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Quantum State Mapping in the 133 Cs Hyperfine Ground Manifold BRIAN ANDERSON, AARON SMITH, POUL JESSEN, University of Arizona — Quantum systems with Hilbert space dimension greater than two (qudits) are often thought of as carriers of quantum information. Quantum control of the entire qudit system could prove to be very useful for information processing task allowing for the implementation of novel protocols for robust quit manipulation and error correction. We will describe a method to achieve quantum control of the 16 dimensional hyperfine ground manifold of Cesium using a nearly decoherence free protocol involving the application of static, RF and microwave magnetic fields. Numerical optimization can be used to design time dependent control fields that map any initial state to any target state. We have implemented this control protocol and have mapped an initial state to all 16 magnetic eigenstates. Stern-Gerlach analysis shows apparent mapping fidelities around 95 percent, limited by error in the control fields and measurement accuracy.

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