$27^{\text{èmes}}$ **Rencontres de Blois**

Blois May 31 - June 5 2015

Particle Physics and Cosmology

Parallel Sessions

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Top + Higgs

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Recent Top Quark Results from the Tevatron

Reinhild Yvonne Peters (University of Manchester)

In this talk, I will discuss recent results in the area of top quark physics from the CDF and D0 collaborations at the Tevatron proton-antiproton collider. The presented analyses range from results of top quark production to properties of the top quark.

Top quark mass measurements at the LHC

Juan Fuster Verdu (IFIC, Universitat de València)

The latest measurements of the top quark mass using the ATLAS and CMS experiments at the LHC are presented. The discussion includes the results obtained using the conventional methods (Template/Ideogram) and those derived from the so called alternative methods. Results from the conventional methods using the various top final states (lepton+jets, di-lepton and full hadronic) are reviewed. Determinations using the inclusive ttbar production, the ttbar production with an additional jet and the lepton-b-jet invariant mass distribution are also discussed.

Top-quark production at the LHC

Javier Fernandez Menendez (University of Oviedo)

Measurements of the inclusive top quark pair production cross section at 7 TeV and 8 TeV are presented. The results were obtained using ATLAS and CMS data collected in 2011 and 2012. The total cross section is measured in the lepton+jets, dilepton and fully hadronic channels, including the tau-dilepton and tau+jets modes. First measurements of top quark pair production with additional b-quarks in the final state are also presented. Differential cross sections are measured and are given as functions of various kinematic observables, including the transverse momentum and rapidity of the (anti)top quark and the top-antitop system and the jets and leptons of the event final state. Multiplicity and kinematic distributions of the jets produced in addition to the top pair are also investigated. The results are combined and confronted with precise theory calculations.

Measurements of top-quark properties at the LHC

Kelly Beernaert (Ghent University)

Measurements of several top-quark properties are presented, obtained from the ATLAS and CMS data collected in 2011 and 2012 at centre-of-mass energies of 7 and 8 TeV. The results include measurements of the top pair charge asymmetry, the top quark polarization in pair production and single top production, the W helicity in top decays. Results of spin correlation in top quark pairs are presented and interpreted in terms of the SM predicted values. The results are compared with predictions from the standard model as well as new

physics models. The cross section of ttbar events produced in association with a W, Z boson or a photon is also presented.

Constraining top quark Z-boson couplings at the LHC

Markus Schulze (CERN, Geneva)

I will summarize the current knowledge of top quark electroweak couplings. These couplings are defined through the interaction of a top quark with a photon, Z, W or Higgs boson. Most constraints on these couplings are set by electroweak precision data (LEP/SLC) or by indirect determinations from B-physics. The upcoming LHC run-2 will allow, for the first time, to directly probe those couplings in the processes $pp \to t\bar{t} + \gamma/Z/W/H$. I will review the status of theory predictions for these processes and then focus on coupling determinations in $pp - - > t\bar{t} + Z$ production at the LHC.

A precise characterisation of the top quark electro-weak vertices at the ILC

Roman Pöschl (LAL, Orsay)

Top quark production in the process $e^+e^- \to t\bar{t}$ at a future linear electron positron collider with polarised beams is a powerful tool to determine indirectly the scale of new physics. The presented study, based on a detailed simulation of the ILD detector concept, assumes a centre-of-mass energy of $\sqrt{s} = 500\,\text{GeV}$ and a luminosity of $\mathcal{L} = 500\,fb^{-1}$ equally shared between the incoming beam polarisations of $P_{e^+}, P_{e^-} = \pm 0.8, \mp 0.3$. Events are selected in which the top pair decays semi-leptonically and the cross sections and the forward-backward asymmetries are determined. Based on these results, the vector, axial vector and tensorial CP conserving couplings are extracted seperately for the photon and the Z^0 component. With the expected precision, a large number of models in which the top quark acts as a messenger to New Physics can be distinguished with many standard deviations. This will dramatically improve expectation from e.g. LHC for electro-weak couplings of the top quark.

Search for rare top-quark decays at the LHC

Filipe Almeida Veloso (LIP, Coimbra)

Flavour-changing neutral-current (FCNC) top quark decays are suppressed by the GIM mechanism, but are enhanced by BSM models. Any evidence for top-quark FCNC decays could be an evidence for new physics. Searches for the FCNC decays $t \to qX$ where $X = Z, \gamma, H, g$ and $q = u, c$ performed by the ATLAS and CMS Collaborations are presented. Data collected during 2011 and 2012 from proton-proton (pp) collisions at the LHC at a centre-of-mass energy of $\sqrt{s} = 7$ and 8 TeV, corresponding to integrated luminosities ranging from 2.1 fb^{-1} to 25 fb^{-1}, are analysed. Top-quark pair-production events with one top quark decaying through the $t \to qZ, q\gamma, qH$ channels and the other through the dominant Standard Model mode $t \to bW$ are considered as signal, as well as direct top production for the $t \to qg$ channel. No evidence for FCNC signals are found and upper limits on the $t \to qX$ branching ratios are set at 95% confidence level.

Light Quark Composite Partners

Seung J. Lee (KAIST, Daejeon)

I will discuss phenomenological implications of a large degree of compositeness for the light generation quarks in composite pseudo-Nambu-Goldstone-boson Higgs models. In particular I will present a discovery potential at the Run2 of the LHC, where theoretical tools such as jet substructure become important for tagging the boosted particles from the decay of composite partners. I will also discuss flavorful naturalness, where top partner is not a mass eigenstate, but an admixture of composite top and charm partners is.

Search strategies for heavy quark partners at LHC run-II

Thomas Dieter Flacke (KAIST, Daejeon)

We present results on several new search strategies for heavy vector-like quark partners at the early stages of the LHC run-II. Run-II will have sensitivity to single- and pair-produced quark partners with masses beyond 1 TeV. Decays of such heavy particles yield highly boosted tops, Higgses, and weak gauge bosons, all of which decay dominantly hadronically. At low boost, hadronic final states suffer from large Standard Model backgrounds, such that leptonic or semi-leptonic decay channels yielded better discovery potential at run-I. At high boost, the SM background of hadronic final states can be substantially suppressed when applying jet-substructure techniques. We present several case studies where the identification of hadronically decaying tops, Higgses, and/or electroweak gauge bosons allow to make new search channels competitive at run-II.
Based on: arXiv:1409.0409, 1410.8131, 1501.07456, and work in progress.

Di-boson production at the LHC and gauge couplings

Alexander Oh (University of Manchester)

The Large Hadron Collider (LHC) has completed in 2012 its first running phase and the experiments have collected data sets of pp collisions at centre-of-mass energies of 7 and 8 TeV with an integrated luminosity of about 5 fb^{-1} and 20 fb^{-1}, respectively. Analyses of these data sets have produced a rich set of results in the electroweak sector of the standard model. This presentation reviews the run-1 analysis of the inclusive and exclusive di-boson production processes from ATLAS and CMS, and the interpretation of the differential pro-

duction cross sections in the framework of anomalous gauge boson couplings. Emphasis will be given to most recent results.

Prospects for W-mass measurements at the LHC

Mariarosaria D'Alfonso (UC Santa Barbara)

High precision electroweak measurements, compared to accurare theoretical predictions of electroweak observables, provide a precision test of the standard model. A very good understanding of the lepton and missing momemtum spectrum and theoretical description of the W production and decay model are needed to be obtaing a precision of 10 MeV on m_W. I will review the experimental and theoretical challeges to reach a competitive measurement of the W mass at LHC.

Electroweak Chiral Lagrangians

Juan José Sanz-Cillero (Universidad Autónoma de Madrid)

We show that, in the case of low-energy non-linear EFT's (EW Chiral Lagrangians including the Higgs), one-loop contributions can be as important as those from higher dimension operators. Indeed, one can determine all the one-loop UV divergences of the effective action through the background field method. They require specific operators of higher chiral dimension to fulfill the renormalization. Thus, in order to have a consistent description one must consider both one-loop corrections and tree-level diagrams with higher dimension operator. These two sources of new-physics effects are in principle equally important: only the analysis of particular models -or experimental data- can discern the relative relevance

EW constraints with Gfitter

Thomas Peiffer (Universität Hamburg)

We present an update of the global electroweak fit using electroweak NNLO calculations for all precision observables that enter the fit. The knowledge of the mass of the Higgs boson improves the global electroweak fit considerably. The global fits are used as powerful tools to assess the validity of the Standard Model and to constrain scenarios for new physics. We present updated constraints on a model with modified Higgs couplings to bosons and fermions, and two-Higgs-doublet models. We show that in many cases the Higgs signal strength measurements give complementary information to constraintes obtained from electroweak precision observables.

One-loop effects from spin-1 resonances in Composite Higgs models

Matteo Salvarezza (Università di Roma "La Sapienza")

We compute the 1-loop correction to the electroweak observables from spin-1 resonances in SO(5)/SO(4) composite Higgs models. The strong dynamics is modeled with an effective description comprising the Nambu-Goldstone bosons and the lowest-lying spin-1 resonances. The 1-loop contribution of the resonances is extracted in a diagrammatic approach by matching to the low-energy theory of Nambu-Goldstone bosons. We find that the correction is numerically important in a significant fraction of the parameter space and tends to weaken the bounds providing a negative shift to the S parameter.

