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Quantum Sensing with Trapped Ions

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Formal developments in the context of quantum information theory, together with the superb experimental control on quantum systems attained in the last couple of decades, are giving rise to the appearance of a new field of research and development—quantum technologies—the use of quantum protocols and system to enhance available technology or even develop totally new devices [1]. Within this field, quantum metrology or quantum sensing focuses in establishing the measurement uncertainties achievable according to

quantum mechanics, to devise physical systems able to test them, and to design new measurement devices that translate these findings into practical applications [2]. Building on the exquisite control and precise detection methods available for trapped atomics ions [3], we have developed two proposals to use them as quantum probes of weak and/or short-pulsed electric fields. In our first proposal, we measure and stabilize the carrier-envelope-offset phase of a femtosecond frequency comb by multi-pulse quantum interferometry—a new interferometry protocol that uses a trapped ion as a nonlinear detector of the pulse-to-pulse phase variations of a fast train of laser pulses [4]. Our second work relies again on trapped ions, together with quantum logic and state-dependent forces, to determine the electric dipole moment of a polar molecule by measuring the extremely weak electric field that this produces on the nearby probe ion [5,6].

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Entanglement Classification and Matrix Product States

(Invited)

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We will give an arrangement of entanglement classes for symmetric states related to their Matrix Product State structure. In this manner we will assign physical significance to an entanglement classification.

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