BENJAMIN K CHANG

Email: bkchang8@gmail.com
Homepage: https://bkchang.github.io/

Understanding the **Physics** *in* **Materials**
by **Computations** *and* **Machine Learning**.

EDUCATION

National Taiwan University (NTU), M.S. in **Physics** 09/2015-07/2017
Thesis: First-Principles Studies of Cubic Sb-Doped GeTe Compounds for Thermoelectric Applications (doi: 10.6342/NTU201701378)
Graduated with **Dean's Award**

National Tsing Hua University (NTHU), B.S. in **Interdisciplinary Program of Sciences (IPCS)** 09/2011-06/2015
Physics and **Materials Science**, Minor in **Computer Science**
Graduate Ranking: **1**/27 (**top 3.7%**) || GPA: **3.94**/4.0 (**4.03**/4.3)

Coursera Certificates (Offered by Prof. Andrew Ng at Stanford University) 2017
Machine Learning & Deep Learning

PUBLICATIONS

1. Deniz P. Wong, Masoud Aminzare, Chin-Sheng Pang, Benjamin K. Chang, Hsiang-Ting Lien, Sun-Tang Chang, Chia-Hua Chien, Yang-Yuan Chen, Ming-Wen Chu, Yaw-Wen Yang, Wen-Pin Hsieh, Gerda Rogl, Peter Rogl, Mei-Yin Chou, Li-Chyong Chen, and Kuei-Hsien Chen. **Boosting zT above 2.5: Temperature-Induced Valence Band Convergence in GeTe-rich Ge-Sb-Te Thin Film.** Submitted to Nature Energy.
2. B. K. Chang and M.-Y. Chou, **First-Principles Studies of Cubic Sb-Doped GeTe for Thermoelectric Applications.** Waiting for submission after the first paper is published.

RELEVANT COURSES

Physics
Undergraduate (Average GPA: **4.0**/4.0 || **4.19**/4.3)

- Quantum Mechanics (I)
- Thermal and Statistical Physics (I)
- Quantum Physics (I, II)
- Electromagnetics (I, II)
- Theoretical Mechanics (I, II)
- Introduction to Elementary Particle Physics (II)
- Applied Mathematics (I, II)

Graduate (Average GPA: **4.0**/4.0 || **4.14**/4.3)

- Quantum Mechanics (I, II)
- Statistical Physics(I)
- Classical Electrodynamics (I)
- Classical Mechanics
- Topics on Theoretical Materials Physics

Computer Science
Undergraduate (Average GPA: **4.0**/4.0 || **4.16**/4.3)

- Design and Analysis of Algorithms
- Operating Systems
- Computer Architecture
- Data Structures
- Logic Design
- Scientific Computing
- Web Programming, Technologies, and Applications
- Introduction to Programming
- Linear Algebra (I, II)
- Statistics

Materials Science and Engineering
Undergraduate (Average GPA: **3.96**/4.0 || **4.00**/4.3)

- Biomedical Materials
- The Physical Properties of Materials
- Ceramic Materials
- Introduction to Crystal Structure and Diffraction Theories
- Material Science and Engineering (I, II)
- Thermodynamics of Materials (I, II)

Machine Learning
Coursera (All Passed with **Certificates**)

- Machine Learning
- Neural Networks and Deep Learning
- Structuring Machine Learning Projects
- Improving Deep Neural Networks: Hyperparameter tuning, Regularization and Optimization
- (All offered by Prof. Andrew Ng at Stanford University)

SKILLS AND TOOLS

First-Principles (*Ab-initio*) Computation VASP, Quantum Espresso, BandUP, BoltzTrap, Phonopy
Machine Learning & Deep Learning Tensorflow

Other Basic Languages and Tools Python, C/C++, Matlab, Shell Script, HTML5/CSS, Javascript, PHP, SQL, LabVIEW

RESEARCH EXPERIENCES

Institute of Atomic and Molecular Sciences (IAMS), Academia Sinica, Taipei 09/2015-06/2017

