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Toulouse, FR, 24 April 2024.

Subject : Opponent's report for the Doctoral Thesis of Stefan Gohl « Timepix Detector in Space Applications and Radiation Belt Dynamics Observed at Low Altitudes »

The doctoral thesis of Stefan Gohl focuses on the study of Earth radiation belts dynamics at Low Earth altitude. As part of the thesis work, an extensive analysis of new innovative in-situ measurements performed by a Timepix radiation monitor (SATRAM) onboard the Low Earth Orbiting PROBA-V spacecraft is performed. Next, the response of electron radiation belt to interplanetary shock is investigated using various in-situ measurement at LEO.

The Thesis begins with an introduction where the context of the study is provided and the goals of the current work are well stated:

(1) Develop and compare methods of particle specie identification from the SATRAM measurements

(2) Deduce electron flux out of the SATRAM measurements and compare them with third party measurements

(3) Investigate solar wind conditions impact on radiation belt dynamics

Chapter 1 presents a thorough description of background knowledge of solar wind, magnetosphere and radiation belt properties that are relevant for understanding the new research that is detailed in the remainder of the Thesis.

Section 2 is dedicated to Timepix detector description and section 3 presents the use and application of the Timepix detector to measure space radiations that are relevant for understanding the following activities, i.e. particle identification challenge and particle flux determination.

Section 4 describes in details the methods to identify particle specie implemented to perform the data exploitation. This is an extensive part of the work performed in the thesis and it is an essential step to guaranty further use of the data. Specie identification in a mixed field, as the one encountered in the Earth space environment is a very challenging task. As a result, none of the methods are perfect (but anyone working on space radiation measurement is facing similar issues, with different complexity depending on the instrument design) and it has been very much appreciated to see that the pros and cons of each method implemented are well explained and discussed.

Chapter 5 is dedicated to the derivation of the STARAM measurements in physical units, i.e. particle flux and then compared the SATRAM results with EPT measurements performed on the same spacecraft. This is perfect situation to cross compare measurement with very limited assumptions. This opportunity is well exploited in the thesis. Although the two instruments do not have the same energy and time resolution, first good similarities have been found. These results are very encouraging for future use of more recent development of the Timepix detector and its applicability to measure space radiation in a mixed field.

Finally, chapter 6 is dedicated to in-situ radiation data exploitation measured at LEO. Statistical analysis by mean of superposed epoch analysis is performed to highlight any main features between solar wind conditions and radiation belts dynamics during intense storm.

In summary, the thesis demonstrates Stefan Gohl's ability to perform independent and creative scientific work. The manuscript is well written and clear and I highly appreciated that all along the document many references to related work are provided. I also want to point out that Stefan Gohl is the first author of four published papers and co-author of 5 other papers. Therefore, I strongly recommend the presented doctoral work for the defense.

Opponent: Sébastien Bourdarie

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Toulouse, France