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The EPSI R&D: Development of an innovative electron-positron discrimination technique for space application

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The direct measurement of the antimatter components in cosmic rays provides a crucial information on the mechanisms responsible for their acceleration/propagation and represent a powerful tool for the indirect search of dark matter. At present, charge sign discrimination has been performed by the use of magnetic spectrometers, which are not suited to extend the current measurements at higher energies in a relatively short time scale. Since most of present and future experiments in space dedicated to the high energy frontier are based on large size calorimeters, it would be important to develop an alternative charge sign discrimination technique that can be integrated with them.

This is the main goal of the Electron Positron Space Instrument (EPSI) project, an R&D that has been approved and financed in Italy as a PRIN (Research projects of relevant national interest), whose activity started in September 2023. To this end, we plan to exploit a principle that has been suggested long time ago, based on the synchrotron radiation emitted by charged particles as they travel into the geomagnetic field. The simultaneous detection of a electron/positron with an electromagnetic calorimeter and synchrotron photons with a X-ray detector is enough to discriminate among the two leptons at the event level. The main challenge of this approach is to develop a X-ray detection array with very large active area, high X-ray detection efficiency, low energy detection threshold and compliant with space applications.

In this contribution, we will discuss the feasibility of such a detection technique for a future space experiment, by sketching a basic design of the instrument geometry and examining the challenges due to astrophysical backgrounds. Then, we will describe the idea for the realization of the required X-ray detector, with the single cell based on a small scintillator, a large area SiPM and a thin aluminum layer deposition. Different solutions for the components and the geometry of the detection cell are currently under test, both with laboratory measurements and detailed simulations. We will present the current status of the R&D and the next steps for the fulfillment of the project goals.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

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