

# Mohammadreza Zakeri

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## Research Interests

My main research is in physics beyond the Standard Model (BSM). The BSM models are mainly designed for the purpose of explaining the nature of Dark Matter (DM) and the origin of neutrino mass and involve particle and symmetry extensions of the SM. I work on their possible signatures in colliders, direct and indirect DM signals. I am also interested in BSM physics signatures in extreme environments such as neutron stars (NS). My studies on possible new physics effects on NS structure and evolution involve a wide range of topics in particle & nuclear physics, astrophysics and general relativity.

## Employment

- 2021 - Now **Postdoc at University of Kentucky**, *From Jun 15, 2021 to Present.*  
Lexington, KY, USA
- 2021 - 2021 **Teacher at Saint Paul American School (SPAS)**, *From Feb 1, 2021 to May 21, 2021.*  
Beijing, P. R. China
- 2017 - 2021 **Postdoc at Institute of Theoretical Physics (ITP), Chinese Academy of Sciences (CAS)**,  
*From Oct 27, 2017 to Mar 31, 2021.*  
Beijing, P. R. China
- 2012 - 2017 **Teaching Assistant at UC Riverside**, *From Sep 28, 2012 to Jul 31, 2017.*  
Riverside, California, USA

## Education

- 2012-2017 **University of California, Riverside**, Riverside, California  
*Doctor of Philosophy (2017), Master of Science (2013)*  
Advisor: Ernest Ma  
PhD Thesis: "Extensions of the Standard Model with Dark Matter in Some Explicit Examples"  
PhD Defense Date: June 21<sup>st</sup> 2017 (Received on September 16<sup>th</sup> 2017)
- 2008-2012 **Sharif University of Technology**, Tehran, Iran.  
*Bachelor of Science in Physics*
- 2001-2008 **Rouzbeh Institute**, Tehran, Iran.  
*Diploma in Mathematics and Physics*

## Awards & Honors

- 2019 CAS President's International Fellowship Initiative (PIFI) from the Chinese Academy of Sciences
- 2017 Outstanding Teaching Assistant Award from the Department of Physics & Astronomy at UCR
- 2016 Three GSA Conference Travel Grant Awards from UC Riverside
- 2012 Dean's Distinguished Fellowship from Graduate Division of UC Riverside

