

# YUEYING NI

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## EDUCATION

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### Carnegie Mellon University

*Ph.D. in Physics*

Pittsburgh, PA

Sep. 2017 – present

### Fudan University

*B.S. in Physics*

Shanghai, China

Sep. 2013 – June 2017

## RESEARCH INTERESTS

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**High- $z$  galaxies and quasars:** cosmological hydrodynamic simulations, constrained Gaussian realizations, large-scale structures, growth of the first quasars, galaxy formation, AGN feedback, the dynamics of supermassive black holes

**Deep Learning:** generative model, super-resolution simulations

**Alternative dark matter:** astrophysical probes of Fuzzy Dark Matter (FDM) model

## WORK HIGHLIGHTS

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### ASTRID Simulation

- Developing a new large-volume cosmological hydrodynamic simulation (on TACC Frontera Supercomputer) to study the epoch of re-ionization as well as the formation of galaxy and supermassive black holes at  $z > 2$ .

### AI/Super-resolution simulations

- Use super resolution generative models to produce high-resolution realizations of the dark matter field from the low-resolution cosmological simulation. Currently working on applying the model to hydro simulations.

### BLUETIDES Simulation

- Carry out the BLUETIDES simulation (the largest ever cosmological hydrodynamic simulation) down to  $z = 6.5$  with the full capacity of BlueWater Supercomputer, to study the  $z > 6$  quasars in cosmological volume.

### Early quasar growth in Constrained Realizations

- Develop the first open-source code *GaussianCR* for the implementation of the constrained realization technique on Gaussian random field, to probe the relation between the initial density peaks and the growth of the early quasars.

## PUBLICATIONS

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### First Author Papers (8)

- Y. NI, T. Di Matteo, S. Bird, R. Croft, Y. Feng, N. Chen et al., *The ASTRID simulation: the evolution of Supermassive Black Holes*, *arXiv e-prints* (2021) arXiv:2110.14154 [[2110.14154](#)]
- Y. NI, Y. Li, P. Lachance, R. A. C. Croft, T. Di Matteo, S. Bird et al., *AI-assisted superresolution cosmological simulations - II. Halo substructures, velocities, and higher order statistics*, *MNRAS* **507** (2021) 1021 [[2105.01016](#)]
- Y. NI, T. Di Matteo and Y. Feng, *Not all peaks are created equal: the early growth of Supermassive Black Holes*, *MNRAS*, in press (2021) arXiv:2012.04714 [[2012.04714](#)]
- Y. NI, T. Di Matteo, R. Gilli, R. A. C. Croft, Y. Feng and C. Norman, *QSO obscuration at high redshift ( $z > 7$ ): predictions from the BLUETIDES simulation*, *MNRAS* **495** (2020) 2135 [[1912.03780](#)]
- Y. NI, M.-Y. Wang, Y. Feng and T. Di Matteo, *Predictions for the abundance of high-redshift galaxies in a fuzzy dark matter universe*, *MNRAS* **488** (2019) 5551 [[1904.01604](#)]
- Y. NI, T. Di Matteo, Y. Feng, R. A. C. Croft and A. Tenneti, *Gas outflows from the  $z = 7.54$  quasar: predictions from the BLUETIDES simulation*, *MNRAS* **481** (2018) 4877 [[1806.00184](#)]
- Y. NI, J. Jiang and C. Bambi, *Testing the Kerr metric with the iron line and the KRZ parametrization*, *J. Cosmology Astropart. Phys.* **2016** (2016) 014 [[1607.04893](#)]

Y. NI, M. Zhou, A. Cárdenas-Avendaño, C. Bambi, C. A. R. Herdeiro and E. Radu, *Iron  $K\alpha$  line of Kerr black holes with scalar hair*, *J. Cosmology Astropart. Phys.* **2016** (2016) 049 [[1606.04654](#)]

## Second Author Papers (5)

S. Bird, Y. NI, T. Di Matteo, R. Croft, Y. Feng and N. Chen, *The ASTRID Simulation: Galaxy Formation and Reionization*, *arXiv e-prints* (2021) [arXiv:2111.01160](#) [[2111.01160](#)]

N. Chen, Y. NI, M. Tremmel, T. Di Matteo, S. Bird, C. DeGraf et al., *Dynamical Friction Modeling of Massive Black Holes in Cosmological Simulations and Effects on Merger Rate Predictions*, *arXiv e-prints* (2021) [arXiv:2104.00021](#) [[2104.00021](#)]

Y. Li, Y. NI, R. A. C. Croft, T. Di Matteo, S. Bird and Y. Feng, *AI-assisted superresolution cosmological simulations*, *Proceedings of the National Academy of Science* **118** (2021) 2022038118 [[2010.06608](#)]

M. A. Marshall, Y. NI, T. Di Matteo, J. S. B. Wyithe, S. Wilkins, R. A. C. Croft et al., *The host galaxies of  $z = 7$  quasars: predictions from the BLUETIDES simulation*, *MNRAS* **499** (2020) 3819 [[1912.03428](#)]

