

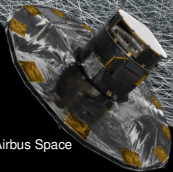


Reflections on Gaia

Anthony Brown

Leiden Observatory, Leiden University

brown@strw.leidenuniv.nl

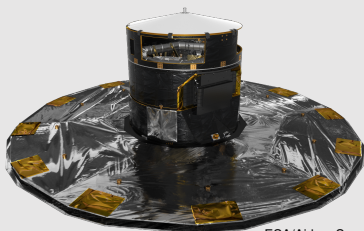


Airbus Space

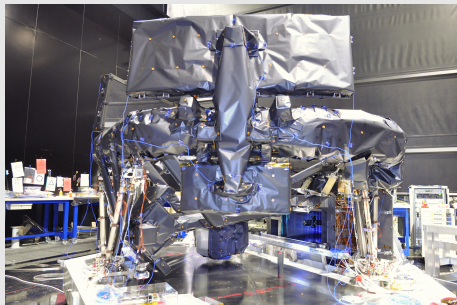
ESA/Gaia/DPAC

Gaia mission summary

- Astrometry and spectrophotometry for ~ 2 billion objects
- Radial velocities for ~ 100 million objects
- Survey
 - ▶ Complete to $G = 20.7$ ($V = 20\text{--}22$)
 - ▶ Autonomous on-board source detection, unbiased
 - ▶ Quasi-regular time-sampling, ~ 140 observations over 10 years
- Launch December 2013
- Operational at L2: Jul 2014 – Jan 2025
- ◆ Gaia DR3 June 2022 (2.8 yrs data)
- ◆ Gaia DR4 Dec 2026 (5.5 yrs data)
- ◆ Gaia DR5 Q4 2030 (10.5 yrs data)

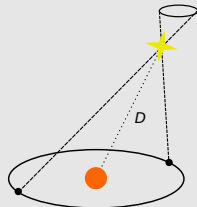
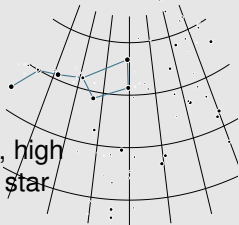


ESA/Airbus Space



Gaia collects fundamental astronomical data

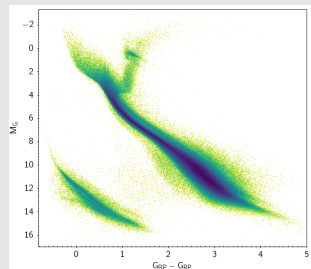
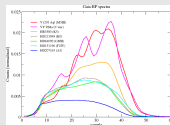
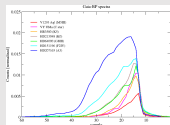
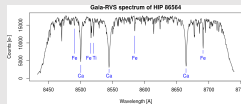
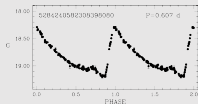
All-sky,
complete, high
accuracy star
atlas



Parallaxes and proper
motions



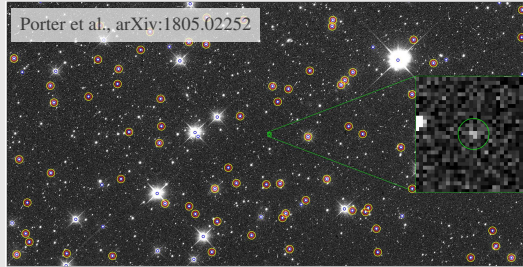
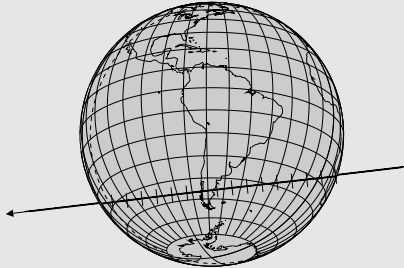
Astrometric,
photometric,
spectroscopic,
radial velocity
time series



