



CRC 1227  
Designed Quantum States of Matter



## GUEST LECTURE

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(Guest of Prof. Klemens Hammerer)

Leibniz Universität Hannover  
DQ-mat Colloquium  
**14 October 2021, 3.00 pm**  
(via Zoom-Meeting)

### **"Photonic frequency-domain circuits for quantum state generation and processing"**

A key challenge in today's quantum science relies in the realization of large-scale complex non-classical systems to enable, e.g., accelerated computations. Optical quantum frequency combs, characterized by many equidistantly spaced frequency modes, allow the storage of a large amount of quantum information. The combination with control techniques, embodied by e.g. electro-optical frequency shifting, can represent a powerful frequency-domain quantum circuit and an approach towards realizing large-scale controllable quantum systems. In this presentation, we will discuss the efficient realization of quantum frequency combs in on-chip waveguide structures and micro-resonators as well as demonstrate their use for the realization of quantum states with considerably enhanced complexity, particularly generating and manipulating on-chip multi-photon as well as high-dimensional quantum states. These frequency-domain circuits permitted the first realization of discrete high-dimensional cluster states, laying at the basis of measurement based-quantum computing, as well as the frequency-domain Hong-Ou-Mandel interference of independent photons, fundamental to quantum information processing. Microcavity-based photonic frequency comb states and their control using accessible telecommunications infrastructure can open up new venues for reaching the processing capabilities required for meaningful quantum information science.

**All DQ-mat members and all interested are cordially invited to attend.**