
NSC
FINLAND

NSC
FINLAND

NANONEWS in

2019

Editorial

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Figures

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Eric Leraillez
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PREFACE

This second NSC newsletter highlights some of our activities during 2019. The emphasis during this year has been on strategy planning and community building. They go quite well hand in hand, because building and implementing a successful strategy requires everyone's contribution, and common goals help unify us. Here we include some snapshots of the strategy paper, but I urge everyone to read and comment the full NSC strategic plan (paper version found in the lobby and online on our site). This is because this year we will start implementing the strategy especially in our suggestions for the Academy of Finland university profiling call.

On looking ahead to the year 2020, I already see three major funding calls as besides the university profiling projects, the Academy of Finland will also open calls for the Center of Excellence and for Finland's Roadmap for Research Infrastructures. We will hopefully be active in each of these, along with the usual calls for the Academy of Finland projects, ERC grants and foundation projects. In addition, we will release an internal call for the next interdisciplinary NSC postdoctoral positions. I recommend that once preparing your application you take a peek at our strategy paper and ponder how you could use it in your favor. In particular, does your project help tackling our grand challenges? Does it already belong to NSC's strong or rising fields, or new openings? If it does, tell this clearly in your application. If not, tell us how we should modify the grand challenge description, or make sure we list your research area in the next update of the plan.

I wish you all Merry Christmas and a Happy JYU year 2020!

Prof. Tero Heikkilä
Scientific Director of NSC

Announcements

The 30th Jyväskylä Summer School
10.–21.8.2020

Nordic Femtochemistry
19.–20.8.2020

Nanoscience Days 2020
6.–7.10.2020

NSC Paper of the Year Award
December 2020

All seminars and events in Year 2020:
- **Light and Matter seminar**, Every second Monday at 9:00, YNC330
- **Microbiology seminar**, Every second Tuesday at 9:00,YNC122
- **Nanophysics Theory seminar**, Tuesdays at 14:30, YNC122
- **NSC Explain this!** at 14:00 first Wednesday of each month, NSC coffee room
- **Ruusupuisto Well-being seminar**, Fridays at 10:00 (Lunch ticket), Ruusupuisto
- **Nanoseminar**, Fridays at 13:00, YNC121

More information:
www.jyu.fi/nanoscience/current

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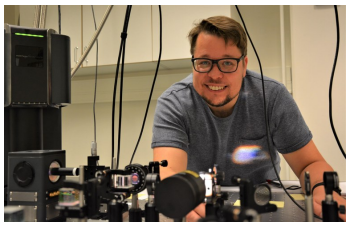
New Projects at NSC

Nanoresearcher Juha Muhonen receives a significant grant for developing components for a quantum computer



Associate professor, academy research fellow, Juha Muhonen from the University of Jyväskylä has received the highly competitive European Research Council (ERC) Starting Grant. The ERC uses the Starting Grants to support talented scientists in the early stages of their career in pursuing ground-breaking projects for a duration of five years. The grant amount is 1.6 million euros. Muhonen works at the Department of Physics and the Nanoscience center (NSC) at University of Jyväskylä.

Read more: www.jyu.fi/en/current/archive/2019/09/nanoresearcher-juha-muhonen-receives-a-significant-grant-for-developing-components-for-a-quantum-computer

More information:
Juha Muhonen, juha.t.muhonen@jyu.fi

Nanoscience received nearly two million euros to develop bio-applications

Jane and Aatos Erkko foundation has awarded this year a total of almost two million euros for researchers working at the Faculty of Mathematics and Science. All of four researchers work also at the Nanoscience Center.

