# J. Andrew Casey-Clyde

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## Biosketch

J. Andrew Casey-Clyde is a doctoral candidate at the University of Connecticut and visiting researcher at Yale University. His research focuses on gravitational waves from merging supermassive black holes. He is directly mentoring one undergraduate student on this research and regularly supports the mentorship of four other undergraduates with related research topics. In addition to research, Andrew is passionate about teaching physics. He considers broadly accessible explanations of topics in physics to be crucial for teaching a diverse student body.

## Experience

### Academia

**Yale University** **New Haven, CT**
*Visiting Assistant in Research* *2023–present*

- Primary mentor for an undergraduate student researcher on methods in computational astrophysics.
- Assisting in research mentorship of four additional undergraduates.
- Developing novel models of supermassive black hole binaries and their gravitational wave signals.
- Lead search for discreteness in the gravitational wave background for the NANOGrav collaboration.

**University of Connecticut** **Storrs, CT**
*Graduate Assistant* *2019–2023*

- Taught undergraduate physics labs in mechanics and electromagnetism, and for non-STEM majors.
- Received letter of recognition for excellence in teaching in the Fall 2020 semester.
- Mentored an undergraduate student researcher on methods in computational astrophysics.
- Developed multi-messenger models of supermassive black hole binaries.

**San José State University** **San Jose, CA**
*Graduate Research and Teaching Associate* *2016–2019*

- Taught undergraduate physics labs, including mechanics and electromagnetism.
- Analyzed kinematics of gas observed in the central 5 pc around Sagittarius A*.

### Industry

**Salient Process, Inc.** **Sacramento, CA**
*Software Engineer* *2015–2016*

- Developed and maintained both internal and client-facing software.

## Education

**University of Connecticut** — **Storrs, CT**
*Ph.D. Physics, GPA: 3.791* — *2019–present*
*Advisor:* Chiara M. F. Mingarelli

**University of Connecticut** — **Storrs, CT**
*M.S. Physics* — *2019–2023*
Awarded en route to Ph.D.

**San José State University** — **San Jose, CA**
*M.S. Physics, GPA: 3.791* — *2016–2019*
Computational concentration
*Advisors:* Elisabeth A.C. Mills, Aaron Romanowsky

**University of California, Davis** — **Davis, CA**
*B.S. Physics, GPA: 2.945* — *2010–2014*
Astrophysics emphasis

## Ph.D. Thesis Proposal

**Title**: *Characterizing Gravitational Wave Background Anisotropies with Multimessenger Supermassive Black Hole Binary Models*

**Advisors**: Chiara M. F. Mingarelli, Jonathan R. Trump, Daniel Anglés-Alcázar

**Description**: I have proposed to place multi-messenger constraints on supermassive black hole binary (SMBHB) populations and anisotropy in the gravitational wave background. This work builds on my previous research, in which I developed a quasar-based model of SMBHBs and placed multi-messenger constraint on their population. For my thesis I will predict anisotropy in the gravitational wave background. To do so I will combine the constraints I previously placed on SMBHBs with an all-sky survey of galaxies – some of which likely host a SMBHB – to simulate real gravitational wave skies.

## Master's Thesis

**Title**: *Integrated Kinematic Fitting of Gas Streams in the Milky Way's Circumnuclear Disk*

**Supervisors**: Elisabeth A. C. Mills, Aaron Romanowsky

**Description**: I developed a numerically integrated orbital model for the central regions of the Milky Way, accounting for the distribution of mass in the galactic center. Using this model I then constrained the position of a highly linear, dense molecular gas structure near our galaxy's central supermassive black hole.

## Memberships

**UConn Physics Graduate Student Association**

*Member* — *2023–present*

*Event Coordinator* — *2019–2020, 2022–2023*

**NANOGrav**

*Full Member* — *2023–present*

*Associate Member* — *2021–2023*

**American Astronomical Society**

*Graduate Student Member* — *2018–present*

**American Physical Society**

*Graduate Student Member* — *2018–present*

## Computer Skills

| | Level | Skill | Years | Comment |
|---|---|---|---|---|
| **Language:** | ■■■■■ | Python | 9 | *Extensive professional use, primary language used.* |
| | ■■■□□ | SLURM | 4 | *Used both with stand-alone python scripts and to host Jupyter Lab environments.* |
| | ■■□□□ | SQL | 2 | *Primarily used with SDSS SkyServer.* |
| | ■■□□□ | C++ | 1 | *Academic use and experience.* |
| | ■■□□□ | C | 1 | *Academic use and experience.* |
| **Software:** | ■■■■□ | Jupyter Lab | 5 | *Primary development environment.* |
| | ■■■■□ | Spyder | 8 | *Alternate development environment.* |
| **OS:** | ■■■■□ | macOS | 4 | *Primary OS used for professional work.* |
| | ■■■■□ | Linux | 6 | *Currently used for HPC interactions. Previous primary OS.* |
| | ■■■□□ | Windows | 15 | *Academic and industry use.* |

