Virtual Conference on Applications of Statistical Methods and Machine Learning in the Space Sciences – 17-21 May 2021

Adnane Osmane
Department of Physics, University of Helsinki, Finland

Consequences of ULF fluctuations with finite correlation time on radial diffusion of radiation belts' particles

A. Osmane & Solène Lejosne (Space Science Laboratory, Berkeley, California, USA)

Radial diffusion in planetary radiation belts is a dominant transport mechanism resulting in the energisation and losses of trapped particles by large-scale ULF fluctuations. In this talk we will revisit the radial diffusion formalism of Fälthammer JGR, (1965) by relaxing the assumption of zero correlation time in the spectrum of fluctuations responsible for the diffusion of trapped particles. We will show that a finite autocorrelation time comparable or larger than the azimuthal drift period results in (1) a nonlinear L* dependence of the diffusion coefficient qualitatively consistent with recent statistical studies (Sarma et al. JGR, 2020) and (2) characteristic diffusion time faster than for short correlation time. However, in the absence of sources and sinks, radial diffusion for both short and long autocorrelation times inevitably result in a flattening of the distribution function along L* with differences of less than ten percents across lower drift shells. Thus, the presence of ULF fluctuations with long autocorrelation time leads to faster diffusion during intermediary times and before the flattening of the distribution function across a broad range of magnetic drift shells. We will conclude by using information-theoretic measures to quantify the length of intermediary time periods upon which the inclusion of finite correlation time of fluctuations significantly impacts modelling results.