P9-DPP2017

Relativistic Particle Acceleration and Loss in Our Cosmic Backyard: Van Allen Radiation Belt Exploration

Daniel N. Baker, Director and Distinguished Professor
Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO, USA.

The first great scientific discovery of the Space Age was that the Earth is shrouded in toroids, or "belts", of very high-energy magnetically trapped charged particles. Early observations of the radiation environment suggested that the Van Allen belts could be delineated into an inner zone dominated by high-energy protons and an outer zone dominated by high-energy electrons. Subsequent studies showed that electrons in the energy range 100 keV < E< 1 MeV often populated both the inner and outer zones with a pronounced "slot" region relatively devoid of energetic electrons existing between them. The energy distribution, spatial extent and particle species makeup of the Van Allen belts has been subsequently explored by several space missions. However, recent observations by the NASA dual-spacecraft Van Allen Probes mission have revealed wholly unexpected properties of the radiation belts, especially at highly relativistic (E > 1 MeV) and ultra-relativistic (E > 5 MeV) electron kinetic energies. In this presentation we show using high spatial and temporal resolution data from the Relativistic Electron-Proton Telescope (REPT) experiment on board the Van Allen Probes that multiple belts can exist concurrently. We also show that an exceedingly sharp inner boundary exists for ultra-relativistic electrons. Using additionally available Van Allen Probes data, we demonstrate that these persistent features of energetic electrons are not due to a physical boundary within Earth's intrinsic magnetic field. Rather it likely that human-generated electromagnetic transmitter wave fields produce such effects. We conclude from these unique measurements that human-made wave-particle scattering effects deep inside the Earth's magnetosphere can help create an almost impenetrable barrier through which the most energetic Van Allen belt electrons cannot migrate. We provide a comprehensive survey of radiation belt acceleration, transport, and loss processes using the remarkable Van Allen Probes data in this lecture.

First Asia-Pacific Conference on Plasma Physics (AAPPS-DPP2017)
Chengdu, China
September 18-22, 2017.

Invited talk

Lou-Chuang Lee, louclee@earth.sinica.edu.tw