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EISCAT-STARE study of irregularity drifts in high-latitude E region and wave-wave interaction

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The purpose of the present study is to examine the EISCAT plasma velocity measurements in the auroral E region with emphasis at the STARE irregularity flow velocity dependence on the line-of-sight (los or l-o-s) electron flow magnitude, V_{ExB}^{los}, and the flow angle $\Theta^{N,F}$. (Superscript N and/or F means the STARE Norway and Finland radar). We found that in the noon-evening sector the flow angle dependence of multi-pulse ACF Doppler velocities, $V_{irr}^{N,F}$, inside and outside of Farley-Buneman (FB) instability cone (where $\left|V_{ExB}^{los}\right|$is more or less than the local ion acoustic speed C_s, respectively) was similar and much weaker than earlier suggested. In a band of flow angles 45^o $<$ $\Theta^{N,F}$ <85^o it can be reasonably described as $\left|V_{irr}^{N,F}\right| \propto A_{N,F} C_s \cos^n \Theta^{N,F}$, where $A_{N,F}$ ≈1.2-1.3 are weakly monotonically increasing functions of V_{ExB} and the index n is ∼0.2 or even smaller. The present study (a) does not support the conclusion by Nielsen and Schlegel (1985), Nielsen et al. (2002, [18]) that at the flow angle of more than ∼60^o (or $\left|V_{irr}^{N,F}\right| \leq$ 300m/s) the STARE Doppler velocities are equal to the component of the electron flow velocity. We also found (b) that for any bin with the l-o-s electron flow magnitude, V_{ExB}^{los}, the largest STARE Doppler velocities are always inside the largest flow angle bin. In the largest flow angle bin the Doppler velocity is also larger than its l-o-s electron flow velocity component, $\left|V_{irr}^{N,F}\right| > \left|V_{ExB}^{los}\right|$. Both features (a and b) and the too weak flow angle dependence are experimental proof that the l-o-s electron flow velocity cannot be the single factor, which controls the motion of the backscattering ∼1-m irregularities at the large flow angles. An important fact for this study is also that the intense

backscatter was collected at aspect angle $\sim 1^o$ and mainly at flow angle $\Theta > 60^o$, where the linear fluid and kinetic theories cannot explain the excitation of irregularities. All the facts can be reasonably explained involving the nonlinear wave-wave coupling developed and described by Kudeki and Farley (1989) for the equatorial electrojet and studied in numerical simulation by Otani and Oppenheim (1998, 2006).