

Dr. Athira Menon

PhD: 6th June, 2018

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Department of Astronomy, Columbia University, New York City, U.S.A. - 10027

CURRENT POSITION

Postdoctoral Fellow and Lecturer, Columbia University, U.S.A.

July 2024 - July 2027

RESEARCH INTERESTS

My research aims at solving fundamental puzzles of stellar astrophysics by building detailed and innovative models of massive and low-mass stars, that follow their evolution and nucleosynthesis in binary systems—especially of their mergers. I use tools such as MESA and KEPLER for 1D stellar evolution models, NuGRID for post-processing nucleosynthesis yields, and PHOEBE for computing synthetic light and radial-velocity curves of binary systems, implemented primarily in Python and Fortran.

By integrating my models into synthetic galaxy populations, I probe the origins of observed stellar classes, peculiar stars, supernovae and compact remnants. Guided by observational surveys such as Gaia, TESS, VLT, and OGLE, my simulations are primed to predict the properties of stellar populations, and the electromagnetic and gravitational-wave transients from next-generation facilities such as Vera Rubin LSST, 4MOST, JWST, and LIGO–VIRGO–KAGRA.

EDUCATION

• Monash University	March 2014 - June 2018
<i>PhD</i>	Melbourne, Australia
• University of Victoria	September 2010 - March 2013
<i>MSc. in Astronomy & Physics, with distinction</i>	Victoria, Canada
• University of Canterbury	June 2009 - July 2010
<i>BSc. Hons., in Astronomy & Physics, First Class</i>	Christchurch, New Zealand
• St. Xavier's College, University of Mumbai	June 2006 - June 2009
<i>BSc. Physics, First Class</i>	Mumbai, India

FELLOWSHIPS & COMPUTATIONAL GRANTS

• Columbia Science Fellowship	2024–2027
<i>Awarded to lead independent research at the Department of Astronomy, Columbia University</i>	New York City, U.S.A.
<i>Remuneration (annual): USD 71,050; Research allowance (net): USD 16,326</i>	
• Spanish Ministry's Juan de la Cierva- Incorporación Fellowship	2022–2024
<i>Awarded by the Ministry of Science & Innovation, Spain</i>	Institute of Astrophysics (IAC), Spain
<i>Remuneration (annual): EUR 32,040; Research allowance (net): EUR 9600</i>	
• Humboldt Research Fellowship	2021–2022
<i>Awarded by the Alexander von Humboldt Foundation</i>	Bonn, Germany
<i>Remuneration (annual): EUR 35,374.56; Research allowance (net): EUR 6000</i>	
• 500,000 CPU hours on supercomputer 'Cartesius'	2019-2020
<i>Awarded by SURFsara/NWO national computing time programme</i>	Amsterdam, The Netherlands
• Collaborative access to OzSTAR supercomputer	2023-2024
<i>To run large model grids of metal-rich binaries</i>	Melbourne, Australia
• Collaborative access to supercomputer 'Ginsburg', Columbia University	2024-ongoing
<i>To run large model grids of mergers and single stars</i>	New York City, U.S.A

LONG-TERM VISITING POSITION (> 1 MONTH)

- Guest researcher at the Center for Computational Astrophysics (CCA), Simons Institute, NYC, U.S.A, 2024-ongoing
- Researcher invited by the Visiting Joint Research program at the National Astronomical Observatory of Japan (NAOJ), Japan, April 2024
- ASTRO 3D and Ozgrav visiting scientist at Monash University, Australia, January–March 2024
- Visiting scientist and collaborator of the massive-star group at the Argelander Institute of Astronomy, University of Bonn, Germany, 2019- ongoing

LEAD AUTHOR PUBLICATIONS (9)

