Ultimate Characteristics of Wideband Electromagnetic Radiation Source Based on Superluminal Photoemission Current Pulse

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The object of our study is process of generation of wide-band directional electromagnetic radiation that arise due to electrons emitted from the vacuum–medium interface where the emission front propagates with a velocity exceeding velocity of light ***c***. A simple design of a source of this kind includes a planar accelerating diode with photocathode and a grid anode that is exposed to an inclined beam of ionizing radiation (fig.1)

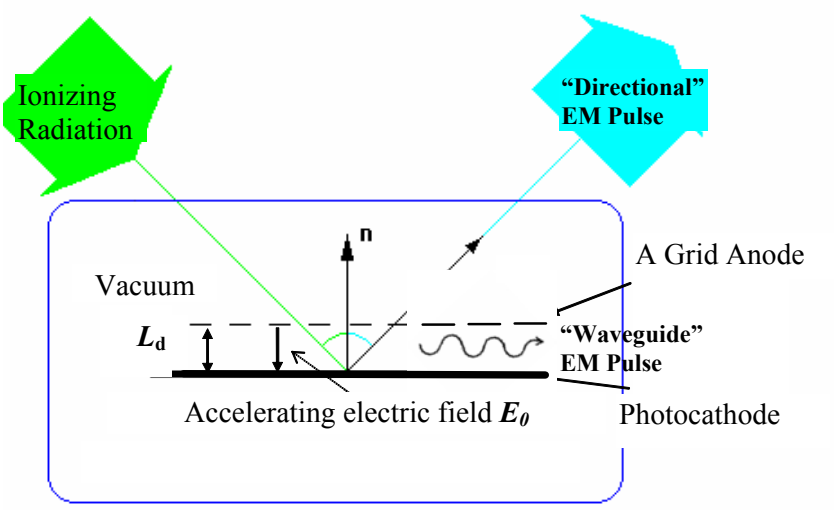

Figure 1. Basic scheme of Electromagnetic Pulse generation

The specific feature of such system is the generation of two electromagnetic pulses. The first "directional" pulse propagates in the free half-space over the anode in the direction that is "specular" relative to the direction of the incident X-rays. Its parameters depend on the rate of change of the parameters of the dipole layer over anode that are made up by the electrons accelerated in the diode.
The second pulse is generated in the planar waveguide formed by the cathode and anode. The field of this waveguide electromagnetic radiation adds up with the field of the space charge of the electrons emitted, effectively reducing the accelerating field in the diode and thus decreasing the ultimate current density on the anode.
We define both analytically and with numerical simulation the ultimate parameters of electromagnetic radiation that may be obtained in systems and its dependence from the rate of rise of the electron photoemission current, diode voltage and the width of the accelerating gap.
The results are compared with the experimental data obtained with the Iskra-5 laser, which was used for generation of laser plasma as soft X-ray source.