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List of Abstracts

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http://euler.doa.fmph.uniba.sk/TrojKralKonf.html

The following is the list of abstracts for the talks presented at the conference ordered alphabetically with respect to the last name of the presenter.

Broňa Brejová, brejova@dcs.fmph.uniba.sk,

From a Myriad of Short Strings to Biological Discovery

The last decade has witnessed a great revolution in DNA sequencing technologies, which became several orders cheaper and faster than before. Although DNA molecules in our chromosomes consist of hundreds of millions of nucleotides, most DNA sequencing machines are able to read only short fragments of DNA. I will discuss several bioinformatics problems related to processing of DNA sequencing data which are interesting from both theoretical and practical point of view. In our research group, we have developed several tools for such data based on probabilistic models which is a very natural choice given that mutations in DNA as well as the sequencing process have a stochastic nature. I will conclude with examples of biological discoveries which were results from our collaboration with genome sequencing consortia and local biology research groups.

Dominik Csiba, cdominik@gmail.com,

Stochastic Dual Coordinate Ascent with Adaptive Probabilities

This paper introduces AdaSDCA: an adaptive variant of stochastic dual coordinate ascent (SDCA) for solving the regularized empirical risk minimization problems. Our modification consists in allowing the method to adaptively change the probability distribution over the dual variables throughout the iterative process. AdaSDCA achieves provably better complexity bound than SDCA with the best fixed probability distribution, known as importance sampling. However, it is of a theoretical character as it is expensive to implement. We also propose AdaSDCA+: a practical variant which in our experiments outperforms existing non-adaptive methods.

Ondrej Chvala, ondrejch@gmail.com,

Introduction to reactor theory for general physicists

Zuzana Fecková

Vplyv klastrov na fluktuácie multiplicity pri ultrarelativistických jadrových zrážkach

Pre výskum fázového diagramu silno interagujúcej hmoty v relativistických jadrových zrážkach sú vhodnou pozorovateľnou veličinou fluktuácie protónovej multiplicity, predovšetkým vyššie momenty ich rozdelenia. Ich nemonotónna závislosť na energii zrážky by mohla odhaliť prítomnosť kritického bodu. My sme sa zamerali na výskum vplyvu formovania klastrov, predovětkým deuterónov, v koncovej fáze zrážky na rozdelenie protónovej multiplicity. Pozorovali sme výrazný pokles tretieho a štvrtého momentu rozdelenia pri nízkych energiách, s rastúcou tendenciou v závislosti na energii zrážky.

Jana Fodorová,

Kvarkóniá v jadrovej hmote

Dalibor Froncek, dalibor@d.umn.edu

Groups, cycles, and hypercubes

Let G be a graph with a vertex set V of order n, Γ an Abelian group of order n, and f a bijection $f : V \to \Gamma$. We define the *weight* of a vertex x as the sum of the labels of its neighbors, that is,

$$w(x) = \sum_{xy \in E(G)} f(y).$$

When all vertices have the same weight, say $w(x) = \mu$ for every x, then f is called a Γ-*distance magic labeling* and G is a Γ-*distance magic graph*.

A *Cartesian product* of cycles C_k and C_m, denoted $C_k \times C_m$, can be visualized as follows. Take km vertices and place them in a $k \times m$ grid. Then join each row of vertices by a copy of C_m, and each column by a copy of C_k.

A d-dimensional hypercube is a graph with vertices represented by binary strings of length d where two vertices are joined by an edge if and only if the strings differ in exactly one position. Observe that $Q_4 \cong C_4 \times C_4$ and in general $Q_{2m} \cong C_4 \times Q_m$.

We present some results on Γ-distance magic labelings of hypercubes and products of cycles and pose several open problems.

