

Yonglin Zhu

North Carolina State University
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OVERVIEW

My research interests fall in the intersection of astrophysics and nuclear physics, connecting experimental and theory nuclear physics to astrophysical observables.

EDUCATION

Ph.D. Physics 2012 - 2020

North Carolina State University. Thesis advisor: Gail C. McLaughlin

M.S. Physics 2012 - 2014

North Carolina State University

B.S. Optical Information and Technology 2008 - 2012

China University of Mining and Technology, GPA Rank: 1st/82

EMPLOYMENT

Machine Learning Developer	2020/02 - present
Advanced Analytics R&D, SAS Institute.	
Predictive Analysis & Machine Learning Intern	2019/05 - 2019/12
Advanced Analytics R&D, SAS Institute.	
Research Assistant	2017/05 - 2019/05
Department of Physics, North Carolina State University	
Teaching Assistant	2016/08 - 2017/05
Department of Physics, North Carolina State University	
Research Assistant	2013/05 - 2016/08
Department of Physics, North Carolina State University	
Teaching Assistant	2012/08 - 2013/05
Department of Physics, North Carolina State University	

PEER-REVIEWED JOURNAL PAPERS [\[INSPIREHEP\]](#)

6. J. Barnes, **Yong-Lin Zhu**, et al., “Kilonovae across the nuclear physics landscape: The impact of nuclear physics uncertainties on r-process-powered emission”, *Submitted to APJ arXiv:2010.11182*, (2020).
5. **Yong-Lin Zhu**, et al., “Modeling Kilonova Light Curves: Dependence on Nuclear Inputs”, *Submitted to APJ arXiv:2010.03668*, (2020).

4. N. Vassh, ..., **Y. L. Zhu**, and G. C. McLaughlin , “Using excitation-energy dependent fission yields to identify key fissioning nuclei in r-process nucleosynthesis”, *Journal of Physics G: Nuclear and Particle Physics* 46 (6), 065202 , (2018).
3. **Yong-Lin Zhu**, R. T. Wollaeger, N. Vassh, R. Surman, et al., “Californium-254 and Kilonova Light Curves”, *The Astrophysical Journal Letters* 863 (2), L23 , (2018).
2. M. B. Deaton, E. O’Connor, **Yong-Lin Zhu**, G. C. McLaughlin, “Elastic Scattering in General Relativistic Ray Tracing for Neutrinos”, *Physical Review D* 98 (10), 103014 , (2018).
1. **Yong-Lin Zhu**, A. Perego, and G. C. McLaughlin, “Matter-neutrino Resonance Transitions above A Neutron Star Merger Remnant.”, *Physical Review D* 94 (10), 105006 **Editors’ Suggestion**, (2016).

CONFERENCE PROCEEDINGS

5. Kelsey Lund, **Yong-Lin Zhu**, et al., “Identification of Key Isotopes in Kilonova Heating”, *Bulletin of the American Physical Society* , (2020).
4. **Yong-Lin Zhu**, et al., “Uncertainties in Kilonova Heating from Nuclear Physics Inputs”, *Bulletin of the American Physical Society* , (2019).
3. Kelsey Lund, **Yong-Lin Zhu**, et al., “Uncertainties in Kilonova Heating from Nuclear Physics Inputs”, *Bulletin of the American Physical Society* , (2019).
2. A. Aprahamian, R. Surman, A. Frebel, G. C. McLaughlin,..., **Yong-Lin Zhu**, “FRIB and the GW170817 Kilonova”, *Proceedings of FRIB-TA topical program on FRIB and the GW170817 kilonova* , (2018).
1. **Yong-Lin Zhu**, T. Sprouse, M. R. Mumpower, et al., “The Nuclear Physics Uncertainty on Kilonova Heating Rates and the Role of Fission”, *Proceedings of Nuclei in the Cosmos XV* , (2018).

