ESA Ministerial Council meeting is in November
   2025 and ESA will get its new budget!
- We may have to make a proposal in 2026/27 for GaiaNIR
- Currently we are working on a new White Paper focused on technical performance of GaiaNIR
- Each country will have at least one co-PI (S, M, L)
- The co-PI must interact with the funding agencies and SPC representatives to put GaiaNIR on the map



Data Processing Centres

Small external contributions from: Algeria, Brazil, Chile, China, Israel, United States, European Southern Observatory

Gaia DPAC - 2017 - all countries in dark blue participate in Gaia DPAC

# GaiaNIR Working Groups

- Galactic Structure and Dynamics
- Relativity & Fundamental Physics
- AGN & Reference Frame
- Extragalactic
- Solar Neighbourhood
- Stellar Physics & Stellar Types
- Grouping, clouds, associations & clusters
- Exoplanets
- Binaries

- Solar System
- Technology Detectors
- Spectroscopy RVS
- Spectroscopy RV
- Photometry
- Astrometry
- Crowding
- Variables
- Transients

- Dark Matter
- Cosmology
- Multi-messenger
- White papers
- Proposals
- Webpage
- Outreach

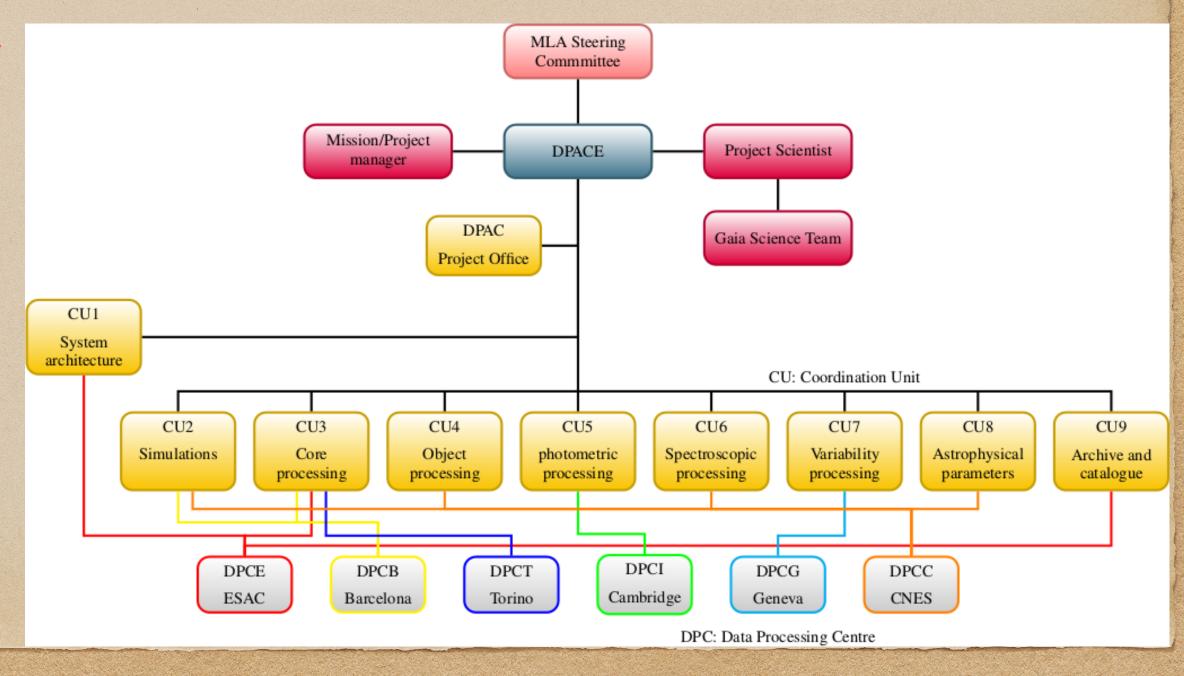
https://www.gaianir.org/

### GaiaNIR DPAC

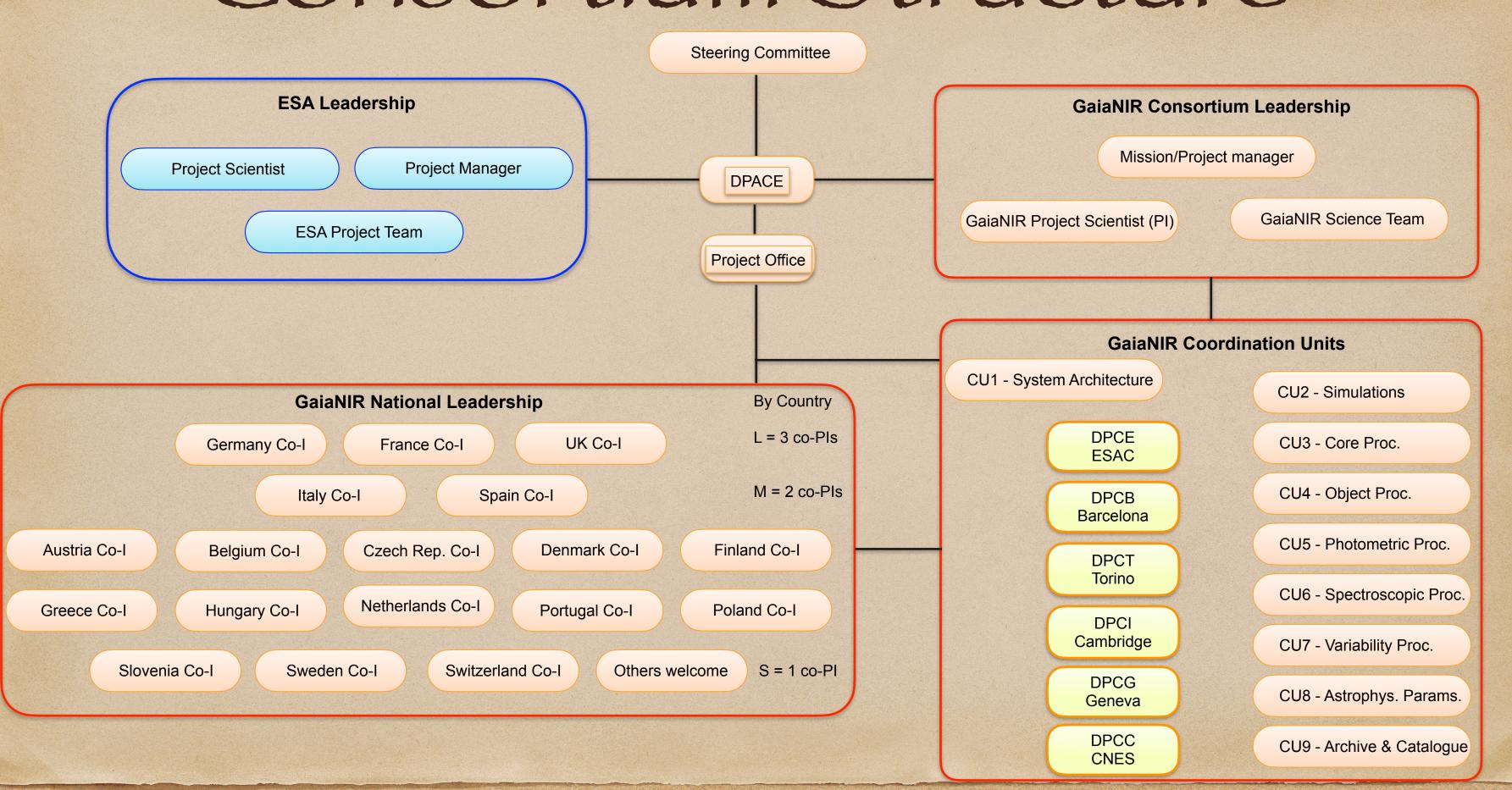
What are the lessons learned from Gaía's organisation?

What do we want to change?

What do we want to keep?



