Frontiers of Fundamental Physics 14

List of speakers in conference
High Energy Physics

Updated on January 8, 2015

Alain **Blondel** (DPNC University of Geneva) **July, 15, 14h30 – 15h00, Amphi "Massiani", High Energy Physics**

Precision Electroweak Measurements at Future High Energy Colliders

The prospects for precision measurements of the properties of the Z, W, Higgs and top particles will be reviewed. The machines considered will be the LHC and its upgrade, the future e+e- colliders, both linear and circular, and the 100 TeV Future Hadron Collider. The importance of improvements in some other experimental inputs and in the theoretical calculations will be addressed.

John **Bulava** (TCD) **July, 18, 16h00 – 16h30, Amphi "Massiani", High Energy Physics**

Exotic hadrons in Experiment and on the Lattice

Although the constituent quark model correctly predicts the quantum numbers of nearly all known hadrons, it fails to account for so-called 'exotic' states. After briefly reviewing the current experimental status of some candidate exotic hadrons, I will discuss prospects for elucidation of their properties using numerical Lattice QCD simulations. Recent theoretical advances have greatly improved lattice calculations of hadronic resonances, but some of the most interesting systems (such as exotic charmonium states) remain a challenge.

Sabine **Crépé-Renaudin** (LPSC) **July, 17, 17h30 – 18h00, Amphi "Massiani", High Energy Physics**

Searches for heavy resonances at the LHC

Resonances decaying into a pair of particles are an obvious place to look for phenomena beyond the Standard Model. This talk summarizes recent results from the ATLAS and CMS experiments on searches for resonances in pairs of jets, leptons, bosons or a mix of those objects. Various models are considered from Z' and W' to the ADD large extra dimension scenario, from excited quarks or technicolor to quantum black holes as well as contact interactions. Results from $\sqrt{s} = 8$ TeV are presented.

Sam **Cunliffe** (IC) **July, 18, 15h00 – 15h30, Amphi "Massiani", High Energy Physics**

Observables and anomalies in $B^0 \to K^{*0}\mu^+\mu^-$ decays

Recent angular analyses of $B^0 \to K^{*0}\mu^+\mu^-$ decays at LHCb are in tension with the standard model predictions. Phenomenological interpretations of these results imply hints of a contribution from a new vector particle. These results are difficult to account for within supersymmetric models. This talk will cover the experimental aspects of performing such an angular analysis using the LHCb detector as well as the theoretical motivation for making such a measurement and the rationale behind the choices of observables. I will devote some time to reviewing the phenomenological interpretations.

Jeremy **Dalseno** (UOB) **July, 18, 14h30 – 15h00, Amphi "Massiani", High Energy Physics**

"CP violation effects in multibody B decays" on behalf of the LHCb Collaboration

CP Violation is one of the necessary ingredients to produce the matter anti-matter asymmetry we observe in the Universe today. The LHCb experiment is a general purpose forward-spectrometer located along the LHC proton-proton collider at CERN and is ideally suited for the investigation of such phenomena. We present the latest results of 3-body charmless *B* decays where large local *CP* violating effects have been observed across various regions of the phase space [1,2]. These results are discussed in the light of recent theoretical developments that attempt to understand the origin of the large asymmetries [3] and their impact on future amplitude analyses.

References

1] R. Aaij *et al.* (LHCb Collaboration), *Measurement of CP Violation in the Phase Space of* $B^\pm \to K^\pm\pi^+\pi^-$ *and* $B^\pm \to K^\pm K^+ K^-$ *Decays*, Phys. Rev. Lett. **111** (2013) 101801.

[2] R. Aaij *et al.* (LHCb Collaboration), *Measurement of CP Violation in the Phase Space of* $B^\pm \to K^+K^-\pi^\pm$ *and* $B^\pm \to \pi^+\pi^-\pi^\pm$ *Decays*, Phys. Rev. Lett. **112** (2014) 011801.