Read more (*in Finnish*): www.jyu.fi/fi/ajankohtaista/arkisto/2019/11/nanotutkimus-sai-lahes-kaksi-miljoonaa-euroa-biosovellusten-kehittamiseen

Matti Jalasvuori, the Department of Biology and Environmental Sciences, 255 000 €: "*Conjugative Delivery of CRISPR-Cas9 System for Eradicating Antibiotic Resistance*"
Perttu Permi, the Departments of Biology and Environmental Sciences and Chemistry, 696 000 €: "*Peptidoglycan hydrolases as weapons against resistant Staphylococcus aureus*"
Mika Pettersson: the Department of Chemistry 450 000 €: "*Towards graphene-based neuroprosthetics*"
Jussi Toppari, the Department of Physics, 557 000 € (together with assistant professor Anton Kuzyk, Aalto University): "*Functional optical nanostructures by DNA self-assembly*"

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Mika Pettersson, mika.j.pettersson@jyu.fi
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Jane and Aatos Erkko Foundation: jaes.fi/myonnetyt-avustukset/2019-2/

Nearly three million euros for nanoscience research

The researchers of the Nanoscience Center, University of Jyväskylä have been successful in applications for external funding from Academy of Finland. Nanoscience research received a total over three million euros.

Read more (*in Finnish*): www.jyu.fi/fi/ajankohtaista/arkisto/2019/06/jyvaskylan-yliopistoon-viiden-miljoonan-euron-rahoitus-tukemaan-luonnontieteiden-matematiikan-ja-tekniikan-lapimurtoja

Academy Projects (01.09.2019 - 31.08.2023):
Perttu Permi (The Department of Biology and Environmental Sciences, 599 820 €): "*Fight the resistance – Peptidoglycan hydrolases as weapons against resistant Staphylococcus aureus*"
Heikki Tuononen (The Department of Chemistry, 505 630 €): "*Fast and Accurate Computational Thermochemistry Simulations (FACTS)*"

Gerrit Groenhof (The Department of Chemistry, 385 197 €) and Jussi Toppari (The Department of Physics, 399 091 €): "*Manipulating Chemistry with Vacuum Light Fields*"
Petri Pihko (The Department of Chemistry, 362 416 €): "*Bioinspired organic redox flow batteries for sustainable and safe energy storage*"
Tero Heikkilä (The Department of Physics, 246 646 €): "*Microwave optomechanics with magnons*"

Academy Research Fellow (01.09.2019 - 31.08.2024):
Juha Muhonen (The Department of Physics, 438 874 €): "*Optical readout for spins in silicon*"

Academy Postdoctoral Researchers (01.09.2019 - 31.08.2022):
Pauliina Salmi (The Department of Biology and Environmental Sciences, 247 821 €): "*Bio-optical Properties of Microalgae in Environmental Monitoring and Research*"

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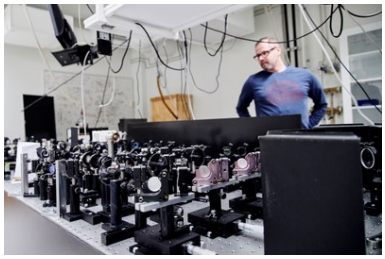
New advanced chemical imaging research infrastructure to Finland



New advanced chemical imaging research infrastructure received funding of 1.6 million euros from Academy of Finland. The research infrastructure partners are the University of Helsinki, the University of Jyväskylä and the LUT University. The new research infrastructure strengthens the collaboration between leading vibrational spectroscopy, imaging and application research groups in Finland.
Read more: www.jyu.fi/en/current/archive/2019/12/new-advanced-chemical-imaging-research-infrastructure-to-finlan

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Strategic funding (150 000 €) for novel antiviral products against enteroviruses

An inter-disciplinary team of experts on virology and mycology in the University of Jyväskylä and Natural Resources Institute Finland (Luke), respectively, won the first price and strategic funding (150 000 €) from LukeLEADS pitching competition for innovative research ideas. With this funding, the team will test and optimize novel antiviral products against enteroviruses, and head for further support for licensing and commercialization.
Read more: www.jyu.fi/science/en/current/current/strategic-funding-150-000-20ac-for-novel-antiviral-products-against-enteroviruses

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A significant European supercomputing grant to nanoscience researchers for investigations of atomically precise nanocatalysts

PRACE organization has awarded 35 million CPU core hours for a joint project of Academy Professor Hannu Häkkinen and Professor Karoliina Honkala at the University of Jyväskylä's Nanoscience Center.
Read more: www.jyu.fi/en/current/archive/2019/04/a-significant-european-supercomputing-grant-to-nanoscience-researchers-for-investigations-of-atomically-precise-nanocatalysts

