

**Project Title:**

**Study on the performances of the JEM-EUSO mission**

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**Description of the project**

The JEM-EUSO mission is a space based Ultra High Energy Cosmic Ray observatory planned to fly on the International Space Station in FY 2016. This project sees the collaboration of more than 250 scientists from 13 countries. The Computational Astrophysics Laboratory led by Toshikazu Ebisuzaki and Marco Casolino plays a key role in developing the instrument and planning the mission.

Ultra High Energy Cosmic Rays (UHECR) are extremely high energy ( $1e20eV$ ) particles propagating in space. Both the sources and mechanisms responsible for the production of such enormous energies are presently unknown. Moreover the extremely high energies offer the unique opportunity to test the interaction of matter at energies many millions of times higher than reachable by any human made accelerator.

In order to solve the longstanding UHECR origin problem and starting the study of physics at such high energy we are in the process of constructing a UV telescope in order to detect the light emitted by the cascades of secondary particles generated by UHECR as they interact with Earth's atmosphere. This telescope will be placed on the International Space Station (ISS) and monitor atmosphere from above.

Due the very high risk related with the space mission busyness massive simulation studies must be performed prior to the mission launch. Moreover the data processing framework has to be established in order to analyze the scientific output of the mission.

In particular, we are involved in the development of the simulation framework for the JEM-EUSO

mission (The Euso Simulation & Analysis Framework).

The ESAF software takes care of the simulation of the Cosmic Ray events, the propagation of light to the instrument and the simulation of the instrument itself.

Moreover it performs the data analysis on the detector response in order to recognize the signal on the focal surface, determine arrival direction, energy and type of the incoming particle.

In the past we concentrated more on the aspect related with the detector assessments. We assessed data transfer rate, background rejection capability, number of detected events and many more aspects.

During the past year we used the RICC facility for developing the analysis software. In particular we developed a new algorithm for the Cosmic Ray energy determination. After raw data has been filtered and the signal has been recognized we apply a reconstruction process which, in the end, determines the energy of the primary through fitting of the reconstructed cascade profile with a theoretically derived formula. The Cluster has been used for performing large scale tests of the algorithm and then to produce results for assessing the performance of the mission.

As matter of fact, results of our simulations are vital for the collaboration and have been presented in many occasions in internal meetings and discussions.

Some publication has been produced and attached to the present report.

Several reviewed publications are in the process of being prepared making massive use of the RICC

## RICC Usage Report for Fiscal Year 2011

facility.

Moreover the Cluster will be used also for producing the necessary data for the PhD thesis which I will conclude this year and for which I am in RIKEN as IPA student.

Fiscal Year 2011 List of Publications Resulting from the Use of RICC

[Publication]

[Proceedings, etc.]

F.Fenu, T. Mernik, A. Santangelo, K. Sinozaki et al. : The ESAF simulation framework for the JEM-EUSO mission.

Contribution to the International Cosmic Ray Conference in Beijing 2011

T. Mernik, F.Fenu, D. Durso, A. Santangelo et al: The ESAF reconstruction framework of UHECR Events for the JEM-EUSO mission

Contribution to the International Cosmic Ray Conference in Beijing 2011

[Oral presentation at an international symposium]

[Others]

Posters related to the previous proceedings.