[3] Z.-H. Zhang, X.-H. Guo, and Y.-D. Yang, Phys. Rev. D **87** (2013) 076007; B. Bhattacharya, M. Gronau, and J. L. Rosner, Phys. Lett. B **726** (2013) 337; I. Bediaga, O. Lourenço, and T. Frederico, Phys. Rev. D **89** (2014) 094013; D. Xu, G.-N. Li, and X.-G. He, arXiv:1307.7186 (2013).

Pasquale **Di Bari** (UoS) **July, 16, 15h30 – 16h00, Amphi "Sciences Naturelles", Astroparticle Physics, High Energy Physics**

Leptogenesis and low energy neutrino data

I will review the status of thermal leptogenesis and how this, in combination with low energy neutrino data, can be used as a powerful tool to probe models of new Physics. I will discuss how the possibility to realise independence of the initial conditions (strong thermal leptogenesis) relies on a special right-handed neutrino mass pattern and require quite special conditions, in particular a deviation of light neutrino masses from the hierarchical limit that can be tested in future years with cosmological observations. Intriguingly the set of conditions for strong thermal leptogenesis can be realise within SO(10)-inspired leptogenesis and in this case one obtains a set of definite predictions on future low energy neutrino measurements. Interestingly this solution requires non vanishing reactor mixing angle, now robustly established in reactor neutrino experiments, and a negative neutrino oscillation CP violation invariant parameter, as hinted by recent neutrino oscillation experimental results.

Kiran **Joshi** (UoM) **July, 15, 16h00 – 16h30, Amphi "Massiani", High Energy Physics**

Measurement of EW production of Z + 2j at the LHC

The electroweak production of a Z-boson in association with dijets ($Z + 2j$), which includes the vector boson fusion process, is an important background to the vector boson fusion production of a Higgs boson in association with dijets. Both ATLAS [1] and CMS [2,3] have made measurements of the electroweak production of $Z+2j$. In this talk the methods and results of extracting the electroweak component of the cross section are presented. Detector-corrected distributions of hadronic jets are also presented and show sensitivity to the electroweak production process. The distributions can be used to probe the different approaches to generating both QCD and electroweak $Z + 2j$ events.

References

[1] ATLAS Collaboration, *Measurement of the electroweak production of dijets in association with a Z-boson and distributions sensitive to vector boson fusion in proton-proton collisions at* $\sqrt{s} = 8$ *TeV using the ATLAS detector*, JHEP 1404 (2014) 031 [arXiv:1401.7610].
[2] CMS Collaboration, *Measurement of the hadronic activity in events with a Z and two jets and extraction of the cross section for the electroweak production of a Z with two jets in pp collisions at* $\sqrt{s} = 7$ *TeV*, JHEP 1310 (2013) 062 [arXiv:1305.7389].
[3] CMS Collaboration, *Measurement of pure electroweak production of a Z boson in association with two forward/backward jets in proton-proton collisions at 8 TeV*, CMS-PAS-FSQ-12-035.

Nikolas **Kauer** (RHUL) **July, 17, 16h00 – 16h30, Amphi "Massiani", High Energy Physics**

Off-shell Higgs signal and total width determination at the LHC

A substantial far-off-shell contribution to the Higgs boson signal in the $H \to ZZ$ decay mode [1] facilitates a novel, complementary approach to constraining the Higgs width Γ_H at the Large Hadron Collider (LHC) [2]. A first experimental analysis [3] obtained $\Gamma_H < 22$ MeV (95% CL), which is 5.4 times the expected value in the Standard Model at the measured Higgs boson mass. I review the theoretical basis of the new approach and discuss its significance and potential in comparison to other methods to bound and measure the Higgs width at the LHC and future colliders.

