Joonas Nättilä

joonas.nattila@su.se

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

Nordita
Roslagstullsbacken 17
SE-10691, Sweden
Tel: +358 453577992

Research interests

Computational physics: fluid and plasma dynamics, high performance computing, numerical methods.
High-energy astrophysics: neutron stars, X-ray bursts, equation of state; black holes, accretion; relativity, ray tracing.
Statistics: Bayesian inference, Monte Carlo methods.

Professional experience

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

2016 | **Nordita Visiting Ph.D. 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 2017
Summer 2016
Summer 2015 | **Lecturer, High Performance Computing Summer School**, CSC, Finland.
Lecturer & tutor for Finnish IT Center for Science HPC Summer School.

Spring 2017
Spring 2016
Spring 2015 | **Lecturer, Software tools in Physics**, University of Turku, Finland.
Lecturer of the "Introduction to Unix" section of the course (3 ECTS).

Fall 2016 | **Teaching Assistant, Optics**, University of Turku, Finland.
Exercise assistant of Optics course (6 ECTS).

Summer 2013
Summer 2012
Summer 2011 | **Teaching Assistant, Thermophysics**, University of Oulu, Finland.
Exercise assistant of Thermophysics summer course (6 ECTS).

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
Spring 2011 | **Teaching Assistant, Waveforms and Optics**, University of Oulu, Finland.
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 M.Sc. thesis.

2017–	**Vladislav Loktev**, M.Sc. thesis research project, University of Turku, Finland. Polarized neutron star atmosphere models.
2015–2017	**Jere Kuuttila**, M.Sc. thesis research project, University of Turku, Finland. X-ray burst time evolution dependency on the spectral state.
2015–2016	**Tuomo Salmi**, M.Sc. thesis research project, University of Turku, Finland. Neutron star mass and radius constraints from pulse profile modeling.
2014–2015	**Jere Kuuttila**, B.Sc. thesis research project, University of Turku, Finland. X-ray bursts as standard candles.

Memberships

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

Presentations & Talks

5 invited, 17 contributed talks.

Invited:

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

Contributed:

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

Funding

Research

2015–2017 **UTUGS Physical and Chemical Sciences funded 3yr. Ph.D. scholarship**
Constraining neutron star mass and radius.

2014–2015 **∼ 23 000 eur Väisälä Foundation grant**
Magnetar atmosphere models: breaking the barrier between observations and theory

Travel

2016 **∼ 1 000 eur CERN** From quarks to gravitational waves workshop.
2016 **∼ 2 000 eur Magnus Ehrnrooth Foundation** JINA-CEE symposium (Ohio) and COSPAR 2016 (Istanbul).
2016 **∼ 1 000 eur UTUGS Physical and Chemical Sciences** JINA-CEE symposium (Ohio).
2016 **∼ 2 000 eur ESAC** Visiting scientist (host: Jari Kajava).
2015 **∼ 1 000 eur UTUGS Physical and Chemical Sciences** The Neutron Star Radius, and All That Jazz -conference, Montreal.
2015 **∼ 1 000 eur ESAC** 40 years of X-ray bursts - conference.
2014 **∼ 1 000 eur ESAC** Research visit (host: Jari Kajava).

+ Some smaller travel grants.

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). And in international media: Cosmos 27.11.2017.

Open source software

Bender, ray tracing code, general relativistic ray tracing code for computing radiation from rapidly rotating oblate neutron stars. `https://github.com/natj/bender`

Hydro, modular 2d hydrodynamical code with unsplitted HLLC Rieman solver, second order Runge-Kutta time-stepping, and linear piecewise reconstruction. `https://github.com/natj/hydro`

CellularAutomata.jl, Julia library for elementary and totalistic Cellular automata modeling. `https://github.com/natj/CellularAutomata.jl`

Publications

13 publications, 175 citations; h-index 7, g-index 13, i10-index 5 (ADS).

Peer-reviewed scientific articles

[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. *submitted to A&A*, 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. *submitted to A&A*, April 2018, [arXiv:1804.04670].

[11] **J. Nättilä** and P. Pihajoki. Radiation from rapidly rotating oblate neutron stars. *A&A in press*, February 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.