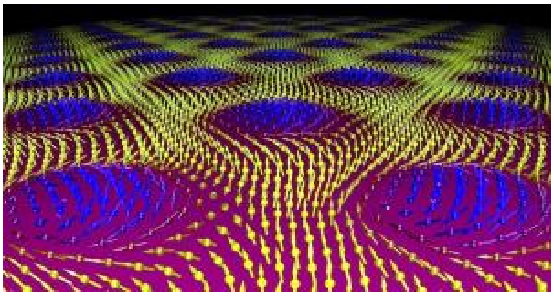
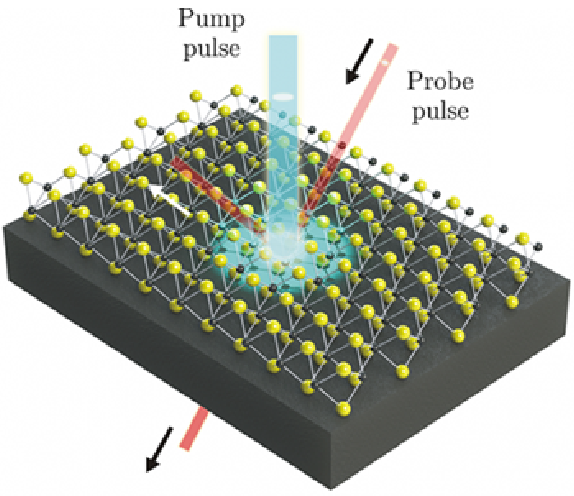
Technion- Israel Institute of Technology Electrical engineering department
Electro-optics research center

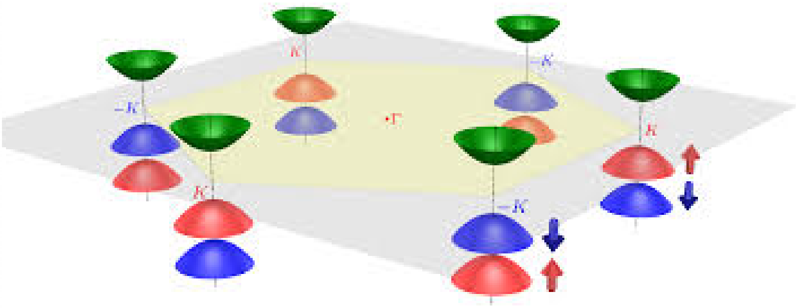
Project proposal
Experimental ultrafast control of angle-resolved Valleytrnoics in 2D-materials

Preliminaries: Physics 3 (mandatory), EE or Physics Solid State course (in parallel)
Theoretical background:



Valleytronics is one of the modern fields in emerging electronics which employs valley degree of freedom and spin in certain two dimensional materials for information exchange.
2D-materials are sometimes referred as layered materials having thickness of a single or few atomic layer(s). The laws of quantum mechanics govern electron transport between valleys.
The main goal of the project is to investigate exciting properties of monolayers and their applications in the field of quantum information. A powerful laser generates short 2 pico-second pulses, making investigation of ultrafast electron dynamics possible. The excited electrons travel between valleys transmitting the desired information. We want to explore electron transport in MoS_2 monolayer as a function of the incident angle between an exciting pump beam and the material surface. The unique technique called pump-probe is implemented in order to investigate ultrafast processes. The intense pump beam excites electrons and weak probe beam tracks the changes in reflectivity of the sample, thus making electron dynamics apparent.
The application of these materials can be found in various fields of quantum information, spintronics, condensed matter and semiconductor physics. Hybrid devices based on monolayers and some novel materials have not been investigated yet, therefore research in the field could reveal interesting new phenomena. For example, combination of superconducting materials with monolayers may create entangled light source, which plays the crucial role in quantum information exchange.





Additional information:
Laboratory: Ultrafast quantum device lab. Fishbach 251
Supervisor: Prof. Alex Hayat alex.hayat@ee.technion.ac.il