M. Sten Delos

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RESEARCH INTERESTS

January 24, 2024

Dark matter and gravitational dynamics

Origins of matter and structure in the universe

PROFESSIONAL HISTORY

Sept. 2023-present	**Carnegie Observatories** CTAC Postdoctoral Fellow	Pasadena, CA, USA
Sept. 2020-Aug. 2023	**Max Planck Institute for Astrophysics** Postdoctoral Fellow	Garching, Germany
May 2020-Sept. 2020	**University of North Carolina at Chapel Hill** Postdoctoral Research Associate	Chapel Hill, NC, USA
Aug. 2016-May 2020	**University of North Carolina at Chapel Hill** Graduate Research Assistant Graduate Teaching Assistant	Chapel Hill, NC, USA
Jan. 2016-May 2016	**Guilford Technical Community College** Adjunct Instructor	Jamestown, NC, USA
Aug. 2010-May 2012	**State University of New York at Stony Brook** Graduate Teaching Assistant	Stony Brook, NY, USA

EDUCATION

May 2020	**University of North Carolina at Chapel Hill** Ph.D. in Physics Thesis: “Probing the early universe using dark matter minihalos” Advisor: Adrienne Erickcek	Chapel Hill, NC, USA
May 2015	**State University of New York at Stony Brook** M.A. in Physics	Stony Brook, NY, USA
May 2010	**University of Virginia** B.S. in Physics and Mathematics *with Highest Distinction*	Charlottesville, VA, USA

HONORS

2023 CTAC Fellowship

2020 MPA Postdoctoral Fellowship

2019 Dissertation Completion Fellowship (UNC-Chapel Hill)

2019 North Carolina Space Grant Graduate Research Fellowship

2019 Kenan Trust Graduate Student Research Grant (UNC-Chapel Hill)

2010 Sigma Pi Sigma Physics Honor Society

PROFESSIONAL SERVICE AND OUTREACH

Lecture: "The physical bases for the structures of collisionless dark matter halos."
Postdoc/staff lecture series on cosmology, MPA, May 2023,
https://wwwmpa.mpa-garching.mpg.de/~komatsu/lectureseries/2023.html.

Outreach article: "The lingering imprint of the first cosmic structures."
MPA Research Highlight, February 2023,
https://www.mpa-garching.mpg.de/1069215/hl202302.

Referee for *Monthly Notices of the Royal Astronomical Society*, *Physical Review D*, *Physical Review Letters*, and *Journal of Cosmology and Astroparticle Physics*.

Grant reviewer for *North Carolina Space Grant*.

Organizer of cosmology group meetings at the Max Planck Institute for Astrophysics.

Senior graduate student pre-candidacy mentoring team at UNC-Chapel Hill.

PRESENTATIONS

Invited Talks at International Conferences

"The smallest dark structures."
32nd Texas Symposium on Relativistic Astrophysics; Shanghai, China; December 2023.

"Prompt cusp formation from the cosmological initial conditions."
Mathematical Justification for the Kinetic and Fluid Equations of Plasmas and Self-Gravitating Systems; Marseille, France; July 2023.

"Density profiles of the first halos & microhalo evolution through stellar encounters."
News from the Dark 7; Montpellier, France; June 2022.

Other Invited Conference and Seminar Presentations

"Prompt cusps of dark matter."

- CERN-TH cosmology seminar; Geneva, Switzerland; January 2024.
- Astro-seminar at the University of Southern California; Los Angeles, CA, USA; October 2023.
- Cosmology and Gravitation seminar at the Perimeter Institute for Theoretical Physics; Waterloo, ON, Canada; October 2023.
- Astrophysics seminar at the University of North Carolina at Chapel Hill; Chapel Hill, NC, USA; August 2023.
- Astrophysical and Cosmological Relativity seminar at the Albert Einstein Institute; Postdam, Germany; May 2023
- Cosmology seminar at the Helsinki Institute of Physics; Helsinki, Finland; April 2023.
- Seminar at the Lorentz Institute; Leiden, The Netherlands; February 2023.
- Seminar at the Strasbourg Observatory; Strasbourg, France; February 2023.
- Particle and Astroparticle Theory Seminar at the Max Planck Institute for Nuclear Physics; Heidelberg, Germany; November 2022.
- SFB1258 Neutrinos and Dark Matter colloquium; Garching, Germany; October 2022.
- Cosmology Seminar at the Max Planck Institute for Astrophysics; Garching, Germany; September 2022.
- ICAP Meeting at the Institut d'Astrophysique de Paris; Paris, France; September 2022.

