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A joint analysis of the S-wave in the $\pi^+\pi^-$ and $\pi^0\pi^0$ data

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PACS: 13.60.Le; 13.75.Lb; 13.85.Hd; 14.40.Cs

Abstract. We use our former results on $\pi^+\pi^-$ S-wave obtained in a nearly assumption-free way from the 17.2 GeV/c data to predict the $\pi^0\pi^0$ S-wave. The predictions are compared with the recent results of the E852 experiment at 18.3 GeV/c. A good agreement is found for only one (the "down-flat") solution while the second one (the "up-flat") is excluded by the $\pi^0\pi^0$ data. Thus the long-standing "up-down" ambiguity has been finally resolved in favour of the S-wave intensity which stays large and nearly constant up to the $K\overline{K}$ threshold. A joint analysis of both sets of data leads to a reduction of errors for this solution.

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Hodge-type self(antiself)-duality for general p-form fields in arbitrary dimensions

M. Botta Cantcheff

Abstract. It is often claimed that the (Hodge type) duality operation is defined only in even dimensional spacetimes and that self-duality is further restricted to twice-odd dimensional spacetime theories. The purpose of this paper is to extend the notion of both duality symmetry as well as self-duality.

By considering tensorial doublets, we introduce a novel well-defined notion of self-duality based on a duality Hodge-type operation in arbitrary dimension and for any rank of these tensors. Thus, a generalized Self-Dual Action is defined such that equations of motion are the claimed generalized self-duality relations. We observe in addition, that taking the proper limit on the parameters of this action, it always provides us with a master-action, which interpolates models well-studied in physics; by considering a particular limit, we find an action which describes an interesting type of relation, referred to as semi-self-duality, which results to be the parent action between Maxwell-type actions.

Finally, we apply these ideas to construct manifest Hodge-type self-dual solutions in a (2+1)-dimensional version of the Maxwell's theory.

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A next-to-leading order study of photon–pion and pion pair hadro-production in the light of the Higgs boson search at the LHC

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PACS: 12.38 Bx, 13.85 Ni, 13.85 Qk, 14.80 Bn

Abstract. We discuss the production of $\gamma\pi^0$ and $\pi^0\pi^0$ pairs with a large invariant mass at collider energies. We present a study based on a perturbative QCD calculation at full next-to-leading order accuracy, implemented in the computer programme *DIPHOX*. We give estimations for various observables, which concern the reducible background to the Higgs boson search in the channel $H \to \gamma\gamma$, in the mass range 80–140 GeV at the LHC. We critically discuss the reliability of these estimates due to our imperfect knowledge of fragmentation functions at high z and a subtle interplay between higher order corrections and realistic experimental cuts. Whereas the invariant mass spectrum of photon–pion pairs is theoretically better under control, in the dipion case large uncertainties remain. Finally we comment on the impact of our findings on Higgs boson searches at the LHC. We conclude that the qualitative statement that the pion backgrounds should not be dangerous for the $H \to \gamma\gamma$ search channel remains true at the next-to-leading order level.

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$B \to K\tau^+\tau^-$ decay in the general two Higgs doublet model

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Abstract. We study the branching ratio, CP-violating asymmetry, forward-backward asymmetry and the CP-violating asymmetry in the forward-backward asymmetry for the exclusive decay $B \to K\tau^+\tau^-$ in the two Higgs doublet model with tree level flavor changing neutral currents (model III). We analyse the dependencies of these quantities on the neutral Higgs boson contributions and the CP parameter $sin\theta$ in the model III. We observe that to determine the neutral Higgs boson effects, the measurements of the forward-backward asymmetry and the CP-violating asymmetry in the forward-backward asymmetry for the decay $B \to K\tau^+\tau^-$ are promising.

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ATLAS discovery potential for a heavy charged Higgs boson

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PACS: 14.80.Cp, 12.60.Jv, 11.10.Kk

Abstract. The sensitivity of the ATLAS detector to the discovery of a heavy charged Higgs boson is presented. Assuming a heavy SUSY spectrum, the most promising channels above the top quark mass are $H^\pm \to tb$ and $H^\pm \to \tau^\pm\nu_\tau$ which provide coverage in the low and high $\tan\beta$ regions up to $\sim$ 600 GeV. The achievable precisions on the charged Higgs mass and $\tan\beta$ determination are also discussed. The $H^\pm \to W^\pm h^0$ channel, though restricted to a small MSSM parameter space, shows a viable signal in NMSSM where the parameter space is less constrained. The observation of the channel $H^- \to \tau_L^-\nu_\tau + c.c.$ may constitute a distinctive evidence for models with singlet neutrinos in large extra dimensions.

