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Origin of Trapped Radiation in theNear Earth Environment (Arne Richter Award for Outstanding Young Scientists Lecture)

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The Van Allen radiation belts consist of energetic electrons and ions that have energies above 100 keV and are trapped by the Earth's magnetic field. Energetic particles, particularly relativistic electrons, are responsible for deep dielectric charging in sensitive electronic components and are one of the major causes of frequent satellite failures and operational problems. Five decades after the beginning of the space age and the discovery of trapped radiation, understanding of the Van Allen radiation belts still presents a major challenge. The dynamical evolution of the radiation belt fluxes results from the competition of various acceleration and loss mechanisms including resonant interactions between particles and plasma waves. Similar acceleration and loss processes occur at other planets of the solar system and may occur at other corners of the Universe. Recent observations combined with predictive and data assimilative modeling showed that energetic electrons can be accelerated locally to relativistic energies by taking energy from plasma waves. After solar superstorms, local acceleration may become very efficient at distances of less than three Earth Radii; this situation would significantly increase the near-Earth radiation hazard and may be devastating for near-Earth orbiting satellites.