References

[1] N. Kauer and G. Passarino, *Inadequacy of zero-width approximation for a light Higgs boson signal*, JHEP **1208** (2012) 116 [arXiv:1206.4803 [hep-ph]].
[2] F. Caola and K. Melnikov, *Constraining the Higgs boson width with ZZ production at the LHC*, Phys. Rev. D **88** (2013) 054024 [arXiv:1307.4935 [hep-ph]]; J. M. Campbell, R. K. Ellis and C. Williams, *Bounding the Higgs width at the LHC using full analytic results for* $gg \to e^- e^+ \mu^- \mu^+$, JHEP **1404** (2014) 060 [arXiv:1311.3589 [hep-ph]].
[3] V. Khachatryan *et al.* [CMS Collaboration], *Constraints on the Higgs boson width from off-shell production and decay to Z-boson pairs*, CERN-PH-EP-2014-078, arXiv:1405.3455 [hep-ex].

Wolfgang **Mader** (IKTP) **July, 17, 15h30 – 16h00, Amphi "Massiani", High Energy Physics**

Searches for BSM Higgs bosons at LHC

Since the discovery of the Higgs-like boson at the LHC by the two experiments ATLAS and CMS, properties of the new boson are now being measured with increasing precision, restricting the phase space for Beyond the Standard Model physics. In this talk, the re-interpretation of these measurements by ATLAS and CMS in BSM scenarios like e.g. the Two-Higgs-Doublet Model are reviewed.

Satoshi **Mishima** (University of Rome, La Sapienza) **July, 15, 15h00 – 15h30, Amphi "Massiani", High Energy Physics**

Constraints on Higgs physics from EW precision measurements

The electroweak precision measurements offer a very powerful handle on the underlying mechanism of electroweak symmetry breaking and on the nature of the Higgs boson. In this talk, I will present current constraints on new physics beyond the Standard Model from the electroweak precision fit, and discuss the interplay between the electroweak precision fit and the Higgs measurements at the Tevatron and LHC.

Jordi **Nadal** (II. Physikalisches Institut) **July, 15, 17h00 – 17h30, Amphi "Massiani", High Energy Physics**

Top production at the LHC

Latest LHC results of the top quark production are presented. With the focus on the ATLAS and CMS experiment I will present top quark production cross-section in the different channels and also the latest results on the single top production, giving the state-of-art measurements. I also include differential cross-section as well as top quark pair production in association with W/Z bosons.

Christopher **Neu** (UVa) **July, 17, 15h00 – 15h30, Amphi "Massiani", High Energy Physics**

Search for ttH in Run 1 at the LHC

With the discovery in 2012 of a Higgs boson at the LHC, the focus of the Higgs physics campaigns at the ATLAS and CMS experiments has transitioned from the search for the Higgs to the pursuit of the complete characterization of this new particle. This is an essential step that is necessary in the determination of whether this is the Higgs boson of the standard model, or a component of some other, more exotic explanation of the fundamental world. Principal among these characterizations is the understanding of the interaction strength, or coupling, between this Higgs boson and the other known fundamental particles; among these couplings, the largest and arguably the most important is that between the Higgs and the top quark, the most massive of the known fundamental particles. The only direct probe of this coupling is through the observation of Higgs boson production in association with top quarks at the LHC. In this talk, the search strategy and current status will be described, focusing on the results from the 2010-2012 Run 1 of the LHC, with also an eye toward future studies in Run 2. The observation of this process is one of the highest-priority aspects of the current LHC physics program.

Antonio **Palazzo** (MPI) **July, 16, 14h30 – 15h00, Amphi "Sciences Naturelles", Astroparticle Physics, High Energy Physics**

Global status of neutrino oscillations

I will present the current status of the global neutrino data analysis, pointing out its unique role in constraining the two crucial (still) unknown parameters: the CP-violating phase δ and the θ_{23} octant. In this context, I will discuss the slight overall preference for θ_{23} in the first octant and for non-zero CP violation with $\sin\delta < 0$. The (in-)stability of such intriguing indications within different combinations of data sets will be considered in detail. Finally, I will discuss the robustness of the 3-flavor analysis in the presence of new light sterile neutrinos, whose existence is suggested by very-short-baseline experiments and cosmological data.

