

# CHENCHAO ZHAO

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OBJECTIVE            A Ph.D in the field of theoretical condensed matter physics.

EDUCATION            *Bachelor of Physics*  
Department of Physics<sup>1</sup>, Beijing Normal University, expected June 2013

*List of Scores*

- Major average  
Theory 90.3 + Lab 85.7 + Math 93.0<sup>2</sup> = Total 89.9
- TOEFL 111, Speaking section 28
- GRE 1320 + 3.5

*Familiar subjects*

- Cold atom BEC, superfluidity, BCS superconductivity
- Topological insulator/superconductor
- Quantum Hall fluids
- Topological orders
- AdS/CMT

*Additional courses*

- *Classical field theory* and *the general theory of relativity*
- Functional formulation of *quantum many-body physics*
- Some elementary knowledge of string theory
- Mathematics: Mathematical analysis, differential geometry, advanced linear algebra, operator theory, functional calculus, group theory and etc.

*Computer skills*

- Languages/software: Fortran, Octave (Matlab), Gnuplot, Maxima, Inkscape, L<sup>A</sup>T<sub>E</sub>X
- Operating system: Linux
- Numerical recipes: Exact-diagonalization

RESEARCH            COLD ATOM            August, 2012 – Now  
EXPERIENCE            *Effects of Rashba-Dresselhaus competition in 2D two-component spinor BEC*

- I combined the two spin-orbit coupling strengths into a single complex parameter  $\tilde{\kappa} = \kappa e^{i\alpha}$  with argument  $\alpha$  characterizing the mixing.
- In the free particle model, I demonstrated explicitly how the ground state degeneracy evolves as a function of  $\alpha$ ;
- Effects of Zeeman term and parity breaking term on dispersion relation were also studied.

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<sup>1</sup>I spent one prior year at *College of Life-science* and then changed major to physics.

<sup>2</sup>Including calculus, linear algebra, complex variables, differential equations, integral transformations and etc.

- Next step is to solve the system at the present of a harmonic trap with numerical diagonalization method.
- Harmonic oscillator eigenstates as the basis, the free Hamiltonian was rewritten in terms of ladder operators
- My goal is to study the ground state ( $T = 0$ ) profile in momentum space and expect condensations at finite momentum.
- I will lift the ground state degeneracy manually with external perturbation and calculate the tendency of spontaneous symmetry breaking in the limit of zero perturbation.
- I will also study how interactions drive the symmetry breaking.

#### OVERVIEW

- **Freshman** Took the course *Differential Geometry and General Relativity* intended for graduates and senior undergraduates.
- Read and finished problems (chapter 1-7) of *Atomic Physics* by Christopher J Foot, in exchange for the contents of freshman physics course *Quantum Physics* taught by Professor MEI ZHANG.
- **Sophomore** Joined the theoretical condensed matter group led by Professor SUPENG KOU and have been attending weekly group meetings regularly (including talks of my research progress).
- I delivered a concise presentation on the generalization of the second law to the realm of non-equilibrium thermodynamics during the course *Introduction to Biological Physics*.
- **Junior** Attended the serial lectures *Quantum Many-Body Correlation Functions and Applications to BEC* (Tsinghua, April, 2012) by Professor ALEXANDER FETTER and volunteered to edit the lecture notes.
- Participated in the serial talks on *Superfluidity* (Tsinghua, April, 2012) by Professor GORDON BAYM.
- Attended the talk titled *The Interplay between Magnetism, Superconductivity and Spin-Orbit Coupling in Topological Insulators* (CAS, May, 2012) by Professor TAYLOR HUGHES.
- Participated the program *Critical behavior of lattice models in atomic and molecular, condensed matter and particle* (KITPC, Summer, 2012), organized by Professor XIAO-GANG WEN, *et al.*
- I held a student discussion session on *topological insulators with interactions* at KITPC under kind permission of Professor WEN

#### EXTRA-CURRICULAR ACTIVITIES

- Co-director and participant of the university held “12-9 Chorus Competition.”
- Participant of the university held “Student’s Fashion Show.”
- Granted the “excellent design” title for T-shirt design by department of physics.