### Consortium Structure



## The Consortium

- A basic version of the GaiaNIR consortium needs to be in place next year
- Gaía will end in early 2030's and we want to retain people and knowledge for GaíaNIR
- Establishing a consortium with Co-l's in each country will allow people:
  - to begin discussions with funding agencies for a long term commitment if selected
  - to ask their funding agencies for student and postdoc grants
- Co-l's must actively engage with the funding agencies and SPC representatives to put GaiaNIR on the map



# White papers

- A new White Paper focused on technical performance of GaiaNIR is being prepared and we want to use this to attract people to work on GaiaNIR
- The older White paper mainly on science cases needs to be updated
- · Both papers will form the basis for a detailed proposal in a few years

### The GaiaNIR Project

Concepts, design and performance assessment of the mission

Lund Observatory, Division of Astrophysics, Department of Physics, Lund University, Box 43, SE-22100, Lund, Sweden.

e-mail: david.hobbs@fvsik.lu.se\*

e-man: uaviu.noous@rysik.iu.se
University of Alexandria, Department of Cosmic Geometry, Egypt. e-mail: c.ptolemy@hipparch.uheaven.eg

Received September 15, 2026; accepted March 16, 2027

Context. ESA's long term plan for its science program themes "Voyage 2050" was revealed in June of 2021. The large class mission themes focused on moons of the giant Solar System planets. temperate explanets or the galactic ecosystem. and new physical probes Context. ESA's long term plan for its science program themes "Voyage 2050" was revealed in June of 2021. The large class mission themes focused on moons of the giant Solar System planets, temperate exoplanets or the galactic ecosystem, and new physical probes of the early Universe as possible choices for the launch window 2034–2050. Our white paper on "All-Sky Visible and Near InfraRed themes focused on moons of the giant Solar System planets, temperate exoplanets or the galactic ecosystem, and new physical probes of the early Universe as possible choices for the launch window 2034–2050. Our white paper on "All-Sky Visible and Near InfraRed (NIR) Space Astrometry" [Hobbs et al 12021] fitted perfectly within the theme of the galactic ecosystem. The project aimed to build of the early Universe as possible choices for the launch window 2034–2050. Our white paper on "All-Sky Visible and Near intraked (NIR) Space Astrometry" [Hobbs et al.] [2021] fitted perfectly within the theme of the galactic ecosystem. The project aimed to build on the success of the Gaia mission by extending the wavelength range into the NIR to reveal the hidden regions of our Galaxy. (NIR) Space Astrometry Hobbs et al. [2021] fitted perfectly within the theme of the galactic ecosystem. The project aimed to on the success of the *Gaia* mission by extending the wavelength range into the NIR to reveal the hidden regions of our Galaxy.

Aims. The *GaiaNIR* mission would discover at least 15 billion new objects that remained hidden to *Gaia*'s gaze but also important. on the success of the *Gaia* mission by extending the wavelength range into the NIR to reveal the hidden regions of our Galaxy.

Aims. The *GaiaNIR* mission would discover at least 15 billion new objects that remained hidden to *Gaia*'s gaze but also improve the astrometry measurements of the existing vast catalogue of almost 2 billion sources from *Gaia*. ESA had already conducted a Aims. The GaiaNIR mission would discover at least 15 billion new objects that remained hidden to Gaia's gaze but also improve the astrometry measurements of the existing vast catalogue of almost 2 billion sources from Gaia. ESA had already conducted a the astrometry measurements of the existing vast catalogue of almost 2 billion sources from Gaia. ESA had already conducted a the astrometry measurements of the existing vast catalogue of almost 2 billion sources from Gaia. ESA had already conducted a concurrent Design Facility (CDF) study of the GaiaNIR mission in 2017 but since then the concept has evolved and new ideas have the astrometry measurements of the existing vast catalogue of almost 2 billion sources from Gaia. ESA had already conducted a Concurrent Design Facility (CDF) study of the GaiaNIR mission in 2017 but since then the concept has evolved and new ideas have emerged which would greatly enhance the science return if they can be implemented within the mission budget.

emerged which would greatly enhance the science return if they can be implemented within the mission budget.

Methods. This paper extends the earlier Voyage 2050 white paper by considering how these new concepts can be implemented, their Methods. This paper extends the earlier Voyage 2050 white paper by considering how these new concepts can be implemented during the science return and also the impact of new types of NIR detectors. suitable for a scanning mission. which have matured during the science return and also the impact of new types of NIR detectors. Concurrent Design Facinity (CDF) study of the Gaianir mission in 2017 but since then the concept has evolved emerged which would greatly enhance the science return if they can be implemented within the mission budget.

