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Quantum Dot Spins and Photons

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Self-assembled semiconductor quantum dots are interesting and rich physical systems. Their inherently mesoscopic nature leads to a multitude of interesting interaction mechanisms of confined spins with the solid state environment of spins, charges and phonons. In parallel, the relatively clean spin-dependent optical transitions make quantum dots strong candidates for stationary and flying qubits within the context of spin-based quantum information science. The recently observed quantum dot resonance fluorescence has become a key enabler for further progress in this context. I will first discuss the real-time optical detection (or single-shot readout) of quantum dot spins, and then I will discuss how resonance fluorescence allows coherent generation of single photons suitable (and tailored) for linear-optics quantum computation and for establishing a high-efficiency spin-photon quantum interface within a distributed quantum network.