

## The Continuing Journey of REPTiles (Relativistic Electron and Proton Telescope Integrated Little Experiments): Achievements and Future Impact

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Building on the successes of REPTile [1][2] and REPTile-2 [3][4], a unique opportunity has emerged: a refurbished REPTile-2 engineering model (EM), now designated as REPTile-3, will be onboard Emirates Mission to the Asteroid Belt (EMA) [5]. Scheduled for launch in March 2028, EMA will perform a series of Venus and Earth flybys/gravity assists before reaching the first three asteroids in 2030-2031. The mission will then proceed to a Mars flyby in September 2031, before visiting four additional asteroids, and culminating with a rendezvous at the main-belt asteroid Justitia in October 2034. REPTile-3 will play a key role in this mission, providing detailed measurements of energetic particles, including protons, electrons, and helium ions.

**The original REPTile**, onboard the Colorado Student Space Weather Experiment (CSSWE) CubeSat mission, was a miniaturized and simplified version of the REPT instrument flown on NASA's Van Allen Probes (2012–2019). REPTile measured 0.5 to >3.8 MeV electrons and 8–40 MeV protons during its successful operation in low Earth orbit (LEO) from 2012 to 2014. The CSSWE mission, with a cost cap of \$860K, was developed through graduate student project classes under close professional mentorship. This mission resulted in 29 peer-reviewed publications, including two in *Nature*, and supported five Ph.D. dissertations.

**REPTile-2**, onboard the Colorado Inner Radiation Belt Experiment (CIRBE) CubeSat mission, launched on 15 April 2023 into a highly inclined LEO. It operated successfully until CIRBE's re-entry on 4 October 2024. This instrument demonstrated the capability to measure protons (6.5–100 MeV) and electrons (0.25–6 MeV) with high energy resolution, all within a compact 1.5U (10×10×15 cm<sup>3</sup>) volume. REPTile-2 provided unprecedented detailed energy spectra of trapped energetic electrons and protons in the Earth magnetosphere and solar energetic particles (SEPs) during high-latitude passes [6][7].

**REPTile-3**, with a modified structure, shortened collimator (resulting in an expanded field of view), and updated particle event binning [7], represents a significant advancement. It will measure SEPs and cosmic ray particles during EMA's multi-year cruise phase and at its final rendezvous with Justitia. Operating across a wide range of solar radii (0.71 to ~3 AU) and more than half a solar cycle, REPTile-3 will achieve high energy resolution for 1.2–100 MeV protons, 0.1–5 MeV electrons, and 18–200 MeV helium ions [8][9].

### References:

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