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HENSA++ for cosmic-ray neutrons spectrometry: project status and future developments

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Neutrons are continuously produced as secondary radiation from cosmic-ray interactions in Earth's upper atmosphere. Characterizing these secondary neutrons has implications across multiple fields, including environmental radioactivity [1], single event upsets (SEUs) in microelectronics [2], cosmic-ray physics, and space weather [3].

The High Efficiency Neutron Spectrometry Array (HENSA) project focuses on designing, developing, and utilizing high-efficiency neutron spectrometers [4]. The latest iteration, HENSA++, has been specifically optimized for studying cosmic-ray neutrons and their applications in space weather monitoring and environmental dosimetry. HENSA++ operates on the same principles as Bonner Sphere Spectrometers (BSS) [5], but with topological modifications in detector geometry, achieving up to a tenfold increase in detection efficiency compared to standard BSS [6]. The HENSA++ array comprises sixteen He-3 tubes, each one surrounded by different materials, including high-density polyethylene moderators, cadmium shielding, and lead neutron multipliers, providing spectral sensitivity across a range from thermal to GeV neutrons.

In this work, we discuss the current status and mid-term perspectives of HENSA++. Preliminary results from the recent commissioning of the spectrometer and laboratory measurements conducted during solar storm conditions in 2024 will be presented. We will also outline future plans to install HENSA++ as a permanent cosmic-ray neutron monitoring station at the high-altitude Observatorio Astrofísico de Javalambre (OAJ).

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Abstract

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