Reaalteaduste doktorantide konverents
Workshop-seminar for PhD students
Abstracts

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0.1 Laurits Puust: Vees lahustuvad järelhelenduvad tsirkoonia nanoosakesed bioloogiliste objektide visualiseerimiseks.

Tartu Ülikool, Füüsika instituut; Tartu University, Institute of physics

TKristallilise tsirkoonia (ZrO_2) nanoosakesed pakutakse välja kui paljulubavad järelhelenduvad materjalid bioloogiliste objektide jälgimiseks. Leidsime, et sool-geel meetodiga valmistatud nanoosakeste dispersioon vees oli tohutult paranenud peale osakeste katmist amorfse SiO_2 kihiga, kusjuures säilitades endiselt piisava järelhelenduse võimekuse.

0.2 Kreete Lüll: Prediabetes traits in association with human gut microbiome.

Tartu Ülikool, Molekulaar ja rakubioloogia instituut; Tartu University, Institute of molecular and cell biology

The importance of the human gut microbiota and microbiome in health and disease is becoming gradually clear. Recently publications have shown that gut bacterial plays a crucial role in host metabolism, the gut-brain axis, and immune system development, regulation, etc. Dysbiosis - microbial imbalance in the body - may lead to different types of pathological conditions, such as cancer, both type I and type II diabetes, obesity, and gastrointestinal diseases. During recent years, next generation sequencing has provided insight into host-microbiome interactions.

Type II diabetes (T2D) has become a global public health concern. In 2011, there were 366 million people affected by T2D globally and it is estimated that by 2030 the number will rise to 522 million, which means that T2D is the fastest growing illness in the world. Although T2D has a global impact and receives abundant funding, the cause of the illness remains a mystery. Recently, there has been an increase in research focused on the role of the microbiome in various diseases, including T2D. Currently, I am concentrating on the predisposition of T2D and its association with gut microbiome.

Presently, we have gut microbiome 16S rRNA sequencing data from 929 men from METSIM (METabolic Syndome In Men) cohort, collected from Easter Finland. For 212 individual we have microbiome data from two different time points. Together with microbiome data, there are also thorough phenotype, gene expression and blood metabolites (lipids, amino acids, triglycerides etc.) information for these 929 samples. In my study, I compare healthy individuals with individuals with symptoms indicative of prediabetes, such as elevated glycated hemoglobin (HbA1C), impaired fasting blood sugar levels, high levels of lipids. I compared all the healthy individuals within the same time point with those who had probable prediabetes based on oral glucose tolerance test (OGTT). Secondly, I compared the microbiome of those people who in the first time point had normal OGTT results, but in the second time point had developed prediabetes. In the preliminary results, I could see that the biggest changes within these groups are on genus level in two genera from phylum Bacteroidetes and one genera from phylum Firmicutes that had statistically significant p-values. Plaudibacter (p-value=0.016) and an unknown genus from Porphyromonadaceae family (p-value=0.044), and Oscillibacter (p-value=4.70e-3), respectively.

0.3 Faiza Summer: The magic of electric double layer of charges

0.4 Janek Urvik: The slow pace of seabird life

Tartu Ülikool, Ökoloogia ja maateaduste instituut; Tartu University, Institute ecology and earth sciences

For a bird, life at sea offers good possibilities for applying a slow pace-of-life, mainly due to low predation risk. Accordingly, many seabirds live long lives and exhibit low yearly reproductive output, two main traits that are indicative of a slow pace-of-life. In a breeding colony of known-aged common gulls (*Larus canus*) inhabiting a small islet at the Baltic Sea, I and my colleagues have conducted a series of studies measuring age-dependence of various physiological traits, as well as traits related to sexual signaling and reproduction. In the presentation, I will summarize the results of our studies which demonstrate that as a long-lived species, the common gull does indeed invest in somatic maintenance over reproduction.

