

# EVAN J. ARENA

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## RESEARCH INTERESTS

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**Theoretical astrophysics and cosmology**, including general relativity, gravitational lensing, modified gravity, large-scale structure, 21 cm cosmology, dark energy, inflation, dark matter, radio astronomy, and gravitational waves.

## EDUCATION

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### Drexel University

Ph.D. Student/Candidate of Physics	2018 – Present
M.S. in Physics	2020

### Stony Brook University

B.S. in Physics, second major: Astronomy/Planetary Sciences <i>Cum Laude</i> <i>Departmental Honors in Physics</i>	2017
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## POSITIONS HELD

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### Drexel University

<i>Doctoral Teaching Fellow and CoAS Dean's Fellow</i> Department of Physics	2018 – Present
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### Stony Brook University and Brookhaven National Laboratory

<i>Research Assistant</i> SBU Department of Physics & Astronomy and BNL Department of Physics	2015 – 2019
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### Brookhaven National Laboratory

<i>Intern</i> Department of Physics	2012 – 2013
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## AWARDS AND HONORS

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<i>Graduate College Continuing Excellence in Teaching Assistance Award</i> , Drexel University	2022
<i>Graduate College Continuing Excellence in Teaching Assistance Award</i> , Drexel University	2021
<i>Graduate College Teaching Assistant Excellence Award</i> , Drexel University	2020
<i>Sigma Xi Scientific Research Honor Society Member</i> , Drexel University	2019
<i>College of Arts and Sciences (CoAS) Dean's Fellowship</i> , Drexel University	2018
<i>Sigma Pi Sigma National Physics Honor Society Member</i> , Stony Brook University	2017
<i>Presidential Scholarship</i> , Stony Brook University	2013

## RESEARCH HISTORY

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2018 – Present	<b>Weak gravitational lensing</b> Developed a novel method for measuring the second-order weak gravitational lensing effect known as flexion; Created a full theoretical formalism for “cosmic flexion” – a family of cosmological weak lensing signals originating from the large-scale structure of the universe; Discovered previously unknown cosmological weak lensing signals and posited the existence of non-commutativity in weak lensing; Exploration of flexion in the Dark Energy Survey; Discovered unique weak lensing signatures for negative mass compact objects and exotic objects such as the Ellis wormhole.
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- 2015 – 2019      **Low redshift 21 cm intensity mapping**  
Cosmological parameter and modified gravity forecasts for a general 21 cm cosmology experiment, member of the DOE Cosmic Visions Dark Energy 21 cm Working Group, and design and construction of the radio telescope used for the 21 cm Baryon Mapping eXperiment at Brookhaven National Laboratory.
- 2013              **Gravitational waves**  
New method for the indirect detection of gravitational waves.
- 2012              **Modified Newtonian Dynamics**  
Investigated the plausibility of Modified Newtonian Dynamics on a local scale based on rotation curves of the Milky Way.

## REFEREED PUBLICATIONS

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3. **Arena, E. J.**, “*Weak gravitational flexion in various spacetimes: Exotic lenses and modified gravity*,” Phys.Rev.D **106**, 064019 (2022) [[arXiv:2207.07784](#)]
2. **Arena, E. J.**, Goldberg, D. M., and Bacon, D. J., “*Cosmic flexion*,” Phys.Rev.D **105**, 123521 (2022) [[arXiv:2203.12036](#)]
1. Fabritius, J. M., **Arena, E. J.**, and Goldberg, D. M. “*Shape, color, and distance in weak gravitational flexion*,” Mon.Not.Roy.Astron.Soc. **501**, 4103 (2021) [[arXiv:2006.03506](#)]

