

Contribution ID: **74** Type: **Oral**

Modeling the Variability of Relativistic Electron Flux in the Outer Radiation Belt Using Deep Learning

Wednesday, August 19, 2026 4:10 PM (20 minutes)

The main factors governing the variability patterns of high-energy electron flux in the outer radiation belt are well established in the literature and are modulated by external physical mechanisms. These correspond to different solar wind structures, such as Interplanetary Coronal Mass Ejections (ICMEs) and High-Speed Solar Wind Streams (HSSs). These processes are associated with low-energy electron flux injections and also with wave-particle interactions, in which electrons are accelerated through L-shell layers. Thus, attempting to capture, predict, and explain the dynamics of hight-energy electron flux enhancement and dropout effects during perturbed periods using machine learning methods can yield new insights into the physical mechanisms controlling such variations in the outer radiation belt, as well as into the interplanetary medium, since one construct derives from the other. The models are trained using electron flux data from the Relativistic Electron Proton Telescope (REPT), an instrument aboard the Van Allen probes, solar wind data from ACE satellite, and global geomagnetic indices. The results obtained by the models, capable of reproducing the flux variability, are compared with the physical processes observed during quiet and disturbed periods of the previous solar cycle, between 2015 and 2018, a period whose onset of cadence is similar to the state of the current solar cycle. In addition to the results inferred by the models, methodologies capable of providing a comprehensive and coherent interpretability of the processes that occur during the breaking of the third invariant, an effect capable of contributing to the increase in the asymmetry of the radiation belts, will be investigated. Finally, this data science-based computational modeling work aims to improve the capabilities of forecasting space weather, contributing to the understanding of the dynamics of radiation belts under different space weather conditions, while also revealing relevant information about the main causative drivers.

Authors: SANT ANNA, Thiago (National Observatory (ON)); ALVES, Livia (National Institute for Space Research - INPE); Dr BENYOSEF, Luiz (National Observatory (ON)); Dr SILVA, Ligia (National Institute for Space Research - INPE); Dr RESENDE, Laysa (National Institute for Space Research - INPE); Dr MARCHEZI, José (National Institute for Space Research - INPE); Dr DEGGERONI, Vinicius (National Institute for Space Research - INPE); Ms FERREIRA, Karen (National Institute for Space Research - INPE); Ms MELO, Jayne (National Institute for Space Research - INPE); Ms NOBREGA, Gislayne (National Institute for Space Research - INPE); Ms ROSALES, Laine (National Institute for Space Research - INPE); Mr ROCKENBACH, Edu (National Institute for Space Research - INPE); Mr FISTER, Pedro (National Institute for Space Research - INPE)

Presenter: SANT ANNA, Thiago (National Observatory (ON))

Session Classification: Oral Contributions

Track Classification: Machine Learning and AI: Space Weather Forecasting & Operations