Dr. Pradip Gatkine

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BRIEF STATEMENT

I like problem solving. With my diverse background in Physics, Astronomy, Photonics, Programming, and Engineering I have brought in unique perspectives and skills to solve challenging problems in Astronomy. I have worked extensively on a new approach for astronomical instrumentation called 'Astrophotonics'. My research has involved development of a slew of astrophotonic chips/devices using nano-fabrication as well as study of galaxies in the early universe.

EMPLOYMENT

NASA Hubble Fellow (hosted at Caltech)	Sept 2021 - Present
David & Ellen Lee Prize Postdoctoral Fellowship, Caltech	Sept 2020 - Present
NASA Earth & Space Science Fellowship (hosted at Univ. of MD)	Aug 2018 - Aug 2020
Graduate Research Assistant, Univ. of MD	Aug 2014 - July 2018

EDUCATION

University of Maryland College Park
PhD in Astronomy — Aug 2020
Thesis: Building astrophotonic spectrographs & Probing the early universe with Gamma-ray Bursts
M.S. in Astronomy [GPA: 4.0/4.0] — 2014 - 2016
Masters Thesis: Development of on-chip astrophotonic spectrograph in near-infrared H-band

Indian Institute of Technology Bombay — 2010-2014
B.Tech. in Mechanical Engineering (with Honors) and Minor in Physics [GPA: 8.8/10.0]

AWARDS & FELLOWSHIPS

- NASA Hubble Fellowship (hosted at Caltech) — 2021-24
- David & Ellen Lee Prize Postdoctoral Fellowship, Caltech — 2020
- MIT Kavli Fellowship (declined) — 2020
- NASA Earth and Space Science Fellowship, with three years of graduate support ($45k/yr) — 2018-20
- Board of Visitors Outstanding Graduate Student Award for research excellence, Univ. of MD ($5k) — 2020
  ∗ *One award across Computer, Math, and Natural Sciences at Univ. of MD*
- Rodger Doxsey Dissertation Travel Award, American Astronomical Society — 2020
- Andrew S. Wilson Prize for Excellence in Research, UMD Astronomy — 2019
- Outstanding Graduate Assistant Award, Univ. of Maryland — 2019
- SPIE Optics and Photonics Education Scholarship ($3500), for the prospect of long term contribution to the field of optics and photonics, International Society for Optics and Photonics — 2017
- Best Student Presentation award at SPIE Astronomical Telescopes + Instrumentation, — 2016
- Best Poster Award, Nanotechnology Day, University of Maryland — 2016
- Kulkarni Graduate Student Summer Research Fellowship ($5000), Univ. of Maryland — 2016
- John Chi-Lin Wang Award for Academic Excellence ($1000), for best overall performance in Masters research and coursework, Dept of Astronomy, University of Maryland — 2016

- Dean's Fellowship ($10,000) and Merit Fellowship ($2000), awarded to outstanding incoming graduate students, University of Maryland 2014-15

SKILLS

- **Programming:** Python, C++, C, LaTeX, Matlab, Labview, Mathematica.
- **Software tools**: Rsoft CAD and optical simulation, Fimmwave/Fimmprop photonic simulator, Zemax
- **Nanofabrication**: Electron-beam lithography, photolithography, dry/wet-etching, PECVD, LPCVD

RESEARCH EXPERIENCE

Development of an Astrophotonic AWG Spectrograph Aug 2014 - 2020

· Developed (designed, fabricated, and characterized) an on-chip photonic Arrayed Waveguide Grating (AWG) spectrograph geared towards future large telescopes covering the near-infrared H band ($\lambda \sim 1.45-1.65\ \mu m$) with a moderate resolving power of 1500 and a chip size of 12mm × 6mm.

· Currently working on developing a multi-input, polarization-insensitive AWG in the H band to incorporate the multiple single-mode fiber outputs from a photonic lantern (a multi-mode fiber)

Atmospheric OH-suppression using Waveguide Bragg Gratings 2015 - 2017

· Co-developed and demonstrated an on-chip filter using Waveguide Bragg Gratings (WBGs)

· Simulated the performance of the WBG filters on a 4-m telescope towards suppression of atmospheric OH emission lines and estimated a 5−10x improvement in the signal-to-noise ratio for absorption lines of C, O, Fe when the universe was $\sim 10\%$ of its age.

