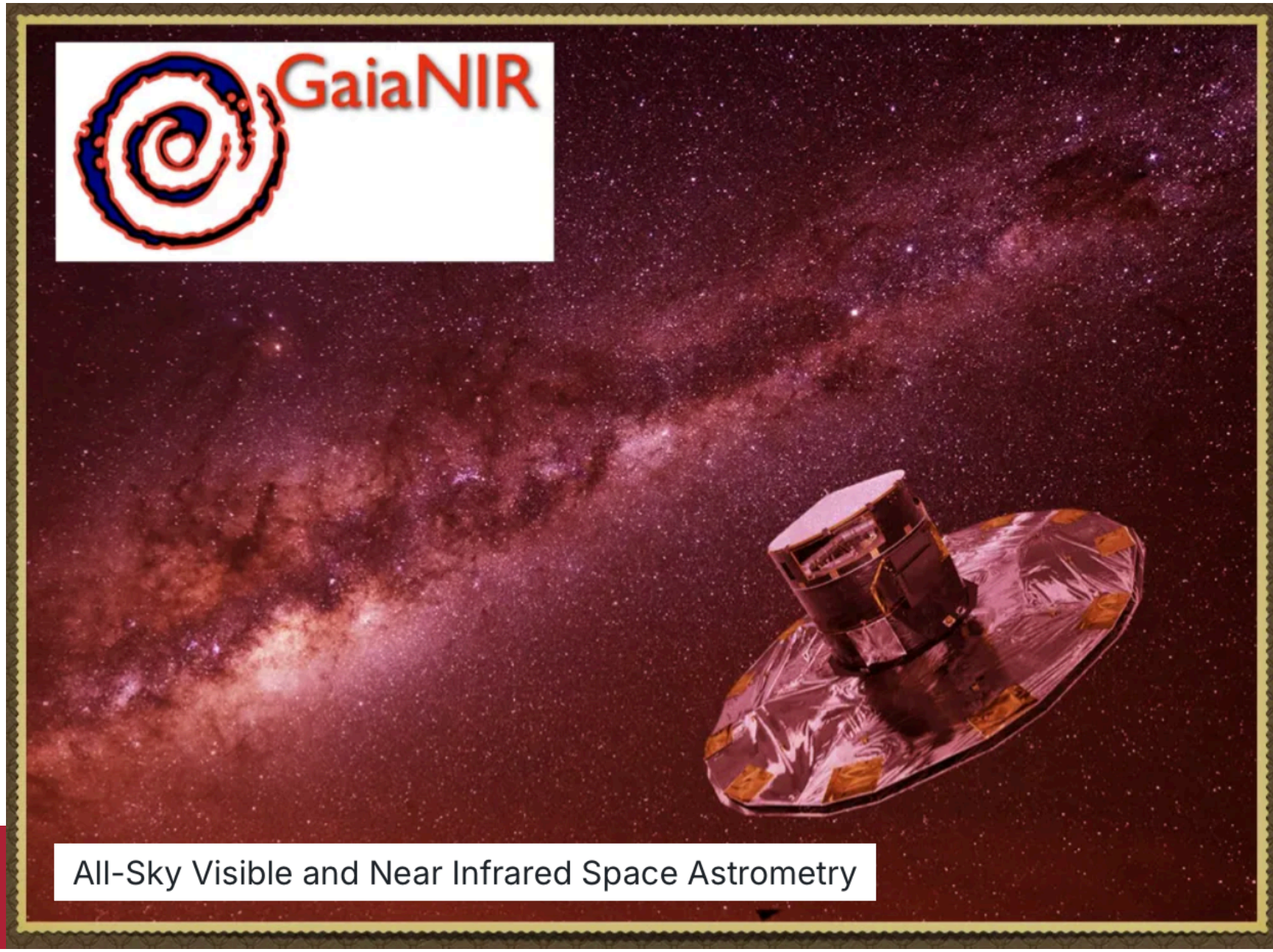


Timo Prusti
Masaryk University

Background

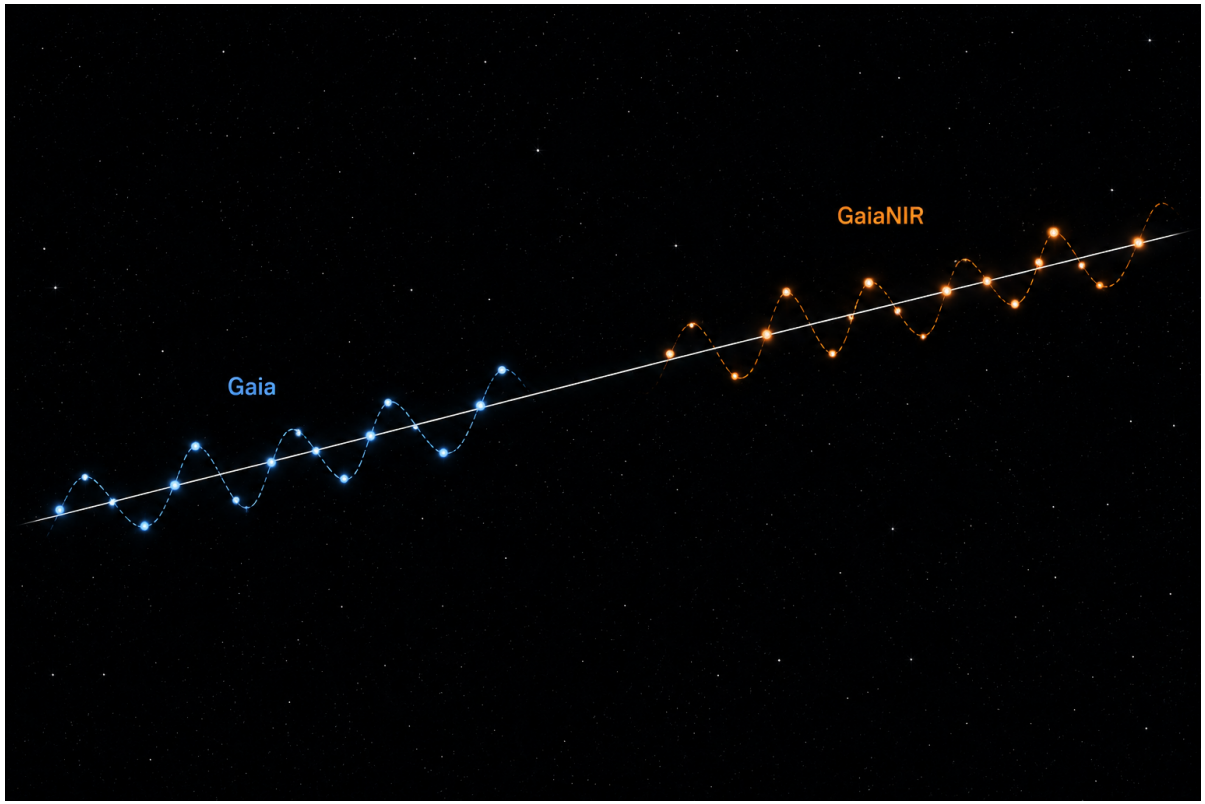
- After 18 years ESA project scientist for Gaia now visiting professor at Masaryk University working in Tereza Jerabkova's group

- Gaia is an ESA corner stone mission that was operational 2013-2025
- Main method astrometry complemented with photometry and spectroscopy
- Main science goal the Milky Way structure and evolution
- 3 data releases with DR4 coming out 2 December this year covering the first 5.5 years of the mission
  - Today 16,000+ refereed publications and last 5 years 2,000+ per year
- Data Processing and Analysis Consortium will work toward DR5, the Legacy archive, to be released 2030 covering all data

- Highly successful Gaia triggered discussions of the continuation …

GaiaNIR

- Move from Gaia optical wavelengths to near infrared => GaiaNIR
- Reveal structures in our Milky Way where Gaia is hampered by dust extinction
- For common sources improve astrometry especially for motion



