

Michael Josef Tremmel, PhD

NSF Postdoctoral Fellow
Department of Astronomy, Yale University
Office and Mail: 52 Hillhouse Avenue
New Haven, CT 06511

Phone: (224) 577-8525
Email: michael.tremmel at yale dot edu
Homepage: <http://mtremmel.github.io>
Birth Date: January 22, 1989
Citizenship: United States of America

Major Research Interests

- Cosmological simulations of galaxy evolution; Supermassive black holes (SMBHs)
- Co-evolution of galaxies and SMBHs
- Star formation regulation; Galaxy quenching; High mass galaxy evolution
- Galaxy and SMBH mergers; Dynamics of SMBHs; Dual Active Galactic Nuclei; Gravitational waves

Education

B.A. Physics and Mathematics, Northwestern University, 2011.

Senior Honors Thesis: The Evolution of the Normal Galaxy X-Ray Luminosity Function

Adviser: Vicky Kalogera

Ph.D. Astronomy, University of Washington, July 2017. (M.S. 2013)

Thesis: Modeling Supermassive Black Holes in Cosmological Simulations

Adviser: Fabio Governato and Tom Quinn

Academic Positions

Sept. 2020 - Sept. 2023: NSF Astronomy and Astrophysics Postdoctoral Fellow, Yale University

Sept. 2017 - Sept. 2020: YCAA Postdoctoral Fellow, Yale University

April 2016 - Present: Member of the SAMI collaboration

Sept. 2011 - Present: Member of the N-body Shop Collaboration

Sept. 2011 - August 2017: Research and Teaching Assistant, University of Washington

Oct. 2007 - June 2011: Undergraduate Researcher, Northwestern University

Awards and Fellowships

- National Science Foundation Astronomy and Astrophysics Postdoctoral Fellowship (2020 - 2023)
- Yale Center for Astronomy and Astrophysics Fellowship (2017 - 2020)
- Achievement Rewards for College Scientists (ARCS) fellowship (2011 - 2014)
- Outstanding Junior in Physics and Astronomy at Northwestern (2010)
- Illinois Space Grant Consortium Scholarship (2008 - 2009, 2010 - 2011)
- J.G. Nolan and Henry Crew/Welch Scholarships for outstanding academic performance (2008 - 2011)

Professional Services

- Referee for Monthly Notices of the Royal Astronomical Society (MNRAS), The Astrophysical Journal (ApJ), and The Journal of Open Source Software (JOSS)
- Creator and developer of the publicly available code, ICInG, which generates initial conditions for a cosmologically collapsing, isolated halo (github.com/N-BodyShop/ICInG)
- Contributor to pynbody, an open source simulation analysis code (github.com/pynbody/pynbody)

- Co-developer of TANGOS, a database tool that ingests, calculates, and stores various properties of simulated galaxies and dark matter halos (github.com/pynbody/tangos).
- Developer for CHANGA, the massively parallel tree+SPH code (github.com/N-BodyShop/changa)
- Member of Yale TAC for Keck and Palomar telescopes, 4 cycles
- Proposal Reviewer for Subaru
- Proposal Reviewer for DiRAC HPC allocations
- Member of the Astronomy Climate and Diversity Committee at Yale
- Involved in drafting of the Yale Astronomy Department five year diversity, equity, and inclusion plan
- Founder of the Inclusion, Diversity, and Equity in Astronomy Journal Club at Yale
- Led the creation of a code of conduct for the N-body Shop international collaboration (nbody.shop)

Teaching and Mentoring

- Instructor (2013), Academic Mentor (2014), and administrative staff (2011-2017) for the Pre-Major in Astronomy Program at the University of Washington. The materials I developed for the research methods course can be found here [[click to view](#)]
- Teaching Assistant for Astronomy 101 (Intro to Astronomy), 150 (The Planets), and 115 (Astrobiology) at the University of Washington
- Substitute lecturer for Astronomy 150, University of Washington
- Substitute lecturer for two graduate courses at Yale (Physics of Astrophysics and Cosmology)
- Guest lecturer for undergraduate courses “Frontiers and Controversies in Astrophysics” and “Gravity, Astrophysics, and Cosmology” at Yale
- Guest lecturer for Yale Summer Program in Astrophysics (high school students)
- Extensive experience mentoring high school, undergraduate, and graduate students with research. I have mentored several PhD students both locally and remotely on projects central to their thesis work.

