A study of Frozen-in property of Field-aligned Irregularities in Ionospheric Sporadic E region using Chung-Li VHF Radar

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Abstract:

In this paper, we developed a method to examine the Frozen-in property of field-aligned irregularities in Sporadic E region. We first analyze the effects of along and transverse radar beam drifts of sporadic E field-aligned irregularities localized in the expected echoing region on mean Doppler velocity and spectral width. Detailed analysis shows that the Doppler velocity nearly linearly proportional to the mean angular distance of the irregularities from the radar beam axis decreases with the increase of the horizontal dimension of the plasma structure. This feature strongly suggests that the beam broadening effect caused by the drift of the field-aligned irregularities cross the radar beam in the geomagnetically zonal direction may play a role in broadening the Doppler spectral width. With this property, we then transverse beam drift velocity of the irregularities in the zone direction. The drift velocity component of the irregularities parallel to the radar beam axis can be obtained from the radial velocity of the irregularities located at the radar beam axis. The use of the drift velocity combined with the configuration of expected echoing region and the plasma structure can estimate corresponding trace velocity of the echo pattern. The result show that the estimated trace velocity is in good agreement with the measurement by using radar interferometer method, strongly showing that the 3-meter plasma irregularities observed in this experiment have frozen-in property, which drifting with large scale plasma structure at the same velocity.