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Auroral Research with the Suomi 100 Nanosatellite, EISCAT HF Facility and All-sky Cameras

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The Suomi 100 nanosatellite was launched on Dec. 3, 2018 (http://www.suomi100satelliitti.fi/eng). The 1 Unit (10 cm x 10 cm x 10 cm) polar orbit cubesat performs ionosphere radio science research with the HEARER (High frEquency rAdio spectRomEteR) instrument and auroral research with a wide-angle white light camera. The HEARER, which is optimized to measure in the 4-10 MHz frequency range radio waves, has been used to perform both global, over a full orbit, measurements, and local high-resolution measurements.

Suomi 100 satellite type of nanosatellite, a so-called CubeSat, provides a cost-effective possibility to provide in-situ measurements in the ionosphere. Combined CubeSat observations with ground-based observations can give a new view on auroras and associated electromagnetic phenomena. Especially, joint CubeSat – ground-based observation campaigns enable the possibility of studying the 3D structure of the ionosphere. Suomi 100 satellite provides an example of such joint observations. During 2019-2020, two ionosphere research campaigns has been carried out where the satellite measured radio waves transmitted from the EISCAT HF facility. Moreover, satellite's images of auroras have been analyzed together with optical ground-based measurements.

The presentation introduces the Suomi 100 CubeSat mission and how a small nanosatellite on a circular orbit at about 600 km altitude can be used to perform ionosphere and aurora research. We show how the satellite's camera was calibrated in space [Knuuttila et al., 2022] and how camera observations have provided complementary aurora imaging observations [Kallio et al., 2022a]. We also show results from the EISCAT heater campaign when the satellite observed HF waves transmitted through the ionosphere [Kallio et al., 2022b].

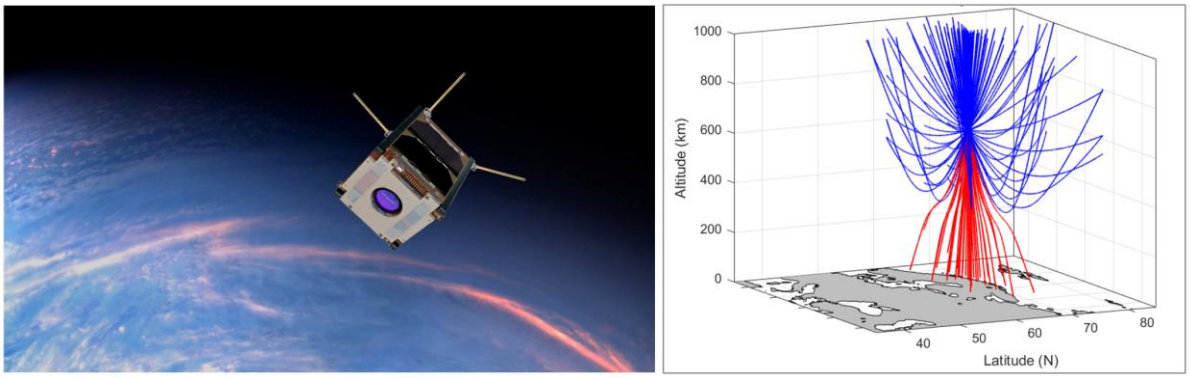

Figure 1. (left) A composite figure of the Suomi 100 satellite photographed before the launch and a dayside photograph of the Earth by the satellite from the orbit. (right) An example of the analysis where the origin of the radio waves observed by the Suomi 100 satellites' HEARER radio spectrometer above the EISCAT heater facility, Tromsø, Norway, is investigated by the developed 3D ray tracing model. Blue (red) rays show the source regions from the space (ground)