- [1] Menon, et al. (2025), *A new sample of massive B-type contact binary candidates from the OGLE survey of the Magellanic Clouds*, accepted on 1st October 2025, **A&A**
- [2] Menon, et al. (2024), *Evidence for Evolved Stellar Binary Mergers in Observed B-type Blue Supergiants*, 2024 **ApJ** 963L 42M
- [3] Moriya & Menon (2024), *Blue supergiants as a progenitor of intermediate-luminosity red transients*, 2024 **PASJ** 76L 27M
- [4] Menon et al. (2021), *Detailed evolutionary models of massive contact binaries – I. Model grids and synthetic populations for the Magellanic Clouds*, 2021 **MNRAS** 507 5013M
- [5] Menon et al. (2019), *Low-metallicity CO + He WD post-merger models for RCB stars as a source of pre-solar graphite grains*, 2019 **MNRAS** 482 2320M
- [6] Menon et al. (2019), *Explosions of blue supergiants from binary mergers for SN 1987A*, 2019 **MNRAS** 482 438M
- [7] Menon & Heger (2017), *The quest for blue supergiants: binary merger models for the evolution of the progenitor of SN 1987A*, 2017 **MNRAS** 469 4649M
- [8] Menon et al. (2013), *Reproducing the Observed Abundances in RCB and HdC Stars with Post-double-degenerate Merger Models—Constraints on Merger and Post-merger Simulations and Physics Processes*, 2013 **ApJ** 772 59M
- [9] Staff, Menon et al. (2012), *Do R Coronae Borealis Stars Form from Double White Dwarf Mergers?*, 2012 **ApJ** 757 76S

PUBLICATIONS IN PREP. (1)

- [1] Menon, Patrick, Wang, et al., *Closing the gap in massive-star evolution with stellar mergers*

ACCEPTED OBSERVATIONAL PROPOSALS (2)

- [1] PI: Menon, De, El-Badry, Prša, *The missing majority: a spectroscopic census of B-type massive contact binaries in the Magellanic Clouds*, NSF-NOIRLab SOAR 4m, 6 nights 2025B-274519
- [2] Patrick, Bianchi, ..., Menon, et al., *Hot and cool - hot companions as probes of red supergiant*, 2023 HST prop. 17530P

CO-AUTHORED PUBLICATIONS (14)

- [1] Sana, H., Shenar, T., ..., Menon, A., et al. *A high fraction of close massive binary stars at low metallicity*, 2025 **Nature Astronomy** 9.1337S
- [2] Britavskiy, N., Mahy, L., ..., Menon, A., et al. *Binarity at Low Metallicity (BLoeM): Multiplicity of early B-type supergiants in the SMC*, 2025 **A&A** 698A 40B
- [3] Patrick, L.R., Lennon, D. J., ..., Menon, A. et al. *Binarity at Low Metallicity (BLoeM): The multiplicity properties of BAF-type supergiants in the SMC*, 2025 **A&A** 698A 39P
- [4] Vrancken, Abdul-Masih, Escorza, Menon, et al., *Constraining the overcontact phase in massive binary evolution – III. Period stability of known B+B and O+B overcontact systems*, 2024 **A&A** 691A 150V
- [5] Shenar, Bodensteiner, ..., Menon, et al., *Binarity at Low Metallicity (BLoeM): A spectroscopic VLT monitoring survey of massive stars in the SMC*, 2024 **A&A** 690A 289S
- [6] Abdul-Masih, Escorza, Menon, et al., *Constraining the overcontact phase in massive binary evolution. II. Period stability of known O+O overcontact systems*, 2022 **A&A** 666A 18A
- [7] Sen, Langer, Marchant, Menon, et al., *Detailed models of interacting short-period massive binary stars*, 2022 **A&A** 659A 98S