Lukáš Kramárik,

Jety ťažkých kvarkov

Karol Kovařík, karol.kovarik@gmail.com

Tmavá hmota - signál fyziky za štandardným modelom

Viaceré astrofyzikálne merania v posledných 10-15 rokoch naznačujú existenciu tmavej hmoty. Jedným možným vysvetlením tmavej hmoty sú takzvané slabointeragujúce ťažké častice (WIMP), ktoré však v Štandardnom modeli chýbajú a preto by objavenie tmavej hmoty automaticky znamenalo prelomový objav fyziky, ktorá nie je v súlade so Štandardným modelom. V tomto príspevku sú prezentované predpovede pre hustotu tmavej hmoty vo vesmíre v Minimálne supersymetrickom rozšírení Štandardného modelu. Keďže experimentálne predpovede pre hustotu tmavej hmoty dosahujú presnosť okolo 1-5%, do predpovedí boli zahrnuté hlavné jednoslučkové korekcie.

Roman Lietava, roman.lietava@cern.ch

Quarkovo-gluónová plazma

V prednáške budem hovoriť o motivácii experimentov so zrážkami ťažkých iónov na LHC a o ich výsledkoch.

Tibor Macko, macko@math.uni-bonn.de

Topológia vysoko-rozmerných variet

Pod kompaktnou (hladkou) varietou rozumieme kompaktný lokálne euklidovský hausdorffovský priestor (s hladkým atlasom). Variety sú názornými príkladmi topologických priestorov, ktoré sa vyskytujú v mnohých oblastiach matematiky a fyziky, spomeňme aspoň Lieove grupy.

Jedným z cieľov algebraickej topológie je povedať čo najviac o klasifikácii variet. V dimenziách menších ako 4 možno dúfať v úplnú klasifikáciu, avšak v dimenzii 4 a vyšších úplná klasifikácia nie je možná vzhľadom na neriešiteľnosť problému slov v logike. Preto sa obmedzujeme na istú triedu variet.

Teória chirurgií a algebraická K-teória ponúkajú systematický prístup ku klasifikácii, ak si ako triedu variet, ktorá nás zaujíma, vyberieme všetky variety homotopicky ekvivalentné s daným priestorom X.

V tejto prehľadovej prednáške sa budem venovať príkladom, prediskutujem vyššie uvedené fenomény a témy a načrtnem najzaujímavejšie výsledky a otvorené otázky. Medzi príkladmi sa objavia aj projektívne priestory, šošovkové priestory, exotické sféry a iné.

Peter Markoš, peter.markos@fmph.uniba.sk

Andersonov prechod kov - izolant

Prezentujeme základy teórie prechodu kov-izolant v neuspriadaných modeloch. Ukážeme, že napriek 50-ročnému teoretickému úsiliu nebol dosiahnutý súhlas medzi predpoveďami analytických teórií a vsledkami numerických simulácií.

Christine Nattrass,

Background subtraction methods for di-hadron and jet-hadron correlations

Roman Nedela, nedela@ntis.zcu.cz

O nesprávnom sčítavaní zlomkov

Tomáš Peitl, tomas.peitl@gmail.com,

Dependencies in Quantified Boolean Formulae

Tomáš Peitl

Abstract

Quantified Boolean Formulae are a generalisation of propositional formulae which provides a natural way of encoding many real-world problems, especially those that have a 2-player-game-like structure. Modern search-based SAT solvers use, apart from other important techniques, variable-picking heuristics that speed up the search process and can in many cases provide a critical run-time improvement. Attempting to lift this technique from SAT to QSAT - the satisfiability of QBFs - runs into the constraints imposed by the prefix ordering of the variables - a variable can only be assigned if all of its predecessors have been assigned already. We attempt to alleviate this obstacle using dependency schemes - procedures that detect when a variable does not depend on one of its predecessors and thus can be assigned prior to it. We mainly work with two dependency schemes - the Standard Dependency Scheme and the Resolution-Path Dependency Scheme. The first one is implemented in the state-of-the-art QBF solver DepQBF and we work to devise a model extraction procedure for the proofs generated by it, for the second one, we seek to find a fast implementation to make it usable within DepQBF.