"Primordial black holes and ultradense halos."

- UCLA TEPAPP Seminar; Los Angeles, CA; May 2023
- Padova cosmology journal club; Padua, Italy; March 2023

"The structures of dark halos."

- Institute Seminar at the Max Planck Institute for Astrophysics; Garching, Germany; January 2023.

"Stellar streams and dark substructure."

- Munich Dark Matter Meeting; Munich, Germany; March 2022.
- Ringberg Meeting of the MPA Galaxy Group; Kreuth, Germany; July 2021.

"Observational signatures of early matter domination."

- Particle seminar at Carleton University; Ottawa, Canada; September 2021.

"Probing cosmology using dark matter microhalos."

- CGI Seminar at the University of California, Santa Cruz; Santa Cruz, CA, USA; April 2021.
- Joint Cambridge-LMU online cosmology workshop; January 2021.
- Fermilab CPC Seminar; Batavia, IL, USA; November 2020.
- Institute Seminar at the Max Planck Institute for Astrophysics; Garching, Germany; October 2020.
- Seminar at the Perimeter Institute; Waterloo, ON, Canada; February 2020.

"Predicting the dark matter distribution at the smallest scales."

- Munich/Garching *Dark Matter Day* mini-workshop; Garching, Germany; October 2020.

Contributed Conference Presentations

"Prompt cusps of dark matter halos"
Cosmology from Home 2023; July 2023.

"Primordial black holes and ultradense halos"
Black Hole and Gravitational-Wave Day; Garching, Germany; May 2023.

"Prompt cusps of the first halos."
COSMO'22; Rio de Janeiro, Brazil; August 2022.

"The gamma-ray signature of an early matter-dominated era."
- *APS April Meeting 2019*; Denver, CO, USA; April 2019.
- *Eighth International Fermi Symposium*; Baltimore, MD, USA; October 2018.

"Constraining the primordial power spectrum using minihalos."
APS April Meeting 2018; Columbus, OH, USA; April 2018.

PUBLICATION LIST

Submitted Journal Articles

M. Sten Delos. "An analytic description of substructure-induced gravitational perturbations of hot stellar systems." [arXiv:2312.13338].

M. Sten Delos, Michael Korsmeier, Axel Widmark, Carlos Blanco, Tim Linden, and Simon D. M. White. "Limits on dark matter annihilation in prompt cusps from the isotropic gamma-ray background." [arXiv:2307.13023].

Refereed Journal Articles

Himanish Ganjoo and **M. Sten Delos**. "Simulations of gravitational heating due to early matter domination." Accepted by *JCAP* January 2024 [arXiv:2306.14961].

M. Sten Delos. "Can prompt cusps of WIMP dark matter be detected as individual gamma-ray sources?" Accepted by *Physical Review D* January 2024 [arXiv:2310.15214].

M. Sten Delos. "Accurate halo mass functions from the simplest excursion set theory." *MNRAS* **528**, 1372 (2024) [arXiv:2311.17986].

M. Sten Delos and Simon D. M. White. "Prompt cusps and the dark matter annihilation signal." *JCAP* 10 (2023) 008 [arXiv:2209.11237].

M. Sten Delos, Kayla Redmond, and Adrienne L. Erickcek. "How an era of kination impacts substructure and the dark matter annihilation rate." *Phys. Rev. D* **108**, 023528 (2023) [arXiv:2304.12336].

M. Sten Delos. "Massive prompt cusps: a new signature of warm dark matter." *MNRAS: Letters* **522**, L78 (2023) [arXiv:2302.03040].

M. Sten Delos and Gabriele Franciolini. "Lensing constraints on ultradense dark matter halos." *Phys. Rev. D* **107**, 083505 (2023) [arXiv:2301.13171].

M. Sten Delos and Joseph Silk. "Ultradense dark matter haloes accompany primordial black holes." *MNRAS* **520**, 4370 (2023) [arXiv:2210.04904].

M. Sten Delos and Simon D. M. White. "Inner cusps of the first dark matter haloes: Formation and survival in a cosmological context." *MNRAS* **518**, 3509 (2023) [arXiv:2207.05082].

