YICHEN LIU

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Yichen Liu

EDUCATION

University of Illinois at Urbana-Champaign | College of Liberal Arts & Sciences **Aug 2022 - Present**
- Bachelor of Science (**Honor**) in **Astrophysics** and **Mathematics**, expected May 2024 **4.00/4.00**
- Minor in **Physics**, **Computer Science**, and **Chemistry**

University of Macau | Faculty of Science and Technology **Aug 2019 - May 2022**
- Completed Junior Year of **Applied Physics and Chemistry (Honour)**

PUBLICATIONS AND TALKS

1. **Yichen Liu**, Colin J. Burke, Charlotte A. Ward, Xin Liu, Priya Natarajan, "Host galaxy properties of HSC-SSP variable AGNs in the COSMOS field and expectations for Rubin Observatory", American Astronomical Society Meeting #243, id. 3936
2. Grant Merz, **Yichen Liu**, Colin J. Burke, Patrick D. Aleo, Xin Liu, Matias Carrasco Kind, Volodymyr Kindratenko, Yufeng Liu, "Detection, Instance Segmentation, and Classification for Astronomical Surveys with Deep Learning (DeepDISC): Detectron2 Implementation and Demonstration with Hyper Suprime-Cam Data," Monthly Notices of the Royal Astronomical Society 526, 1122 (2023)
3. **Yichen Liu**, Peixia Zheng, and Hong-Chao Liu, "Anti-loss-compression image encryption based on computational ghost imaging using discrete cosine transform and orthogonal patterns," Optics Express 30, 14073 (2022)
4. Peixia Zheng, **Yichen Liu**, and Hong-Chao Liu, "Single-pixel imaging and metasurface imaging," Infrared and Laser Engineering 50, 20211058-1 (2022)

RSEARCH EXPERIENCES

Research Assistant at *Department of Astronomy, University of Illinois* **Sep 2022 - Present**
- Advisor - Professor Xin Liu
- Project 1 - instance segmentation in astronomical surveys using machine learning (NCSA SPIN internship)
  - Evaluated and optimized source extraction pipelines for `DeepDISC` and `Astro R-CNN` using `Sep` and `Scarlet` frameworks
  - Orchestrated simulations employing diverse models and configurations on PhoSim data via the Hardware-Accelerated Learning (HAL) cluster with `Detectron2` integration.
  - Enhanced the pipeline by incorporating Transformer models, specifically MViT and VitDet, to improve instance segmentation
- Project 2 - DES SED fitting
  - Performed SED fitting on sources cataloged in DES and WISE using the `CIGALE` toolkit
  - Developed selection criteria and identified AGN candidates from extensive source catalogs
- Project 3 - host galaxy properties of variable AGNs
  - Cross-referenced dwarf AGN candidates between HSC DR2 and subsequent catalogs, including DR3, SIMBAD, DESI, and COSMOS2020
  - Created scripts for batch downloading of optical spectra from various sources such as SDSS, zCOSMOS, Magellan, DEIMOS, among others, and econciled discrepancies in redshift data across different databases
  - Determined black hole mass - host galaxy mass relation through SED fitting
  - Investivated star formation main sequence using `PyQSOFit` toolkit

Summer Research Internship at *National Observatory of China* **Jun 2022 - Aug 2022**
- Advisor - Professor Chaojian Wu
- Project - meteor slitless spectrum
  - Analyzed the spectral data of 2021 Gemini meteors captured with DSLR cameras equipped with diffraction gratings
  - Employed Python to dissect the intensities of Sodium and Magnesium lines
  - Developed machine learning algorithms for the automated detection and photometric assessment of meteor recordings

Research Assistant at *Institute of Applied Physics & Materials Engineering, University of Macau* **Aug 2019 - May 2022**
- Advisor - Professor Hongchao Liu
- Project 1 - ghost imaging in complex environment
  - Conducted a comprehensive review of contemporary ghost imaging and single-pixel imaging research
  - Assessed the quality of ghost imaging across various setups using MATLAB, producing reports and comparative analyses
  - Investigated the reflection patterns from distorting mirrors, contrasting them with standard mirror reflections to inform imaging technique improvements
- Project 2 - anti-loss image encryption based on ghost imaging