Outreach

- Five public lectures through Astronomy on Tap (AoT) Seattle, AoT New Haven, and Seattle Science Slam. One of my AoT talks can be viewed on YouTube [[click to view](#)]
- Society of Physics Students, Northwestern Chapter, President (2010-2011), General Officer (2009-2010)
- Demonstrator for the ‘Yuri’s Night’ public event for kids at Leitner Observatory, Yale University.
- Publicly available interviews for Event Horizon and Universe University [[click names to visit websites](#)]

Selected Talks

18 Contributed Conference Talks

- 50 Years of X-ray Binaries (Boston, 2012)
- KITP: Massive Black Holes: Birth, Growth and Impact (Santa Barbara, 2013)
- AAS Winter Meeting (Seattle, 2015/2019)
- South by High Redshift (Austin, 2015)
- UCSC Galaxy Workshop (Santa Cruz, 2015/2016/2018/2019)
- The Great Lakes Cosmology and Galaxies Conference (Hamilton, 2016)
- AGN Winds on the Georgia Coast (Jekyll Island, 2017)
- RAS Meeting: The link between AGN and Galaxy Formation (London, 2017)
- SnowCluster (Salt Lake City, 2018)
- NERQUAM, Yale University (New Haven, 2018)
- Massive Black Holes in Evolving Galaxies (Paris, 2018)
- Thinkshop 2018: Feedback in Galaxies (Potsdam, 2018)
- What Matters Between Galaxies (Spineto, 2019)
- AAS Winter Meeting (Hawaii, 2020)

Invited talks, Seminars, and Colloquia

- “Dynamic Duos: SMBH Pairs in Merging Galaxies”, Invited Talk, JILA Astrophysics Seminar, University of Colorado at Boulder, November 2020
- “Dynamic Duos: SMBH Pairs in Merging Galaxies”, Invited Talk, *Exploring Supermassive Black Holes*, The Princeton Gravity Initiative, Princeton Center for Theoretical Science, October 2020
- “Dynamic Duos: SMBH Pairs in Merging Galaxies”, Invited Talk, *Getting Ready to Descend the Slippery Slope of Multi-Messenger Cosmological Black Hole Data*, Sexten Center for Astrophysics, February 2020.
- “Dynamic Duos: SMBH Pairs in Merging Galaxies”, Colloquium, Vanderbilt University, November 2019
- “Exploring Galaxy Evolution in Clusters with Unprecedented Resolution”, Seminar, Canadian Institute for Theoretical Astrophysics, November 2019
- “Exploring Galaxy Evolution in Clusters with Unprecedented Resolution”, Seminar, McMaster University, November 2019
- “Nature vs. Nurture: Ultra-Diffuse Galaxies in the RomulusC Galaxy Cluster Simulation”, Seminar, Space Telescope Science Institute, November 2019
- “Exploring Galaxy Evolution in Clusters with Unprecedented Resolution”, CCAPP Seminar, The Ohio State University, October 2019.
- “Dynamic Duos: SMBH Pairs in Merging Galaxies”, Astronomy Seminar, Carnegie Melon University, October 2019.

“Dancing to ChaNGa: The formation of supermassive black hole (SMBH) pairs in the Romulus simulations”, Colloquium, University of Kansas, February 2019.

“Dancing to ChaNGa: A Self-Consistent Prediction For Close SMBH Pair Formation Timescales Following Galaxy Mergers”, Colloquium, Goddard Space Flight Center, October 2018.

“Studying Galaxy Evolution in Clusters with RomulusC: A Cosmological Simulation of a Galaxy Cluster with Unprecedented Resolution”, Cosmology Seminar, Max Plank Institute for Astrophysics, September 2018

“A Song of Fire and Feedback: The Importance of AGN-driven Outflows in Quenching Star Formation in Massive Galaxies”, Colloquium, University of Heidelberg

“The RomulusC Simulation: Galaxy Evolution in Clusters at High Resolution”, CCA Galaxy Cluster Workshop, Center for Computational Astrophysics, May 2018

“Dancint to ChaNGa: The formation of supermassive black hole (SMBH) pairs in cosmological simulations”, YCAA Seminar, Yale University, January 2018.

“Dancing to ChaNGa: A Self-Consistent Prediction For Close SMBH Pair Formation Timescales Following Galaxy Mergers”, Astrophysics Seminar, American Museum of Natural History, November 2017.

“Supermassive Black Hole Mergers: Predictions from Cosmological Simulations”, Invited Talk, *The Universe Through Gravitational Waves*, Simons Center for Geometry and Physics, Stony Brook University, December 2016.