Keywords: charged Higgs; extra dimensions; tau polarisation

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Renormalization of higher derivative scalar theory

Pierre Gosselin, Hervé Mohrbach

Abstract. We consider a lattice scalar field model with higher derivative terms in the action whose phase diagram contains a tricritical point which is also a triple point between the paramagnetic, ferromagnetic and antiferromagnetic phases. The continuum limit is defined by approching the tricritical point from the paramagnetic side. Contrary to the lattice tricritical $g_6\phi^6$ model we can do a perturbative computation in dimension four. The non-perturbative aspect of the theory relies on the dispersion relation which has the particular feature of having several minima similar to the propagator of lattice fermions. It is shown that this new model is perturbatively renormalizable and provides a non trivial mass spectrum. The

positive norm Hilbert space and the unitarity of the time evolution operator in Minkowski space is established by means of the reflection positivity property.

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A simulation of gauge mediated supersymmetry breaking with a supersymmetric tau as the next-to-lightest supersymmetric particle in the ATLAS detector at the large hadron collider

Jörgen Sjölin

PACS: 12.60.Jv; 13.25.Hw

Abstract. The feasibility for mass measurements of supersymmetric particles from minimal gauge mediated models in the ATLAS detector at the large hadron collider is studied using parameterized simulations. The covered models are characterized by having the supersymmetric tau as the only next-to-lightest supersymmetric particle (NLSP). Given independent measurements of the lightest Higgs mass and the NLSP lifetime, a sufficient number of supersymmetric particle mass measurements are performed such that all underlying model parameters are constrained.

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Frequentist and Bayesian confidence intervals

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Abstract. Frequentist (classical) and Bayesian approaches to the construction of confidence limits are compared. Various examples which illustrate specific problems are presented. The Likelihood Principle and the Stopping Rule Paradox are discussed. The performance of the different methods is investigated relative to the properties coherence, precision, bias, universality, simplicity. A proposal on how to define error limits in various cases are derived from the comparison. They are based on the likelihood function only and follow in most cases the general practice in high energy physics. Classical methods are not recommended because they violate the Likelihood Principle, they can produce inconsistent results, suffer from lack of precision and generality. Also the extreme Bayesian approach with arbitrary choice of the prior probability density or priors deduced from scaling laws is rejected.

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Neutrino mass matrix solutions and neutrinoless double beta decay

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PACS: 14.60.Pq; 13.15.+g; 23.40.-s

Abstract. We present a determination of the neutrino mass matrix which holds for values of the neutrinoless double beta decay effective mass m_{ee} larger than the neutrino mass differences. We find eight possible solutions and discuss for each one the corresponding neutrino mass eigenvalues and zero texture. A minimal structure of the perturbations to add to these zero textures to recover the full mass matrix is also determined. Implications for neutrino hot dark matter are discussed for each solution.

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A preliminary search for Q-balls by delayed coincidences in NaI(Tl)

F. Cappella, R. Cerulli, A. Incicchitti

Abstract. A preliminary search for Q-balls, stable non-topological solitons allowed by supersymmetric models, with highly radiopure NaI(Tl) detectors is discussed.

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Detection of heavy charged Higgs bosons at future Linear Colliders

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PACS: 12.60.Fr, 14.65.Ha, 14.60.Fg, 41.75.Fr

Abstract. We show how a statistically significant signal of heavy charged Higgs bosons of a general Two-Higgs Doublet Model produced in association with tau-neutrino pairs can be established at future Linear Colliders in the $H^+ \to t\bar{b} \to 4$ jet decay channel. This signature is particularly relevant in the kinematic configuration $\sqrt{s} \lesssim 2M_{H^\pm}$, when the pair production channel $e^+e^- \to H^-H^+$ is no

longer available. Here, the initially overwhelming background, constituted by top quark pair production and decay, can vigorously be reduced thanks to a dedicated selection procedure that allows one to extract a signal in a region of several tens of GeV around $M_{H^\pm} \approx \sqrt{s}/2$, for $\tan\beta \gtrsim 40$.