New science

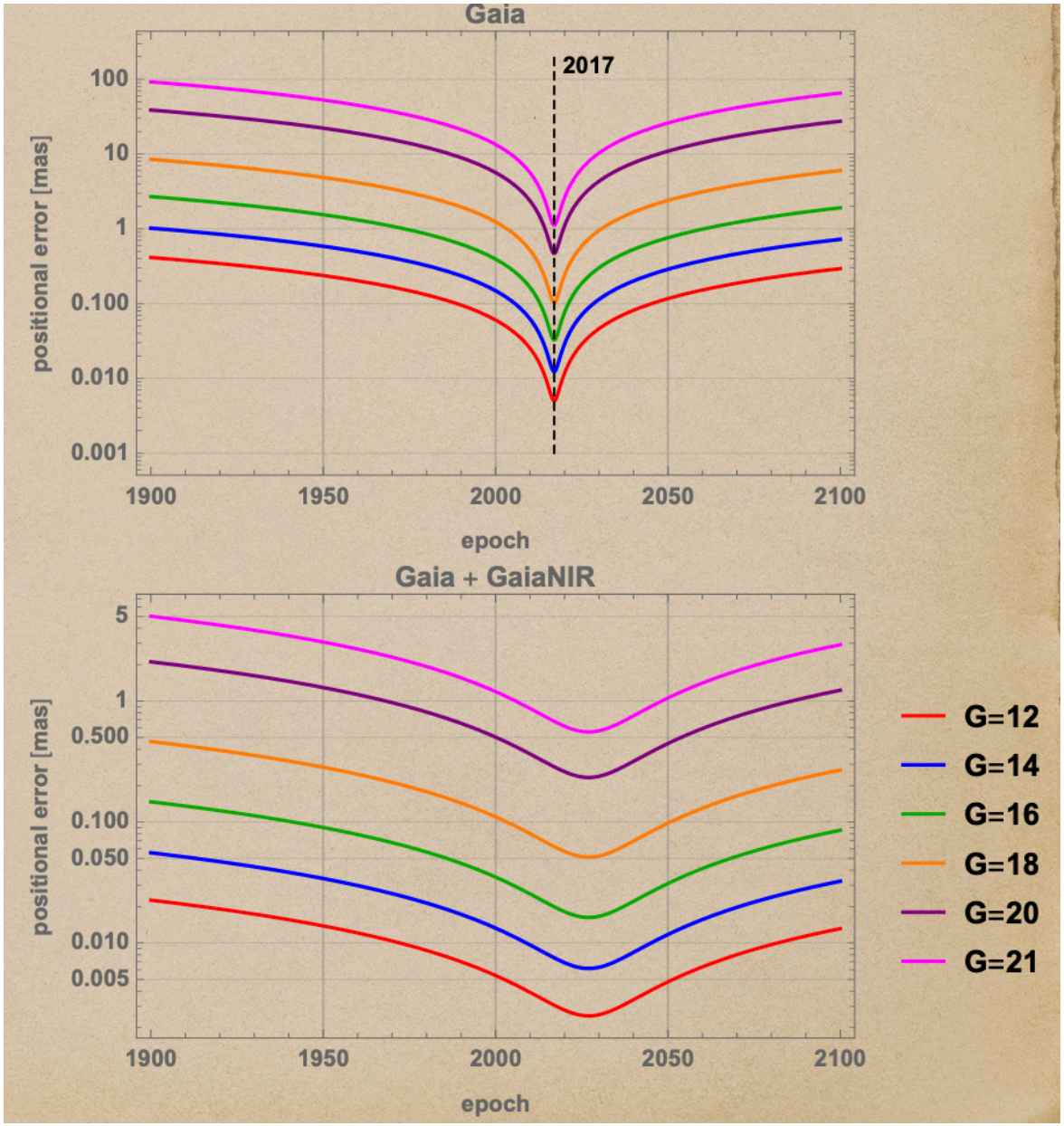
- Dusty Bulge/bar region is dynamically important for the Milky Way
- Chase intermediate mass black holes in embedded clusters
- Probe dark matter in the thin and thick disc and spiral arms
- Unveil the inner disk which is not well known
- Map in detail the dusty spiral arms - astrometry for 100’s of millions of objects
- Exoplanets in dusty and star forming regions
- Study internal & bulk dynamics of young clusters
- Many other science cases: brown dwarfs, M-dwarfs, cool white dwarfs, free floating planets, period-luminosity relations of red Mira’s, etc.