Advisor: Prof. Mei-Yin Chou (Vice President of Academia Sinica)

First-Principles Studies of Cubic Sb-Doped GeTe Compounds for Thermoelectric Applications (Master Thesis)

- Collaborated with the experimental group of Prof. Kuei-Hsien Chen (Director of IAMS).
- Discovered that the function of the defects in cubic GST is nearly just tuning the Fermi level.
- Proposed a rigid band model of using cubic GeTe band structure to approximate GST band structure.
- Speculate the electron-donor role of the Si-substrate for GST film fabrications.
- Predicted that substrates other than Si would not result in the same high thermoelectric performance GST film. Later confirmed by experiments.
- Two papers on their way. Please refer to **PUBLICATIONS**.

Department of Physics, Fudan University, Shanghai 07/2013-08/2013

Supervisor: Prof. Jian Shen (Director of the Department)

Co-Alq_3-LSMO Film and Giant Magnetoresistance

- Took part in the preparation of Co-Alq_3-LSMO film using molecule beam epitaxy (MBE).
- Improved the UI and functionality of the monitor program by using LabVIEW.
- Earned the distinctive honor of Chun-Tsung Scholar based on my performance.
- This work was continued by the group and later published on Nature Communications (doi: 10.1038/ncomms5396).

Department of Physics, NTHU, Hsinchu 2013

Supervisors: Prof. Ya-Chang Chou (Department of Physics, NTHU); Prof. Kiwing To (Institute of Physics, Academia Sinica)

Mechanics of Molecular Motors

- Participated in the simulation of long-chain molecular motors' motion using a vibrational platform.
- Attempted to formulate a model for rotational molecular motors.

CURRENT PROJECT

Institute of Atomic and Molecular Sciences (IAMS), Academia Sinica, Taipei 06/2017-present

Instructor: Prof. Mei-Yin Chou (Vice President of Academia Sinica)

Finding Large Anharmonic Force Contants of SnSe Using Machine Learning

- Collaborating with student at the Department of Physics at Georgia Institute of Technology.
- Implemented a machine learning method called "Compressive Sensing" using Tensorflow.
- Used nearly ten thousand atomic displacement data derived from DFT to find the significant anharmonic force constants up to the fourth order.

HONORS AND AWARDS

Dean's Award, *College of Science, NTU* 08/2017

Awarded to graduate students outstanding in academic research.

Phi Tau Phi Honorary Membership, *NTHU Branch, Phi Tau Phi Scholastic Honor Society of the Republic of China* 06/2016

Awarded to top 1% undergraduate students annually.

College of Science Elite Student Award, *College of Science, NTHU* 04/2015

Awarded to 1 student in each year in each department in the College of Science annually.

Academic Achievement Award (2 times), *NTHU* 02/2013-01/2014

Awarded to top 5% students of each department, every semester.

Yu Kuo-Hua Scholarship, *Yu Kuo-Hua Foundation* 12/2013

Awarded to 2 students in the College of Science at NTHU annually.

Chun-Tsung Scholar, *Hui-Chun Chin and Tsung-Dao Lee Chinese Undergraduate Research Endowment (CURE)* 11/2013

Awarded to 2 undergraduate students outstanding in academic research from each of the 6 top universities of Republic of China and People's Republic of China (National Tsing Hua, Peking, Fudan, Shanghai Jiao Tong,

Soochow, and Lanzhou University).

Dr. Chen Ke-Zhong Memorial Scholarship, *NTHU* 10/2013

Awarded to 1 student in the College of Science every semester.

Mr. Ma Shang-Keng Memorial Scholarship, *NTHU* 10/2013

Awarded to 2 students outstanding in "subjects in physics" annually.

Mr. Jiang Ying-Bin Memorial Scholarship, *NTHU* 10/2013

Awarded to 1 NTHU student outstanding in both academic performance and team activities annually.

Academic Exchange Scholarship to People's Republic of China, *NTHU* 07/2013-08/2013

Awarded to a small number of students with good academic performance annually.