- [8] Abdul-Masih, Hugues, ..., **Menon**, et al., *Constraining the overcontact phase in massive binary evolution. I. Mixing in V382 Cyg, VFTS 352, and OGLE SMC-SC10 108086*, 2021 **A&A** 651A 96A
- [9] Utrobin, Wongwathanarat, ..., **Menon**, et al., *Supernova 1987A: 3D Mixing and Light Curves for Explosion Models Based on Binary-merger Progenitors*, 2021 **ApJ** 914 4U
- [10] Langer, Schürmann, ..., **Menon**, et al., *Properties of OB star-black hole systems derived from detailed binary evolution models*, 2020 **A&A** 638A 39L
- [11] Jerkstrand, Wongwathanarat, ..., **Menon**, et al., *Properties of gamma-ray decay lines in 3D core-collapse supernova models, with application to SN 1987A and Cas A*, 2020 **MNRAS** 494 2471J
- [12] Alp, Larsson, ..., **Menon** *X-Ray and Gamma-Ray Emission from Core-collapse Supernovae: Comparison of Three-dimensional Neutrino-driven Explosions with SN 1987A*, 2019 **ApJ** 882 22A
- [13] Abdul-Masih, Sana, ..., **Menon**, et al. *Clues on the Origin and Evolution of Massive Contact Binaries: Atmosphere Analysis of VFTS 352*, 2019 **ApJ** 880 115A
- [14] Fröhlich, Curtis, ..., **Menon**, et al. *Nucleosynthesis for SN 1987A from single-star and binary-merger progenitors*, 2019 **J. Phys. G: Nucl. Part. Phys.** 46 084002

SCHOLARSHIPS & SCIENCE COMMUNICATION PRIZES

- Invited TEDx Speaker on 'The exciting lives of massive stars and their companions', *TEDx University of Amsterdam, 2019*. Talk available [here](#).
- Runner-up at *FameLab International 2019*, the World's largest science communication contest. Talk available [here](#).
- Winner and People's choice awardee at *FameLab Netherlands, 2019*. Talk available [here](#).
- Invited speaker at the InScience film festival 2020, Netherlands.
- Finalist at the Young Speakers Contest ('FYSICA 2020') held by the Dutch Physics Society.
- Runner-up (\$2000 cash prize) and People's choice award (\$1000 cash prize) at the *3 minute thesis (3MT) 2017 finals*, Monash University. Talk available [here](#).
- Awarded best student talk at the Australian National Institute of Theoretical Astrophysics (ANITA) meeting, 2015.
- International Postgraduate Research Scholarship and the Australian Postgraduate Award for PhD studies, 2014-2018
- Internship scholarship at the Indian Institute of Astrophysics, 2013
- University of Victoria postgraduate fellowship for MSc in Physics & Astronomy, 2010-2012
- Summer research scholarship recipient, University of Canterbury, New Zealand, 2010
- LKBF Dutch national travel grant for invited seminars at Harvard and Louisiana State University, USA, 2020 .

RESEARCH EXPERIENCE

- **Columbia University, Science Fellow & Lecturer** *New York City, U.S.A, July 2024 - July 2027*

I am leading the first holistic effort to *resolve the long-standing blue supergiant problem*—one of the most persistent challenges in massive-star evolution—through novel models that unify genuinely single and merger-born stars. With my undergraduate research students, I show that the Hertzsprung-gap population arises from both channels, with *merger-born systems dominating these stars* (*Menon et al., in prep.*). I am also investigating the broader cosmic impact of massive-star mergers in collaboration with experts in cluster-evolution. In parallel, *I am leading a spectroscopic campaign targeting the largest sample of massive contact-binary candidates*, mined from the OGLE survey using my theoretical predictions (*Menon et al. 2025, A&A*), and serve as a theoretical consultant for the *Binarity at Low Metallicity (BLOeM)* survey in the Small Magellanic Cloud.

