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The Optical and Mechanical Design of POEMMA Balloon with Radio

POEMMA Balloon with Radio (PBR) is a NASA super pressure balloon mission building toward the proposed Probe Of Extreme Multi-Messenger Astrophysics (POEMMA) dual satellite mission. In its planned 2027 launch, PBR will study Ultra-High-Energy Cosmic Rays, Neutrinos, and High-Altitude Horizontal Air-showers from 33 km above the Earth. By operating at balloon altitudes, PBR will provide a novel vantage point to study air-shower physics while offering competitive instantaneous exposure to neutrinos from transient astrophysical phenomena. The payload's optical instrument is a 0.95 m^2 aperture hybrid Schmidt telescope with a 3.81 m^2 segmented mirror focusing light onto a Fluorescence Camera and a bi-focalized Cherenkov Camera. The payload will also feature a Radio Instrument consisting of two sinuous antennas based on the Payload for Ultrahigh Energy Observations (PUEO) low-frequency instrument. A combined gamma ray/x-ray detector and IR cloud camera round out the instrumentation package, meaning PBR will be the first multi-hybrid balloon-borne multi-messenger observatory flown. This extensive instrumentation must be combined into a radio quiet payload that satisfies the scientific needs and can operate in near vacuum at extreme temperatures, all while meeting NASA safety requirements and weighing no more than 3000 lbs (1361 kg). Accomplishing these tasks together will mark a significant step toward establishing technological readiness for the POEMMA satellite mission. We present an overview of PBR's mechanical and optical systems, additionally detailing our strategies to mitigate electromagnetic interference for the radio instrument and prepare for the harsh near-space environment.

Collaboration(s)

JEM-EUSO Collaboration

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