Probing the circumgalactic medium with Gamma-ray burst afterglows Jan 2018 - Present

· I am using exquisite spectra of GRB afterglows in the early universe ($z > 2$) to uniquely probe the chemical enrichment of the circumgalactic material (CGM) around the GRB host galaxy

· Developed a model to simulate the line-of-sight spectra of a variety of galaxy ecosystems including their complex gas flows and compare them with the observations to extract the gas kinematics

· Unravelled a possible CGM-galaxy co-evolution over the cosmic history of 12 billion years.

Optical Follow-up of Gravitational Wave Sources May 2018 - June 2021

Actively involved in the search and study of optical counterparts of compact binary mergers from LIGO

MENTORING & LEADERSHIP EXPERIENCE

- Currently mentoring a Caltech undergraduate student (Marcos Perez) on *Simulating the performance of photonic spectrographs for exoplanet spectroscopy* (June 2021 - Present)
- Currently mentoring an undergraduate student (Harsha Pradeep) at the International School of Photonics on *Optimizing tapers for on-chip photonic spectrographs* (2020 - Present)
- Mentored a UMD undergraduate student (Meghna Sitaram) on *building a near-infrared camera for on-chip photonic spectrographs* (2018 - 2020)
- Mentored two undergraduate students on *Simulation and design of kilonova observations with James Webb Space Telescope* as a part of GRAD-MAP[1] Summer Scholars Program, Univ of MD. (2018)
- Mentored three undergraduate students on *GW170817 evolution: Kilonova lightcurve and SED fitting* as a part of GRAD-MAP[1] winter workshop, University of Maryland (2018)
- Mentored two UMD undergraduates as a part of SPIE Educational Outreach grant (as a PI) on *Building demonstrations of optical technologies in astronomy* (2017-18)

[1]GRAD-MAP is an initiative to increase the involvement of underrepresented minorities in physics and astronomy.

- Mentored a pre-college student on *Search for gravitationally lensed transients in the iPTF survey* (2017)
- Led a 10-member team of Mars Society India, IIT Bombay for the development of a prototype mars rover and field trials at *Arkaroola Mars Robot Challenge Expedition* in Australia (2014)

TEACHING

- Successfully completed a course on *Principles of University Teaching and Learning in STEM* (Spring 2021)
- Guest lectures in the course *Honors 289V: Mars Exploration: Past, Present, Future*, Instructor: Prof. Douglas Hamilton (Spring 2017, 2018, 2019)
- Guest lecture in *Astro 320: Theoretical Astrophysics*, Instructor: Prof. Massimo Ricotti, (Spring 2019)
- Guest lecture on Application of Markov Chain Monte Carlo method to spectroscopy in the course *Astro 866S: Practical Astrostatistics*, Instructor: Prof. Cole Miller (Spring 2018)

SUCCESSFUL GRANTS / TELESCOPE TIME PROPOSALS*

* These are highly competitive proposals to acquire research funding and/or telescope time on some of the largest telescopes in the world.

- **NSF Advanced Technologies and Instrumentation (2021)**: **Co-I**, $317,639, *Mastering the photonic lantern: The key to transformative diffraction-limited spectroscopy*
- **SPIE Educational Outreach grant 2017**: **PI**, $3000, *Putting the Distant Worlds in the Right Spot*
- **NICER X-ray Telescope**: **PI**, Target of Opportunity, 40 ks, *The unusual spectral and temporal evolution of a nearby GRB 190829A* (2019)
- **NUSTAR X-ray Telescope**: **PI**, Target of Opportunity, 40 ks, *The unusual spectral and temporal evolution of a nearby GRB 190829A* (2019)
- **Very Large Array**: **PI**, Semester 2020A, Observing time: 26.1 hours, *Tracing the Molecular Gas in GRB host galaxies at $z > 2$*
- **Very Large Array**: **PI**, Semester 2018B, Observing time: 24 hours, *Measuring the star formation rate of massive GRB hosts in the CGM-GRB sample*
- **Discovery Channel Telescope**: **PI**, Semesters 2020A (3 nights), 2020B (3 nights), 2019A (3 nights), 2019B (3 nights); Co-I 2018A (3 nights) *Gamma-ray bursts and their host environments*
- **Hubble Space Telescope**: Co-I, Cycle 25, Time: 6 orbits, *Coordinated Far-Ultraviolet and Radio Observations of the Feedback Engine in Quasar Mrk 231*
- **Keck Telescope**: PI, Semester 2021A, 2021B (4 nights) *CGM of high-z GRB hosts* ; Co-I, Semesters 2018B, 2019A, 2019B *Spectroscopy of Gravitational Wave Counterparts: Constraining the Origin of r-process Elements*

