SSP2012 - 5th International Symposium on Symmetries in Subatomic Physics

Sonntag, 17. Juni 2012 - Freitag, 22. Juni 2012

Buch der Abstracts

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Lorentz symmetry on trial on beta decay

Autoren Gerco Onderwater[1]; Stefan Mueller[1]

Co-Autoren: Hans Wilschut [1]; Jacob Noordmans [1]; Rob Timmermans [1]

[1] *KVI / University of Groningen*

Korrespondenzautoren: onderwater@kvi.nl, s.mueller@kvi.nl

One of the most fundamental principles on which our current understanding of nature is based is the invariance of physical laws under Lorentz transformations. Theories trying to unify the Standard Model with Quantum Gravity may break this invariance, and and dedicated
high-precision experiments at low energy could be used to reveal such suppressed signals from the Planck scale.

In the framework of the TRImP (Trapped Radioactive Isotopes: micro-laboratories for fundamental Physics) program at KVI, we will test Lorentz invariance searching for a dependence of the decay rate of spin-polarized nuclei on the daily, yearly or deliberate re-orientation of the spin. Observation of such a dependence would hint at a breakdown of Lorentz invariance.

We will present results from the first experiments using 80Rb and 20Na atoms produced with the AGOR cyclotron at the KVI.

Thu 16:00-17:40 / 7

DARK ENERGY AND QUANTUM GRAVITATION, FROM NEUTRINO OSCILLATIONS

Autor Maurice LALOUM[1]

[1] *Ex - CNRS/IN2P3/LPNHE Paris (retired)*

Korrespondenzautor: maurice.laloum@orange.fr

We argue that the present classical formalism of neutrino oscillations is just approximate (cf. PDG 2006), thus still requiring various second-order corrections : internal momentum dispersion from internal mass dispersion ; apparent violation of Lorentz invariance, in transitions of the kind m1 => m2 , between different mass eigenstates, salient in phase factors through the energy shifts (m22 – m12)/(2p) , and to be cured ; so, necessary transfers of quadri-momentum from any medium, even from "vacuum"; so, evidence of ethereal "dark energy"of purely weak essence within vacuum oscillations ; actual violation of some deeply rooted principles of quantum mechanics (particle elementarity, orthogonality between eigenstates amplitudes, Wigner's rules of super-selection, Heisenberg's relations of uncertainty) ; strict non-hermiticity of the Hamiltonian operator, involving finite proper lifetimes ; neutrino mass matrices duly of the "CKM"type, as for quarks ; "ubiquity"concept and existence of "probability waves", instead of matter waves, giving serious credibility to the paradoxical lemma of intense radiation from the vicinity of so-called "black holes"and "pulsars"(thus faking genuine "white wells"). Spontaneous individual birth of zero-mass neutrinos (not by pairs, from Lorentz invariance !) might explain the paradoxical excess of "dark energy"over "dark mass", overwhelming at cosmological scales. Opposition is thus made between coherent radiation endowed with gravitational effects, and incoherent radiation with zero gravitational power, as a fundamental lemma for "QUANTUM GRAVITATION". Full necessity of "absolute frames"in dark-matter Relativity is evoked.

Baryon Charge Condensate Baryogenesis

Autor Daniela Kirilova[1]

Co-Autor: Mariana Panayotova [2]

[1] *Institute of Astronomy and NAO, Bulgarian Academy of Sciences*

[2] *Institute of Astronomy*

Korrespondenzautor: dani@astro.bas.bg

We present successful baryogenesis models in the framework of the scalar condensate baryogenesis scenario compatible with inflation.

We have numerically followed the evolution of the baryon
charge carrying field and the baryon charge of the Universe from the inflationary stage till the baryon asymmetry formation.
It is known that particle creation processes play
an essential role for baryogenesis and reheating.
We illustrate the importance of the account of particle creation processes for the correct determination of the value of the baryon asymmetry, generated in these baryogenesis models.

The scenario is applicable also to inhomogeneous baryogenesis models, predicting cosmologically significant regions of antimatter in the Universe.

Thu 16:00-17:40 / 10

Lepton Asymmetry and Neutrino Oscillations Interplay

Autor Daniela Kirilova[1]

[1] *Institute of Astronomy and NAO, Bulgarian Academy of Sciences*

Korrespondenzautor: dani@astro.bas.bg

We discuss the interplay between lepton asymmetry L and neutrino oscillations in the early Universe. Neutrino oscillations may suppress or enhance previously existing L. On the other hand L is capable to suppress or enhance neutrino oscillations. The mechanism of L enhancement in resonant neutrino oscillations in the early Universe is numerically analyzed.
Lepton asymmetry cosmological effects through neutrino oscillations are studied. It is shown how L changes the BBN constraints on neutrino and how the BBN model with electron-sterile neutrino oscillations constrains lepton asymmetry. This model allows to obtain the most stringent constraints on L value.
We discuss also the cosmological role of active-inert neutrino mixing and L in connection with the indications about additional relativistic density in the early Universe, pointed out by BBN, CMB and LSS data and the analysis of global neutrino data.

Wed 16:00-17:40 / 11

The new ultracold neutron source at the Paul Scherrer Institute.

Autor Bernhard Lauss[1]

[1] *Paul Scherrer Institute*

Korrespondenzautor: bernhard.lauss@psi.ch

on behalf of the UCN Project Team

August 2011 marked the official startup of regular beam operation of the ultracold neutron (UCN) source at the Paul Scherrer Institute. Switzerland. The design goal is to exceed the currently available UCN densities by a factor 50 to 100 and to use these neutrons for fundamental physics experiments, most prominently the search for a neutron electric dipole moment (nEDM), the precise determination of the lifetime of the free neutron or the precision determination of neutron decay parameters, amongst others.
The main components of the complex apparatus will be introduced and the principles of operation explained.
The experience of the first months of operation together with first neutron measurements characterizing the source performance during startup will be presented.

