



Russell Berrie Nanotechnology Institute
Technion - Israel Institute of Technology



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▶ "Solids in Ultrafast Strong Fields:
Topological Attosecond Phenomena"

Wednesday,
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12:00 refreshments
12:30 lecture

Solid State Auditorium

RBNI
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Seminar
Series
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Solids in Ultrafast Strong Fields: Topological Attosecond Phenomena

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We present our latest results for a new class of phenomena in condensed matter nanooptics when a strong optical field $\sim 1 - 3 \text{ V/\AA}$ changes a solid within optical cycle. Such a pulse drives ampere-scale currents in dielectrics and adiabatically controls their properties, including optical absorption and reflection, extreme UV absorption, and generation of high harmonics in a non-perturbative manner on a 100-as temporal scale. Applied to a metal, such a pulse causes an instantaneous and, potentially, reversible change from the metallic to semimetallic properties. We will concentrate on our latest theoretical results on graphene (a semimetal) and other two-dimensional solids such as transitional metal dichalcogenides (TMDCs), which are direct-bandgap semiconductors. Such materials in the reciprocal space are characterized by such nontrivial topological properties as Berry curvature and Berry flux in the K- and K'-valleys. Graphene in a strong ultrashort pulse field exhibits unique behavior, in particular, induced chirality, related to its topological properties. The TMDCs are predicted to exhibit a significant valley polarization induced by just a single-oscillation chiral optical pulse. We also predict resonances in TMDCs that are solely due to the Berry curvature (topological resonances). The corresponding phenomena are among the fastest processes in optics unfolding on a time scale of hundreds attoseconds. They offer potential for petahertz-bandwidth signal processing, generation of high harmonics on a nanometer spatial scale, femtosecond valleytronics, etc.