# THE EFFECT OF HF-WAVE INTERACTIONS WITH THE AURORAL IONOSPHERE ON THE GENERATION OF UNUSUALLY BRIGHT ARTIFICIAL AIRGLOW

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At mid-latitudes, in general, only the 630.0 nm oxygen line is bright enough to unambiguously detect in HF-induced artificial airglow, with rare cases of detectable 557.7 nm emissions (Bernhardt et al., *J. Geophys. Res.*, **94**, 9071, 1989). However, if a sporadic E-layer (Es) develops, then the heating HF wave interacts with dense plasma at much lower altitudes and brighter 557.7 nm emissions (up to 100 R) are observed (Djuth et al., *Geophys. Res. Lett.*, **26**, 1557, 1999; Kagan et al., *Phys. Rev. Lett.*, **85**, 218, 2000). In the case of patchy Es, the 557.7-nm airglow induced presents a footprint of the Es horizontal structure (Kagan et al., *Phys. Rev. Lett.*, **85**, 218, 2000). Unlike the mid-latitudes, the nighttime E-layer at high latitudes is either created by auroral precipitation which is associated with strong ionospheric absorption and bright auroral emissions, or is in the form of thick slabs of ionization (a so-called cusp- or C-type Es). In the March 2004 HAARP optical campaign, very bright (4 kR) green line airglow emissions were observed in kilometer-scale patches between auroral arcs during E-layer conditions (Pedersen and Gerken, *Nature*, **433**, 498, 2005). The single most surprising feature of these airglow patches observed in the presence of aurora is their brightness. At 4 kR, these patches are above the naked eye threshold and are comparable to dim visible aurora. Since the airglow height for this observation is unknown, two mechanisms for the generation of such bright airglow are possible based on the ionospheric conditions at the time. One possibility is that the bright airglow was caused by a nonlinear interaction of the HF-wave with an overdense cloud of ionization centered near 120 km (a so-called cusp- or C-type Es) whose thickness was of about an order of magnitude higher than that observed at Arecibo and therefore the HF waves deposited significantly more power. The second possible mechanism is that the bright airglow resulted from heater beam focusing by underdense sporadic ionization patches produced by auroral precipitation near 100 km altitude. We present our observations of artificial airglow in the presence of aurora and discuss both possible generation mechanisms.

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