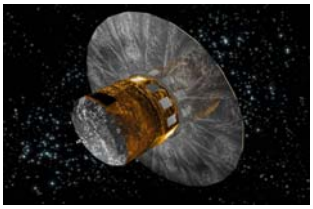

ESAC and the Gaia Catalogue

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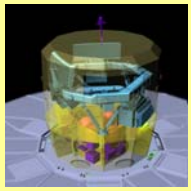
Abstract

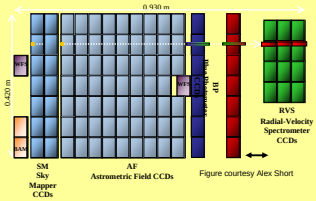
The Gaia mission will rely on the proven principles of ESA's Hipparcos mission to solve one of the most difficult yet deeply fundamental challenges in modern astronomy: to create an extraordinarily precise three-dimensional map of about 1 billion stars aiming at star magnitudes up to 20 throughout our Galaxy and beyond. The Gaia overall Ground Segment is composed of two main elements: the Mission Operations Ground Segment (consisting of the core MOC and the Ground Stations supporting the mission) and the Data Processing Ground Segment (the SOC at ESAC and DPCs). ESAC will also host the final Gaia catalogue.

GAIA

The **Gaia spacecraft** is comprised of a payload module, and a mechanical and electrical service modules.

It will be placed in an orbit around the Sun at L2. One of the advantages is that L2 offers uninterrupted observations.

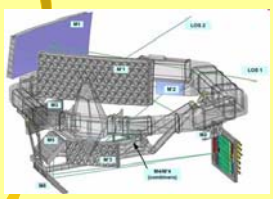




The **Focal Plane (FPA)** of Gaia comprises all Gaia instruments: the Astrometric Field (AF), the Photometric Field (BP/RP) and the Spectrometric Field (RVS), as well as the Sky Mapper (SM), the Basic Angle Monitoring (BAM) and the Wavefront Sensor (WFS). It is a huge Focal Plane with 106 CCDs, 938 million pixels in total. Its size is approximately half a square-meter representing a total active area of 0.75 deg^2.

Gaia contains two identical **telescopes**, pointing in two directions separated by a 106.5deg basic angle and merged into a common path at the exit pupil. The optical path of both telescopes is composed of six reflectors (M1-M6), the last two of which are common (M5-M6). Both telescopes have an aperture of 1.45m x 0.5m and a focal length of 35m.

The telescope elements are build around the hexagonal optical bench with a 3m diameter, which provides the structural support.



The **Cebreros ground station** with its 35m antenna supplemented by the New Norcia station (35m) will be used by Gaia during the routine (and extended) operational phase. The foreseen ground contact time available per day is 8 hours with Cebreros, extended to 16-18 hours when supported with New Norcia and the full visibility of Cebreros during scans of the sky containing high stellar densities (e.g. along the galactic plane)

ESOC – Darmstadt

The **MOC**, located in Darmstadt, Germany, is the sole interface with the Gaia satellite, i.e., all commands to the spacecraft and technology packages are generated at the MOC. All telemetry for the Gaia Satellite is routed to the MOC which is responsible for distributing them within the Gaia Ground Segment, in accordance with the different needs.

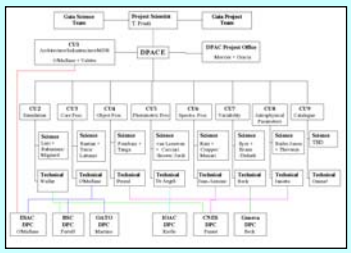
The MOC is responsible for safety and health monitoring of the satellite, including the technology packages.

The MOC is also responsible for LEOP operations, spacecraft commissioning operations, orbit maintenance and spacecraft on-board software maintenance throughout the mission

ESAC - Madrid

The **Data Processing Ground Segment** is jointly operated by ESAC and the Gaia DPAC. This is comprised of the Science Operations Centre (SOC) operated by ESA and a set of Data Processing Centres (DPCs). The SOC is at the same time a DPC (DPCE)

As the 'hub' in the Gaia Science Ground Segment, DPCE is the interface between the MOC and the other DPAC DPCs. It also has responsibility for interactions with MOC with respect to payload calibration and operations.



Gaia will produce an impressive volume of raw data with about 50GB of uncompressed science data per day, yielding at mission completion a telemetry data volume of roughly 100TB. Transforming the data into scientifically meaningful quantities is the task of the **Data Processing Analysis Consortium (DPAC).**

DPAC is comprised of a number of **Coordination Units (CUs)**. Each one is responsible for a well-defined part of the Gaia data processing.

