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Ultrafast optical spin echo of a single electron spin in a quantum dot KRISTIAAN DE GREVE, DAVID PRESS, PETER MCMAHON, E.L. Ginzton Laboratory, Stanford University, THADDEUS LADD, E.L. Ginzton Laboratory, Stanford University and National Institute of Informatics, Tokyo, Japan, BENEDIKT FRIESS, MARTIN KAMP, CHRISTIAN SCHNEIDER, SVEN HOEFLING, ALFRED FORCHEL, Technische Physik, Univ. of Wuerzburg, Wilhelm-Conrad-Roentgen-Research Center for Complex Material Systems, Am Hubland, D-97074 Wuerzburg, Germany, YOSHIHISA YAMAMOTO, E.L. Ginzton Laboratory, Stanford University and National Institute of Informatics, Tokyo, Japan —
We report on the ultrafast optical implementation of a Hahn Echo sequence on a single electron spin in an InGaAs quantum dot. With this technique, we were able to overcome the shot-to-shot variations of the electron spin's magnetic environment in our multi-shot, time-averaged read-out scheme. We measured the electron spin coherence time T_2, both as a function of applied magnetic field, and for different types of sample surface treatment. Measured T_2-times of 3 μs, together with our experiment all-optical single spin rotation times of 30 ps, would allow 10^5 single qubit gate operations. Furthermore, we observe pronounced non-linear, hysteretic effects in a 2-pulse Ramsey interference experiment, which we attribute to an electron-spin dependent polarization of the nuclear spins. .

Kristiaan De Greve
E.L. Ginzton Laboratory, Stanford University

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