
NSC
FINLAND

NSC FINLAND

NANONEWS in

2020

Editorial
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Figures
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Johanna Schirmer
Romain Chevigny
Evgeny Bulatov
Henri Lyyra
Antti Kanniainen
Saara Karttunen
University of Jyväskylä

PREFACE

This is the third NSC newsletter, this time produced only electronically as many of you would access it from home. I am pretty sure that everyone is really tired of reading any Covid-related text, so I just mention it by thanking everyone for their good work in hard conditions. While we have been relatively lucky to be able to run majority of the experimental work, I am sure everyone misses the "close" contacts and encounters, and the non-planned discussions where it is impossible to mute your partner with a mouse click. Despite the problems we have had a relatively good year as you can also see in this Newsletter.

Looking into 2021, three points come to my mind: NSC International Advisory Board meeting in April 22-23, implementing the Profi6 program, and I already forgot the third. Well, that happens in a home office. In addition, we will work hard to seek upgrades for our infrastructure, get centers of excellence, and more industry contacts. I hope to be able to also find some time for research. Above all, I look forward to meeting you people in person the post-Covid era.

I wish you all Merry Christmas and a Happy New Year 2021!

Prof. Tero Heikkilä
Scientific Director of NSC

Announcements

The 30th Jyväskylä Summer School
9.–20.8.2021

Nordic Femtochemistry
18.–19.8.2021

Nanoscience Days 2021
5.–6.10.2021

NSC Paper of the Year Award
December 2021

All seminars and events in Year 2021:
- **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

Maija Vihinen-Ranta to partake 5.6 million € H2020 project

The aim of the CoCID (Compact Cell-Imaging Device) project is to develop a microscope based on low energy X-ray radiation. This technology will facilitate fast 3D imaging of whole, virus infected cells. Resulting more accurate information regarding host cell changes caused by virus infection can be used to develop new antiviral therapies. In addition to Finland, the consortium has members from three European countries, Ireland, Germany, and Spain. Consortium member, a company called SiriusXT, Ltd, provides the expertise in the technology development and others are responsible for virus research, imaging and image analysis. The University of Jyväskylä's share of the funding is just over 830 000 €.
Read more (*in Finnish*): https://www.jyu.fi/fi/ajankohtaista/arkisto/2020/10/jyvaskylan-yliopisto-on-mukana-kehittamassa-nopeaa-rontgensateilyyn-perustuvaa-virus-solu-vuorovaikutusten-kuvantamismenetelmaa-2013-tutkittavana-myos-pandemiaa-aiheuttava-koronavirus

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Business Finland granted 660 000 € funding for commercializing natural antivirals

Luke and the University of Jyväskylä have discovered natural bioactive agents that have strong antiviral properties against viruses infecting humans. The efficacy has been confirmed with enteroviruses and coronaviruses, including SARS CoV-2. Riikka Linnakoski from Natural Resources Institute Finland (Luke) and professor Varpu Marjomäki from JYU and NSC received 660 000 € for developing cosmetics and health care products contributing to the prevention of future epidemies. The focus is on developing the invention to a readiness level where it can be commercialized.
Read more *(in Finnish)*: https://www.jyu.fi/fi/ajankohtaista/arkisto/2020/12/metsaluonnosta-arvoaineita-koronaviruksen-paihittamiseen-2013-business-finland-myonsi-tutkimusrahoitusta-kaupallistamisen-valmisteluun

More information:
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BUSINESS FINLAND

Business Finland granted 336 000 € for phage-based solutions

Matti Jalasvuori's group has developed, together with researchers from University of Helsinki, an emergency treatment based on phage solutions. These solutions are meant for cases where traditional methods to combat bacterial infections are ineffective. Matti Jalasvuori's group received 336 000 € Research to business funding for investigating the business possibilities of phage-based solutions.
Read more: https://www.jyu.fi/en/current/archive/2020/12/viruses-against-bacterial-diseases

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Business Finland Co-Creation funding for "Antiviral fibers"