Spacetime curvature and the Higgs stability during inflation

Tommi Markkanen (Imperial College London)

It is currently widely accepted that for a high scale of inflation the EW Higgs vacuum is unstable due to large fluctuations of order H. However, this conclusion is reached by neglecting potentially significant effects induced by the spacetime curvature. In this talk I review the derivation of a one-loop SM Higgs effective potential in curved space and discuss its implications. In particular I will show that generally a large curvature mass is generated which can stabilize the potential against fluctuations induced by inflation.

Study of Higgs boson production in bosonic decay channels at the LHC (incl. off-shell production)

Susumu Oda (Kyushu University, Fukuoka)

The experimental study of Higgs boson prodcution in bosonic decay channels at the LHC will be presented in this presentation. The bosonic decay channels include ZZ, WW, $\gamma\gamma$ and $Z\gamma$. WW decay channels has a large branching fraction. $\gamma\gamma$ and ZZ can construct the whole event topology. $Z\gamma$ can be sensitive to exotic Higgs decays. Also, off-shell production is now expected to be sensitive to the Higgs decay width and additional Higgs bosons or new phenomena beyond the Standard Model (SM) of the particle physics. Therefore, the bosonic decay channels are assumed to a key to probe the SM and beyond that. This presentation will show the results at $\sqrt{s} = 7-8$ TeV and the prospect at $\sqrt{s} = 13-14$ TeV.

Study of Higgs boson production in fermionic decay channels at the LHC (incl. mumu and tau-mu)

Maria Cepeda (University of Wisconsin, Madison)

The discovery of the Higgs boson at a mass of 125 GeV has started a new era in particle physics, in which measuring the properties of the boson is key. In particular, the

observation of its decays to fermion pairs is essential to establish its compatibility with the Standard Model. The two main fermionic final states accessible at the LHC are the decays into pairs of b quarks and tau leptons. Using a combination of data collected in proton-proton collisions at center-of-mass energies of 7 and 8 TeV, the ATLAS and CMS collaborations have reported strong evidence for a fermionic decay mode of the Higgs, with a branching ratio compatible with that of the SM Higgs boson. The coupling of the new boson to lighter leptons has also been explored. The observed upper limits on the production cross section times branching ratio to muon pairs is found to be compatible with the expectation, showing that the leptonic couplings of the new boson are not flavour-universal. We also report the first direct search for lepton violating decays of the Higgs boson to a muon-tau pair. The sensitivity of this search is an order of magnitude better than the previous indirect limits.

Higgs boson couplings, from combination of all channels

Tae Min Hong (University of Pittsburgh)

Higgs boson coupling values from the combination of signal strengths of all channels are presented. The results use 25 fb^{-1} of data collected by the ATLAS and CMS Experiments during Run-1 of LHC operations. Scenarios are presented based on specific assumptions on the relations of and between individual coupling values and on the total width.

Pseudo-observables in Higgs decays

David Marzocca (University of Zurich)

We define a set of pseudo-observables, defined at the amplitude level, characterizing the properties of Higgs decays in generic extensions of the Standard Model with no new particles below the Higgs mass. The pseudo-observables can be determined from experimental data, providing a systematic generalization of the "κ-framework", and can be computed in any Effective Field Theory approach to Higgs physics. We analyze the reduction of the number of independent pseudo-observables following from the hypotheses of lepton-universality, CP invariance, custodial symmetry, and linearly realized electroweak symmetry breaking.

Boosted Higgs boson channel(s)

Matthias Josef Schlaffer (DESY, Hamburg)

Precise measurements of the Higgs couplings are crucial to pin down new physics beyond the Standard Model. In gluon fusion, both a modified top Yukawa and new colored particles can alter the cross section. However, in a large set of composite Higgs models and in realistic areas of the MSSM parameter space, these two effects can conspire and hide new physics in a Standard Model like inclusive cross section.

We show that it is possible to break this degeneracy in the couplings by demanding a boosted Higgs recoiling against a high-p_T jet. We propose an analysis based on this idea in the $H \to 2\ell + \not{p}_T$ channel. This measurement allows for an alternative determination of the important top Yukawa besides the $t\bar{t}H$ channel.

Higgs boson properties (mass, spin/CP)

Nikolina Ilic (University of Toronto)

The Higgs mass and spin/CP measurements from the ATLAS and CMS detector are summarized. The measurements of the Higgs mass are presented for the high resolution channels. The standard model Higgs hypothesis of a spin 0+ Higgs boson is tested against spin 0-, spin 1 and spin 2 hypotheses in various decay channels.

DiHiggs production and new physics

Andreas Papaefstathiou (CERN, Geneva)

The process of Higgs boson pair production at hadron colliders has received considerable attention recently, owing to the discovery of the Higgs boson itself. This is partly due to the fact that its observation can probe the self-consistency of the electroweak sector of the standard model. However, it can also provide important orthogonal information on possible new physics effects that may be beyond direct reach of collider experiments. In this talk we will briefly review the strategies for extracting constraints in the framework of D=6 EFT using di-Higgs production.

Searches for BSM Higgs bosons at the LHC

Anne-Marie Magnan (Imperial College London)

Recent results on searches for Beyond Standard Model production of Higgs bosons at the LHC by the ATLAS and CMS collaborations are presented. Minimal supersymmetric models (MSSM), next-to-minimal supersymmetric models (NMSSM) and generic two-higgs-doublet models (2HDM) are explored. Additional Higgs bosons (pseudoscalar, charged, light and heavy scalars) are also looked for in multiple final states, including invisible decays.

Double Higgs boson production in the Standard Model with extra scalar particles

Evgenii Zhemchugov (ITEP, Moscow)

When the Standard Model is extended with an isotriplet or an isosinglet, the neutral scalar particles mix to form two physical mass eigenstates. One of these eigenstates is associated with the recently discovered 125 GeV Higgs boson. If the other eigenstate is sufficiently massive, it may decay into two lighter states, and thus provide a significant contribution to the $pp \to hh$ cross section which is 40 fb for $\sqrt{s} = 14$ TeV in the Standard Model. Bounds on the cross section are coming from the custodial symmetry violation (isotriplet) and electroweak precision observables (isosinglet). In the case of the isosinglet they allow for values as high as 0.5 pb, while for the single isotriplet only 20 extra fb is feasible.

Beyond the Standard Model and Dark Matter

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- New Physics for EW baryogenesis
  José Miguel No (University of Sussex, Brighton)
- Interference effects in BSM processes
  Elina Fuchs (DESY, Hamburg)
- Constraints on supersymmetry after Run 1 ATLAS searches
  Anyes Taffard (University of California Irvine)
- Light stop decays
  Ramona Groeber (INFN Sezione Roma Tre)
- Results on searches using jet(s) + ETmiss signatures
  Norraphat Srimanobhas (Chulalongkorn University)
- Weakly interacting and third generation SUSY searches at the LHC
  Alexandre Aubin (IPHC, Strasbourg)
- Searches for RPV SUSY and long lived particles at the LHC
  Minghui Liu (Univ. of Science & Tech. of China, Hefei)
- Revisiting LHC gluino mass bounds through radiative decays using MadAnalysis 5
  Guillaume Chalons (LPSC, Grenoble)
- Searching for links between general relativity and quantum mechanics
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Wednesday Session

- Searches for heavy resonances at the LHC
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- Searches for dark matter and extra dimensions at the LHC
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- SHiP: a new facility for searching for long-lived neutral particles and studying the tau neutrino properties
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- Search for Pseudoscalar and Scalar Weakly Interacting Sub-eV Particles with the OSQAR Experiment
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- Probing the non thermal dark matter at hadron colliders with events containing a single top quark in the final state
  Mykhailo Dalchenko (Texas A&M University, College Station)

- A taste of dark matter: flavour constraints on pseudoscalar mediators
  Christopher McCabe (GRAPPA University of Amsterdam)
- Self-interacting asymmetric dark matter
  Kalliopi Petraki (NIKHEF, Amsterdam)
- Particle cosmological probes on light dark matter
  Kenji Kadota (CTPU, Daejeon)
- Latest Results from the LUX Dark Matter Search Experiment
  Simon Fiorucci (Brown University, Providence)
- Dark Matter searches with HESS
  Knut Morå (Stockholm University)
- Status of the first EDELWEISS-III physics run
  Valentin Kozlov (KIT, Karlsruhe)
- The direct WIMPs search within the XENON Project: the status of the art
  Fabio Valerio Massoli (Università di Bologna)
- Recent Results from the CRESST Experiment
  Raimund Strauss (MPI, Munich)
- Vortices in axion condensate dark halos
  Marek Szydlowski (Jagiellonian University, Krakow)

Accidental matter at the LHC

Luca Di Luzio (Università di Genova)

We classify weak-scale extensions of the Standard Model which automatically preserve its accidental and approximate symmetry structure at the renormalizable level and which are hence invisible to low-energy indirect probes. By requiring the consistency of the effective field theory up to scales of 10^{15} GeV and after applying cosmological constraints, we arrive at a finite set of possibilities. One of the most striking signatures of this framework is the presence of new charged and/or colored states which can be efficiently produced in high-energy particle colliders and which are stable on the scale of detectors.

