Physikalisches Institut
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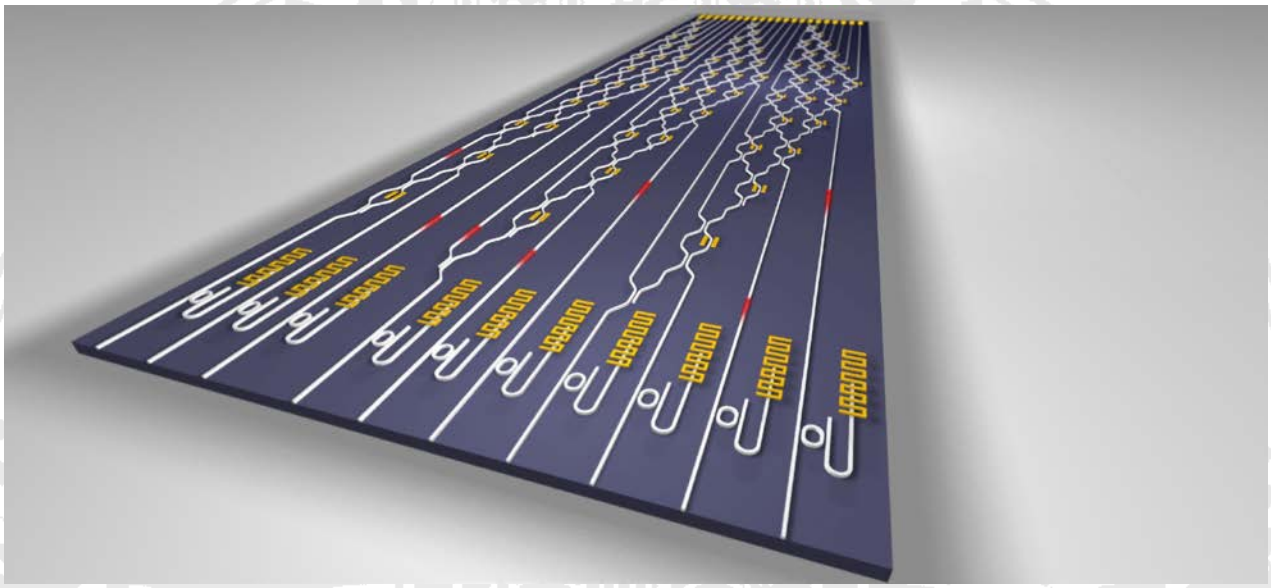
Albert-Ludwigs-Universität Freiburg

# PHYSIKALISCHES KOLLOQUIUM

AM 18. MAI 2015 UM 17 UHR C.T.

IM GROßEN HÖRSAAL



AN INTEGRATED QUANTUM PHOTONIC CIRCUIT ON A CHIP (IMAGE: COURTESY OF PETE SHADBOT)

## SEMICONDUCTOR SINGLE PHOTON SOURCES AND SPIN-BASED QUANTUM MEMORIES FOR FUTURE QUANTUM TECHNOLOGIES

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The transmission of single photons enables the secure exchange of information via quantum key distribution (QKD), which is the first commercially available quantum information technology. Experimental QKD systems have reached high repetition rates, and communication channels beyond 200 km have been successfully implemented. In this presentation, we summarize how single photons can be efficiently generated based on semiconductor quantum dots integrated in microcavities, and how these single photons can be utilized to establish secure communication across a 500 m long free-space link in down-town Munich [1,2]. To realize long distance communication and overcome limitations of single photon absorption, quantum repeater protocols have been invented, which utilize the teleportation of quantum properties over distance to increase the distance of quantum communication links. We furthermore present and discuss the realization of single spin quantum memories [3,4], quantum dot spin-photon entanglement [5] and the generation highly indistinguishable single photons [6] as important building blocks for the realization of future quantum networks.

[1] Heindel et al. New J. Phys. 14 083001 (2012)
[2] Rau et al. New J. Phys. 16, 043003 (2014)
[3] Press et al., Nature Photonics 4, 367 (2010)
[4] De Greve et al., Nature Physics 7, 872 (2011)
[5] De Greve et al., Nature 491, 421 (2012)
[6] He et al., Nature Nanotechnology 8, 213 (2013)