

# CV Jannik Ehrich

Postdoctoral Fellow · Department of Physics · Simon Fraser University, Burnaby, BC, Canada  
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current as of April 6, 2023

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## Research experience

- 2020 - present    **Postdoctoral fellow** at the Simon Fraser University in Burnaby, BC, Canada in the groups of Prof. John Bechhoefer and Prof. David A. Sivak. Topic: Maxwell's demon in the real world: Constraints governing information processing
- 10 - 12/2018    **Visiting researcher** with Prof. Juan M.R. Parrondo at the Universidad Complutense de Madrid, Spain. Topic: Thermalization of systems in collisional baths
- 2016 - 2020    **Graduate research (Ph.D.)** at the Universität Oldenburg with Prof. Andreas Engel. Topic: Stochastic thermodynamics of systems with multiple interacting degrees of freedom, systems with hidden degrees of freedom, and microswimmers
- 2015 - 2016    **Graduate Research (Master)** at the Universität Oldenburg. Topic: Model illustrating how predictive information bounds energy dissipation in small biomolecular systems
- 04 - 09/2014    **Undergraduate Research** at the Universität Oldenburg. Topic: Analyzing and extending the 'Mandal-Jarzynski model' of Maxwell's demon
- 02 - 04/2014    **Internship** at ForWind, Center for Wind Energy Research, Oldenburg, Germany. Topic: Wind tunnel experiments on the effect of wind velocity gradients on cup anemometers

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## Education

- 02/2020    **Ph.D. (Dr. rer. nat.) in physics** with Prof. Andreas Engel, Universität Oldenburg, Germany. Thesis title: *Coupled and Hidden Degrees of Freedom in Stochastic Thermodynamics* (grade: *summa cum laude*)
- 10/2016    **Master studies in physics**, Universität Oldenburg, Germany, Degree: Master of Science (grade\*: 1.0). Thesis title: *Thermodynamics of Predictive Information*
- 10/2014    **Bachelor studies in engineering physics**, Universität Oldenburg, Germany, Degree: Bachelor of Engineering (grade\*: 1.0). Thesis title (translated): *Analysis of a model of Maxwell's demon*
- 2011 - 2012    **Bachelor studies in physics**, Jacobs University Bremen, Germany

\*German grades are awarded on a scale from 1 to 4, 1.0 being the best possible grade.

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## Publications

peer reviewed: 12, first author: 5, co-first author: 1, h-index: 8, total citations: 202 [Google Scholar]

### Preprints:

- \* T. K. Saha, **J. Ehrich**, M. Gavrilov, S. Still, S. A. Sivak, and J. Bechhoefer, *Information engine in a nonequilibrium bath*, arXiv:2208.00288 (2022)
- \* **J. Ehrich**, S. Still, and D. A. Sivak, *Energetic cost of feedback control*, in press at Phys. Rev. Research, arXiv:2206.10793 (2022)

