Investigating waves and instabilities in the auroral E region via multi-points in-situ from the SPIDER sounding rockets

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On February 2nd 2016 the SPIDER sounding rocket released ten Free Falling Units (FFUs) inside an active westward-travelling auroral electrojet (between 100 to 120 km altitude). Each FFUs carried four electric field probes and four Langmuir probes, respectively on 2 and 1-meter wire booms, as well as a 3-axis fluxgate magnetometer, a gyroscope, an accelerometer and a GPS recorder. The main scientific objective of the project was to study waves and instabilities on various spatial scales, in particular the Farley-Buneman instability, as well as providing an in-situ picture of plasma properties inside the aurora.

Six FFUs were successfully recovered after landing and, despite some mechanical issues on some units, the recorded data showed promising results. Some of these results will be discussed in this presentation, namely (i) the electron density and temperature profiles from two FFUs compared to the incoherent scatter radar measurements from the EISCAT facility, (ii) the hints of different turbulence regimes along the flight seen in the electron density, (iii) the search for Farley-Buneman instability in the electric field data via wavelet analysis, (iv) the observation of electric field waves propagating between two FFUs and the comparison with ground-based observation of the aurora from the ALIS multi-camera system, and finally (v) a global comparison between perturbations seen in the electric field, magnetic field and plasma density and temperature on two FFUs.

These results demonstrated the potential of multi-point in-situ measurements for understanding multi-scale processes in auroras, and preliminary results from the reflight of the rocket to be happening in February 2020 will also be briefly presented.