Keywords: Beyond Standard Model, Two Higgs Doublet Models, Charged Higgs Bosons

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Search for the radion using the ATLAS detector

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L. Vacavant

Abstract. The possibility of observing the radion using the ATLAS detector at the LHC is investigated. Studies on searches for the Standard Model Higgs with the ATLAS detector are re-interpreted to obtain limits on radion decay to $\gamma\gamma$ and $ZZ^{(*)}$. The observability of radion decays into Higgs pairs, which subsequently decay into $\gamma\gamma + b\bar{b}$ or $\tau\tau + b\bar{b}$ is then estimated.

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Pomeron exchange and t-dependence of the scattering amplitude

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PACS: 11.55.Jy 12.40.Nn 13.85.Dz

Abstract. Constraints on the t-dependence of the hadronic scattering amplitude at asymptotic energies are derived by considering the exchange of the Pomeron, as a Regge pole, between off-shell gluons. Covariant reggeization ensures pure spin α exchange, where α is the Regge trajectory of the Pomeron. The structure of the amplitude, as a function of t, has been derived without a specific choice for the partonic wave functions of the hadrons. New terms appear, with respect to the standard approach, and allow to describe non trivial properties of the diffraction cone in agreement with experimental data, as shown in a specific example.

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Scientific Note:
High transverse momentum physics at the large hadron collider

The ATLAS and CMS Collaborations
Edited by
J.G. Branson, D. Denegri, I. Hinchliffe, F. Gianotti, F.E. Paige, P. Sphicas

Abstract. This note summarizes many detailed physics studies done by the ATLAS and CMS Collaborations for the LHC, concentrating on processes involving the production of high mass states. These studies show that the LHC should be able to elucidate the mechanism of electroweak symmetry breaking and to study a variety of other topics related to physics at the TeV scale. In particular, a Higgs boson with couplings given by the Standard Model is observable in several channels over the full range of allowed masses. Its mass and some of its couplings will be determined. If supersymmetry is relevant to electroweak interactions, it will be discovered and the properties of many supersymmetric particles elucidated. Other new physics, such as the existence of massive gauge bosons and extra dimensions can be searched for extending existing limits by an order of magnitude or more.

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Scientific Note:
Observation potential of the decays $\mathbf{B^0_{s,d} \to J/\psi\eta}$ in the ATLAS experiment at the LHC

C. Driouichi, P. Eerola, M. Melcher, F. Ohlsson-Malek, S. Viret

PACS: 13.25 Hw

Abstract. The observation potential of the decays $B^0_{s,d} \to J/\psi\eta$ with the ATLAS detector at the LHC is described in this paper. At present there exist only upper limits for the branching fractions, but at LHC, a clear signal for the decay mode $B^0_s \to J/\psi\eta$ is expected. The branching fraction of this decay mode can thus be measured, and other parameters such as B^0_s lifetime can be measured as well. The decay mode $B^0_s \to J/\psi\eta$ is analogous to the mode $B^0_s \to J/\psi\phi$, which has been studied extensively in view of CP violation measurements. In these two decay modes, the CP asymmetry predicted by the Standard Model is very small, and the observation of a sizeable effect would be a signal of physics beyond the Standard Model. The decay mode $J/\psi\eta$ constitutes thus a cross-check for the mode $J/\psi\phi$. Furthermore, the former final state is a CP-eigenstate and no angular analysis is thus needed.

The reconstruction of η-mesons at LHC experiments has not been addressed before, and therefore the study presented here can also be regarded as an example of the physics prospects with η-mesons at the LHC.

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Scientific Note:

Prospects for the measurement of B_s^0 oscillations with the ATLAS detector at LHC

B. Epp, V. M. Ghete, A. Nairz

PACS: 14.40.Nd

Abstract. The capabilities of the ATLAS detector to measure the B_s^0 oscillations in proton-proton interactions at the Large Hadron Collider were evaluated. B_s^0 candidates in the $D_s^- \pi^+$ and $D_s^- a_1^+$ decay modes from semileptonic events were fully simulated and reconstructed, using a detailed detector description. The sensitivity and the expected accuracy for the measurement of the oscillation frequency were derived from unbinned maximum likelihood amplitude fits as functions of the integrated luminosity. A detailed treatment of the systematic uncertainties was performed. The dependence of the measurement sensitivity on various parameters was also evaluated.