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Other Institutes



Book of Abstracts

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A simple diagram to classify meteoroid impacts

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One of the important steps in the prediction of an impact threat to Earth raised by potentially hazardous asteroids is the understanding and modeling of the processes accompanying the object's entry into the terrestrial atmosphere. Such knowledge enables characterization, simulation and classification of possible impact consequences. For observed meteor events the reconstructed atmospheric trajectory is the key to deriving the pre-impact meteoroid's orbit in the Solar System on one hand, while on the other hand, it is also a required for dark flight simulations which enable to locate surviving meteorite fragments on the ground. Using dimensionless expressions, which involve the pre-atmospheric meteoroid parameters, we have built physically based parametrisation to describe the changes in mass, height, velocity and luminosity of the object along its atmospheric path. The developed model is suitable to estimate a number of crucial unknowns including the shape change coefficient, ablation rate, and surviving meteorite mass. This is a fast and robust method to implement and run on a large dataset with the purpose to classify/group meteoroid impacts and identify which fireballs are producing meteorites. We demonstrate its application using the wide range of observational data from meteorite-producing fireballs appearing annually to larger scale impactors (such as the Chelyabinsk, Sikhote-Alin and Tunguska event). We have used a set of ~300 fireballs observed by the Desert Fireball Network (DFN) in Australia to show how visualisation in the proposed two parameter diagram can quickly identify which fireballs are likely meteorite candidates. In the recent past this approach enabled us to successfully recover the Annama meteorite based on the analysis of the fireball observed by the Finnish Fireball Network in April 2014 as well as the Ozerki meteorite fall in Russia in June 2018.

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Accelerated expansion?

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The standard model of cosmology describes a universe which is currently expanding at an accelerating rate and which has an energy content of largely unknown physical origin. The model fits convincingly with observations but the theoretical foundations of the model are extremely weak.

In this talk I will give a brief overview of standard cosmology with a focus on both its strengths and its weaknesses. Then, I will introduce different attempts at overcoming the shortcomings of the model, focusing mainly on the particular attempt known as cosmic backreaction. Cosmic backreaction is an effect that appears when taking the structures of the Universe into account in the Einstein equations and can e.g. appear if regions in space are either larger or smaller than they appear to be from the outside. In principle, cosmic backreaction can make both dark matter and dark energy obsolete and reduce the accelerated expansion to an illusion. Unfortunately, quantifying cosmic backreaction and relating it to observables is proving to be extremely difficult. However, upcoming astrophysical surveys will yield data that can be used to put the standard model of cosmology to the test. If observational data passes these tests there is still room for small effects of cosmic backreaction. If, on the other hand, the data fails the tests, the standard model of cosmology will have been falsified at its most fundamental levels and all bets will be off...

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Atmosphere turbulence spectra as the result of external periodical forcing

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We present results of experimental and numerical study of the flows of incompressible fluid in a layer between concentric spheres. We show that periodical forcing in the form of outer sphere rotational rate modulation can provide transition from periodical flow to turbulent one. This turbulent flow is spatially non-uniform. Near the inner sphere, where the synchronization between outer sphere and flow velocity is weak, three-dimensional turbulence is observed with the spectra slope close to $-5/3$. Near the outer sphere, where synchronization is strong, the spectrum slope at low frequencies is -3 , at higher frequencies $-5/3$. In both cases third order structure velocity function was found negative. Properties of the latter kind of turbulence are similar to the properties of turbulence in the upper Earth atmosphere, obtained by in situ measurements.

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Contributed talk: A simple diagram to classify meteoroid impacts

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Contributed talk: Accelerated expansion?

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Contributed talk: Empowering integration of art and science, facing climate change together

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Contributed talk: Identifying oral cancer biomarkers from saliva and oral soft tissue using near-infrared spectroscopy

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¹ *University of Eastern Finland*

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Contributed talk: Nuclear astrophysics, role models and efforts for better gender balance

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Contributed talk: Small biases on appreciation that lead to substantial and harmful effect of segregation in task centered groups: An agent based simulation of discourse pattern formation

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Contributed talk: Taming Macromolecules by Light - Supramolecular Photobreathing Zwitterionic Micelles

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Contributed talk: Women in Radio Science

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Effect of noise on the selection of the flow wave number after the first instability

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In a series of spherical Couette flow experiments, we have considered how the selection of one from the two possible wave numbers in the onset of azimuthal waves following the first instability depends on the noise amplitude. Noise perturbations were added by introducing small disturbances with zero mean into the inner sphere rotational speed signal while it was increased linearly from a subcritical flow to supercritical one. With weak noise transition to azimuthal wave number $m=3$ was found to occur, while with noise amplitude increasing, preferable wave number became $m=4$. It was shown that the action of imposed noise leads to energy transfer from initially preferred to corresponding damped mode, increasing both its maximum amplitude and increment of growth. This work was supported by the Russian Foundation for Basic Research, projects nos. 19-05-00028 and 18-08-0074.