For each CU there is at least one **Data Processing Center (DPC)** with dedicated resources for the data processing of the CU.

Science telemetry upon arrival at the SOC requires non-scientific pre-processing (packet reconstruction) and storage before being processed by the **Initial Data Treatment** (IDT).

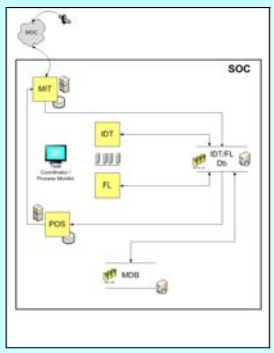
IDT extracts the raw sample data from the telemetry stream. IDT will also apply a basic calibration to raw astrometric data to create elementary observations, which are matched against known sources. An initial attitude estimate is also derived from the raw spacecraft attitude data.

This process requires reference data extracted from the Main Database. The outputs of IDT are also stored in the **Main Database**.

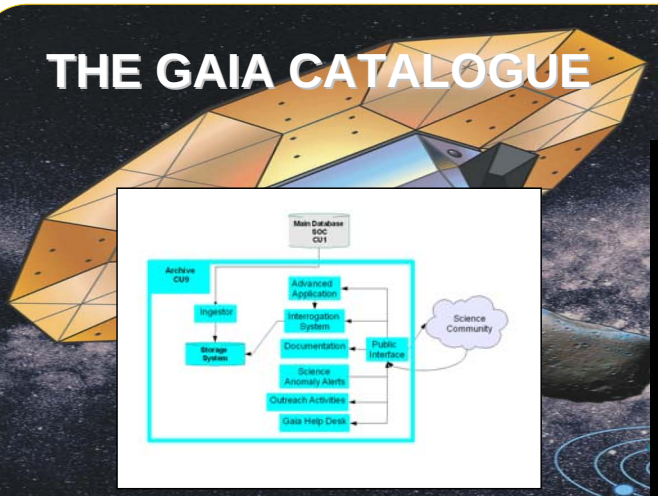
An initial calibration is derived from the science by the **First Look** (One-Day Calibration systems).

The First Look (Detailed First Look – DFL) also performs an in-depth scientific assessment of the status of the satellite and instruments in a sophisticated manner.

After IDT and FL run, the output is sent to all the DPCs.



THE GAIA CATALOGUE



The archive must deliver the Gaia data products to the science community. This mainly means making a suite of search and data mining tools available to the community to filter and interpret the catalogue.

The production of the catalogue will be integrated in DPAC later as the ninth Coordination Unit (CU9). ESAC must have a copy of the archive (although this does not preclude others institutes involved also having a copy).

At the time of the creation of this poster, the main components are:

- **COMMUNITY INTERFACE**
  The portal to access all Gaia data, documentation and support. The VO and/or other communities may provide some of what is needed
- **INGESTOR**
  To populate the archive with data from the Main Database
- **STORAGE SYSTEM**
  Physical disk, machines and DBMS
- **INTERROGATION SYSTEM**
  An efficient query engine will need to be presented to the community in an uniform manner. The DBMS will need to be tuned to answer the type of queries the astronomy community will ask. And it may also require some extra functionality, such as the HEALPix of HTM indexing to make spatial queries faster
- **ADVANCED APPLICATIONS**
  Along with the archive, some advanced interrogation tools shall be provided, such as 3D visualisation tools or perhaps a sky navigator
- **DOCUMENTATION**
  To describe the data, its processing, validation and access. This is the very large part of the archive activity
- **SCIENCE ALERTS**
  Anomaly science alerts, or announcements coming from the CUs can be distributed through the catalogue (e.g. variability announcements based on the light curve analysis)
- **PUBLIC OUTREACH**
  The catalogue is the "face" of the Gaia project and its product not only to the interested science community but also to the general public
- **HELP DESK**
  Should be ready to answer questions of the mission archive

There are still many open areas: cross-matching other catalogues, implications for maintainability, security, …, living archive, etc.
There will be more than one release: the first one probably two or three years after launch.

Image credits: Alex Short, Jos de Bruijne, William O'Mullane (ESA), ESA. Thanks to the Gaia Team at the SOC/ESAC, especially to M.Ramos, J. Fleitas, W.O'Mullane and H.Siddiqui.