New Physics for EW baryogenesis

José Miguel No (University of Sussex, Brighton)

The existence of extra Higgses in Nature could lead to a cosmological first order electroweak phase transition and explain the origin of the matter-antimatter asymmetry in the Universe. We analyze the LHC 'smoking gun' signatures of such a phase transition in a two-Higgs-doublet model extension of the SM, and show that the observation of the decay $A^0 \to H^0 Z$ at the 14 TeV run of LHC in $llbb$ or $bbWW$ final states would signal a strong EW phase transition as required by baryogenesis.

Interference effects in BSM processes

Elina Fuchs (DESY, Hamburg)

Many models beyond the SM predict new particles and the possibility for (approximate) degeneracies. In case of nearby resonances, interference effects between several unstable BSM particles may be relevant. However, the interference term is neglected by the standard narrow-width approximation (NWA).
We have developed an extension of the usual NWA which allows for a consistent treatment of the interference term between nearly mass-degenerate states, including higher-order corrections. Phenomenological consequences of interference effects between neutral MSSM Higgs bosons will be presented. The two heavier states are quasi degenerate in a wide part of the parameter space. Therefore, especially in the MSSM with $\mathcal{CP}$-violating complex phases, interference effects can have a significant impact on the interpretation of searches for additional Higgs bosons.

Constraints on supersymmetry after Run 1 ATLAS searches

Anyes Taffard (University of California Irvine)

Despite the absence of experimental evidence, weak scale supersymmetry remains one of the best motivated and studied Standard Model extensions. This talk summarizes Run-1

ATLAS results for searches for supersymmetric (SUSY) particles. Weak and strong production in both R-Parity conserving and R-Parity violating SUSY scenarios are considered. The searches involved final states including jets, missing transverse momentum, light leptons, taus or photons, as well as long-lived particle signatures. Sensitivity projections for the data that will be collected in 2015 are also presented.

Light stop decays

Ramona Groeber (INFN Sezione Roma Tre)

The relevant stop search channels in the low-mass range are flavour-violating decays to a charm quark and a neutralino and four-body decays into $b\tilde{\chi}_1^0 f\bar{f}'$ or, if kinematically allowed, into $b\tilde{\chi}_1^0 W$. In this talk I will discuss the calculation of the flavour-violating two-body decay modes including the SQCD corrections and the four-body decay with special focus to the transition region to the three-body decay. The resulting branching ratios in either of the decay channels can significantly deviate from one in large parts of the parameter space. Taking this into account, the experimental exclusion limits, which are based on the assumption of branching ratios equal to one, are considerably weakened leaving still space for a rather light stop.

Results on searches using jet(s) + ETmiss signatures

Norraphat Srimanobhas (Chulalongkorn University)

The results of searches for new physics in events using jet(s) and missing transverse momentum will be presented. These results are based on analyses using the data from the Large Hadron Collider with corresponding integrated luminosities of 20.3 fb^{-1} for ATLAS, and 19.7 fb^{-1} for CMS experiments. The event topologies of interest in this talk include monojet/multijets and missing transverse momentum, monotop and top quark pair, and razor analyses. The interpretations for new physics include dark matter, extra-dimensions, and model independent.

Weakly interacting and third generation SUSY searches at the LHC

Alexandre Aubin (IPHC, Strasbourg)

In this talk, we discuss the third generation and electroweak SUSY searches in ATLAS and CMS during Run I. These searches are motivated by cosmological and naturalness arguments. The talk focuses on new results, or searches targetting particular corners of the phase space. Finally, the prospects for Run II and beyond are briefly presented.

Searches for RPV SUSY and long lived particles at the LHC

Minghui Liu (Univ. of Science & Tech. of China, Hefei)

Abstract not received

Revisiting LHC gluino mass bounds through radiative decays using MadAnalysis 5

Guillaume Chalons (LPSC, Grenoble)

The ATLAS and CMS experiments at the CERN LHC have collected about 25 fb^{-1} of data each at the end of their 8 TeV run, and ruled out a huge swath of parameter space in the context of Minimally Supersymmetric Standard Model (MSSM). Limits on masses of the gluino ($\tilde{g}$) have been pushed to above 1 TeV. This limits are however extremely model dependent and do not always reflect the level of exclusion. So far the limits on the gluino mass using the simplified model approach only constrained its value using its three-body decays. We show in this work that already existing ATLAS and CMS analysis can also constrain the radiative gluino decay mode and we derived improved mass limits in particular when the mass difference between the LSP and the gluino is small.

Searching for links between general relativity and quantum mechanics

Thuan Vo Van (Vietnam Atomic Energy Institute)

In analogue to the de Sitter formalism, we investigated a formulation of the 4D physical space-time from an ideal extended flat symmetrical 6D time-space. Basically, the symmetry between a linear time-like interval and a linear space-like one is defined to be conserved in a transformation from a higher dimensional geometry to a lower dimensional space-time. A simplified cylindrical model of gravitational geometrical dynamics leads to a micro geodesic description of the curved micro space-time. In particular, due to interaction of a Higgs-like cosmological potential with individual space-time fluctuations the original time-space symmetry is spontaneously broken, then a strong time-like curvature and a weak spatial curvature are created. It is defined that the physical time of the 4D space-time consists of a linear component and of the transverse curved components. The two time-like extra-dimensions can be made explicit in terms of the quantum wave function and the proper time variable. As a result, the basic Klein-Gordon-Fock equation for massive elementary particles is derived, which implies a duality between the quantum mechanics equation and the geodesic law of micro time-space curvatures. Consequently, a new attempt to search for the links between general relativity and quantum mechanics is carried out. In particular, the Heisenberg indeterminism would originate from the time-space curvatures. Moreover, extending the time-like curvatures to a higher order than one of the cylindrical configuration, we can find a reasonable ratio of lepton

masses of all generations. Some other basic phenomena of micro physics are also discussed.

Searches for heavy resonances at the LHC

Aidan Sean Randle-Conde (Université Libre de Bruxelles)

Searches for heavy resonances at the LHC during Run I are presented. This talk focuses on the searches performed by the ATLAS and CMS experiments, covering a variety of final state topologies.

Searches for dark matter and extra dimensions at the LHC

Marie-Hélène Genest (LPSC, Grenoble)

The talk will review the most recent results on the search for dark matter and extra dimensions in 8 TeV proton-proton collisions at the Large Hadron Collider. Several analyses performed by the ATLAS and CMS collaborations using the full integrated luminosity will be summarized, including a discussion of the limits obtained in different scenarios.

New Physics at the LHC: Heavy quarks and multileptons

Loïc Valéry (IFAE, Barcelona)

The Standard Model limitations strongly motivate the consideration of various other theories, called "New Physics" theories. Their manifestations are searched for in peculiar final states by the ATLAS and CMS collaborations. Among these final states, the ones containing heavy quarks (such as the top quark), or multiple leptons, provide very specific signatures, studied in details in several ATLAS and CMS analyses. This talk summarizes some of these, focusing on the ones involving heavy vector-like quarks, both in the single and multi-lepton final states.

SHiP: a new facility for searching for long-lived neutral particles and studying the tau neutrino properties

Géraldine Conti (CERN, Geneva)

SHiP is a new general purpose fixed target facility, proposed at the CERN SPS accelerator. In its initial phase the 400GeV proton beam will be dumped on a heavy target, integrating 2×10^{20} p.o.t. in 5 years. A dedicated detector located downstream of the target, based on a long vacuum tank followed by a spectrometer and particle identification detectors, will allow probing a variety of models with light long-lived exotic particles and masses below O(10) GeV/c^2. The main focus will be the physics of the so-called Hidden Portals, i.e. search for Dark Photons, Light scalars and pseudo-scalars, and Heavy Neutrinos. The sensitivity to Heavy Neutrinos will allow for the first time to probe, in the mass range between the kaon and the charm meson mass, a coupling range for which Baryogenesis and active neutrino masses could also be explained. Direct detection of light and long-lived SUSY particles, such as RPV neutralinos and pseudo-Dirac gauginos could also be performed in an unexplored parameter range. Another dedicated detector, based on the Emulsion Cloud Chamber technology already used in the OPERA experiment, will allow to study active neutrino cross-sections and angular distributions. In particular measurements of the tau neutrino deep inelastic scattering cross section will be performed with a statistics 1000 times larger than currently available, with the extraction of the F_4 and F_5 structure functions, never measured so far. Tau neutrinos will be distinguished from tau anti-neutrinos, thus providing the first observation of the tau anti-neutrino.

