

The CNES role in the GAIA data processing

Xavier Passot CNES Toulouse DCT/PS
Olivier La Marle CNES Paris headquarters DSP/EU



Summary

- The actions of the French space agency for space astronomy, particularly for Hipparcos.
- The supporting role of CNES for the French astronomy laboratories,
- The acting role in the DPAC consortium for the Gaia data processing
 - ◆ CNES is integrating the scientific chains of object processing (CU4), spectroscopic processing (CU6) and astrophysical parameters (CU8) in one processing centre.
 - ◆ It will be operated in CNES during the whole Gaia mission.

The actions of the French space agency for space astronomy

- **CNES is the French Space Agency**
- **It proposes and enhances the French space program**
- **It represents France at ESA**

- **The CNES mandate is detailed in pluriannual State-CNES agreements**

Extract : « To develop the knowledge and the technologies required to increase the performances and the competitiveness of the [French] scientific research and space industries

- ⇒ **To participate to the mandatory science program of ESA**
- ⇒ **To take part to a ambitious and credible solar system exploration program**
- ⇒ **To use the ISS for life sciences and sciences of the matter**
- ⇒ **To implement national-lead missions with high scientific and technological potentials**
- ⇒ **To develop the key technologies and the innovative concepts**

The actions of the French space agency for space astronomy

In the field of the Sciences of the Universe, the CNES program is science-driven :

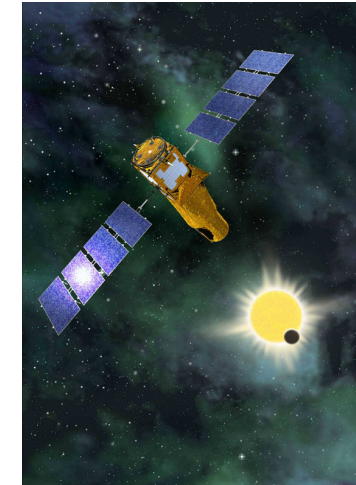
- Space missions, balloon experiments, participations to external missions are proposed by the scientific community (periodical announcements of opportunities)
- CNES performs the selection upon recommendations of scientific advisory structures
- CNES leads or supports the development of the selected proposals, in cooperation with French laboratories and external space agencies
- CNES leads or supports the operations and exploitation of the in-flight missions

The CNES intervention is multi-folded :

- R&T activities on key technologies for astronomical instrumentation and new mission concepts (in-house and/or contracts with laboratories/industries)
- Doctoral and postdoctoral grants
- Support for the project development, from financial support to the laboratories up to the full lead of the project
- Operation (or participation to the operations) of the mission, scientific exploitation (support to the laboratories)

Operational space astronomy programs

- **Corot : exoplanets and astroseismology**
 - ◆ launched in 2006
 - ◆ Joint project with astronomy laboratories and ESA



- **Herschel : Infrared observatory**
 - ESA program, launched 2009
 - CNES was participating to 3 instruments SPIRE, PACS et HIFI



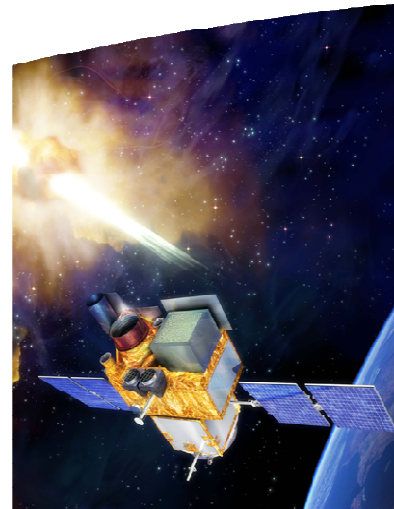
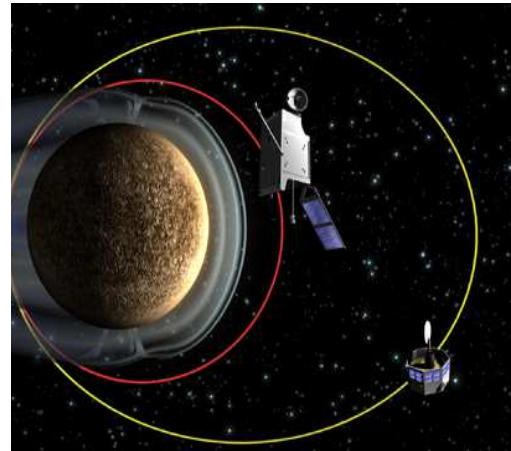
- **Planck : Submillimetric observatory :**
 - Cosmic Microwave Background
 - ESA program launched 2009
 - ◆ CNES was participating to the Planck-HFI instrument and to the data processing

