

**Project Title:**

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

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1. COSMIC RAYS are high energy particles (protons, nuclei, neutrinos...) propagating through the universe. Eventually, CRs will reach the Earth and generate, after the encounter with the atmosphere, a cascade of secondary particles. Those secondary particles can be detected by the fluorescence light they emit while traversing the atmosphere. After 100 years since their discovery no clear answer has been given about CRs origin. Several detectors have been built over the decades and many other are under construction to solve the questions related to their origin.

ULTRA HIGH ENERGY COSMIC RAYS are a subclass of Cosmic Rays which have energies above  $10^{19}$  eV (~1 Joule !).

JEM-EUSO - the Extreme Universe Space Observatory onboard the Japanese Experiment Module aims at detecting the Ultra High Energy Cosmic Rays (UHECR). The detector will be mounted on the International Space Station to monitor the earth's atmosphere from space at night time in order to observe the fluorescence light emitted by UHECR induced air showers. This mission, which is lead by Riken, is planned to fly on the International Space Station in the years 2015-2020.

**2. Our group is carrying out computer simulations to evaluate the expected performance of the JEM-EUSO instrument.**

This effort is needed to plan and develop the mission itself. In fact, our results will be used by the JEM-EUSO Collaboration to further

develop the mission. More in detail, the RIKEN Cluster serves to carry out extensive studies on the observatory performances. In other terms the RICC facility will be needed to provide us a proper statistics to evaluate background rejection of the detector as well as angular and energy resolution of the incoming particles. Our results are at the moment important for the mission development and in the future will be used to try to answer to questions regarding the origin of CRs.

3. Until now, no scientific results have been obtained from the RICC Cluster of clusters since we arrived in Riken very recently. Furthermore we had several problems in compiling code successfully on the RIKEN Cluster of clusters.

4. We solved technical issues regarding the Software structure and installation. We are now ready to start the performance evaluation.

5. Now, where our simulation framework is running on the RIKEN Cluster of Clusters we will be able to carry out extensive simulations. The emphasis will mainly be on the production of CRs showers and reconstruction of CRs events. The background rejection performances evaluation will be also an extremely important topic of our simulations. For our studies we will need several months of extensive studies. We therefore plan to work on these issues for the entire fiscal year 2010. However we see this project as a long term project to be extended over several years since the JEM-EUSO mission is going to be launched in

the years 2015-2016. During this time we will need resources to assess the mission performances for planning the instrument configuration. After launch also data analysis to reconstruct the Cosmic Ray properties and origin will start.

6. Up to now we used a very little amount of the available resources. This is because of the very short time we spent here in Riken. Up to now we spent time to prepare the software for the massive simulations. Moreover we had problems in installing the software on the RICC Cluster. In the next usage term we will however simulate a large sample of CRs showers to evaluate the background rejection scheme capability and the event energy and arrival direction reconstruction resolution .
7. Due to to the very short time we spent in Riken we were not able of producing scientific results with the RICC cluster. Furthermore we had to solve several technical issues concerning the installation of the software. However we are now able to start our studies.