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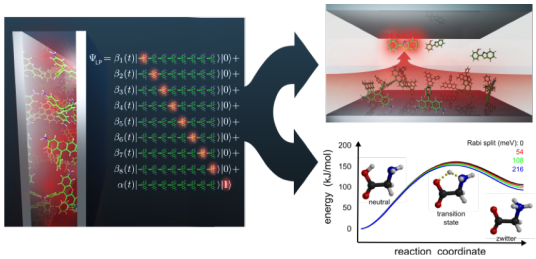
Postdoc project – Polaritonic chemistry

The upcoming transition to solar energy requires novel means to steer photochemical reactions, but catalysts to control excited state dynamics do not exist yet. The observation that the yield of a photochemical reaction increases when the reactants are inside optical cavities, suggests that cavities may be promising catalysts for photochemistry. The confinement of light inside such cavities increases the interaction with the photoactive molecules and leads to the formation of new hybrid light-matter states, called polaritons, that are coherent super positions of excitations of the molecules and of the cavity. The hybridization between light and matter not only delocalizes the excitation over many molecules but also changes their potential energy surface, and thus could be a new way to control chemistry. The goal in this project is to unlock the potential of cavities as catalysts for important photochemical reactions, such as excitation energy transfer and photo-isomerization. To efficiently design suitable cavities, we developed theory as well as multi-scale molecular dynamics simulations techniques to accurately model the effects of strong-light matter coupling on the dynamics and reactivity of photoactive molecules. Guided by the results of our theory and simulations, we perform experiments on strongly coupled photo-reactive molecules to demonstrate the power of catalysis with confined light.



Read more about postdoc projects: www.jyu.fi/nanoscience/research/projects/postdoc-projects

More information:
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Jussi Toppari, jussi.toppari@jyu.fi

Research Collaboration with BINA: The Frozen Quantum Bridge

The interaction between light in an optical cavity and a mechanical resonator is highly nonlinear and could be a major resource for quantum information and sensing. The objective of this proposal is to study at millikelvin temperatures a particular cavity optomechanical system: a sliced photonic crystal nanobeam. These structures are generally used by JYU group at 3 Kelvin temperatures but have not been characterized at millikelvin temperatures where the system is expected to reach a regime of high quantum cooperativity between the light stored in the photonic crystal cavity and the mechanical motion of the nanobeam, allowing new phenomena to be demonstrated. The project aims to modify existing optical millikelvin setup at BINA to be used for these experiments, and lay ground work for a longer research collaboration.
Read more about BINA collaboration: www.jyu.fi/nanoscience/research/project/bina-nsc

More information: Juha Muhonen, juha.t.muhonen@jyu.fi

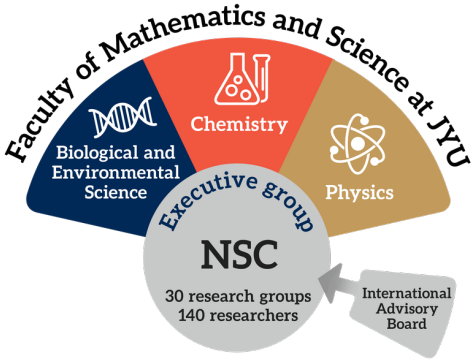
Excerpts from NSC's strategic plan

The complete strategy paper can be found in the NSC lobby and at r.jyu.fi/nscstrategy.pdf

Based on

JYU mission:
We are a university with social impact
(vaikuttava sivistysyliopisto)

One of JYU faculty of mathematics and science core fields:
Multidisciplinary nanoscience



Vision

Using methods from physics, chemistry and biology, we strive to understand and control natural phenomena at the nanoscale.

Mission

To provide nanoscientists with an enthusiastic, supportive and creative environment to carry out world-leading research. To educate multidisciplinary experts with the most recent knowhow for the benefit of the society. To communicate nanoscience to the science community and the general public.

