On the location of the red line airglow spot for different pump beam inclinations

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We present results on HF pump-induced ionospheric airglow in the red line of atomic oxygen (the radiation of level O(^{1}D) with a wavelength of 630 nm and an excitation threshold energy of 1.96 eV), obtained at the SURA heating facility in September 2004. We found that for vertical pumping the airglow spot was displaced to the North with an increase of the reflection altitude from 260 to 320 km of the pump wave at a frequency $f_0 = 4.3$ MHz. The displacement achieved $6 - 7^\circ$. An analysis has shown that the displacement was related mainly to the precipitation of accelerated electrons along the geomagnetic field lines from "pump-plasma interaction altitude" to "airglow excitation altitude". The former is the upper hybrid resonance altitude, where $f_0 \approx f_{\rm uh} = (f_{\rm pe}^2 + f_{\rm ce}^2)^{1/2}$, $f_{\rm uh}$ is the upper hybrid frequency; the latter ($\approx 230-260$ km) is optimal for the airglow generation due to excitation of the neutrals by electron impact [1,2]. For a pump beam inclination of 16° to the South (the magnetic field dip angle is 18.5° at the SURA facility) the airglow spot was displaced to the South by $1 - 2^\circ$ in comparison to straight projection of the pump beam onto the sky. For a pump beam inclination of 12° to the South, the optical spot was displaced by $4 - 5^\circ$ to the South relative to the projection. The southward displacement for 16° inclination is shown to be related to the group propagation of the pump beam, while the southward displacement of the optical spot for 12° inclination exceeds that expected from the ray tracing and may be related, most probably, to the so-called "magnetic zenith" effect [3]. In addition, magnetic field aligned structures were well distinguished in the optical images during the pumping.

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References

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