

Chengchao Yuan

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RESEARCH INTERESTS

- High-energy astrophysics (particle acceleration, transport and radiation processes): theoretical & numerical
- Multimessenger astrophysics (gamma rays, neutrinos and cosmic rays from extreme sources)

EMPLOYMENT HISTORY

(Current)	Postdoctoral Fellow , Deutsches Elektronen-Synchrotron DESY (German National Accelerator), Germany
2022 -	
2018 - 2022	Research Assistant , Dept. of Physics, Penn State
2016 - 2022	Teaching Assistant , Dept. of Physics, Penn State
Summer 2015	REU Intern , Dept. of Astronomy and Astrophysics, Penn State

EDUCATION

08/2022	Ph.D. in Physics, Pennsylvania State University Supervised by Prof. Péter Mészáros and Prof. Kohta Murase Thesis: <i>Neutrino and Electromagnetic Counterparts of Galaxy and Astrophysical Black Hole Mergers</i>
06/2016	B.Sc. in Astronomy, Nanjing University, China Supervised by Prof. Xiangyu Wang and Prof. Fayin Wang Undergraduate Thesis: <i>The origin of high-energy astrophysical neutrinos</i>

HONORS & AWARDS

2022	TDLI Prize Postdoctoral Fellowship , Tsung-Dao Lee Institute (declined)
2022, 21	W. Donald Miller Graduate Fellowship , Pennsylvania State University
2019-2022	David C. Duncan Graduate Fellowship , Pennsylvania State University
2018	APS Graduate Student Travel Grant , American Physical Society
2017	Homer F. Braddock Scholarship , Pennsylvania State University
2016	School of Astronomy and Space Science Dean's Scholarship , Nanjing Univ.
2016	Outstanding Thesis Award , Nanjing University
2015	REU Intern Travel Grant (host institution: Penn State), Nanjing University

CONFERENCES AND SCIENTIFIC TALKS

Invited talks & seminars

04/2023	CP3 seminar, UCLouvain, Belgium "Multi-Messenger Signals of Tidal Disruption Events and Supermassive Black Hole Mergers"
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- 02/2023 **Lepto-Hadronic Workshop, Bochum, Germany** *"Modeling the Hadronic Cascade Emission from Neutrino-Emitting TDEs"*
- 11/2022 **DESY THAT Seminar** *"Neutrino and Electromagnetic Counterparts of Galaxy and Compact Binary Mergers"*
- 03/2022 **University of Maryland CTC talk series** *"The Multimessenger View of Galaxy and Compact Binary Mergers"*
- 12/2021 **Columbia University HEP Seminar** *"The Multimessenger View of Galaxy and Compact Binary Mergers"*
- 11/2021 **DESY THAT Seminar** *"The Multimessenger View of Galaxy and Compact Binary Mergers"*
- 10/2021 **UNLV Astronomy Colloquium** *"The Multimessenger View of Galaxy and Compact Binary Mergers"*
- 10/2020 **Tohoku University Astroparticle Seminar, Japan** *"Galaxy and Supermassive Black Hole Mergers in the Era of Multi-Messenger Astrophysics"*
- 10/2020 **CCAPP AstroParticle Lunch, Ohio State University** *"High-energy neutrino emission from super-massive black hole (SMBH) mergers"*
- 09/2020 **Penn State Astronomy Lunch Talk** *"High-energy neutrino emission subsequent to gravitational wave radiation from SMBH mergers"*
- 08/2020 **Time-Domain High-Energy Messenger Astrophysics Workshop, University of Kyoto, Japan (virtual)** *"High-energy neutrino emission subsequent to gravitational wave radiation from SMBH mergers"*
- 06/2019 **IGC@25: Multimessenger Universe Workshop** *"Neutrino and Secondary Electromagnetic Emissions from Galaxy Mergers"*
- 08/2015 **Penn State Astronomy Lunch Talk** *"High-Redshift Star-Forming Galaxies as Hidden Neutrino Sources"*

Contributed conference talks & posters

- 09/2023 **TeVPA 2023, Napoli, Italy** *"Neutrino and electromagnetic cascade models for tidal disruption events"*
- 07/2021 **EPS Conference on High Energy Physics** *"Jet-induced high-energy neutrino and electromagnetic counterparts of supermassive black hole mergers"*
- 04/2021 **APS April meeting (virtual)** *"Jet-induced high-energy neutrino and electromagnetic counterparts of supermassive black hole mergers"*
- 02/2021 **Institute for Gravitation and the Cosmos (IGC), Penn State (virtual)** *"High-energy neutrino emission subsequent to gravitational wave radiation from SMBH mergers"*
- 07/2019 **Poster: 36th International Cosmic Ray Conference (ICRC), Madison, WI** *"A Multimessenger Picture of Galaxy Mergers: Neutrinos and Electromagnetic Emissions"*
- 04/2018 **APS April meeting, Columbus, OH** *"Cumulative Neutrino and Gamma-ray Backgrounds from Halo and Galaxy Mergers"*

SOFTWARES

Astrophysical Modeling with Multiple Messengers (AM³)

An open-source tool for time-dependent lepto-hadronic modelling of astrophysical sources (code publication in preparation)

- **Developers:** Shan Gao, Marc Klinger, Xavier Rodrigues, Chengchao Yuan, Gaëtan Fichet de Clairfontaine, Anatoli Fedynitch, Walter Winter, Martin Pohl
- **Contribution:** radiating blob expansion implementation; TDE examples; code tests; C++ documentation.