Our grand challenges

Appreciation of science in society
Science education and outreach, collaboration with industry
Health and well-being
New means against antibiotic resistance, development of novel antimicrobials and antivirals, nanosafety, diagnostics, label-free and non-invasive imaging, neuroprosthetics
Sustainable society
Sustainable chemistry, circular economy, light responsive molecules and nanostructures along with their applications in photonics R&D, catalytic processes towards low carbon society
Second quantum revolution
Quantum technologies, designer matter, room-temperature superconductivity, light-matter interactions

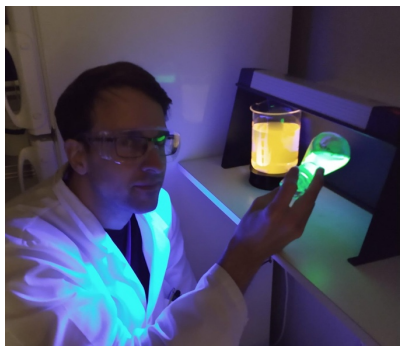
Our strategic aims

- Support interdisciplinary nanoscience research combining all our research fields (physics, chemistry and biology)
- Promote deep understanding of the studied phenomena with a strong theoretical foundation
- Encourage group leaders to focus and strengthen their research to achieve leading role in their discipline
- Attract talented students and researchers
- Realize larger national and international research consortia where NSC has significant role
- Join national infrastructure roadmap
- Offer unique nanoscience education at the national level
- Foster the impact of our research and education on society and industry, both locally and globally

1. What's your name, your group leader, and your core field at NSC?
2. What is your project and how often do you visit at NSC building?
3. Why do you want to be part of NSC?
4. What is your major scientific finding in Year 2019?
5. What should researchers at NSC do together in Year 2020?

1. My name is Noora Aho, I work in the group of Gerrit Groenhof in the field of computational biomolecular chemistry.
2. The goal of my PhD project is to understand how proton translocation across a membrane is coupled to the mechanical motion of ATP synthase protein located in this membrane. The research is done by computational methods, mainly classical molecular dynamics simulations.
3. I want to be part of NSC, because the environment is equal and people are inspiring, and all the research we do is high-quality.
4. My major scientific finding, or progress in 2019 has been implementing a new computational method to study biomolecular systems. Once finalized, the method enables simulating biomolecules at constant pH with one of the best-known simulation software.
5. In 2020, the researches at NSC should get to know each other even better, build an even stronger community and get involved with new research questions open-minded!

1. My name is Gabriel Magno de Freitas Almeida, my group leader is Lotta-Riina Sundberg and my core field is microbiology.
2. I work with bacteriophages, trying to understand peculiarities of their biological interactions and how to use then as agents of phage therapy.
3. Being part of the NSC allows for interdisciplinary collaborations, in my case the most important being related to imaging biological samples.
4. In 2019 I published a paper describing interactions between phages-bacteria-animals, with impact for evolutionary sciences and also for applied phage therapy.
5. It would be interesting to get to know other projects of the NSC, maybe by starting a seminar series.



1. My name is Ville Saarnio. I work with the host-pathogen interactions group led by Varpu Marjomäki, while my research happens in the field of nanochemistry under the supervision of Tanja Lahtinen.
2. The research is about developing fluorescent sensors for detecting nucleic acids (and other things) with improved properties to offer new ways for my colleagues to detect viral RNA (and other things) related to the behavior of enteroviruses. I spend most of my days here at NSC.
3. I belong here. My research is multidisciplinary in the interface between chemistry and cell and molecular biology and I couldn't think of a better place than the NSC to do this kind of research.
4. In the year 2019 I've been making great progress with Sailee Shroff to develop synthetic methods in surface functionalization of silver nanoparticles.
5. I think in 2019 the NSC has seen introduction of many new great activities (weNSC, new seminar series as well as the sports shift of NSC (shout-out to Jaakko)) for the community. For 2020 it would be enough just to keep these things alive and

increase our participation (myself included) to appreciate the efforts of the people putting work into them.

1. My name is Ari Helenius. I work in Prof. Ilari Maasilta's group and my field is experimental nanophysics of superconducting radiation detectors.
2. I am working in two different projects studying different superconducting detectors, their properties and analysis, transition-edge sensors and thermo-electric detectors, latter being from SUPERTED EU-project. I visit NSC mostly every day.
3. I want to be part of NSC, because of the expertise in variety of fields and people that can help tackle problems from multitude of directions.
4. The highlight of my year was finding a working algorithm to trivialize the analysis of transition-edge sensors, cutting down analysis time in 1-2 orders of magnitude.
5. NSC staff could have more after work events and better attendance for Explain this! outside ones' comfort zones.

