ON ESTIMATES OF THE TRUE ELECTRON DRIFT VELOCITY FROM THE STARE DATA

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The accepted point of view is that phase velocities of electrojet irregularities in the auroral E-region are limited to a value near Cs, the local ion-acoustic velocity (Nielsen and Schlegel, 1985, Nielsen et al., 2001). The so-called ion-acoustic approach (IAA) has physical background and also some experimental support, but it is rather a complicated approach. It was found recently that the phase velocity is slightly higher than the Cs and is also flow-angle dependent. The non-linear IAA velocity dependence on the E-field magnitude inside and outside of the FB-instability cone should inevitably modify the STARE routine vector azimuths. So far nobody has tried to use this fact to support IAA.

The arguments mentioned motivate us to look for more data to IAA validation. Similar as in solar physics it can be productive to screen out the sun disc during an eclipse, we considered a case with the Fin STARE line-of-sight velocities when the EISCAT velocity component was suppressed the velocity being nearly exactly orthogonal to the Fin STARE beam 3. We found a case where the Fin STARE velocities were mainly larger than the EISCAT plasma velocities. Also a moderate 5-20-deg offset in their vector velocity azimuths was observed. Since formally that is outside of the IAA, we looked for an alternative explanation.

We found that the Fin STARE phase velocity “over-speed” and the EISCAT-STARE vector velocity azimuth offset can be explained by the fluid plasma theory arguments as due to the ion drift contribution to the irregularity phase velocity. It can happen under the condition of a moderate backscatter off-orthogonality. We suggest that backscatter is in reality a so-called thick-layer backscattering (e.g. 10-15-km). Then the effective off-orthogonal angle is not-zero (e.g. ~0.5 deg) even at the altitude 105 km over EISCAT, where formally for a straight ray trajectory it is just zero. At larger altitudes this angle goes gradually to a larger value. The effect was enhanced during two intervals with E-layer lifting up seen by the EISCAT radar. As a conclusion we present and discuss two possible ways of the electron drift velocity estimation based on STARE data supported by EISCAT electron drift velocity and ion-acoustic velocity measurements.