Supervisor'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 focuses on energetic particle detectors onboard low-altitude spacecraft, particularly the Timepix-family detectors, and their applications in monitoring radiation belt electron fluxes. The results obtained can be divided into two major parts. The first part focuses on the Timepix detector itself, identifying respective particle species and recalculating the measured data into proper physical flux units. These data are then compared with electron fluxes measured aboard the same spacecraft by a different energetic particle instrument, demonstrating overall good agreement and confirming the suitability of the Timepix detector for use as a radiation belt monitor. The second part demonstrate some possible applications of the radiation belts monitors at low altitudes, benefiting from the fact that they regularly and quickly sample a wide range of L-shells. This analysis includes systematic changes in the electron fluxes associated with significant geomagnetic storms and interplanetary shock arrivals.

The topics analyzed in this doctoral thesis build upon and naturally expand the previous experience of Stefan Gohl with high-energy particle detectors and align with the focus of his group at the Institute of Experimental and Applied Physics, Czech Technical University in Prague, where he has conducted a significant portion of his research. Stefan Gohl possesses excellent knowledge of energetic particle detectors, having successfully developed new methods for Timepix data analysis, and he is very knowledgeable about the corresponding applications for space physics purposes. He is the author or coauthor of nine papers, serving as the first author on six of them. Additionally, he has presented his results at several international conferences, participating fully and demonstrating the maturity expected of a successful PhD candidate.

The doctoral thesis is composed in English. It includes a brief general introduction to the solar wind, magnetosphere, and radiation belts, followed by a description of the Timepix detector and other instrumentation used. The particle identification and flux calculation methods designed and used by Stefan Gohl are further discussed, followed by a comparison of these results with those obtained from the EPT detector onboard the same spacecraft, serving as a kind of benchmark. The good agreement achieved demonstrates the suitability of Timepix-family instruments for radiation belt flux monitoring and highlights the capability of the methods developed by Stefan Gohl, showing great promise for future research and applications. The final chapter addresses the specific applications of low-altitude spacecraft monitors during significant geomagnetic storms and interplanetary shock arrivals. Systematic variations revealed through the applied data processing are thoroughly discussed for their possible meanings and interpretations. It is noteworthy that the data sources used are not limited to a single spacecraft, underlining the complexity of the work performed.

The thesis is typeset using LaTeX and is of very good graphical and typographical quality. The text is well-written, with clear English and largely free of significant errors. Its length is appropriate for a doctoral thesis. Automatically identified similarities with other sources are minimal and do not in any way affect the originality of Stefan Gohl's work.

To summarize, I believe that the presented thesis is of very high quality in its scope, form, and content. It contains an appropriate theoretical introduction and summarizes the original scientific results of the author, which have been published in several papers. I further believe that Stefan Gohl has clearly demonstrated his ability to perform independent scientific work and complex data analysis and interpretation. Thus, without any doubts, I recommend this doctoral thesis be recognized as worthy of a PhD degree.

Prague, 22 April 2024

Prof. RNDr. František Němec, Ph.D.

supervisor