

Joonas Nättilä

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Sex: Male

Born: June 25th, 1989, Tornio, Finland

Nationality: Finnish citizen

Languages: Finnish (native), English, Swedish

Nordita

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Research interests

High-energy astrophysics: accretion (accretion disks); compact objects (neutron stars, black holes)

Plasma physics: collisionless plasma dynamics; turbulence; particle acceleration

Computer sciences: high-performance computing; parallelization paradigms; machine learning; Julia language

Statistics: Bayesian inference; Monte Carlo methods

Mathematics: cellular automata models

Employment

2021–	Flatiron Research Fellow , Flatiron Institute’s Center for Computational Astrophysics, New York, USA.
2019–	Postdoctoral Research Scientist , Columbia University, New York, USA.
2018–2019	Nordita Fellow , Nordita (Nordic Institute for Theoretical Physics), Stockholm, Sweden.

Education

2014–2017	Ph.D. in Astrophysics (with honours) , University of Turku, Finland. Supervisor: Prof. Juri Poutanen, Director of Tuorla Observatory. Title: X-ray bursts as a tool to constrain the equation of state of the ultra-dense matter inside neutron stars
2012–2013	M.Sc. in Astronomy , University of Oulu, Finland.
2008–2012	B.Sc. in Physics , University of Oulu, Finland.

Awards & Recognitions

2019	Joint Princeton/Flatiron Postdoctoral Research Fellowship, Princeton University (<i>Declined</i>)
2018	Turku Finnish University Society Prize for best doctoral dissertation
2018	Väisälä Prize 2018: Prize for outstanding thesis in Astronomy
2018	PCS Best Doctoral Thesis of 2017 Prize
2016	Nordita Visiting Ph.D. Fellow

Teaching

2018, 2019 (2 times)	Lecturer, Introduction to Julia , CSC, Finland. Lecturer for an introductory course on the Julia programming language.
2015–2018 (4 times)	Lecturer, High Performance Computing Summer School , CSC, Finland. Lecturer & tutor for Finnish IT Center for Science HPC Summer School.
2015–2017 (3 times)	Lecturer, Software tools in Physics , University of Turku, Finland. Lecturer of the “Introduction to Unix” section of the course (3 ECTS).

In addition, teaching assistant in **Optics** (2016; 6 ECTS) in Univ. Turku, and **Thermophysics** (3 times, 2011–2013; 6 ECTS), **Electricity and Magnetism** (2012; 4 ECTS), **Laboratory Exercises in Physics 1** (2 times, 2011–2012; 3 ECTS), **Mathematics of Physics** (2011; 6 ECTS), and **Waveforms and Optics** (2 times, 2011; 6 ECTS) in Univ. Oulu.

Mentoring & Supervision

2017–	Tuomo Salmi , PhD student, University of Turku, Finland. Neutron star mass and radius constraints from pulse profile modeling.
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In addition, co-supervised **J. Kuuttila** (M.Sc. thesis; 2015–2017), **T. Salmi** (M.Sc. thesis; 2015–2016), and **J. Kuuttila** (B.Sc. thesis; 2014–2015).

Presentations & Talks

Most recent ones include:

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| 2019 | Invited: Astro Colloquium , University of Tübingen, Tübingen, Germany. |
| 2019 | Invited: Astro talk , Uppsala University, Uppsala, Sweden. |
| 2019 | Extreme Objects Meeting , Stockholm, Sweden. |
| 2018 | Astroplasmas: Particle acceleration and transport , Rende, Italy. |
| 2018 | Tuorla-Tarto meeting , Turku, Finland. |
| 2018 | Invited: Time for Accretion , Sigtuna, Sweden. |
| 2018 | Astroplasmas seminar , Princeton, USA. |
| 2018 | High energy astro group meeting , Columbia University, USA. |
| 2018 | Nordita Seminar , Nordita, Sweden. |
| 2018 | Invited: Astronomers' days , Kuusamo, Finland. |

In total 9 invited, 20 contributed.

Funding

Research

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| 2016 | ~ 2000 eur Magnus Ehrnrooth Foundation Travel grant |
| 2015–2017 | UTUGS Physical and Chemical Sciences funded 3yr. Ph.D. scholarship
Constraining neutron star mass and radius. |
| 2015–2016 | 23 000 eur Väisälä Foundation grant
Magnetar atmosphere models (<i>Declined</i>) |
| 2014–2015 | 23 000 eur Väisälä Foundation grant
Magnetar atmosphere models: breaking the barrier between observations and theory |
- + Some smaller travel grants (in total ~ 10k eur).

