

# 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

*Nuclear physics*: equation of state of cold ultra-dense matter

*General relativity*: ray tracing

*Statistics*: Bayesian inference; Monte Carlo methods

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

*Mathematics*: cellular automata models; topology

## Employment

2018 – 2019 | **Nordita Fellow**, Nordita, Stockholm, Sweden.

## Education

2014–2017 | **Ph.D. in Astrophysics (with honours)**, University of Turku, Finland.  
Supervisor: Prof. Juri Poutanen, Director of Tuorla Observatory.

2012–2013 | **M.Sc. in Astronomy**, University of Oulu, Finland.

2008–2012 | **B.Sc. in Physics**, University of Oulu, Finland.

## Teaching

2018 | **Lecturer, Introduction to Julia**, CSC, Finland.

Lecturer for an introductory course on the Julia programming language.

Summer 2018 | **Lecturer, High Performance Computing Summer School**, CSC, Finland.

Summer 2017 | Lecturer & tutor for Finnish IT Center for Science HPC Summer School.

Summer 2016

Summer 2015

Spring 2017 | **Lecturer, Software tools in Physics**, University of Turku, Finland.

Spring 2016 | Lecturer of the “Introduction to Unix” section of the course (3 ECTS).

Spring 2015

Fall 2016 | **Teaching Assistant, Optics**, University of Turku, Finland.

Exercise assistant of Optics course (6 ECTS).

Summer 2013 | **Teaching Assistant, Thermophysics**, University of Oulu, Finland.

Summer 2012 | Exercise assistant of Thermophysics summer course (6 ECTS).

Summer 2011

Summer 2012 | **Teaching Assistant, Electricity and Magnetism**, University of Oulu, Finland.

Exercise assistant of Electricity and Magnetism summer course (4 ECTS).

2011 – 2012 | **Assistant, Laboratory Exercises in Physics 1**, University of Oulu, Finland.

Assistant in Laboratory Exercises in Physics 1 (3 ECTS), in the fall and spring semesters.

Summer 2011 | **Teaching Assistant, Mathematics of Physics**, University of Oulu, Finland.

Exercise assistant of Mathematics of Physics summer course (6 ECTS).

Summer 2011 | **Teaching Assistant, Waveforms and Optics**, University of Oulu, Finland.

Spring 2011 | Exercise assistant of Waveforms and Optics (6 ECTS) in spring and summer courses.

## Mentoring & Supervision

Co-supervised 2 M.Sc. thesis, 1 B.Sc thesis. Currently co-supervising 1 PhD thesis.

2017–	<b>Tuomo Salmi</b> , PhD student, University of Turku, Finland. Neutron star mass and radius constraints from pulse profile modeling.
2015–2017	<b>Jere Kuuttila</b> , M.Sc. thesis research project, University of Turku, Finland. X-ray burst time evolution dependency on the spectral state.
2015–2016	<b>Tuomo Salmi</b> , M.Sc. thesis research project, University of Turku, Finland. Neutron star mass and radius constraints from pulse profile modeling.
2014–2015	<b>Jere Kuuttila</b> , B.Sc. thesis research project, University of Turku, Finland. X-ray bursts as standard candles.

## Awards & Recognitions

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 2017
2016	Nordita Visiting Ph.D. Fellow, Nordita, Stockholm, Sweden.

## Presentations & Talks

7 invited, 18 contributed talks.

### Invited:

2018	<b>Time for Accretion</b> , Sigtuna, Sweden.
2018	<b>Astronomers' days</b> , Kuusamo, Finland.
2018	<b>Fire and Ice: Hot QCD meets cold and dense matter</b> , Saariselkä, Finland.
2017	<b>Holographic dense QCD and neutron stars</b> , ENS, Paris.
2016	<b>From quarks to gravitational waves: Neutron stars as a laboratory for fundamental physic</b> , CERN.
2016	<b>COSPAR 2016, E1.1: Accreting Neutron Stars and Stellar-mass Black Hole</b> , Istanbul, Turkey. ( <i>Conference canceled!</i> )
2016	<b>JINA-CEE Symposium: Neutron Stars in the Multi-Messenger Era</b> , Ohio, USA.