Professor Varpu Marjomäki has received 88 000 € funding for a 6 month long co-creation project to work towards co-innovation funding. The project is executed together with Natural Resources Institute Finland (Luke) and Finnish growth-oriented companies. The goal is to develop new intelligent product solutions to control the coronavirus pandemic and possible future epidemics by using side-streams of the forest processing industry. Some promising preliminary results already exists, thus binding the extracts to fiber material has the potential to lead into novel product solutions.
Read more: https://jyunity.fi/en/science-news/researchers-keen-eye-on-the-enterovirus-finds-also-molecules-against-the-coronavirus-from-the-nature/

More information:
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Academy Projects (01.09.2020 - 31.08.2024):
Nearly 800 000 € for GenEn project consortium

Professor Janne Ihalainen and Professor Gerrit Groenhof received funding of almost 800 000 euros for a project consortium called GenEn in Academy Project funding call (1.9.2020-31.8.2024). The aim of the project is to undestand how the environment surrounding a protein affects its function. Time-resolved spectroscopy, time-resolved crystallography and computational methods are used to investigate enzymatic reactions both in crystal and solution conformation, providing answers at temporal and spacial resolution.

ACADEMY OF FINLAND

Read more: https://www.jyu.fi/en/current/archive/2020/06/the-academy-of-finland-grants-the-university-of-jyvaskyla-20ac2-4-million-for-academy-projects-in-mathematics-and-natural-sciences

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Gerrit Groenhof, gerrit.x.groenhof@jyu.fi

More than 500 000 € for studying intranuclear virus dynamics

Adjunct Professor Maija Vihinen Ranta received over 500 000 € funding for a project called "Way out through chromatin: nuclear exit of herpesvirus capsids and mRNA". The project aims at unraveling the virus-induced chromatin reorganization mechanisms. It is important to understand the intranuclear virus dynamics because they may lead into discovery of oncolytic virus therapies and novel antivirals.
Read more: https://www.jyu.fi/en/current/archive/2020/05/the-academy-of-finland-granted-funding-for-three-academy-projects-at-the-university-of-jyvaskyla

More information:
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Other Academy of Finland funding

Academy Research Fellow (01.09.2020 - 31.08.2025):
Heikki Takala (The Department of Biology and Environmental Sciences, 438 874 €): "*Phytochrome-based modules – function and applications*"

Aaron Mailman (The Department of Chemistry, 438 874 €): "*Functional Organic Radical Materials: Molecular radicals as conductors*"

Special funding for research into COVID-19 vaccines and pharmaceutical development (01.07.2020 - 31.12.2022):

Varpu Marjomäki and Perttu Permi (The Department of Biology and Environmental Sciences, 249 592 € + 166 693 €): ” *Fighting COVID19 with calpain inhibitors / Consortium: Calpain-antivirals*”

Matti Jalasvuori (The Department of Biology and Environmental Sciences, 188 217 €): ” *Treating severe COVID-19 associated secondary bacterial infections with Phage Therapy under the Declaration of Helsinki / Consortium: COVID-19_Phage*”

Read more: https://www.jyu.fi/en/current/archive/2020/06/the-academy-of-finland-supports-jyu2019s-strong-coronavirus-research-2013-bacteriophages-or-calpain-inhibitors-may-help-to-find-cure-for-the-virus

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Two new professors at the NSC

The new professors share their main research interests and talk about their ideas for the future as NSC professors.

Professor Varpu Marjomäki

The main interests of my research deal with virus-host interactions. On one hand I want to promote fundamental understanding of virus infection mechanisms and, on the other hand, to develop novel and safe solutions to prevent viral infections. Based on previous molecular screens of synthetic and natural substances, we have found several hits that show strong anti-viral potency against both enveloped and non-enveloped viruses. I want to get understanding on the molecular mechanisms of the antiviral action but also develop best candidates for future antiviral applications.

I expect the collaborations with other NSC groups to increase further in the coming years. Also, I hope to bring novel scientific approaches and knowledge concerning molecular virology and antiviral applications to the teaching in nanoscience and biology.

During the past year I have been able to initiate new collaborations with companies to develop antiviral applications. I hope the new role will boost the company collaborations further and help creating new ones with mutual goals. In addition, I hope the scientific collaboration e.g. with Pasteur Institute in Paris and with LUKE in Finland will bring novel findings and solutions to help with the present and future epidemics and pandemics.

