Laser plasma accelerators: status and applications

Victor Malka

Laboratoire d'Optique Appliquée, ENSTA- CNRS - Ecole Polytechnique, France
Email : victor.malka@ensta.fr

Compact accelerators based on laser plasma cavities, which support hundreds of GV/m electric field [1], deliver today electron beam with unique parameters. In 2004 quasi mono-energetic electron beams have been produced in the bubble regime [2] by focusing intense laser beam in under-dense plasma targets. This efficient bubble regime of acceleration is now currently working in many laboratories over the world. In 2006 stable and quasi mono-energetic electron beams have been demonstrated at LOA using by colliding two laser pulses in under-dense plasma [3]. This last approach is very promising for future applications because of the stability of the electron beams and the easy control of their parameters. The very high brightness and shortness (fs) [4] make them very attractive for many applications. I will present the different regimes of acceleration and relevant applications that have been recently considered at LOA: For medicine to treat the cancer by radiotherapy, for fundamental studies in radiobiology (short-time-scale), for chemistry (radiolysis in the femtosecond range), for material science in automobile and aeronautic industries (for non-destructive dense matter inspection by γ radiography), and finally for accelerator physics [5].

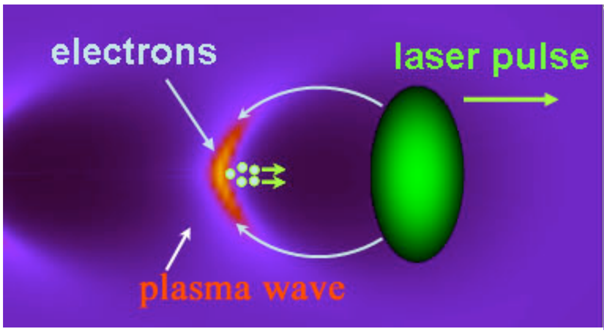

Figure 1: scheme of principle of the bubble regime. The laser pulse evacuates electrons creating a bubble structure which accelerates electrons during a very short time and in a very small area.

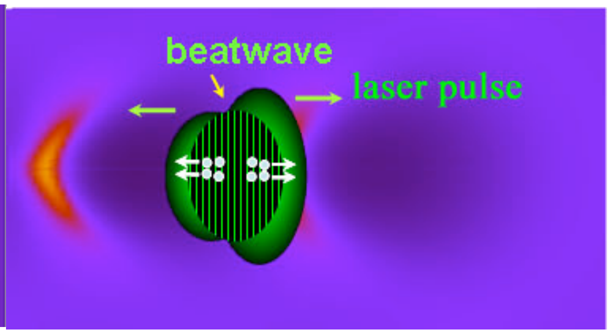

Figure 2: scheme of principle of the colliding laser pulses. The beating of the two laser pulses which counter propagates heats electrons. Electrons are then trapped by the wakefield driven by the pump laser beam

References
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[2] Dream Beams issue of Nature **431**, 538 - 544 (2004).
[3] J. Faure et al., Nature **444**, 737 (2006).
[4] O. Lundh et al., Nature Physics 7 (2011)
[5] V. Malka et al., Nature Physics **4** (2008).