

# BENJAMIN K CHANG

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*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](https://doi.org/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. Benjamin K. Chang and Mei-Yin Chou, **First-Principles Studies of Cubic Sb-Doped GeTe for Thermoelectric Applications**. Waiting for submission after the first paper is published.

## RELEVANT COURSES

Physics	Computer Science
Undergraduate (Average GPA: <b>4.0/4.0</b>    <b>4.19/4.3</b> )	Undergraduate (Average GPA: <b>4.0/4.0</b>    <b>4.16/4.3</b> )
Quantum Mechanics (I)	Design and Analysis of Algorithms
Thermal and Statistical Physics (I)	Operating Systems
Quantum Physics (I, II)	Computer Architecture
Electromagnetics (I, II)	Data Structures
Theoretical Mechanics (I, II)	Logic Design
Introduction to Elementary Particle Physics (II)	Scientific Computing
Applied Mathematics (I, II)	Web Programming, Technologies, and Applications
Graduate (Average GPA: <b>4.0/4.0</b>    <b>4.14/4.3</b> )	Introduction to Programming
Quantum Mechanics (I, II)	Linear Algebra (I, II)
Statistical Physics(I)	Statistics
Classical Electrodynamics (I)	
Classical Mechanics	
Topics on Theoretical Materials Physics	
Materials Science and Engineering	Machine Learning
Undergraduate (Average GPA: <b>3.96/4.0</b>    <b>4.00/4.3</b> )	Coursera (All Passed with <b>Certificates</b> )
Biomedical Materials	Machine Learning
The Physical Properties of Materials	Neural Networks and Deep Learning
Ceramic Materials	Structuring Machine Learning Projects
Introduction to Crystal Structure and Diffraction Theories	Improving Deep Neural Networks: Hyperparameter tuning, Regularization and Optimization
Material Science and Engineering (I, II)	(All offered by Prof. Andrew Ng at Stanford University)
Thermodynamics of Materials (I, II)	

## SKILLS AND TOOLS

**First-Principles (*Ab-initio*) Computation** VASP, Quantum Espresso, BandUP, BoltzTrap, Phonopy

**Machine Learning & Deep Learning** Tensorflow, Scikit-learn

## RESEARCH EXPERIENCES

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### 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<sub>3</sub>-LSMO Film and Giant Magnetoresistance

- Took part in the preparation of Co-Alq<sub>3</sub>-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](https://doi.org/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

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### Institute of Atomic and Molecular Sciences (IAMS), Academia Sinica, Taipei

06/2017-present

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

#### Identifying Large Anharmonic Force Constants of SnSe Using Machine Learning

- Collaborating with student at the Department of Physics at Georgia Institute of Technology.
- Applied a machine learning method called "Compressive Sensing".
- Trained the statistic model "LASSO" using nearly ten thousand atomic displacement data derived from DFT to identify the significant anharmonic force constants up to the fourth order.

## HONORS AND AWARDS

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### 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).	
<b>Dr. Chen Ke-Zhong Memorial Scholarship, NTHU</b>	10/2013
Awarded to 1 student in the College of Science every semester.	
<b>Mr. Ma Shang-Keng Memorial Scholarship, NTHU</b>	10/2013
Awarded to 2 students outstanding in “subjects in physics” annually.	
<b>Mr. Jiang Ying-Bin Memorial Scholarship, NTHU</b>	10/2013
Awarded to 1 NTHU student outstanding in both academic performance and team activities annually.	
<b>Academic Exchange Scholarship to People’s Republic of China, NTHU</b>	07/2013-08/2013
Awarded to a small number of students with good academic performance annually.	
<b>Student Award, Department of IPCS, NTHU</b>	11/2012
Awarded to outstanding students in the Department of IPCS annually.	

## TEACHING EXPERIENCES

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<b>Teaching Assistant, Classical Mechanics (Graduate Course), Department of Physics, NTU</b>	09/2016-01/2017
Instructor: Prof. Kazuo Hosomichi	
Marking homework, answering online questions and offering office hours, all in English. 34 students.	
<b>Teaching Assistant, Quantum Physics (Undergraduate Course), Department of Physics, NTU</b>	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.	
<b>Teacher of NTHU Belize Educational Volunteer Service Group, Cayo District, Belize</b>	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.	
<b>Dean’s Honorable Peer Tutor, NTHU</b>	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

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<b>First-Principles Studies of Cubic Sb-Doped GeTe for Thermoelectric Applications (Upcoming Poster),</b>	10/2017
<i>The 20<sup>th</sup> Workshop on First-Principles Electronic Structure Calculations, Nanning, China</i>	
Going to present master’s work on cubic GST.	
<b>First-Principles Studies of Cubic Sb-Doped GeTe for Thermoelectric Applications (Poster),</b>	09/2017
<i>Joint Workshop with Yokohoma City Univeristy, IAMS, Taipei, Taiwan</i>	
Going to present master’s work on cubic GST.	
<b>Introduction to Machine Learning (Talk), IAMS Theory Groups Joint Meeting</b>	07/2017
Gave a pedagogical talk in English on the current development of machine learning. About 20 attendants.	
<b>Electron Localization Function (Talk), IAMS Theory Groups Joint Meeting</b>	08/2016
Gave a pedagogical talk in English on the development of electron localization function. About 20 attendants.	
<b>Low Thermal Conductivity Thermoelectric Materials (Talk), IAMS Theory Groups Joint Meeting</b>	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.	
<b>Thermal Transport Theory (Term Project)</b>	
Reviewed the formulation of thermal transport, including Born-Oppenheimer approximation, anharmonic interactions, Boltzmann equation, and the formula for thermal conductivity.	

## WORK EXPERIENCES

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<b>Research Assistant, IAMS, Academia Sinica</b>	02/2016-present
<b>Teaching Assistant, Classical Mechanics, Department of Physics, NTU</b>	09/2016-01/2017
<b>Teaching Assistant, Quantum Physics, Department of Physics, NTU</b>	09/2016-01/2017

## LEADERSHIP AND TEAMWORK EXPERIENCES

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- 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 2017.09.14