



Solid State Institute  
המכון למצב מוצק

TECHNION  
Israel Institute  
of Technology



הטכניון  
מכון טכנולוגי  
לישראל

**SPECIAL SEMINAR**

**סמינר מיוחד**

**Optical phenomena in spherical structures, coherent vibrational-modes in helical structures, and drug discovery for Covid-19 using free-energy calculations**

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**Abstract**

High-resolution far-field localization is one of the main challenges in optics and has immense importance in chemistry, biology, and medicine. Here we approach this challenge by introducing a spherical layer with a resonant permittivity, which naturally generates the spatially continuous time-reversed signal of an atomic and molecular multipole transition at the origin. We start by utilizing a spherical layer with a resonant TM  $l=1$  permittivity situated in a uniform medium with a dipole source that removes the degeneracy of the eigenfunctions, to generate a subwavelength free-space focal spot at the origin. We then show that spherical structures exhibit a unique type of degeneracy, in which an infinite number of eigenvalues asymptotically coalesce, resulting in a variety of optical phenomena. In addition, to achieve deep-subwavelength far-field localization, we explore a three-body resonance mechanism and the possibility that the time-reversal of the field emitted in an atomic or molecular transition will spatially correlate with the quantum transition current.

Helical structures like alpha helices, DNA, and microtubules have profound importance in biology. It has been suggested that these periodic arrangements of constituent units could support collective excitations similarly to crystalline solids. Here, we examine the interaction between such constructs and oscillating dipoles, and evaluate the role of the helicity in the coupling between electrodynamic fields and vibrations. Based on vibrational and field-expansion analyses we identify a group of modes of coherent oscillations that can give rise to a strong and frequency, and typical interaction range. This new type of resonances – delocalized response, selectivity in identified here may help explain the role of electrodynamic fields in the diverse functionality of cytoskeletal microtubules in the cellular environment.

Finally, we briefly present a project with the goal of discovering a peptide-drug for Covid-19 using free-energy calculations.

**ההרצאה תתקיים ביום רביעי, ה- 23.12.20 בשעה 15:30**

**[בזום קישור](#)**

**The lecture will take place on Wednesday, 23.12.20 at 15:30**

**Via Zoom [Link](#)**

**Host: Assistant Professor Yoav Sagi**