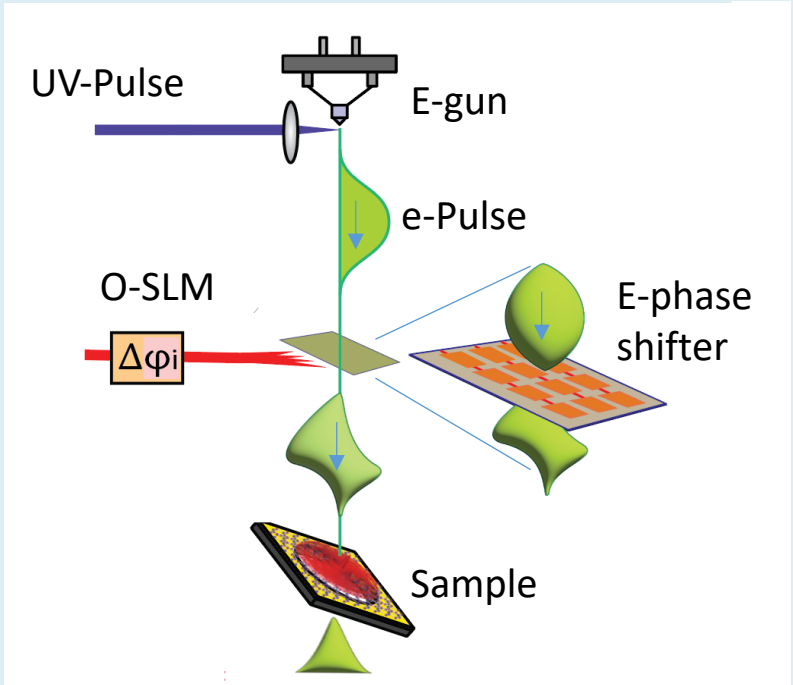
Joint PhD position proposal:

Shaping Quantum Wavefunctions in Electron Microscopes

We propose a joint Jülich ER-C/Technion position for a PhD student to develop a laser-based spatial electron phase modulation. In building such a device, we aim to harness electron coherence using interferometry as a key method for lowering the required electron dose in imaging of dose-sensitive materials using high-end electron microscopes.

Cutting-edge interferometric techniques necessitate precise manipulation of the electron wavefunction and its phase front. **Mastering dynamic control over this phase front** represents a significant yet unresolved challenge, promising substantial advancements in the field.



***Laser-control of quantum wavefunctions in transmission electron microscopy**. The PhD student will build a spatial electron phase modulator, where each "PIXEL" independently shifts the local phase of the electron wave.*

The modulators we will build, take advantage of a novel physics phenomenon: the phase shift of the electron wavefunction when traversing built-in electric fields in semiconductor devices, such as PN or Schottky junctions. These devices will be externally controlled by laser beams for dynamic, ultrafast operation, as schematically described in the figure.

The Ernst Ruska-Centre for Microscopy (ER-C) in Jülich is the German national center of excellence for high-end electron microscopy and It is the world's largest and most advanced electron microscopy center.

The AdQuanta group at the Technion is one of the world leaders in ultrafast electron microscopy. The group develops unique theoretical and experimental capabilities for exploring the physics of novel kinds of electron-photon interactions.

Research highlights:

- The first interaction of a free electron with quantum light [Science **373**, 6561 (2021)]
- The first spatiotemporal imaging of coherent dynamics in 2D materials [Science **372**, 1181 (2021)]
- Tunable laser-induced spatial modulation of free electrons [Nature Materials **22**, 345 (2023)]

Reach out to interview for this PhD program and get to work in leading laboratories in Israel and Germany. On top of a full PhD fellowship, the position includes a special housing allowance and substantial support for frequent international travels between Germany and Israel.

To apply, kindly forward your CV and a cover letter to kaminer@technion.ac.il and r.dunin-borkowski@fz-juelich.de.

Please note: acceptance to the program necessitates successful interviews at both Technion and the Jülich Research Center.