Cavity-induced topological superconductivity

Applications: From now on
Start of project: March – October 2021

Topological states of matter are one of the most active fields of contemporary condensed matter physics. Of particular interest is topological superconductivity, hosting protected exotic edge modes like **Majorana fermions** [1].
In this ambitious Master project, we will investigate theoretically **a new strategy to create topological superconductivity**, which relies on the use of strong light-matter coupling in optical cavities. In the setup illustrated in the figure below, the interaction between laser photons and a nanoplasmonic cavity (blue) can give rise to attraction between electrons [2]. You will explore whether this recently proposed strategy to induce electronic interactions can be applied to a topological insulator and analyze the resulting superconducting state. To this end, you will **combine concepts and methods from quantum optics, condensed matter theory and topology**. Experience in one of those fields will be helpful, though not strictly initially required. **Collaboration with the University of Oxford** is planned.
This project will be jointly supervised by **Dr Thore Posske** (tposske@physnet.uni-hamburg.de) and **Dr Frank Schlawin** (frank.schlawin@mpsd.mpg.de) in the thriving environment of the Excellence Cluster CUI:AIM at the University of Hamburg. You can contact us for further details. For general information on the groups visit www.posske.de.

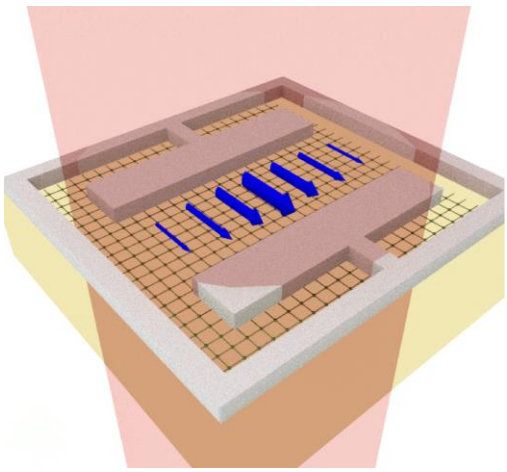

Fig. 1: The creation of topological superconductivity in a nanoplasmonic cavity. This challenging master's thesis combines cutting-edge research on driven systems, photons, and topological electronic states of matter.

[1] A. Y. Kitaev, Phys. Usp. **44**, 131 (2001), H. Kim, A. Palacio-Morales, T. Posske et al., Sci. Adv. **4**, eaar5251 (2018).
[2] H. Gao, F. Schlawin et al., Phys. Rev. Lett. **125**, 053602 (2020).