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## Publications

1. **Neutron Stars with Baryon Number Violation, Probing Dark Sectors**, *J. M. Berryman, S. Gardner, M. Zakeri*, *Symmetry* 14 (2022) 518, [arXiv:2201.02637].
2. **Constraining Time Dependent Dark Matter Signals from the Sun**, *M. Zakeri, Y. F. Zhou*, *JCAP* 04 (2022) 04, 026, [arXiv:2109.11662].
3. **Exotic Lepton-Flavor Violating Higgs Decays**, *J. A. Evans, P. Tanedo, M. Zakeri*, *JHEP* 01 (2020) 028, [arXiv:1910.07533].
4. **Non-Abelian Vector Boson as FIMP Dark Matter**, *B. Barman, S. Bhattacharya, M. Zakeri*, *JCAP* 02 (2020) 029, [arXiv:1905.07236].
5. **Multipartite Dark Matter in  $SU(2)_N$  Extension of Standard Model and Signatures at the LHC**, *B. Barman, S. Bhattacharya, M. Zakeri*, *JCAP* 09 (2018) 023, [arXiv:1806.01129].
6. **A Minimal Model For Two-Component FIMP Dark Matter: A Basic Search**, *S. P. Zakeri, S. M. MoosaviNejad, S. Y. Ayazi, M. Zakeri*, *Chin. Phys. C* 42 (2018) no.7, 073101, [arXiv:1801.09115].
7. **Alternative  $[SU(3)]^4$  Model of Leptonic Color and Dark Matter**, *C. Kownacki, E. Ma, N. Pollard, O. Popov, M. Zakeri*, *Nucl. Phys. B* 928 (2018) 520-534, [arXiv:1801.01379].
8. **Dark Revelations of the  $[SU(3)]^3$  and  $[SU(3)]^4$  Gauge Extensions of the Standard Model**, *C. Kownacki, E. Ma, N. Pollard, O. Popov, M. Zakeri*, *Phys. Lett. B* 777 (2018) 121-124, [arXiv:1710.00762].
9. **Dark Gauge  $U(1)$  Symmetry for an Alternative Left-Right Model**, *C. Kownacki, E. Ma, N. Pollard, O. Popov, M. Zakeri*, *Eur. Phys. J. C* 78 (2018) no.2, 148, [arXiv:1706.06501].
10. **Quartified Leptonic Color, Bound States, and Future Electron-Positron Collider**, *C. Kownacki, E. Ma, N. Pollard, O. Popov, M. Zakeri*, *Phys. Lett. B* 769 (2017) 267-271, [arXiv:1701.07043].
11. **Generalized Gauge  $U(1)$  Family Symmetry for Quarks and Leptons**, *C. Kownacki, E. Ma, N. Pollard, M. Zakeri*, *Phys. Lett. B* 766 (2017) 149-152, [arXiv:1611.05017].
12. **Gauge  $B-L$  Model of Radiative Neutrino Mass with Multipartite Dark Matter**, *E. Ma, N. Pollard, O. Popov, M. Zakeri*, *Mod. Phys. Lett. A* 31 (2016) no. 27, 1650163, [arXiv:1605.00991].
13. **Phenomenology of the Utilitarian Supersymmetric Standard Model**, *S. Fraser, C. Kownacki, E. Ma, N. Pollard, O. Popov, M. Zakeri*, *Nucl. Phys. B* 909, 644 (2016), [arXiv:1603.04778].
14. **Verifiable Associated Processes from Radiative Lepton Masses with Dark Matter**, *S. Fraser, E. Ma, M. Zakeri*, *Phys. Rev. D* 93, 115019 (2016), [arXiv:1511.07458].
15. **Gauge  $B-L$  Model with Residual  $Z_3$  Symmetry**, *E. Ma, N. Pollard, R. Srivastava, M. Zakeri*, *Phys. Lett. B* 750 (2015) 135-138, [arXiv:1507.03943].
16.  **$SU(2)_N$  Model of Vector Dark Matter with a Leptonic Connection**, *S. Fraser, E. Ma, M. Zakeri*, *Int. J. Mod. Phys. A* 30, 1550018 (2015), [arXiv:1409.1162].

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## Talks & Posters

1. **Constraining Baryon Number Violation with Neutron Stars**, *Invited Talk: High Energy/Astrophysics Seminar*, University of Cincinnati. Cincinnati, OH, USA, Oct 2022
2. **Possible Baryon Number Violation in Neutron Stars**, *Conference Talk: Neutron Rich Matter on Heaven and Earth (INT-22-2A)*. Seattle, WA, USA, Jul 2022