■□□□□ basic knowledge

■■□□□ intermediate knowledge with some project experience

■■■□□ extensive project experience

■■■■□ deepened expert knowledge

■■■■■ expert / specialist

# Publications

## Published

[1] Johnson, Aaron D., [...], **Casey-Clyde, J. Andrew**, et al. May 2024. "NANOGrav 15-Year Gravitational-Wave Background Methods". *Physical Review D* 109, p. 103012.

[2] Davis, Megan C., [...], **Casey-Clyde, J. Andrew**, et al. Apr. 2024. "Reliable Identification of Binary Supermassive Black Holes from Rubin Observatory Time-domain Monitoring". *The Astrophysical Journal* 965, p. 34.

[3] Agazie, Gabriella, [...], **Casey-Clyde, J. Andrew**, et al. Mar. 2024. "The NANOGrav 12.5 Yr Data Set: A Computationally Efficient Eccentric Binary Search Pipeline and Constraints on an Eccentric Supermassive Binary Candidate in 3C 66B". *The Astrophysical Journal* 963, p. 144.

[4] Agazie, Gabriella, [...], **Casey-Clyde, J. Andrew**, et al. Mar. 2024. "The NANOGrav 12.5 Yr Data Set: Search for Gravitational Wave Memory". *The Astrophysical Journal* 963, p. 61.

[5] Agazie, Gabriella, [...], **Casey-Clyde, J. Andrew**, et al. Mar. 2024. "The NANOGrav 15 Yr Data Set: Search for Transverse Polarization Modes in the Gravitational-wave Background". *The Astrophysical Journal* 964, p. L14.

[6] Bécsy, Bence, [...], **Casey-Clyde, J. Andrew**, et al. Dec. 2023. "How to Detect an Astrophysical Nanohertz Gravitational Wave Background". *The Astrophysical Journal* 959, p. 9.

[7] Agazie, Gabriella, [...], **Casey-Clyde, J. Andrew**, et al. Oct. 2023. "The NANOGrav 15 Yr Data Set: Search for Anisotropy in the Gravitational-wave Background". *The Astrophysical Journal* 956, p. L3.

[8] Khusid, Nicole M., [...], **Casey-Clyde, J. Andrew**, et al. Sept. 2023. "Strongly Lensed Supermassive Black Hole Binaries as Nanohertz Gravitational-wave Sources". *The Astrophysical Journal* 955, p. 25.

[9] Agazie, Gabriella, [...], **Casey-Clyde, J. Andrew**, et al. Aug. 2023. "The NANOGrav 15 Yr Data Set: Constraints on Supermassive Black Hole Binaries from the Gravitational-wave Background". *The Astrophysical Journal* 952, p. L37.

[10] Agazie, Gabriella, [...], **Casey-Clyde, J. Andrew**, et al. July 2023. "The NANOGrav 15 Yr Data Set: Bayesian Limits on Gravitational Waves from Individual Supermassive Black Hole Binaries". *The Astrophysical Journal* 951, p. L50.

[11] Arzoumanian, Zaven, [...], **Casey-Clyde, J. Andrew**, et al. July 2023. "The NANOGrav 12.5 Yr Data Set: Bayesian Limits on Gravitational Waves from Individual Supermassive Black Hole Binaries". *The Astrophysical Journal* 951, p. L28.

[12] Falxa, M., [...], **Casey-Clyde, J. A.**, et al. June 2023. "Searching for Continuous Gravitational Waves in the Second Data Release of the International Pulsar Timing Array". *Monthly Notices of the Royal Astronomical Society* 521, pp. 5077–5086.

[13] Koss, Michael J., [...], **Casey-Clyde, J. Andrew**, et al. Jan. 2023. "UGC 4211: A Confirmed Dual Active Galactic Nucleus in the Local Universe at 230 Pc Nuclear Separation". *The Astrophysical Journal* 942, p. L24.

