The Institute of Applied Physics Colloquium

Seminar Hall, Bergman Building
Wednesday, November 29 at 12:00
Refreshments at 11:45

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"Highly nonlinear optics in solids: Strong fields meet Floquet Physics, quantum matter, and magnetism"

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Abstract:
In the last decade, strong-field laser driving in solids has been employed for developing novel ultrafast spectroscopies. It has allowed (among others) probing band structures, Berry curvatures, phase transitions, and correlations. Here, intense laser pulses irradiate a sample, triggering non-perturbative responses such as high harmonic generation (HHG), photocurrent generation, etc., which are analyzed to obtain information about the sample and (potentially attosecond) dynamics within it.
These spectroscopies require an intimate comparison between theory and experiment, and a deep understanding of the underlying physical mechanisms generating the response. However, calculations often involve many untested approximations, and the fundamental mechanisms behind HHG are still under debate.
This issue is further complicated by the potential simultaneous presence of Floquet light-dressed phases of matter that could affect the dynamics. I will present our recent efforts exploring the fundamental nature of intense light-matter interactions in solids from an *ab-initio* perspective.
First, I'll show that Floquet physics indeed arises in the strong-field regime[1], but its contribution is quite complex and depends on the particular process being studied[2,3].
I'll argue that by performing time- and angle-resolved photoemission spectroscopy (Tr-ARPES) one can probe the interplay of Floquet phases and highly nonlinear optics. Next I'll present our recent work on HHG spectroscopy of topological insulators[4], which suggests that topology plays a rather minor role in highly nonlinear optics, contrary to the common conception in the field.
Lastly, I'll show that strong-field laser irradiation allows inducing non-perturbative attosecond magnetization dynamics[5], which are the fastest magnetic responses predicted to date.