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The X-IFU Gazette

After almost three years insuring the tricky task to coordinate the development of the Detector Cooling System (DCS), our CNES colleague Michel LE DU left the black holes to move to the closer Jupiter and joined the JUICE project team. We all wish him the very best, in his newest adventure.

In the news:

Editorial: Where do we stand with Athena?

Athena is currently undergoing what is called status review 1 (SR1), which corresponds to the closure of the industrial phase A. It is thus a formal review of the industrial activities.

The cost model of Athena will be reviewed and an estimate of the 20 row mirror configuration cost will be derived. At SR1, the first assessment of the 15 row mirror configuration cost will also be provided. The development status the Science Instrument Module (SIM) will be evaluated and the status of the technology development activities will be checked.

The final board meeting of SR1 is due on January 17th, 2018. The outcome of SR1 will be presented to the Athena Science Study Team on January 22-23rd, and it is expected that the cost-constrained mission will be defined as the new baseline configuration for Athena.

An industrial bridging phase (A1 to A2) will follow and will be concluded by a Status Review 2. This will enable industry to consolidate the design of the new baseline configuration and get a more accurate estimate of its cost.

At SR2 it is also expected that the interfaces with the payload components are agreed so that the SIM can be transfered back to the Primes. The instrument Preliminary Requirement Review (IPRR) should then be held at the end of 2018, so that the Mission Formulation Review can take place before summer 2019.

As to meet the X-IFU IPRR milestone, all activities will now converge towards the definition of a new baseline configuration for the instrument by June 2018.

This activity will involve the whole consortium, with the clear objective to pass a successfull IPRR, in order to move forward into the next phase of the Athena program.

Didier Barret (IRAP, X-IFU PI)

The Dewar Peer review

These last months, the main activity led in the frame of the simplification of the X-IFU Instrument design (as recommended by ESA at the Delta-MCR) was the Dewar Peer review.

The Peer Review assessed whether the current design is on the right way or if it is necessary to steer the design works in a completely new direction, but also to open a large trade-off on the Dewar design.

The future Dewar can be envisaged in two very different ways: as a closed Dewar (same family as currently engaged) or as an open Dewar, taking benefit of the open space low temperature.

Both concepts will be analyzed.

Focusing on the first one, a large set of optimizations and improvements have been proposed such as dramatically decreasing the Outer Vessel temperature, a promising way to save a cooler, removing the cooler compressors from the Dewar, in order to mitigate the microvibrations effects, considering improved performances of the coolers themselves, etc.

The improvement and refinement of the thermal models are also warmly recommended, increasing the number of thermal nodes and thus the accuracy of the results.

The reliability and redundancy philosophy of the whole cooling chain will be analyzed..

By June, the improved close cryostat configuration will be analyzed deeply. Similarly the open cryostat configuration (or any alternative ones identified before then) will be also be documented, highlighting the pros and the cons of such a concept.

Alice Pradines (CNES Dewar manager) - Françoise Douchin (CNES Engineering manager)

A new cool spot in Toulouse soon

The Toulouse IRAP and CNES teams are actively setting up a sub-kelvin test bench in order to both perform functional tests of the Digital Readout Electronics (DRE) subsystem of the X-IFU readout chain developed at IRAP and to help familiarize the Toulouse teams with the operation of microcalorimeters.

We have selected the manufacturer of the 50 mK ADR cryostat, and we will install the test bench in the IRAP high bay in June 2018, with the possibility of moving it to the CNES site in the future.

In addition to obtaining a prototype DRE, we have started to gather from the X-IFU collaboration the subsystems required to form a complete functional detection chain. This includes a focal plane assembly with a detector chip containing a few tens of microcalorimeters, the associated cold readout electronics, the low-noise amplifiers, and the front-end electronics at room temperature.

François Pajot (Calibration team leader)

NEXT CONSORTIUM MEETING: N°7 PARIS

The next Consortium Meeting will be held at the Laboratoire d'Astroparticules et Cosmologie (APC) in Paris (10, rue Alice Domon et Léonie Duquet 75013 Paris).

It will cover the week of March 19th to 23rd, 2018. It will consist of several meetings and a 1.5 day plenary session.

We are extremely grateful to Damien Prêle and Sarodia Vydelingum to take care of the organization of the event. They both are putting the right emphasis on the choice of the place for the social dinner which will take place on Wednesday night.