Wed 9:00-10:30 / **13**

A T-odd Momentum Correlation in Radiative Beta-Decay

Autor Susan Gardner[1]

Co-Autor: Daheng He [1]

[1] *University of Kentucky*

Korrespondenzautor: gardner@pa.uky.edu

We consider neutron radiative beta-decay and compute the T-odd
triple momentum correlation in the decay rate arising from electromagnetic final-state interactions in the Standard Model.
Our expression for the corresponding T-odd asymmetry is exact
in O(alpha) up to terms of recoil order, and we evaluate
it numerically under various kinematic conditions. Noting the universality of the V-A law in the absence of recoil order terms,
our results serve as a template for the computation of the
asymmetry in allowed nuclear and hyperon radiative beta-decays
as well. We consider the pattern of the asymmetries in nuclear decays and show that the asymmetry can be suppressed in particular cases, facilitating searches for new sources of CP-violation in such processes.

Fri 16:00-17:40 / **14**

Leptogenesis with small violation of B-L

Autoren Jean Racker[1]; Manuel Peña[1]; Nuria Rius[1]

[1] *IFIC - Universidad de Valencia*

Korrespondenzautor: juandiego.racker@gmail.com

We analyze leptogenesis in the context of seesaw models with almost conserved lepton number, focusing on the L-conserving contribution to the CP asymmetry. We find that, contrary to previous claims, leptogenesis is feasible with heavy neutrino masses ~ 10^6 GeV, well below the gravitino bound for supersymmetric scenarios.

Thu 14:00-15:30 / 15

Detector and measurement of Daya Bay Experiment

Autor Changgen Yang[1]

[1] *Institute of High Energy Physics, Beijing*

Korrespondenzautor: yangcg@ihep.ac.cn

Precise determination of the least well known mixing angle of PMNS matrix, 13, is essential for future measurements of CP-violation in the lepton sector. The Daya Bay reactor neutrino experiment is designed to determine 13 with a sensitivity of 0.01 or better in sin2213.The experiment is located in southern China, near the Daya Bay nuclear power plant. The designed sensitivity is based on comparing the relative flux of antineutrinos between "identical"antineutrino detectors at near and far distances. The detectors are immersed in water pools that provide active and passive shielding against backgrounds. 6 antineutrino detectors are taking data now in 3 experimental halls, the results on the observation of electron antineutrino disappearance at Daya Bay will be shown.

Tue 16:00-17:40 / 16

Flavor Changing Neutral Currents and a Z-prime

Autor German Valencia[1]

[1] *Iowa State University*

Korrespondenzautor: valencia@iastate.edu

Many extensions of the standard model contain an additional $U(1)'$ gauge group with an associated Z' gauge boson. In some of those constructions the $U(1)'$ charges are generation dependent and therefore introduce tree-level flavor changing neutral currents mediated by the Z'. We discuss the phenomenology of these FCNC couplings for meson decays and possible LHC implications. We discuss a class of models with a down-quark mass matrix of the Georgi-Jarlskog type which naturally satisfies the current experimental constraints on FCNC.

Fri 16:00-17:40 / 17

Simulation of light antinucleus-nucleus interactions

Autor Aida Galoyan[1]

Co-Autor: Vladimir Uzhinsky [2]

[1] *Joint Institute for Nuclear Research, Dubna*

[2] *CERN*

Korrespondenzautor: galoyan@lxpub01.jinr.ru

Main assumptions of simulation of antiproton and light antinucleus interactions with nuclei are presented. Cross sections of scatterings of the antiparticles by protons and nuclei in the energy range from 100 MeV/c to 1000 GeV/c per anti-nucleon are calculated in the Glauber approximation which provides an excellent description of all known antiproton-nucleus cross sections. The results were obtained

using a new parameterization of total and elastic antiproton-proton cross sections. Problems of a soft antinucleon-nucleon interaction are considered within the Quark-Gluon-String model. The model is a combination of the Regge phenomenology, quark ideas and 1/Nf expansion of QCD. A good description of antiproton-proton interaction channels has been reached, and a Monte Carlo program for event simulation of the interactions is proposed.

It is observed that differential cross sections of elastic antiproton-nucleus and antinucleus-nucleus scatterings are well described by the strong absorption model. The model is also applicable to antiproton-proton scattering data as well as to proton-proton ones.

A package of computer codes for calculations of the cross sections and simulations of elastic and inelastic antiproton and antinucleus scatterings by protons and nuclei has been created and included in the Geant4 simulation toolkit.

Tue 14:00-15:30 / 18

Branching fractions of B->D(*)taunu and B->taunu at BABAR and implications for new physics

Autoren BABAR Collaboration[1]; Marcello Rotondo[2]

[1] *SLAC*

[2] *Universita' di Padova*

Korrespondenzautor: marcello.rotondo@pd.infn.it

The decays B -> tau nu, B -> D tau nu, and B -> D* tau nu are sensitive to physics beyond the standard model, in particular to contributions from charged Higgs bosons. The multiple-neutrino final states make studies of these decays particularly challenging and require reconstruction of the full event, which can be performed only at an electron-positron collider. We use the full BABAR data set and much improved full-event-reconstruction techniques to make improved measurements of these branching fractions. We report consistency with the standard model and limits on new-physics models.

Tue 14:00-15:30 / 19

Direct measurement of time-reversal violation at BABAR

Autoren BABAR Collaboration[1]; Chih-Hsiang Cheng[2]

[1] *SLAC*

[2] *Caltech Pasadena*

Korrespondenzautor: chcheng@hep.caltech.edu

Although CP violation in the B-meson system has been well established by the B factories, there has been no direct observation of time-reversal violation in this system. Using 468 million B-Bbar pairs collected by the BABAR detector at SLAC, we measure T-violating parameters in the time evolution of neutral-B mesons by comparing the probabilities of B0 or anti-B0 transforming into definite CP

final states and vice versa. The results lead to the first direct observation of Time Reversal non-invariance, independent of CP violation.

Fri 14:00-15:30 / 20

Neutron Electric Dipole Moment Experiment at the Paul Scherrer Institute.

