Solid State Institute
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**SEMINAR** **סמינר**

# Topological insulator lasers


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Abstract

Topological insulators are a phase of matter with an insulating bulk and conducting edges. A topological insulator is characterized by a bulk bandgap where topological gapless unidirectional edge states reside. These edge states are robust to any perturbation that does not close the bandgap. In this way, deformations of the system like disorder, strain, or imperfections have little effect on the transport of such topological edge modes. The discovery of topological insulators has subsequently motivated the search of topological systems in optics and photonics towards robust optical devices. In photonics, the first topological insulators were demonstrated using strong magnetic fields in microwave frequencies, and more recently at optical frequencies in a modulated photonic lattice and silicon ring resonators arrays. On this background, it is interesting to ask: Can topological protection improve the single most important optical device, the laser?

In this seminar, we introduce the new concept of the topological insulator laser: a photonic topological insulator that lases. The design of such a laser system is highly non-standard - a laser is an open, non-Hermitian (due to gain/loss) system that is also highly nonlinear (due to saturation). Our topological system consists of an array of microring resonators in which the topological edge-states are the first modes to lase. In this way, the lasing modes are confined to the edge of the cavity, and the transport of light in the cavity is topologically protected: the lasing mode is unidirectional and robust to backscattering and imperfections. This creates a laser cavity that is robust to disorder and defects, with high slope efficiency that remains unchanged even under large disorder. We present the new concept that includes both theoretical and experimental results.


**ההרצאה תתקיים ביום רביעי, ה-31.1.18 בשעה 12:30**

**באודיטוריום המכון למצב מוצק, קומת כניסה**

**The lecture will take place on Wednesday, 31.1.18 at 12:30**

**at the Solid State Institute auditorium, entrance floor**

**Ph.D. Student of Distinguished Professor Moti Segev**