### Published articles:

- 12 **J. Ehrich** and D. A. Sivak, *Energy and information flows in autonomous systems*, Frontiers in Physics **11**, 1108357 (2023), arXiv:2209.10644 (2022)
- 11 T. K. Saha, J. N. E. Lucero, **J. Ehrich**, D. A. Sivak, and J. Bechhoefer, *Bayesian information engine that optimally exploits noisy measurements*, Phys. Rev. Lett. **129**, 130601 (2022), **Editor's Suggestion, Synopsis on phys.org**
- 10 J. N. E. Lucero, **J. Ehrich**, J. Bechhoefer, and D. A. Sivak, *Maximal fluctuation exploitation in Gaussian information engines*, Phys. Rev. E **104**, 044122 (2021)
9. **J. Ehrich**, *Tightest bound on hidden entropy production from partially observed dynamics*, J. Stat. Mech., 083214 (2021)
8. T. K. Saha, J. N. E. Lucero, **J. Ehrich**, D. A. Sivak, and J. Bechhoefer, *Maximizing power and velocity of an information engine*, Proc. Natl. Acad. Sci. USA **118**, e2023356118 (2021), **PNAS Commentary, featured on SFU News**
7. S. J. Large, **J. Ehrich**, and D. A. Sivak, *Free energy transduction within autonomous systems*, Phys. Rev. E **103**, 022140 (2021)
6. K. Proesmans, **J. Ehrich**, and J. Bechhoefer *Optimal finite-time bit erasure under full control*, Phys. Rev. E **102**, 032105 (2020)
5. K. Proesmans, **J. Ehrich**, and J. Bechhoefer *Finite-time Landauer Principle*, Phys. Rev. Lett. **125**, 100602 (2020), **Editor's Suggestion, featured on phys.org**
4. **J. Ehrich**, M. Esposito, F. Barra, and J.M.R. Parrondo, *Micro-reversibility and thermalization with collisional baths*, Physica A **552**, 122108 (2020)
3. **J. Ehrich** and M. Kahlen, *Approximating microswimmer dynamics by active Brownian motion: Energetics and efficiency*, Phys. Rev. E **99**, 012118 (2019)
2. M. Kahlen and **J. Ehrich**, *Hidden slow degrees of freedom and fluctuation theorems: an analytically solvable model*, J. Stat. Mech, 063204 (2018)
1. **J. Ehrich** and A. Engel, *Stochastic thermodynamics of interacting degrees of freedom: Fluctuation theorems for detached path probabilities*, Phys. Rev. E **96**, 012118 (2017)

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## Talks and conference contributions

### Invited talks (5):

- 07/2021 *Information thermodynamics with some biophysics spice*, Quantitative Biological Physics in Canada Seminar, online
- 01/2020 *Stochastic thermodynamics with hidden degrees of freedom*, Physics Seminar, Université du Luxembourg
- 09/2019 *Stochastic thermodynamics with hidden degrees of freedom*, Workshop on *Fundamental Aspects of Statistical Mechanics and the Emergence of Thermodynamics in Nonequilibrium Systems*, Hanse-Wissenschaftskolleg, Delmenhorst, Germany
- 11/2018 *Fluctuation Theorems for Interacting Systems and Systems with Hidden Degrees of Freedom*, Seminar of the Group of Statistical Mechanics, Dto. Física Atómica, Molecular y Nuclear, Universidad Complutense de Madrid, Spain
- 09/2018 *Overview: Stochastic Thermodynamics and Fluctuation Theorems*, Retreat of the Turbulence, Wind Energy and Stochastics group of the Carl von Ossietzky Universität Oldenburg, Neu Sammit, Germany

### Contributed talks (10):

- 03/2023 *How information fuels small-scale machinery*, SFU Postdoctoral Research Day, Burnaby, BC, Canada
- 03/2023 *An information engine that rectifies nonequilibrium fluctuations*, GSNP Postdoctoral Speaker Award Session, APS March Meeting 2023, Las Vegas, USA
- 06/2022 *Ratchets, ratchets everywhere! How information can fuel molecular machines and why you should care*, Frontiers in Biophysics 2022, Vancouver, BC, Canada
- 07/2021 *Maximizing the performance of an information engine*, Information Engines at the Frontiers of Nanoscale Thermodynamics, Telluride, CO, online, USA
- 06/2021 *Maximizing the performance of an information engine*, Joint European Thermodynamics Conference (JETC21), Prague, online, Czech Republic
- 05/2021 *Tight bounds on hidden entropy production from partially observed dynamics*, Workshop on Stochastic Thermodynamics II, Santa Fe Institute, online, USA
- 03/2021 *Finite-Time Landauer Principle*, APS March Meeting 2021, online, USA
- 07/2019 *How to deal with hidden degrees of freedom in stochastic thermodynamics?*, StatPhys27, Buenos Aires, Argentina
- 04/2019 *Approximating microswimmer dynamics by active Brownian motion: Energetics and efficiency*, DPG-Spring Meeting (Annual Conference of the German Physical Society), Regensburg, Germany
- 03/2018 *Fluctuation Theorems for Detached Path Probabilities*, DPG-Spring Meeting and EPS-CMD27, Berlin, Germany

