”Collider Physics” 2nd Symposium of the Division for Physics of Fundamental Interactions of the Polish Physical Society

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Book of Abstracts

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Dark matter near a resonance

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We study dark matter annihilation via a mediator with a mass in the vicinity of the resonance. In this case, Breit-Wigner enhancement leads to the averaged cross-section that strongly depends on the temperature. As a result, the standard "freeze-out" mechanism is altered and an effective annihilation can last long after decoupling from the equilibrium. We show, how a dark matter with the large self-interaction cross-section can be obtained in this framework and comment on the tension with indirect detection experiments, particularly Fermi-LAT observations of dwarf spheroidal galaxies.

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Axino dark matter with low reheating temperature

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We examine axino dark matter in the regime of a low reheating temperature T_R after inflation and taking into account that reheating is a non-instantaneous process. This can have a significant effect on the dark matter abundance, mainly due to entropy production in inflaton decays. We study both thermal and non-thermal production of axinos in the context of the MSSM with ten free parameters. We identify the ranges of the axino mass and the reheating temperature allowed by the LHC and other particle physics data in different models of axino interactions. We confront these limits with cosmological constraints coming the observed dark matter density, large structures formation and big bang nucleosynthesis. We find a number of differences in the phenomenologically acceptable values of the axino mass and the reheating temperature relative to previous studies. In particular, an upper bound on the axino mass becomes dependent on T_R, reaching a maximum value at T_R~10^2 GeV. If the lightest ordinary supersymmetric particle is a wino or a higgsino, we obtain lower a limit of approximately 10 GeV for the reheating temperature. We demonstrate also that entropy production during reheating affects the maximum allowed axino mass and lowest values of the reheating temperature.

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4-jet production in high-energy fatorization

Authors: Andreas van Hameren[1]; Antoni Szczurek[2]; Krzysztof Kutak[3]; Mirko Serino[4]; Rafal Maciula[2]

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Recent progress in the computation of gauge-invariant scattering amplitudes with off-shell particles allows us to perform the first complete High Energy Factorization study of 4-jet production, including all the single and double parton scattering channels. We examine the differences between the two approaches and motivate the importance of using asymmetric cuts in order to pin down multi-parton interactions in future experimental analysis of 4-jet events.

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Advances in amplitudes with off-shell partons

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Factorization prescriptions that take into account the transverse momentum of the initial-state partons require hard scattering amplitudes with off-shell initial-state partons. We report on recent advances in the computation of such amplitudes, both at tree-level and at one loop.

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Clocks and dynamics in Quantum Universe

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Dynamics of general relativistic systems is given with respect to internal clocks. I employ the so called reduced phase space quantization of canonical relativity to show how the choice of the internal clock determines the properties of quantum gravity. For illustration I make use of a semiclassical theory of a FRW model, which replaces the classical singularity with a bounce. As I show, switching the internal clock, on which the quantization is based, can alter the resultant semiclassical theory in almost any way. I conclude by pointing to possible consequences of this result.

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Probing TeV scale physics with neV neutrons

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The observed excess of matter over antimatter in the Universe remains one of the most important puzzles in physics and unknown sources of fundamental CP symmetry violation are its necessary precondition. Intensive searches for new physics beyond the Standard Model (BSM) concentrate on two main frontiers: (i) high energy experiments performed at collider accelerators and (ii) low energy precision experiments. While the first group looks for exotic particles produced on-shell in high

energy collisions, the second ones seek for tiny deviations in low energy observables which can be attributed to non-existing in the SM exotic interactions. In specific scenarios, low-energy precision experiments offer the insight into the mass scale which is hardly reachable or not reachable at all at present high energy colliders. Slow and very slow neutrons play a prominent role at the low-energy (or precision) frontier providing as many as 20 observables reach in physical information. Electric dipole moment (EDM), decay correlations, n-nbar and n-n' oscillation parameters probe BSM physics. Exceptional properties of precision experiments with cold and ultra-cold neutrons also allow for searching of Lorentz Invariance violation and extra dimensions. Presentation will briefly address recent achievements of fundamental neutron physics.

