4. Physikalisches Institut
Prof. Dr. Harald Giessen

UNIVERSITÄT STUTTGART

Einladung zum Gastvortrag

Rashid ZIA

Brown University, School of Engineering

Accessing Forbidden Transitions:
Magnetic Dipoles and Electric Quadrupoles for Nano-Optics

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Although it is often assumed that all light-matter interactions at optical frequencies are mediated by electric dipole transitions, strong optical frequency magnetic dipoles do exist. In fact, we see magnetic dipole emission every day from the many lanthanide ions (such as trivalent europium and erbium) that help to illuminate everything from fluorescent lighting to telecom fiber amplifiers. Higher-order processes such as magnetic dipole and electric quadrupole transitions also play an important part in the light emission from transition metal ions and semiconductor quantum dots. Nevertheless, most applications have overlooked the device implications of these electric-dipole-forbidden transitions throughout the visible and near-infrared regime, and their contributions to many important emitters have not been fully characterized.

In this presentation, we will experimentally characterize the "forbidden" transitions in a range of solid-state emitters and investigate their applications and implications for nanophotonics. We will examine the electric dipole approximation commonly used to describe light-matter interactions and discuss naturally occurring systems that exhibit higher-order magnetic dipole and electric quadrupole emission. We will illustrate how these nanoscale quantum transitions can provide both a new way to probe magnetic light-matter interactions and a new degree of design freedom for active electronic and photonic devices. Specifically, we will demonstrate how the different symmetries of multipolar transitions can be exploited to identify, quantify, and control light emission, even at sub-lifetime scales.