Professor Pekka Koskinen

My nanoscience interests relate to the computational research of low-dimensional nanostructures. These structures include nanowires, nanotubes, graphene, two-dimensional elemental metals, and other atomically thin nanomaterials. For example, I have thoroughly enjoyed contributing to optically forged graphene research with Mika Pettersson's group and modified graphene-based catalyst research with Karoliina Honkala's group.

During recent years, my research interests have bifurcated toward physics and science education research. These research interests are coupled firmly to teaching development and applied to both teaching methods and practices. I hope this professorship will strengthen computational research and support within the nanoscience center and beyond, to further increase and widen the momentum in teaching development.

More information:
https://www.jyu.fi/en/current/archive/2020/09/four-new-professors-appointed-at-the-university-of-jyvaskyla-in-the-fields-of-physics-animal-ecology-cell-and-molecular-biology-and-mathematics

Introducing a new NSC group leader

My name is Heikki Takala and I started as a group leader in the University of Jyväskylä in September 2020. Once gained my PhD in the University of Jyväskylä in 2011, I had postdoctoral visits in the University of Gothenburg and the University of Helsinki. After these postdoctoral periods, I wanted to return to Jyväskylä as an independent group leader.

My research lies in the fields of cell- and molecular biology, biochemistry, and structural biology, and focuses on phytochromes photoreceptors. Phytochromes undergo structural changes in response to red light. My aim is to reveal in detail how these changes take place and affect the biological activity of the entire protein. I will also generate novel phytochrome-based applications, optogenetic tools, which enable the control of various cellular processes with red light.

” Becoming an NSC group leader was no-brainer.”

Currently my research group in the University of Jyväskylä consists of only a shared postdoctoral researcher and me. However, our group will increase by a PhD student and a Master’s student in the beginning of next year.

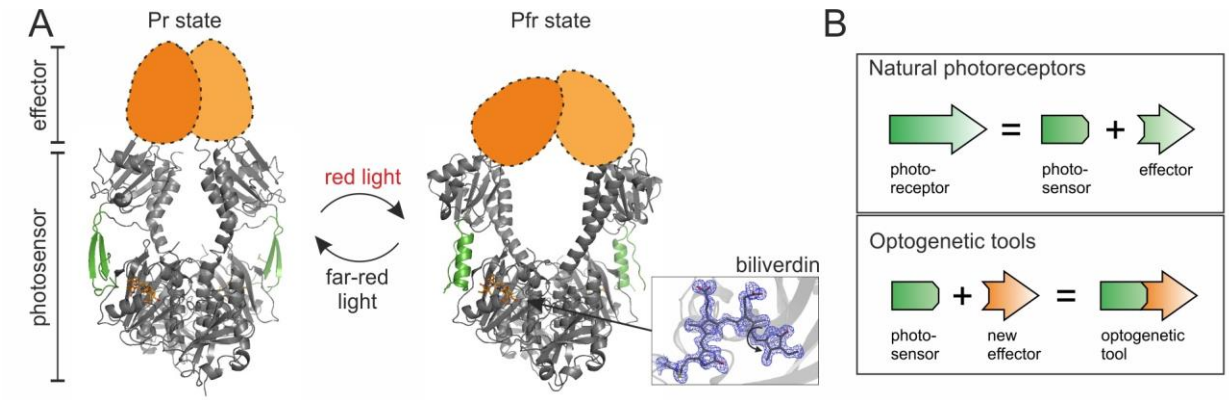
After I started as a group leader at the Department of Biological and Environmental Science in autumn

2019, becoming an NSC group leader was a no-brainer. My research is tightly associated with the NSC and fits very well with its research profile.

Anticipating interdisciplinary collaboration in 2021

Nanoscience Center is a great platform for research that extends beyond traditional boundaries of disciplines. Therefore, I am looking forward to new interdisciplinary research and collaborations as a new NSC group leader.

More information:
https://www.jyu.fi/science/en/bioenv/research/biosciences/optogenetic-modules/optogenetic-modules-function-and-applications



1. What is 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 2020?
5. What should researchers at NSC do together in Year 2021?