Axions-like particles at colliders

Ken Mimasu (University of Sussex, Brighton)

New pseudo-scalars, often called axion-like particles (ALPs), abound in model-building and are often associated with the breaking of a new symmetry. Traditional searches and indirect bounds are limited to light axions, typically in or below the KeV range for ALPs coupled to photons. I will discuss the role of colliders in constraining ALPs from mono-γ, tri-γ and mono-jet searches in a model independent fashion, including current limits and prospects for future machines. These are are complementary to existing searches, as they are sensitive to heavier ALPs and have the capability to cover an otherwise inaccessible region of parameter space. Assuming certain model dependent correlations between the ALP coupling to photons and gluons and considering the validity of the effective description of ALP interactions points to mono-jet searches as the most suitable and effective in indirectly constraining ALP scenarios.

Search for Pseudoscalar and Scalar Weakly Interacting Sub-eV Particles with the OSQAR Experiment

Matthias Schott (University of Mainz)

Weekly interacting sub-eV particles (WISPs) are theorized to have a di-photon coupling vertex which allows for an experimental search using quantum oscillations of optical photons facing a strong magnetic field. The OSQAR photon regeneration experiment searches for scalar- and pseudo-scalar WISP candidates by a Light-Shining-Through-Wall setup. The analysis of the data, taken in the year 2014 with an improved experimental setup, shows no excess of events over the expected background, allowing us to constrain the di-photon coupling strength down to $3.2 \cdot 10^{-8} GeV^{-1}$ in the massless limit. This result is the most stringent constraint on the di-photon coupling strength ever achieved in a laboratory based experiment.

Probing the non thermal dark matter at hadron colliders with events containing a single top quark in the final state

Mykhailo Dalchenko (Texas A&M University, College Station)

We investigate the collider phenomenolgy of a minimal non thermal dark matter model with a 1-GeV dark matter candidate, which naturally explain baryongensis. The dark matter candidate is not protected by parity and can be produced single with an association of the high-energy jet. The decay chain containing the top quark provides a sensitivity to the production mechanism due to significant correlations between the top quark chirality and transverse momentum of the resulting b-jet. Sensitivity estimation for the LHC Run II data offers offer significant bounds on the model parameters.

A taste of dark matter: flavour constraints on pseudoscalar mediators

Christopher McCabe (GRAPPA University of Amsterdam)

Dark matter interacting via the exchange of a light pseudoscalar can induce observable signals in indirect detection experiments and experience large self-interactions while evading the strong bounds from direct dark matter searches. The pseudoscalar mediator will however induce flavour-changing interactions in the Standard Model, providing a promising alternative way to test these models. In this talk, I describe constraints arising from rare meson decays and fixed target experiments for different coupling structures between the pseudoscalar and Standard Model fermions. The resulting bounds are highly complementary to the information inferred from the dark matter relic density and the constraints from primordial nucleosynthesis. I then briefly discuss the implications of these findings for the prospects of probing dark matter coupled to a light pseudoscalar with direct or indirect detection experiments. In particular, we find that a pseudoscalar mediator can only explain the Galactic Centre excess if its mass is above that of the B mesons, and that it is impossible to obtain a sufficiently large direct detection cross section to account for the DAMA modulation.

Self-interacting asymmetric dark matter

Kalliopi Petraki (NIKHEF, Amsterdam)

Self-interacting dark matter offers a compelling explanation of the observed galactic structure. Particle physics models of self-interacting dark matter can be well accommodated within the asymmetric dark matter scenario, which hypothesises that the dark-matter abundance is due to an excess of dark particles over antiparticles, and allows for sizeable direct couplings of dark matter to light force mediators. Exploring the low-energy phenomenology of self-interacting asymmetric dark matter, including the effect on the dynamics of haloes and possible detection strategies, presupposes understanding the cosmology of these models, which can be quite complex. I will illustrate the above in the context of the atomic dark matter model.

Particle cosmological probes on light dark matter

Kenji Kadota (CTPU, Daejeon)

The constraints on the light (the mass below GeV-scale) dark matter will be discussed. A few concrete examples will also be presented, including the constrains on the light dipole dark matter from the collider (ILC), supernovae and the large scale structure (21cm), to illustrate the complementarity of the particle physics and cosmology probes.

Latest Results from the LUX Dark Matter Search Experiment

Simon Fiorucci (Brown University, Providence)

The LUX experiment uses 370 kg of pure xenon as a target for WIMP-nucleus interactions in a dual-phase time projection chamber setup. I will summarize the results obtained to date, highlight the most recent progress, and outline the projections for data through 2016.

Dark Matter searches with HESS

Knut Morå (Stockholm University)

Cosmological measurements of the universe indicate that a large component of non-visible gravitating matter is present in the universe. A common hypothesis is a weakly interacting, massive particle. Annihilation or decays of such particles could be visible in gamma-ray spectra. The HESS experiment is an imaging air Cherenkov telescope located in Namibia studying very high energy gamma-rays between 300 GeV and 10 TeV. HESS has published limits on the co-annihilation cross section from the galactic center, at the level of $< \sigma v >= 10^{-27} cm^3 s^{-1}$ for a mono-energetic signal, and $3 * 10^{-24} cm^3 s^{-1}$ in the case of annihilation to light quarks. The talk will present a review of HESS searches for dark matter in the very high energy region.

Status of the first EDELWEISS-III physics run

Valentin Kozlov (KIT, Karlsruhe)

EDELWEISS is a direct dark matter search program looking for WIMPs using a 20 kg array of cryogenic Ge detectors installed in the Frejus tunnel. This third phase of the experiment is currently accumulating data, with improved resolution and rejection performance relative to the results of EDELWEISS-II. A part of the data has been analyze to check the new performance for the search of low-mass WIMPS.

The direct WIMPs search within the XENON Project: the status of the art

Fabio Valerio Massoli (Università di Bologna)

We present the status of the XENON Project focused on the direct detection of WIMPs using double phase, LXe/GXe, TPC. The XENON100 experiment, that is still taking data at LNGS, for the 2012 has set the most stringent limits on WIMP-nucleon spin-independent cross section for WIMP masses above 8 GeV/c^2, with a minimum at $\sigma = 2 \cdot 10^{-45}$ cm^2 at 55 GeV/c^2 (90% CL). The XENON collaboration is now focused on the construction and the installation of the XENON1T detector that will lower the current limits by about two orders of magnitude. To reach such a goal, a background level of about 1 event in a 1 tonne-year exposure is required. To estimate the background we performed detailed MC simulations and through the sensitivity studies (done with the Maximum Gap and Profile Likelihood methods) we prove that XENON1T will be able to reach its goal.

Recent Results from the CRESST Experiment

Raimund Strauss (MPI, Munich)

The CRESST (Cryogenic Rare Event Search with Superconducting Thermometers) experiment aims at the direct detection of WIMPs. In summer 2013 a new Dark Matter run has been started with a total target mass of 5kg. With respect to previous measuring campaigns the intrinsic radiopurity of CaWO4 crystals and the capability to reject recoil events from alpha surface contamination has been significantly improved. We analysed the first 80 live-days of data acquired by a single 250g CaWO4 detector which combines an unprecedented background level with a low trigger threshold of 600eV. In this talk, we present a new detector design and the results of a low-threshold analysis which set stringent limits for the spin-independent WIMP-nucleon cross section, in particular for low-mass WIMPs. The status of the currently ongoing preparations towards the next phase of CRESST and the strategy beyond will be discussed.

Vortices in axion condensate dark halos

Marek Szydlowski (Jagiellonian University, Krakow)

We consider the possibility of the vortex formation in axion condensates in galactic halos to explain the dark matter problem in astrophysics. We assume vortices as a result of global rotation of the early universe. We study the Bose-Einstein condensate of axion using the non-relativistic Gross-Pitaevski equation. We reconstruct the galaxy rotation curves and show that they are in good agreement with observational data. However, as we show, the extremely low velocity dispersions of the axion velocities are required to form the single vortex on the galactic scales. We find that the required velocity dispersion is of the order of $\sigma \approx 10$–12 ms^{-1}. This is much smaller that predicted within the present understanding of the axion physics. The vortices in the axion condensate can be however formed on the much smaller scales and give seeds to the galaxy formation and to their angular momenta. On the other hand, the vortices can be formed on the galactic scales, but only if the mass of the axion-like particles is of the order of 10–30 eV. In this case, the particle de Broglie wavelength is comparable with the galactic diameter, in order to keep the coherence of the quantum condensate on galactic scales.