Autor Jacek Zejma[1]

[1] *Jagiellonian University, Krakow, Poland*

Korrespondenzautor: jacek.zejma@uj.edu.pl

The quest for the neutron electric dipole moment (nEDM) started more than fifty years ago and is still one of the most important tasks faced by experimental physicists. The reason is that a non zero value of this observable would break both parity (P) and time reversal (T) symmetries. Such symmetry violation is predicted by the Standard Model (SM) as well as by the various Standard Model extensions, however the nEDM value predicted by the SM is several orders of magnitude smaller than those predicted by the extensions. Therefore, the nEDM value can be used to test the extensions. The choice of a neutron is not accidental, since it is possible to investigate free neutrons, where the nEDM observable is not interfered by interactions with other objects in an atom or nucleus. The most precise limit of the nEDM value was given by the RAL/Sussex/ILL collaboration (Phys. Rev. Lett. 97 (2007) 131801). The nEDM collaboration is continuing this experiment using a new source of ultra-cold neutrons at PSI and the extensively rebuilt RAL/Sussex/ILL apparatus, what should enable us to decrease the existing nEDM limitation by almost one order of magnitude within the next two years. The source has already started operating and the first nEDM measurements have been performed. The actual status of the experiment and future plans concerning development of the experiment aiming at the next order of magnitude in accuracy will be presented.

Fri 14:00-15:30 / 21

Test of Time-Reversal Invariance at COSY (TRIC)

Autor Dieter Eversheim[1]

[1] *Helmholtz Institut für Strahlen- und Kernphysik, University Bonn, Germany*

Korrespondenzautor: evershei@hiskp.uni-bonn.de

At the Cooler Synchrotron COSY a novel (P-even, T-odd) null test of time-reversal invariance to an accuracy of 10-6 is planned as an internal target transmission experiment. The parity conserving time-reversal violating observable is the total cross-section asymmetry Ay,xz. This quantity is measured using a polarized proton beam with an energy of 135 MeV and an internal tensor polarized deuteron target from the PAX atomic beam source. The reaction rate shall be measured by means of a beam current transformer (BCT) or an integrated beam transformer (ICT). Thus, the cooler ring serves as ideal forward spectrometer, as a detector, and an accelerator.

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Searching for cosmological spatial variations in values of fundamental constants using laboratory measurements

Autoren Julian Berengut[1]; Victor Flambaum[1]

[1] *University Of New South Wales*

Korrespondenzautor: jcb@phys.unsw.edu.au

The results of a very large study of around 300 quasar absorption systems using data from both the Keck telescope and the Very Large Telescope provide hints that there is a spatial gradient in the variation of the fine structure constant, alpha. In one direction on the sky alpha appears to have been smaller in the past, while in the other direction it appears to have been larger. A remarkable result such as this must be independently confirmed by complementary searches.

Terrestrial measurements of time-variation of the fundamental constants in the laboratory, meteorite data, and analysis of the Oklo nuclear reactor can be used to corroborate the spatial variation observed by astronomers. In particular we can expect laboratory measurements to show an annual variation in alpha at parts in 10^(19). The required accuracy is two orders of magnitude below current atomic clock limits, but there are several proposals that could enable experiments to reach it. These include nuclear clocks and transitions in highly-charged ions that would have the highest sensitivity to variation of the fine-structure constant ever seen in atomic systems.

Wed 16:00-17:40 / 23

Optical transitions in highly charged ions for atomic clocks with enhanced sensitivity to variation of fundamental constants

Autoren Andrew Ong[1]; Julian Berengut[1]; Victor Flambaum[1]; Vladimir Dzuba[1]

[1] *University Of New South Wales*

Korrespondenzautor: jcb@phys.unsw.edu.au

Optical transitions can occur in some highly charged ions (HCIs) when the ion stage and nuclear charge are tuned such that orbitals with different principal quantum number and angular momentum are nearly degenerate. In these cases the transition energy may be within laser range even though the ionisation energy is large (of order several hundred eV). We have identified several such systems and shown that they have a number of properties that could make them suitable for atomic clocks with high accuracy. Strong E1 transitions provide options for laser cooling and trapping, while narrow transitions can be used for high-precision spectroscopy and tests of fundamental physics. In particular we found transitions that would have the highest sensitivity to variation of the fine-structure constant ever seen in atomic systems. HCI clocks utilising these transitions could confirm the indications of a spatial gradient in the fine-structure constant observed in quasar absorption spectra data.

Tue 14:00-15:30 / 26

Physics Prospects for the SuperB Factory

Autor Kevin Flood[1]

[1] *Caltech*

Korrespondenzautor: kflood@hep.caltech.edu

With an integrated luminosity goal larger than 75 ab-1, the SuperB factory is expected to be built on the Tor Vergata campus near Rome Italy by 2016. Its goal is to unravel the detailed structure of the new physics likely to be discovered at the LHC, and to explore BSM physics beyond the direct reach of the LHC. These goals will be achieved through the study of a wide variety of rare B, charm and tau processes which are sensitive to the presence of new degrees of freedom in virtual loops. The physics prospects of this ultra-high luminosity e+e- collider will be presented in detail, as well as the

innovations in the machine and detector designs. The advantages of building a new collider, rather than upgrading a previous generation machine, will be discussed. These include beam polarization and the ability to run at charm threshold with a significant boost.

Fri 14:00-15:30 / **27**

Search for electron EDM in laser-cooled francium factory

Autor Hirokazu Kawamura[1]

Co-Autoren: Atsushi Hatakeyama [2]; Hidetomo Yoshida [3]; Hiroshi Arikawa [1]; Huliyar Nataraj [1]; Kenichi Harada [1]; Kenichi Imai [4]; Kichiji Hatanaka [3]; Masatoshi Itoh [1]; Saki Ezure [1]; Taisuke Ishikawa [1]; Takatoshi Aoki [5]; Takeshi Furukawa [6]; Takeshi Inoue [1]; Tetsuya Murakami [7]; Tomohiro Hayamizu [1]; Tomohiro Kato [1]; Tomotsugu Wakasa [8]; Tomoya Sato [1]; Yasuhiro Sakemi [1]; Yasuhiro Shimizu [1]

[1] *Tohoku University*

[2] *Tokyo University of Agriculture and Technology*

[3] *Osaka University*

[4] *JAEA*

[5] *University of Tokyo*

[6] *Tokyo Metropolitan University*

[7] *Kyoto University*

[8] *Kyusyu University*

Korrespondenzautor: kawamura@cyric.tohoku.ac.jp

The electric dipole moment (EDM) of an electron that implies the violation of the time-reversal symmetry has been searched from a half century ago. Francium (Fr) is one of the most promising candidates that could lead to observe a significant EDM because the electron EDM would be enhanced by being bounded in a heavier atom. Therefore, a factory of laser-cooled Fr atoms is being constructed currently at the Cyclotron and Radioisotope Center, Tohoku University. Our factory has achieved the production of high quality Fr ions – the extraction efficiency is around 40% and the extraction yield is about 10^6 pps. It is planning to trap Fr atoms using laser after neutralizing ions to measure the EDM of Fr precisely. Currently, the neutralization and magneto-optical trap using rubidium whose chemical property is similar to one of Fr have been developed. At the conference, we will show the whole of our research plan and report the current status of the development.

