EBERHARD KARLS UNIVERSITÄT TÜBINGEN

iRyd

SPP 1929 – Seminar

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Universität Tübingen
Room D4 A19
Auf der Morgenstelle 14, 72076 Tübingen

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Self-Induced Transparency in Room-Temperature Dense Rydberg Gases

Aggressively large Doppler effects is of the challenge to create static optical nonlinearities in atomic gases beyond ultracold temperatures. We show the creation of strong dispersive optical nonlinearities of nanosecond laser pulses in high number density atomic gases at room temperature. This is examined in a vapor cell setting where the laser light resonantly excites atoms to Rydberg P states through a single-photon transition. Using fast Rabi flopping and strong Rydberg atom interactions, both in the order of GHz, can overcome the Doppler effect as well as dephasing due to thermal collisions between Rydberg electrons and surrounding atoms. In this strong-driving regime both the light intensity and Rydberg interactions contribute to the generation of the optical nonlinearity. We show the emergence of a modified self-induced transparency (SIT) where the stable light propagation relies on the Rydberg interactions, modifying the area theorem. We furthermore demonstrate that a conditional optical phase gate can be implemented by harvesting strong Rydberg atom interactions and SIT. Our study paves a route to explore nonlinear optics in Rydberg gases from low to room temperature, and contributes to current efforts in developing quantum information and communication devices with glass cell technologies.