SCIENTIFIC ACHIEVEMENTS

- Examined different combinations of nuclear inputs of nuclear mass/fission rate/fission yields in modeling kilonova light curves. Such nuclear physics uncertainties typically generate at least one order of magnitude uncertainty in key quantities such as the nuclear heating (one and a half orders of magnitude at one day post-merger), the bolometric luminosity (one order of magnitude at five days post-merger), and the inferred mass of material from the bolometric luminosity (factor of eight when considering the eight to ten days region).[Zhu et al 2020, Barnes et al 2020]
- Performed dynamical nucleosynthesis calculations and identified a single isotope, ^{254}Cf , which has a particularly high impact on the brightness of electromagnetic transients associated with mergers on the order of 15 to 250 days[Zhu et al 2018a].
- Confirmed that Matter-neutrino Resonance transitions occur for both hierarchies close the merger core, which may potential change the physics of nucleosynthesis and neutron star merger[Zhu et al 2016]. Then confirmed that Matter-neutrino Resonance transitions occur with elastic scattering in general relativistic ray tracing for neutrinos[Deaton et al 2018].

CONTRIBUTED TALKS

9. Uncertainties in Kilonova Heating from Nuclear Physics Inputs
2019 Fall Meeting of the APS Division of Nuclear Physics, Crystal City, Virginia 10/2019
8. (Poster) The Nuclear Physics Uncertainty on Kilonova Heating Rates and the Role of Fission Nuclei in the Cosmos XV, Assergi, Italy 07/2018
7. The Nuclear Physics Uncertainty on Kilonova Heating Rates and the Role of Fission FIRE Topical Collaboration Meeting, Raleigh, NC 05/2018
6. Impact of Neutrino Oscillation on Nucleosynthesis in Neutron Star Merger Remnants
Quantum Effects on Precision Cosmological Observations 2017, Santa Fe, NM 08/2017
5. Matter Neutrino Resonance Transitions above A Neutron Star Merger Remnant
The Summer Institute for Neutrino Theory, Blacksburg, VA 07/2017
4. Nucleosynthesis in Neutron Star Merger
FIRE Topical Collaboration Meeting, Livermore, CA 06/2017
3. Matter Neutrino Resonance Transitions above A Neutron Star Merger Remnant
JINA-CEE Frontiers in Nuclear Astrophysics Meeting, East Lansing, MI 02/2017
2. Matter Neutrino Resonance Transitions above A Neutron Star Merger Remnant
Joint CNA and JINA-CEE Winter School on Nuclear Astrophysics, Shanghai, China 12/2016
1. Neutrino Oscillations above Merging Compact Objects
Doctoral Training Program at ECT*, Trento, Italy 06/2016

SYNERGISTIC ACTIVITIES

Conference Committee

2019 JINA-CEE Frontiers in Nuclear Astrophysics Conference, East Lansing, MI

Coordinator & Volunteer

2015 Fifty-one Ergs Conference on the Physics and Observation of Supernovae and Supernova Remnants, Raleigh, NC

COMPETITIVE HONORS AND AWARDS

- Doctoral Training Fellowship** (6 weeks program at ECT* in Italy) 2016
The European Centre for Theoretical Studies in Nuclear Physics and Related Areas
- China National Scholarship** 2009, 2010
Ministry of Education of the People's Republic of China, awarded to top 0.2 % undergraduate students nationwide

WORKSHOPS & SCHOOLS

- FRIB and the GW170817 kilonova, East Lansing, MI 2018
Nuclei in the Cosmos Summer School, Caserta, Italy 2018
- FRIB Theory Alliance - Neutron star merger summer school, East Lansing, MI 2018
Quantum Effects on Precision Cosmological Observations 2017, Santa Fe, NM 2017

The Summer Institute for Neutrino Theory, Blacksburg, VA	2017
The Nuclear Physics Summer School, Boulder, CO	2017
JINA-CEE Frontiers in Nuclear Astrophysics Conference, East Lansing, MI	2017
Joint CNA and JINA-CEE Winter School on Nuclear Astrophysics	2016
Doctoral Training Program at ECT*	2016

