Shouzhuo Yang

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Education

Swarthmore College PA, USA

B.A. Physics and Mathematics; ***GPA: 3.97/4.00*** *Sep 2019 – May 2023*

Courses and Skills

Advanced Phyiscs Coursework: General Relativity, Quantum Field Theory, Quantum Information Science, Cosmological Physics, Condensed Matter Physics, Liquid Crystal, The Interstellar Medium

Advanced Mathematics Coursework: Differential Geometry, Complex Analysis, Modern Algebra, Analytical Number Theory, Stochastic Processes and Numerical Methods, Knot Theory

Languages: C/C++, Java, Python, MATLAB, The Wolfram Language

Technologies: Git, slurm, PyTorch, TensorFlow, LaTeX, Dedalus

Publications

[1] Yang, S., Li, X., & Yoshida, N. (2023). Three-Dimensional Reconstruction of Weak-Lensing Mass Maps with a Sparsity Prior. II. Weighing Triaxial Cluster Halos. arXiv: 2312.00309 [Submitted to *The Astrophysical Journal*]

[2] Yang, S., Zhang, B., Murdock, S. R., & Collings, P. J. (2022). Orientational order of dyes in a lyotropic chromonic liquid crystal. Soft Matter, 18(38), 7415-7421.

[3] Ji, S., **Yang, S.**, Dominguez, W., Bester, C. Using Physics Simulations to Find Targeting Strategies in Competitive Bowling. arXiv:2210.06753

[4] Yang, S., & Collings, P. J. (2020). The Genetic Algorithm: Using Biology to Compute Liquid Crystal Director Configurations. Crystals, 10(11), 1041.

[5] Ahmed, N., Ball, W., Buckminster, E., Rivkin, E., Torrance, D., Viscusi, J., ... & **Yang, S.** (2021). Domains of Convergence for Polyhedral Packings. arXiv preprint arXiv:2109.01289.

Research Experience

Shear Estimation with Flexion Carnegie Mellon University

Research Assistant, Advisor: Dr. Xiangchong Li and Prof. Rachel Mandelbaum *Aug 2023 – Present*

- Performing image simulations, using perturbation methods to solve for flexion distortion of galaxy profiles and constraining the form of flexion's contribution to the additive and multiplicative bias in shear estimation using spin number.
- Contributing non-affine transformation methods in public repositories BatSim and FPFS.

Machine Learning and Solar Neutrino Background in JUNO Institute of High Energy Physics

Research Assistant, Advisor: Prof. Liangjian Wen *July 2023 – Present*

- Using machine learning algorithms to suppress Solar Neutrino background in the $0\nu\beta\beta$ experiment in JUNO second phase.
- Implemented $0\nu\beta\beta$ and anisotropic solar neutrino generator in the JUNO offline simulation software.
- Experimenting a combination of attention mechanism and spherically invariant neural network to distinguish between solar and $0\nu\beta\beta$ signal.

3-D Cosmological Mass Map Reconstruction with Sparsity Prior The University of Tokyo

Research Assistant, Advisor: Naoki Yoshida *Oct 2022 – Present*

- Constructed a 3-D reconstruction algorithm to locate and weigh dark matter halo to constrain cosmological parameters.
- Implemented a parallelized lensing simulation program for different triaxial halo models (e.g., Navarro-Frenk-White Halos).
- Reached 90% detection accuracy with 5% detection mass bias for the medium mass halo with Year 1 Hyper-Suprime-Cam noise.

Genetic Algorithm to Compute Liquid Crystal Director Swarthmore College

Research Assistant, Advisor: Peter Collings *Dec 2019 – May 2021*

- Applied genetic algorithms to calculate liquid crystal director alignment by minimizing liquid crystal free energy, which includes elastic, electric, and surface free energies.
- Calculated the director alignment for Frederiks Transition, 90 Degree twisted cell, Escaped Radial Cell, and Twisted Nematic cell, before verifying solutions with Euler-Lagrange equations.
- Published the research findings in the journal *Crystals*.

Orientational Order of Dyes in Lyotropic Liquid Crystal Swarthmore College

Research Assistant, Advisor: Peter Collings *Sep 2022 – May 2023*

- Studied the physical interactions between liquid crystal molecules under mixture.
- Measured the changes in the absorption spectrum and the indices of refraction of dye molecules mixed with crystal disodium cromoglycate (DSCG).
- Showed that the alignment of the dye molecules correlates with the interaction between the dyle molecules and the stacked DSCG molecules.
- Published the research findings in the journal *Soft Matter*.

Computational Plasma Research Swarthmore College

Research Assistant, Advisor: Michael Brown *June 2020 – May 2023*

- Investigated the merging of Taylor states plasma to determine whether it is suitable for inertial-magnetic confinement fusion.
- Simulated ion trajectory in the Harris Sheet, an approximation of magnetic reconnection layer, with the Boris algorithm.
- Simulated the merging of Taylor states with a resistive Magnetohydrodynamic regime under the Dedalus Framework.

Awards and Grants

Phi Beta Kappa *2023*
Membership

The McWilliams Center for Cosmology Seed Grant *2022*
$4975, 250 kSU

Swarthmore College Honors Fellowship *2022*
$5200

Peer Assistance Certificate *2021*
For recognition of outstanding teaching assistant performance

The Carl Grossman Summer Opportunity Fund *2021*
$4800

Swarthmore College Summer Research Fellowship *2020*
$4800

Teaching Experience

Swarthmore College

Teaching Assistant for PHYS 005: Spacetime and Quanta *Fall 2020, 2021*

Grader for MATH 067: Introduction to Modern Algebra *Spring 2020*

Grader for MATH 035: Several-Variable Calculus with Theory *Spring 2020*

Chester Children's Chorus

SAT Math Tutor *Fall 2020*

Leadership and Other Activities

Swarthmore College

Student Hiring Committee, Department of Physics and Astronomy *Fall 2022*

Student Hiring Committee, Department of Mathematics and Statistics *Spring 2020*

American Physical Society, Division of Plasma Physics

62nd Annual Meeting Poster Presentation *Nov 2020*

63rd Annual Meeting Poster Presentation *Nov 2021*

Language and Skills

Languages: Chinese/Mandarin (Native), English (Proficient), Japanese (Proficient)

Computer Skills: Proficient in Java Script, Python, C++, Matlab, Mathematica. | Competent in C, Fortran