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The PBR Mission: the balloon-borne precursor of the space-based POEMMA multi-messenger Observatory

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The main objective of the international JEM-EUSO (Joint Exploratory Missions for Extreme Universe Space Observatory) Collaboration is to develop a large mission with dedicated instrumentation looking down on the Earth atmosphere from space, both towards nadir and/or towards the limb, to detect the Extensive Air Shower (EAS) and the High Altitude Horizontal Airshowers (HAHA) initiated by Ultra-High-Energy Cosmic Ray (UHECR) and Very-High-Energy Neutrino (VHEN). In the last decade, the JEM-EUSO Program successfully developed five intermediate missions: one ground based (EUSO-TA), three balloon-borne (EUSO-Balloon, EUSO-SPB1, EUSO-SPB2) and one space-based (MINI-EUSO). The new balloon-borne mission PBR (POEMMA-Balloon with Radio) represents a huge leap in the direction of a space-based full-scale mission: the stereo double telescope Probe Of Extreme Multi-Messenger Astrophysics (POEMMA), a multi-messenger observatory to be considered for a NASA Probe Mission in the next decade. Already approved and funded by the USA space agency, the PBR mission is a Ultra-Long Duration Balloon payload scheduled for launch in Spring 2027 from Wanaka, New Zealand over the Southern Ocean for expected 50 days. The PBR mission is a real precursor of the POEMMA observatory, accomodating a multi-hybrid detector (Cherenkov and fluorescence telescopes, Radio and X/Gamma detectors), properly adpated on board, and aspiring to primary scientific goals: observation of EASs and HAAs induced by UHECRs and search for VHENs. In this contribution, the payload and its detectors, the corresponding advances in their assembling and completion in view of the pre-flight tests and studies of performances, in addition to the expected scientific results, will be described in detail.

Primary author(s) : CARUSO, Rossella (Department of Physics and Astronomy "E.Majorana" - University of Catania & INFN-CT)

Presenter(s) : CARUSO, Rossella (Department of Physics and Astronomy "E.Majorana" - University of Catania & INFN-CT)

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