[14] Mingarelli, Chiara M. F. and **Casey-Clyde, J. Andrew**. Nov. 2022. "Seeing the Gravitational Wave Universe". *Science* 378, pp. 592–593.

[15] Antoniadis, J., [...], **Casey-Clyde, J. A.**, et al. Mar. 2022. "The International Pulsar Timing Array Second Data Release: Search for an Isotropic Gravitational Wave Background". *Monthly Notices of the Royal Astronomical Society* 510, pp. 4873–4887.

[16] **Casey-Clyde, J. Andrew** et al. Jan. 2022. "A Quasar-based Supermassive Black Hole Binary Population Model: Implications for the Gravitational Wave Background". *The Astrophysical Journal* 924, p. 93.

### Submitted

[1] **Casey-Clyde, J. Andrew** et al. May 2024. *Quasars Can Signpost Supermassive Black Hole Binaries*. arXiv: 2405.19406 [astro-ph].

[2] Agazie, Gabriella, [...], **Casey-Clyde, J. Andrew**, et al. Apr. 2024. *The NANOGrav 15 Yr Data Set: Looking for Signs of Discreteness in the Gravitational-wave Background*. arXiv: 2404.07020 [astro-ph].

### White Papers

[1] Haiman, Zoltán, [...], **Casey-Clyde, J. Andrew**, et al. June 2023. *Massive Black Hole Binaries as LISA Precursors in the Roman High Latitude Time Domain Survey*.

[2] Shen, Yue **Casey-Clyde, J. Andrew** et al. June 2023. *Discovery and Characterization of Galactic-scale Dual Supermassive Black Holes Across Cosmic Time*.

## Presentations

### Talks

[1] **Casey-Clyde, J. Andrew**. Jan. 2024. *Quasars Can Signpost Supermassive Black Hole Binaries*. Contributed Talk. New Orleans, Louisiana.

[2] **Casey-Clyde, J. Andrew**. Dec. 2023. *Multi-Messenger Constraints on Supermassive Black Hole Binaries*. Invited Talk. Pittsburgh, Pennsylvania.

[3] **Casey-Clyde, J. Andrew**. Dec. 2023. *Quasars Can Signpost Supermassive Black Hole Binaries*. Contributed Talk. Miami, Florida.

[4] **Casey-Clyde, J. Andrew**. Oct. 2023. *Interpreting Power-Law Excursions in Nanohertz Gravitational-Wave Background Spectra*. Contributed Talk. Vancouver, British Colombia, Canada.

[5] **Casey-Clyde, J. Andrew**. July 2023. *How Many Quasars Host Supermassive Black Hole Binary Systems?* Contributed Talk.

[6] **Casey-Clyde, J. Andrew**. June 2023. *How Many Quasars Host SMBHB Systems?* Contributed Talk. Port Douglas, Australia.

[7] **Casey-Clyde, J. Andrew**. Mar. 2023. *How Many Quasars Host Supermassive Black Hole Binary Systems?* Contributed Talk.

[8] **Casey-Clyde, J. Andrew**. Mar. 2023. *Interpreting Nanohertz Gravitational-Wave Background Spectra*. Contributed Talk. Corvallis, Oregon.

[9] **Casey-Clyde, J. Andrew**. Feb. 2023. *How Many Quasars Host Supermassive Black Hole Binaries?* Invited Talk. Storrs, Connecticut.

[10] **Casey-Clyde, J. Andrew**. Jan. 2023. *How Many Quasars Host Supermassive Black Hole Binaries?* Contributed Talk. Seattle, Washington.

[11] **Casey-Clyde, J. Andrew**. Oct. 2022. *How Many Quasars Host Supermassive Black Hole Binaries?* Contributed Talk. Milwaukee, Wisconsin.

[12] **Casey-Clyde, J. Andrew**. July 2022. *Quantifying the Relationship Between Supermassive Black Hole Binaries and Quasars Using Pulsar Timing Arrays.* Contributed Talk. Nashville, Tennessee, United States.

[13] **Casey-Clyde, J. Andrew**. July 2022. *Quantifying the Relationship Between Supermassive Black Hole Binaries and Quasars Using Pulsar Timing Arrays.* Contributed Talk.

[14] **Casey-Clyde, J. Andrew**. June 2022. *A Quasar-Based Supermassive Black Hole Binary Population Model: Implications for the Gravitational-Wave Background*. Contributed Talk. Pasadena, California, United States.

