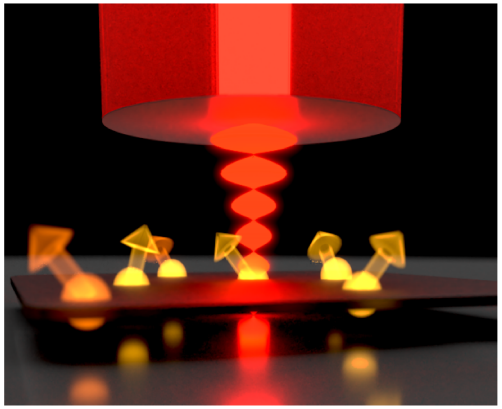
# Physikalisches Kolloquium

Universität Konstanz

**Prof. Dr. David Hunger**
Physikalisches Institut, KIT

Di 10.11.20
15:15 Uhr
Zoom-Meeting



## Quantum and nano-optics with tunable microcavities

Optical microcavities are a powerful tool to enhance light-matter interactions. This enables applications ranging from ultra-sensitive spectroscopy and sensing to quantum information. To achieve large cavity enhancement on a flexible platform, we have developed microscopic Fabry-Perot cavities based on laser-machined optical fibers [1].

We employ such cavities to realize efficient readout of individual quantum emitters by means of Purcell enhancement of fluorescence emission. We study solid state quantum emitters such as NV centers in diamond [2,3] and rare earth ions [4], with the goal to realize a quantum repeater for long-distance quantum communication, and optically addressable multi-qubit registers as quantum computing nodes.

In a different direction in the context of sensing, we use microcavities for imaging and spectroscopy applications, as well as for sensing of dynamic properties of individual nanosystems. We have developed scanning cavity microscopy as a versatile method for spatially and spectrally resolved maps of various optical properties of a sample with ultra-high sensitivity [5,6]. Integration of microcavities in a microfluidic environment has allowed us to resolve the Brownian motion of un-labelled nanoparticles and track their positions in 3D [7]. Simultaneous enhancement of absorptive, dispersive, and scattering signals promises intriguing potential for optical studies of nanomaterials, molecules and biological nanosystems.

[1] D. Hunger et al., New J. Phys. 12, 065038 (2010)
[2] H. Kaupp et al., Phys Rev Applied 6, 054010 (2016)
[3] J. Benedikter et al., Phys Rev Applied 7, 024031 (2017)
[4] B. Casabone et al., New J. Phys. 20, 095006 (2018)
[5] C. Gebhardt et al., Sci. Rep. 9,13756 (2019)
[5] M. Mader et al., Nature Commun. 6, 7249 (2015)
[6] T. Hümmer et al., Nature Commun. 7, 12155 (2016)
[7] L. Kohler et al., arXiv:2008.12173 (2020)