



FORSCHUNGSPROJEKT

„Research Project on cosmic rays at the University of
Hawai’I“

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Geomagnetic efficiency for cosmic ray measurements

From July to October 2025 Kai Langer from the Elite Graduate Program “Physics Advanced with integrated graduate program” in Erlangen did a three month research internship on the geomagnetic cutoff and -efficiency for low-rigidity cosmic-ray measurements at the University of Hawai’I at Manoa in the working group of Philip von Doetinchem.

Geomagnetic efficiency for cosmic ray measurements

The first task was to produce maps of the rigidity-cutoff across the Earth for the full timeframe of AMS-02 data taking since May 2011 up to today. Alpha Magnetic Spectrometer (AMS-02) is a particle detecting experiment mounted on the International Space Station (ISS) and measuring anti matter in cosmic rays. Based on these results Kai Langer sampled the ISS trajectory around Earth and calculated the geomagnetic efficiency. In simple words this is the percentage of measurement time during which the rigidity cutoff lies below a fixed rigidity thus making it possible for the detector to measure primary cosmic-rays which do not result from reactions in the Earth’s atmosphere. The research group of Philip von Doetinchem is especially interested in the measurement of low-rigidity cosmic-rays thus making it especially important to have a good knowledge of the geomagnetic efficiency and the specific geomagnetic rigidity cutoff for each measurement point and time. The normalized geomagnetic efficiency is the geomagnetic efficiency for a forbidden path probability greater than 0 divided by the geomagnetic efficiency for forbidden path probability 0. This can give us an insight in which rigidity range it may be fruitful to consider measured events with forbiddenPathProbability >0 which have a probability of being a primary cosmic-ray $1 - \text{forbiddenPathProbability}$.

The final step of the research project was to analyse the temporal evolution of the (normalized) geomagnetic efficiency for the operational period of AMS-02. Here not only spikes in the geomagnetic efficiency are observed during periods of increased solar activity but while analysing simulated data for a complete solar cycle of 11 years a gradual increase of the overall normalized geomagnetic efficiency has been found. It will be the task of future analysis to find potential correlations of different magnetic field parameters and the geomagnetic efficiency.

Living and working in Manoa, Hawai’i

Working and living in Manoa and Honolulu provides you with unique possibilities next to your internship. Honolulu, the capital of Hawai’i, where Kai Langer was living, is located on the island of O’ahu and boasts with a wide variety of culture, beaches, mountains, international restaurants and other freetime activities. Personal highlights of Kai Langer were many different theatres and plays, the Honolulu Museum of Art, the Bishop Museum on the history and culture of Hawai’i, incredible beaches like De-Russy and Waikiki and especially the many hiking trails all over the mountain ridges.

DAAD and RISE Worldwide

RISE Worldwide is a program of the DAAD to support undergraduate students in natural sciences in conducting research internships worldwide. For this cause professors around the globe can offer research opportunities and German undergraduate students can apply for up to three of those for a duration of six to twelve weeks. For the application process a letter of recommendation, your transcript of records and a motivational letter is needed. The program not only encompasses the internship position, but also a financial stipend, insurance and recommendation letters for a potential visa process.

Mehr zum Elitestudiengang:

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[!\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\) ***Physics Advanced with integrated graduate program***](#)