## Quantum Science and Technology Mini-Symposium
## Room Ballroom BC - Session QS-ThP

## Quantum Science and Technology Mini-Symposium Poster Session

**QS-ThP-1 Frugal Quantum Magnetometry for Education***, **John Muth**, Jonathan Rabe,* North Carolina State University

The use of color centers for magnetometry is well established, with the nitrogen-vacancy (NV) center in diamond being the most prominent example. Recently, there has been growing interest in using silicon carbide as a more cost-effective alternative material. However, for educational purposes, the cost of associated optics and electronics can present a significant barrier with many approaches costing in excess of $10,000.

This poster presents the design of a printed circuit board using off-the-shelf electrical components, integrated with an adjustable 3D-printed optical mount. The entire system can be built for under $500 (excluding the cost of the diamond). The stand-alone device is compact and portable, and can be connected to a laptop for data acquisition and analysis.

Collected data demonstrate that the system achieves sensitivity in the low microtesla range and that hyperfine splitting can be observed. It can be used to generate color maps that visualize Zeeman splitting and to investigate how the orientation of NV centers affects the fitting of the zero-field splitting. As an alternative to optically detected magnetic resonance (ODMR) in diamond, the use of spin-dependent recombination to enable an all-electrical quantum magnetometer based on silicon carbide will also be briefly discussed.

**QS-ThP-4 Telecom Quantum Photonics Enabled by Erbium-Doped SiC Nanostructures: A Scalable Nanofabrication and Materials Science Engineering Approach***, **Alexander Kaloyeros**, Spyros Galis,* University at Albany-SUNY

The development of scalable photonic technologies relies on integrating compact, on-chip nanoscale devices into quantum photonic integrated circuits (qPICs). Key components of these systems, such as quantum LEDs (qLEDs) that are based on engineered point-defect nanoscale emitters, require material platforms that support operation at elevated temperatures, enable electrical addressability, and are compatible with high-yield, large-scale fabrication. Additionally, operation in the highly desirable telecom C-band (~1540 nm) is critical for low-loss optical communication. However, despite significant progress, none of the current material systems has been able to meet all these requirements within this important set of constraints. Current technologies are limited by non-ideal emission wavelengths, low-yield fabrication of emitters (e.g., randomness in spatial placement, orientation, and emission frequency), and the need for cryogenic temperatures.Collectively, these challenges pose major barriers to scalable integration. We present a nanofabrication- and materials-engineering-driven strategy to create a material platform that resolves these key challenges. Notably, this platform enables coherent optical control at 77 K, including the ability to resolve Rabi oscillations from a single $Er^{3+}$ emitter, which emit in the telecom C-band (~1534 nm), and narrow optical linewidth of ~90 MHz. The approach is based on the fabrication of arrays of $Er^{3+}$-doped silicon carbide (SiC) hollow nanopillars (HNPs) and nanowires (NWs) using a scalable, CMOS-compatible process. A key breakthrough is the precise spatial positioning of $Er^{3+}$ ions with sub-5 nm accuracy. This is achieved through a novel strategy in which placement is governed not by lithographic patterning but by the critical dimension of the nanostructures, defined by our highly controlled conformal SiC deposition. This addresses one of the primary limitations of current single-photon emitter platforms: the randomness in emitter location, orientation, and spectral properties that impedes large-scale integration. The fabrication of these foundational structures and their properties will be presented in the context of advancing quantum photonic integrated devices. Furthermore, we demonstrate the ability to control both the density and spatial distribution of Er ions, enabling the isolation of single and few $Er^{3+}$ ions at temperatures ≥77 K—capabilities not previously achievable in bulk systems. Together with polarization control and compatibility with optical cavity integration, these results highlight the potential of this platform for scalable, high-performance quantum photonic technologies.

**QS-ThP-5 Accurate Atomic Correlation and Total Energies for Correlation Consistent Effective Core Potentials (ccECP) for Transition Metals***, **Aqsa Shaikh**,* North Carolina State University, India

In this work we utilize the correlation consistent effective core potentials (ccECPs) and present highly accurate correlation and total energy calculations for a selected set of transition metals and other heavy elements. We calculated the total energies using a variety of sophisticated correlated methods including configuration interaction (CI), coupled-cluster (CC) to multiple excitations and also with stochastic sampling approaches such as Quantum Monte Carlo (QMC). Calculations were performed with basis sets up to cc-pV5Z to limit discrepancies and then extrapolated to estimate the complete basis set limit. Kinetic energies were similarly assessed through CI to various excitation levels. We also present diffusion Monte Carlo (DMC) energies, providing insight into fixed-node/phase biases in single-reference trial wave functions. These results establish reliable benchmarks for ccECP performance across a broad spectrum of electronic structure methods, ensuring their utility in future high-accuracy calculations in correlated deterministic and stochastic frameworks.

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