### Posters (6):

- 01/2021 *Minimizing the energetic costs of fast computations*, SFU Physics 2021 Poster competition, Burnaby, Canada

- 09/2018 *Hidden slow degrees of freedom and fluctuation theorems*, stet18, workshop on *Stochastic Thermodynamics: Experiment and Theory*, Dresden, Germany
- 03/2018 *Hidden slow degrees of freedom and fluctuation theorems: an analytically solvable model*, DPG-Spring Meeting and EPS-CMD27, Berlin, Germany
- 04/2017 *On the Role of Latent Variables in Stochastic Thermodynamics*, workshop on *Non-Markovianity and Strong Coupling Effects in Thermodynamics*, Bad Honnef, Germany
- 03/2017 *On the Role of Latent Variables in Stochastic Thermodynamics*, DPG-Spring Meeting, Dresden, Germany
- 07/2016 *On the Thermodynamics of Predictive Information*, conference on *Statistical physics methods in biology and computer science* (StatPhys satellite meeting), Paris, France

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### Peer Review

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10 in total

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|--------|--|
| 3 each | Physical Review E  |
| 2 each | Physical Review Letters<br>Physical Review Research                          |
| 1 each | Physical Review X<br>Nature Communications<br>Journal of Statistical Physics |

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### Professional Societies

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| since 2022 | American Physical Society     |
| since 2020 | Biophysical Society of Canada |
| since 2011 | German Physical Society       |
| 2020-2022  | European Physical Society     |

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### Teaching and mentoring

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|-------------|---|
| 2021 -2022  | <b>Co-supervisor</b> of two summer students and one Master student  |
| 2018        | <b>Substitute lecturer</b> (4 weeks) of theoretical quantum mechanics   |
| 2016 - 2019 | <b>Thesis co-supervisor</b> of three Bachelor students and subsequent thesis review   |
| 2016 - 2019 | Several <b>tutorials</b> in theoretical physics (classical mechanics, electrodynamics, quantum mechanics, and statistical physics)  |
| 2012 - 2016 | Several <b>tutorials</b> in experimental physics (classical mechanics, optics, electrodynamics, atomic physics, and thermodynamics) |

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### Service

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| 2021 - 2022 | <b>President</b> of the Simon Fraser University Postdoctoral Association                                |
| 2020 - 2021 | <b>Vice President - External Communications</b> of the Simon Fraser University Postdoctoral Association |

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## Popular Science

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**Invited Speaker** at the *Klaus-von-Klitzing-award* ceremony (2017), the state youth science competition *Jugend forscht* (2018), and the *pedagogic week* (2018), all hosted in Oldenburg, Germany

**Finalists** at the *groschen 2018*, a science-communication competition for a 10.000€ prize awarded by the *Landessparkasse zu Oldenburg*, Germany

**Science Slams** in Bremen, Oldenburg, Hannover, Lübeck, Osnabrück, and Ulm, Germany. Northern German Science Slam champion and contestant in the German finals of 2017

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## Awards and honors

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|----------------------|--|
| 03/2023              | One of five selected finalists for GSNP Postdoctoral Speaker Award Session at APS March Meeting 2023 in Las Vegas, USA                       |
| 06/2019              | Young Scientist participant at the <b>Lindau Nobel Laureate Meeting</b> 2019   |
| 2017                 | <b>‘Golden brains’</b> for winning the Science Slams in Oldenburg and Bremen   |
| 2016                 | Master’s <b>degree with honors</b>   |
| 2014                 | Bachelor’s <b>degree with honors</b>   |
| 2013, 2014, and 2015 | Three consecutive <i>Landesstipendien</i> ( <b>state scholarships</b> ) covering the tuition fees (500€) at the public Universität Oldenburg |
| 2011                 | <b>Partial Scholarship</b> (25%) towards the tuition fees at the private Jacobs University, Bremen   |

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## Miscellaneous

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**Languages:** German (native), English (professional), French (intermediate), Dutch (basic)

**Computer skills:** Matlab, C, Java, Python, Maple, LaTeX, MSOffice, Linux

Jannik Ehrich  
Burnaby, April 6, 2023