SERVICE

- Led a white paper on Astrophotonics for Astro2020 Decadal Survey
- Science team member of NASA explorer mission study: CETUS – Cosmic Evolution Through UV Spectroscopy
- Review panelist for NSF Advanced Technologies and Instrumentation
- Review panelist for NASA Astrophysics Data Analysis Program
- Referee for various high-impact journals: Optics Express, Optics Letters, Applied Optics, Journal of Optical Society of America (B), IEEE Photonics Journal, Photonics Research Journal

- Science Organizing Committee member, Keck Science Meeting, September 2021
- Review panelist, Keck & Palomar telescopes time allocation committee (TAC), 2021B and 2022A

OUTREACH EFFORTS

- Served as an American Astronomical Society Ambassador for local outreach activities (2019)
- Created and led a popular science activity: *Putting the Distant Worlds in the Right Spot* for Maryland Day (3000+ visitors), as a part of SPIE Educational Outreach grant (2018)
- Served as a hand-on tutor for MCMC smapling techniques at the ZTF Summer School (Aug 2021)
- As a Univ of MD Graduate Innovation Fellow (2020), I learnt about innovation mindsets and coached participants in three creativity workshops on prototyping, improvisations, and feedback synthesis.
- Served as a hands-on tutor for optical and X-ray data analysis at the Zwicky Transient Facility Summer School (Aug 2020)
- Served as Python bootcamp mentor at *GRAD-MAP Winter workshop*, Univ of Maryland (2018)
- Delivered two science popularization talks at *College Park Academy* for high school students (2016)
- Volunteered at the *4th USA Science and Engg Festival* with 'Science Laser Spectacular' activity (2016)
- Mentored and took science classes for academically struggling middle-school students at a government school in Mumbai, India as a part of National Service Scheme (2010-11)

PROFESSIONAL TALKS

1. *Invited Talk: Conference on astro-photonics & MKID-arrays — 09/2021
   On-chip Arrayed Waveguide Grating (AWG) spectrometers for astronomy
2. *Invited talk: Global Webinar on Laser, Optics and Photonics — 09/2021
   Astronomical spectrographs on a chip
3. *Invited talk: Indian Institute of Science, Dept of Astronomy — 06/2021
   Recent Advances in Astrophotonics
4. *Invited talk: Space Science & Astrobiology Division Seminar, NASA Ames Research Center — 05/2021
   Astronomical spectrographs and filters on a chip
5. *Invited talk: NASA JPL Micro-devices Laboratory Seminar — 04/2021
   Recent Advances in Astrophotonics: Integrated Spectrometers and Photonics Filters
6. *Invited seminar: MIT Brown Bag Lunch Seminar — 03/2021
7. *Invited talk: AAO-MQ seminar at Australian Astronomical Optics, Macquarie University — 10/2020
   Astronomical spectrographs on a chip - Getting ready for the next-generation telescopes
8. Dissertation talk: 235th Meeting of The American Astronomical Society, Hawaii — 01/2020
9. Instrumentation Talk: Dept of Astronomy, Univ of California, Santa Cruz — 01/2020
10. Lunch talk: Kavli Institute for Particle Astrophysics and Cosmology, Stanford University — 01/2020
11. Lunch Talk: Space Telescope Science Institute, Baltimore, MD — 10/2019
12. Afternoon Talk: Dept of Astronomy, Univ. of California, Berkeley — 09/2019
13. Afternoon Talk: Caltech Optical Observatories — 09/2019
14. ARI Seminar: Astrophysics Research Institute, Liverpool John Moores University, UK — 06/2019

