Emilie Marie **Hertig**

PhD Student in Astronomy · Gates Cambridge Scholar · Trinity College

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Education

University of Cambridge — *Cambridge, United Kingdom*

PhD in Astronomy — *2021 - present*

- Working thesis title: "Probes of Cosmic Inflation: from the CMB to Quantum Systems"
- Supervisors: Prof. Anthony Challinor and Prof. Blake Sherwin
- Expected submission by June 2025

Ecole Polytechnique Fédérale de Lausanne (EPFL) — *Lausanne, Switzerland*

MSc in Physics — *2019 - 2021*

- Thesis title: "Model-Independent Search for New Physics in Gravitational Waves"
- Supervisors: Prof. Sergey Sibiryakov and Dr. Inar Timiryasov
- Grades: first year 5.42/6.00, second year 5.83/6.00, thesis 6.00/6.00

University of British Columbia (UBC) — *Vancouver, Canada*

Overseas Exchange Program — *2018 - 2019*

- Honours thesis title: "Characterization of CHIME's Complex Gain Using New Transits of CygA and CasA"
- Supervisors: Prof. Gary Hinshaw and Dr. Mateus Fandino
- GPA: 4.33/4.33 (average grade 91.2%)

Ecole Polytechnique Fédérale de Lausanne (EPFL) — *Lausanne, Switzerland*

BSc in Physics — *2016 - 2019*

- General average grade (first two years): 5.28/6.00

Research Experience

Lattice simulations of false vacuum decay — *June 2024 - Present*

Side project in collaboration with Prof. Hiranya Peiris and the QSimFP Consortium

I am analyzing true vacuum bubble profiles to characterize the impact of renormalization on the effective lattice potential. This will allow for direct comparisons between real-time simulations of early-Universe phase transitions and Euclidean instanton theory, as well as yield predictions for observables in upcoming cold-atom analogue experiments.

Delensing pipeline development and early data analysis for the Simons Observatory — *September 2021 - Present*

Main PhD work within the Simons Observatory (SO) L3 and BB Analysis Working Groups

Aiming to optimize constraints on inflation from upcoming CMB polarization maps, I integrated B-mode delensing into SO's main component separation pipeline. After validating the algorithm on simulations, I am now building a lensing template from multiple external datasets including ACT DR6, and will be leading the first demonstration of delensing on early SO data.

Machine learning-based anomaly detection in gravitational waves — *September 2020 - Present*

Master project at EPFL's Laboratory of Particle Physics and Cosmology (LPPC), with recent extension

My work consisted of developing a model-independent search for physics beyond General Relativity (GR) in gravitational waves from binary black hole mergers. This was successfully achieved on simplified mock data by parametrizing arbitrary deviations from GR with an artificial neural network. I am now working on a paper extending this method for application to real data.

Time-delay cosmography with strongly lensed quasars — *September 2019 - July 2020*

Semester project at EPFL's Laboratory of Astrophysics (LASTRO)

Applying forward modelling techniques to images of quasar J1537-3010, I inferred physical parameters needed to determine H_0.

Thermal model for the calibration of the CHIME radiotelescope — *September 2018 - April 2019*

Undergraduate Honours thesis in Prof. Gary Hinshaw's group at UBC Vancouver

I analyzed thermal variation patterns in the complex gain of CHIME, which will measure the expansion rate of the Universe (H_0) through observations of baryon acoustic oscillations. This work contributed to an improved calibration algorithm.

Honours and Awards

2024	**Best poster**, *HAMLET Physics* conference, University of Copenhagen	—
	Selection as a speaker for the James H. Williams, Jr. (1968) Award Research Colloquium, honouring the most outstanding postgraduate research papers in Trinity College, Cambridge	—
	Rouse Ball / Eddington Fund, conference travel award from Trinity College, Cambridge	*£1,690*
	Accommodation grant, 58th Rencontres de Moriond (Cosmology)	*€350*
2022	**Gold medal (1st place) at the International Young Physicists' Tournament (IYPT)**, acting as coach of the Swiss team and experienced juror	—
2021	**IBM Research Award**, for the best EPFL master thesis on new computational techniques	*CHF 5,000*
	Gates Cambridge Scholarship, full funding for a 4-year PhD in Cambridge awarded by the Bill and Melinda Gates Foundation	*∼ £60,000/yr*
	Harding Distinguished Scholarship, University of Cambridge (declined to take up Gates scholarship)	*∼ £60,000/yr*
	Lausanne Zonta Club Award, recognizing an outstanding young woman in science	*CHF 5,000*
	Nomination as candidate for Women in Technology Scholarship, Zonta International (withdrew from competition to take up Gates scholarship)	—
2019	**Canadian Association of Physicists Lloyd G. Elliott University Prize Exam**, 6th rank overall, distinction by UBC for placing in national top 10	—
	Gold medal (3rd place) at IYPT, acting as leader of the Swiss team and juror	—
2018	**EPFL overseas exchange scholarship**, awarded based on academic merit in the first year of undergraduate studies	*CHF 2,000 + UBC tuition waiver*
	Bronze medal (10th place) at IYPT, acting as leader of the Swiss team	—
2017	**Swiss Youth in Science national competition**, distinction	*CHF 500*
	Bronze medal (13th place) at IYPT, acting as coach of the Swiss team	—
2016	**1st prize awarded by the Vaud Society of Natural Sciences**, for an outstanding scientific paper by a student under 21	*CHF 1,000*
	Gold medal (3rd place) at IYPT, selected as a member of the Swiss team after placing 3rd individually in the national SYPT competition	—
	High school graduation awards, for record-breaking average (5.89/6.00) and exam grades (6.00/6.00), as well as outstanding performance in Physics, Mathematics and German	*CHF 750*