1. My name is Kamila Mentel. I work in Prof. Mika Pettersson's group. My core field is spectroscopy and photodynamics.
2. My project is about modifying the properties of graphene using direct laser writing. My office and the laser equipment that I use are located in the Nanoscience Center, therefore I am there every day.
3. NSC brings together specialists from different fields and gives an opportunity to perform high quality multidisciplinary scientific research.
4. We have shown that optical forging can be used to create 3D patterns not only in graphene but also in other 2D materials such as hexagonal boron nitride and molybdenum disulfide, making this technique a great tool for nanomaterials engineering.
5. More lectures, at the introductory level, about the work carried out within the different NSC research groups.

Master's Degree Programme in Nanoscience

Application round: 8.–22.1.2020
Studies begin: Autumn 2020
Extent: 120 ECTS credits (2 years)
Language of instructions: English

More information: www.jyu.fi/en/apply/masters-programmes/masters-degree-programmes/nanoscience/programme-description

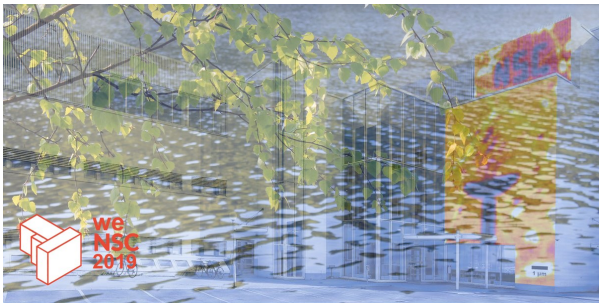
"My experience here in JYU was enjoyable and exceptionally engaging. The unique "atmosphere" of this place, students, teachers keep you energized and motivated. You can feel the science in the air."
Read Alex's full story: www.jyu.fi/en/apply/masters-programmes/student-stories/techniques_at_nanoscale

Research Outreach and Highlights

FIRST LEGO League

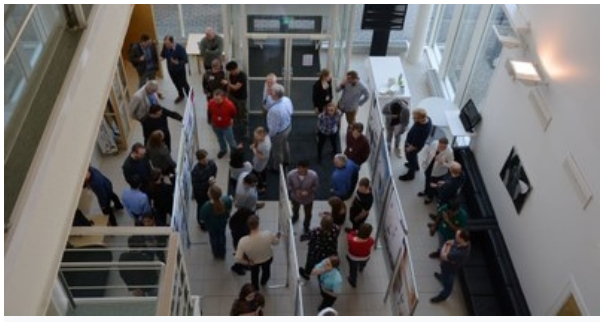
The first *FIRST* LEGO League (FLL) regional competition in Central Finland was organized 4.2.2019 at JYU by Valmet, JYU Faculty of Science and IT, the City of Jyväskylä, the Central Finland LUMA Center, the Parenting Forum of Jyväskylä and the Robotics and Science Education ry. In 2019 competition theme is space, which is visible in robotics and science projects. Nearly 100 school children attended the event. **Read More (*in Finnish*):**
www.jyu.fi/fi/ajankohtaista/arkisto/2019/01/yhdeksan-joukkuetta-osallistuu-robottikisan-keski-suomen-aluekarsintaan

WeNSC



The researchers of Nanoscience Center (NSC), from graduate students to professors in University of Jyväskylä envisioned the new strategy for their unit at the Konnevesi research station from 23rd to 24th of April. Almost 60 nanoresearchers from varying fields, together with NSC alumnus were gathered together. **Read more:**
www.jyu.fi/science/en/current/current/the-nanoscience-center-challenged-its-researchers-to-be-brave-both-in-research-and-communication

International Advisory Board meeting



The University of Jyväskylä's Nanoscience Center (NSC) received good reviews for its research work from international advisory board. The board estimated that all research areas at the NSC are excellent and have the potential for significant new discoveries. **Read more (*in Finnish*):**
www.jyu.fi/fi/ajankohtaista/arkisto/2019/04/kansainvalinen-raati-nosti-nanotiedekeskuksesta-karkeen-kymmenen-tutkimusaihetta