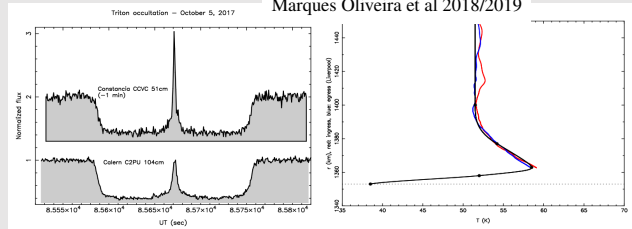
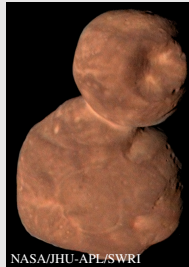
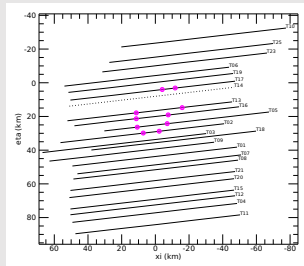
Astrophysical properties

The impact of Gaia

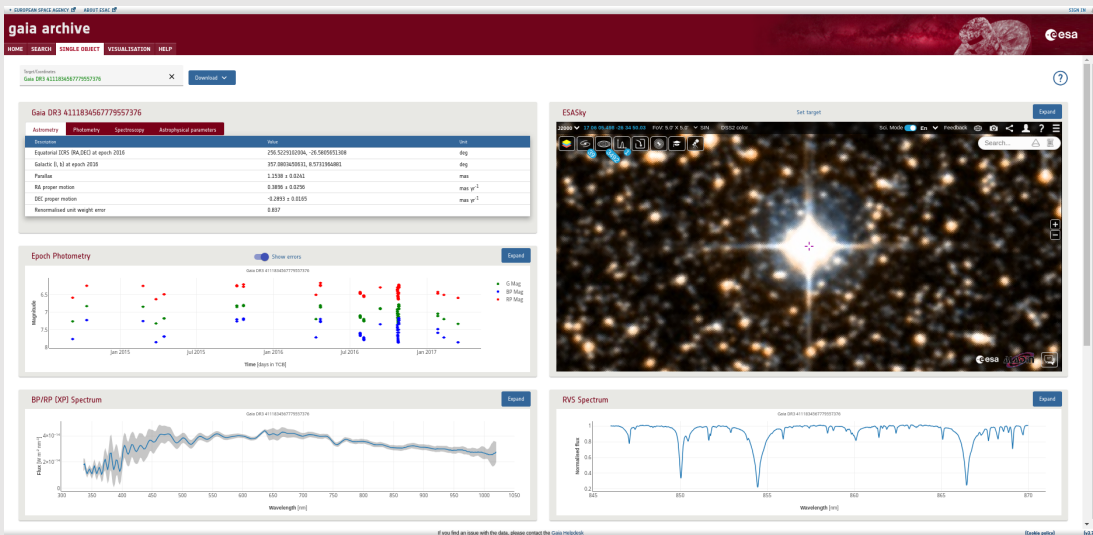
High accuracy dense star atlas to faint magnitudes



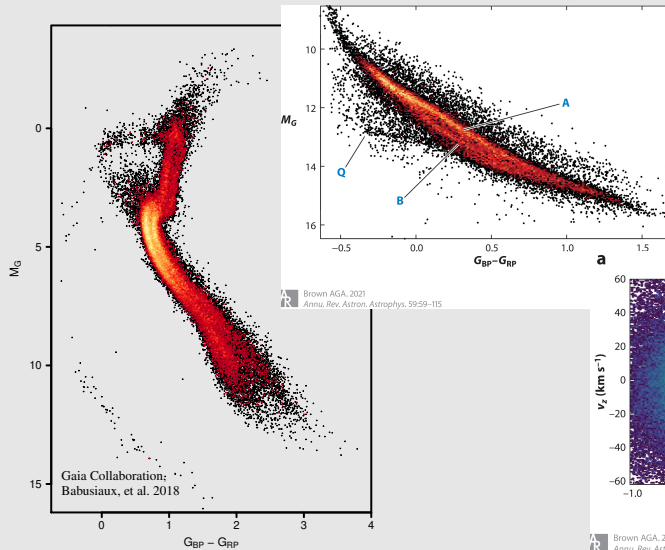
Buie et al 2020, AJ, arXiv:2001.00125



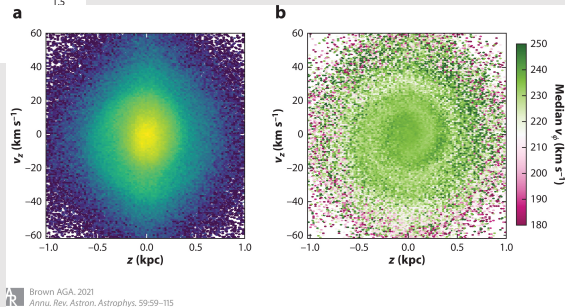
Easily available fundamental astronomical data