  - Executed experimental research into ghost imaging, investigating the potential of metamaterials and metasurfaces as well as topological materials
  - Created Python algorithms leveraging compressive sensing and gradient descent methodologies.
  - Managed and fine-tuned computational imaging simulations on PyTorch with high-performance GPUs
  - Published a first-authored research paper as the first undergraduate student in the department; this publication was exposed by local media
- Project 3 - ghost imaging using recurrent neural network
  - Collaborated with a team of postgraduate students in managing laser equipment for experimental setups
  - Validated existing ghost imaging techniques incorporating neural networks
  - Developed Python computational pipelines integrating recurrent and convolutional neural network architectures for ghost imaging

OBSERVATION EXPERIENCE

- Cerro Tololo Inter-American Observatory, Blanco 4m / DECam: 3 nights observation — Jan 2023 - Apr 2023
- Personal remote observatory, BKP250 / QHY9sm: astrophotography and photometry — Jul 2019 - Aug 2022

AWARDS AND GRANTS

- AAS 243rd Meeting Travel Grants, Department of Astronomy — Oct 2023
- NCSA SPIN Internship (Summer 2023 & Academic Year 23-24) — Aug 2023
- University of Illinois Dean's Honor List (2022-2023) — Jul 2023
- Smart Star Sponsorship for studies at University of California, Berkeley — Jun 2022
- University of Macau Dean's Honour List (2020 and 2022) — Aug 2022
- Residential College Summer Programme Sponsorship for studies at Shanghai Jiao Tong university — May 2021
- Third Prize, China Undergraduate Physics Tournament — Oct 2020
- National Team Leader at the 2019 European Union Contest for Young Scientists — Sep 2019
- University of Macau Full Scholarship (2019-2021) — Aug 2019
- Bronze Medal, International Olympiad of Astronomy and Astrophysics — Nov 2018
- First Prize, China Adolescents' Science and Technology Innovation Contest — Aug 2018
- Second Prize, Deng Feng National Contest on Science and Innovation — Aug 2018
- Second Prize, China National Astronomy Olympiad — May 2018

SYNERGISTIC ACTIVITIES

- Talks:
  - AAS 243rd Meeting, Scheduled Jan 2024, LA, US
  - NCSA, Jul 2023, IL, US
- Conferences:
  - AAS 243rd Meeting, **Oral presenter**, Scheduled Jan 2024, LA, US
  - STEM Career Exploration and Symposium at UIUC, **Poster Presenter**, Jul 2023, IL, US
  - The Transient and Variable Universe Conference at NCSA, Jun 2023, IL, US
  - AAS 241st Meeting, Jan 2023, WA, US
  - EU Contest for Young Scientists, **Poster Presenter**, Sep 2019, Sofia, Bulgaria
- Was student in:
  - University of California Berkeley (4.000/4.000), Summer 2022
  - Shanghai Jiao Tong University (4.00/4.00), Summer 2021
- Is member of:
  - LSST Dark Energy Science Collaboration

TEACHING

Undergraduate Tutor of Department of Astronomy — **Jan 2023 - May 2023**

- Designed and led interactive tutoring sessions for undergraduates majoring in Astronomy, covering foundational concepts in thermal physics, quantum physics, and astrophysics to supplement their introductory courses

Physics and Mathematics Educator on Youtube/Bilibili — **Sep 2021 - Present**

- Produced and broadcasted educational content on physics and mathematics to a wide audience on the Bilibili platform, with a focus on undergraduate topics and self-study materials, notably complex variables.
- Achieved widespread outreach with the most viewed video surpassing 160,000 views, contributing to the public understanding of scientific concepts

Organizer and Lecturer of Seminar of Physics at the University of Macau **Feb 2022 - May 2022**