Young Researcher Entrepreneur

Kunal Garg, a PhD student at NSC, Department of Biology and Environmental Sciences, is a Young researcher entrepreneur of the Year 2019. The award was given by the KAUTE foundation for a socially significant business idea. **Read more (*in Finnish*):**
kaute.fi/vuoden-nuori-tutkijayrittaja-kunal-garg/

Researchers' night

A European-wide science event, the Researchers' night, makes the science familiar to the general public. On 27th September 2019 1300 visitors could explore nanoscience through researchers' meetings, science shows, and laboratory visits for free at NSC. **Read more:**
www.tutkijoidenyo.fi/en

NSDays2019

The Nanoscience Days (*chair* Toni Metsänen) were held during 8th–9th October, 2019. The conference is a traditional event organized more than fifteen years by NSC. The topics present a balanced overview of emerging trends and perspectives in the field of nanoscience. **Read more:** www.jyu.fi/en/current/archive/2019/10/the-nanoscience-days-in-jyvaskyla-on-8-9-of-october-molecules-turn-into-nanoswitches-and-bacteriophages-prevent-fish-bacterial-diseases

Business Day at the Nanoscience Center

University of Jyväskylä (JYU) Nanoscience Center (NSC) hosted a Business Day event in Jyväskylä on 22nd November 2019. The event gathered company representatives, science students, and researchers from the fields of biology, physics and chemistry. A strong connection to business and companies increases the employment of nanoscientists: 97 per cent of from JYU graduated nanoscientists are employed at the moment, half of them to companies. **Read more:** www.jyu.fi/en/current/archive/2019/11/nanoscientists-find-a-job-easily-business-day-at-the-nanoscience-center-is-an-excellent-networking-event-for-tech-experts

MAL: Best Master's Thesis of the year

Academic Association for Mathematics and Natural Sciences – MAL awarded M.Sc Emmi Kirjanen for the best Master's thesis of the year. Kirjanen did her work at The Nanoscience Center at the University of Jyväskylä. The prize is 5 000 euros and it was awarded on Thursday 28th November, 2019. **Read more:** www.jyu.fi/en/current/archive/2019/11/emmi-kirjanen-received-an-award-for-her-master2019s-thesis-on-nanoscience

The Nobel Evening

The experts from University of Jyväskylä introduced this year's Nobel Prize winners. One of the experts was Prof. Karoliina Honkala who told about the development of battery technologies and what kind of will be the next-generation lithium-ion batteries. The Scientific Director of the NSC Tero Heikkilä was organizing the event. The public lectures were held on 10th December, 2019 at the Jyväskylä City Library. **Read more:** www.jyu.fi/fi/ajankohtaista/arkisto/2019/12/jyvaskylan-yliopiston-asiantuntijat-taustoittavat-vuoden-nobelistien-saavutukset-yleisoluennolla