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Empowering integration of art and science, facing climate change together

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Physical sciences work on questions that require collaboration over field of science and other boarders. Communication on climate change is an example of when a set of answers that are focused on principles and physical processes behind the problem is not enough for the information to be received by non-scientists. Facing climate change causes can cause defense mechanisms such as denialism, and Hulme (2015) concludes that we cannot find solutions on facts alone but it is also crucial to cultivate adequate spaces of public encounter and listening. Head and Harada (2017) found out that climate change scientists often suppress painful emotions, use humor and switch off from work to protect themselves. Davenport (2017) recommend facing feelings such as worry, anger and regret and fostering and practicing resilience e.g. in the form of transformational leadership that supports hope and action. Art can provide an alternative path, it activates viewers more than engagement or participatory activities (Sommer et al., 2019).

University of Helsinki and Arts University organize joint intensive master & doctoral student courses that emphasize dialogue, communication and language. How is information about climate change and its impacts communicated and understood? How can this be utilized in society to promote solutions? What kind of feelings we experience when facing climate change? Can we turn them into an asset? The collaboration was piloted in spring 2018 with Think Like a Forest residential course (<https://blogs.helsinki.fi/vallisaari/>). Climates of Change course, spring 2019, continued the collaboration and focused on gaining insight on art - atmospheric science collaboration.

The courses aim at: 1) Exchange of skills and knowledge; Participation, discussions and group work reveal practical means to address climate change and foster ideas of how artistic and scientific work contribute to working towards solutions of climate change. 2) Creation of new practices: Emphasizing integration, this transdisciplinary workshop will support emerging new practices in short and long term. 3) Empowering; Students rightly view climate change as a phenomenon of complex factors. They express anxiety and powerlessness in relation to it. We support students in becoming the

agents of change. Students gain skills, information and experiences for different forms of working cultures.

In our experiences bringing students from different backgrounds together, building trust and collaboration among the diverse group the students is very productive. The course participants faced climate changes eco-anxiety and –hope on personal as well as societal level. Working together has been inspiring and activating as the teachers and students shared different approaches and gained new insights from one another.

Head & Harada, *Emotion, Space and Society*, 2017

Hulme, *Zygon*, 2015

Sommer, Klöckner & Andreas. *Psychology of Aesthetics, Creativity, and the Arts*, 2019

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Identifying oral cancer biomarkers from saliva and oral soft tissue using near-infrared spectroscopy

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Oral cancer and oral infectious lesions are among the six most frequent oral diseases globally. The symptoms of these diseases tend to overlap which makes accurate diagnosing with visual inspection or palpation harder. Novel techniques that can identify the type of oral lesion before they are visually observable are needed. This study aims to identify common oral cancer biomarkers from saliva and oral tissue using near-infrared spectroscopy (NIRS) that is a non-ionizing optical imaging method that measures transitions in vibrational levels through the IR-absorption. NIRS studies of oral cavity need to take account on saliva due to its high water content that has a strong NIR absorption around 1450 nm and 1940 nm. Saliva contains locally expressed proteins and substances called biomarkers. The concentration of proteins and substances in saliva change when diseases appear. Oral cancer cells shed into saliva already in early stage, and oral epithelial cells shed constantly. Measurements were conducted for L-proline and L-fucose in liquid solution (1:1, 1:10, 1:100, 1:1000), for pure proline and fucose, for saliva sample of two oral cancer patients and for pig gums *ex vivo*. The aim was to find wavelength regions that best discriminate solutions with different concentrations, saliva and pig gums from pure water. Discriminating wavelengths could be used to identify oral cancer biomarkers. Reference measurements were done from samples of L-fucose and L-proline pressed into 3 mm thick tablets. Pig gum samples stored in salt solutions were measured to see if there are any similarities between the biomarkers and the gums. The setup used in this study consists of two spectrometers, a light source and a customized arthroscopic optical fiber probe. The absorbance spectra were calculated from the raw data using Beer-Lambert law $A = -\log_{10}[(S - D)/(W - D)]$, where A absorbance, S sample, D dark reference and W white reference. The spectra of fucose and proline solutions and saliva were dominated by the strong absorption of water. Spectra of pure fucose and proline samples showed the absorption bands characteristic to those substances. The spectra of the pure samples were compared with the spectra of the solutions and the saliva. Comparison fails to show enough similarities between the spectra. Water absorbance overlaps the absorbance peaks of proline and fucose in the water solutions. In the liquid samples some peaks were not assigned to water, but those peaks could not be assigned to fucose or proline either. Spectra of pig gums had strong water absorptions bands and bands that can be assigned to C-H, N-H and O-H groups. These preliminary results show that identifying biomarkers from water solutions is impossible. Pig gum measurements show possibility of identifying biomarkers. Sample preparation needs refining to get better results.