Tue 16:00-17:40 / **28**

Hadronic parity violation in $\gamma d \to \vec{n} p$ at low energies

Autor Chang Ho Hyun[1]

Co-Autoren: Jae Won Shin [2]; Shung-Ichi Ando [3]

[1] *Department of Physics Education, Daegu University*

[2] *Sungkyunkwan University*

[3] *Daegu University*

Korrespondenzautor: hch@daegu.ac.kr

Hadronic parity violation is studied in the photo-disintegration of the deuteron at low energies. We calculate the parity-violating spin asymmetries $P_{x'}$ and $P_{z'}$ with the polarized outgoing neutrons. Non-vanishing asymmetry arises from the interference of opposite parity states in the initial and final state wave functions. Parity admixtures are accounted by using a pionless effective field theory

with dibaryon fields. The results are obtained in terms of the unknown low-energy constants at the parity-violating dibaryon-nucleon-nucleon vertices. We find that the magnitude of the observables, aside from the low-energy constants, is of the similar order to the parity-violating polarization in $np \to d\gamma$ at thermal energies. We discuss the implication of the results to our understanding of the hadronic parity-violating interactions.

Tue 16:00-17:40 / 29

Discover Potential in a Search for Time-Reversal Invariance Violation in Nuclei

Autor Vladimir Gudkov[1]

Co-Autor: Young-Ho Song [1]

[1] *University of South Carolina*

Korrespondenzautor: gudkov@sc.edu

Time reversal invariance violating (TRIV) effects in low energy physics could be very important for a search for new physics, being complementary to neutron and atomic electric dipole moment (EDM) measurements. In this relation, we discuss a sensitivity of some TRIV observables in neutron scattering and nuclear EDMs to different models of time-reversal (CP) violation and their dependencies on nuclear structure. As a measure of a sensitivity of TRIV effects to the value of TRIV nucleon coupling constant, we introduce a coefficient of a "discovery potential", which shows a possible factor for improving the current limits of the EDM experiments by measuring nuclear TRIV effects.

Thu 14:00-15:30 / 30

T2K results on electron neutrino appearance in a muon neutrino beam

Autor Scott Oser[1]

[1] *University of British Columbia*

Korrespondenzautor: oser@phas.ubc.ca

The T2K (Tokai to Kamioka) long-baseline neutrino experiment searches for the appearance of electron neutrinos in a 0.7 GeV muon neutrino beam as it travels 295km between Tokai, Japan and the Super-Kamiokande detector. The rate of this process is sensitive to the neutrino mixing angle theta-13 and the CP-violating phase delta of the PMNS mixing matrix. A sophisticated suite of beam monitors and near detectors constrain the neutrino beam flux and composition at its production point. I will present updated results from a search for electron neutrino appearance using all T2K data up to May 2012, and place the results in the context of the global picture of theta-13 measurements. I will also review T2K's results on muon neutrino disappearance and discuss future prospects for long-baseline neutrino experiments.

Fri 16:00-17:40 / 31

Symmetry Breaking and Transition Form Factor from eta and omega Decays

Autor Ankhi Roy[1]

[1] *Indian Institute of Technology Indore*

Korrespondenzautor: ankhi.roy@gmail.com

The physics goals of the WASA-at-COSY collaboration are based on meson production and decays. One has to analyse different rare decay channels of the mesons to fulfill the physics motivation of finding the symmetry breaking patterns. The combination of high intensity COSY (COoler SYnchrotron) beams and the WASA 4pi detector setup allows us to measure the rare decay channels of light mesons.
We are analysing different symmetry breaking decay channels of eta mesons . One rare decay channel eta->pi+pi–e+ e- has been used to test the CP violation. The asymmetry in the angle between the electron and pion planes gives insight about the degree of CP violation. The study of another rare decay channel eta->pi0 e+ e- helps to test C-parity violation.

Our analysis of transition form factors of different mesons through their conversion decays (eta->gamma*gamma->e+e-gamma, omega->pi°gamma->* pi°e+e-) provide insight about the hadron structure. Transition form-factor of omega meson provides information about the form factor in the time-like region where the two vectors particles (the omega and the intermediate virtual photon) have an invariant mass squared significantly greater than zero. The interesting point is that the prediction of vector meson dominance for transition form factor of pseudoscalar meson decays agree but the same for the omega meson decays deviate from the prediction by vector meson dominance.

In this presentation we will report about preliminary results for different symmetry breaking channels as well as for the transition form factor of eta mesons. Very first results from pilot experiments where omega mesons have been produced will be shown.

Fri 11:00-12:30 / 32

Measuring the electron electric dipole moment in YbF

Autor Ben Sauer[1]

[1] *Imperial College London*

Korrespondenzautor: ben.sauer@imperial.ac.uk

The standard model of particle physics predicts that the permanent electric dipole moment (EDM) of the electron is very nearly zero. A non-zero value would violate time reversal symmetry. Many extensions to the standard model predict an electron EDM just below current experimental limits, thus there is great interest in new experiments and in improving current experimental precision.

I will discuss our recent measurement of the electron EDM using YbF molecules at Imperial College London. This experiment uses a form of laser-radiofrequency double resonance spectroscopy to search for very small energy differences between hyperfine levels in a strong electric field. In addition to describing our experimental and analysis techniques, I will also give an overview of sensitivity improvements that are underway.

