

What can we do with a 5 PW laser?

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Laser plasma acceleration of electrons has progressed along with laser technology advances. It is thus expected that the development in the near-future of multi-PW-class laser and facilities world-wide will enable a vast range of scientific opportunities for laser plasma acceleration research. On one hand, high peak powers can be used to explore the extremely high intensity regime of laser wakefield acceleration, producing for example large amounts of electrons in the GeV range or generating high energy photons. On the other hand, the available laser energy can be used in the quasi-linear regime to create accelerating fields in large volumes of plasma and study controlled acceleration in a plasma stage of externally injected relativistic particles, either electrons or positrons.

After a general description of the key topics that can be addressed using multi-PW laser, examples of studies planned in France will be given. In the frame of the Centre Interdisciplinaire de la Lumière EXtrême (CILEX), the Apollon laser will deliver two PW level, ultra-short ($>15\text{fs}$) pulses to a target area dedicated to electron acceleration studies, such as the exploration of the non-linear regimes predicted theoretically, or multi-stage laser plasma acceleration.

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