1. My name is Johanna Schirmer. I work in Mika Pettersson's group in the field of Nanochemistry.
2. The project of my PhD focuses on the development of interfaces between graphene and the neural system and belongs to the bigger "Graphene-based Interfaces for Neuroapplications" project. This means a lot of lab work for me so that I visit NSC almost daily.
3. Our project is interdisciplinary and at the nanoscale: Physicists, Biologists and Chemists work with graphene-based systems, gels, proteins, cells and computations. It fits perfectly to the slogan of NSC: Strength in collaboration.
4. I was able to observe targeted protein immobilization on optically modified graphene surfaces in situ with AFM. This got me a lot of hands-on sessions at the AFM so that I could deepen my knowledge about this technique. AFM will be important for my future experiments, too.
5. It would be interesting to get to know other projects in NSC better. Though the possibilities are limited to online seminars at the moment.

1. My name is Romain Chevigny. I work in Prof Maija Nissinen´s group and my core field is supramolecular chemistry.
2. I work on designing gelator molecules and developing gelation methodologies, combining the gel properties with graphene surfaces towards neuro-prosthetic applications. The laboratory and apparatus being at NSC, I am myself at NSC every day.
3. At NSC you can find researchers from a plenty of fields, you are constantly in the process of working together and it gives you many approaches to face an issue and develop your skills.
4. This year we highlighted an easy and straightforward methodology to gel peptide-based low molecular weight gelator based on a deprotection/protection equilibrium.
5. NSC could organize staff events outside of work to get people to know each other, beyond everyone´s own group members.

1. My name is Evgeny Bulatov, and I'm a postdoctoral researcher in the group of Dr. Kaisa Helttunen working mainly on organic synthesis.
2. Our group studies anion receptors based on calix[4]pyrroles. I work in the synthesis laboratory of NSC pretty much every day.
3. I see many flexible-minded interdisciplinary researchers at NSC, always open to new ideas, projects, and challenges, and I want to learn from them to become such a versatile researcher myself, to be able to cope with the dynamic nature of scientific work.
4. Changing several postdoctoral positions this year, my major finding was that I can withstand much more stress and pressure than I previously thought; but this is not yet published result. In the lab I worked mainly on sustainable solid catalysts: 3d-printed catalyst containing palladium nanoparticles for cross-coupling reactions (ChemCatChem 2020, 12, 4831) and active carbon-based catalyst for oxidative dehydrogenation reactions (yet to be published).
5. After this year full of remote meetings, conferences, and even remote coffee breaks, I think many of us just want to hang out with friends and colleagues in both formal and informal settings, as soon as it becomes relatively safe.

1. I'm Henri Lyyra and I am a postdoctoral researcher in the group of associate professor Juha Muhonen. Our group's main interest is hybrid quantum technologies in silicon.
2. I am working with our PhD student Cliona on optomechanical readout mechanisms of donor spins in silicon. In a nutshell, the main idea is that the donor spins couple to a mechanical resonator through strain, influencing the resonator's resonance frequency. The mechanical resonator also forms an optical cavity so we can use a laser to measure the resonance frequency of the mechanical resonator. The initial goal of the project is to detect the change in the donor spin state through its influence on the measured mechanical frequency. I visit the building daily.
3. During my studies, I always found the possibilities of quantum technologies. Thus, reading about the current project caught my full attention when considering different options after finishing my PhD. On a larger scale, there are many people with different backgrounds at NSC, which allows very interesting collaborations.
4. During my PhD, we developed a theoretical toolbox for constructing quantum probing measurements which give reliable information - even in cases where the unitary system-probe coupling is unknown. This year, we managed to perform the first experimental implementation of such measurement (Phys. Rev. A 102, 022232).
5. As people have been mostly remote working since I arrived here, I have not had the chance to meet many of my co-workers at NSC. When the situation gets better, some outdoor or sport activities would be fun. In the previous group, we had "sports club" where each month one of the group members would teach the basics of their hobby and everyone got the chance to try it out. Something like that would be interesting if enough people join in.

1. I'm Antti Kanniainen. I started my PhD studies in Juha Muhonen's research group at the fall 2020. My core field is experimental nanophysics of quantum technologies in silicon.
2. Focus of my research is on studying the effects of millikelvin temperatures on optomechanical systems and coupling single-spin qubits to the system. We are currently building our measurement setup and a lot of hands-on work is needed, therefore I'm at the NSC on most days.
3. I want to be part of NSC because the work environment is open and equal. Also, my colleagues are highly motivated and provide high quality research.
4. I haven't yet gotten any major scientific findings, but hopefully our measurement setup will finish soon and science can happen!
5. Hopefully next year the current situation will change and we can go back real face-to-face meetings.