0.5 Siiri Külm: Values and changes in Estonian cemetery landscape.

Eesti Maaülikool, Põllumajandus- ja keskkonnainstituut; Estonian University of Life Sciences, Institute agriculture and environmental sciences

The cemetery landscape of Estonia has been influenced through different eras and historical rulers. Therefore, the mixture of religions and different burial traditions aside with many historical events have formed a unique cemetery landscape. Understanding the significance of multicultural cemetery landscape's value has an important role in preservation of cultural heritage. In the same time new trends are changing the look of traditional cemeteries and in the long run the way how our next generations will see the landscape of cemeteries. Fact that cremation is becoming more and more popular among (Estonian) people is obvious. How to preserve historical cemetery landscape and combine new burial traditions with their design elements into old ones is an important question to find answers to.

0.6 Martin Kala: Identification of cellular transcription factors modulating human papillomavirus life cycle

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0.8 Taavi Riit: Oomütseetide globaalne mitmekesisus

0.9 Yauhen Yakimenka: Mini Heartcatcher : Error Correction: Noise, Codes, and Linear Algebra

Tartu Ülikool, Arvutiteaduse instituut; Tartu University, Institute of computer science

My research is about iterative methods of error correction. These methods are usually not optimal (i.e. they don't correct all the errors) but they are very fast. And with current developments of extremely fast transmission media (recall fibre optics on the beds of the oceans), the speed becomes more important.

In my talk, I will briefly introduce the importance of error correction in everyday usage of internet, and then give an example of hot this magic works on a toy example of repetition code. We'll end with discussing modern challenges in information transmission.

0.10 Annika Meitern: Diurnal patterns in plants

0.11 Jinfeng Zhao: Electric double layer structure and energy storage characteristics of ionic liquid based systems

Tartu Ülikool, Keemia instituut; Tartu University, Institute of chemistry

Ionic liquids are widely studied in many electrochemical applications owing to their tunable physicochemical properties. And ionic liquids have been proposed as alternative electrolytes for supercapacitors, solar cells, fuel cells and secondary batteries. The electrochemical reactions at the interface reflect the interfacial processes. Theoretically, water is undesirable for non-aqueous electrolytes composed of ionic liquids. Whereas, adding small amount of water to ionic liquids could increase the conductivities. Here, we study the effects of water on the electric double layer capacitance at ionic liquid | electrode interfaces. The large capacitance effects suggests this ionic liquid with small amount of water could be a candidate electrolytes for supercapacitors. Thus, studying the electrical double layer structure in ionic liquids is important to provide fundamental understanding for application of ionic liquid based systems.

0.12 Marko Eltermann: Vees lahustuvad järelhelenduvad tsirkoonia nanoosakesed bioloogiliste objektide visualiseerimiseks.

Tartu Ülikool, Füüsika instituut; Tartu University, Institute of physics

Gas sensors can be found in various applications, such as smoke sensors, breathalysers and exhaust systems. A common example of a gas sensor is the human nose, which is an example of a universal gas sensor that can detect various smells and odours. We are investigating a TiO_2 based gas sensor material that operates in a dual mode. On one hand it operates as a typical electrical gas sensor, but on the other hand, it is also a photoluminescence based optical gas sensor. Our current work tries to improve the precision of the sensor by combining the two sensing mechanisms. The present work focuses on oxygen sensitivity, but we have data that indicates that the material can detect NH_3 and potentially other gases as well.

0.13 Sandhra-Mirella Valdma: Measuring the speed of light in optical fiberse

Tartu Ülikool, Füüsika instituut; Tartu University, Institute of physics

Optical fibers — usually not seen by public but used daily by many through telecommunication. The wider field called photonics – science of light, is said to be the electronics of the 21st century. The importance of the field is also supported by European commission, who has chosen photonics as one of the five key-enabling technologies of this century.

Furthermore, during the recent years, the optical fiber industry has seen a considerable growth not only to due the telecommunication but also medicine, military and sensing. This in turn has increased the development of new types of fibers, which has established a need for convenient and quick methods for characterizing the properties of the fibers. One of the most important being the speed of light at different wavelengths, also called dispersion of light.

The aim of this work is to develop a new method for measuring the dispersion of optical fibers in visible wavelength range. We are redesigning an already known optical method called SEA TADPOLE, which previously has been used for characterizing light fields and measuring their speed, for the current project. As this method has not been previously used for neither refractive index or dispersion measurements of optical materials, this work will provide us many new insights. We will plan to provide proof-of-principle measurements by measuring one most widely spread type of fibers — single mode step-index fibe, - and compare our results with already existing methods.

