Sun Woo (P.) Kim

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Education

PhD in Physics, King's College London (visiting University of Cambridge) *2023-*

Statistical physics, quantum information, condensed matter theory.
Working with Dr. Curt von Keyserlingk of King's College London and Prof. Austen Lamacraft of University of Cambridge

MASt in Physics, University of Cambridge *2018-2019*

Distinction.
Notable courses: Theories of Quantum Matter, Quantum Field Theory, Quantum Information

BSc Physics with Theoretical Physics, Imperial College London *2015-2018*

1st Class (80.7%), Dean's List for all three years.
Notable courses: Foundations of Quantum Mechanics, General Relativity, Complexity and Networks

International Baccalaureate, United World College of South East Asia Dover Campus *2012-2014*

41/45 (91%). Additional Standard Chemistry 6/7.
7 Subjects, Higher Physics 7/7, Higher Mathematics 7/7, Higher Geography 7/7, Standard English 6/7.

Employment/Experience

Research scientist at AIRS Medical (Republic of Korea national service) *2019-2023*

- Part of National service in Republic of Korea as a 'Skilled Industry Personel', applying machine learning to medical imaging and diagnostic settings.
- Came 1st for all tracks in the 2020 Facebook FastMRI Challenge, see publications for details. Published 7 patents.

Research student at Max Planck Institute of Complex Systems *2019-2022*

- Worked with Prof. Markus Heyl, Dr. Giuseppe De Tomasi in many-body localization, see publications for details.
- This research project was done part-time during my time in Republic of Korea's national service.

Undergraduate research project: group theoretic analysis of structured elastic plates *2018*

- Worked with Prof. Richard Craster, Dr. Mehul Makwana. Band-structure of many wave-like systems with lattice symmetry can be predicted using representation theory. This method is not system-dependent and therefore can be used in photonics, condensed matter, and platonics, which was the focus of the project. Using rep. theory of 2D nonsymmorphic wallpaper groups and $k \cdot p$ perturbation theory, predicted features of its bulk band structure. Combined this with Chern insulator theory to design topological waveguides. Demonstrated the theory using MATLAB.
- Awarded the UROP Prize in Mathematics.

Publications

Measurement-induced phase transitions in quantum circuits and hidden Markov models *In prep.*

- Upcoming work with Dr. Curt von Keyserlingk, Prof. Austen Lamacraft. We show a connection between monitored quantum dynamics to Bayesian inference in hidden Markov models, and study its implications in the context of quantum circuits and quantum error correction.

The planted directed polymer: inferring a random walk from noisy images [arXiv:2404.07263] *2024*

- Work with Prof. Austen Lamacraft. The problem of Bayesian inference of a random walker from noisy images was mapped to a generalised version of the directed polymer. In 1D, we presented evidence that there is no phase transition in the mean-squared error. For the tree, we use two theoretical frameworks to show that there is a phase transition in fractional overlap wih the true path.

Results of the 2020 fastMRI Challenge for Machine Learning MR Image Reconstruction [IEEE:9420272] *2021*

- Work with AIRS Medical. State-Of-The-Art for all tracks in MRI reconstruction in the 2020 Facebook FastMRI Challenge.

Real-time dynamics of one-dimensional and two-dimensional bosonic quantum matter deep in the many-body localized phase [PhysRevB.104.144205] *2021*

- Work with Dr. Giuseppe de Tomasi, Prof. Markus Heyl. Developed method to calculate local dynamical observables for 2D bosonic MBL systems polynomial in system size, as well as allowing for analytic treatment. Numerically computed the observables using Numba on the MPI-PKS cluster.

Awards

EPSRC DTP International Studentship *2023*

Granted to one international applicant in the department at King's College London. Grant Ref no: EP/W524475/1

E. M. Burnett Prize *2019*

In recognition for obtaining Distinction in Master of Advanced Studies.

UROP Prize in Mathematics *2018*

Awarded to students of outstanding performance in the Undergraduate Research Opportunity Programme (UROP), for the project 'Group Theoretic Analysis of Structured Elastic Plates'.

Dean's List for 1st, 2nd and 3rd Years *2016, 2017, 2018*

Awarded for being the top 10% of students in cohort of 2017/18 of the Physics programme at Imperial College London.

Other Experiences

Organiser for Many Body Circle Seminar Series/Journal Club *2023–*

- Collaborated PhD students from condensed matter theory and disordered systems groups at KCL. Invited external speakers (Imperial, UCL)
- Past events at sites.google.com/view/kclmanybodycircle/events

Teaching Assistant *2023–*

- Fall 2023: Mathematical Methods for Physics, second year undergraduate course at KCL. Worked through example questions in lecture theatre of 40+ students.
- Spring 2024: Symmetry in Physics, second year undergraduate course at KCL.
- Fall 2024: Theories of Quantum Matter, fourth year (Part III) master's course at University of Cambridge.

OUTREACH Mentoring Scheme *2016–2017*

- Mentored students and prospective students on various areas such as Physics, Maths, and Computing. Worked with a group of mentors organising activities and demonstrations for 20 students.
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Skills

Computing

- Scientific programming. In python: NumPy, SciPy, Numba, and ML using PyTorch, PyTorch Lightning, TensorFlow in Python. In Julia: iTensor. Experience in MATLAB, Mathematica, Fortran, C++. git, LaTeX, Slurm.

Languages

- English (native fluency), Korean (native fluency)

Further Interests

Jazz Guitar

- Straight-ahead (bebop, hard-bop, latin), fusion, and contempory. Played in small band (Duo, Trio, Quartet) and big band (Churchill Jazz Band, Jesus College Big Band) gigs. Attending jams in Seoul, London.

Map Designer for Starcraft II *2013–2014*

- Created official maps, such as Frost, Bridgehead, and Fruitland for real time strategy game, Starcraft II.
- Combined game knowledge with critical thinking to create effective, balanced, and fun maps, that were used for over 4 years in the competitive scene, played in over 3000+ competitive matches.

Details are available upon request