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Introduction to poster session

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Invited Talk: Earthquakes: From mega to micro

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Invited Talk: Emerging Materials for Photovoltaics: towards Solar Paint

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Invited Talk: The Ghostly Messengers of the Universe

Neutrinos are key particles in a wide range of astrophysical sources. Neutrinos affect the stellar dynamics, drive the formation of new elements, and carry information about the physics of the most energetic events occurring in our Universe. The role of neutrinos in astrophysics and astronomy will be discussed.

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Invited Talk: Urban Meteorology

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Invited Talk: Women and Physics in Denmark

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Invited Talk: Women and Physics in Finland

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Invited Talk: Women and Physics in Iceland

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Invited Talk: Women and Physics in Norway

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Invited Talk: Women and Physics in Sweden

Gender equality is a widely debated topic at many levels of society in Sweden. In the early 1990s, there were only few universities in Sweden, with about 2000 professors, of whom only 7 % women. Since then, a series of reforms and initiatives changed the structure of the higher education system, aiming to increase the number of universities as well as of women in permanent lecturer positions or higher ranks. Dedicated committees and special appointments based on gender are two examples of initiatives aiming to balance the unequal treatment of women over the years, even if this is widely recognized not to be the best way for the achievement of an effective gender equality. How does the picture look for women physicists today? Which are the opportunities and the future perspectives offered? In this talk, we will briefly present statistics in Sweden, trying to understand which are the measure taken to retain women in Physics, and which are the current opportunities offered to both women and men to advance their careers.

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Key Note Talk: Implicit Bias in Academia

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Key Note Talk: Science and Diversity at CERN

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Nuclear astrophysics, role models and efforts for better gender balance

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Nuclear astrophysics is an exciting research field combining nuclear physics, astronomy, and astrophysics to better understand astronomical events and the origin of chemical elements in the Universe. In the European nuclear astrophysics research network ChETEC (Chemical Elements as Tracers of the Evolution of the Cosmos) 1, we are striving to obtain a better gender balance e.g. by aiming to have at least 30% women representation in all management structures and events, and systematically monitoring this. We have also chronicled a selection of twelve outstanding women [2] who helped to develop nuclear astrophysics and presented the work as a poster in conferences and outreach events. Female role models reduce the impact of stereotype threat on women, i.e., the risk of conforming to a negative stereotype about one's social, gender, or racial group [3,4]. Women scientists may underperform or leave their scientific career because of negative stereotypes such as, not being as talented or as interested in science as men. Sadly, history rarely provides role models for women scientists; instead, it often renders these women invisible [5]. The ChETEC poster [6] is aimed to tackle this issue and is freely available. In this contribution, I will shortly introduce nuclear astrophysics and discuss activities done within the ChETEC network for better gender balance.

1. www.chetec.eu

2. C.V. Hampton et al., Springer Proc.Phys. 219 (2019) 367-372. https://doi.org/10.1007/978-3-030-13876-9_67 ; arXiv:1809.01045 [physics.hist-ph]
3. C. Fine: Delusion of Gender, p.36, W.W. Norton & Co., NY (2010), ISBN 0-393-06838-2
4. C.M. Steele, and J. Aronson, Journal of Personality and Social Psychology, 69, pp.797-811 (1995). <http://dx.doi.org/10.1037/0022-3514.69.5.797>.
5. CafeBabel Homepage, <http://www.cafebabel.co.uk/society/article/georgette-sand-when-history-makes-women-invisible.html>, last accessed 2018/7/24.
6. <http://www.chetec.eu/news/nic-poster-women-scientists-who-made-nuclear-astrophysics.pdf/view>

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Panel discussion about Unconscious Bias, by Prof. Jadranka Gvozdanovic, Prof. Tomas Brage, Chairperson of the Helsinki Association of Women Researchers Päivi Salmesvuori - Moderator Katja Lauri