In conclusion, this method shows a great promise for single-shot fiber dispersion measurements in a wide spectral range and thus provides an important input for fiber industry. Subsequently, in the future this method can be further developed for usage in telecom wavelengths and perfected to be able to resolve different dispersions.

0.14 Diana Pungar: Connectivity and landscape patterns in human dominated landscapes

Eesti Maaülikool, Põllumajandus- ja keskkonnainstituut; Estonian University of Life Sciences, Institute agriculture and environmental sciences

The scientific importance of the paper is to get valuable data about human dominated landscapes in order to obtain a suitable data set for modelling vegetation change. The fieldwork was carried out from 2015 to 2017. 250 areal and linear plots were recorded and their characteristics and frequency described.

The results of the data comparison based on the fieldwork and the Atlas of the Estonian flora demonstrates the efficiency of the methodology. 433 species were recorded which is 24% of all species in the country. However, as the target of the research is to emphasize on the disturbed areas, the rare species (less than 30 records in the atlas) were left out. With this selection criterion, the database involves 42% of all common species in Estonia.

The main results are: firstly, invasive species are found especially in linear elements such as roadsides and lines of trees. Furthermore, the amount of bare ground gives spare room for extra colonization for new species.

Secondly, different habitats are vulnerable to robust and vigorous invasive species as *Galega orientalis*, *Bunias orientalis* and *Lupinus polyphyllus* and competitive local species such as *Filipendula ulmaria* and *Epilobium angustifolium*. Analysis of the Atlas of Estonian flora shows trends in species distribution. For example, *Lupinus polyphyllus* is mostly prevalent in Southern-Estonia, but it is spreading rapidly, causing changes in vegetation distribution in several habitats, including forests.. Comparison of clear felled areas and forest habitats show obvious changes in vegetation composition. Disturbed soil makes the habitat vulnerable - new species have potential to invade and take advantages in spreading. At the same

time, the number of forest species is decreasing.

The research shows that the habitats, with human impact has a great role in species colonization and hence their contribution to connectivity.

0.15 Heiki Lill: Capacitor and Battery Energy Storage System Sizing Ratio for Wind Microgenerators.

Eesti Maaülikool, Tehnikainstituut; Estonian University of Life Sciences, Institute of Technology

The power output of wind farms is directly dependent on the instantaneous wind speed. At variable weather conditions there will be an instantaneous excess of electrical power that cannot be stored by a conventional battery bank. In recent years, great progress has been made in the development of short term storage units like ultracapacitors, which are capable of absorbing high power pulses within seconds. Another advantage of ultracapacitors is a high number of charge cycles. This article focuses on a hybrid energy storage system consisting of ultracapacitors and a battery bank. Ultracapacitors are used to store temporarily the energy that the batteries are unable to absorb due to the power limit in the charging process caused by their electrochemical properties. Afterwards the energy stored in the capacitors is transferred to the batteries. The article is focused on the optimal battery-to-capacitor ratio. The hypothesis is a storage capacity ratio of 1:1500 in favour of batteries. Simulations on the basis of measured solar and wind production data are made for this purpose.

0.16 Kristian Kuppart: Materjalide arvutisimulatsioonid fundamentaalfüüsika teenistuses

0.17 Olivier Etebee Nonga: Designing a "working" drug molecule — challenges.

Tartu Ülikool, Keemia instituut; Tartu University, Institute of chemistry

In the family of interactions taking place between an enzyme and its bisubstrate inhibitor, there are some which are preferred. All becomes more interesting when conformational (3D) rearrangements of the molecules come into play. Here, we deal with designing an inhibitor for a mutated enzyme B, which should have better selectivity towards B (wild-type) than Bm (mutant).We expose the challenges of the enzymes'interaction with their inhibitor due to those rearrangements in aqueous solution.