Agostino **Patella** (CERN) **July, 18, 15h30 – 16h00, Amphi "Massiani", High Energy Physics**

Lattice gauge theories beyond QCD

As the number of flavours in QCD is increased beyond some threshold, chiral symmetry is restored and long-distance physics becomes scale invariant. The region of parameter space in which this happens is called "conformal window". The phenomenology of theories in the conformal window or close to it is very different from real-world QCD, and clearly shows how rich gauge theories can be. Near-conformal gauge theories have been conjectured to be viable models for physics beyond the Standard Model, and as they might naturally incorporate a Higgs-like scalar, and in this sense they are very different from traditional techicolor theories. As these theories are inherently non-perturbative, lattice simulation provide a unique setup to investigate them from first principles. In this talk I will review the main results and open questions in this field, the challenges ahead, and the techniques used.

Jérémie **Quevillon** (LPT Orsay) **July, 17, 14h30 – 15h00, Amphi "Massiani", High Energy Physics**

Constraints on BSM physics through the Higgs couplings

We will discuss the implications from the measured mass and production/decay rates of the observed Higgs boson on several well motivated extensions of the Standard Model.

Firstly, we will show that in the Minimal Supersymmetric Standard Model, to a good approximation, the phenomenology of the lighter Higgs state can be described by its mass and three couplings: those to massive gauge bosons and to top and bottom quarks. We will then demonstrate that the value $M_h \simeq 125$ GeV together with the non-observation of superparticles at the LHC, indicates that the SUSY-breaking scale M_S is rather high, $M_S > 1$ TeV, leading to a Higgs sector that can be described, to a good approximation, by only two free parameters.

Secondly, we will discuss how the LHC limits on the invisible Higgs branching fraction impose strong constraints on Higgs portal models of dark matter.

Heidi **Rzehak** (Uni Freiburg) **July, 17, 17h00 – 17h30, Amphi "Massiani", High Energy Physics**

SUSY after LHC run 1

The successful data taking of the LHC experiments during run 1 allowed already for a detailed investigation of possible models with underlying supersymmetry as well as for the discovery of a Higgs boson. In this talk, the status of the experimental results will be briefly summarized and implications of the findings of LHC run 1 for viable models based on supersymmetry will be discussed. Constraints from direct searches as well as from indirect measurements, in particular the Higgs boson mass, will be taken into account.

Xavier **Sarazin** (LAL) **July, 16, 16h00 – 16h30, Amphi "Sciences Naturelles", Astroparticle Physics, High Energy Physics**

Review of neutrinoless double beta decay search

The observation of a neutrinoless double beta decay would be the proof that the neutrino is a Majorana particle, identical to its own anti-particle, and would correspond to a process violating the leptonic number. In this talk, I will give a review of the various experiments which are searching for a neutrinoless double beta decay.

Diego **Stocco** (Subatech) **July, 18, 17h30 – 18h00, Amphi "Massiani", High Energy Physics**

ALICE results in p–Pb collisions at the LHC

ALICE studies the properties of the strongly interacting matter at the extreme energy densities reached in heavy-ion collisions at the LHC. In this context, the measurements in proton-proton and proton-nucleon collisions are mandatory: the former sets the reference, while the latter provides further insight into the effects due to cold nuclear matter, which is crucial in the understanding of heavy-ion collisions. In this talk, a selection of the recent results in p–Pb collisions at the LHC will be presented.

Kalman **Szabo** (ISC-JSC) **July, 18, 17h00 – 17h30, Amphi "Massiani", High Energy Physics**

Recent progress in Lattice QCD thermodynamics

I review some of the most important recent results from finite temperature lattice QCD based on the contributions of the Budapest-Wuppertal collaboration. In particular I'll cover the equation of state [1], the role of the charm quark, and the fluctuation observables also measured in heavy ion physics [2]. I will comment on the the reliability of the hadron resonance gas model for low temperatures and the hard thermal loop approximation at high temperatures [3].

