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Evaluation of scientific performance of JEM-EUSO mission with Space-X Dragon option

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The Extreme Universe Space Observatory on-board the Japanese Experiment Module (JEM-EUSO) is a mission devoted to the observation of ultra-high energy cosmic rays (UHECRs) around and above the so-called Greisen-Zatseptin-Kuzimin energy at $\sim 5 \times 10^{19}$ eV. The origin of these enigmatically energetic cosmic rays remain an open question since their discovery more than 50 years ago. Very high statistics observations of UHECRs are essential to provide key information to answer this question. Very large exposure are indeed necessary to overcome their extremely low fluxes of an order of a few events per square kilometer per century. JEM-EUSO is designed to measure the extensive air showers induced by UHECRs using an super-wide field-of-view ultra-violet fluorescence telescope pointed downwards nighttime atmosphere. Orbiting onboard the International Space Station (ISS), JEM-EUSO rather uniformly covers the entire celestial sphere, allowing a thorough analysis of UHECR arrival direction distributions. In the present work, we introduce the current design of the JEM-EUSO telescope using the Space-X Falcon 9 as launcher and the Dragon as transport vehicle to the ISS. We then discuss the expected performances, and in particular the science of the search for the UHECR origin. Assuming the detector configuration based on the full-scale JEM-EUSO, the expected exposure and quality of arrival direction distribution analysis during the assumed mission lifetime are evaluated by simulation studies. We also preliminarily investigate an advanced scenario based on the use of silicon photomutiplers as focal surface detectors. Eventually we report the expected efficiency of UHECRs observation for these options including the expected sky map UHECRs.

Collaboration

JEM-EUSO

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