OUTREACH

Physics Demonstration Volunteer	Astronomy Days in North Carolina Museum of Natural Sciences	2017
Organizer	NCSU Astronomy Open House	2016
Tutorial Instructor	The American Chemical Society at the NC State Fair	2013

TEACHING

Kelsey Lund (Graduate Student)	2018 - present
On nuclear network calculations and calculations of radioactive decay power light curve	
Sam Flynn (Graduate Student)	2018 - present
On multi-energy neutrino oscillation calculations including simulated neutrino-neutrino interaction	
Instrumental and Data Analysis for Physics	Fall 2016
NCSU, Lab instructor for undergraduate research students	
Physics for Engineers and Scientists I	Fall 2012
NCSU, Lab instructor	
Physics for Engineers and Scientists I	Spring 2012
NCSU, Lab instructor	

RESEARCH EXPERIENCES

The Nuclear Physics Uncertainty on Kilonova Light Curves	2017 - 2019
<i>Colaborated with J. Barnes(Columbia), R. Surman(ND), M. R. Mumpower(LANL), N. Vassh(ND), T. Sprouse(ND)</i>	

- Combine experimental and theory nuclear inputs and re-heating trajectory to perform nucleosynthesis calculations with PRISM.
- Calculated effective heating rates from nucleosynthesis calculations and identify specific nuclei contributing to light curve
- Investigate interplay between nuclear reaction channels and its implication for light curve

Nucleosynthesis in Neutron Star Merger Remnants	2016 - 2019
<i>Fire (Fission in R-process Elements) Topical Collaboration</i>	

- Apply state-of-the art density functional theory (DFT), nuclear reaction theory and high-performance computing to compute atomic masses, fission fragment distributions, fission, beta decay, and neutron capture rates
- Assess their impact on abundance patterns for each potential astrophysical site of the r-process considering neutrino oscillation attribution
- Develop nuclear reaction network calculation programs including neutrino oscillation results and fission, and compare predictions with solar data as well as spectroscopic data from halo stars

Neutrino Oscillations from Raytracing neutrino above Neutron Star Merger Simulation including General Relativity	2017 - 2018
<i>SPX Collaboration</i>	

- Perform Simulation of black holes and other extreme space-times to gain a better understanding of Relativity, and the physics of exotic objects in the distant cosmos
- Investigate Neutrino Oscillations Above Neutron-neutron stars by solving nonlinear ODE with self-developed parallelized C++ program with OpenMP
- Apply Ray Tracing neutrino to investigate the impacts of inelastic scattering and elastic scattering on neutrino spectral and collective neutrino oscillations

Neutrino Oscillations above Accretion Disks from Merging Compact Objects (Neutron Star Merger Remnants) 2014 - 2016

Collaborated with Albino Perego (INFN)

- Investigated Neutrino Oscillations Above Accretion Disks from Neutron-neutron stars and black-hole mergers by solving nonlinear ODE with self-developed C++ program
- Performed large scale of Data collection/analysis with Python from 3D hydrodynamic Neutron star merger simulation
- Constructed and tested a new analytical model to describe new types of Neutrino Oscillations in compact object mergers

Polymer Weathering Project

2013 - 2014

Eastman Chemical Company

- Performed Quantum Molecular Dynamics simulation (Car-Parrinello Molecular Dynamics) of polymer UV-degradation with CPMD
- Investigated new types of UV-degradation polymer materials and testing new materials with modelling
- Composed research progress reports monthly

REFERENCES

Prof. Gail C. McLaughlin Department of Physics, North Carolina State University. Raleigh, NC 27695 E-mail gail_mclaughlin@ncsu.edu	Thesis advisor
Prof. James Kneller Department of Physics, North Carolina State University. Raleigh, NC 27695 E-mail jim_kneller@ncsu.edu	Thesis committee member
Prof. Rebecca Surman Department of Physics, University of Notre Dame Notre Dame, IN 46556 E-mail rsurman@nd.edu	Collaborator