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High Quality Sciences by CubeSat Missions and Future Potential

Xinlin Li
LASP/U. of Colorado, Aerospace Engineering Science, Boulder, United States (lix@lasp.colorado.edu)

Based on measurements from our first CubeSat funded by National Science Foundation, Colorado Student Space Weather Experiment (CSSWE), we have resolved a 60-year-old mystery regarding the source of relativistic electrons near the inner edge of the inner radiation belt by identifying the electrons produced by Cosmic Ray Albedo Neutron Decay (CRAND), and that this CRAND process also contributes to electrons elsewhere in the inner magnetosphere. These results were published in Nature [Li et al., 2017]. This success has demonstrated that CubeSats can achieve high quality science. Radiation belts were the first discovery of the satellite era and we have learned much since. However, technical challenges in making clean measurements of inner radiation belt electrons in the presence of energetic protons, which are also trapped in the inner belt and can penetrate instrument and spacecraft shielding, still remain. Our next CubeSat mission funded by NASA, CubeSat: Inner Radiation Belt Experiment (CIRBE), with its innovative design, will make much cleaner measurements of inner radiation belt electrons and help address some long standing science questions, e.g., the energy dependence of inward radial transport of relativistic electrons from the outer radiation belt to the inner radiation belt and the quantification of the CRAND contribution. If tailored well, specific science objectives can be achieved by CubeSat missions.

[Li et al., 2017] Li, Xinlin, Richard Selesnick, Quintin Schiller, Kun Zhang, Hong Zhao, Daniel Baker, and Michael Temerin (2017), Measurement of electrons from albedo neutron decay and neutron density in near-Earth space, Nature 552, 382-385, doi:10.1038/nature24642.