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Privilege walk & discussion, Prof. Hanna Vehkamäki

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Small biases on appreciation that lead to substantial and harmful effect of segregation in task centered groups: An agent based simulation of discourse pattern formation

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Interaction and discourse patterns in a small, task centered group are known to be affected by group member's views of their own competency regarding the task as well as their views about their peers' competencies. Such a mutual comparison is an important factor in formation of one's self-efficacy and proficiency in a task centered group, in learning as well as in professional life. Perhaps the most common and ubiquitous situation where such social actions constantly and in subtle ways take place, is a situation of discussions and discourse, and the weak mutual signals of appreciation mediated in that discourse 1. It can be assumed that in such situation the mutual appreciation and collaboration patterns form largely through the group's internal social dynamics when group members compete for floor in discourse. Here we approach such discourse pattern formation through the agent-based model (ABM). In the ABM introduced here the agents' interactions and participation in discussions are dependent on the agents' inherent potential activity to participate in discussion and on realized, externalized activity, discursivity. The discourse patterns are assumed to be outcomes of peer-to-peer comparison events, where agents competitively compare their activities and discursivities, and where activities also affect agents' cooperation in increasing the discursivity, i.e. floor for discourse. These two effects and their influence on discourse pattern formation are parameterized as competitiveness α and cooperativity λ . The discourse patterns are here based on the agents' discursivity. The

patterns in groups of four agents up to seven agents are characterized through triadic census (i.e. though counting triadic sub-patterns). The cases of low competitiveness α is shown to give rise to fully connected egalitarian, triadic patterns, which with increasing competitiveness are transformed to strong dyadic patterns. An increase in cooperativity λ enhances the emergence of egalitarian triads and helps to maintain the formation of fully and partially connected triadic pattern also in cases of high competitiveness. In larger groups of six and seven agents, isolation becomes common, in contrast to groups of four agents where isolation is relatively rare. These results are in concordance with known empirical findings of discourse and participation patterns in small groups. The results also point out that very subtle bias-effects, weak signals of feedback, may have tremendous effect when the same signals and feedback are repeated, eventually leading to strong and irreversible segregation of groups.

1 Ismo T. Koponen and Maija Nousiainen. An Agent-Based Model of Discourse Pattern Formation in Small Groups of Competing and Cooperating Members. *Journal of Artificial Societies and Social Simulation* 21(2) 1, 2018. Doi: 10.18564/jasss.3648 Url: <http://jasss.soc.surrey.ac.uk/21/2/1.html>

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Taming Macromolecules by Light - Supramolecular Photobreathing Zwitterionic Micelles

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Dynamic self-assembly of synthetic components, i.e. self-assembly driven and sustained by a flux of energy into the system, is promising for creating artificial, life-like, material systems. Visible light is an attractive tool for such flux, because of its high resolution, temporal and spatial control, and absence of contamination, as there is no need for physical contact between the stimulus source and the material. In this contribution, we demonstrate that spiropyran can be loaded into custom-synthesized micelles consisting of poly(styrene)-block-poly(3-(4-vinylpyridin-1-ium-1-yl)propane-1-sulfonate) (PS-P4VP-zwitter) by taking advantage of supramolecular interactions in a polar organic solvent. The loading (during which the merocyanine diffuses into, and is stabilized by, the zwitterionic micelle cores) is triggered by illuminating the spiropyran with UV-light.

By virtue of this supramolecular strategy, we can control the extent of the photoinduced size change in the PS-P4VP-zwitter system, which is not possible for conventional covalently bound systems due to the number of photoresponsive units being fixed by synthesis. The micelles shrink upon illumination when there is a low amount of spiropyran in the solution (1:0.5 and 1:1 molar ratio of zwitterionic repeat units to spiropyran), similar to what was reported for micelles consisting of spiropyran covalently grafted to polymers. When the ratio is increased to 1:2, the size of the micelles increases drastically upon illumination of the micelles with UV-light. The diameter of the micelles continues to increase (up to 110 %) with an increasing amount of spiropyran present in the solution until a 1:5 ratio. This change in size is reversible and can be reversed by visible light, leading to a “photobreathing” supramolecular system. The possibility of alternating between the “inhalation” and “exhalation” of the small-molecule cargo by light also opens avenues towards micellar nanoreactors, in which the reaction rate and direction can be controlled by an external stimulus.

Welcome / 9

Welcome by NORNDiP Conference Chairperson

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Welcome by the Vice-Rector of the University of Helsinki

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