Publications

Journal Articles

Published

[1] ***E. Hertig**, K. Wolz, T. Namikawa, A. Baleato Lizancos, S. Azzoni *et al.*, *The Simons Observatory: Combining cross-spectral foreground cleaning with multitracer B-mode delensing for improved constraints on inflation* (2024), Physical Review D 110:043532.

Upcoming

[2] ***E. Hertig**, A. Baleato Lizancos, A. Challinor, B. Sherwin *et al.*, *The Atacama Cosmology Telescope: B-mode delensing with DR6 data and external tracers of large-scale structure*, in prep., expected submission by Feb. 2025.

[3] ***E. Hertig**, I. Timiryasov and S. Sibiryakov, *Model-independent anomaly detection in gravitational waves*, in prep. based on master thesis, expected submission by summer 2025.

[4] C. Hervias *et al.* incl. **E. Hertig**, *The Simons Observatory: Validation of reconstructed power spectra from filtered maps for the Small Aperture Telescope survey*, in Collaboration review.

[5] The Simons Observatory Collaboration, *The Simons Observatory: Enhanced science goals and forecasts for the Large Aperture Telescope*, in Collaboration review.

Conference Proceedings and Theses

[6] ***E. Hertig** *et al.*, *The Simons Observatory: Combining delensing and foreground cleaning for improved constraints on inflation* (2024), Proceedings of the 58th Rencontres de Moriond (Cosmology), arXiv:2405.13201 [astro-ph].

[7] K. Wolz *et al.* incl. **E. Hertig**, *The Simons Observatory: component separation pipelines for B-modes* (2024), Proceedings of the 58th Rencontres de Moriond (Cosmology), arXiv:2407.06891 [astro-ph].

[8] ***E. Hertig**, *Characterization of CHIME's Complex Gain Using New Transits of CygA and CasA* (2019), UBC Undergraduate Research, DOI:10.14288/1.0379212.

Publications in Other Fields

[9] **E. Hertig**, L. Van Box Som and D. Vinck, *Inventing and innovating when no one wants to pay: Cleaning up space debris* (2020), Technology and Innovation 5, DOI: 10.21494/ISTE.OP.2020.0482.

[10] E. Schertenleib, A. Miloglyadova, **E. Hertig**, M. Niese and D. Keller, *Project-based teaching with problems of the Swiss Young Physicists' Tournament* (2020), Bulletin of the Swiss Society of Mathematics and Physics Teachers 144, orig. German text.

[11] ***E. Hertig**, *"Lagging Pendulum" — Stable trajectories of a forced pendulum* (2016), Bulletin of the Swiss Society of Mathematics and Physics Teachers 132, orig. French text.

Conference Contributions and Seminars

Upcoming (May 2025)	***WE-Heraeus Seminar: New windows on the Universe**, invited flash talk & poster	*Kitzbühel, Austria*
Upcoming (March 2025)	**QSimFP Consortium Meeting**, contributed talk	*Nottingham, UK*
Dec. 2024	***Perimeter Institute for Theoretical Physics**, invited seminar	*Waterloo, CA*
Nov. 2024	**DAMTP**, Cosmology Lunch Seminar	*Cambridge, UK*
Oct. 2024	**Trinity College**, Lunchtime Seminar	*Cambridge, UK*
	Cambridge-LMU Cosmology Meeting, contributed talk	*Cambridge, UK*
Sep. 2024	***New Physics from Old Light* workshop on CMB secondaries**, contributed talk	*Cambridge, UK*
Aug. 2024	****HAMLET Physics* conference on machine learning**, invited poster	*Copenhagen, DK*
	***Perimeter Institute for Theoretical Physics**, invited seminar	*Waterloo, CA*
July 2024	**SO Collaboration Meeting**, talk on behalf of the L3.3 Analysis Working Group + poster	*Chicago, USA*
	SO:UK Collaboration Meeting, online talk	*Oxford, UK*
June 2024	***Cosmology from Home***, online talk	*Online*
	***James H. Williams, Jr. (1968) Award Research Colloquium**, invited talk	*Cambridge, UK*
May 2024	**Cambridge Interdisciplinary Forum for Postgraduate Research**, flash talk + poster	*Cambridge, UK*
	Trinity College Legacy Lunch Poster Session, poster	*Cambridge, UK*
April 2024	**58th Rencontres de Moriond (Cosmology)**, contributed talk	*La Thuile, IT*
Dec. 2023	**Cambridge-LMU Cosmology Meeting**, contributed talk	*Garching, DE*
July 2023	**National Astronomy Meeting**, contributed talk	*Cardiff, UK*
May 2023	**Gates Cambridge Day of Research**, contributed talk	*Cambridge, UK*
Feb. 2023	**Institute of Astronomy**, departmental seminar	*Cambridge, UK*