15. Lunch Extragalactic Seminar: Kavli Institute for Cosmology, University of Cambridge, UK 06/2019
16. *Invited talk: 233rd Meeting of The American Astronomical Society, Seattle 01/2019
    Probing the circumgalactic medium in the early universe
17. Instrumentation Group Talk: Australian Astronomical Observatory, Sydney 07/2018
    Astrophotonic Spectrograph using Arrayed Waveguide Gratings
18. *Invited seminar talk: Institute of Photonics and Optical Science, Univ of Sydney 07/2018
    On-chip Astrophotonic Spectrographs
19. Contributed talk: The 5th Annual DC/MD/VA Space Science Summer Meeting 07/2017
    The tale of an astrophotonic spectrometer
20. Afternoon talk: Institute of Photonics and Optical Science, Univ of Sydney 07/2018
    On-chip Astrophotonic Spectrographs
21. *Invited seminar talk: Dept of Physics, Univ of Virgin Islands 09/2017
    Arrayed Waveguide Gratings as astrophotonic spectrographs
22. *Invited Colloquium: Aryabhatta Research Institute of Observational Sciences, Nainital, India 07/2016
    Astrophotonics: A new paradigm for astronomical instrumentation
23. Contributed talk: 6th Biomedical Engineering International Conference 10/2013
    Development of piezo-electric sensor based noninvasive low cost Arterial Pulse Analyzer
24. Contributed talk: International Radar Symposium, Bangalore India 12/2013

POSTER PRESENTATIONS

1. SPIE Astronomical Telescopes + Instrumentation, Virtual 12/2020
2. 236th Meeting of the American Astronomical Society 06/2020
3. 7th Annual GMT Community Science Meeting, Carlsbad, CA 09/2019
4. 233rd Meeting of the American Astronomical Society, Seattle, WA 01/2019
5. SPIE Astronomical Telescopes + Instrumentation, Austin, TX 07/2018
6. 231st Meeting of the American Astronomical Society, Washington DC 01/2018
7. SPIE Astronomical Telescopes + Instrumentation, Edinburgh, UK 07/2016
8. SPIE Optics + Photonics, San Diego, CA 08/2018

Publication List

Total Citations: 739

FIRST-AUTHOR / SIGNIFICANT CONTRIBUTIONS

1. **P. Gatkine** et al. *Potential of commercial SiN MPW platforms for developing mid/high-resolution integrated photonic spectrographs for astronomy*, Applied Optics, 60(19), D15-D32, (2021) arXiv/ Journal
2. **P. Gatkine** et al. *The CGM-GRB Study II: Outflow-Galaxy Connection at* $z \sim 2-6$, Submitted to ApJ, arXiv
3. **P. Gatkine**, S. Vogel, S. Veilleux, *New Radio constraints on the obscured star formation rates of massive GRB hosts at* $z \sim 2-3.5$, The Astrophysical Journal, 897, 2020, p 1-9 arXiv Link
4. **P. Gatkine**, S. Veilleux, A. Cucchiara, *The CGM-GRB Study I. Uncovering The CircumGalactic Medium around GRB hosts at redshifts 2−6*, The Astrophysical Journal, 884 66, 2019, p 1-42 arXiv Link
5. **P. Gatkine**, S. Veilleux, M. Dagenais, *Astrophotonic Spectrographs*, Applied Sciences, 9(2):290-307 (2019) arXiv Link
6. **P. Gatkine** et al. *Arrayed waveguide grating spectrometers for astronomical applications: New results*, Optics Express, 25(15):17918−17935 (2017) arXiv Link
7. Y. Hu, Y. Zhang, **P. Gatkine** et al. *Characterization of low-loss waveguides using Bragg gratings*, IEEE Journal of Selected Topics in Quantum Electronics, 24(4):1-8 (2018) Paper Link
8. T. Zhu, Y. Hu, **P Gatkine** et al. *Arbitrary on-chip optical filter using complex waveguide Bragg gratings*, Applied Physics Letters, 108 (101104):1-5 (2016). Paper Link
9. T. Zhu, Y. Hu, **P. Gatkine** et al. *Ultrabroadband high-coupling-efficiency fiber-to-waveguide coupler using* Si_3N_4/SiO_2 *waveguides on Silicon*, IEEE Photonics Journal, 8(5):1-12 (2016) Paper Link
10. **P. Gatkine**, B. Kumar, *Dynamical modeling and resonance frequency analysis of 3.6 m optical telescope pier*, International Journal of Structural & Civil Engg. Research, 3(1):1-12 (2014) Paper Link

