# Statistical Analysis of ULF Signals Generated by SURA Facility in the Upper Ionosphere

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A new class of ULF signals not connected with ionospheric current modulation by powerful RF waves was detected in the first experiments on the generation of ULF signals by HAARP. The amplitude of these signals did not depend on the geomagnetic activity, moreover, they were also observed at night (K. Papadopoulos et al, Geophys, Res. Lett., 38, L20107, 2011). Such kinds of ELF signals also are generated in *F*-layer at mid-latitudes by SURA facility. The main properties of such signals investigated in 2010-2015 experimental campaigns were published earlier (D. Kotik et al, Radiophysics and Quantum Electronics, 6, 344-354, 2013). Here some new results are presented as a result of statistical data processing.

Low-frequency signals in the range of 2-20 Hz were studied at receiving points near the SURA (Barkovka, 2.8 km, Sosnovka, 11.2 km, both located North-East of the facility and Petrovsky, 10.7 km to the South-West). Part of the accumulated data was subjected to the statistical analysis. A comparison was made of the amplitudes of low-frequency signals simultaneously received at two receiving points (Barkovka and Sosnovka) in 63 sessions. The amplitudes of the artificial ULF signals measured under night conditions are approximately equal as it follows from the results of the processing of the experimental data (for night-time 28 sessions on O-mode, the ratio was equal $1 \pm 0.2$, and 25 sessions X-mode, $1 \pm 0.76$ for the mentioned above points). The measurements conducted in the day-time (10 sessions) showed that the amplitude of the ULF signals at the point Barkovka higher by 26% compared to the more remote point Sosnovka. The signals amplitude differed from 2 to 5 times Sometimes in separate sessions. similar measurements were made at receiving point Petrovsky in 2011 October. The magnitude of the observed artificial low-frequency signals ranged from 0.1 to 0.4 pT, what corresponds in order of magnitude to the observed signals at the receiving points Barkovka and Sosnovka.

The influence of pumping wave polarization on the magnitude of low-frequency signals was investigated in 2012 June experimental campaign. The amount of 83 of 15-mimutes sessions signal on frequencies 2,4,11 and 17 Hz for obtaining the average amplitudes were processed (22 of them at night-time and 34 on day-time, with heater on X-mode, and 24 at night-time on O-mode). The amplitudes of ULF signals in day-time and night-time conditions were close in magnitude each other when X-mode was used. The comparison the efficiency of O- mode versus X-mode showed that at night conditions the artificial ULF signals were less by 10-15% for O-mode depending on the pump wave modulation frequency.