

Mouza Almualla

mouzaalmuallaa@gmail.com
g00074394@aus.edu

Research Interests	I am interested in the intersection of theory and data in various fields within astrophysics. In the past, I have worked on detecting and understanding <i>kilonovae</i> , which are counterparts to binary neutron star and neutron star – black hole mergers. In graduate school, I am hoping to expand my knowledge in the areas of cosmology and large-scale structure.	
Education	<i>Ph.D. in Astronomy and Astrophysics</i> Harvard University	Starting Sep. 2022
	<i>Bachelor of Science in Physics</i> <i>Bachelor of Science in Electrical Engineering</i> American University of Sharjah, <i>summa cum laude</i>	Sep. 2017 - May 2022 Sep. 2017 - May 2022
Awards and Honors	Chancellor’s List Scholarship, (2017 - Present) Distinguished Student Scholarship, (2017 - Present) Dean’s List Scholarship, (2017 - Present) Regional Winner in <i>Mathematics and Physics</i> , Global Undergraduate Awards (2021) Highly Commended Entrant (top 10%) in <i>Mathematics and Physics</i> , Global Undergraduate Awards (2021) 1st Place, Explore Mars Poster Competition (2019)	
Skills	<ul style="list-style-type: none">• Programming languages: Python, MATLAB, C/C++• Operating systems: Mac OS, Linux• Software: LaTeX, Git, Bash Scripting, Ansys HFSS, LabVIEW, PSPICE	
Research Experiences	<i>Constraining Kilonova Ejecta Geometries using POSSIS</i> Physics Senior Research Project Mentored by Dr. Michael Coughlin (UMN), Dr. Mattia Bulla (Stockholm U.) and Dr. Nidhal Guessoum (AUS)	August 2021 - Present
	<ul style="list-style-type: none">• Produced multiple large-scale kilonova grids using radiative transfer simulations• Showed that incorporating an angular dependency in one of the ejecta components improves best-fit to GW170817 by 50%	
	<i>Deepfake detection using Visual Transformers and Autoencoders</i> Electrical Eng. Senior Design Project Mentored by Dr. Usman Tariq (AUS) and Dr. Abhinav Dhall (Monash U.)	Jan 2021 - Present
	<ul style="list-style-type: none">• Incorporated autoencoder and visual transformer architectures into deepfake detection pipeline• Achieved accuracies of up to $\sim 90\%$	
	<i>Serendipitous Observations of Kilonovae</i> University of Minnesota Summer Research Program Mentored by Dr. Michael Coughlin (UMN) and Shreya Anand (Caltech)	July 2020 - April 2021

- Generated realistic simulations of survey observations conducted by the Zwicky Transient Facility (ZTF)
- Evaluated the efficiency of different survey strategies in detecting kilonovae to help strategize for Phase II of ZTF
- Published [journal paper](#) describing these optimal survey strategies and the resulting improvements.

LIGO Noise Subtraction and Detector Characterization July - Oct. 2020
 University of Minnesota Summer Research Program
 Mentored by Dr. Michael Coughlin (UMN) and Dr. Guillermo Valdes (LSU)

- Tested and optimized a noise subtraction pipeline that utilizes machine learning methods using gravitational-wave events from the second and third observing runs of LIGO
- Participated in LIGO Detector Characterization Noise Sprint working on intermittent noise investigations

Optimizing Detection of EM Counterparts to Gravitational Waves July 2019 - Present
 LIGO Lab, California Institute of Technology
 Mentored by Dr. Nidhal Guessoum (AUS) and Dr. Michael Coughlin (UMN)

- Spent one month at Caltech developing improvements to the scheduling software used for Target of Opportunity observations conducted by the GROWTH Collaboration
- Published [journal paper](#) describing scheduling improvements

Publications

Almualla, M., Ning, Y., Bulla, M., Dietrich, T., Coughlin, M.W., and Guessoum, N., “Using Neural Networks to Perform Rapid High-Dimensional Kilonova Parameter Inference” (2022), *arXiv:2112.15470*, <https://arxiv.org/abs/2112.15470>.

Almualla, M., Anand, S., Coughlin, M.W., Dietrich, T., Guessoum, N., Sagues Caracedo, A., Ahumada, T., Andreoni, I., Antier, S., Bellm, E.C., Bulla, M. and Singer, L.P., “Optimizing Serendipitous Detections of Kilonovae: Cadence and Filter Selection” (2021), *Monthly Notices of the Royal Astronomical Society*, 504(2), 2822–2831.