- **Instituto de Astrofísica de Canarias, Juan de la Cierva-Incorporacion fellow** *Tenerife, Spain, June 2022 - June 2024*
I led an international collaboration of 11 researchers, bringing together experts in 3D hydrodynamics, 1D stellar evolution, and observations, to create the *first models of evolved stellar mergers* to explain the *uniformly enhanced nitrogen in blue supergiants* (*Menon et al. 2024, ApJL*). As an NAOJ visiting researcher, my collaborator and I identified *faint blue-supergiant explosions as progenitors of intermediate-luminosity red transients* (*Moriya & Menon 2024, PASJ*).
- **Argelander Institute for Astronomy, Humboldt fellow** *Bonn, Germany, June 2021 - June 2022*
Through detailed evolutionary models, I demonstrated the *metallicity independence of massive contact binary distributions* in the local Universe and computed their *period variability* to compare with observations, along with contributing to *constraining the internal mixing of observed massive-contact systems* and statistical methods to interpret short-period main-sequence binary populations.
- **University of Amsterdam, Postdoctoral researcher** *Amsterdam, Netherlands, September 2018 - September 2020*
I computed the *first dedicated grid of massive contact systems*, comprising of ~3000 detailed binary models and identified them as the *progenitors of main-sequence stellar mergers* in the Magellanic Clouds. I also predicted that most contact binaries are B-type binaries with mass ratios of 1 and periods under 1 day. (*Menon et al. 2021, MNRAS*). I contributed to *interpreting 3D neutrino-driven simulations of SN 1987A* that reproduce its observed gamma- and X-ray signatures, constraining mixing and radioactive decay of this benchmark supernova.
- **Monash University, PhD** *Melbourne, Australia, March 2014 - June 2018*
I uncovered the binary-merger origin of *blue-supergiant progenitors of SN 1987A* using the first grid of post-merger stellar models (*Menon & Heger 2017, MNRAS*). I later collaborated with experts in supernova simulations to produce the most *accurate light-curve fits of SN 1987A from merger-born progenitors* (*Menon et al. 2019, MNRAS*). In a separate study, I identified *R Coronae Borealis stars* as potential sources of carbon-rich *pre-solar meteorite grains* (*Menon et al. 2019, MNRAS*).
- **University of Victoria, MSc** *Victoria, Canada, September 2010 - March 2013*
I determined key *nucleosynthesis products during the merger of white-dwarf binaries* in 3D hydrodynamic simulations (*Staff, Menon et al. 2011, ApJ*). Building on this, I developed the *first detailed models of hydrogen-deficient R Coronae Borealis stars* evolved from white-dwarf mergers, reproducing their key observational chemical signatures (*Menon et al. 2013, ApJ*).

TEACHING & MENTORSHIP EXPERIENCE

- **Lecturership** *2024 - ongoing*
 - **Frontiers of Science Lecturer, Columbia University**, teaching 41 freshmen a diverse array of subjects including: neuroscience, relativity, genetics and climate science over 24 hours per week, 2024-2017
 - **Guest Lecturer, MSc. Astronomy**, University of La Laguna, Spain, 2024
- **Student advisor roles** *2019-ongoing*
 - Advisor of undergraduate students, Jerry Wang (Cornell University) and Nathaniel Rodgers (Columbia University), on stellar evolutionary models of mergers and single stars towards the blue supergiant problem, 2025 - *ongoing*
 - Co-mentor of PhD candidate Alexandra Masegian (Columbia University) on spectroscopic observations and binary pathways in rapid-population synthesis codes, 2024 - *ongoing*
 - Co-advisor of BSc. thesis student, Kai Förster (University of Bonn) on exploring mixing parameters of contact binaries, 2022-2023
 - Mentored PhD candidates, Andrea Ercolino and Harim Jin (University of Bonn) on the implications of stellar mergers on supernovae progenitors and main-sequence stars, 2022-2024
 - Mentored PhD candidate, Koushik Sen (University of Bonn) on statistical methods to interpret binary populations, 2019-2021
- **Teaching Assistantship** *2010 - 2017*
 - ASP3012 'Stars and Galaxies', ASP 2011 'Observational Astronomy', Monash University
 - A101 'Exploring the Night Sky', A102 'Exploring the Cosmos', University of Victoria
 - Physics 101, 'Problem solving', University of Canterbury

PROFESSIONAL SERVICE

• Referee Service

- Astronomy and Astrophysics (A&A) journal
- Astrophysical Journal (ApJ)
- Monthly Notices of the Royal Astronomical Society (MNRAS) journal
- Open Astronomical Journal (OAJ)

