Recovery of ponderomotive parametric instability after long pumping of the ionosphere

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The narrow continuum maximum ($\mathrm{NC_m}$) feature in stimulated electromagnetic emission (SEE) spectra is situated at frequencies $f \sim f_0 - (3-5)$ kHz (f_0 is the pump wave frequency). The $\mathrm{NC_m}$ can be well seen at the intermediate stage of pumping, before the development of the upper-hybrid (UH) related SEE features, *e.g.* the down-shifted maximum (DM). At $f_0 \sim nf_{\mathrm{ce}}$ (f_{ce} is the electron cyclotron frequency, n an integer) the $\mathrm{NC_m}$ is distinguishable in the SEE spectra even after long pumping [1]. We revealed that for $f_0 - 5f_{\mathrm{ce}} \sim$ 2–5 kHz, after switching of the pump wave from continuous pumping to low duty cycle pulse pumping (50 ms "on" 950 ms "off"), the $\mathrm{NC_m}$ recovers in the SEE spectra: it became well seen during 20–50 ms of the pulses a few seconds after the switch and became a dominating feature in the SEE spectrum after 7-10 s. Simultaneously, the ionospherically reflected pump wave signal exhibits a recovery of so-called ponderomotive self-action (PSA) (during 2-3 ms after the pulse switch-on) and so-called "spikes" (during 10-50 ms). PSA, spikes, and $\mathrm{NC_m}$ are known to be related to the ponderomotive parametric instability (PPI) near the pump wave reflection point [1,2]. The PPI is responsible for the excitation of Langmuir waves during HF pumping of the ionosphere. The intensity of the UH related DM feature also increases during 1-2 s after switching to the pulse mode, but later, together with PPI related phenomena recovery, the DM intensity noticeably decreases. The latter is related to the relaxation of small-scale irregularities (striations), which have quite low intensity and, therefore, disappear quite fast at $f_0 \approx 5f_{\mathrm{ce}}$.

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References

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