Scuola di Dottorato in Fisica
Dipartimento di Fisica Enrico Fermi – Università di Pisa

Corso Avanzato di Struttura della Materia – a.a. 2013/14

Mon, May 5, 2014 – 14.00-16.00 – room 131 building C

Pulsed High Power Laser.

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The design of a high power laser involves different optical and technological problems. In this short lesson, the key factors will be discussed to given an idea of the issues the need to resolved.
In particular the lesson will be focused on:
- Pulsed laser and limits
- Amplification medium
- MOPA architecture
- Linear optics: chromatic aberration and dispersion
- Non linear optics: B-Integral
- CPA technique
- Final pulse shape.

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Novel aspects of classical and quantum radiation reaction

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Classical electrodynamics (CED) and Quantum electrodynamics (QED) are well established theories and their predictions have been successfully conrmed experimentally in different regimes. However, there are still areas of CED and QED that deserve theoretical and experimental investigation. In view of the increasingly stronger available laser elds it is becoming feasible also to employ them to test CED and QED under the extreme conditions supplied by ultra-intense fields [1].
A fundamental problem in electrodynamics is the so-called \radiation reaction" problem: classically, when a charged particle (an electron, for definiteness) is accelerated by an external field, it emits radiation and this emission alters the motion of the electron. At sufficiently intense background fields this usually results in a strongly damped motion, with the electron losing a large fraction of its initial energy. In [2] we have shown that the electron dynamics in a bichromatic laser pulse can be indirectly controlled by a comparatively small radiation-reaction force through its interplay with the Lorentz force. What is the quantum analog of radiation reaction? We have answered this question in the realm of strong-field QED [3], by connecting radiation reaction to the emission by an electron of many photons (see also [4]), and we have shown the existence of the so-called quantum radiation dominated regime. In this regime, both quantum recoil and radiation-reaction effects dominate the dynamics of the electron. The role of the stochasticity of the multiple photon emission in quantum radiation reaction has been also elucidated [5] together with its consequences for observing quantum radiation reaction itself.

[1] A. Di Piazza, C. Mueller, K. Z. Hatsagortsyan, and C. H. Keitel, Rev. Mod. Phys. **84, 1177 (2012).**
[2] M. Tamburini, C. H. Keitel, and A. Di Piazza, Phys. Rev. E **89, 021201(R) (2014).**
[3] A. Di Piazza, K. Z. Hatsagortsyan, and C. H. Keitel, Phys. Rev. Lett. **105, 220403 (2010).**
[4] F. Mackenroth and A. Di Piazza, Phys. Rev. Lett **110, 070402 (2013).**
[5] N. Neitz and A. Di Piazza, Phys. Rev. Lett. **111, 054802 (2013).**