QCD + Heavy Flavours

Tuesday Session

- Recent Heavy Flavor Physics Results from the Tevatron
  Brad Abbott (University of Oklahoma, Norman)
- Measurement of Heavy Flavour Production at Atlas and CMS
  Alexis Pompili (University of Bari and INFN-Bari)
- Measurement of Heavy Flavour properties at Atlas and CMS
  Adam Edward Barton (Lancaster University)
- Measurements of CP-violating phases in B decays at LHCb
  Laurence Carson (University of Edinburgh)
- Measurements of CP violation and mixing in charm decays at LHCb
  Oliver Lupton (University of Oxford)
- Results on CP violation in heavy meson decays at e^+e^- B Factories
  Thomas Latham (University of Warwick)
- Semileptonic b-hadron decays at LHCb
  Brian Hamilton (University of Maryland, College Park)
- Rare beauty and charm decays at LHCb
  Alessandro Mordà (CPPM, Marseille)
- Leptonic B decays and related results at B Factories
  Youngmin Yook (Yonsei University, Seoul)

Wednesday Session

- Charmed hadron physics at BESIII
  Yong Huang (IHEP, Beijing)
- Exotics and charmonia at BESIII
  Zhihong Wang (USTC, Hefei)
- Heavy quark spectroscopy at LHCb
  Yiming Li (LAL, Orsay)
- Recent results and prospects on kaon physics from CERN
  Plamen Petrov (Université Catholique de Louvain)
- Results of HI physics from Atlas and CMS
  Émilien Chapon (LLR, Palaiseau)
- Test of the Weak Equivalence Principle on antimatter with the AEgIS experiment
  Davide Pagano (UCL, Louvain)
- Electroweak physics and QCD in the forward direction at LHCb
  William Barter (CERN, Geneva)
- Recent QCD and Electroweak Results from the Tevatron
  Darren Price (University of Manchester)
- Latest results on jets and photon production from Atlas and CMS
  Kadir Ocalan (Necmettin Erbakan University, Konya)

- Inclusive W, Z, and W&Z+jets production at the LHC
  Benjamin Brau (University of Massachusetts, Amherst)
- NNLO corrections to Higgs + 1 jet
  Fabrizio Caola (CERN, Geneva)
- N3LO corrections to inclusive Higgs production
  Bernhard Mistlberger (ETH Zurich)
- Progress in NNPDF
  Valerio Bertone (CERN, Geneva)

Recent Heavy Flavor Physics Results from the Tevatron

Brad Abbott (University of Oklahoma, Norman)

The most recent results on heavy flavor production and decays from the Tevatron experiments CDF and D0 are presented using the Full RunII dataset.

Measurement of Heavy Flavour Production at Atlas and CMS

Alexis Pompili (University of Bari and INFN-Bari)

Recent results of the ATLAS and CMS experiments on heavy flavour production at LHC, including quarkonium promptly produced, alone or in association with another quarkonium or a vector boson, are reviewed.

Measurement of Heavy Flavour properties at Atlas and CMS

Adam Edward Barton (Lancaster University)

The recent Measurements of heavy Flavor Properties at ATLAS and CMS will be presented. These include CP violation measurements and searches for new excited states.

Measurements of CP-violating phases in B decays at LHCb

Laurence Carson (University of Edinburgh)

The latest results from the LHCb collaboration relating to measurements of the CP-violating phases γ, β and ϕ_s will be presented. Precise measurements of these phases are crucial in constraining the CKM picture of quark mixing in the Standard Model, and in searching for possible small effects from Beyond the SM physics.

Measurements of CP violation and mixing in charm decays at LHCb

Oliver Lupton (University of Oxford)

LHCb has collected the world's largest sample of charmed hadrons. This sample is used to search for both direct and indirect CP violation in D^0 decays, and to measure D^0 mixing parameters. Recent results are presented on these topics, and on related studies of the charm system.

Results on CP violation in heavy meson decays at e^+e^- B Factories

Thomas Latham (University of Warwick)

We present results from the BaBar and Belle experiments of recent studies of CP violation phenomena in the mixing and decays of beauty and charm mesons. The analyses presented use the final data sets collected by each experiment at the $\Upsilon(nS)$ resonances.

Semileptonic b-hadron decays at LHCb

Brian Hamilton (University of Maryland, College Park)

Semileptonic b decays provide a potentially powerful probe for a variety of interesting scenarios of physics beyond the standard model. At the end of B factory running, puzzling discrepancies still remain in these channels. Among these are the B to tau semileptonic decay rates, sensitive to violations of charged lepton universality, which have remained persistently above standard model predictions. Also of particular interest is the longstanding discrepancy between inclusive and exclusive determinations of Vub, which is potentially sensitive to new charged current interactions. I will discuss what can be said so far about these semileptonic observables using the LHCb Run 1 dataset.

Rare beauty and charm decays at LHCb

Alessandro Mordà (CPPM, Marseille)

Rare Flavour Changing Neutral Currents (FCNC) decays can proceed in Standard Model (SM) only through loop processes. For that reason they are a powerful tool to test the quantum structure and the flavor sector of the SM and, at the same time, they are sensitive indirect probes of New Physics (NP) effects beyond the SM. In particular they provide information on the couplings and masses of heavy intermediate states appearing inside the loops and allow to explore energy scales well above the ones reacheable with direct searches. The latest results on rare decays of beauty and charm hadrons obtained from the LHCb experiment with data collected during the first run of the LHC will be presented in this talk.

Leptonic B decays and related results at B Factories

Youngmin Yook (Yonsei University, Seoul)

Since the leptonic decays of B mesons can be calculated precisely in the Standard Model (SM), they can provide determinations of the SM parameters and probe New Physics effects. The $B^+ \to \ell^+\nu_\ell\gamma$ decay is expected to have larger branching fraction compared to the leptonic decay and measurements of its branching fraction can provide constraints of its QCD-based calculation. In this talk, we present the recent results of leptonic B decays and related at the Belle and BaBar experiment.

Charmed hadron physics at BESIII

Yong Huang (IHEP, Beijing)

We would herein report charmed hadron physics analysis at BESIII experiment, including both the published result in the last year and the on-doing works which have the preliminary results.

Exotics and charmonia at BESIII

Zhihong Wang (USTC, Hefei)

In quark model, hadron matter existing in our universe is composed of 3 quarks (baryon) or quark-anti-quark pairs (meson). However, QCD allows new forms of hadrons called exotic states, such as multi-quark states, hybrids, glue balls and so on. In charmonium mass region, many new particles (called charmoniumlike states or XYZ particles) were observed and show different features with normal charmonium states, and might be good candidates for exotic states. With the ability to run at 2.0 to 4.6 GeV, the BESIII experiment located in BEPCII has becoming a pioneer in searching and studying charmoniumlike states. In 2013, BESIII Collaboration discovered a charged charmoniumlike states $Z_c(3900)^\pm$ via process $e^+e^- \to Z_c(3900)^\pm\pi^\mp \to \pi^+\pi^- J/\psi$, which is confirmed by Belle and CLEO-c Collaborations with the same process, and provides the best candidates for a four quark states by now. This state is close to and above the $D\overline{D}^*$ mass threshold. BESIII experiment also studied the process $e^+e^- \to \pi^\pm(D\overline{D}^*)^\mp$, and observed a structure $Z_c(3885)$ in the $(D\overline{D}^*)^\mp$ invariant mass distribution. Further study still needed for whether the $Z_c(3885)$ is the same as the $Z_c(3900)$. With the continuous studies by BESIII experiment, possible partner particles $Z_c(4020)^\pm/Z_c(4020)^0$ (πh_c) in $e^+e^- \to \pi^+\pi^- h_c/\pi^0\pi^0 h_c$, $Z_c(4025)^\pm$ $[(D^*\overline{D}^*)^\pm]$ in $e^+e^- \to \pi^\pm(D^*\overline{D}^*)^\mp$. Also, BESIII reveals the potential connection between $Y(4260)$ and $X(3872)$ for the first time, which may help us understand XYZ particles in a new sight. More results from BESIII are under way.

Heavy quark spectroscopy at LHCb

Yiming Li (LAL, Orsay)

The latest results on heavy quark spectroscopy from LHCb experiment will be reported, including the studies on excited bottom and charm mesons and charmonium-like exotic states such as X(3872).

Recent results and prospects on kaon physics from CERN

Plamen Petrov (Université Catholique de Louvain)

The NA62 experiment at the CERN SPS aims to collect of the order of 100 $K^+ \to \pi^+\nu\nu$ events in two years of data taking, keeping the background at the level of 10%. Thanks to their theoretical cleanliness the rare decays $K^+ \to \pi^+\nu\nu$ are excellent processes to make tests of new physics at the highest scale. The physics prospects and the status of the NA62 experiment after the commissioning run of 2014 will be reviewed. The first observation of the very rare decay $K^\pm \to \pi^\pm\pi^0 e^+ e^-$ by the NA48/2 experiment will be presented as well as the search for the dark photon (A') via the decay chain $\pi^0 \to \gamma A'$, $A' \to e^+e^-$.

Results of HI physics from Atlas and CMS

Émilien Chapon (LLR, Palaiseau)

We will present an overview of recent results from the ATLAS and CMS collaborations on heavy ion physics. Using data from proton-proton, proton-lead and lead-lead collisions, these results help to shed light on the properties of nuclear matter.

Test of the Weak Equivalence Principle on antimatter with the AEgIS experiment

Davide Pagano (UCL, Louvain)

The AEgIS experiment at the CERN's Antiproton Decelerator (AD) aims at performing the first direct measurement of the gravitational force on antimatter. This measurement would be of great interest in Cosmology as it would probe, for the first time, the Weak Equivalence Principle of General Relativity with antimatter. The idea is to measure the vertical displacement of a cold antihydrogren beam, due to the gravitational force, by using a Moiré deflectometer. Antihydrogen will be formed through the reaction of charge exchange between cold antiprotons and Rydberg positronium. In addition to the measurement of the gravitational interaction between matter and antimatter, longer term plans also include spectroscopy measurements. Comparisons of hydrogen and antihydrogen spectroscopy would be a high-precision test of CPT symmetry. An overview of the physics goals, of the experimental setup and of the preliminary results from the 2014 data taking is presented.

