A stand-alone mobile quantum memory system

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Quantum memories (QMs) are central to many applications in quantum information science. To date, many realisations of QMs have been demonstrated with different physical systems, ranging from cold atomic ensembles to solid-state systems. As a necessary element of quantum repeaters, these devices should be able to operate in non-laboratory environments, and as such their future deployment in space could advance global quantum communication networks [1]. In this context, warm-vapour QMs are particularly promising due to their low complexity and low size, weight and power. Unlike many other systems, they do not require laser or cryogenic cooling, which would make them attractive for practical applications.

We will present the implementation and performance analysis of a portable, rack-mounted stand-alone warm vapour QM system [2], that also includes the laser package and control electronics. The optical memory is based on long-lived hyperfine ground states of Cesium which are connected to an excited state via the D1 line at 895 nm in a lambda-configuration. The memory is operated with weak coherent pulses containing on average < 1 photons per pulse. The long-term stability of the memory efficiency and storage fidelity is demonstrated at the single photon level together with operation in a non-laboratory environment. As an outlook, we will also discuss storage of non-classical states and different methods to micro-integrate this platform

Figure 1. Stand-alone warm vapour QM system integrated in a 19" Rack, including the laser package and control electronics.

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[2] M. Jutisz *et. al.*, in preparation (2024)