Supercomputer time

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| 2019 | ~ 22M CPUh SNIC/Beskow/Kebnekaise, Co-PI: Astrophysical turbulence and dynamo action |
| 2018 | ~ 60k CPUh SNIC/Kebnekaise, PI: Relativistic plasma in silico (testing of PLASMABox). |

Professional Societies and Services

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| 2018– | IAU Junior member |
| 2017 | Organizer & Convener for CompCoffee meetings (weekly meetings to discuss computational problems) |
| 2016– | eXTP Dense Matter science working group |
| 2015–2018 | ESA XIPE satellite Science Team (SWG2.2 Accreting Millisecond Pulsars) |
| 2014– | Member of organizing committee for CSC HPC Summer Schools |
| 2013– | Member of JuliaLang organization (Open source community for Julia programming language) |
| 2012– | Member of Finnish Astronomical Society |

In addition, referee for Monthly Notices of the Royal Astronomical Society, Astronomy & Astrophysics, European Physical Journal A, and Universe.

Conference organization

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| 2017 | Nordita Workshop: Exascale thinking of particle energization problems , Stockholm, Sweden.
Member of the scientific and local organizing committee. |
| 2015 | Workshop on Relativistic Astrophysics , Kavalto, Finland.
Member of the local organizing committee. |
| 2015 | PCS Annual Seminar day , University of Turku, Finland.
Chairman & member of the organizing committee. |

Public outreach

My research has been presented in various local (Finnish) media: tiedetuubi.fi (30.11.2016), [Turun Sanomat](#) (10.11.2017), [Turkulainen](#) (10.11.2017), [Tähdet & Avaruus](#) (25.11.2017), [Aamuset](#) (8.12.2017), [Tekniikka & Talous](#) (8.12.2017), [Verkkouutiset](#) (8.12.2017), [Tähdet ja Avaruus](#) (4/2019); And in international media: [Cosmos](#) 27.11.2017, [Phys.org](#).

Publications — Joonas Nättilä

16 refereed publications, 311 citations; h-index 9, g-index 17, i10-index 9 ([ADS](#)).

Peer-reviewed scientific articles

- [18] F. Nauman and **J. Nättilä**. Exploring helical dynamos with machine learning. Submitted to A&A, May 2019, [[arXiv:1905.08193](#)].
- [17] E. Annala, T. Gorda, A. Kurkela, **J. Nättilä**, and A. Vuorinen. Quark-matter cores in neutron stars. submitted, March 2019, [[arXiv:1903.09121](#)].
- [16] J. J. M. in't Zand, E. Bozzo, J. Qu, X.-D. Li, L. Amati, Y. Chen, I. Donnarumma, V. Doroshenko, S. A. Drake, and et al. (incl. **J. Nättilä**). Observatory science with eXTP. *Science China Physics, Mechanics, and Astronomy*, 62:29506, February 2019.
- [15] A. L. Watts, W. Yu, J. Poutanen, S. Zhang, S. Bhattacharyya, S. Bogdanov, L. Ji, A. Patruno, T. E. Riley, and et al. (incl. **J. Nättilä**). Dense matter with eXTP. *Science China Physics, Mechanics, and Astronomy*, 62:29503, February 2019.
- [14] Z. Li, V. F. Suleimanov, J. Poutanen, T. Salmi, M. Falanga, **J. Nättilä**, and R. Xu. Evidence for the Photoionization Absorption Edge in a Photospheric Radius Expansion X-Ray Burst from GRS 1747–312 in Terzan 6. *ApJ*, 866:53, October 2018, [[arXiv:1809.00098](#)].
- [13] T. Salmi, **J. Nättilä**, and J. Poutanen. Bayesian parameter constraints for neutron star masses and radii using X-ray timing observations of accretion-powered millisecond pulsars. *A&A*, 618:A161, October 2018, [[arXiv:1805.01149](#)].
- [12] P. Pihajoki, M. Mannerkoski, **J. Nättilä**, and P. H. Johansson. General purpose ray-tracing and polarized radiative transfer in General Relativity. *ApJ*, 863:8, August 2018, [[arXiv:1804.04670](#)].
- [11] **J. Nättilä** and P. Pihajoki. Radiation from rapidly rotating oblate neutron stars. *A&A*, 615:A50, July 2018, [[arXiv:1709.07292](#)].
- [10] **J. Nättilä**, M. C. Miller, A. W. Steiner, J. J. E. Kajava, V. F. Suleimanov, and J. Poutanen. Neutron star mass and radius measurements from atmospheric model fits to X-ray burst cooling tail spectra. *A&A*, 608:A31, December 2017, [[arXiv:1709.09120](#)].
- [9] V. F. Suleimanov, J. J. E. Kajava, S. V. Molkov, **J. Nättilä**, A. A. Lutovinov, K. Werner, and J. Poutanen. Basic parameters of the helium-accreting X-ray bursting neutron star in 4U 1820-30. *MNRAS*, 472:3905–3913, December 2017, [[arXiv:1708.09168](#)].
- [8] J. J. E. Kajava, K. I. I. Koljonen, **J. Nättilä**, V. Suleimanov, and J. Poutanen. Variable spreading layer in 4U 1608-52 during thermonuclear X-ray bursts in the soft state. *MNRAS*, 472:78–89, November 2017, [[arXiv:1707.09479](#)].
- [7] J. Kuuttila, J. J. E. Kajava, **J. Nättilä**, S. E. Motta, C. Sánchez-Fernández, E. Kuulkers, A. Cumming, and J. Poutanen. Flux decay during thermonuclear X-ray bursts analysed with the dynamic power-law index method. *A&A*, 604:A77, August 2017, [[arXiv:1705.05653](#)].
- [6] V. F. Suleimanov, J. Poutanen, **J. Nättilä**, J. J. E. Kajava, M. G. Revnivtsev, and K. Werner. The direct cooling tail method for X-ray burst analysis to constrain neutron star masses and radii. *MNRAS*, 466:906–913, April 2017, [[arXiv:1611.09885](#)].
- [5] J. J. E. Kajava, **J. Nättilä**, J. Poutanen, A. Cumming, V. Suleimanov, and E. Kuulkers. Detection of burning ashes from thermonuclear X-ray bursts. *MNRAS*, 464:L6–L10, January 2017, [[arXiv:1608.06801](#)].
- [4] **J. Nättilä**, A. W. Steiner, J. J. E. Kajava, V. F. Suleimanov, and J. Poutanen. Equation of state constraints for the cold dense matter inside neutron stars using the cooling tail method. *A&A*, 591:A25, June 2016, [[arXiv:1509.06561](#)].
- [3] **J. Nättilä**, V. F. Suleimanov, J. J. E. Kajava, and J. Poutanen. Models of neutron star atmospheres enriched with nuclear burning ashes. *A&A*, 581:A83, September 2015, [[arXiv:1507.01525](#)].
- [2] J. J. E. Kajava, **J. Nättilä**, O.-M. Latvala, M. Pursiainen, J. Poutanen, V. F. Suleimanov, M. G. Revnivtsev, E. Kuulkers, and D. K. Galloway. The influence of accretion geometry on the spectral evolution during thermonuclear (type I) X-ray bursts. *MNRAS*, 445:4218–4234, December 2014, [[arXiv:1406.0322](#)].
- [1] J. Poutanen, **J. Nättilä**, J. J. E. Kajava, O.-M. Latvala, D. K. Galloway, E. Kuulkers, and V. F. Suleimanov. The effect of accretion on the measurement of neutron star mass and radius in the low-mass X-ray binary 4U 1608-52. *MNRAS*, 442:3777–3790, August 2014, [[arXiv:1405.2663](#)].