Electroweak physics and QCD in the forward direction at LHCb

William Barter (CERN, Geneva)

The LHCb detector is a forward arm spectrometer, originally designed to study the decays of heavy-flavour particles. However, LHCb also has a rich programme studying both QCD and EW physics in the forward region, and their interplay. This talk shall present measurements of W and Z boson production cross-sections, and the ratios of these cross-sections. These results allow new constraints to be placed on parton distribution functions. The talk shall also present the results of heavy flavour jet production in association with electroweak bosons.

Recent QCD and Electroweak Results from the Tevatron

Darren Price (University of Manchester)

We present the latest measurements of QCD and electroweak phenomena from the D0 experiment in $p\overline{p}$ collisions at 1.96 TeV. These include measurements probing double parton scattering, vector boson plus heavy flavour production, forward-backward production asymmetries, and central exclusive production, as well as studies of the underlying event at various $p\overline{p}$ collision energies.

Latest results on jets and photon production from Atlas and CMS

Kadir Ocalan (Necmettin Erbakan University, Konya)

Latest results on jet and photon production from ATLAS and CMS experiments are discussed. We mainly review cross sections, parton distribution function, and strong coupling measurements for various jet productions from center-of-mass enegies of 7 TeV and 8 TeV at the LHC.

Inclusive W, Z, and W&Z+jets production at the LHC

Benjamin Brau (University of Massachusetts, Amherst)

The ATLAS and CMS experiments at the LHC have made many measurements of the production of the vector bosons, W and Z, in association with energetic jets. Understanding W/Z + jets and W/Z + heavy flavor production is important for many other analyses including studies of the top quark, the Higgs boson, measurement of the W mass, and for many new physics searches. In this talk, I will discuss several recent measurements of the associated production of jets and vector bosons the first run of the LHC. Results are compared to a variety of different perturbative QCD predictions.

NNLO corrections to Higgs + 1 jet

Fabrizio Caola (CERN, Geneva)

I will report on the recent computation of Higgs boson production in association with one

hard jet at next-to-next-to-leading order in perturbative QCD. I will show predictions for the fiducial 1-jet cross-section at the 8 TeV and 13 TeV LHC and present selected kinematics distributions.

N3LO corrections to inclusive Higgs production

Bernhard Mistlberger (ETH Zurich)

I present the recently obtained Higgs boson production cross-section at N3LO in perturbative QCD and discuss some phenomenological implications.

Progress in NNPDF

Valerio Bertone (CERN, Geneva)

I my talk I will present the developments that are presently being carried on in the NNPDF collaboration for a more accurate determination of parton distribution functions (PDFs). More in particular, I will discuss the inclusion of the threshold resummation in a global determination of PDFs and the fit of the charm PDFs. Finally, I will briefly present some recent technical and theoretical developments towards a new release of the NNPDF family sets: the NNPDF3.1 sets.

Neutrinos

Tuesday Session

- Results of T2K
  Benjamin Quilain (University of Kyoto)
- The NOνA experiment: status and future
  Bruno Zamorano (University of Sussex)
- Latest results from the Double Chooz experiment
  Antoine Collin (MPIK, Heidelberg)
- Results from the Daya Bay experiment
  Bedrich Roskovec (Univerzita Karlova)
- KM3NeT/ORCA: Measuring neutrino oscillations and the mass hierarchy in the Mediterranean
  Martijn Jongen (NIKHEF, Amsterdam)
- Searching for neutrinoless double beta decay of ^{130}Te with CUORE-0 and CUORE
  Claudia Tomei (INFN Sezione di Roma)
- The GERDA Experiment for the Search of Neutrinoless Double Beta Decay: Phase I Results and Phase II Upgrades
  Manuel Walter (University of Zurich)
- Leptonic flavour models
  Christoph Luhn (University of Siegen)
- Hadron Production Measurements from NA61/SHINE for Neutrino Flux Predictions
  Katarzyna Kowalik (National Center for Nuclear Research, Warsaw)
- Neutrino electromagnetic interactions:a window to new physics
  Alexander Studenikin (Moscow State University & JINR Dubna)

Results of T2K

Benjamin Quilain (University of Kyoto)

The T2K (Tokai-to-Kamioka) experiment is a long-baseline neutrino experiment which measures the oscillation parameters through the transformation of muon neutrinos and antineutrinos. The muon neutrino (antineutrino) beam is produced at J-PARC and detected 295 km away, at the Super- Kamiokande detector. Through the appearance of electron neutrino, T2K observed a non-null θ_{13} value which leads to the possibility of observing a CP violation effect in the lepton sector through neutrino oscillation. In particular, the very large θ_{13} value measured by T2K in the neutrino sector is in tension with the recent and precise results measured by reactor experiments (DayaBay, RENO, Double Chooz) in the antineutrino sector. The observation of antineutrino disappearance is therefore crucial to determine if this tension can be due to CP violation in the lepton sector. Using the 2.3×10^{20} POT taken in antineutrino mode, we will present the latest results of muon antineutrino disappearance at T2K. We will discuss the constraints on the $\overline{\theta}_{23}$ and $\Delta\overline{m}^2_{32}$ oscillation parameters and their compatibility with the neutrino sector measurements. Finally, we will present the first results of the search for Lorentz (and CPT) symmetry violation at T2K. This violation is predicted in some unification theories (string theories, quantum gravity etc...) as a consequence of merging gravity to the Standard Model. The neutrino oscillation being one of the most sensitive probe to this effect, we will show the T2K results using the high-statistics near detector.

The NOνA experiment: status and future

Bruno Zamorano (University of Sussex)

The NuMI Off-axis ν_e Appearance (NOνA) experiment is a two-detector, long-baseline neutrino oscillation experiment which addresses some of the main open questions in the neutrino sector through precision measurements of neutrino and antineutrino oscillations. NOνA uses the upgraded NuMI neutrino beam at the Fermi National Accelerator Laboratory and a highly active, finely segmented 14-kton far detector at Ash River, Minnesota. This so-called "fully-active" design provides an outstanding event identification capacity, which allows for precision measurements of the oscillation parameters in both the appearance and disappearance of neutrinos and antineutrinos. In particular, NOνA will provide constraints on θ_{13}, θ_{23}, $|\Delta m^2_{atm}|$, the neutrino mass ordering and the CP-violation phase δ. In this review we will discuss the experiment design and construction and its expected sensitivity for these parameters.

Latest results from the Double Chooz experiment

Antoine Collin (MPIK, Heidelberg)

Located at the Chooz nuclear power plant in France, the Double Chooz experiment is searching for disappearance of antineutrinos produced by the reactors. In order to measure the θ_{13} mixing angle, two identical detectors are placed at distances of about 400m and 1km, near the first maximum amplitude of the oscillation. The former one monitors the emitted neutrino flux while the comparison with the latter one gives an estimate of the deficit induced by the oscillation, canceling most of systematic uncertainties related to neutrino flux emission and detection. The latest results of the far detector only analysis will be presented.
The near detector data taking started this year: a status of the two detector phase will be given.

Results from the Daya Bay experiment

Bedrich Roskovec (Univerzita Karlova)

The Daya Bay Experiment has been measuring reactor anti-neutrino disappearance on short baseline with unprecedented precision since 2011. It was the first experiment which in 2012 observed a non-zero value of mixing angle θ_{13}. Since then the experiment accumulated high statistics of more than 2 million detected electron antineutrinos.
Results of neutrino oscillation parameters $\sin^2 2\theta_{13}$ and $|\Delta m^2_{ee}|$ based on 621 days of data will be presented as well as result of a largely independent measurement of $\sin^2 2\theta_{13}$ using neutron capture on hydrogen.
With precise measurement and high statistics the Daya Bay Experiment can go beyond 3-flavor neutrino mixing framework. Most stringent limits on the light sterile neutrino mixing angle θ_{14} were obtained for mass squared differences $10^{-3}eV^2 < \Delta m^2_{41} < 10^{-1}eV^2$.
Results of the absolute reactor anti-neutrino flux measurement will be presented. Being lower than the theoretical predictions, it favours the so called 'reactor anomaly' which is in an agreement with previous measurements of other short-baseline experiments.
The measured reactor anti-neutrino spectrum, which exhibits deviation from traditional predictions, will be also shown.

KM3NeT/ORCA: Measuring neutrino oscillations and the mass hierarchy in the Mediterranean

Martijn Jongen (NIKHEF, Amsterdam)

Since the measurement of the mixing angle θ_{13}, the determination of the neutrino mass hierarchy (normal vs. inverted) has become one of the central challenges of neutrino physics, together with the search for CP violation in the leptonic sector. Recent studies have pointed out that the neutrino mass hierarchy can reveal itself in the atmospheric neutrino sector, in the energy range 1 – 20 GeV, where oscillations are affected by Earth matter effects.