Conference Full Papers

11. **P. Gatkine** et al. *An on-chip astrophotonic spectrograph with a resolving power of 12,000*, Proceedings of SPIE Volume 11819, article ID 118190I, 2021, page 1-10 Link
12. **P. Gatkine** et al. *Development of an integrated near-IR astrophotonic spectrograph*, Proceedings of SPIE Volume 11451, article ID 114516L, 2020, page 1-7 Link
13. **P. Gatkine** et al. *Towards a multi-input astrophotonic AWG spectrograph*, Proceedings of SPIE Volume 10706, article ID 1070656, 2018, page 1-8 arXiv Link
14. Y. Hu, Y. Zhang, **P. Gatkine** et al. *An efficient approach to characterize low-loss waveguides using Bragg gratings*, Conference on Lasers and Electro-Optics, OSA, paper JW2A.65 (2018) Paper Link
15. **P. Gatkine**, G. Zimerman, E. Warner *A do-it-yourself spectrograph kit for educational outreach in optics and photonics*, Proceedings of SPIE Volume 10741, article ID 107410S, 2018, page 1-7 arXiv Link
16. **P. Gatkine** et al. *Development of high-resolution arrayed waveguide grating spectrometers for astronomical applications: first results*, Proc. of SPIE Volume 9912, article ID 991271, 2016, p 1-12 arXiv

    Best Student Presentation Award at SPIE Astronomical Instruments + Telescopes, 2016
17. **P. Gatkine**, K. P. Ray, *New method for asteroid shape detection using spherical segmentation based delay-Doppler analysis*, International Radar Symposium, India 2013 Paper Link

18. **P. Gatkine** et al. *Development of piezo-electric sensor based noninvasive low cost Arterial Pulse Analyzer*, Biomedical Engineering International Conference, 2013, page 1-4 Paper Link

WHITE PAPERS (ASTRO 2020)

1. **P. Gatkine** et al. *Astro2020: Astrophotonics White Paper*, Submitted to the National Academy of Sciences for Astro 2020 Decadal Survey, Bulletin of American Astronomical Society, 51g.285G, 2019, p 1-14 arXiv Link
2. N. Jovanovic et al. (incl. **P. Gatkine**) *Enabling the next generation of scientific discoveries by embracing photonic technologies*, Submitted to the National Academy of Sciences for Astro 2020 Decadal Survey, Bulletin of American Astronomical Society, 51g.270J, 2019, p 1-16 arXiv Link
3. S. Heap, et al. (incl. **P. Gatkine**) *The Probe-class mission concept, Cosmic Evolution Through UV Surveys (CETUS)*, Submitted to the National Academy of Sciences for Astro 2020 Decadal Survey, Bulletin of American Astronomical Society, 51g.159H, 2019, p 1-15 Paper Link