Pavel Petrovič

Exkurzia do robotického laboratória

Soňa Pochybová,

Hľadanie pôvodu pomeru protón/pión vo vysokoenergetických zrážkach

Peter Richtárik, peter.richtarik@ed.ac.uk

Randomized Iterative Methods for Solving Linear Systems

We develop a novel, fundamental and surprisingly simple randomized iterative method for solving consistent linear systems. Our method has six different but equivalent interpretations: sketch-and-project, constrain-and-approximate, random intersect, random linear solve, random update and random fixed point. By varying its two parametersa positive definite matrix (defining geometry), and a random matrix (sampled in an i.i.d. fashion in each iteration)we recover a comprehensive array of well known algorithms as special cases, including the randomized Kaczmarz method, randomized Newton method, randomized coordinate descent method and random Gaussian pursuit. We naturally also obtain variants of all these methods using blocks and importance sampling. However, our method allows for a much wider selection of these two parameters, which leads to a number of new specific methods. We prove exponential convergence of the expected norm of the error in a single theorem, from which existing complexity results for known variants can be obtained. However, we also give an exact formula for the evolution of the expected iterates, which allows us to give lower bounds on the convergence rate. Time permitting, I will briefly com-

ment on a new 7th formulation which uncovers hidden duality underlying the method. This leads to new insights, including new complexity results for the primal function values, dual function values and the duality gap.

References:

[1] Robert M. Gower and Peter Richtarik. Randomized iterative methods for linear systems. to appear in SIAM J. Matrix Analysis and Applications, 2016.

[2] Robert M. Gower and Peter Richtarik. Stochastic Dual Ascent for Solving Linear Systems. Working Paper, 2015

Tomáš Roch, tomas.roch@fmph.uniba.sk

Exkurzia do laboratórií nanotechnológií

Pavol Ševera, pavol.severa@gmail.com

O copoch a deformačnom kvantovaní

Deformačné kvantovanie je matematický problém inpirovaný fyzikou (kvantovou mechanikou): Ako môžeme zmeniť (zdeformovať) obyčajný komutatívny súčin na nekomutatívny ale stále asociatívny? Metóda, o ktorej budem hovoriť, používa copy a Drinfeľdov asociátor (čo je matematická príšera s copmi spojená); nekomutatívnosť vznikne, keď sa pri pletení copu dostatočne zamotáme.

Karel Výborný, vybornyk@fzu.cz,

Spin-orbit torques in ferromagnets and antiferromagnets

Magnetisation in a ferromagnet can be manipulated by applying magnetic field but more sophisticated methods are commonly used nowadays. Spin-orbit torques (SOTs) rely on a delicate effect of both quantum-mechanical and relativistic nature and could be a basis for new generation of spintronic memory devices (such as currently already commercialy produced MRAMs which make use of spin-transfer torques). Their advantage is that they arise both in ferromagnets [Phys. Rev. B 91, 134402 (2015)] and antiferromagnets [Phys. Rev. Lett. 113, 157201 (2014)] where in the latter case, writing information is difficult to achieve by other means.

Peter Zeman, zeman@iuuk.mff.cuni.cz

Automorphism Groups of Geometrically Represented Graphs

We describe a technique to determine the automorphism group of a geometrically represented graph, by understanding the induced action of the automorphism group on the set of all geometric representations. Each automorphism of a graph can be decomposed into two parts: an automorphism of a representation and a morphism of a representation to another one. We apply this technique to interval graphs, unit interval graphs, permutation graphs, circle graphs and comparability graphs. We show that interval graphs have the same automorphism groups as trees and unit interval graphs the same as disjoint unions of caterpillars. For permutation (which are comparability graphs of the dimension two) and circle graphs, we show their classes of automorphism groups as slightly larger than for trees, and we give their

inductive descriptions. On the other hand, we show that any finite group is the automorphism group of a comparability graph with the dimension at most four.

Our approach combines techniques from group theory (group products, homomorphisms, quotients, actions) with computer science data structures (PQ-trees, modular trees, split trees).