- Founded and co-organized a series of informal but comprehensive lectures with my peer, Jiheng Duan, to provide advanced mathematical and physical concepts beyond the University of Macau's curriculum
- Addressed gaps in the theoretical understanding necessary for future research in physics, covering topics such as classical mechanics and partial differential equations for Department of Physics and Chemistry students
- Authored a comprehensive guide for freshmen at the Department of Physics and Chemistry, providing a roadmap for academic development and graduate study preparation.
- Regularly conducted sessions bi-weekly throughout the semester, maintaining a consistent and rigorous teaching schedule
- Personally developed and delivered *SPUM 102 The tools of physical tools*, a lecture series encompassing topics such as complex variables, gamma functions, integral transforms, delta functions, and Green's functions, with a detailed syllabus provided
- Made lecture recordings accessible to the public on Youtube, extending the reach of these resources beyond the classroom

PROFESSIONAL EXPERIENCES

Astrophotographer at *Personal 25-centimeter Remote Observatory (Hebei, China)* **Jan 2018 - Jul 2022**

- Sourced and developed a 2×2-meter remote observatory with full internet connectivity and a retractable roof in Hebei, China
- Curated and calibrated a suite of astronomical equipment and 3D-printed accessories, achieving the operation of a fully remote-controlled observatory
- Conducted regular astrophotography sessions, capturing images of emission nebulae, with a curated selection showcased on my personal website.

Director of *Physics Society, University of Macau (Macau SAR, China)* **Aug 2020 - Feb 2021**

- Initiated and led the Physics Society, spearheading promotional campaigns across various digital platforms
- Drove a significant increase in society membership by organizing outreach initiatives and participating in university events
- Coordinated and mentored an undergraduate team for the 2020 China Undergraduate Physics Tournament, fostering a collaborative research environment

Student Helper at *Department of Physics and Chemistry, University of Macau (Macau SAR, China)* **Jul 2020 - Oct 2020**

- Managed inquiries for equipment quotations and engaged in contract negotiations with vendors for physics research resources
- Monitored and advised on the department's budget allocations for procurement, optimizing resource utilization
- Facilitated the acquisition of materials necessary for the successful execution of the China Undergraduate Physics Tournament

Organizer of *Beijing Astronomy and Astrophysics Olympiad (Beijing & Guangdong, China)* **Jan 2018 - Apr 2018**

- Orchestrated the logistical planning of the 2018 Olympiad, liaising with high schools nationwide for participation
- Hosted academic luminaries for lectures and workshops, enriching the Olympiad experience with expert insights
- Composed the Olympiad's examination materials, orchestrated material procurement, and supported the judging panel throughout the competition
- Directed the National Astronomical Observatory's awards ceremony, celebrating scholarly achievements in the field

President of *Beijing Youth Astronomy Union (Beijing, China)* **Aug 2017 - Aug 2018**

- Conducted educational series on astrophysics, providing Olympiad candidates with additional training resources
- Organized public stargazing events adjacent to Beijing's Olympic Park to foster community engagement in astronomy
- Participated in the Ninth National Astronomical Society Development Forum, contributing to discourse on the advancement of astronomy
- Managed the WeChat account " 北京市中学生天文联盟", achieving widespread readership with posts exceeding 100,000 views

TECHNICAL SKILLS

Skilled in:	Python, LaTeX, MATLAB, Git, Arduino, and Shell Bash/Zsh
Basic Knowledge:	C/C++, Mathematica, Julia, docker, SQL, and Java
Softwares:	MaxIm DL, COMSOL, Altium Designer, KiCAD, Solidworks, Cinema 4D, and SPSS
Often-used Packages:	`AstroPy`, `Scarlet`, `PyTorch`, `Detectron2`, and `CIGALE`
Contributions:	`DeepDISC`: Using deep learning for classification on astornomical survey images
	`Metspec`: Auto-detection and photometry of meteor slitless spectrum
	`DES-SED-Fitting`: SED fitting and classification of DES sources
	`DECat-pointings`: working repository of DECam
	`Dwarf-AGN-COSMOS`: Spectral analysis for dwarf AGN candidates in COSMOS field