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Generalized quantum measurements on a ^{87}Rb Bose-Einstein condensate JOSEPH D. MURPHREE, AZURE HANSEN, JUSTIN T. SCHULTZ, MAITREYI JAYASEELAN, NICHOLAS P. BIGELOW, University of Rochester — We investigate two applications of generalized measurements on a ^{87}Rb Bose-Einstein condensate (BEC). The first involves preparing the BEC in one of two non-orthogonal states constructed from a superposition of two atomic spin states. A positive-operator valued measure (POVM) for this system can be defined by three vectors in the 2D spin space. A two-photon Raman process rotates these vectors into a higher-dimensional space associating each with its own spin state, whose relative populations are measured using Stern-Gerlach imaging. This allows the possibility of unambiguously determining in which state the system was prepared. For the second application, a superposition of two spin states is used to put the BEC into one of three non-orthogonal states in the trine state configuration and measured using a POVM as before. Here an unambiguous measurement is impossible, but the POVM minimizes the error probability, improving upon the error probability associated with a traditional projective von Neumann measurement. Finally, incorporating orbital angular momentum states of the BEC allows for the possibility of extending these techniques into higher dimensions.

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