Thu 16:00-17:40 / 34

Update on The MAJORANA Neutrinoless Double-beta Decay Experiment

Autor Reyco Henning[1]

[1] *University of North Carolina at Chapel Hill and Triangle Universities Nuclear Laboratory*

Korrespondenzautor: rhenning@unc.edu

The MAJORANA collaboration is actively pursuing research and development aimed at a tonne-scale 76Ge neutrinoless double-beta decay (bb(0n)-decay) experiment. The current, primary focus is the construction of the MAJORANA DEMONSTRATOR experiment, an R&D effort that will field approximately 40kg of germanium detectors with mixed enrichment levels. This article provides a status update on the construction of the DEMONSTRATOR and an overview of recent R&D activities.

Thu 16:00-17:40 / 35

Neutrinos as a Probe of Dark-Matter Particles

Autor W-Y. Pauchy Hwang[1]

[1] *Department of Physics, National Taiwan University*

Korrespondenzautor: wyhwang@phys.ntu.edu.tw

We try to envision that there might be a dark-matter world and neutrinos, especially the right-handed ones, might be coupled directly with particles in the dark-matter world. This means that the minimal Standard Model [1], which describes the ordinary-matter world to begin with, should be extended in some way. Our candidate theory would be the extended Standard Model based on $SU_c(3) \times SU_L(2) \times U(1) \times SU_f(3) \times SU_R(2)$ [2, 3], with the search of the detailed version suggested to be simplified via the two working rules, "Dirac similarity principle" and "minimum Higgs hypothesis" [4].

PACS Indices: 98.80.Bp (Origin and formation of the Universe); 12.60.-i (Models beyond the standard model); 12.10.-g (Unified field theories and models).

This research is supported in part by National Science Council project (NSC 99-2112-M-002-009-MY3). We wish to thank the authors of the following books [1] for thorough reviews of the minimal Standard Model.

References:

[1] Ta-You Wu and W-Y. Pauchy Hwang, "Relatistic Quantum Mechanics and Quantum Fields" (World Scientific 1991); Francis Halzen and Alan D. Martin, "Quarks and Leptons" (John Wiley and Sons, Inc. 1984); E.D. Commins and P.H. Bucksbaum, "Weak Interactions of Leptons and Quarks" (Cambridge University Press 1983). This was "my" early list of the textbooks on the "Standard Model".

[2] W-Y. Pauchy Hwang, Nucl. Phys. A844, 40c (2010); W-Y. Pauchy Hwang, International J. Mod. Phys. A24, 3366 (2009); the idea first appeared in hep-ph, arXiv: 0808.2091; talk presented at 2008 CosPA Symposium (Pohang, Korea, October 2008), Intern. J. Mod. Phys. Conf. Series 1, 5 (2011); plenary talk at the 3rd International Meeting on Frontiers of Physics, 12-16 January 2009, Kuala Lumpur, Malaysia, published in American Institute of Physics 978-0-7354-0687-2/09, pp. 25-30 (2009).

[3] J.C. Pati and A. Salam, Phys. Rev. D10, 275 (1974); R.N. Mohapatra and J.C. Pati, Phys. Rev. D11, 566 (1975); D11, 2559 (1975).

[4] W-Y. P. Hwang, arXiv:11070156v1 (hep-ph, 1 Jul 2011), Plenary talk given at the 10th International Conference on Low Energy Antiproton Physics (Vancouver, Canada, April 27 - May 1, 2011), to be published.

Wed 14:00-15:30 / 36

Status of laboratory tests on variations of fundamental constants

Autor Ekkehard Peik[1]

[1] *PTB*

Korrespondenzautor: ekkehard.peik@ptb.de

The comparison of different types of clocks and frequency standards over periods of a few years has allowed to place stringent limits on variations of fundamental constants in terrestrial laboratories in the present epoch. Presently, all experiments are consistent with the constancy of constants, for example the relative change of the fine structure constant is constrained in the range of the low 1E-17/yr. Further advances in this field can be expected from the rapidly improving precision of optical clocks with laser-cooled atoms and ions and from the availability of a wider range of systems, including molecules and nuclei, with high sensitivity to the values of specific constants.

Mon 16:00-17:40 / **37**

WITCH, a Penning Trap Experiment for Weak Interaction Studies

Autor Tomica Porobic[1]

[1] *IKS, KU Leuven*

Korrespondenzautor: tomica.porobic@fys.kuleuven.be

One of the goals of precision measurements in nuclear beta-decay is searching for deviations from the Standard Model that could point to new physics. The primary aim of WITCH experiment [1] at the ISOLDE/CERN facility is the search for a scalar interaction in beta-decay by a precise (0.5%) determination of the beta-neutrino angular correlation coefficient, a, which would constrain a possible scalar contribution to less than 10%. For that purpose, a scattering-free source made of two Penning traps is combined with a MAC-E filter to probe the energy of recoiling daughter nuclei. First daughter recoil spectrum was obtained in June 2011 in the decay of argon-35, allowing for a first albeit still crude determination of a. A subsequent online run, in November, resulted in data of much higher quality. Presently, this dataset is being analyzed for systematic effects. This presentation will focus on recent results and outlook of the WITCH experiment.

