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Far-field optical imaging and manipulation of individual spins with nanoscale resolution PETER MAURER, JERO MAZE, Harvard University, PAUL STANWIX[1], Harvard-Smithsonian, LIANG JIANG, ALEXEY GORSKOV, ALEXANDER A. ZIBROV, Harvard University, BENJAMIN HARKE, MPG, JONATHAN HODGES, MIT, ALEXANDER S. ZIBROV, Harvard University, DANIEL TWITCHEN, Element Six Ltd, STEFAN HELL, MPG, RONALD WALSWORTH, MIKHAIL LUKIN, Harvard University — A fundamental limit to existing optical far field techniques for measurement and manipulation of spin degrees of freedom is set by diffraction. Here, we demonstrate an efficient far-field optical technique that overcomes this limit. Our technique involves selective flipping of the orientation of individual spins, associated with Nitrogen-Vacancy centers in diamond, using a focused beam of light with intensity vanishing at a controllable location. This enables simultaneous single-spin imaging and magnetometry at the nanoscale. Furthermore, by inhibiting spin transitions away from the laser intensity null using a quantum Zeno-like effect, selective coherent rotation of individual spins is realized. This technique can be extended to sub-nanometer dimensions, thus enabling applications in diverse areas ranging from quantum information science to bioimaging.

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