0.18 Oleksandr Karasov: Mini Heartcatcher — How to measure colour harmony of landscape? A mapping approach.

Eesti Maaülikool, Põllumajandus- ja keskkonnainstituut; Estonian University of Life Sciences, Institute agriculture and environmental sciences

The concept of colour harmony, being rarel used in geography, landscape and environmental studies, has been significantly developed in psychology, art and computer science. We borrowed some principles of colour harmony from the psychological literature and attempted to investigate the ways of mapping the colour harmony of landscape, based on satellite Earth observations, as well as to explain its spatial variability. The naturalness of

environment, as well as heat and moisture balance, are confirmed to be the main drivers of landscape colour harmony. We used the crowdsourced photographs, collected from Mapillary service, to link satellite and ground-based estimations of the colour harmony on "proof of concept" level. Therefore, remote sensing data provide a significant support for nature conservation and sustainable nature management, especially for mapping of the colour harmony of landscape as important indicator of environmental beauty.

0.19 Upendra Bhele: The Ecospace model as a simulation tool for spatial planning scenarios of fish biomass in a large shallow lake.

Eesti Maaülikool, Põllumajandus- ja keskkonnainstituut; Estonian University of Life Sciences, Institute agriculture and environmental sciences

We wanted to examine the combined effects of climate change and human activities (fishing fleets and gear) on the fish biomass distribution in a large shallow eutrophic lake located in Estonia (northeastern Europe) using Ecospace model (Ecopath with Ecosim modelling suite). We simulated and analyzed the spatiotemporal model results for 37 years of data consisting in 19 functional group including 3 multi-stanza (larvae, juvenile & adult) for predator fishes (pike and pikeperch), also including two fishing fleets. The results showed that the spatial distribution of fish biomass was very uneven in the lake, with the southern province exhibiting a greater fish concentration than all other regions combined. The density of macrophytes and inaccessibility to fishing fleet were the main cause for such discrepancies. We also introduced spatial scenarios based on one-meter lake water level rise or decrease for predicting changes in species population density, distribution and fishery pattern. The 1m decrease scenario caused a diminution in surface area as well as in biomass of several species including the phytoplankton and fishes. With respect to control, the fishing pattern clustered in a few specific areas and was reduced overall. In 1m increase scenario caused a weak decrease in all the species biomass whereas the fishing effort is similar to the control model. The simulation of these scenarios would be effective tools for future spatial management regulation where fishing resources ought to be protected.

0.20 Syed Hamim Jeelani: Proterozoic Granite Magmatism along the western margin of Nellore Schist Belt — An Implication on crustal accretionary processes

Tartu Ülikool, Ökoloogia ja maateaduste instituut; Tartu University, Institute ecology and earth sciences

Rapur area forms southern part of the Nellore schist belt of Andhra Pradesh. The area under study located between latitude 14° 15' 00" and 14° 11' 30" and longitude 79° 32' 55" and 79° 37' 30"and covers an area about 30 Km^2. The dominant rock types exposed in the area are Metabasalt, Quartz Mica Schist, Quartzite belonging to Nellore Schist Belt (NSB), undifferentiated granitoids of PGC II and younger acidic and basic intrusives. These granitoids are sandwiched between NSB and Nallamalai Fold Belt (NFB) rocks, which are exposed along eastern and western side of the mapped area.

The unclassified granitoids of the area has been mapped and classified on the basis of their modal percentage, mineralogical and geochemical characteristics, which are grouped into two suites: 1. Tonalite-Granodiorite-Monzonite suites (TGM) 2. Monzonite-Syenite suite (MS).

Rapur area predominated by TGM suite of rocks, which includes mainly Hornblende Biotite Gneiss and Orbicular Granite. Hornblende Biotite Gneiss aretonalitic to granodioritic in composition. The gneissosity is defined by parallel alignment of mafic and felsic minerals in the Hornblende Biotite Gneiss. Gneissosity plane is parallel to the schistosity of metabasalt of NSB trending NW-SE direction defining the regional foliation in the area. The orbicular granite, a variant of Hornblende Biotite Gneiss, contains oval to orb-shaped phenocryst of plagioclase and k-feldspar set within fine grained matrix of quartz, feldspars, biotite and hornblende. The MS suites of rock consist of alkali feldspar granite and monzogranite, which are exposed near Marlapudi and NE of Rapur. The alkali feldspar granite intruded along NS trending plane, while Monzogranite intruded along NE trending axial plane of regional F3 fold.