Research Outreach and Highlights

FIRST LEGO League

The FIRST LEGO League (FLL) regional competition in Central Finland for season 2019/2020 was organized 3.2.2020 at JYU by Valmet, Arkkitehtipalvelu, GoFore Jyväskylä, Peda.net, JYU Faculties of Mathematics and Science, and IT, the City of Jyväskylä, the Central Finland LUMA Center, and the Robotics and Science Education ry. This season, the competition theme was City Shaper, focusing on the development of one's living environment. **Read More (*in Finnish*):** https://www.jyu.fi/fi/ajankohtaista/arkisto/2020/01/keski-suomen-koululaiset-kisaavat-asuinympariston-kehittamisessa-first-lego-league-2013karsinnassa

Corona virus online live broadcast on 10th of March 2020

The University of Jyväskylä and Nanoscience Center together with Central Finland Heath Care District (KSSHP) and Keskisuomalainen, organized an online live broadcast where doctors from the KSSHP and two scientists, Varpu Marjomäki and Lotta-Riina Sundberg, from NSC shared knowledge regarding corona virus. **Read more: (*in Finnish*):** https://www.jyu.fi/fi/ajankohtaista/arkisto/2020/03/tutkimustietoa-koronaviruksesta-10-3-luentotilaisuus-ja-nettilahetys

Researchers' night

European science event, the Researchers' night, makes science familiar to the public. On 27th November 2020, visitors explored nanoscience through free virtual events. **Read more:** www.tutkijoidenyo.fi/en https://www.jyu.fi/en/current/archive/2020/12/researchers2019-night-online-raised-wide-interest-on-27-november

NSDays 2020

The Nanoscience Days (*chair* Tuomas Puurtinen) took place during 6th–7th October 2020. The event was held completely online, using Zoom platform. Nano sauna acted as the main event arena for the chairing team and the technical support. Nanoscience Days are a traditional event organized for the sixteenth time by NSC. The scientific program included high-profile plenary lectures, oral communications selected based on abstracts, and an online poster session. The topics presented a balanced overview of emerging trends and perspectives in nanoscience and nanotechnology. **Read more:** https://www.jyu.fi/en/current/archive/2020/10/nanoscience-days-online-conference-started-top-topics-include-qubits-quantum-sensors-biomedical-proteins-and-nanomaterials

The Nobel Evening

Offered by the University of Jyväskylä, Nanoscience Center and Keskisuomalainen, the Nobel Evening was organized as an online event on 10th December 2020. In the usual fashion, the experts from University of Jyväskylä introduced this year's Nobel Prize winners. Two of the experts were from the Nanoscience Center. Lotta-Riina Sundberg introduced the chemistry Nobel awarded to CRISPR/Cas9 genetic scissors. This technique can be used to edit DNA molecules at a predetermined site. Maija Vihinen-Ranta discussed the medicine Nobel awarded to the discovery of the Hepatitis C virus. Hepatitis C virus is readily transmitted through blood and can lead into chronic hepatitis, development of cirrhosis and liver cancer. It is global health concern comparable to HIV infection and tuberculosis. The Scientific Director of the NSC Tero Heikkilä gave the closing words of the evening. **Read more:** https://www.jyu.fi/fi/ajankohtaista/arkisto/2020/11/nobel-kattaus-10-12-tieteen-lapimurtoaiheet-esitellaan-verkkolahetyksessa