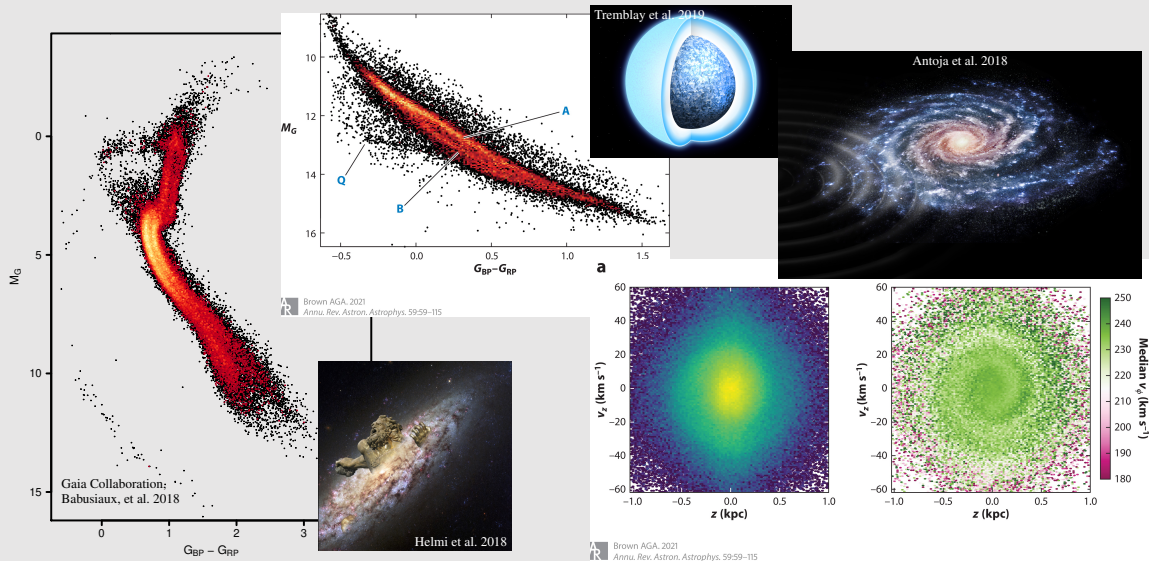
Dense sampling of CMD and phase space



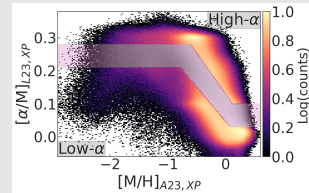
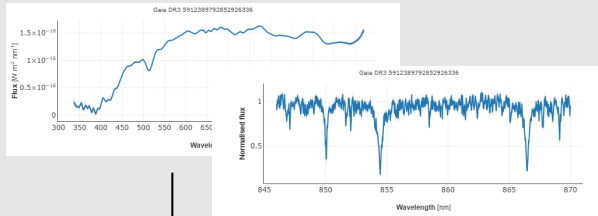
Brown AGA, 2021
Annu. Rev. Astron. Astrophys. 59:59–115



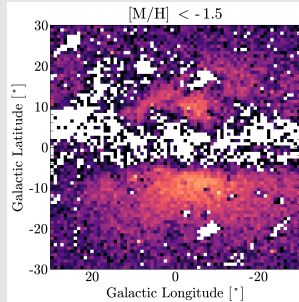
Dense sampling of CMD and phase space



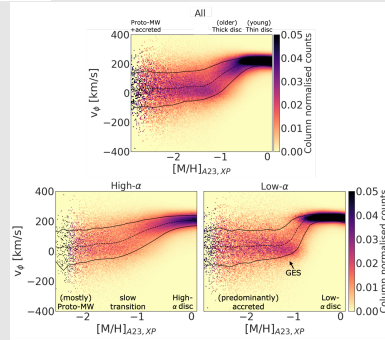
Astrophysical properties for large numbers of sources