K.-W. Huang, Y. NI, Y. Feng and T. Di Matteo, *The early growth of supermassive black holes in cosmological hydrodynamic simulations with constrained Gaussian realizations*, *MNRAS* **496** (2020) 1 [[1906.00242](#)]

## Other co-author Papers (3)

M. A. Marshall, S. Wilkins, T. Di Matteo, W. J. Roper, A. P. Vijayan, Y. NI et al., *The Impact of Dust on the Sizes of Galaxies in the Epoch of Reionization*, *arXiv e-prints* (2021) [arXiv:2110.12075](#) [[2110.12075](#)]

M. A. Marshall, J. S. B. Wyithe, R. A. Windhorst, T. D. Matteo, Y. NI, S. Wilkins et al., *Observing the host galaxies of high-redshift quasars with JWST: predictions from the BLUETIDES simulation*, *MNRAS* **506** (2021) 1209 [[2101.01219](#)]

K. Ren, M. Trenti, M. A. Marshall, T. Di Matteo and Y. NI, *The Diversity of Environments around Luminous Quasars at Redshift  $z = 6$* , *ApJ* **917** (2021) 89 [[2106.07027](#)]

## TALKS

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<b>BlueWater Symposium</b> Talk: <i>BlueTides simulation: first galaxies and QSOs at the cosmic dawn</i>	June 2019 Sunriver, OR
<b>Big eye in the early universe</b> Talk: <i>High-<math>z</math> quasar outflows and obscuration</i>	January 2019 UCLA, CA
<b>Camels Project Meeting</b> Talk: <i>Super resolution simulations</i>	Jan 2021 virtual, Flatiron Institute, CCA, NY
<b>Cosmology group meeting</b> Talk: <i>Super resolution simulations</i>	Nov 2020 virtual, Harvard-CfA, MA
<b>NSF AI Institute seminar</b> Talk: <i>Super resolution simulations</i>	March 2021 virtual, CMU
<b>Kavli IPMU seminar</b> Talk: <i>Super resolution simulations</i>	May 2021 virtual, IPMU
<b>Tsinghua Astrophysics seminar</b> Talk: <i>Super resolution simulations</i>	May 2021 virtual, Tsinghua University
<b>LISA Astrophysics Working Group Meeting</b> Recorded Talk: <i>Massive BH binaries and their EM counterparts in the Asterix simulation</i>	June 2021 virtual, LISA collaboration
<b>Cosmos'21 Conference</b> Talk: <i>Super resolution simulations</i>	August 2021 virtual, University of Illinois

## AWARD

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<b>McWilliams Fellowship</b> Carnegie Mellon University	Sep. 2021 - May. 2022
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## STUDENT MENTORING

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**Kerry Jappe (Physics undergraduate, CMU)**  
*Cosmological simulation of the fuzzy dark matter*

*Oct. 2019 - Apr. 2020*

## SERVICE

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**Simulation data portal:** BlueTides database (<http://bluetides.psc.edu>)

A project with Pittsburgh Supercomputing Center. Build the public available database that provides access and API for BLUETIDES simulation.

**Code publicly available:** GaussianCR (<https://github.com/yueyingn/gaussianCR>)

A python module that impose constraints on Gaussian primordial density field and generate constrained initial conditions for cosmological simulations.

**Referee for Astrophysical Journal (ApJ)**

## TEACHING EXPERIENCE

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- 33-141 Physics I for Engineering Students, *Spring 2019*
- 33-104 Experimental Physics, *Fall 2018*
- 33-152 Matter and Interaction II, *Spring 2018*
- 33-121 Physics I for Science Students, *Fall 2017*

## PRESS RELEASES

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*Evolving the early universe in 24 hours on Frontera*, featured in TACC Press Releases (url: <https://www.tacc.utexas.edu/-/evolving-the-early-universe-in-24-hours-on-frontera>).

*Simulations Show Webb Telescope Can Reveal Distant Galaxies Hidden in Quasars' Glare*, featured in NASA's James Webb Space Telescope Science Release (url: <https://webbtelescope.org/contents/news-releases/2020/news-2020-51>).

*Machine learning accelerates cosmological simulations* featured in Phys Org Release (url: <https://phys.org/news/2021-05-machine-cosmological-simulations.html>).

*New Application of Artificial Intelligence Just Removed One of the Biggest Roadblocks in Astrophysics* featured in Simons Foundation Press Release (url: <https://www.simonsfoundation.org/2021/05/04/new-application-of-artificial-intelligence-just-removed-one-of-the-biggest-roadblocks-in-astrophysics/>).

*Machine Learning Accelerates Cosmological Simulations* featured in MCS CMU news (url: <https://www.cmu.edu/physics/news-events/news-archive/2021/0505-supersims.html>).

## SKILLS AND LANGUAGES

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**Programming:** Python, C/C++, PyTorch, bash

**Simulation codes:** MP-Gadget, FastPM

**Languages:** Mandarin (native), English (fluent)