PHYSIKALISCHES KOLLOQUIUM

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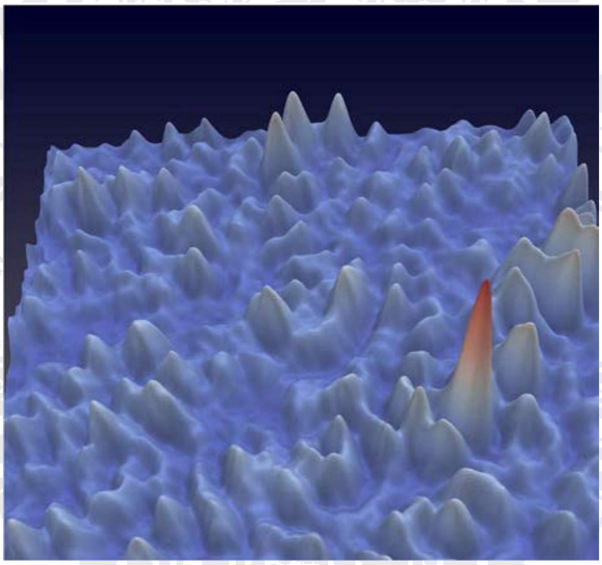
IM GROßEN HÖRSAAL



NANOSCALE LIGHT
- VISUALIZATION, FASCINATION AND APPLICATION -

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Trapping and manipulating light is the central theme of (nano)photonics. Photonic crystals and plasmonic nanostructures are able to exert a huge control over light at the nanoscale. Their ability to confine light to extremely small volumes and/or slowing it down substantially, enable a manipulation of effective light-matter interactions, even to the extent of inducing optical properties that don’t occur naturally. Moreover, typically all 6 components of the electromagnetic field play a role.

We use a near-field microscope to visualize the nanoscale patterns of light as it propagates through a nanostructure. Interestingly, we found that this conventional near-field microscope is not only sensitive to the electric field of the propagating wave, but –contrary to common wisdom- also to the magnetic field. The interplay between the various components of either the magnetic or the electric fields leads to optical entities that, in their size, put nanophotonics to shame: these optical singularities have a size zero. It turns out that optical singularities near nanoscale structures exhibit a markedly different behavior from those in macroscopic beams. Moreover, we show in a purely classical experiment that these singularities and their associated local helicity can be applied for new quantum technology as they can be used to deterministically couple a spin-transition to emission direction.

Our near-field microscope also has access to dynamic phenomena in photonic nanostructures. In chaotic cavities we observe the occurrence of so-called rogue waves: instances of high local intensities that appear and disappear on femtosecond timescales at (seemingly) random positions in the cavities. Interestingly, the chaotic cavities exhibit rogue wave behavior even though no nonlinearities are present.