Registrations are open as has been announced through the general mailing list. **The sooner you register the better for the organisation.** Do not book your hotel at the last minute as Paris is always a busy city.

ApC: http://www.apc.univ-paris7.fr/

Form to register: https://fs6.formsite.com/XIFU/X-IFU-week/index.html

Javier Gomez Elvira

Born in Madrid and attracted by the space challenges from the beginning of my professional activities. In the late seventies, when the Vikings missions were launched and influenced by them, I took the decision to study aerospace engineering. I got the doctoral degree in the middle of the 80's.

In Spain, the Instituto Nacional de Tecnica Aeroespacial (INTA) is the right place for aerospace engineering because it allows working in many fields.

I started in mechanical design working for different satellite equipment and was involved in the development of the first Spanish communications satellite.

After that, I worked on some projects related to space robotics and moved to the space instrumentation field. I work in Mars exploration being the principal investigator of the REMS instrument in the NASA Mars Science Laboratory.

At the same time I took over some management activities being vicedirector and director of the Centro de Astrobiología (CSIC-INTA).

Presently, with X-IFU I have the opportunity to start to work in a quite attractive space engineering aspect, which is the cryogenic field.

TIME/CODE DOMAIN MULTIPLEXING WORKING GROUP

The Frequency Domain Multiplexing is identified as a risk for X-IFU. Risk assessment and mitigation plan is part of the IPRR (Instrument Preliminary Requirement Review). Time or Code Domain Multiplexing (TDM or CDM) offers a backup solution to FDM.

We have initiated a study of a backup readout solution, including a system assessment of the impacts on the driving parameters of the instrument.

This study will be performed by a large group of experts, including all the partners involved in the current detection and read-out chain baseline (GSFC, NIST, Stanford, SRON, ApC, IRAP, CNES).

The kick-off took place end of November 2017 at GSFC, hosted by Simon Bandler's team (GSFC) and led by Hervé Geoffray, the CNES detection and read-out chain leader.

The attendees got to visit the NASA-GSFC labs.

This meeting was the opportunity for GSFC and NIST teams to present their background on TDM or CDM method and for SRON to lay out the current baseline.

A preliminary list of actions was produced and, according to the schedule, a preliminary report is expected on March and the final one released for June. Several meetings will be necessary to achieve this goal.

Hervé Geoffray
(CNES Detection and Read-out chain leader)

KNOW MORE ABOUT: THE INTA CONTRIBUTION

X-IFU detectors are the core of the instrument and require to be maintained isolated from its electromagnetic surrounding environment and at a temperature in the order of millikelvin.

As well they should be mechanically supported to survive the launch loads and to adequately isolate them from external sources of microvibrations, during the operational phase, because they become to be a source of noise in the measurements.

For that purpose, X-IFU has a big vessel, acting like a dewar, with external interfaces with cryocoolers and their electronics and internal interfaces with the Focal Plane Assembly (FPA), i.e. detectors and their proximity electronics, and Suk-Kelvin cooler..

INTA is involved in the whole design of the vessel. What implies this? The design of an external vessel with supports for cryocoolers and warm electronics as well as a number of legs for joining to the spacecraft: in all joints, a maximum electromagnetic isolation should be assured. Inside it, several thermal shields will be implemented to guarantee a minimum thermal radiation over the FPA.

The design of a set of internal elements for supporting the FPA, minimizing thermal conductivity and microvibration transmission.

The internal harness is the other aspect in which INTA is involved: the design goal, in this case, is the routing of thousands of wires minimizing the heat flux through them and paying special care to their electromagnetic isolation, without any intermediate connectors between the FPA and the warm electronics.

All those activities require a design, modeling and technology maturation relevant effort. Regarding the latter, the extreme stability conditions established for the FPA from a thermal and mechanical point of view, any simulation demand a very good knowledge of the materials properties used in the design, which means a test campaign to characterize them in the operational range of temperatures. But also, some subassemblies should be breadboarded and tested to verify that the assumptions done in the analysis are right.

An important issue that should be kept in mind from the beginning is the integration of the system. The complexity of the whole vessel is so big that mock-ups, breadboards and detailed study of the integration tools should be planned from the early step of the project to minimize risks with the flight units.

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Head of Payload Technologies Area INTA

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