References

[1] S. Borsanyi, Z. Fodor, C. Hoelbling, S. D. Katz, S. Krieg and K. K. Szabo, Phys.Lett.B **730** (2014) 99 [arXiv:1309.5258 [hep-lat]].
[2] S. Borsanyi, Z. Fodor, S. D. Katz, S. Krieg, C. Ratti and K. K. Szabo, arXiv:1403.4576 [hep-lat].
[3] N. Haque, A. Bandyopadhyay, J. O. Andersen, M. G. Mustafa, M. Strickland and N. Su, JHEP **1405** (2014) 027 [arXiv:1402.6907 [hep-ph]].

Cristina **Volpe** (APC) **July, 16, 17h30 – 18h00, Amphi "Sciences Naturelles", Astroparticle Physics, High Energy Physics**

Recent advances in neutrino astrophysics

Neutrinos of astrophysical origin are messengers produced in stars, in explosive phenomena like core-collapse supernovae, in the accretion disks around black holes, or in the Earth's atmosphere. Their fluxes and spectra encode information both on their sources, the environments they traverse and on key unknown neutrino properties. We will discuss the status and key open questions in our current understanding of neutrino flavour conversion in media and its impact on astrophysical observations. We will describe some of the important recent advances in the field of neutrino astrophysics.

References

[1] C. Volpe, *Open issues in neutrino astrophysics*, Annalen Phys. 8-9 (2013) [arXiv:1303.1681].

Gordon **Watts** (UW, Seattle) **July, 15, 17h30 – 18h00, Amphi "Massiani", High Energy Physics**

Top quark mass measurements at hadron colliders

The top quark mass is the best known quark mass. This talk will be a quick review of the measurements of the top mass at the four main collider experiments, CDF and DZERO from the Tevatron accelerator located at Fermilab, and ATLAS and CMS from the Large Hadron Collider located at CERN. Besides results at brief survey of techniques and future prospects will be given.

Susanne **Westhoff** (PITT PACC) **July, 15, 18h00 – 18h30, Amphi "Massiani", High Energy Physics**

The Top-Quark Charge Asymmetry – Testing Strong Interactions and More

An overview of the charge asymmetry in top-antitop quark production at hadron colliders is presented. I discuss the origin of the charge asymmetry in the Standard Model and potential contributions from new physics [1,2] in the light of the enhanced asymmetry observed by the CDF collaboration at Tevatron. A measurement of the charge asymmetry at the LHC requires tailored observables, which cope with the large symmetric background [3].

References

[1] M. Bauer, F. Goertz, U. Haisch, T. Pfoh and S. Westhoff, *Top-Quark Forward-Backward Asymmetry in Randall-Sundrum Models Beyond the Leading Order*, JHEP **1011**, 039 (2010) [arXiv:1008.0742 [hep-ph]].
[2] U. Haisch and S. Westhoff, *Massive Color-Octet Bosons: Bounds on Effects in Top-Quark Pair Production*, JHEP **1108**, 088 (2011) [arXiv:1106.0529 [hep-ph]].
[3] S. Berge and S. Westhoff, *Top-Quark Charge Asymmetry Goes Forward: Two New Observables for Hadron Colliders*, JHEP **1307**, 179 (2013) [arXiv:1305.3272 [hep-ph]].

Marco **Zaro** (LPTHE, UPMC) **July, 15, 15h30 – 16h00, Amphi "Massiani", High Energy Physics**

(Getting ready for) precision physics at hadron colliders

I will review recent progresses in the field of higher-order predictions at hadron colliders, with focus on the LHC. The inclusion of higher order corrections, in particular of those corrections related with QCD, is crucial in order to get accurate and reliable predictions which are needed both to validate the Standard Model of fundamental interaction and to seek for yet unknown particles, but leads to a huge growth of the computational complexity. Recent works have lead to the possibility of computing the first subleading order (Next-to-Leading Order, NLO) corrections in a fully automated manner for any process, hiding all the computational complexity to the user. For what concerns higher orders (next-to-next-to Leading Order, NNLO and beyond), the most relevant processes for LHC physics in the SM have been covered at NNLO in the last few years, with huge efforts from different groups.