Proceedings

- [2] E. Annala, T. Gorda, A. Kurkela, **J. Nättilä**, and A. Vuorinen. Constraining the properties of neutron-star matter with observations. In *12th INTEGRAL Conference*, Geneva, Switzerland, 11-15 February 2019 [[arXiv:1904.01354](#)].
- [1] P. Soffitta, R. Bellazzini, E. Bozzo, V. Burwitz, A. Castro-Tirado, E. Costa, T. Courvoisier, H. Feng, S. Gburek, R. Goosmann, and et al. (incl. **J. Nättilä**) XIPE: the x-ray imaging polarimetry explorer. In *Space Telescopes and Instrumentation 2016: Ultraviolet to Gamma Ray*, volume 9905 of *Proc. SPIE*, page 990515, July 2016. doi.org/10.1117/12.2233046.

Theses

- [3] **J. Nättilä**. X-ray bursts as a tool to constrain the equation of state of the ultra-dense matter inside neutron stars. PhD thesis, University of Turku, Finland, 2017. ISBN:978-951-29-7057-5.
- [2] **J. Nättilä**. Mass and radius constraints for neutron stars using the cooling tail method. Master’s thesis, University of Oulu, Finland, 2013. oulu-201312041966.
- [1] **J. Nättilä**. Spectral analysis of X-ray bursts from neutron stars: IGR J1747–2721 (*Neutronitähtien röntgenpurkaukset ja niiden spektrianalyysi: IGR J1747–2721*). Bachelor’s thesis, University of Oulu, Finland, 2012.

Open source software

- [6] **PlasmaBox**, Modern C++14/PYTHON3 toolbox for kinetic plasma simulations. <https://github.com/natj/plasmabox>
- [5] **CORGI**, C++14 grid infrastructure for massively parallel multi-physics simulations. <https://github.com/natj/corgi>
- [4] **mpi4cpp**, User-friendly C++14 MPI headers with template metaprogramming. <https://github.com/natj/mpi4cpp>
- [3] **Bender, ray tracing code**, General relativistic ray tracing code for computing radiation from rapidly rotating oblate neutron stars in JULIA/PYTHON3. <https://github.com/natj/bender>
- [2] **Hydro, modular 2D hydrodynamical code** with unsplitted HLLC Rieman solver, second order Runge-Kutta time-stepping, and linear piecewise reconstruction written in pure JULIA. <https://github.com/natj/hydro>
- [1] **CellularAutomata.jl**, JULIA library for 1/2D elementary and totalistic Cellular automata modeling. <https://github.com/natj/CellularAutomata.jl>

+ Smaller libraries and software available at <https://github.com/natj>.