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

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 2018 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.

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

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

Presentations & Talks

7 invited, 17 contributed talks.

Invited:

2018 | **Time for Accretion**, Sigtuna, Sweden.
2018 | **Astronomers' days**, Kuusamo, Finland.
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, 205 citations; h-index 7, g-index 14, i10-index 7 (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*, 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.