3. **Baryon Number Violation in Neutron Stars**, *Conference Talk: XV International Conference on Interconnections between Particle Physics and Cosmology*.  
St. Louis, MO, USA, Jun 2022
4. **Baryon Number Violation in Neutron Stars**, *Physics Department Theory Seminar*, University of Kentucky.  
Lexington, KY, USA, Jan 2022
5. **Dark Matter Solar Signals**, *Conference Talk: ITP Postdoctoral Symposium*, Institute of Theoretical Physics, Chinese Academy of Sciences.  
Beijing, China, May 2020
6. **Exotic Lepton-Flavor Violating Higgs Decays**, *Conference Talk: New physics beyond the Standard Model (PICTP program)*.  
Beijing, China, Oct 2019
7. **Dark Gauge U(1) and the DAMPE Signal**, *Poster: KEK Theory Meeting 2018(KEK-PH2018)*.  
Tsukuba, Japan, Feb 2018
8. **Leptonic Color, and the Future Electron-Positron Collider**, *Journal Club Talk*, Institute of Theoretical Physics, Chinese Academy of Sciences.  
Beijing, China, Nov 2017
9. **Gauge B–L Model with Residual  $Z_3$  Symmetry**, *Invited Talk: BLV 2017*.  
Cleveland, OH, USA, May 2017
10. **Quantified Leptonic Color, Bound States, and Future Electron-Positron Collider**, *Journal Club Talk*, University of California, Riverside.  
Riverside, CA, USA, May 2017
11. **Leptonic Color, and the Future Electron-Positron Collider**, *Invited Talk*, Institute of Modern Physics, Chinese Academy of Sciences.  
Lanzhou, China, Dec 2016
12. **Asymmetric Reheating After Inflation**, *Poster: COSMO-16*.  
Ann Arbor, MI, USA, Aug 2016
13. **Radiative Lepton Masses**, *Conference Talk: Phenomenology 2016 Symposium*.  
Pittsburgh, PA, USA, May 2016

## Conferences & Schools

1. Neutron Rich Matter on Heaven and Earth (INT-22-2A), Seattle, WA, USA, Jul 2022
2. Neutrino Theory Network Workshop, Fermilab, IL, USA, Jun 2022
3. XV International Conference on Interconnections between Particle Physics and Cosmology, St. Louis, MO, USA, Jun 2022
4. ITP Postdoctoral Symposium, Beijing, China, May 2020
5. PICTP program: New physics beyond the Standard Model, Beijing, China, Oct 2019
6. KEK Theory Meeting 2018(KEK-PH2018), Tsukuba, Japan, Feb 2018
7. Winter School on Gravitational-Wave Data Analysis, Beijing, China, Dec 2017
8. International Workshop on Baryon & Lepton Number Violation 2017, Cleveland, OH, USA, May 2017
9. SOCAL BSM 2017, Riverside, CA, USA, Apr 2017
10. COSMO-16, Ann Arbor, MI, USA, Aug 2016
11. TASI Summer School, Boulder, CO, USA, June-July 2016

12. Phenomenology 2016 Symposium, Pittsburgh, PA, USA, May 2016

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## Teaching Experiences

### **Saint Paul American School**, Beijing, China

Spring 2021 *Teacher*, AP Chemistry

Spring 2021 *Teacher*, Chemistry (10th Grade)