• Organizational Roles

- SOC chair of the first ever symposium on '*Stellar interactions: contact binaries and common-envelope evolution*', at the European Astronomical Society (EAS) meeting, 2023.
- Developed and conducted a training workshop for the science-communication contest Fame Lab, University of Amsterdam, 2020
- Conducted a workshop on the stellar-evolution code MESA, Louisiana State University, 2012

LIST OF INVITED & CONTRIBUTED TALKS

- **Invited** Keynote speaker at the *Ten Years of Gravitational Waves* conference at the Italian Academy of Sciences, Columbia University, 2025
- **Invited** Astronomy outreach lecture, Columbia University, 2025
- **Invited** Physics & Astronomy colloquium speaker at Villanova University, 2025
- **Invited** AstroLunch seminar speaker at University of Pittsburgh and Carnegie Mellon, 2025
- **Invited** Physics & Astronomy colloquium speaker at Louisiana State University, 2025
- **Invited** seminar speaker by the IAU Working Group on Active B-type stars (WGABS), 2024
- **Invited** astrophysics seminar speaker at Louisiana State University, 2023 ¹
- **Invited** astronomy seminar speaker at the University of New South Wales, 2023
- **Invited** to lead discussion on '*Stellar mergers and where to find them in the local Universe*' at the 'Stellar Astrophysics in the era of Gaia, spectroscopic, and asteroseismic surveys' workshop, MIAPbP, Germany, 2023
- **Invited** visitor of the massive-star group at the Nicolaus Copernicus University, Torun, Poland, 2023
- **Invited** seminar speaker at Monash University, 2021
- **Invited** seminar speaker at the Instituto de Astrofísica de Canarias, 2021
- **Invited** speaker at the 'Stars & Planets' seminar series, CfA, Harvard University, 2021
- **Invited** seminar speaker at Louisiana State University¹, 2020
- **Invited** speaker at the InScience Film Festival, Netherlands, 2020
- **Invited** seminar speaker at Flatiron Institute¹, 2020
- **Invited** seminar speaker at Liverpool University¹, 2020
- **Invited** visitor and seminar speaker at the University of Birmingham, 2019
- **Invited** seminar speaker at the Indian Institute of Astrophysics (IIA), India, 2015
- Contributed talk at "Massive Stars and their Diverse Transients" session, European Astronomical Society (EAS), 2025
- Contributed talk at the Munich Institute for Astro- and Particle Physics workshop, Germany, 2023
- Contributed talk at 'Two in a Million' conference, MPA, Garching, Germany, 2023
- Selected participant at the ASPEN Center for Physics meeting on Stellar Interactions, 2023²

¹Cancelled due to COVID-19 outbreak

²Unable to attend due to lack of visa appointment dates

- Selected participant and speaker at the MIAPbP workshop, Garching, Germany, 2023
- Contributed talk at ‘3,2,1: Massive Triples, Binaries and Mergers 2023’ conference, KU Leuven, Belgium, 2023
- Sponsored participant at the ERASMUS school on ‘Binaries and Asteroseismology’, La Palma, Spain, 2022
- Sponsored participant at the school on ‘Life and Death: Stars to Compact Objects’, Asiago, Italy, 2022
- Contributed talk at the ‘Supernova Remnants and their Progenitors’ conference, CfA, U.S.A., 2022
- Contributed talk at the F.O.E. (Fifty-One Ergs) Supernova Conference, U.S.A., 2019
- Contributed talk at the Massive Stars Meeting, KU Leuven, Belgium, 2018
- Contributed talk at the ‘Supernovae–Progenitor Connections’ Ringberg Workshop, Germany, 2016
- Contributed talk at the ‘Death Throes of Massive Stars’ IAU Symposium, New Zealand, 2015
- Contributed talk at the ‘Stellar Behemoths’ Focus Meeting, IAU General Assembly, U.S.A., 2015
- Contributed talk at the ANITA Meeting, Australia, 2015
- Contributed talk at the JINA Frontiers Meeting, Michigan State University, U.S.A., 2012
- Contributed talk at the Canadian Workshop on the Nuclear & Astrophysics of Stars, 2010