Methods: This paper extends the audion Venness 2000 white paper by considering how those next cancer as a considering for the control of the contro is paper extends the earlier Voyage 2050 white paper by considering how these new concepts can be implemented, their and also the impact of new types of NIR detectors, suitable for a scanning mission, which have matured during the pages.

intervening years.

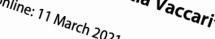
Results. Our new proposal result in a mission that can outperform the Gaia mission and improve on many of the science cases for

Experimental Astronomy (2021) 51:783-843 https://doi.org/10.1007/s10686-021-09705-z

All-sky visible and near infrared space astrometry David Hobbs 1 . Anthony Brown 2 . Erik Høg 3 . Carme Jordi 4 .

Tanga 6 . Sergei Klinner 7 . Alessar David Hobbs 1 Anthony Brown 2. Erik Høg 3. Carme Jordi 4. Valeri Makarov 12. Nicholas Walton 10. Antonella Vallenari 11. Nathan Secrest 12. Roger Mor 4. Jeff J. Andrews 3. Sozzetti 8.

Valeri Makarov<sup>12</sup>
Paul J. McMillan<sup>1</sup> · Jan Rybizki<sup>13</sup> · Fran Jiménez-Esteban<sup>14</sup>
Daniel Hestroffer<sup>18</sup> · Cristina Chiappini<sup>16</sup> · Johan P. U. Fynbo<sup>3</sup> · Yuan-Sen Ting<sup>17</sup> · Oscar A. Gonzalez<sup>22</sup> · Mattia Vaccari<sup>23</sup>, 24 Received: 24 July 2020 / Accepted: 28 January 2021 / Published online: 11 March 2021





# Webpage

- We have a basic webpage but it is only maintained by myself
- We need to brain storm about how to develop this more
- You can sign up to register your interest in GaiaNIR under "The Consortium" tab:

https://www.astro.lu.se/form/register-your-interest-gaianir

The main url is:

https://www.gaianir.org/

### All-Sky Visible and Near Infrared Space Astrometry

Search this site

Department of Astronomy and Theoretical Physics, Lund University

Research Education News Events Meetings Resources People Outreach

Start > All-Sky Visible and Near Infrared Space Astrometry

The Vision (>)

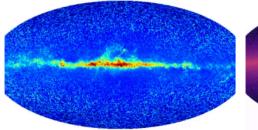
Mission Summary 🕥

The Consortium (>)

Science and technology roadmap for µas studies of the Milky Way 🛇



The Art of Astrometry and Computation 🕥





### Science Cases 🕥

All-sky NIR astrometry to peer through the dust of the Milky Way to reveal the hidden regions of the Galaxy

All-sky visible astrometry to combined with the older Gaia catalogue and a 20 year interval will give very accurate proper motions and improved parallaxes needed to measure larger distances

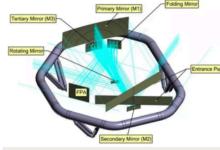
Re-initialise the slowly degrading accuracy of the Gaia visible reference frame back to





### Mission Design 🕥

The space telescope will be based on an offaxis f=35m Korsch telescope similar to that used for Gaia. New detectors are being developed that will enable Near InfraRed astrometry and will operate in Time Delayed Integration mode to accumulate the faint stellar light as the telescope scans the entire

