Einladung zum Physikalischen Kolloquium

Invitation to the Physics Colloquium

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“Chiral Quantum Optics”

Controlling the interaction of light and matter is the basis for diverse applications ranging from light technology to quantum information processing. Nowadays, many of these applications are based on nanophotonic structures. It turns out that the confinement of light in such nanostructures imposes an inherent link between its local polarization and its propagation direction, also referred to as spin–momentum locking of light. Remarkably, this leads to chiral, i.e., propagation direction-dependent emission and absorption of light. In our group, we observed this effect in the interaction between single rubidium atoms and the evanescent part of a light field that is confined by continuous total internal reflection in a whispering-gallery-mode microresonator. In the following, this allowed us to realize an integrated optical isolator as well as an integrated optical circulator which operate at the single-photon level and which exhibit low loss. The latter are the first two examples of a new class of nonreciprocal nanophotonic devices which exploit the chiral interaction between single quantum emitters and transversally confined photons. Finally, we showed that chiral effects even occur in standard imaging systems like an optical microscope. There, they lead to a shift of the image of an elliptically polarized point-like emitter with respect to the emitter’s real position.