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Laser Acceleration - Enabling unparalled accelerating gradients

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A focused electromagnetic field represents an extreme electromagnetic field. Maybe the highest electric field we can get under controlled conditions? One electric charge inside that field is subject to a tremendous force and it is thus accelerated to relativistic speeds on a few femtoseconds (lab frame time). The relativistic motion of a charged field inside an extreme laser is going to be reviewed with the emphasis not only in the maximum speed it get but also on the violent acceleration (and also slow down) it suffers on femtosecond scale.
When such an extreme field hits a target, solid or gas, atoms are instantaneously ionized and so –as charged particles- accelerated by the field. Depending on the initial intensity, plasma effects can be dominant.
With appropriate conditions, plasma effects can boost the acceleration process. Different approaches are going to be presented in the talk, depending on the plasma density and the laser parameters. Comparison with standard RF (radio frequency) accelerators is to be discussed also.
The presentation will include a review of the state of the art ultra-intense NIR (near infrared) laser facilities around the world, and its usefulness for acceleration. Also comparison with FIR (far infrared) lasers will be mentioned, since FIR lasers lie somehow in between a RF field and an optical laser.
The fast acceleration scheme provided by lasers maybe will allow in the future other hybrid techniques. Among them, post acceleration of short-lived particles, such as charged pions or muons.

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