

(Form02-2)

Digging the past: Uncovering the archival detector data for intense solar particle storms in mid-20 century

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The ISEE International Joint Research Program Project “**Digging the past: Uncovering the archival detector data for intense solar particle storms in mid-20 century**” led by Dr. Sergey Koldobskiy was aimed at developing investigations and digitization for measurement diagrams in contemporary publications and reports about early GLEs and the corresponding detectors, systematize and calibrate the data obtained, and interpret the collected results physically and quantitatively.

Throughout the project, we successfully collaborated on the main activity described above while also discussing possible collaborations on other topics.

In detail, we study and systemize data from non-standard detectors, which recorded solar particle events by ground-level detectors (so-called GLE events) in the 1940s. We analyzed the contemporaneous reports, digitized their diagrams, and standardized the SPE observations for GLE #1–4 registered in the 1940s. Here, Dr. Sergey Koldobskiy applied multiple models on what Dr. Hisashi Hayakawa digitized from the contemporaneous reports. These results allow us to qualitatively analyze the spectra of these GLEs. We managed to get our result accepted for publication in the Philosophical Transactions of the Royal Society A (Hayakawa, Poluianov, Koldobskiy et al., 2026). We also started some seed discussions for the analysis of GLE #5 (23-Feb-1956) records with non-standard detectors. This GLE had the greatest flux and the hardest spectrum and was also recorded by neutron monitors.

During the visit, Dr. Sergey Koldobskiy also had discussions with Dr. Nicholas Larsen regarding their research on possible radiation doses for commercial air flights during geomagnetic reversal events.

During the project, Dr. Sergey Koldobskiy had one visit (17 days, 23 September to 9 October) to Japan to work on the project and participate in the following events co-organized by ISEE: the 43rd NIHU Symposium "Astronomy and Citizen Science" (solicited talk: “Implications of Synoptic Cosmic-Ray Observations for the Recent Ground Level Enhancements and Extreme Cases”). Within the project, to date, we have published two joint research papers:

1. N. Larsen, I. Usoskin, A. Mishev, S. Koldobskiy, and P. Väisänen, “Reduced Geomagnetic Shielding During the Laschamps Excursion and Its Impact on Cosmic - Ray - Induced Atmospheric Radiation,” J. Geophys. Res. Sp. Phys., vol. 131, no. 2, p. 2025JA034820, Feb. 2026.
2. H. Hayakawa, S. Poluianov, S. Koldobskiy, et al., “The First Four Ground-Level Enhancements in the 1940s: Investigation, Digitisation, and Analysis of Forgotten Data,” Mar. 2026. arXiv:2602.24250 (accepted for publ. in Philosophical Transactions of the Royal Society A).