

PHYSIKALISCHES KOLLOQUIUM

AM 11. JULI 2016 UM 17 UHR C.T.

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THE DIAMOND QUANTUM REVOLUTION

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The precision of any measurement is limited by quantum mechanics. Yet, in practice, hardly any measurement reaches its quantum limits. This is because dephasing typically influences the measurement device, thus rendering sensitivity below its physical limits. A new class of quantum sensors based on spin defects in materials like diamond, however, reach quantum-limited precision even under ambient conditions. Such sensors, e.g. allow for very precise detection of quantities like magnetic and electric fields, temperature, and pressure. By using multispin entanglement, quantum algorithms or quantum memories, Heisenberg scaling of sensitivity is achieved. While the physics of engineering optimum quantum states is subject to intense research in laboratories around the world, diamond quantum sensors start to venture into applications. First proof of principle work has demonstrated their use in material science, biology, medical imaging, and even industry.