Highlights at NSC in 2020*

- S. Heiskanen and I. Maasilta, *"Superconducting tunnel junction fabrication on three-dimensional topography based on direct laser writing"*. Appl. Phys. Lett. 2020, 117, 232601.
- P. Virtanen, R. Gommers, T.E. Oliphant, M. Haberland, T. Reddy, et. al., "SciPy 1.0: fundamental algorithms for scientific computing in Python", Nature Methods 2020, 17, 261.
- C.R. Harris, K.J. Millman, S.J. van der Walt, R. Gommers, P. Virtanen, et. al., "Array programming with NumPy", Nature 2020, 585, 357.
- M. Pamuła, M. Nissinen and K. Helttunen, *"Correlating Solution- and Solid-State Structures of Conformationally Flexible Resorcinarenes: Significance of a Sulfonyl Group in Intramolecular Self-Inclusion"*. Chem. Eur. J. 2020, 26, 7374.
- A. Longo, E. J. J. de Boed, N. Mammen, M. van der Linden, K. Honkala, H. Häkkinen, P. E. de Jongh and B. Donoeva, *"Towards Atomically Precise Supported Catalysts from Monolayer-Protected Clusters: The Critical Role of the Support"*. Chem. Eur. J. 2020, 26, 7051.
- A. Pihlajamäki, J. Hämäläinen, J. Linja, P. Nieminen, S. Malola, T. Kärkkäinen, and H. Häkkinen, "*Monte Carlo Simulations of Au38(SCH3)24 Nanocluster Using Distance-Based Machine Learning Methods*". J. Phys. Chem. A 2020, 124, 23, 4827.
- Grinenko, V., Sarkar, R., Kihou, K. et al. *"Superconductivity with broken time-reversal symmetry inside a superconducting s-wave state"*. Nat. Phys. 2020, 16, 789.
- P. Yuan, R. Zhang, E. Selenius, P. Ruan, Y. Yao, Y. Zhou, S. Malola, H. Häkkinen, B. K. Teo and N. Zheng. *"Solvent-mediated assembly of atom-precise gold–silver nanoclusters to semiconducting one-dimensional materials"*, Nat. Commun. 2020, 11, 2229.
- V. M. Stone, M. M. Hankaniemi, O. H. Laitinen, A. B. Sioofy-Khojine, A. Lin, I. M. Diaz Lozano, M. A. Mazur, V. Marjomäki, K. Loré, H. Hyöty, V. P. Hytönen and M. Flodström-Tullberg, *"A hexavalent Coxsackievirus B vaccine is highly immunogenic and has a strong protective capacity in mice and nonhuman primates"*, Science Advances 2020, 6, 19, eaaz2433.
- E. Claesson, W. Y. Wahlgren, H. Takala, S. Pandey, L. Castillon, V. Kuznetsova, L. Henry, M. Panman, J. Kübel, R. Nanekar, L. Isaksson, A. Nimmrich, A. Cellini, D. Morozov, M. Maj, M. Kurttila, R. Bosman, E. Nango, R. Tanaka, T. Tanaka, L. Fangjia, S. Iwata, S. Owada, K. Moffat, G. Groenhof, E. A. Stojković, J. A. Ihalainen, M. Schmidt and S. Westenhoff., "*The primary structural photoresponse of phytochrome proteins captured by a femtosecond X-ray laser*", eLife 2020, 9, e53514.
- G. M. F. Almeida and L.-R. Sundberg, "*The forgotten tale of Brazilian phage therapy*", Lancet Infectious Diseases 2020, 20, 5, E90.
- A. Julku, T. J. Peltonen, L. Liang, T. T. Heikkilä, and P. Törmä, "*Superfluid weight and Berezinskii-Kosterlitz-Thouless transition temperature of twisted bilayer graphene*" Phys. Rev. B 2020, 101, 060505(R).
- K. Sokołowska, Z. Luan, E. Hulkko, C. Rameshan, N. Barrabeś, V. A. Apkarian, and T. Lahtinen, "*Chemically Selective Imaging of Individual Bonds through Scanning Electron Energy-Loss Spectroscopy: Disulfide Bridges Linking Gold Nanoclusters*" J. Phys. Chem. Lett. 2020, 11, 796.

31
Group leaders*

145
Researchers*

117
Peer-reviewed publications**

Top 5	Author (No. of Publications)
1.	Hannu Häkkinen (12)
2.	Sami Malola (10)
3.	Kari Rissanen (7)
4.	Lotta-Riina Sundberg (7)
5.	Dmitry Morozov (6)

*Data taken from NSC websites on 10.12.2020
**Data taken from Scopus on 15.12.2020, affiliation search with keywords: Nanosci* and Univ* Jyvaskyla