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SUMMATION OF EMISSION FROM SUPERRADIANT SOURCES AS A WAY TO OBTAIN EXTREME POWER DENSITY MICROWAVES

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A theoretical model that covers both spontaneous and stimulated Cherenkov emission from an extended electron bunch has been developed. The initiation is described of the generation of superradiant pulses [1-3] by emission from the leading edge of the electron bunch. In combination with the proven experimentally picosecond stability of explosive emission from a cold cathode [4], it provides the possibility for strong correlation of phase of the SR pulses with respect to the leading edge of the electron pulse [5].

By division of the driving voltage pulse on several parallel channels equipped with independent cathodes we can synchronize an unlimited number of SR sources to arrange two-dimensional super-powerful array of in-phased oscillators. Obviously, in the process of coherent summation of signals from such an array the maximal power density will grow quadratically [6,7] with the increasing number of elementary radiators.

In experiments carried out, an array consisting of four relativistic Ka band SR generators with peak power 600 MWs and pulse duration 200 ps (FWHM) resulted at the interference maximum of the directional diagram a radiation density that is equivalent to radiation from a single source with power 10 GW. At a distance 1 m from the output cross-sectional amplitude of the electrical field this amounts to ~140 kV/cm and power density of ~10 MW/cm^2.

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