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Innovative source of intense laser-driven electromagnetic pulses and its manipulation of charged particle beams

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Intense laser-matter interactions produce broadband transient electromagnetic emissions, with overall power that can exceed the TW level. The low-frequency content of these emissions lies in the radiofrequency-microwave range, and it is known as "Electromagnetic Pulse" (EMP) [1]. This can easily reach intensities beyond the MV/m order, and for this reason a main research activity is devoted to its mitigation. Indeed, there are several promising studies for exploiting the source mechanisms of such intense fields, for example to produce kT transient magnetic fields [2] and traveling waves for particle acceleration and focusing [3]. A new application has been recently proposed [4] for creating large-intensity (MV/m and beyond) transient electric fields over large volumes and with specific spatial distributions, for many applications such as: particle acceleration, medicine, biology, electromagnetic compatibility, material science, aerospace, electronics, sensors. This is a significative example of inertial-fusion technologies efficiently applied to other fields and has the great potential to enable present and future laser plants to become innovative sources of tailored radiofrequency-microwave transient fields for a wide number of significant applications. We show here the methodology and the unique and very promising features provided by these high-field technologies, with both experimental measurements of laser-production of such fields and the results of their numerical modeling. We show also the details of the specific application and unique advantages of such fields for the management and the conditioning of accelerated particle beams, produced by both conventional particle accelerators and laser-plasma interaction schemes.

References

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