The influence of the mass hierarchy on neutrino oscillations in matter leaves its imprint on the atmospheric neutrino flux via the characteristic appearance/disappearance patterns of different neutrino types as a function of energy and path through the Earth. ORCA - Oscillations Research with Cosmics in the Abyss - will be a dense configuration of KM3NeT

detection units, optimised for studying the interactions of neutrinos in seawater at low energies. To be deployed at the French KM3NeT site, ORCA's multi-PMT optical modules will take advantage of the excellent optical properties of deep seawater to accurately reconstruct both cascade and track events with a few GeV of energy. This contribution reviews these methods and technology, and compares ORCA's power for not only determining the neutrino mass hierarchy, but placing new constraints on other key parameters such as θ_{23}, with other current and near-future experiments.

Searching for neutrinoless double beta decay of ^{130}Te with CUORE-0 and CUORE

Claudia Tomei (INFN Sezione di Roma)

The Cryogenic Underground Observatory for Rare Events (CUORE) is a large-scale double beta decay experiment based on cryogenic bolometers currently in the final stages of construction at the Gran Sasso National Laboratory (LNGS). Its primary goal is to observe the neutrinoless double beta decay of 130Te and measure the Majorana neutrino mass with a projected sensitivity reaching the so-called inverted mass hierarchy region. CUORE-0 is a single CUORE-like tower, made of 52 TeO2 cryogenic bolometers for a total mass of 39 kg. Assembled using the new low background techniques used for CUORE, CUORE-0 started taking data in spring 2013 at LNGS and reached a total exposure of 35.2 kg y. Besides validating the ultra clean assembly procedures and materials of CUORE, CUORE-0 is also a competitive double beta decay experiment. Thanks to the lower background achieved and to the improvement in energy resolution, CUORE-0 has surpassed the sensitivity of the predecessor experiment, Cuoricino, in approximately half the runtime. In my talk, I will present the first physics results from CUORE-0 data and the combination with the Cuoricino result. I will also discuss the status and the physics potential of CUORE.

The GERDA Experiment for the Search of Neutrinoless Double Beta Decay: Phase I Results and Phase II Upgrades

Manuel Walter (University of Zurich)

GERDA is searching for the neutrinoless double beta decay, a lepton number violating process. It employs bare high-purity Ge diodes enriched to 86 % in ^{76}Ge directly immersed in liquid Ar. Phase I set a new lower limit of $T_{1/2}>2.1\cdot10^{25}$ yr (90% C.L.) at a mean background of $1\cdot10^{-2}$ cts/(keV·kg·yr), strongly disfavouring the long-standing claim of signal observation. For Phase II, additional 20 kg of BEGe-type detectors with improved pulse shape discrimination, more radio-pure front end electronics and detector holders as well as a hybrid liquid Ar veto, consisting of coated optical fibres with SiPMs and coated reflectors with PMTs will be installed. A sensitivity of $1.5\cdot10^{26}$ yr at a background of $1\cdot10^{-3}$ cts/(keV·kg·yr) are expected.

Leptonic flavour models

Christoph Luhn (University of Siegen)

It is a well-established fact that quarks and leptons come in three families. Yet the principles governing their origin and structure remain shrouded in mystery. In this talk we review the symmetry approach to this flavour puzzle. Originally, family symmetries were largely motivated by the idea of tri-bimaximal lepton mixing. In 2012, this simple pattern was ruled out by the measurement of the reactor mixing angle of about 9 degrees. We will present an overview of new strategies in constructing models of neutrino masses and mixing. Ways of testing such scenarios will be highlighted.

Hadron Production Measurements from NA61/SHINE for Neutrino Flux Predictions

Katarzyna Kowalik (National Center for Nuclear Research, Warsaw)

The long-baseline neutrino experiments rely on hadron production measurements to improve the precision of neutrino flux predictions. We present measurements of hadron production in proton-carbon interactions at 31GeV/c from the NA61/SHINE experiment at the CERN SPS. Recent new results for the thin carbon target are based on the full available statistics and combine different analysis techniques to cover the full phase-space of importance to T2K with an improved precision and coverage as compared to published results. Further improvements in the flux precision are expected from measurements with the replica target and here new results based on the first large statistics run will be presented. Furthermore, plans for measurements related to the neutrino program at Fermilab will be discussed.

Neutrino electromagnetic interactions:a window to new physics

Alexander Studenikin (Moscow State University & JINR Dubna)

A short introduction to the present status of neutrino electromagnetic properties and neutrino electromagnetic interactions is presented. We start with consideration of the electromagnetic form factors for the Dirac and Majorana neutrinos. Then we discuss experimental constraints on neutrino magnetic and electric dipole moments, electric millicharge, charge radius and anapole moments from the terrestrial laboratory experiments. The main manifestation of neutrino electromagnetic interactions, such as: 1) the radiative decay in vacuum, in matter and in a magnetic field, 2) the Cherenkov radiation, 3) the plasmon decay, 4) spin light in matter, 5) spin and spin-flavour precession, 6) neutrino pair production in a strong magnetic field, and the related processes and their astrophysical phenomenology are considered. The astrophysical constraints on neutrinos electromagnetic properties are also reviewed. The talk is based, in particular, on our recent papers: (1). C.Giunti, A.Studenikin, Electromagnetic interactions of neutrinos: a window to new

physics, arXiv: 1403.6344v2, Feb 23, 2015, accepted for publication in Rev.Mod.Phys. (2015), 79 p.
(2). K.Kouzakov, A.Studenikin, Theory of neutrino-atom collisions: the history, present status and BSM physics, Adv.High Energy Phys. 2014 (2014) 569409 (16 p.).
(3). C.Broggini, C.Giunti, A.Studenikin, "Electromagnetic properties of neutrinos", Adv. High Energy Phys. 2012 (2012) 459526 (47 p.).
(4). A. Studenikin, I. Tokarev, "Millicharged neutrino with anomalous magnetic moment in rotating magnetized matter", Nucl. Phys. B 884 (2014) 396-407.
(5). A. Studenikin, "New bounds on neutrino electric millicharge from limits on neutrino magnetic moment", Europhys. Lett. 107 (2014) 21001 (5 p.).
(6). V.Brudanin, D. Medvedev, A.Starostin, A. Studenikin, "New bounds on neutrino electric millicharge from GEMMA experiment on neutrino magnetic moment", arXiv: 1411.2279.
(7). I.Balantsev, A.Studenikin, "Spin light of relativistic electrons in neutrino fluxes", arXiv: 1502.05346 (8 p.).

Astroparticle Physics and Cosmology

Wednesday Session

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- Preliminary results of the final SNLS cosmology analysis
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A compelling Case for Dark Matter in the Gamma-Ray Sky

Tim Linden (University of Chicago)

In scenarios where WIMP dark matter can annihilate to produce standard model particles, gamma-ray observations are among the best probes to elucidate the nature of the dark matter particle. Observations of the Milky Way's galactic center are expected to provide the highest flux from dark matter in the sky, while observations of dwarf galaxies are expected to provide a low-background target for sensitive WIMP annihilation searches. Intriguingly, there are hints of an excess, compatible with the annihilation of a 50 GeV WIMP to bottom quarks in both observations of the Galactic Center, and in the recently discovered dwarf galaxy, Reticulum 2. In this talk, I will summarize the current status of these observations and discuss dark matter and astrophysical interpretations of the data. Finally, I will posit upcoming tests which will strongly suggest, or rule out, a dark matter interpretation.

Preliminary results of the final SNLS cosmology analysis

Patrick El-Hage (LPNHE, Paris)

We report on the analysis of the of the SNLS 5-year sample. The main improvements with respect to the 3-year analysis are described. We begin with a brief summary of the methodology behind supernova cosmology, as well as a review of the current state of constraints on dark energy. We then move on to describing the improvements that the final SNLS analysis will bring forth. The improvements we will focus on are threefold. We begin by describing the new photometric calibration which greatly reduces the systematic uncertainty on the cosmological parameters. We will then go over improvements in the photometry method itself. Finally, we consider the impact of adding new data sets to the construction of spectrophotometric templates of type Ia supernovae and in the cosmology. We conclude with an updated estimate of the uncertainty that will be reached on the equation of state parameter of dark energy in the context of the final SNLS analysis as well as explore possible further impro vements of the analysis methods and expected precision.

The LSST: General Presentation and New Method for Redshift Reconstruction

Adeline Choyer (LPSC, Greboble)

The Large Synoptic Survey Telescope (LSST) will be the most powerful wide field imager ever designed. With its large field of view, it will cover half of the sky every three nights and will observe billions of galaxies, in six optical photometric bands. Among many science goals, LSST data will accurately measure Dark Energy parameters through four distinct probes: supernovae, week lensing, Baryon Acoustic Oscillations (BAO) and clusters. For Dark Energy parameters study, photometric redshift are crucial and the accuracy of their estimation is the key for LSST success. An enhanced template fitting method has been developed to significantly improves photo-z quality up to large redshifts. This talk will start with a short presentation of the LSST instrument and it's science goal. Then, I will introduce the method used for the photometric redshift reconstruction and present our mains results.