Science from improved accuracy

- Improved proper motions allow sub-structure in streams, dwarf galaxies and the Halo to be resolved
- Better estimates of Galaxy mass and help resolve the cusped/core (flat) dark matter Halo problem
- Question of intermediate mass black holes in globular clusters, like Omega Centauri, may be addressed
- Internal dynamics of local group galaxies, dwarf spheroids, globular clusters, and the Magellanic Clouds
- Map the dark matter sub-structure in the local group
- Vastly improve measurements of the rotation curve
- Proper motions of hyper-velocity stars to trace their origin and constrain triaxial models
- Exoplanet & binary detectable periods up to 40 yr with Gaia + GaiaNIR (Saturn P=29 yr). Solar system analogue survey!
- Wide binaries to test alternative gravity theories
- Solar System orbits for >100,000 objects - greatly improved
- Improve knowledge of Solar System acceleration
- Address low frequency gravitational waves question

Reference frame

- Due to proper motion uncertainties, the optical reference frame degrades in time
- Adding GaiaNIR will make this degradation much slower
- In addition to radio and optical reference frames GaiaNIR will provide an infrared frame

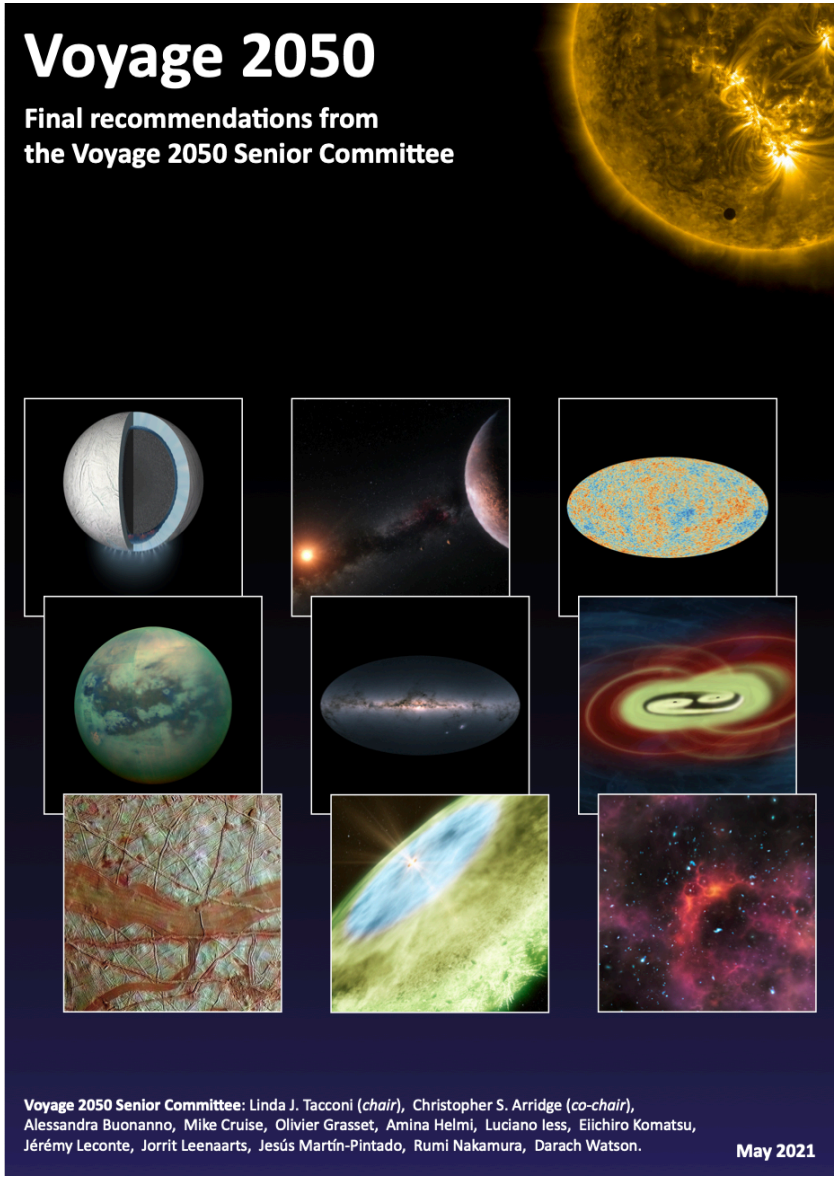


A bit of history

- In 2016 ESA announced a call for new and innovative science ideas for future space missions
  - 26 proposals were received and 3 were selected for further study - including NIR global astrometry
  - In late 2017 ESA conducted a Concurrent Design Facility (CDF) study of the proposal and the results were published in early 2018
  - Identified needs for technology development
- A Voyage 2050 science case white paper was submitted August 2019