### Contributed:

2018	<b>Tuorla-Tarto meeting</b> , Turku, Finland.
2018	<b>Astroplasmas seminar</b> , Princeton, USA.
2018	<b>High energy astro group meeting</b> , Columbia University, USA.
2018	<b>Nordita Seminar</b> , Nordita, Sweden.
2017	<b>Astrophysics Seminar</b> , Helsinki, Finland.
2017	<b>Exascale thinking of particle energization problems</b> , Nordita, Sweden.
2016	<b>INT-16-2b: Phases Of Dense Matter Workshop</b> , Seattle, USA.
2016	<b>Nordita Workshop on accretion onto magnetized neutron stars</b> , Stockholm, Sweden.
2015	<b>Workshop on Relativistic Astrophysics</b> , Kavalto, Finland.
2015	<b>University of Maryland, Colloquium speaker</b> , Washington, USA.
2015	<b>University of Tennessee, Colloquium speaker</b> , Tennessee, USA.
2015	<b>The Neutron Star Radius, And All That Jazz</b> , Montreal, Canada.
2015	<b>40 years of X-ray bursts: Extreme explosions in dense environments</b> , Madrid, Spain.
2014	<b>ESAC (visiting scientist presentation)</b> , Madrid, Spain.
2014	<b>Physics of Neutron Stars Conference</b> , St. Petersburg, Russia.
2014	<b>Astronomers' Days</b> , Savonlinna, Finland.
2013	<b>European Week of Astronomy and Space Science</b> , Turku, Finland.
2012	<b>Astronomers' Days</b> , Porvoo, Finland.

## Funding

### Research

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| 2015–2017 | <b>UTUGS Physical and Chemical Sciences funded 3yr. Ph.D. scholarship</b><br>Constraining neutron star mass and radius.          |
| 2014–2015 | <b>~ 23 000 eur Väisälä Foundation grant</b><br>Magnetar atmosphere models: breaking the barrier between observations and theory |

### Observation time

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| 2018 | <b>NuSTAR/INTEGRAL/XMM-Newton ToO time (30ks/170ks/100ks)</b><br>Co-I, Proposal 1540022: Measuring the High Energy Emission of Millisecond X-Ray Pulsars in Outburst |
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### Computing resources

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| 2018 | <b>~ 60k CPUh SNIC/Kebnekaise, PI:</b> Relativistic plasma in silico (testing of PLASMABox). |
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## Memberships

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| 2018– | IAU Junior member  |
| 2016– | eXTP Dense Matter science working group                                |
| 2015– | ESA XIPE satellite Science Team (SWG2.2 Accreting Millisecond Pulsars) |
| 2014– | Organizing committee for CSC HPC Summer Schools                        |
| 2013– | JuliaLang organization   |
| 2012– | Finnish Astronomical Society   |

## Conference organization

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|------|---|
| 2017 | <b>Nordita Workshop: Exascale thinking of particle energization problems</b> , Stockholm, Sweden.<br>Member of the scientific and local organizing committee. |
| 2015 | <b>Workshop on Relativistic Astrophysics</b> , Kavalto, Finland.<br>Member of the local organizing committee.   |
| 2015 | <b>PCS Annual Seminar day</b> , University of Turku, Finland.<br>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). And in international media: [Cosmos](#) 27.11.2017.

## Open source software

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|  | <b>PlasmaBox</b> , Modern C++-14/PYTHON3 toolbox for kinetic plasma simulations. <a href="https://github.com/natj/plasmabox">https://github.com/natj/plasmabox</a>   |
|  | <b>Bender, ray tracing code</b> , general relativistic ray tracing code for computing radiation from rapidly rotating oblate neutron stars. <a href="https://github.com/natj/bender">https://github.com/natj/bender</a>                  |
|  | <b>Hydro, modular 2d hydrodynamical code</b> with unsplitted HLLC Riemann solver, second order Runge-Kutta time-stepping, and linear piecewise reconstruction. <a href="https://github.com/natj/hydro">https://github.com/natj/hydro</a> |
|  | <b>CellularAutomata.jl</b> , Julia library for elementary and totalistic Cellular automata modeling. <a href="https://github.com/natj/CellularAutomata.jl">https://github.com/natj/CellularAutomata.jl</a>                               |

# Publications — Joonas Nättilä

15 publications, 227 citations; h-index 7, g-index 15, i10-index 7 ([ADS](#)).

## Peer-reviewed scientific articles

- [15] 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.
- [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*, *in press*, May 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

- [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.

## 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.