Cosmology in the Era of BOSS

Nicolas Busca (APC, Paris)

In the course of the 6-year period between 2008 and 2014, BOSS has completed the very ambitious program of collecting the spectra of nearly 1,500,000 galaxies, sampling the z¡0.7 interval, and over 150,000 high-redshift quasars, sampling the 2 ¡z¡ 3.5 interval via the Lyman-α forest, in the largest volume ever surveyed at this density.

I will present per-cent level measurements of the cosmic distance scale from detections of the baryon acoustic oscillations in three redshift bins extending out to z$\sim$2.4, the most precise distance constraints ever obtained from galaxy surveys.

I will use these data to demonstrate the sequence of deceleration followed by acceleration experienced by the expansion of the Universe.

Early Science Results from the Dark Energy Survey

Kathy Romer (University of Sussex, Bighton)

The Dark Energy Survey (DES) is designed to unravel the mystery of the nature of the dark energy. The DES collaboration built and participated in the installation and commissioning of DECam, a 570 mega-pixel optical and near-infrared camera with a large 3 square deg field of view, set at the prime focus of the Vctor M. Blanco 4-meter telescope. Using DECam, DES will map 5000 square deg to a magnitude depth of 24 (in i-band) and observe designated supernova survey fields at high cadence. Using these data, DES will use four main probes to study the properties of dark energy: galaxy clustering on large scales, weak gravitational lensing, galaxy-cluster abundance, and supernova distances. I will describe highlights of the science analyses that have been completed so far. These include: cross-correlation with SPT CMB lensing maps; discoveries of super-luminous supernovae, strong lenses, high-z quasars; galaxy clusters and SNe1a light-curves.

Updates from the BICEP/KECK Array

Zeeshan Ahmed (Stanford University)

The BICEP/Keck Array program consists of a series of telescopes at South Pole designed to measure CMB polarization on degree angular scales, in search of imprints of inflation. We will describe the instrumentation and latest results of the program. Using data collected through 2013 at 150 GHz, the BICEP2+Keck Array polarization maps achieve noise

levels of 57 nK-deg (3.4 μK-arcmin) over an area of 400 deg^2 for a survey weight of 250,000 μK^{-2}. A strong excess above the lensing B-mode signal predicted by ΛCDM is observed, but a joint analysis with Planck finds the excess to be consistent with a galactic dust foreground. A 95% confidence upper limit on inflationary tensor-to-scalar ratio, $r < 0.12$ is obtained. Marginalizing over dust and r, we detect lensing B-modes at 7.0 σ. Keck Array and the newly installed BICEP3 are actively taking data in the same field at 95 and 220 GHz for further foreground control while deepening the inflationary search.

South Pole Telescope E-Mode, B-Mode and Gravitational Lensing Spectra

Jason Gallicchio (KICP, University of Chicago)

SPTpol is the polarization-sensitive receiver on the 10-meter South Pole Telescope. In its first year, we observed 100 square degrees of CMB at 95 and 150 GHz. The E-mode polarization spectrum at $500 < \ell < 5000$ set the best upper limit on point-source polarization power. The B-mode spectrum at $300 < \ell < 2300$ is primarily sensitive to gravitational lensing and was detected at 4.3σ after marginalizing over tensors and dust. Finally, we used a quadratic estimator to make minimum-variance maps of the gravitational-lensing potential from temperature and polarization data with signal-to-noise greater than one at $100 < \ell < 250$, ruling out no lensing at 14σ.

Recent highlights from the Fermi-LAT

Benoît Lott (CENBG, Bordeaux)

Since its launch in 2008, the Fermi-LAT has revolutionized our knowledge of the gamma-ray Universe. The talk will highlight some recent results on the variety of source classes detected by the LAT: pulsars, supernova remnants, gamma-ray bursts, active galactic nuclei as well as on the diffuse emission and the search for dark matter.

ANTARES Results in the Light of IceCube Discovery

Thierry Pradier (IPHC, Strasbourg)

The ANTARES Neutrino Telescope is currently the largest high energy neutrino (HEN) telescope in the Northern Hemisphere. Its main scientific target is the identification of the sources of the HEN cosmic flux recently discovered by IceCube. ANTARES was recently able to put limits on the extension of the possible sources of IceCube neutrinos, and has constrained the Blazar origin for some of the highest HEN detected by IceCube. ANTARES has also developed a range of multi-messenger strategies to exploit the high connection between HEN and other cosmic messengers, for instance, by searching for space/time correlations with GRBs, flaring blazars or gravitational wave bursts, or looking for optical/X counterparts of neutrino candidates. The most important results obtained by ANTARES will be discussed in this contribution.

Status and perspectives of KM3NeT/ARCA

Piera Sapienza (INFN-LNS, Catania)

The discovery of a high-energy cosmic neutrino flux with the IceCube telescope opens the field of the neutrino astronomy. However, unambiguous identification of the emitting neutrino sources will require a km3 neutrino telescopes with a large sky coverage and good angular resolution. The KM3NeT Collaboration aims at building a research infrastructure in the depths of the Mediterranean Sea hosting a cubic kilometre scale neutrino telescope. The technology for the detector construction and operation is defined and validated with prototypes operating at a depth of 2500m and 3500m. The detector array with optical modules will be subdivided into sizeable building blocks of string-type detection units. This intrinsically modular nature of the detector allows for a staged implementation with increasing size. A first stage, KM3NeT phase-1, made of 32 structures with an instrumented volume of 0.1 km3, has been funded and will be completed by 2016. Following phase-1, KM3NeT 2.0 will comprise two detectors with different granularity of the arrays of optical modules: KM3NeT/ARCA at the KM3NeT-It site as the extension of the phase-1 detector to two building blocks dedicated to high-energy neutrino astronomy and KM3NeT/ORCA, a single building block located at the KM3NeT-Fr site offshore Toulon (France) dedicated to the study of neutrino mass hierarchy (covered by another presentation). The latitude of KM3NeT/ARCA will allow for a wide coverage of the observable sky including the region of the galactic centre. Thanks to the favourable characteristics of sea water the direction of neutrinos will be measured with excellent angular resolution also for cascade events. The expected KM3NeT/ARCA sensitivity will allow for the detection of the reported IceCube flux within about one year of observation, providing new data on its origin, energy spectrum and flavour composition; within five years of observation KM3NeT/ARCA could give indications at 3-sigma level on various galactic point-like sources.

VERITAS: Observatory Status and Recent Highlights

Gernot Maier (University of Freiburg)

The VERITAS array of 12-m Cherenkov telescopes carries out an extensive observational program of the gamma-ray sky above 80 GeV. The observations focuses largely on two astrophysical questions: how and where is energy transferred to high-energy particles and the search for emission from decay or annihilation of dark-matter particles. This presentation provides an overview of the current status of the observatory, and summarises recent results from VERITAS observations of supernova remnants, pulsars, binary systems, extragalactic active galaxies, and dark-matter motivated targets.

H.E.S.S. Highlights

François Brun (CEA, Saclay)

H.E.S.S. is an array of Imaging Atmospheric Cherenkov Telescopes observing the gamma-ray sky beyond 100 GeV. In the course of the first 10 years of operation, this experiment significantly contributed to the field of ground-based gamma-ray astronomy. In 2012, a fifth telescope was added at the center of the original array. This large telescope of 28 meters diameter improves the performance of the array, including a lowering of the energy threshold down to a few tens of GeV. This new phase of the experiment provides the first hybrid array of Cherenkov telescopes. In this talk, new results obtained with the large telescope will be presented together with highlights from the legacy of H.E.S.S. phase I observations.

The HAWC gamma ray observatory

Colas Rivière (University of Maryland, College Park)

The High Altitude Water Cherenkov Observatory (HAWC) was completed in March 2015 on the Sierra Negra volcano, Puebla, Mexico, at an altitude of 4,100 m. It is optimized for gamma rays in the 0.1–100 TeV range with a 2 sr instantaneous field of view and ¿95% duty cycle. Observing daily 2/3 of the sky, it is ideal for surveying the high energy gamma sky, looking for new sources, monitoring for transients or studying the extended and diffuse emission. This will make it possible to address various science topics including high energy galactic and extragalactic objects, dark matter, cosmic ray production, Lorenz invariance violation or solar physics. The instrument and its capability will be presented, and first results will be discussed.

Results from the Telescope Array Experiment

Gordon Thomson (University of Utah, Salt Lake City)

The Telescope Array experiment is the largest studying ultrahigh energy cosmic rays in the northern hemisphere. We have important new results on the spectrum of cosmic rays (from 4 PeV to over 100 EeV), the composition of cosmic rays, and on their arrival directions (in particular on the hotspot, a cluster of events centered in Ursa Major).

The MAGIC Telescope System: Scientific Highlights, Status and Future Perspectives

Sabrina Einecke (TU, Dortmund)

MAGIC is a system of two 17m Imaging Air Cherenkov Telescopes located at 2200m above sea level at the Roque de los Muchachos Observatory on the Canary Island of La Palma. Its ability to detect very high-energy gamma-rays in an energy regime between approximately 50GeV and 50TeV allows studies comprising astroparticle and fundamental physics. In this presentation, we report on recent scientific findings obtained from MAGIC observations of Galactic as well as distant extragalactic sources. We also give an overview of the current status and future perspectives for the system.