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Physikalisches Kolloquium — Physics Colloquium

Einladung — Invitation

Monday, 28 January 2019, Lecture Hall N24/H13, 16:15

Coffee and cookies will be served in front of the lecture hall from 16:00

The Stern-Gerlach Effect in Nonlinear Optics

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The Stern-Gerlach effect, separating the electron spin components of Silver atoms that pass in a transversely varying magnetic field, is considered one of the cornerstones of quantum mechanics. I will discuss an analogue effect in nonlinear optics, based on the mixing of two different light waves (signal and idler waves) in a quadratic nonlinear crystal.

The dynamics of the nonlinear sum frequency generation process is similar to that of many other two-level systems, and in particular to spin-1/2 particles in magnetic field. Therefore, light beams that carry signal-idler superposition states can be spatially separated by transversely varying the nonlinear optical coupling. Moreover, when non-classical light, consisting of a signal-idler two-photon pair, is sent into the nonlinear Stern-Gerlach device, these photons emerge together at one of the two output ports, thus representing the frequency domain.

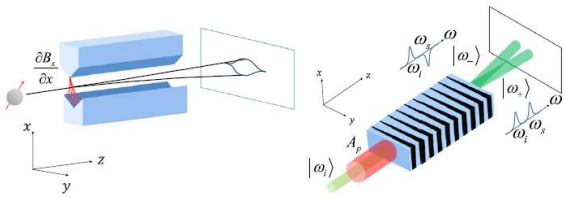

Fig. 1: Left: The original Stern-Gerlach effect – a beam of silver atoms is deflected into two discrete directions owing to the magnetic field gradient; Right: the equivalent Stern-Gerlach effect in nonlinear optics, where light beams are deflected into two discrete directions owing to the nonlinear coupling.

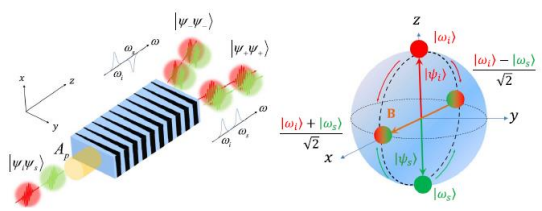

Fig. 2: Left: The Stern-Gerlach effect for quantum light: The signal-idler two photon pair emerges in only one of the two output ports. Right: Bloch sphere representation of this effect.

References:

- Karnieli and A. Arie, "All-Optical Stern-Gerlach Effect", *Physical Review Letters* **120**, 053901 (2018).
- Karnieli and A. Arie, "Frequency Domain Stern-Gerlach Effect for Photonic Qubits and Qutrits", *Optica* **5**, 1297-1303 (2018).

Host: PD Dr. M. Efremov, Prof. W. Schleich, Institute of Quantum Physics

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