[1] M. Beck et al., Eur. Phys. J. A 47 (2011) 15

Mon 11:00-12:30 / **38**

Searches for Lorentz violation in 3He/129Xe clock comparison experiments

Autor Werner Heil[1]

Co-Autor: Kathlynne Tullney [1]

[1] *Institut für Physik*

Korrespondenzautor: wheil@uni-mainz.de

W. Heil(1), F. Allendinger(3), C. Gemmel(1), S. Karpuk(1), Yu.Sobolev(1) , K.Tullney(1), M.Burghoff(2), W. Kilian(2), S.Knappe-Grüneberg(2), W.Müller(2), A.Schnabel(2), F.Seifert(2), L.Trahms(2), and U.Schmidt(3)
1Institut für Physik, 55099 Mainz, Germany
2Physikalisch-Technische Bundesanstalt, 10587 Berlin, Germany
3University of Heidelberg, Germany

We discuss the design and performance of a very sensitive low-field magnetometer based on the detection of free spin precession of gaseous, nuclear polarized 3He or 129Xe samples with a SQUID

as magnetic flux detector. Characteristic spin precession times of up to 60 h were measured in low magnetic fields (about 1μT) and in the regime of motional narrowing. The achieved signal-to-noise ratio of more than 5000:1 leads to an expected sensitivity level (Cramer-Rao Lower Bound) of (100 Zeptotesla) after one day [1].
With the detection of the free precession of co-located 3He/129Xe nuclear spins (clock comparison), the device can be used as ultra-sensitive probe for non-magnetic spin interactions, since the magnetic dipole interaction (Zeeman-term) drops out in the weighted frequency difference, i.e., dw=w_He-g_He/g_Xe*w_Xe . We report on searches for Lorentz violating signatures by monitoring the Larmor frequencies of co-located 3He/129Xe spin samples as the laboratory reference frame rotates with respect to distant stars (sidereal modulation) [2].
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Tue 16:00-17:40 / 39

Phase diagram of QCD-based theories in a small volume

Autor Joyce Myers[1]

[1] *University of Groningen*

Korrespondenzautor: j.c.myers@rug.nl

The phase diagram of QCD at non-zero chemical potential is difficult to calculate from first principles because the coupling strength is large, preventing ordinary perturbation theory, and the action is complex, leading to the "sign problem" and preventing conventional lattice simulations. To understand better how to deal with complex actions and to obtain a qualitative picture of the phase diagram of QCD with chemical potential it can be useful to study the theory in a very small spatial volume, which allows for perturbation theory to be employed at all temperatures. We consider QCD and QCD-based theories on S^1 x S^3 for small S^3 from one-loop perturbation theory. Thermodynamic observables calculated as a function of the chemical potential, such as the free energy and quark number, as well as the Polyakov lines, provide a sketch of the phase diagram for QCD and supersymmetric QCD in the limit of large Nc and Nf, where the theory is described by a matrix model. Finally we consider the effect of additional interactions which lead to spontaneous chiral symmetry breaking for sufficiently small chemical potentials.

Fri 9:00-10:30 / 40

Mu->e+gamma and Mu->3e

Autor Peter-Raymond Kettle[1]

[1] *Paul Scherrer Institut*

Korrespondenzautor: peter-raymond.kettle@psi.ch

The muon as a laboratory for studying charged lepton-flavour violation (cLFV) has proven to be one of the most sensitive areas in the probe to search for "New Physics", due to the muon's copious production rate and relatively long lifetime. The search at the intensity frontier with precision-type experiments is complementary to the search for new particles at the high-energy frontier of TeV colliders. Of the three "golden"muon channels: μ⟶eγ, μ⟶3e and μ⟶e conversion, I will present an overview of the status of the coincidence experiments MEG and the recently initiated Mu3e experiment.

Fri 14:00-15:30 / 41

The electric dipole moment of an electron in H-like ions in an electric storage ring.

Autor Anastasia Bondarevskaya[1]

Co-Autoren: Anton Prozorov [1]; Dieter Liesen [2]; Evgenia Chernovskaya [1]; Fritz Bosch [2]; Günter Plunien [3]; Leonti Labzowsky [1]; Oleg Yu. Andreev [1]

[1] *St. Petersburg State University*

[2] *GSI Helmholzzentrum für Schwerionenforschung mbH*

[3] *TU Dresden*

Korrespondenzautor: nastya.spb@list.ru

Theoretical studies are presented how the Electric Dipole Moment (EDM) of the electron in H-like ions in electric storage rings can be sensitively determined. The investigation follows the recent proposals to measure the muon EDM [1], the nuclear EDM [2] and the electron EDM in H-like Highly Charged Ions (HCI) [3] in magnetic storage rings, as well as the proposals to measure muon, proton and deuteron EDMs in electric storage rings [4]. The basic idea in [4] was that the electric field should compensate the centrifugal force and the injected particles would move along the closed trajectory in the ring. In the applied electric field of the order 10^{5} V/cm and the velocity of the ions 0.1 c we obtain for different ions the radii of the trajectory of the order of few meters. The electron EDM in the H-like ions is strongly (up to 10^{4}) enhanced. With the proposed experiments new constraints of about 10^{-28} - 10^{-30} e cm for the electron EDM can be established what is few orders of magnitude more restrictive than the existing boundaries.

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Tue 16:00-17:40 / 42

Flavor and CP violation in a warped extra dimension and their relaxation

Autor Avihay Kadosh[1]

[1] *University Of Groningen*

Korrespondenzautor: a.kadosh@rug.nl

Warped extra dimensions (WED) are among the most popular alternatives to supersymmetry for addressing the gauge hierarchy problem. In addition, they simultaneously allow for an elegant explanation of the observed fermion mass hierarchy and hierarchical quark mixing by virtue of wave function overlaps along the extra (spatial) dimension.
Strong constraints on models with WED come from electroweak precision measurements and flavor and CP violating observables like
the neutron EDM, ϵ_K and ϵ'/ϵ, $b- > s\gamma$ and more. In this talk I will review the most important features of flavor physics in a warped extra dimensional setup and discuss the structure of new physics contributions to the aforementioned observables in the general (anarchic) case. Subsequently, I will discuss the role of additional flavor symmetries in relaxing the constraints on the scale of new physics. In particular, I shall describe the RS-A4 model, aimed at a unified explanation of fermion masses and mixings (including neutrinos) within a custodial warped extra dimensional setup. The relaxation of the most relevant constraints in comparison with the anarchic case will then be further discussed.

Wed 9:00-10:30 / 43

Time Reversal and the Neutron

Autor Timothy Chupp[1]

[1] *University of Michigan*

Korrespondenzautor: chupp@umich.edu

A number of observables accessible with neutrons are sensitive to violation of time-reversal invariance and, due to the the requirement of symmetry under the combination of charge-conjugation (C), parity (P), and time-reversal (T), of CP symmetry. These include the neutron EDM and T-violating correlations in neutron decay. I will discuss this with particular emphasis on the recently completed analysis of the emiT-II experiment, which measured T-odd, P-even D-coefficient by observing proton-electron coincidences.