### **University of California, Riverside**, Riverside, California

Summer 2017 *Teaching Assistant*, PHYS 040B: General Physics Laboratory

Spring 2017 *Teaching Assistant*, PHYS 040B: General Physics

Winter 2017 *Teaching Assistant*, PHYS 02LB: General Physics Laboratory

Fall 2016 *Course Grader*, PHYS 221A: Quantum Mechanics

*Teaching Assistant*, PHYS 156A: Quantum Mechanics

Summer 2016 *Instructor*, Physics GRE Preparation Course

Spring 2016 *Course Grader*, PHYS 221C: Quantum Mechanics

*Course Grader*, PHYS 212B: Thermodynamics And Statistical Mechanics

Winter 2016 *Course Grader*, PHYS 221B: Quantum Mechanics

*Teaching Assistant*, PHYS 156B: Quantum Mechanics

Fall 2015 *Course Grader*, PHYS 221A: Quantum Mechanics

*Teaching Assistant*, PHYS 156A: Quantum Mechanics

Summer 2015 *Instructor*, Physics GRE Preparation

Spring 2015 *Course Grader*, PHYS 221C: Quantum Mechanics

*Teaching Assistant*, PHYS 040B: General Physics

Winter 2015 *Course Grader*, PHYS 221B: Quantum Mechanics

*Teaching Assistant*, PHYS 156B: Quantum Mechanics

Fall 2014 *Course Grader*, PHYS 221A: Quantum Mechanics

*Teaching Assistant*, PHYS 156A: Quantum Mechanics

Summer 2014 *Teaching Assistant*, PHYS 040C: General Physics

Spring 2014 *Teaching Assistant*, PHYS 040C: General Physics

Winter 2014 *Teaching Assistant*, PHYS 02LB: General Physics Laboratory

Fall 2013 *Teaching Assistant*, PHYS 040C: General Physics Laboratory

Summer 2013 *Teaching Assistant*, PHYS 040C: General Physics Laboratory

Spring 2013 *Teaching Assistant*, PHYS 040C: General Physics Laboratory

Winter 2013 *Teaching Assistant*, PHYS 02LB: General Physics Laboratory

Fall 2012 *Teaching Assistant*, PHYS 02LA: General Physics Laboratory

### **Rouzbeh Institute**, Tehran, Iran

Summer 2010 *Teacher*, 3DS MAX Software

Fall 2010 *Teacher*, Adobe After Effect Software

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## Computer Skills

**Python** 2 years of experience. Familiar with NumPy, SciPy, matplotlib, pandas, sklearn, quandl, multiprocessing, subprocess, math, random, re, cv2, shutil, time, os, sys, logging, gzip, tarfile, Tkinter, Pygame and the standard library.

**C++** 5 years of experience. Regularly use `gsl`, `root`, `omp`, `random`, `algorithm`, `cmath`, `array`, `string`, `ctime`, `chrono`, `fstream`, `vector`, `iostream` libraries.

**HEP** MadGraph, PYTHIA, Root, FastJet, FeynRules, FeynCalc, FeynArts, CalcHEP, SARAH

**Others** Linux, L<sup>A</sup>T<sub>E</sub>X, Mathematica, Xcode, MATLAB, Inkscape, Affinity

**Self-Developed** CompactStar (C++): Analyzes the structure of compact stars by generating equation of states, solving TOV and Hartle equations.

**Self-Developed** DMSS (C++): Analyzes Dark Matter Solar Signals (DMSS) in a specific class of dark matter models by solving the orbit equations for satellites, calculating their exposure to the Sun, and setting limits on signals given the observed events data set.

**Self-Developed** CONFIND (C++): This package is based on CONREC Contouring Subroutine and finds contours for input functions and class methods. Multithreading option is implemented to enhance performance.

**Self-Developed** Pheno (Python & C++): A package for collider analysis using PYTHIA & FastJet. Event cuts and binning procedures can be easily defined by users and events can be selectively exported at various stages. Multiprocessing in python and multithreading in C++ are implemented to improve the performance.

**GitHub** [github.com/ZAKI1905](https://github.com/ZAKI1905)

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## Organized Activities

2022-23 **Co-organizer:** Nuclear Seminar, Department of Physics & Astronomy, U. of Kentucky, KY, USA

2021-22 **Co-organizer:** Theory Seminar, Department of Physics & Astronomy, U. of Kentucky, KY, USA

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## Languages

**Farsi** *Native proficiency*

**English** *Bilingual proficiency*

**Mandarin** *Limited working proficiency*

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## References

- **Gardner, Susan**, *Email: [svg@pa.uky.edu](mailto:svg@pa.uky.edu), Professor at University of Kentucky, Lexington, KY, USA.*
- **Zhou, Yu-Feng**, *Email: [yfzhou@itp.ac.cn](mailto:yfzhou@itp.ac.cn), Professor at Institute of Theoretical Physics (ITP), Beijing, China.*
- **Ma, Ernest**, *Email: [ma@phyun8.ucr.edu](mailto:ma@phyun8.ucr.edu), Professor Emeritus at University of California, Riverside, CA, USA.*
- **Tanedo, Flip**, *Email: [flip.tanedo@ucr.edu](mailto:flip.tanedo@ucr.edu), Associate Professor at University of California, Riverside, CA, USA.*
- **Aiello, Gregory**, *Email: [aiello.gregory.7@gmail.com](mailto:aiello.gregory.7@gmail.com), Principal at Saint Paul American School, South Korea.*