FRIEDRICH-ALEXANDER UNIVERSITÄT ERLANGEN-NÜRNBERG
NATURWISSENSCHAFTLICHE FAKULTÄT

Department für Physik

Physikalisches Kolloquium

19.12.2016, 16 Uhr c.t. **Hörsaal E**

Forging the ring of power – resonant linear, nonlinear and quantum optics –

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Legend says that the ring of power was forged at Mount Doom – Middle Earth (New Zealand). I will show how we strive to harness the power of light bound in crystalline ring resonators touching such fascinating fields as connecting future quantum computers to quantum networks as well as in entangling three photons and such mundane things as sensing the environment. The magic lies in the nonlinear interaction between matter and light.

Strong nonlinear interactions require large optical fields. One of the most successful platforms for harvesting strong nonlinear interactions with continuous wave pumping fields are optical resonators. Large optical fields require long confinement times and small mode volumes. A particular successful system for nonlinear interactions is that of a whispering gallery mode (WGM) resonator. In such a resonator type, the light is confined within a dielectric by total internal reflection at its circular dielectric boundary. Depending on the material choice either second order or third order nonlinearities can be addressed. The confinement by total internal reflection allows modes with small losses throughout the transparency region of the material. This broadband confinement combined with the tight guiding of the modes at the rim of the resonator is ideal for nonlinear interaction

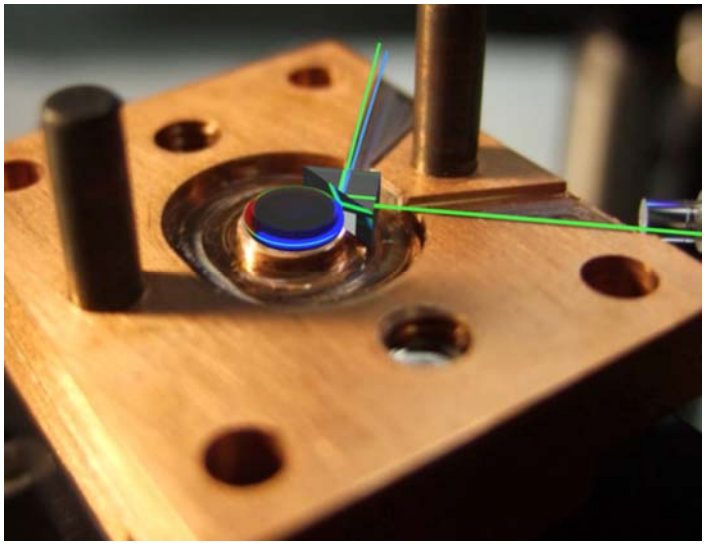

Figure *A three dimensional microwave cavity is coupled to a crystalline whispering gallery mode resonator. Strong nonlinear interaction mediates efficient and coherent conversion of the microwave field into a blue shifted optical sideband. This constitutes a first step towards a bi-directional transducer between superconducting quantum circuits and optical quantum networks.*

between different frequency domains.

In this talk I will present our recent results of coherently converting microwave radiation into the optical domain whereby we provide a route to realistic quantum networks[1]. Furthermore, we investigate third harmonic generation in crystalline WGM resonators. The birefringence of crystalline resonators provides the benefit of allowing efficient out coupling of the generated green light and not interfering with the infrared pump – the reverse process of efficient three-photon generation is the ultimate goal for this project. Finally, I will show provide an overview of further projects ranging from optical telecommunication to sensing.

1. A. Rueda et al., “Efficient microwave to optical photon conversion: an electro-optical realization,” Optica, OPTICA **3**(6), 597–604 (2016) [doi:10.1364/OPTICA.3.000597].

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