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Seminar in Ultrafast Science and Technology

Date/Time: Thursday, 10. December 2015, 11:15 a.m.

Location: Room B116, ExWi building, Sidlerstrasse 5, Bern, Switzerland

High Field Physics and Laser Filamentation

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Laser filaments are self-sustained light structures of typically 100 um diameter and up to tens of meters in length, widely extending the traditional linear diffraction limit[1]. They stem from the dynamic balance between Kerr self-focusing and defocusing by the self-generated plasma and/or negative higher-order Kerr terms[2]. In the recent years, this Kerr polarization saturation appeared as a signature of electrons experiencing a combined ionic-laser field potential[3], closely related to the one involved in high harmonics generation (HHG).

The relative contributions of free, Drude type, electrons and electrons in this mixed potential depend on the driving laser wavelength, intensity and pulse duration. This dependence has been recently emphasized by filamentation experiments[4] (and associated simulations) in the mid-IR.

Applications of these high intensity structures include laser machining, broadening and shortening of laser pulses down to few cycles, as well as atmospheric monitoring and control. In particular, we show that laser filaments can induce water condensation and fast droplet growth up to several µm in diameter in the atmosphere[5,6] as soon as the relative humidity (RH) exceeds 70%. We also demonstrate that the radiative forcing properties of high altitude ice crystal clouds could be modulated by their interaction with high intensity laser filaments.

[1] J. Kasparian et al, *Science* **301**, 61-64 (2003)
[2] P. Bejot et al, *Phys.Rev.Lett.* **104**, 103903 (2011)
[3] M. Richter et al, *New J. of Phys.* **15**, 083012 (2013)
[4] D. Kartashov et al, *Opt.Lett.* **37(16)**, 3456 (2012)
[5] P. Rohwetter et al, *Nature Photonics* **4**, 451 - 456 (2010)
[6] S.Henin et al, *Nature Comm.* **2**, 456 (2011)