

HONGFEI YU

☎ (+1) 608 571 8364 ◊ [phiyu.github.io](https://github.com/phiyu) ◊ ✉ yuhongfei@mail.ustc.edu.cn

Research Interests: Large-scale Structure, Primordial Universe, Dark Energy

EDUCATION

University of Science and Technology of China, China Sep. 2023 - Jun. 2027 (Expected)
Wang Shouguan Talent Program in Astronomy, Department of Astronomy, School of Physical Science

- **Overall GPA:** 3.53/4.30 (85.75/100) **Ranking:** 9/26 , **3rd-year GPA:** 3.81 (90.13)
- **Graduate-level:** General Relativity, Modern Cosmology (97), Large Scale Structure (98), AI and Probability in Astrophysics (91) **Grad-level GPA:** 3.93/4.30
- **TOEFL:** 5.0 (s5.0) **GRE Physics:** 930 (83%, Oct. 26, 2025)

PUBLICATION

- In preparation. Yu, H. & Wang, H. (2026). Anisotropic Cosmic Web Cross-Correlation in Tidal Eigenspace I: Anisotropy of Cosmic Web-Halo Correlation and Assembly Bias. *arXiv preprint, arXiv:2610.xxxxx*

MAIN RESEARCH EXPERIENCE

Research on non-Gaussianity estimation with Cosmic Shear using Neural Network and Higher Order Statistics Jul. 2026 - Jan. 2027 (expected)
University of Wisconsin-Madison | Advisor: Prof. Moritz Münchmeyer *Madison, WI, USA*

- **Motivations:** Local-type primordial non-Gaussianity modulates the small-scale amplitude and cause a scale-depend bias, motivating Neural Network learning a field π that optimally estimates the local amplitude from a lensing map.
- **Achievements:**
 - Constructed the large-scale bias model for the π field and derived its linear model on the sphere.
 - Trained rotation-equivariant spherical graph neural networks (**DeepSphere**) on the Ulagam simulation suites, validated π^{NN} against the δ^2 benchmark, and built the Fisher forecast and MCMC pipeline.
 - Derived a collapsed-trispectrum model for the π auto-spectrum and extended it to the cross-spectra of two π fields, increasing information used in non-NN method (see [Zang & M. Münchmeyer \(2026\)](#)).

Research on Halo-Web Relation and Anisotropic Cross Correlation Function Aug. 2025 - present
University of Science and Technology of China | Advisor: Prof. Huiyuan Wang *Hefei, China*

- **Motivations:** Existing halo-cosmic web cross-correlation analysis average out the directional relation. This motivates a general statistic that retains the full anisotropic relation between tracers and local tidal eigenframe.
- **Achievements:**
 - Distinguished the environment such as matter density and cosmic web effects on halo distribution.
 - Proposed and formulated the **three-dimensional cosmic-web cross-correlation function** (3D-WCCF) and derived its density-weighted estimator.
 - Built the full measurement pipeline on ELUCID simulation including halo-web correlation, halo age effect and robustness validation. Constructed corresponding **Python** package **3dwccf**.

OTHER RESEARCH EXPERIENCE

Research on Frontier Topics in Modern Cosmology

Aug. 2024 - Jul. 2025

National Astronomical Observatories, Chinese Academy of Sciences | Advisor: Prof. Hongming Zhu

Remote

- **Motivations:** Build a working foundation in theoretical cosmology and high-performance scientific computing.
- **Achievements:**
 - Derived the linear evolution of density perturbations in an expanding background, the Jeans criterion, growth functions, and the statistics of the matter power spectrum, compiled into a 45-page English report;
 - Implemented a Python power-spectrum estimator validated on Gaussian random fields against CAMB $P(k)$, together with numerical determinations of k_{eq} and the sound horizon r_{d} .

Research on Constraining Dynamical Dark Energy Clustering

Dec. 2025 - Apr.2026

University of Science and Technology of China | Advisor: Prof. Wenjuan Fang

Hefei, China

- **Motivations:** DESI DR2 favors an evolving equation of state, and any fluid with $w \neq -1$ must perturb. Existing CMB+BAO+SN Ia constraints are geometry-dominated and leave c_s^2 essentially unbounded, motivating a search for other observables that actually carry the clustering signal.
- **Achievements:**
 - Wrote a critical review of dark energy perturbation theory spanning the PPF and EFTofDE frameworks and the Quintom transition;
 - Built a Cobaya+CAMB (PPF) MCMC pipeline and reproduced both the DESI DR2 w_0w_a CDM constraints and the published $\log_{10} c_s^2$ posterior.
 - Attempted to derive an alternative probe based on **the gravitational potential decay rate (DR)**.

TA EXPERIENCE

Theoretical Mechanics A

Sep. 2025 - Jan. 2026

University of Science and Technology of China | Instructor: Prof. Jiejie Zhu

Chinese Class

- **Responsibilities:** Assisted in tutorials and office hours; graded assignments and exams.

Electrodynamics A

Mar. 2026 - Jun. 2026

University of Science and Technology of China | Instructor: Prof. Wandong Liu

Chinese Class

- **Responsibilities:** Assisted in tutorials and office hours; graded assignments and exams.

AWARDS AND HONORS

- Excellent Freshman Scholarship - Gold (2023), Excellent Student Scholarship - Bronze (2024, 2025)
- Funding for the High-performing Students in Basic Disciplines (2025, 2026)

SKILLS

Programming: Python, C, $\text{\LaTeX}$, Markdown
PyPackages: NumPy, SciPy, Matplotlib, healpy, Cobaya, CLASS, emcee,
AI-assisted workflows: Claude Code, Codex for project management, research code development and literature triage.