# LIHAO YAN

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## EDUCATION

**Yale University**                                                                          *May 2027*
Ph.D. in Physics

**University of Notre Dame**                                                          *May 2021*
B.S. in Physics (Honors)
Double Major in Philosophy
GPA: 3.904
Honors: The Dean's Research Award, *cum laude*

## RESEARCH EXPERIENCE

**Theoretical Condensed Matter Physics**                    September 2019 – May 2021
*Notre Dame, IN*

- Worked on confined vortex matter in mesoscopic superconductors under the direction of Prof. Boldizsár Jankó at the University of Notre Dame and in collaboration with Prof. Milorad Milošević from the University of Antwerp
- **Showed that the triangular superconductor samples can be used to identify experimentally the existence of the anisotropic interaction and unconventional pairing**
- Studied how the interplay between sample geometry and anisotropy results in qualitative changes in the structure of the confined vortex matter in mesoscopic superconductors
- Used numerical Ginzburg-Landau calculations and molecular dynamics (MD) simulations to systematically study how the vortices rearrange themselves in mesoscopic containers when the anisotropic interaction is presented
- For the MD simulations, we used an isotropic potential but assumed an anisotropic penetration depth, which was proposed by Prof. Gianni Blatter and his collaborators, and we also used a phenomenological anisotropic potential proposed by Prof. Morten Eskildsen and his collaborators for $MgB_2$
- A manuscript is under preparation

**Applied Math and Theoretical Nuclear Physics**            Summer 2019, Summer 2020
*Berkeley, CA*

- Worked on using reinforcement learning to solve large-scale eigenvalue problems as a Student Assistant intern under the direction of Senior Scientist Dr. Chao Yang from Lawrence Berkeley National Laboratory and in collaboration with Prof. Mark Caprio from Notre Dame and Prof. Weiguo Gao from Fudan University
- **Developed a novel reinforcement learning (RL) based selected configuration interaction (CI) method**
- Our RL algorithm belongs to the approximate Q learning scheme. It is able to effectively identify the most important rows and columns of a large sparse matrix. We then use this information to reduce the computational cost of solving the original matrix
- Realized several existing perturbation-based selected CI algorithms in MATLAB to reduce the cost of *ab initio* calculations of the quantum many-body systems

**Experimental Nuclear Physics**        January 2018 – May 2020, Nov 2020 – May 2021
*Notre Dame, IN*

- Worked on the development of the next generation Active-Target Time Projection Chamber (ND Cube) under the direction of Prof. Tan Ahn at Notre Dame Nuclear Science Laboratory and the Institute for Structure and Nuclear Astrophysics
- **Analyzed the resolution of the ND Cube using electron drift line simulations. The calculated resolution will be compared with the actual experimental data**
- Simulated the electric field inside the detector with the finite element analysis software COMSOL, calculated the electron drift line using Garfield++, a toolkit developed by The European Organization for Nuclear Research (CERN)
- Designed the door of the detector using Autodesk Inventor, devised the electronic ZAP board using Autodesk Eagle, and participated in the commissioning and testing of the ND Cube
- Published the research article "Simulation of the ND Cube Active-Target Time Projection Chamber" in Notre Dame's student science journal *Scientia (Volume 10)*

## PUBLICATIONS

1. Li Zhou, Lihao Yan, M. Caprio, Weiguo Gao, and Chao Yang. Solving the k-sparse Eigenvalue Problem with Reinforcement Learning. *ArXiv*, 2020

2. T. Ahn, J. S. Randhawa, S. Aguilar, D. Blankstein, L. Delgado, N. Dixneuf, S. L. Henderson, W. Jackson, L. Jensen, S. Jin, J. Koci, J. J. Kolata, J. Lai, J. Levano, X. Li, A. Mubarak, P. D. O'Malley, S. Ramirez Martin, M. Renaud, M. Z. Serikow, A. Tollefson, J. Wilson, and L. Yan. The Notre-Dame Cube: An active-target time-projection chamber for radioactive beam experiments and detector development. *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*, 1025:166180, February 2022

## PRESENTATIONS

**The APS Division of Nuclear Physics Meeting (Contributed Talk)**  October 2020
*"Selected configuration interaction using reinforcement learning"*  *Virtual*

**The 2020 APS March Meeting (Contributed Talk)**  March 2020
*"Confined vortex matter with anisotropic interaction"*  *Denver, CO*

**The APS Division of Nuclear Physics Meeting (Poster)**  October 2019
*"Selected configuration interaction using reinforcement learning"*  *Crystal City, VA*

**LBNL Computing Sciences Summer Student Poster Session (Poster)**  August 2019
*"Selected configuration interaction using reinforcement learning"*  *Berkeley, CA*

**Notre Dame College of Science Joint Annual Meeting (COS-JAM) (Poster)**  May 2019
*"Development and simulation of the ND Cube Active Target Time Projection Chamber"* *Notre Dame, IN*

**Notre Dame's Fall Undergraduate Research Fair (FURF) (Poster)**  October 2018
*"Simulation of the ND Cube Active Target Time Projection Chamber"*  *Notre Dame, IN*

## HONORS & AWARDS

**The Dean's Research Award**  May 2021
*The recipient of the Class of 2021*  *Notre Dame, IN*

**College of Science Joint Annual Meeting Best Poster Award**  May 2019
*Won one of the seven Best Poster Award out of about ninety participants*  *Notre Dame, IN*

**Eagan Summer Fellowship**  2018 – 2021
*Awarded $5000 summer research funding each year for three years*  *Notre Dame, IN*

## TECHNICAL SKILLS

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|---|---|
| **Programming** | C/C++, Python, Unix Shell Scripting, Machine Learning Programming, MATLAB, Mathematica, FORTRAN |
| **Engineering Software** | ANSYS, COMSOL, Autodesk Inventor, Autodesk Eagle |
| **Others** | Linux, Git, LaTeX |