CO-AUTHORED PAPERS

1. T. Ahumada et al. (incl. **P. Gatkine**) *Discovery and confirmation of the shortest gamma-ray burst from a collapsar*, Nature Astronomy, 2021 Link
2. B. O'Connor et al. (incl. **P. Gatkine**) *A tale of two mergers: constraints on kilonova detection in two short GRBs at $z \sim 0.5$*, MNRAS 502(1) 1279, 2021 Link
3. A. Thakur et al. (incl. **P. Gatkine**) *A search for optical and near-infrared counterparts of the compact binary merger GW190814*, MNRAS, 499(3) 3868, 2020 Link
4. I. Andreoni et al. (incl. **P. Gatkine**) *GROWTH on S190814bv: Deep Synoptic Limits on the Optical/Near-Infrared Counterpart to a Neutron Star-Black Hole Merger*, Astrophysical Journal 890 131, 2020 arXiv Link
5. Y. Yao et al. (incl. **P. Gatkine**) *ZTF Early Observations of Type Ia Supernovae I: Properties of the 2018 Sample*, Astrophysical Journal 886 152, 2019, arXiv Link
6. M. Kasliwal et al. (incl. **P. Gatkine**) *Kilonova Luminosity Function Constraints Based on Zwicky Transient Facility Searches for 13 Neutron Star Merger Triggers during O3* , Astrophysical Journal 905(2) 145, 2020, arXiv Link
7. M. Coughlin et al. (incl. **P. Gatkine**) *GROWTH on GW190425: Searching thousands of square degrees to identify an optical or infrared counterpart to a binary neutron star merger with the ZwickyTransient Facility and Palomar Gattini IR* Astrophysical Journal Letters, 885 L19, 2019 arXiv Link
8. I. Andreoni et al. (incl. **P. Gatkine**) *GROWTH on S190510g: DECam observation planning and follow-Up of a distant binary neutron-star merger candidate*, Astrophysical Journal Letters, 881 L16, 2019, page 1-11 arXiv Link
9. D. Goldstein et al. (incl. **P. Gatkine**) *GROWTH on S190426c. II. Real-Time search for a counterpart to the probable neutron star-black hole merger using an automated difference imaging pipeline for DECam*, Astrophysical Journal Letters, 881 L7, 2019, page 1-9 arXiv Link
10. T. Hung et al. (incl. **P. Gatkine**) *Discovery of highly blueshifted broad Balmer and metastable Helium absorption lines in a tidal disruption event*, Astrophysical Journal, 879 119, 2019, p 1-17 arXiv Link
11. E. Troja et al. (incl. **P. Gatkine**) *A luminous blue kilonova and an off-axis jet from a compact binary merger at z= 0.1341*, Nature Communications, 9, 4089, 2018, page 1-10 arXiv Link

12. R. Lunnan et al. (incl. **P. Gatkine**) *A UV resonance line echo from a shell around a hydrogen-poor superluminous supernova*, Nature Astronomy, 2:887-895 (2018) arXiv Link

13. R. Lynch et al. (incl. **P. Gatkine**) *The Green Bank North Celestial Cap Pulsar Survey. III. 45 New Pulsar Timing Solutions* The Astrophysical Journal, 859(2), 93, 2018, page 1-19 arXiv Link

ASTRONOMICAL CIRCULARS

1. S. van Velzen et al. (incl. **P. Gatkine**) *Classification of AT2019azh as an Eddington-limited tidal disruption flare*, 2019, ATel 12568.1V

2. I. Andreoni et al. (incl. **P. Gatkine**) *LIGO/Virgo S190510g: Optical Counterpart Candidates from DECam-GROWTH*, 2019, GCN 24467.1A

3. S. B. Cenko et al. (incl. **P. Gatkine**) *LIGO/Virgo S190426c: Discovery Channel Telescope Follow-Up of ZTF19aassfws*, 2019, GCN 24430.1C

4. M. Coughlin et al. (incl. **P. Gatkine**) *LIGO/Virgo S190426c: Optical Wide-field Search with the Zwicky Transient Facility*, 2019, GCN 24283.1C

5. S. Dichiara, **P. Gatkine** et al. *LIGO/Virgo S190425z: DCT ZTF19aarykkb spectroscopy*, 2019, GCN 24220.1D

6. S. Dichiara, **P. Gatkine** et al. *GRB 190106A: DCT observations*, 2019, GCN 23744.1D

PATENT APPLICATIONS

1. N. Jovanovic, J. Jewell, **P. Gatkine**, et al. Provisional Patent Application (63/250,424)
Broadband All-Photonic Spectrum Flattener For Optical Frequency Combs

2. **P. Gatkine**, S. Balasubramanian Indian Patent Office (2929/MUM/2015)
An apparatus for measuring cosmic ray flux in a radiosonde telemetry system, and a method thereof

3. S. Noronha, S. Poojary, **P. Gatkine** USPTO (US20190175031A1)
Hand-based blood pressure measurement system, apparatus, and method