Publications

[Click here for my full ADS listing]

905 total citations, 38 total publications, h-index of 16

16 first and second author refereed or submitted publications

Refereed and Submitted Journal Articles

First Author Publications

1. **M. Tremmel**, A. C. Wright, A. M. Brooks, F. Munshi, D. Nagai, and T. R. Quinn. The formation of ultradiffuse galaxies in the RomulusC galaxy cluster simulation. *MNRAS*, 497(3):2786–2810, July 2020
2. **M. Tremmel**, T. R. Quinn, A. Ricarte, A. Babul, U. Chadayammuri, P. Natarajan, D. Nagai, A. Pontzen, and M. Volonteri. Introducing ROMULUSC: a cosmological simulation of a galaxy cluster with an unprecedented resolution. *MNRAS*, 483(3):3336–3362, Mar 2019
3. **M. Tremmel**, F. Governato, M. Volonteri, A. Pontzen, and T. R. Quinn. Wandering supermassive black holes in milky-way-mass halos. *The Astrophysical Journal Letters*, 857(2):L22, 2018
4. **M. Tremmel**, F. Governato, M. Volonteri, T. R. Quinn, and A. Pontzen. Dancing to CHANGA: a self-consistent prediction for close SMBH pair formation time-scales following galaxy mergers. *MNRAS*, 475:4967–4977, Apr. 2018
5. **M. Tremmel**, M. Karcher, F. Governato, M. Volonteri, T. R. Quinn, A. Pontzen, L. Anderson, and J. Bellovary. The Romulus cosmological simulations: a physical approach to the formation, dynamics and accretion models of SMBHs. *MNRAS*, 470:1121–1139, Sept. 2017
6. **M. Tremmel**, F. Governato, M. Volonteri, and T. R. Quinn. Off the beaten path: a new approach to realistically model the orbital decay of supermassive black holes in galaxy formation simulations. *MNRAS*, 451:1868–1874, Aug. 2015

7. **M. Tremmel**, T. Fragos, B. D. Lehmer, P. Tzanavaris, K. Belczynski, V. Kalogera, A. R. Basu-Zych, W. M. Farr, A. Hornschemeier, L. Jenkins, A. Ptak, and A. Zezas. Modeling the Redshift Evolution of the Normal Galaxy X-Ray Luminosity Function. *ApJ*, 766:19, Mar. 2013