Student Award, *Department of IPCS, NTHU* 11/2012

Awarded to outstanding students in the Department of IPCS annually.

TEACHING EXPERIENCES

Teaching Assistant, Classical Mechanics (Graduate Course), *Department of Physics, NTU* 09/2016-01/2017

Instructor: Prof. Kazuo Hosomichi

Marking homework, answering online questions and offering office hours, all in English. 34 students.

Teaching Assistant, Quantum Physics (Undergraduate Course), *Department of Physics, NTU* 09/2016-01/2017

Instructor: Prof. Yeong-Chuan Kao

Following course, producing the first version of lecture notes, answering after-class questions. About 100 students.

Teacher of NTHU Belize Educational Volunteer Service Group, *Cayo District, Belize* 07/2014-08/2014

Taught basic computer concepts in English with the help of simple Spanish dialogs. More than 150 Belizean children between 6-15 years old.

Dean's Honorable Peer Tutor, *NTHU* 09/2013-06/2014

Offered after-class guidance of selected subjects in mathematics, physics, materials science, and computer science for any NTHU students who made an appointment online, in both Chinese and English.

POSTERS, TALKS AND TERM PROJECTS

First-Principles Studies of Cubic Sb-Doped GeTe for Thermoelectric Applications (Upcoming Poster), 10/2017

The 20th Workshop on First-Principles Electronic Structure Calculations, Nanging, China

Going to present master's work on cubic GST.

First-Principles Studies of Cubic Sb-Doped GeTe for Thermoelectric Applications (Upcoming Poster), 09/2017

Joint Workshop with Yokohoma City Univeristy, IAMS, Taipei, Taiwan

Going to present master's work on cubic GST.

Introduction to Machine Learning (Talk), *IAMS Theory Groups Joint Meeting* 07/2017

Gave a pedagogical talk in English on the current development of machine learning. About 20 attendants.

Electron Localization Function (Talk), *IAMS Theory Groups Joint Meeting* 08/2016

Gave a pedagogical talk in English on the development of electron localization function. About 20 attendants.

Low Thermal Conductivity Thermoelectric Materials (Talk), *IAMS Theory Groups Joint Meeting* 05/2016

Gave a pedagogical talk in English on modern approaches of reducing thermal conductivity of thermoelectric materials, including anharmonicity, cage-like structures, phonon gap production, and lone-pair electrons. About 20 attendants.

Thermal Transport Theory (Term Project)

Reviewed the formulation of thermal transport, including Born-Oppenheimer approximation, anharmonic interactions, Boltzmann equation, and the formula for thermal conductivity.

WORK EXPERIENCES

Research Assistant, *IAMS, Academia Sinica* 02/2016-present

Teaching Assistant, Classical Mechanics, *Department of Physics, NTU* 09/2016-01/2017

Teaching Assistant, Quantum Physics, *Department of Physics, NTU* 09/2016-01/2017

LEADERSHIP AND TEAMWORK EXPERIENCES

Programmer and Strategy Designer, *FDT Global College Student Investment Competition* 03/2016-06/2016

Collaborated with 4 other teammates from different fields. Used Python to implement foreign exchange transaction strategies on the platform provided by Financial Data Technologies (FDT) Ltd.

Chief of the Web and Information Division, *NTHU Graduate Student Association* 09/2014-06/2015

Led division members in designing and creating the association website.

Representative Speaker on Taiwanese Economy, *Exchange Workshop of Economics, Tsinghua University, Beijing* 07/2014

Represented NTHU group to give a talk about education industry's impact on Taiwanese economy at the exchange workshop held by the departments of Economics of Tsinghua University (Beijing) and NTHU.

Fundraiser and Member of the Media Division, *NTHU Belize Educational Volunteer Service Group* 11/2013-10/2014

Produced promotion videos, gave fundraising presentations, gained sponsorship at various charity bazaars, eventually, with colleagues, gathered over 33,000 USD and 40 computer sets in a few months.

-Updated 2017.09.04