  - Out of 95 proposals 4 themes, including Milky Way science, were selected in 2021 for L missions

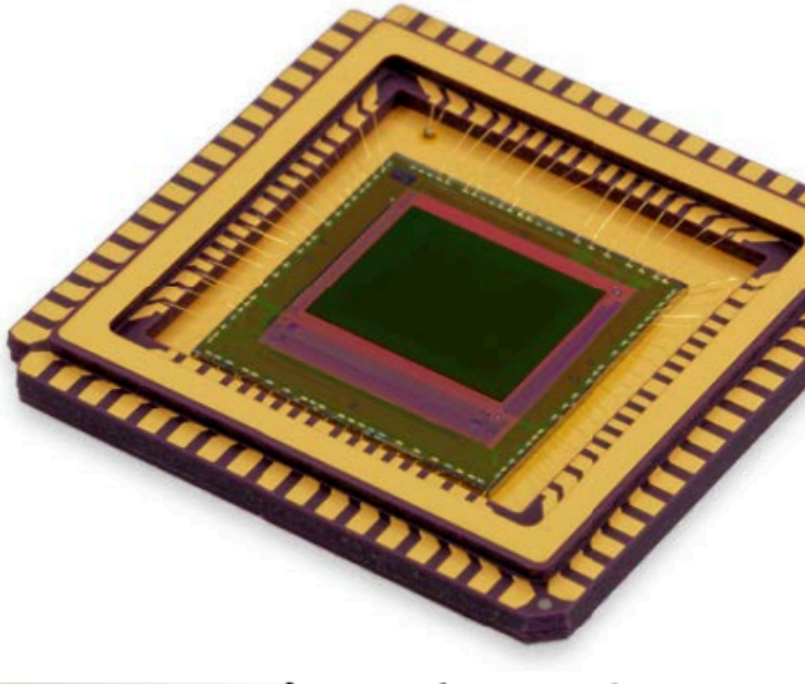
Voyage 2050

- For period 2035-2050 the L missions should address:
  - Moons of the giant planets
  - From temperate exoplanets to the Milky Way
    - Two themes implying further selection down the line
  - New physical probes of the early Universe
- Continuation of M class missions
- Mission selection based on proposals



GaiaNIR in Voyage2050

- GaiaNIR could be an M class mission with partners (or without radial velocity spectroscopy)
- GaiaNIR (or exoplanet mission) should be an L class mission
- Technology studies initiated to enable L class missions
  - For GaiaNIR detector technology is a key element and progress is being made with APDs



The SAPHIRA is a 320×256 pixel linear-mode avalanche photodiode array capable of ‘noiseless’ readouts via an upstream signal multiplication of several hundred.

The way forward

- Main site for GaiaNIR: https://www.astro.lu.se/GaiaNIR (PI David Hobbs, Czech lead Tereza Jerabkova)
- Construction of consortium on-going with work on science cases and technology
  - Expressions of interest to join through the web pages
- Somewhere toward 2030 higher gear for preparing a concrete proposal
- Design and building the mission in the 2030s
- Launch in the 2040s

The way forward for Czech participants

- At this stage more of interest to (young) astronomers working on GaiaNIR science topics
  - This will eventually lead to being part/building the data analysis consortium
- For instrumentation the Czech possibilities may be in the spectroscopy part
  - The current spectroscopic opportunities are there
  - GaiaNIR opportunity is a sign that focus on spectroscopy has also a long term future