Sun Woo (P.) Kim

Last updated 2024-04-14

+44 7856 231214 | swk34 [at] cantab [dot] ac [dot] uk | sunwoo-kim.github.io

Education

King's College London — London (UK)
PhD in Physics — *2023-*

Statistical physics, quantum information, condensed matter theory.
Supervised by Dr. Curt von Keyserlingk and Prof. Austen Lamacraft.

University of Cambridge — Cambridge (UK)
MASt in Physics — *2018-2019*

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

Imperial College London — London (UK)
BSc Physics with Theoretical Physics — *2015-2018*

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

United World College of South East Asia Dover Campus — Singapore (Singapore)
International Baccalaureate — *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.

Research/Publications/Employment

The planted directed polymer: a simple model for object tracking — *2023-*

- 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 [arXiv:2404.07263].

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 places in all tracks, achieving State-Of-The-Art status in MRI reconstruction in the 2020 Facebook FastMRI Challenge, using a CNN-based architecture, which combines deep learning with MRI physics [IEEE:9420272].

Visiting scientist at MPI-PKS: Many-Body localisation in bosons — *2019-2022*

- Work with Prof. Markus Heyl, Giuseppe De Tomasi. Developed a method to calculate local dynamical observables for 2D bosonic MBL systems which required calculation time only polynomial in system size, and also allows for analytic arguments [PhysRevB.104.144205]. Numerically computed the observables using Numba on the MPI-PKS cluster.
- This research project was done part-time during my time in Republic of Korea's national service.

MASt project: non-linear metric tomography using Sobolev gradients — *2018-2019*

- Work with David Al-Attar. In delay time tomography, seismic observations are used to deduce the internal structure of an elastic media, which is an example of an ill-posed inverse problem.
- In inverse problems, the space of solutions must be chosen appropriately to ensure that the solution has the desired properties. Sobolev gradients can be used to restrict the solutions to be differentiable. We introduced Sobolev gradients in the context of geodesic tomography and showed that unlike conventional gradients, our solutions maintained regularity even when spatial resolution is increased. Demonstrated the theory using Fortran.

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

- Work 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.

BSc Project: N=4, d=2+1 supersymmetric quiver gauge field theories *2017–2018*

- Supervisor: Prof. Amihay Hanany. Quiver Gauge Theories describe toy universes of different configurations. Moduli Space of these theories is an abstract space of vacuum expectation values of scalar fields. The properties of the 'Coulomb Branch' of the Moduli Space was calculated using a generating function called the Hilbert Series, which describes algebraic spaces. Analytic calculations used Mathematica.

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)

Awards

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 Year *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–*

- For module 'Mathematical Methods for Physics' and 'Symmetry in Physics', second year undergraduate courses at KCL.
- Worked through example questions in lecture theatre for 40+ students.

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.
- Worked with a group of mentors organising activities and demonstrations for 20 students.

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.

Further Interests

Jazz Guitar Interested in straight-ahead as well as fusion and contempory. Played in small band (Duo, Trio, Quartet) and big band settings (Churchill Jazz Band, Jesus College Big Band).

Learning/Teaching Interested in learning new things and developing new skills and sharing it with others. Self-taught programming, music theory and jazz guitar. Expository writing for research projects and concepts on homepage (sunwoo-kim.github.io).

Design sensitive and interested in design elements, such as font designs and design languages such as minimalism, and skeuomorphism, in the context of UI design, and coding modules.

Details are available upon request