## CONFERENCE PROCEEDINGS, SCIENCE BOOKS, WHITE PAPERS

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3. Timbie, P. et al., including **Arena, E. J.**, “*Research and Development for HI Intensity Mapping*,” ArXiv e-prints (2019) [[arXiv:1907.13090](#)]
2. Slosar, A. et al., including **Arena, E. J.**, “*Packed Ultra-wideband Mapping Array (PUMA): A Radio Telescope for Cosmology and Transients*,” Bull.Am.Astron.Soc. **51**, 53 (2019) [[arXiv:1907.12559](#)]
1. Cosmic Visions 21 cm Collaboration, including **Arena, E. J.**, “*Inflation and Early Dark Energy with a Stage II Hydrogen Intensity Mapping experiment*,” ArXiv e-prints (2018) [[arXiv:1810.09572](#)]

## CONFERENCES AND TALKS

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### Contributed Talks

- “Weak gravitational flexion in the Dark Energy Survey”  
Talk to DES Weak Lensing Working Group, Virtual meeting 11 May 2022
- “Hybrid analytic image modeling and image moments approach to gravitational lensing”  
Research talk to incoming graduate students, Drexel University 17 Sep. 2019
- “Observation of gravitational waves through precision stellar redshift measurement”  
High School Research Program conference, Brookhaven National Laboratory 16 Aug. 2013

### Poster Presentations

- “Hybrid analytic image modeling and image moments approach to gravitational lensing”  
First-year graduate student presentations, Drexel University 11 Jun. 2019
- “Dark matter and its alternatives”  
High School Research Program conference, Brookhaven National Laboratory 27 Nov. 2012

## SOFTWARE DEVELOPED

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### Authored

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<b>F-SHARP</b>	Code for computing weak gravitational lensing correlations. <i>Publicly available code written in Python.</i> <a href="https://github.com/evanjarena/F-SHARP">https://github.com/evanjarena/F-SHARP</a>
<b>Lenser</b>	A tool for measuring weak gravitational flexion. <i>Publicly available code written in Python.</i> <a href="https://github.com/DrexelLenser/Lenser">https://github.com/DrexelLenser/Lenser</a>
<b>21cmMG</b>	A suite for probing modified gravity with 21 cm cosmology. <i>Publicly available code written in Python.</i> <a href="https://github.com/evanjarena/21cmMG">https://github.com/evanjarena/21cmMG</a>
<b>Fisher21cm</b>	Fisher forecast for a general 21 cm experiment. <i>Publicly available code written in Python.</i> <a href="https://github.com/evanjarena/Fisher21cm">https://github.com/evanjarena/Fisher21cm</a>

### Contributed

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<b>LensTools</b>	Useful computing tools for weak lensing analyses. <i>Publicly available code written in Python.</i> <a href="https://github.com/apetri/LensTools">https://github.com/apetri/LensTools</a>
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## TEACHING

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### Drexel University

*Teaching Assistant* (Recitation and Lab Instructor)

PHYS 100, *Preparation for Engineering Studies*

Winter: 2021, 2020, 2019

PHYS 152, *Introductory Physics I*

Spring: 2022, 2021, 2020, 2019

PHYS 154, *Introductory Physics III*

Fall: 2022, 2021, 2020, 2019, 2018

*Grader*

PHYS 131, *Survey of the Universe*

Winter 2022

PHYS 231, *Introductory Astrophysics*

Winter 2022

*Guest Lecturer*

PHYS 231, *Introductory Astrophysics*

Winter 2022

### Stony Brook University

*Lecturer*

Della Pietra High School Applied Math Program

Spring 2017

## PROFESSIONAL ACTIVITIES AND SERVICE

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### Collaborations

External Collaborator, Dark Energy Survey (DES)

Member, Packed Ultra-wideband Mapping Array (PUMA) [Inactive]

Member, Baryon Mapping eXperiment (BMX) [Inactive]

### Working Groups

Member, DOE Cosmic Visions Dark Energy 21 cm Working Group [Inactive]

### Outreach Activities

Invited to appear on the Drexel University Teaching Assistant Orientation Panel, as part of the Teaching Assistant Orientation and Preparation Course GRAD T580 (17 Sep. 2020).

Gave a physics demonstration at the Kaczmarczik Lecture Series Open House, hosted by the Drexel University Department of Physics (14 Nov. 2018).

### Committee Work

Treasurer of the Drexel University Physics Graduate Student Association (2020 – 2021).