0.21 Jonathan Willowi: Synergistic interaction between thiacloprid and tebuconazole, and its effect on the parasitoid wasp *Aphelinus abdominalis*

Eesti Maaülikool, Põllumajandus- ja keskkonnainstituut; Estonian University of Life Sciences, Institute agriculture and environmental sciences

Parasitoid wasps can be effective biological control agents in agroecosystems, often suppressing crop pest populations below thresholds associated with economic loss. However, many farmer still apply pesticides to control crop pests, even though research indicates lethal and sublethal effects on parasitoid wasps of ecological and economic importance. In practice, different types of pesticides are tank-mixed and applied simultaneously to agricultural fields, though pesticide risk assessments on parasitoid wasps have not accounted for this. The present study examines the lethal and sublethal effect of the neonicotinoid insecticide thiacloprid at manufacturer's recommended dose (MRD), and the effect of mixing thiacloprid at one tenth MRD with the fungicide tebuconazole, using the parasitoid wasp *Aphelinus abdominalis* as a model organism. We exposed the insects to dried residues of thiacloprid with- and without tebuconazole added, and monitored the effect of each treatment on survival and functional motor skills (FMS). Exposure to thiacloprid at MRD resulted in significant mortality and loss of FMS. Thiacloprid at one tenth MRD showed a synergistic interaction with tebuconazole when mixtures contained the latter in concentrations as low as one twentieth MRD and one half MRD, for mortality and loss of FMS respectively. Furthermore, the effect of thiacloprid became significantly greater when containing concentrations of tebuconazole as low as one-and-a-half MRD and one half MRD, for mortality and loss of FMS respectively. Our observations confirm the lethality and sublethality of thiacloprid on aphelinid-and similar parasitoid wasp populations. Moreover, we reveal the risk that tank-mixing thiacloprid and tebuconazole imposes upon parasitoid wasp populations. These results have profound implications for updating the methods by which we perform pesticide risk assessments on non-target organisms.

0.22 Martti-Jaan Miljan: Timber based composite structures and the case study of the use of glulam structures made of grey alder | Puidupõhiste liitkonstruktsioonide omadused ja nende kasutusvõimalused kandekonstruktsioonides lepast liimpuidu põhjal.

Eesti Maaülikool, Metsandus- ja maaehitusinstituut; Estonian University of Life Sciences, Institute of Forestry and Rural Engineering

Hardwood species of grey alder (*Alnus incana*) is widely spread throughout the whole of Europe, in Asia, in North-America and also in Estonian forests. Grey alder grows fast in a good habitat. It reaches felling size in only 30 years, and, therefore, it does not start to rot during growing. When grown densely enough, grey alder becomes quality wood, as the trunk grows branchless and as straight as possible. Taking into account this knowledge, the tests to determine the strength properties of grey alder glued laminated timber as well as intact solid alder timber were carried out at the department of rural building in the Estonian University of Life Sciences. The aim was to find out if grey alder is suitable for manufacturing glued laminated timber and to determine the strength of glued laminated timber on bending parallel to grain and the compression strength perpendicular to grain. Comparison tests were done with intact grey alder solid timber to determine the compression strength perpendicular to grain.

Hall leppast (*Alnus incana*) lehtpuu kasvab nii Euroopas, Aasias kui ka Põhja-Ameerikas. Eesti metsades leidub seda puuliiki rohkesti. Selle juurdekasv on kiire ja umbes 30 aastaga saavutab puu raieküpsuse. Selle teadmise baasilt viidi läbi katsed hallist lepast saepuidu ja liimpuiduga Eesti maaülikoolis maaehituse katselaborites. Eesmärgiks oli leida, kas lepast saepuit sobib liimpuidu tootmiseks ja millised on liimpuidust materjali tugevusomadused paindele pikikiudu ja survele ristikiudu ja milline on materjali tihedus antud tugevusnäitajate juures. Läbi viidi ka võrdluskatsed lepapuidust saepuiduga.