Joonas Nättilä

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Sex: Male
Born: June 25th, 1989, Tornio, Finland
Nationality: Finnish citizen
Languages: Finnish (native), English, Swedish

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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 (*Declined*)
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

2015—2019 (5 times)	**Lecturer, High Performance Computing Summer School**, CSC, Finland. Lecturer & tutor for Finnish IT Center for Science HPC Summer School.
2018, 2019 (2 times)	**Lecturer, Introduction to Julia**, CSC, Finland. Lecturer for an introductory course on the Julia programming language.
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.

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).

July 25, 2019

Presentations & Talks

Most recent ones include:

2019	***Invited:*** **Bursting the Bubble**, Lorentz center, Leiden, Netherlands.
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.

In total 10 invited, 20 contributed.

Funding

Research

2016	$\sim$ **2 000 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 (*Declined*)
2014–2015	**23 000 eur Väisälä Foundation grant** Magnetar atmosphere models: breaking the barrier between observations and theory

+ Some smaller travel grants (in total $\sim$ 10k eur).

Supercomputer time

2019	$\sim$ **22M CPUh SNIC/Beskow/Kebnekaise**, **Co-PI**: Astrophysical turbulence and dynamo action
2018	$\sim$ **60k CPUh SNIC/Kebnekaise**, **PI**: Relativistic plasma in silico (testing of Runko).

Professional Societies and Services

2019–	Member of Young Academy Finland (under Finnish Academy of Sciences and Letters)
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

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.

July 25, 2019

Publications — Joonas Nättilä

16 refereed publications, 353 citations; h-index 10, g-index 18, i10-index 11 (ADS).

Peer-reviewed scientific articles

[20] **J. Nättilä**. Runko: Modern multi-physics toolbox for simulating plasma. *arXiv e-prints*, page arXiv:1906.06306, Jun 2019, [arXiv:1906.06306].

[19] A. Veledina, **J. Nättilä**, and A. M. Beloborodov. Pulsar wind-heated accretion disk and the origin of modes in transitional millisecond pulsar PSR J1023+0038. Submitted to ApJ, page arXiv:1906.02519, Jun 2019, [arXiv:1906.02519].

[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] **Runko**, Modern C++14/PYTHON3 toolbox for kinetic plasma simulations. https://github.com/natj/runko

[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.