Maximally Chiral Metasurfaces as a Platform for Chiral Linear and Nonlinear Polaritonics

1. Chair in Hybrid Nanosystems, Ludwig-Maximilians-University of Munich, Munich 80539, Germany

2. Nonlinear Physics Centre, Research School of Physics, Australian National University, Canberra ACT 2601, Australia

Alexander Antonov[1], Yuri Kivshar[2], Andreas Tittl[1]

Email: a.antonov@physik.uni-muenchen.de

Maximally chiral metasurfaces, which remain transparent for light of one circular polarization while resonantly interacting with its counterpart, offer unprecedented prospects for novel optical devices enabling chiral light generation, detection and light-mater interactions. Leveraging the concept of quasi-bound states in the continuum (quasi-BIC), we design and fabricate maximally chiral dielectric nanostructures of different heights and explore them as a platform for chiral polaritons. As a proof of concept, we demonstrate maximally chiral metasurfaces composed of bulk van der Waals (vdW) materials having stable excitons at room temperature, which allows us to access self-hybridized chiral exciton-polaritons. By analyzing the near-field composition of hybrid eigenstates, we demonstrate that formed chiral polaritons closely match the condition of an ideal chiral emitter, making our platform highly promising for chiral linear and nonlinear polaritonics.

Short Bio:

Alexander Antonov received Bachelor's and Master's degrees in Nuclear Physics and Technology from the National Research Nuclear University MEPhI, Moscow. He then earned his PhD degree in Condensed Matter Physics from Shubnikov Institute of Crystallography, Russian Academy of Science, Moscow, in 2023. Following this, Alexander joined Ludwig Maximilians Universität München (LMU) as a postdoctoral researcher under the supervision of Prof. Andreas Tittl. His research focuses on optical dielectric and plasmonic metamaterials, with a particular interest in chiral metasurfaces and chiral light-matter interactions.