Other Publications

1. J. M. Bellovary, S. Hayoune, K. Chaffa, D. Vincent, A. Brooks, C. Christensen, F. Munshi, **M. Tremmel**, T. R. Quinn, J. Van Nest, S. K. Sligh, and M. Luzuriaga. The Origins of Off-Center Massive Black Holes in Dwarf Galaxies. *arXiv e-prints*, page arXiv:2102.09566, Feb. 2021
2. T. Carleton, Y. Guo, F. Munshi, **M. Tremmel**, and A. Wright. An excess of globular clusters in Ultra-Diffuse Galaxies formed through tidal heating. *MNRAS*, 502(1):398–406, Mar. 2021
3. A. Cruz, A. Pontzen, M. Volonteri, T. R. Quinn, **M. Tremmel**, A. M. Brooks, N. N. Sanchez, F. Munshi, and A. Di Cintio. Self-interacting dark matter and the delay of supermassive black hole growth. *MNRAS*, 500(2):2177–2187, Jan. 2021
4. E. Applebaum, A. M. Brooks, C. R. Christensen, F. Munshi, T. R. Quinn, S. Shen, and **M. Tremmel**. Ultrafaint Dwarfs in a Milky Way Context: Introducing the Mint Condition DC Justice League Simulations. *ApJ*, 906(2):96, Jan. 2021
5. E. Barausse, I. Dvorkin, **M. Tremmel**, M. Volonteri, and M. Bonetti. Massive Black Hole Merger Rates: The Effect of Kiloparsec Separation Wandering and Supernova Feedback. *ApJ*, 904(1):16, Nov. 2020
6. R. S. Sharma, A. M. Brooks, R. S. Somerville, **M. Tremmel**, J. Bellovary, A. C. Wright, and T. R. Quinn. Black Hole Growth and Feedback in Isolated ROMULUS25 Dwarf Galaxies. *ApJ*, 897(1):103, July 2020
7. A. Ricarte, **M. Tremmel**, P. Natarajan, and T. Quinn. A Link between Ram Pressure Stripping and Active Galactic Nuclei. *ApJ*, 895(1):L8, May 2020
8. N. N. Sanchez, **M. Tremmel**, J. K. Werk, A. Pontzen, C. Christensen, T. Quinn, S. Loebman, and A. Cruz. One-Two Quench: A Double Minor Merger Scenario. *ApJ*, In Press, arXiv:2009.05581, March 2021
9. A. C. Wright, **M. Tremmel**, A. M. Brooks, F. Munshi, D. Nagai, R. S. Sharma, and T. R. Quinn. The Formation of Isolated Ultra-Diffuse Galaxies in Romulus25. *MNRAS*, In Press, arXiv:2005.07634, March 2021
10. U. Chadayammuri, **M. Tremmel**, D. Nagai, A. Babul, and T. Quinn. Fountains and storms: The role of AGN and mergers in disrupting the cool-core in the RomulusC simulation. *arXiv e-prints*, page arXiv:2001.06532, Jan. 2020
11. N. N. Sanchez, J. K. Werk, **M. Tremmel**, A. Pontzen, C. Christensen, T. Quinn, and A. Cruz. Not So Heavy Metals: Black Hole Feedback Enriches the Circumgalactic Medium. *ApJ*, 882(1):8, Sep 2019
12. I. S. Butsky, J. N. Burchett, D. Nagai, **M. Tremmel**, T. R. Quinn, and J. K. Werk. Ultraviolet signatures of the multiphase intracluster and circumgalactic media in the ROMULUSC simulation. *MNRAS*, 490(3):4292–4306, Dec. 2019
13. A. Ricarte, **M. Tremmel**, P. Natarajan, and T. Quinn. Tracing black hole and galaxy co-evolution in the ROMULUS simulations. *MNRAS*, 489(1):802–819, Oct 2019
14. T. T. Ananna, E. Treister, C. M. Urry, C. Ricci, A. Kirkpatrick, S. LaMassa, J. Buchner, F. Civano, **M. Tremmel**, and S. Marchesi. The Accretion History of AGNs. I. Supermassive Black Hole Population Synthesis Model. *ApJ*, 871(2):240, Feb 2019

15. U. Banik, F. C. van den Bosch, **M. Tremmel**, A. More, G. Despali, S. More, S. Vegetti, and J. P. McKean. Constraining the mass density of free-floating black holes using razor-thin lensing arcs. *MNRAS*, 483(2):1558–1573, Feb 2019
16. J. M. Bellovary, C. E. Cleary, F. Munshi, **M. Tremmel**, C. R. Christensen, A. Brooks, and T. R. Quinn. Multimessenger Signatures of Massive Black Holes in Dwarf Galaxies. *MNRAS*, page 2713, Oct. 2018
17. A. Pontzen and **M. Tremmel**. TANGOS: The Agile Numerical Galaxy Organization System. *ApJS*, 237(2):23, Aug 2018
18. N. N. Sanchez, J. M. Bellovary, K. Holley-Bockelmann, **M. Tremmel**, A. Brooks, F. Governato, T. Quinn, M. Volonteri, and J. Wadsley. Preferential Accretion in the Supermassive Black Holes of Milky Way-size Galaxies Due to Direct Feeding by Satellites. *ApJ*, 860(1):20, Jun 2018
19. A. Di Cintio, **M. Tremmel**, F. Governato, A. Pontzen, J. Zavala, A. Bastidas Fry, A. Brooks, and M. Vogelsberger. A rumble in the dark: signatures of self-interacting dark matter in supermassive black hole dynamics and galaxy density profiles. *MNRAS*, 469:2845–2854, Aug. 2017
20. A. Pontzen, **M. Tremmel**, N. Roth, H. V. Peiris, A. Saintonge, M. Volonteri, T. Quinn, and F. Governato. How to quench a galaxy. *MNRAS*, 465:547–558, Feb. 2017
21. E. W. Lentz, T. R. Quinn, L. J. Rosenberg, and **M. J. Tremmel**. A New Signal Model for Axion Cavity Searches from N-body Simulations. *ApJ*, 845(2):121, Aug 2017
22. A. B. Fry, F. Governato, A. Pontzen, T. Quinn, **M. Tremmel**, L. Anderson, H. Menon, A. M. Brooks, and J. Wadsley. All about baryons: revisiting SIDM predictions at small halo masses. *MNRAS*, 452(2):1468–1479, Sep 2015
23. P. Tzanavaris, T. Fragos, **M. Tremmel**, L. Jenkins, A. Zezas, B. D. Lehmer, A. Hornschemeier, V. Kalogera, A. Ptak, and A. R. Basu-Zych. Modeling X-Ray Binary Evolution in Normal Galaxies: Insights from SINGS. *ApJ*, 774(2):136, Sep 2013
24. T. Fragos, B. Lehmer, **M. Tremmel**, P. Tzanavaris, A. Basu-Zych, K. Belczynski, A. Hornschemeier, L. Jenkins, V. Kalogera, A. Ptak, and A. Zezas. X-Ray Binary Evolution Across Cosmic Time. *ApJ*, 764(1):41, Feb 2013
25. T. Fragos, **M. Tremmel**, E. Rantsiou, and K. Belczynski. Black Hole Spin-Orbit Misalignment in Galactic X-ray Binaries. *ApJ*, 719(1):L79–L83, Aug 2010

