Excitation and Modeling of Artificial Aurora at HAARP

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We present results from the ionospheric heating experiment conducted on March 12, 2013 at the High Frequency Active Auroral Research Program (HAARP) facility in Gakona, Alaska. During the experiment HAARP transmitted X-mode 4.57 MHz waves modulated with the frequency 0.9 mHz and pointed in the direction of the magnetic zenith. The beam was focused on a ~20 km spot at the altitude of 100 km. The heating produced two effects: First, it generated magnetic field-aligned currents producing *D* and *H* components of the magnetic field with frequency of 0.9 mHz detected by fluxgate magnetometer in Gakona. Second, the heating produced bright luminous structures in the heated region detected with the SRI telescope in 427.8 nm, 557.7 nm, and 630.0 nm wavelengths. We emphasize, that for the best of our knowledge, this is the first experiment where the heating of the ionosphere with the X-mode produces luminous structures in the ionosphere. We classify this luminosity as an “artificial aurora”, because it correlates with the intensity of the magnetic field-aligned currents, and such correlation is constantly seen in the natural aurora.

We conclude using the 3-D MHD model that the aurora is produced by the electrons precipitated into the ionosphere by magnetic field-aligned currents caused by the changing of the ionospheric conductivity by high-frequency waves. The luminosity is linked with the magnetic field-aligned currents because the strong disturbances in the magnetic field with the frequency of HAARP modulation have been detected with the ground magnetometer at Gakona, and this correlation between luminosity and magnetic field had been regularly observed in the natural aurora