Ahumada, T., Singer, L.P.,..., **Almualla, M.** et al., “Discovery and confirmation of the shortest gamma-ray burst from a collapsar” (2021), *Nature Astronomy*, doi:10.1038/s41550-021-01428-7

Anand, S., Coughlin, M.W.,..., **Almualla, M.** et al., “Optical follow-up of the neutron star–black hole mergers S200105ae and S200115j” (2021), *Nature Astronomy*, 5(1), 46–53

Kasliwal, M.M., Anand, S.,..., **Almualla, M.**, et al., “Kilonova Luminosity Function Constraints Based on Zwicky Transient Facility Searches for 13 Neutron Star Merger Triggers during O3” (2020), *The Astrophysical Journal*, 905(2), 145

Antier, S., Agayeva, S., **Almualla, M.**, et al., “GRANDMA Observations of Advanced LIGO’s and Advanced Virgo’s Third Observational Campaign” (2020), *Monthly Notices of the Royal Astronomical Society*, 497(4), 5518–5539

Coughlin, M.W., Dietrich, T., Antier, S., **Almualla, M.**, Anand, S., Bulla, M., Foucart, F., Guessoum, N., Hotokezaka, K., Kumar, V., Raajmakers, G., and Nissanke, S., “Implications of the search for optical counterparts during the second

part of the Advanced LIGO's and Advanced Virgo's third observing run: lessons learned for future follow-up observations" (2020), *Monthly Notices of the Royal Astronomical Society*, 497(1), 1181 - 1196

Almualla, M., Coughlin, M.W., Anand, S., Alqassimi, K., Guessoum, N., and Singer, L.P., "Dynamic scheduling: target of opportunity observations of gravitational wave events" (2020), *Monthly Notices of the Royal Astronomical Society*, 495(4), 4366–4371

Coughlin, M.W., Antier, S., Corre, D., Alqassimi, K., Anand, S., Christenen, N., Coulter, D.A., Foley, R.J., Guessoum, N., Mikulski, T.M., **Almualla, M.**, Reed, D., Tao, D., "Optimizing multitelescope observations of gravitational-wave counterparts" (2019), *Monthly Notices of the Royal Astronomical Society*, 489(4), 5775–5783

Talks

July 2021 - "*Optimizing Searches for Serendipitous Kilonovae by Wide-Field Surveys*"
GRANDMA Collaboration Seminars

January 2021 - "*Dynamic Scheduling: Target of Opportunity Observations of Gravitational-Wave Events*"
43rd COSPAR Scientific Assembly

November 2020 - "*Optimizing Searches for Serendipitous Kilonovae by Wide-Field Surveys*"
5th Middle East and Africa Regional IAU Meeting

September 2020 - "*Investigating intermittent, sharp-frequency noise within the GW strain*"
LIGO Detector Characterization Telecon

August 2020 - "*Optimizing Searches for Serendipitous Kilonovae by Wide-Field Surveys*"
GROWTH Multi-Messenger Astronomy Teleconference

September 2019 - "*Exploring Statistical Differences Between Swift and Fermi Burst Measurements*"
15th Gulf Astronomy Colloquium
Sharjah Academy for Astronomy, Space Sciences, and Technology, Sharjah, UAE

September 2019 - "*Scheduling Improvements to GW Target of Opportunity Scheduler GWEMOPT*"
GROWTH Multi-Messenger Astronomy Teleconference

Posters

January 2021 - "*Dynamic Scheduling: Target of Opportunity Observations of Gravitational-Wave Events*"
43rd COSPAR Scientific Assembly

January 2019 - “*Trans-atmospheric Radio Communication on Mars During Solar Energetic Particle Events*”

Mohammed Bin Rashid Space Centre Explore Mars Competition

Outreach

Women in Science Outreach Talk, Zayed University April 2022

- Gave a talk to the the Peer Assistance Leaders (PALs) at Zayed University discussing my journey and the current state of research in astrophysics as a whole.

Vice Chair, IEEE AUS Main Branch Jan. - May 2019

- IEEE (Institute of Electrical and Electronics Engineers) is the largest worldwide technical organization, and focuses on the advance of research and knowledge for the benefit of humanity.
- Organized and managed events, prioritized certain events/tasks, assigned roles.
- Took on Chair’s duties when necessary.

Interview for Mars Poster Competition Winners, Sharjah TV April 2019

- Discussed my poster on Martian ionospheric studies, which won first place at our national space center’s annual science event.

Public Relations Officer, IEEE AUS Main Branch Sep. - Dec. 2018

- Handled correspondence with other organizations and professors.
- Handled social media, posters, and event promotion.

Executive Secretary, College of Arts and Sciences Student Team Sep. - Dec. 2018

- Arranged meetings, kept agendas and took minutes.
- Coordinated between the team and different parts of the university, arranged collaborative events.

Organizer, Gamma Ray Burst Workshop (Hotel Hilton, Sharjah) Oct. 2018

- Engaged in pre-event organization and promotion, and helped provide needed supplies.
- Helped participants and speakers throughout the event to ensure it ran smoothly.