[15] **Casey-Clyde, J. Andrew**. June 2022. *Quantifying the Relationship Between Supermassive Black Hole Binaries and Quasars Using Pulsar Timing Arrays.* Contributed Talk.

[16] **Casey-Clyde, J. Andrew**. Apr. 2022. *A Quasar-Based Supermassive Black Hole Binary Population Model: Implications for the Gravitational-Wave Background*. Contributed Talk. New York, New York, United States.

[17] **Casey-Clyde, J. Andrew**. Mar. 2022. *Quantifying the Relationship Between Supermassive Black Hole Binaries and Quasars Using Pulsar Timing Arrays.* Contributed Talk. New York, New York, United States.

[18] **Casey-Clyde, J. Andrew**. Dec. 2021. *An AGN-based Supermassive Black Hole Binary Population Model: Implications for the Gravitational-Wave Background*. Contributed Talk.

[19] **Casey-Clyde, J. Andrew**. Sept. 2021. *Anchoring Supermassive Black Hole Binaries to Quasars with the Gravitational-Wave Background*. Contributed Talk. Center for Computational Astronomy, Flatiron Institute, New York, New York.

[20] **Casey-Clyde, J. Andrew**. July 2021. *Anchoring Supermassive Black Hole Binaries to Active Galactic Nuclei with the Gravitational-Wave Background*. Contributed Talk.

[21] **Casey-Clyde, J. Andrew**. June 2021. *Anchoring Supermassive Black Hole Binaries to Active Galactic Nuclei with the Gravitational Wave Background*. Contributed Talk.

[22] **Casey-Clyde, J. Andrew**. Apr. 2021. *Interpreting the Gravitational Wave Background in Terms of Supermassive Black Hole Binary Populations*. Contributed Talk.

[23] **Casey-Clyde, J. Andrew**. Oct. 2020. *Interpreting the Gravitational-Wave Background in Terms of Supermassive Black Hole Binary Populations*. Contributed Talk.

[24] **Casey-Clyde, J. Andrew**. Sept. 2020. *Constraining Supermassive Black Hole Binary Populations with PTAs*. Contributed Talk.

[25] **Casey-Clyde, J. Andrew**. July 2020. *Constraining Supermassive Black Hole Binary Populations with PTAs*. Invited Talk.

### Posters

[1] **Casey-Clyde, J. Andrew**. Nov. 2021. *A Quasar-Based Model of Supermassive Black Hole Binaries*. Poster. Windsor Locks, CT, USA.

[2] **Casey-Clyde, J. Andrew**. July 2021. *Anchoring Supermassive Black Hole Binaries to Active Galactic Nuclei with the Gravitational-Wave Background*. Poster.

[3] **Casey-Clyde, J. Andrew**. June 2021. *Interpreting the Gravitational Wave Background in Terms of Supermassive Black Hole Binary Populations*. Poster.

[4] **Casey-Clyde, J. Andrew**. Jan. 2021. *Interpreting the Gravitational-Wave Background in Terms of Supermassive Black Hole Binary Populations*. iPoster.

[5] **Casey-Clyde, J. Andrew**, Thummar, H., and Donet, J. Jan. 2019. *Galaxy Classification with Neural Networks in SDSS*. Seattle, WA, USA.

[6] **Casey-Clyde, J. Andrew**. Jan. 2018. *Mapping Gas Orbits in the Circumnuclear Disk*. Poster. Washington, D.C., USA.

[7] **Casey-Clyde, J. Andrew**. Aug. 2017. *Kinematics of the Eastern Arm in the Circumnuclear Disk*. Poster. Quy Nhon, Vietnam.

## Outreach

**Skyscrapers Amateur Astronomical Society** — **North Scituate, RI**
*Seagrave Observatory* — *May 2024*
Low Frequency Gravitational Waves: A New View of the Universe

**Astronomy on Tap** — **Storrs, CT**
*Hops 44* — *November 2023*
Gravitational Waves and Multi-Messenger Astronomy

**Astronomy on Tap** — **Storrs, CT**
*Hops 44* — *August 2023*
Supermassive Black Holes: A Crash Course on the Biggest Objects in the Universe

**Astrophysical Speaker Series** — **Worcester, MA**
*Ecotarium* — *May 2023*
Low Frequency Gravitational Waves: A New View of the Universe

**Virtual Inventors Club** — **Virtual**
*Connecticut Invention Convention* — *January 2022*
Provided project mentorship to middle school-age student inventors.