Astrophysical Multimessenger Emission Simulator (AMES)

A time-dependent numerical code for the production and propagation of high-energy cosmic rays, neutrinos, and gamma-rays for various astrophysical environments

- **Developers:** Kohta Murase, Bing Theodore Zhang, Chengchao Yuan, Jose Carpio, Shigeo Kiruma
- **Contribution:** implementing the photo-meson/photo-hadronic interactions and cosmic $\gamma\gamma$ interactions.

PROGRAMMING SKILLS

- Programming languages: C++, Python, Mathematica and Fortran
- Extensive experience in using **CRpropa**, an astrophysical simulation code for the propagation of ultra-high-energy particles.

MENTORING

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| 2023 - | Federico Testagrossa (MSc student, University of Padova) - DESY Summer Student Program |
| 2023 - | David Raudales (undergraduate student, National Autonomous University of Honduras) - DESY Summer Student Program |

TEACHING EXPERIENCE

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| 2021 F | T.A. PHYS 561: Quantum Mechanics |
| 2021 S | T.A. PHYS 400: Electrodynamics |
| 2020 F | T.A. PHYS/MATH 479: Special and General Relativity |
| 2018 S - 2020 S | Lab. T.A. PHYS 250: Introductory Physics |
| 2018 F | T.A. PHYS 525: Methods of Theoretical Physics |
| 2016 - 2017 | Lab. T.A. PHYS 212: Electromagnetism |

SERVICE AND OUTREACH

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| Referee | MNRAS, MNRAS Letters, ApJ, ApJL (2023 -) |
| 2023 | DESY Astroparticle Division Retreat Co-organizer |
| 2022 - | DESY Theoretical Astroparticle Seminar Organizer |

2021	Abstract Sorting Committee of AAS 239th Annual Meeting
2021	Journal Club Organizer for the Center of Multimessenger Astrophysics
2017 - 2022	Guest Lecturer and A Tour of Universe Demonstrator at AstroFest (4-night outreach, 2500+ public visitors)
2018	Astropy Demonstrator at K-12 Educators - Bring Cutting-Edge STEM Research into your Classroom (2-day outreach, 100+ high-school teachers)

PUBLICATIONS

 Google Scholar |  ADS Library |  iNSPIRE

Journal articles (first-author: 8)

- [10] **Chengchao Yuan** and Walter Winter (2023), "Electromagnetic Cascade Emission from Neutrino-Coincident Tidal Disruption Events", arXiv: 2306.15659
- [9] B. Theodore Zhang, Kohta Murase, Kunihito Ioka, Deheng Song, **Chengchao Yuan**, Peter Meszaros, (2023) "External Inverse-Compton and Proton Synchrotron Emission from the Reverse Shock as the Origin of VHE Gamma-Rays from the Hyper-Bright GRB 221009A", *ApJL* 947 L14, doi: 10.3847/2041-8213/acc79f
- [8] **Yuan, C.**, Murase, K., Guetta, D., Pe'er, A., Bartos, I., & Mészáros, P., (2021) "GeV Signature of Short Gamma-Ray Bursts in Active Galactic Nuclei", *ApJ* 932 80, doi: 10.3847/1538-4357/ac6ddf
- [7] **Yuan, C.**, Murase, K., Zhang, B. T., Kimura, S. S. & Mészáros, P. (2021) "Post-Merger Jets from Supermassive Black Hole Coalescences as Electromagnetic Counterparts of Gravitational Wave Emission", *ApJL*, 911 L15, doi: 10.3847/2041-8213/abee24
- [6] Zhang, T. B., Murase, K., **Yuan, C.**, Kimura, S. S. & Mészáros, P. (2020) "External Inverse-Compton Emission Associated with Extended and Plateau Emission of Short Gamma-Ray Bursts: Application to GRB 160821B", *ApJL* 908 L36, doi: 10.3847/2041-8213/abe0b0
- [5] **Yuan, C.**, Murase, K., Kimura, S. & Mészáros, P. (2020) "High-energy neutrino emission subsequent to gravitational wave radiation from supermassive black hole mergers", *Phys. Rev. D* 102, 083013. doi: 10.1103/PhysRevD.102.083013
- [4] **Yuan, C.**, Murase, K. & Mészáros, P. (2020) "Complementarity of Stacking and Multiplet Constraints on the Blazar Contribution to the Cumulative High-Energy Neutrino Intensity", *ApJ*, 890:1. doi: 10.3847/1538-4357/ab65ea
- [3] **Yuan, C.**, Murase, K. & Mészáros, P. (2019) "Secondary Radio and X-ray Emissions from Galaxy Mergers", *ApJ*, 878:76. doi: 10.3847/1538-4357/ab1f06
- [2] **Yuan, C.**, Mészáros, P., Murase K. & Jeong, D. (2018) "Cumulative Neutrino and Gamma-Ray Backgrounds from Halo and Galaxy Mergers", *ApJ*, 857:50. doi: 10.3847/1538-4357/aab774
- [1] **Yuan, C.** & Wang, F. (2015) "Cosmological Test Using Strong Gravitational Lensing Systems", *MNRAS*, 452:3. doi: 10.1093/mnras/stv1444

Conference proceedings and other articles

- [2] **Yuan, C.**, Mészáros, P., Murase K. & Jeong, D. (2018) "Cumulative Neutrino and Gamma-Ray

Backgrounds from Halo and Galaxy Mergers”, in *APS April meeting: U17.004*. Talk abstract

- [1] **Yuan, C.**, Murase K. & Mészáros, P. (2019) “A Multi-Messenger Picture of Galaxy Mergers: Neutrinos and Electromagnetic Emissions”, (*ICRC2019*) 1041. Proceedings of Science