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Amplification of a surface electromagnetic wave by a running over plasma surface ultrarelativistic electron bunch as a new scheme for generation of Terahertz radiation

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The amplification of a surface electromagnetic wave (SEW) by means of ultrarelativistic monoenergetic electron bunch running over the flat plasma surface in absence of a magnetic field is studied theoretically. It is shown that when the ratio of electron bunch number density to plasma electron number density multiplied by a powered to 5 relativity factor is much higher than 1, i.e $\gamma 5$ nb /np≫1 , the saturation field of the surface electromagnetic wave induced by trapping of bunch electrons approaches the surface electromagnetic wave front breakdown threshold in plasma:

eEx=eBy=0.16ω pmc e (2 γ5 nb /np)1/ 7 . The SEW saturation energy density in plasma can exceed the electron bunch energy density. Here, we discuss the possibility of generation of superpower Teraherz radiation and on a basis of such scheme.

The SEW on plasma surface and plasma-like media (gaseous plasma, dielectric and conducting media, etc.) attract special attention of researchers due to their unique properties. First of all, due to its high phase and group velocities close to light speed in vacuum at high media conductivity what makes them the most valuable in radiophysics [1]. The SEW are widely applied in physical electronics due to its high phase velocity leading to its uncomplicated generation by relativistic electron bunches and output from plasma.

We consider the case of ultrarelativistic monoenergetic electron bunch which remains relativistic in the frame of reference of SEW generated by this bunch compared to the works [2-4], where the bunches were nonrelativistic. Such a problem of generation of three-dimensional electromagnetic wave (wakefields) in plasma with the help of ultrarelativistic electron and ion bunches through Cherenkov resonance radiation was solved in [5].

The estimated SEW transverse electric field is |Ex |=|By |≈109V /cm=1011 V/m, hence,

the energy density flux (Poyinting vector) |P|=c /4 π(Ex

2)≈6. 1015W /cm−2 .

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