Teaching Experience

Sep. 2023 – June 2024	**Part III / MASt research project co-supervisor**, mentored student Licong Xu during his work on *Impact of the CMB shadow on the tensor-to-scalar ratio measurements at the Simons Observatory*	*Cambridge*
Spring 2022	**Part II *Introduction to Cosmology* supervisor**, course by Prof. Efstathiou	*Cambridge*
Spring 2021	**Teaching assistant in *Probabilities & Statistics***, course by Dr. Koch	*EPFL*
	Teaching assistant in *Analytical Mechanics*, course by Prof. De Los Rios	*EPFL*
Fall 2020	**Teaching assistant in *General Physics: Electromagnetism***, course by Prof. Boero	*EPFL*
Fall 2019	**Teaching assistant in *Advanced Physics I: Mechanics***, course by Prof. Ricci	*EPFL*
Fall 2017	**Teaching assistant in *Information, Computation, Communication***, course by Prof. Chappelier	*EPFL*

Outreach and Community Engagement

Science Communication

Dec. 2024 **Chelmsford Science and Engineering Society** — **Invited talk** — *Echoes of the Big Bang: Probing the origin of our cosmos*

May 2024 **Co-organized a scientific communication workshop with a group of Gates Cambridge Scholars, as part of the Researcher-led Events Scheme**

March 2024 **Cambridge Festival, IoA Open Day** — **Invited talk** — *Echoes of the Big Bang: Probing the origin of our cosmos*

Feb. 2024 **IoA Wednesday Open Evening** — **Talk** — *Echoes of the Big Bang: Probing the origin of our cosmos*

March 2022 **Animated hands-on activities at the IoA Open Day**

March 2021 **Lausanne Zonta Club** — **Invited talk** — *Understanding the Universe: A journey through cosmic mysteries*

Feb. 2020 **Japan Impact EPFL** — **Invited talk** — *From Japanese mythology to modern astronomy*

Dec. 2019 **Astronomy on Tap Lausanne** — **Talk** — *Exploring super-Earths in our Galactic neighbourhood: CHEOPS's challenge*

Nov. 2019 **Callista EPFL Mercury transit event** — **Talk** — *Mercury: A hostile World at the heart of our Solar System*

March 2018 **Astronomy outreach week organized by Callista EPFL** — **Opening talk** — *Exploring constellations*

Mentoring and EDI Activities

STEM Ambassadors volunteering program *Sep. 2023 - present*

- July 2024, Space Inspirations Panel Talk — live discussion on space careers
- July 2024, hosted A-level student Matthew Weiler for a day at the IoA
- Jan. 2024, AMSP Year 10 Maths Enrichment Event (Cambridge) — speed networking session
- Oct. 2023, Advanced Maths Support Programme (AMSP) Year 10 Girls Enrichment Day (Huntingdon) — speed networking session

STEM SMART initiative *Jan. 2023 - July 2023*

- Mentored A-level students from underrepresented groups to widen participation in higher education

Friends of the Lausanne Zonta Club *Dec. 2020 - present*

- Member and invited speaker, aiming to empower women and promote gender equality

Pro IYPT-CH, organization in charge of the Swiss Young Physicists' Tournament (SYPT) *July 2016 - present*

- Board member, volunteered as an SYPT organizer and juror from 2017 to 2021
- Taught at the annual *Physics Week* in 2017, 2018 and 2020
- Still contributing every year to coaching the Swiss team for the international competition (IYPT)

University Societies

Since 2023 **Gates Cambridge Scholars' Council**, Treasurer

Since 2021 **Cambridge University Ice Skating Club**, Welfare Officer (2022 - 2023), Treasurer (2023 - present)

2017-2021 **Callista EPFL (Astronomy Club)**, Committee member, responsible for public outreach events

2018-2019 **UBC Figure Skating Club**, Member, performer in the end-of-year show

Academic Development and Skills

Workshops attended

- SO BB Analysis Working Group hackathons: Oxford (May 2022), Trieste (March 2023), Paris (Nov. 2023), online (April 2024)
- ACT Lensing Hack Week, Cambridge (Dec. 2023)
- Michigan Cosmology Summer School, online (June 2023)
- *Key Challenges for Cosmic Shear and CMB Lensing Cosmology* workshop, Cambridge (July 2022)
- *From Planck to the Future of CMB* workshop, Ferrara (May 2022)
- CMB-S4 Summer School, online (Aug. 2021)
- Training workshop for teaching assistants, EPFL (Sep. 2020)

Computational skills

- Programming languages: Python, C++, Fortran, Matlab, Mathematica
- Techniques: Bayesian inference, neural networks, model comparison, lattice simulations, parallel computing on clusters
- Github username: @ehertig

Languages

- French (native), English (IELTS 8.5), German (B2)