Magnetic field generation and Ohmic heating induced by femto-seconds laser pulse interaction with a solid target.

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It was shown recently [1,2,3] that by using two consecutive laser pulses one can improve the electron beam "natural collimation" induced by the self-generated magnetic field.

The dynamic of the self-generated magnetic was studied analitycally By Davies et al in Ref [4] by solving the Faraday equation in the framework of the “rigid model” approximation and by assuming Spitzer resistivity. The model predicts the evolution of the magnetic field generated by Ultra-High-laser-pulses-genearted electron beams only for pulse duration of the order of pico-second because the target temparature reach the Spitzer regime in a few hundreds femto-seconds (the low temperature beahvior of the target resistivity can so be negnlected). Howevere it break down in the femto-second regime where the low temperature beahviour of the target resistivity becomes important.

In this paper we propose an analytical model based on an extension of the above cited model which also include:

1) A complete description of the target resistivity based on the model developed in [5]
2) The time evolution of the system including the shaping of the electron beam current.

This model describe the evolution of the resistive magnetic field $B_\theta(r,z)$ in a 2D cylindrical geometry for target temperature ranging from room temperature until to the Spitzer regime as well as the target temperature, resistivity and ionization time evolution.

Preliminary simulations show that even in the femto-second scale the self generated resistive magnetic field play and important role for the elecron beam dynamic in the target.

In particuar it confirm that the physical phenomena of the beam collimation can also accour in the femto-second regime.

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