Highlights at NSC in 2019*

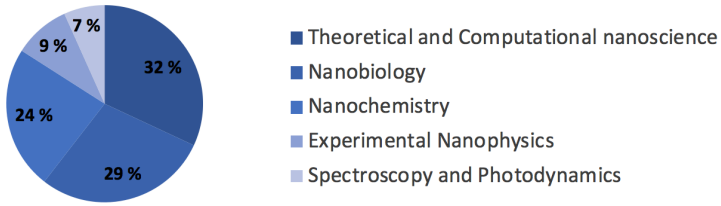
- T. T. Heikkilä, M. Silaev, P. Virtanen, and F. S. Bergeret "*Thermal, electric and spin transport in superconductor/ferromagnetic-insulator structures*" *Progr. Surf. Sci.* 94, 100540, **2019**
- D. S. Rabinovich, I. V. Bobkova, A. M. Bobkov, and M. A. Silaev "*Resistive State of Superconductor-Ferromagnet-Superconductor Josephson Junctions in the Presence of Moving Domain Walls*" *Phys. Rev. Lett.* 123, 207001, **2019**
- J. Basset, M. Kuzmanović, P. Virtanen, T. T. Heikkilä, J. Estève, J. Gabelli, C. Strunk, and M. Aprili "*Nonadiabatic dynamics in strongly driven diffusive Josephson junctions*" *Phys. Rev. Res.* 1, 032009(R), **2019**
- M. Laajala, M. M. Hankaniemi, J. A. E. Määttä, V. P. Hytönen, O. H. Laitinen, and V. Marjomäki. "*Host Cell Calpains Can Cleave Structural Proteins from the Enterovirus Polyprotein*" *Viruses 11*, 12, **2019**
- G. M. F. Almeida, E. Laanto, R. Ashrafi, and L.-R. Sundberg. "*Bacteriophage Adherence to Mucus Mediates Preventive Protection against Pathogenic Bacteria*" *mBio,*10, 6, e01984-19, **2019**
- M. Silaev. "*Nonlinear electromagnetic response and Higgs-mode excitation in BCS superconductors with impurities*" *Phys. Rev. B*, 99, 224511, **2019**
- J. T. Muhonen, G. R. La Gala, R. Leijssen and E. Verhagen. "*State Preparation and Tomography of a Nanomechanical Resonator with Fast Light Pulses*" *Phys. Rev. Lett.*, 123, 113601, **2019**
- S. Malola, P. Nieminen, A. Pihlajamäki, J. Hämäläinen, T. Kärkkäinen and H. Häkkinen, "*A Method for Structure-Prediction of Metal-Ligand Interfaces of Hybrid Nanoparticles*", *Nat. Comm.*, 10, 3973, **2019**
- V. Ruokolainen, A. Domanska, M. Laajala, M. Pelliccia, S. J. Butcher, and V. Marjomäki "*Extracellular Albumin and Endosomal Ions Prime Enterovirus Particles for Uncoating That Can Be Prevented by Fatty Acid Saturation*" *J. Virol.*, 93 (17), e00599, **2019**
- Y. Tian, T. A. Puurtinen, Z. Geng, and I. J. Maasilta "*Minimizing Coherent Thermal Conductance by Controlling the Periodicity of Two-Dimensional Phononic Crystals*" *Phys. Rev. Appl.*, 12, 014008, **2019**
- C. Sun, N. Mammen, S. Kaappa, P. Yuan, G. Deng, C. Zhao, J. Yan, S. Malola, K. Honkala, H. Häkkinen, B. K. Teo, and N. Zheng "*Atomically Precise, Thiolated Copper–Hydride Nanoclusters as Single-Site Hydrogenation Catalysts for Ketones in Mild Conditions*" *ACS Nano*, 13 (5), 5975, **2019**
- H. Ijäs, I. Hakaste, B. Shen, M. A. Kostiainen and V. Linko "*Reconfigurable DNA Origami Nanocapsule for pH-Controlled Encapsulation and Display of Cargo*" *ACS Nano*, 13 (5), 5959, **2019**
- M. R. Narouz, K. M. Osten, P. J. Unsworth, R. W. Y. Man, K. Salorinne, S. Takano, R. Tomihara, S. Kaappa, S. Malola, C.-T. Dinh, J. D. Padmos, K. Ayoo, P. J. Garrett, M. Nambo, J. H. Horton, E. H. Sargent, H. Häkkinen, T. Tsukuda and C. M. Crudden "*N-heterocyclic carbene-functionalized magic-number gold nanoclusters*" *Nat. Chem.*, 11, 419 **2019**
- N. Amdursky, Y. Lin, N. Aho, G. Groenhof "*Exploring fast proton transfer events associated with lateral proton diffusion on the surface of membranes*" *PNAS*, 116 (7) 2443, **2019**
- J. Hicks, A. Mansikkamäki, P. Vasko, J. M. Goicochea, and S. Aldridge "*A nucleophilic gold complex*" *Nat. Chem.*, **11**, 237, **2019**

30
Group leaders*

140
Researchers*

127
Peer-reviewed publications**

Top 5	Author (No. of Publ.)
1.	Hannu Häkkinen (13)
2.	Sami Malola (12)
3.	Kari Rissanen (11)
4.	Mihail Silaev (8)
5.	Lotta-Riina Sundberg (7)



*Data taken from NSC websites at 13.12.2019
**Data taken from Scopus at 13.12.2019, keywords: Nanosci* and Univ* Jyvaskyla