

**Coherences and correlations in an ultracold Bose
gas**

by

Heather Jean Lewandowski

B.S. Physics, Michigan Technological University, 1997

M.S. Physics, University of Colorado, 2001

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written by Heather Jean Lewandowski
has been approved for the Department of Physics

Eric A. Cornell

Deborah S. Jin

Date _____

The final copy of this thesis has been examined by the signatories, and we find that both the content and the form meet acceptable presentation standards of scholarly work in the above mentioned discipline.

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Coherences and correlations in an ultracold Bose gas

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The development of a new and simplified system to create a Bose-Einstein condensate (BEC) is presented, as well as experimental studies of two spin-state condensed and non-condensed samples. The first part of this thesis describes in detail our apparatus and experimental procedure for creating a BEC. We designed a system to create a BEC that is simple and robust enough to be constructed by someone outside of the field of atom cooling and trapping. Our system includes several novel features that reduce the complexity of the apparatus, which include mechanical transfer of atoms and a hybrid magnetic trap.

The second part of this thesis describes studies of two spin-state clouds. We studied the correlations and coherences of non-condensed clouds using Ramsey spectroscopy to gain an understanding of interatomic interactions. We were able to measure precisely the mean-field interactions between coherent particles, as well as determine mechanisms that preserve and destroy coherence. These experiments led us to the study of spin waves, in which scattering of indistinguishable particles gives rise to coherent spin oscillations. Using sensitive Ramsey spectroscopy, we were able to fully examine the spatio-temporal spin-state oscillations. Following the studies of normal cloud coherence, we went on to explore coherence effects in condensates.

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