On going projects

Bepicolombo Mercury exploration

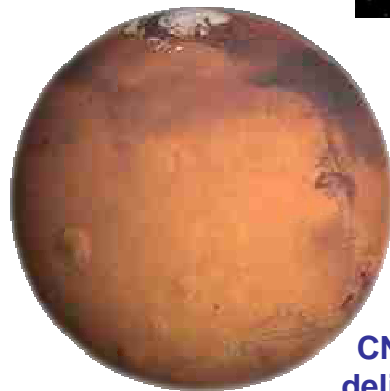
An ESA program, with Jaxa

CNES is primecontractor of the french participation of the laboratories for the instruments MPO et MMO



■ SVOM

- Gamma Ray Burst detection
- A CNES program, joint with the Chinese space agency
- Launch : 2014



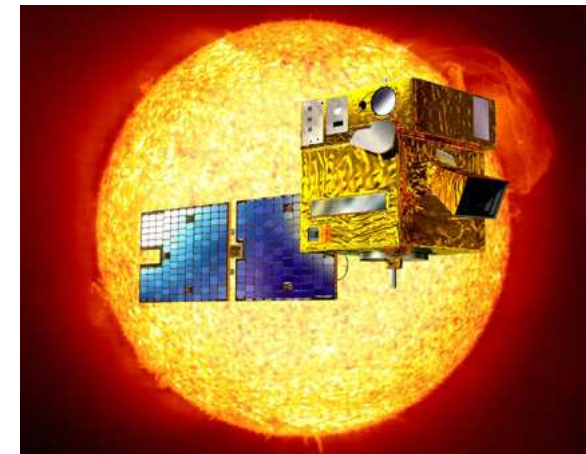
Exomars

An ESA program, with NASA

CNES will validate the deliveries of the french laboratories instruments :
WISDOM, MicrOmega, EISS, ARES et SEIS

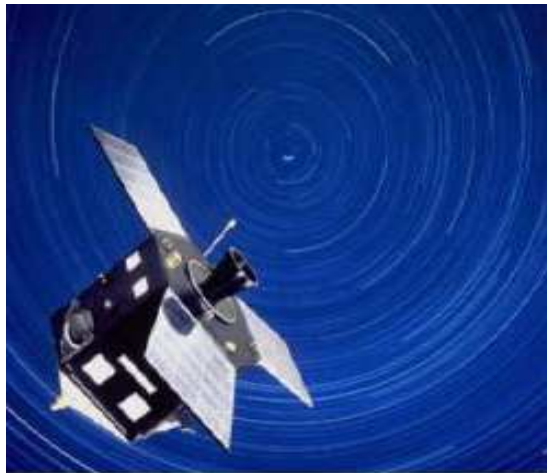
■ Picard

- Solar irradiance, Helioseismology
- A CNES program
- With french, belgian and swiss laboratories
- Microsatellite 150 kg
- *Launch next week from Yasni, on a Dniepr rocket*



Hipparcos : a success story

- **Reminder : the Hipparcos catalogue : 120 000 stars, 1 mas precision**
- **Launched in 1989 on a bad orbit : results better than expected !**



The Hipparcos data processing organisation

■ 3 consortia :