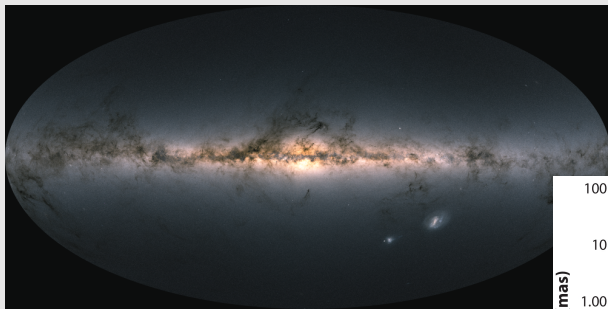
Viswanathan et al. 2024



Rix et al. 2022

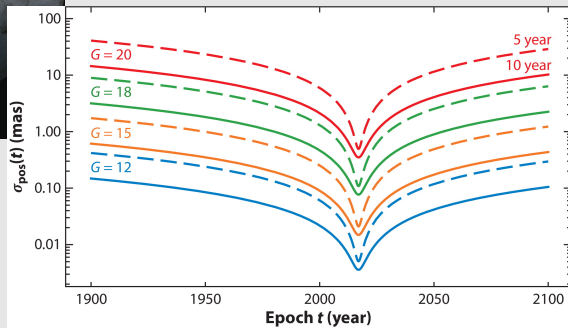


Calibration of past and future surveys

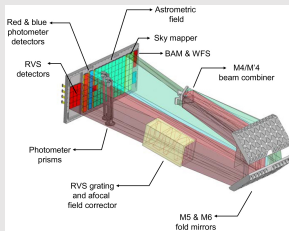


All-sky homogeneous photometry and spectroscopy

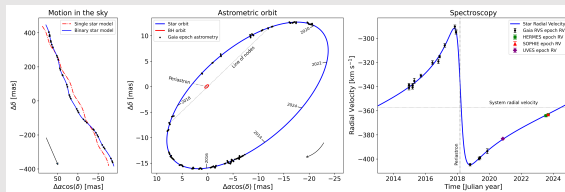
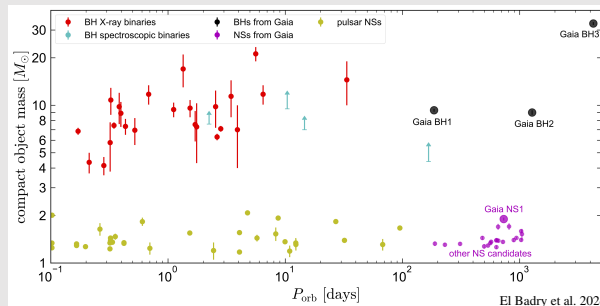
Dense high accuracy stellar reference frame



Time series of simultaneous measurements



Airbus Space

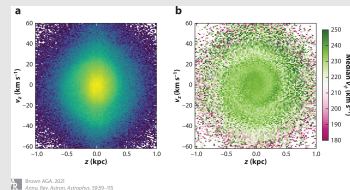
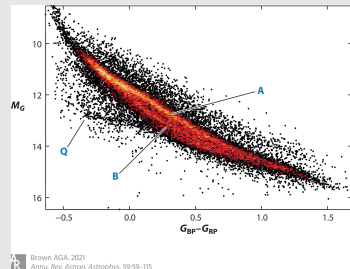


Gaia Collaboration, Panuzzo, et al. 2024

- Quasi-simultaneous time series
 - ▶ astrometry + broad-band photometry
 - ▶ low-resolution BP/RP spectra
 - ▶ high-resolution RVS spectra
- Very rich data set for each observed source
- Enables all-sky transient science

The impact of Gaia

- Gaia is revolutionizing astronomy through a vast set of **easily available fundamental data**
- Definitive demonstration of the **power of an all-sky, high spatial resolution, high astrometric and photometric accuracy survey**
- **Dense sampling of Galactic phase space** at high astrometric, photometric, and radial velocity precisions
 - ▶ uncovering subtle features in phase space and the observational HR diagram
 - ▶ enabling Galactoseismology
- The celestial reference frame provided by **Gaia enables the accurate astrometric and photometric calibration of past, current, and future sky surveys**
- Accurate star map with parallaxes and proper motions allows for **vast improvements in stellar occultation campaigns**
 - ▶ shape measurements of Kuiper-belt objects at < 1 km resolution, limits on atmospheres
 - ▶ enhanced spacecraft navigation and mission planning



- Be ambitious in survey depth and resolution
- Low resolution prism spectra are a must to complement the astrometry with astrophysical properties
 - ▶ Well-designed set of narrow filters could also work
- Radial velocities to complement astrometry must be collected by GaiaNIR
 - ▶ No ground based survey will come close in numbers
- Abundance information essential to Milky Way studies
 - ▶ Optimize spectroscopy for radial velocities **and** abundance information