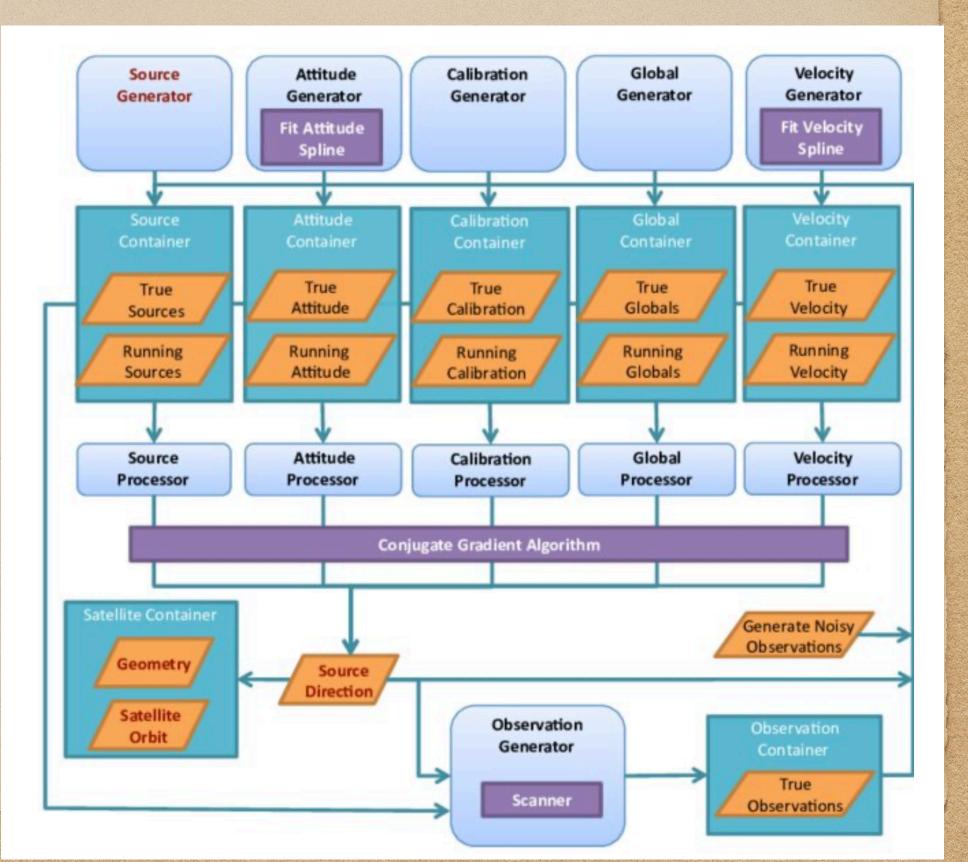


### The Timeline 🕥

Ideally the telescope should be launched around 2045 to allow a sufficient time gap between Gaia and the new mission. The long time baseline will ensure that the accuracy of the proper motions will benefit. The mission aims to include international partners and will be suitable as an ESA Large-class or mediumclass mission.

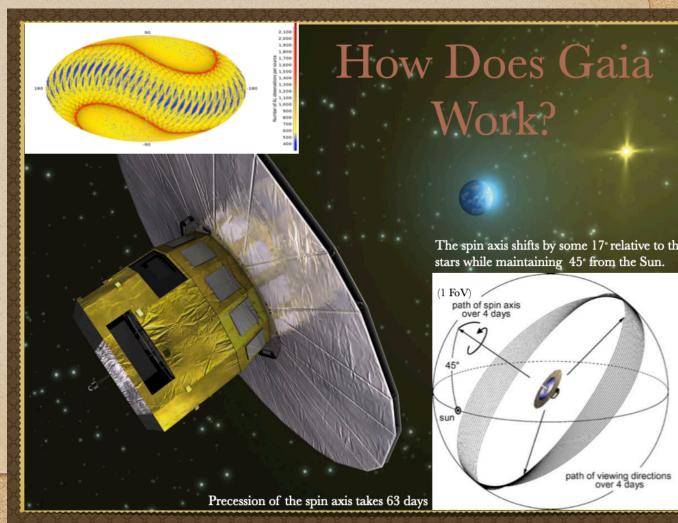
# GaiaNIR Data Processing

- For Gaía we developed AGISLab as a scaled down simulator for Gaía observations
- This was very important for developing the algorithms of the core astrometric solution for Gaia
- For GaiaNIR we need a similar tool but....
   what did we learn?
- Gaia could have been easier if we had thought about this before



# GaiaNIR Data Processing

- GaiaNIRLab should be able to operate in two ways
  - In scaled down simulation mode using simulated data as input. This will be used for developing algorithms and testing ideas
  - In unscaled operational mode using real data as input. This will be used for operational runs
- Most code should be common and developed in a common scientific language. At the moment Python is the only viable option although others may emerge



# GaiaNIR Data Processing

- Challenges:
  - Most code is developed by students who are not used to ESA standards of development, testing and documentation
  - The code will be developed in a distributed university environment where the priority is to get a Phd or paper not a catalogue
  - The code must be designed to allow students to work in parallel developing ideas that may or may not be used for operations
  - Lessons could be learned from other projects, for example, the Vera Rubin project