Mon 16:00-17:40 / 44

The high-precision Penning trap mass spectrometer PENTATRAP

Autor Andreas Doerr[1]

Co-Autoren: C. Boehm [2]; C. Hoekel-Schmoeger [1]; C. Roux [1]; J. Repp [1]; J.R. Crespo López-Urrutia [3]; K. Blaum [1]; M. Goncharov [1]; S. Eliseev [3]; S. Sturm [3]; S. Ulmer [4]; Y.N. Novikov [5]

[1] *Max-Planck-Institut für Kernphysik, Heidelberg, Germany. Fakultät für Physik und Astronomie, Ruprecht-Karls-Universität, Heidelberg, Germany.*

[2] *Max-Planck-Institut für Kernphysik, Heidelberg, Germany. Fakultät für Physik und Astronomie, Ruprecht-Karls-Universität, Heidelberg, Germany. Extreme Matter Institute EMMI, Helmholtz Gemeinschaft, Darmstadt, Germany.*

[3] *Max-Planck-Institut für Kernphysik, Heidelberg, Germany.*

[4] *Max-Planck-Institut für Kernphysik, Heidelberg, Germany. RIKEN Advanced Science Institute, Hirosawa, Wako, Saitama, Japan.*

[5] *Extreme Matter Institute EMMI, Helmholtz Gemeinschaft, Darmstadt, Germany. Petersburg Nuclear Physics Institute, Gatchina, Russia.*

Korrespondenzautor: adoerr@mpi-hd.mpg.de

Currently, the high-precision Penning trap mass spectrometer PENTATRAP is being built up at the Max-Planck-Institut für Kernphysik, Heidelberg, Germany. It aims at mass-ratio measurements of medium- to high-Z elements with uncertainties of a few parts in 10^12. Mass-ratios will be determined by the measurement of cyclotron frequency-ratios in the strong magnetic field of the trap. This will be done with the image current technique: The ions' eigenfrequencies are determined through the detection of the image currents induced in detection circuits by the ions' eigenmotions in the trap. The experiment will host five identical cylindrical Penning traps and will allow for simultaneous cyclotron frequency determinations in all measurement traps. It will feature access to highly charged ions provided by electron beam ion traps. Much effort is invested to stabilize the electric and magnetic trapping fields.
Measurements at PENTATRAP will contribute to various fields of physics. For example, PENTATRAP will provide input parameters for neutrino mass determinations with measurements of Q-values of relevant β-transitions. As another example, it is planned to determine binding-energies in highly charged ions by measuring mass-differences between different charge states, thereby testing QED in the regime of extreme electric fields.
The current status of the experiment as well as future prospects will be outlined.

Wed 11:00-12:30 / 45

Atomic parity non-conservation; the francium project.

Autor Luis Orozco[1]

[1] *University of Maryland*

Korrespondenzautor: lorozco@umd.edu

Atomic parity non-conservation (PNC) experiments provide unique precision tests of the electroweak sector of the standard model at very low energies. Precision measurements of spin-dependent atomic PNC can determine nuclear anapole moments and probe the weak interaction within the nucleus. Among current efforts on PNC are ongoing experiments in a chain of Ytterbium and Dysprosium isotopes at Berkeley and Radium ions at KVA, Barium ions at Seattle, BaF molecules at Yale, and Francium at TRIUMF.

Fr is an excellent candidate for precision measurements of atomic PNC due to its simple electronic structure and enhanced parity violation: Both the optical PNC and anapole moment signals are expected to be over an order of magnitude larger than in cesium. The FrPNC collaboration* is commissioning the Francium Trapping Facility (FTF) in the ISAC hall at TRIUMF for laser cooling and trapping of francium atoms. Experiments should start within the next year with plans to measure the weak mixing angle from an optical PNC measurement of the parity forbidden E1 transition amplitude for the 7s-8s transition, originally pioneered by Wieman and co-workers in cesium. The anapole moment can be measured through microwave spectroscopy of forbidden E1 transitions between hyperfine ground states or through the dependence of the optical PNC method on the hyperfine states.

Work supported by DOE, NSF, from the USA and NSERC, TRIUMF from Canada.

Wed 16:00-17:40 / 46

Microwave transitions in metastable CO to probe a possible time-variation of the proton-to-electron-mass ratio

Autor Adrian de Nijs[1]

Co-Autoren: Rick Bethlem [1]; Wim Ubachs [1]

[1] *LaserLaB Vrije Universiteit Amsterdam*

Korrespondenzautor: ajdnijs@few.vu.nl

The constraint on a possible time-variation of physical constants set by an experiment depends both on the accuracy of the measurement and on the sensitivity of the system the measurement is performed on. Here, we present a laboratory experiment using a system with a highly enhanced sensitivity to a possible time-variation of the proton-to-electron-mass ratio, μ. Due to an incidental degeneracy between the J=8, Ω=0 and the J=6, Ω=1 states in this metastable a^3Π state, the two-photon microwave transition connecting these two states is hundreds times more sensitive than pure rotational transitions. We are planning a molecular beam experiment to measure this transition.

To measure this transition, we excite a supersonic beam of CO molecules to the a^3Π state using a narrow-band pulsed titanium:sapphire laser system. This beam then passes through two microwave cavities, in a Ramsey configuration, after which the molecules are quantum-state selectively deflected using an inhomogeneous electrostatic deflection field. One meter down-stream, the deflected molecules are imaged using a 2D detection system, consisting of an MCP, a phosphor screen and a digital camera.

We have performed UV-spectroscopy to study the a^3Π state and to confirm the expected high sensitivity to variations of the proton-to-electron-mass ratio of the targeted microwave transition. An optimal electrostatic deflection field has been designed, constructed and tested. Here, we present results of recently measured microwave transitions.