- ◆ **INCA (Input Catalogue, led by Catherine Turon) to build the first input catalogue (100 000 stars only, was a lot at that time). Select the stars, collect positions and magnitudes, organize ground observations**
- ◆ **FAST et NDAC processed the data separately, in such a way to cross-check the results**
- ◆ **NDAC with United Kingdom, Sweden, Denmark**
- ◆ **FAST (Fundamental Astronomy by Space techniques) with France, Italy, Germany, Netherlands**
 - Chaired by Jean Kovalevski, led by a steering committee with one representative per country, a technical committee, and a Sotwrae Advisory Group
- ◆ **TDAC: the Tycho consortium, led by Erik Høg then Lindegren, processing the Star-mapper data to produce the Tycho survey**

■ CNES was the prime contractor of the data reduction system.

- ◆ **Made of 6 software components : it was an iterative system on 6 months observation data.**

■ CNES, from 1982 to 1990, was in charge of :

- ◆ **System architectural design,**
- ◆ **Development of the DMCS (Data management and Command System) which managed and monitored the iterative computations and the global data base.**
- ◆ **System interface management : hundreds of file formats for thousands files**
- ◆ **Integration and validation of the FAST software items on the CNES computing Centre**
- ◆ **The operations of the data reduction system.**
- ◆ **The integration and operations of a mission simulator designed by CERGA**

■ CNES team :

- ◆ **led by Jean-Louis Pieplu, was in 1985 made of 6 CNES engineers (Clude Huc), and 6 subcontracted**

■ The last part of the processing was made in Heidelberg : to build, with a permanent scientific expertise, the successive versions of the catalogue

- ***The data processing was a challenge, and it worked***
- ***The collaborative work was a large success***

CNES supports the french astronomy laboratories for the Gaia data processing

- **Several scientists are working thanks to CNES fundings :**
 - ◆ **Non single stars data processing and CU6 interfaces (GEPI, Paris)**
 - ◆ **Radial Velocity determination (GEPI, Paris)**
 - ◆ **Universe model software system (Besançon)**
 - ◆ **Solar system Objects data processing (IMCCE, Paris)**
 - ◆ **Radiation damage correction (GEPI, Paris)**
- **CNES is funding some computer equipments and travel expenses for DPAC meetings and scientific symposia related to Gaia**

CNES as an integrator of scientific chains in a framework

■ What is a data processing framework ?

- ◆ **A software item able to schedule and execute several processing chains**
 - On huge datasets
 - With the best performances (e.g. : avoid any unnecessary data access and random data access)
 - With minimal operator intervention
 - Using many computers
- ◆ **E.g. : the Gaia data processing will be split in ~1 hour jobs corresponding to parts of scientific chains working on millions stars.**

The integration process of CU4, CU6, CU8

- **The Integration of a processing chain in a framework is :**
 - ◆ **Defining interfaces between the framework and the modules**
 - ◆ **Checking the modules compliance with the interfaces**
 - ◆ **Verifying the maintainability of the codes : software QA**
 - ◆ **Managing the various versions of the software items (conf mngt)**
 - ◆ **Optimizing the codes for data handling, memory management, core processing**
 - ◆ **Checking the full processing center (chains within the framework)**
 - ◆ **Checking the interfaces of the DPC with the DPAC**

CNES as a processing center operator

- **CNES will operate the DPCC from the launch until the late mission**
 - ◆ **On a « thousands cores » 6 teraflops computer (cf O'mullane presentation)**
 - ◆ **Operated 24/24h 7/7day**
 - ◆ **97% availability expected**
 - ◆ **managed by mission specialists**



Links

- The CNES web site
 - ◆ <http://www.cnes.fr>
 - The portal for scientific projects where CNES is acting
 - ◆ <http://smc.cnes.fr>
 - The CNES Gaia website
 - ◆ <http://smc.cnes.fr/GAIA/Fr/>
 - french version, but english version is available
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