M. Sten Delos and Tim Linden. "Dark matter microhalos in the solar neighborhood: Pulsar timing signatures of early matter domination." *Phys. Rev. D* **105**, 123514 (2022) [arXiv:2109.03240].

M. Sten Delos and Fabian Schmidt. "Stellar streams and dark substructure: the diffusion regime." *MNRAS* **513**, 3682 (2022) [arXiv:2108.13420].

Rouzbeh Allahverdi, Mustafa A. Amin, Asher Berlin, Nicolás Bernal, Christian T. Byrnes, **M. Sten Delos**, Adrienne L. Erickcek, Miguel Escudero, Daniel G. Figueroa, Katherine Freese, *et al*. "The First Three Seconds: a Review of Possible Expansion Histories of the Early Universe." *Open J. Astrophys.* **4** (2021) [arXiv:2006.16182].

M. Sten Delos, Tim Linden, and Adrienne L. Erickcek. "Breaking a dark degeneracy: The gamma-ray signature of early matter domination." *Phys. Rev. D* **100**, 123546 (2019) [arXiv:1910.08553].

Carlos Blanco, **M. Sten Delos**, Adrienne L. Erickcek, and Dan Hooper. "Annihilation signatures of hidden sector dark matter within early-forming microhalos." *Phys. Rev. D* **100**, 103010 (2019) [arXiv:1906.00010].

M. Sten Delos. "Evolution of dark matter microhalos through stellar encounters." *Phys. Rev. D* **100**, 083529 (2019) [arXiv:1907.13133].

M. Sten Delos. "Tidal evolution of dark matter annihilation rates in subhalos." *Phys. Rev. D* **100**, 063505 (2019) [arXiv:1906.10690].

M. Sten Delos, Margie Bruff, and Adrienne L. Erickcek. "Predicting the density profiles of the first halos." *Phys. Rev. D* **100**, 023523 (2019) [arXiv:1905.05766].

M. Sten Delos, Adrienne L. Erickcek, Avery P. Bailey, and Marcelo A. Alvarez. "Density profiles of ultracompact minihalos: Implications for constraining the primordial power spectrum." *Phys. Rev. D* **98**, 063527 (2018) [arXiv:1806.07389].

M. Sten Delos, Adrienne L. Erickcek, Avery P. Bailey, and Marcelo A. Alvarez. "Are ultracompact minihalos really ultracompact?" *Phys. Rev. D Rapid Communications* **97**, 041303(R) (2018) [arXiv:1712.05421].

TEACHING EXPERIENCE

University of North Carolina at Chapel Hill Chapel Hill, NC, USA

Spring 2019	Cosmology (TA)
Fall 2017	Graduate Quantum Mechanics I (TA)
Summer 2017	Introductory Calculus-based Electromagnetism and Quanta (TA)
Spring 2017	Introductory Calculus-based Electromagnetism and Quanta (TA)
Fall 2016	Introductory Calculus-based Mechanics and Relativity (TA)

Guilford Technical Community College Jamestown, NC, USA

Spring 2016	Conceptual Physics

State University of New York at Stony Brook Stony Brook, NY, USA

Spring 2012	Physics for Life Sciences I (TA)
Fall 2011	Physics for Life Sciences II (TA)
Spring 2011	Physics for Life Sciences II (TA)
Fall 2010	Physics for Life Sciences I (TA)

MENTORED STUDENTS

Himanish Ganjoo (2019-present)
Graduate Student, *North Carolina State University* & *Perimeter Institute*

Margie Bruff (2018-2019)
Undergraduate Student, *University of North Carolina at Chapel Hill*

REFERENCES

Simon White
Emeritus Director, *Max Planck Institute for Astrophysics*
swhite@mpa-garching.mpg.de

Fabian Schmidt
Scientific Staff, *Max Planck Institute for Astrophysics*
fabians@mpa-garching.mpg.de

Adrienne Erickcek (Ph.D. Thesis Advisor)
Associate Professor of Physics and Astronomy, *University of North Carolina at Chapel Hill*
erickcek@physics.unc.edu

Joseph Silk
Professor of Physics, *Institut d'astrophysique de Paris, Université Pierre-et-Marie-Curie*
Homewood Professor of Physics and Astronomy, *Johns Hopkins University*
Emeritus Savilian Professor, *University of Oxford*
silk@iap.fr