

Abstract Submitted  
for the DAMOP20 Meeting of  
The American Physical Society

**New Control and Measurement Techniques for Spin-1 Ensembles<sup>1</sup>**

LIN XIN, MATTHEW BOGUSLAWSKI, MARYROSE BARRIOS, SAMI HAKANI, JULIA COHEN, MICHAEL CHAPMAN, Georgia Inst of Tech — The more complicated quantum phase space of spin-1 atoms compared to the spin-1/2 case offers unique capabilities, but also provides unique challenges for quantum control and measurement. Our work with ultracold, spin-1, rubidium 87 atoms in an all-optical trap has given us insight into how holonomic-type schemes could be realized in an atomic system. We demonstrate the creation and readout of a non-Abelian geometric phase in a spin-1 quantum system. Furthermore, by implementing microwave techniques to selectively isolate hyperfine states, we are able to construct multi-level transitions with an accuracy of 99.5%. We will discuss how these techniques can be applied to quantum metrology, quantum gates, and quantum tomography with spin-1 systems.

<sup>1</sup>National Science Foundation, Grant No. NSF PHYS-1806315

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Date submitted: 02 Feb 2020

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