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Relaxation rates and phase transitions

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Using a bottom-up gauge gravity constructions, relaxation rates of strongly coupled field theories are computed. A variety of phase structures are considered, from a crossover up to a first order phase transition.
It is established that near the transition the applicability of a hydrodynamic description breaks down at lower momenta than in the conformal case. In the case of the first order phase transition, a spinodal region
appears at temperatures for which the speed of sound squared is negative. An estimate of the preferential scale attained by the unstable modes is also given. Additionally we observe a novel diffusive regime for sound modes over a range of wavelengths. Additionally, for a range of wavelengths we observe a novel diffusive regime for sound modes.

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Maximum tension principle and entropic force

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We find the series of example theories for which the relativistic limit of maximum tension F_{max}=c^4/4G represented by the entropic force can be abolished. Among them the varying constants theories, some generalized entropy models applied both for cosmological and black hole horizons as well as some generalized uncertainty principle models.

Summary:

This talked is based on our recently published paper "Abolishing the Maximum tension principle, Phys.Lett. B748 (2015) 428-431"

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The evolution of cosmological domain walls from Higgs effective potential

Author: Tomasz Krajewski[1]

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The study of the renormalization group improved effective potential of the Standard Model has revealed the existence of second minimum at very high field strengths. The existence of the local maximum separating two minima makes the production of cosmological domain walls in the early Universe possible. We investigated the evolution of networks of domain walls using lattice simulations. Our recent results will be presented.

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Dark matter - how well can one determine its properties?

Author: Leszek Roszkowski[1]

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Even if a dark matter signal is measured in direct or indirect search experiments, or both, working out ensuing WIMP properties may prove to be quite challenging. I will discuss some possible outcomes.

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First detection of a gravitational wave signal

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Detection of a gravitational wave signal from merger of two black holes is one of greatest discoveries of this century. It will open a new window on the Universe. I shall present several aspects of this dicovery: gravitational wave detectors, signal modeling and data analysis. I shall mention the follow-up observations of this event by radio, optical, near-infrared, X-ray, and gamma-ray wavelengths with ground- and space-based facilities. I shall describe consequences of this result for physics of fundamental interactions.

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Recent ATLAS and CMS results on the Standard Model and the Higgs boson

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Beyond the Standard Model searches in the Higgs sector from ATLAS and CMS

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Study of matter at extreme conditions with ALICE

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Uncovering BFKL dynamics in production of Mueller-Navelet jets at the LHC

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Soft gluon resummation in associated Higgs boson production

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From exclusive production, through diffraction, to jets correlations - forward physics results from CMS

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Effective particles in quantum field theory

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Lattice QCD: a numerical tool for precision physics in the Standard Model and beyond

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Conformal Standard Model

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The averaging problem in cosmology

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Modern cosmology relies strongly on the assumption of isotropy and homogeneity of the Universe. The difficulties arise when this assumption is applied to Einstein equation. This is problematic, since in general, the Einstein tensor built from the averaged metric is not equal to the averaged stress-energy tensor. In this context, the discrepancy between these quantities is called 'the backreaction' and has been a subject of scientific debate among cosmologists and relativists for more than 20 years. In my talk I will present one of the methods to tackle this problem, i.e. the Buchert scalar averaging, together with its applications and possible drawbacks.

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In search of higher twist effects in proton structure

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Higher twist effects may provide new, non-trivial insight into proton structure, including multi-parton correlations in the proton, and also into multiple scattering mechanism in QCD. In this talk an overview will be presented of possible higher twist effects in inclusive and diffractive DIS, and in the forward Drell-Yan process.

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Hints for the BSM Physics at the LHC

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BSM physics at e+e- colliders

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Enabling Electroweak Baryogenesis through Dark Matter

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Successes and challenges in perturbative QCD

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Recent Belle results

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Recent results from LHCb

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Neutrino properties determined in oscillation experiments

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Astrophysical searches with neutrino detectors

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Neutrino portal to new physics

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