Conference Proceedings, White Papers, and Non-Refereed Articles

1. M. Colpi, K. Holley-Bockelmann, T. Bogdanović, P. Natarajan, A. Sesana, **M. Tremmel**, J. Comerford, E. Barausse, E. Berti, M. Volonteri, F. M. Khan, S. T. McWilliams, S. Burke-Spolaor, and J. S. Hazboun. The Gravitational View of Massive Black Holes. *BAAS*, 51(3):383, May 2019
2. J. Bellovary, A. Brooks, M. Colpi, M. Eracleous, K. Holley-Bockelmann, A. Hornschemeier, L. Mayer, P. Natarajan, J. Slusky, and **M. Tremmel**. Where are the Intermediate Mass Black Holes? *BAAS*, 51(3):175, May 2019
3. J. Burchett, I. Butsky, **M. Tremmel**, R. Bordoloi, G. Bryan, Z. Cai, R. Canning, H.-W. Chen, A. Coil, D. Fielding, M. Fumagalli, S. D. Johnson, V. Khaire, K.-G. Lee, N. Lehner, N. Mand elker, J. O’Meara, S. Muzahid, D. Nelson, B. D. Oppenheimer, M. Postman, M. S. Peeples, T. Quinn, M. Rafelski, J. Ribaudó, K. Rubin, J. Stern, N. Tejos, S. Tonnesen, T. Tripp, Q. D. Wang, C. N. A. Willmer, and Y. Zheng. Ultraviolet Perspectives on Diffuse Gas in the Largest Cosmic Structures. *BAAS*, 51(3):534, May 2019

4. P. Natarajan, V. Baldassare, J. Bellovary, P. Bender, E. Berti, N. Cappelluti, A. Ferrara, J. Greene, Z. Haiman, K. Holley-Bockelmann, G. Mueller, F. Pacucci, D. Shoemaker, **M. Tremmel**, C. M. Urry, A. Vikhlinin, and M. Volonteri. Disentangling nature from nurture: tracing the origin of seed black holes. *BAAS*, 51(3):73, May 2019
5. S. Walker, D. Nagai, A. Simionescu, M. Markevitch, H. Akamatsu, M. Arnaud, C. Avestruz, M. Bautz, V. Biffi, S. Borgani, E. Bulbul, E. Churazov, K. Dolag, D. Eckert, S. Ettori, Y. Fujita, M. Gaspari, V. Ghirardini, R. Kraft, E. T. Lau, A. Mantz, K. Matsushita, M. McDonald, E. Miller, T. Mroczkowski, P. Nulsen, N. Okabe, N. Ota, E. Pointecouteau, G. Pratt, K. Sato, X. Shi, G. Tremblay, **M. Tremmel**, F. Vazza, I. Zhuravleva, E. Zinger, and J. ZuHone. Unveiling the Galaxy Cluster - Cosmic Web Connection with X-ray observations in the Next Decade. *BAAS*, 51(3):218, May 2019
6. M. Volonteri, M. Habouzit, F. Pacucci, and **M. Tremmel**. The evolution of high-redshift massive black holes. In S. Kaviraj, editor, *Galaxies at High Redshift and Their Evolution Over Cosmic Time*, volume 319 of *IAU Symposium*, pages 72–79, 2016
7. S. Garner, **M. J. Tremmel**, S. J. Schmidt, J. P. Wisniewski, and E. Agol. Evaluation of a College Freshman Diversity Research Program. *ArXiv: 1311.5486*, Nov. 2013

Last updated: March 5, 2021