Fri 16:00-17:40 / 47

Minimal lepton flavor violating realizations of minimal seesaw models

Autor Diego Aristizabal[1]

[1] *Universite de Liege*

Korrespondenzautor: daristizabal@ulg.ac.be

We study the implications of the global $U(1)_R$ symmetry present in minimal lepton flavor violating extensions of the seesaw. In the context of minimal seesaw setups with a slightly broken $U(1)_R$, it is shown that depending on the R-charge assignments two classes of generic models can be identified. Models where the right-handed neutrino masses and the lepton number breaking scale are decoupled; and models where the parameters that slightly break $U(1)_R$ induce a suppression in the light neutrino mass matrix. The corresponding charged lepton flavor violating phenomenology of these schemes is discussed and its interplay with preexisting primordial $B-L$ asymmetries is presented.

Mon 14:00-15:30 / 48

Correlation measurements in beta decay probing physics beyond the standard model

Autor Nathal Severijns[1]

[1] *Kath. Univ. Leuven*

Korrespondenzautor: nathal.severijns@fys.kuleuven.be

In recent years the use of atom and ion traps as well as advances in the applicability of the Geant Monte Carlo code for beta particle energies have resulted in a number of new precise determinations of the beta-neutrino correlation and beta-asymmetry parameter in nuclear beta decays. Such measurements are mainly sensitive to time-reversal invariant scalar and tensor weak currents and parity violation. Results obtained extend significantly our understanding of the weak interaction at low energies. An overview will be given of recent, ongoing and planned experiments.

Mon 14:00-15:30 / 49

Precision Measurements in Nuclear Beta Decay

Autor Oscar Naviliat Cuncic[1]

[1] *Michigan State University*

Korrespondenzautor: naviliat@nscl.msu.edu

Measurements in nuclear and neutron decays offer a window to determine specific fundamental couplings, like the Vud matrix element of the CKM matrix, and to perform sensitive tests of discrete symmetries.
This talk will focus on two topics of precision measurements in beta decay. The first concerns recent results from pure Fermi transitions as well as recent developments from nuclear mirror transitions for the determination of Vud. The second describes the final results obtained in the measurement the T-odd, P-odd triple correlation term driven by the R-coefficient in neutron decay, which has been determined for the first time.

Mon 16:00-17:40 / 50

CPT analysis with top physics

Autor Jose A. Ruiz Cembranos[1]

[1] *Universidad Complutense de Madrid*

Korrespondenzautor: cembra@fis.ucm.es

We discuss the possibility of observing CPT violation from top anti-top production in hadronic colliders. We present a general approach by studying constraints on the mass difference between the top and anti-top quarks. We present current bounds from Tevatron data, and analyze the prospects of improving these bounds at the LHC.

Thu 16:00-17:40 / 51

The NOvA Experiment

Autor Ralf Ehrlich[1]

[1] *University of Virginia*

Korrespondenzautor: ehrlich@virginia.edu

NOvA is a long-baseline neutrino experiment designed to study nu_mu –> nu_e and anti-nu_mu –> anti-nu_e oscillations. It will measure the neutrino mixing angle theta_13 with a high precision, probe the neutrino mass hierarchy, and search for CP violation in neutrino oscillations. The experiment consists of two detectors. The Near Detector will be located at Fermilab close to the source of the neutrino beam. The Far Detector is being built at Ash River in Northern Minnesota. It is positioned 14 mrad off the neutrino beam axis where the neutrinos have an energy distribution with a narrow peak around 2 GeV, and where the transition probability of nu_mu –> nu_e is close to its maximum. I will present the current status of the detector construction and show the proposed physics reach for theta_13, the mass hierarchy and CP violation in the neutrino sector.

Thu 9:00-10:30 / 52

Resonant Quantum Transitions in Trapped Antihydrogen

Autor Dirk Peter van der Werf[1]

[1] *Swansea*

Korrespondenzautor: d.p.van.der.werf@swansea.ac.uk

The progress in producing and trapping antihydrogen [1-3] in the last decade has opened up the way to perform stringent tests of the validity of the CPT theorem (charge conjugation, parity and time reversal symmetry) using a purely anti-atomic system. The comparison of the 1S-2S transition in antihydrogen with that of hydrogen, of which the latter is measured with a relative accuracy of about 2 parts in 10^-14, would constitute a compelling, model-independent test of CPT. Similar test between the ground-state hyperfine parameters of the antiatom and its matter counterpart are also of great interest. In this case a relative accuracy of about 10^-12 has been obtained for hydrogen.

In this talk we describe the production and subsequent magnetically trapping of antihydrogen atoms in a 0.54 K magnetic well, followed by resonant spin-flip transitions into high field seeking antiatoms [4]. We also describe how the annihilation signal from the antihydrogen atoms migrating to the wall was isolated from background sources such as cosmic rays [5].

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Mon 16:00-17:40 / 53

Parity Violation in Two-Nucleon Systems

Autor Cheng-Pang Liu[1]

[1] *National Dong Hwa University*

Korrespondenzautor: cpliu@mail.ndhu.edu.tw

Nuclear few-body systems become attractive avenues for study of low-energy parity violation because experiments start to meet the precision requirements and theoretical calculations can be performed reliably. In this talk, an attempt of parametrizing low-energy parity-violating observables by the Danilov parameters will be introduced. Analyses of two-nucleon observables, based on the modern phenomenological potentials or the one of effective field theory, will be discussed.

Thu 9:00-10:30 / 54

Weighing the antiproton: precision laser spectroscopy of antiprotonic helium atoms

Autor Ryugo Hayano[1]

[1] *U. Tokyo*

Korrespondenzautor: hayano@phys.s.u-tokyo.ac.jp

Antiprotonic helium is a metastable three-body neutral atom consisting of an antiproton, a helium nucleus and an electron, which we serendipitously discovered some 20 years ago. The antiproton, which normally annihilates within a few picoseconds when injected into matter, can be "stored" in this system for up to several microseconds, and laser spectroscopy is possible within this time window. From the laser transition frequency, the antiproton-to-electron mass ratio can be deduced to high precision. Recent progress at CERN's antiproton decelerator (AD) will be discussed.

Mon 14:00-15:30 / 56

SUSY and the muon magnetic moment

Autor Dominik Stoeckinger[1]

[1] *TU Dresden*

Korrespondenzautor: dominik.stoeckinger@tu-dresden.de

The SUSY prediction for the muon magnetic moment is reviewed, and the complementarity between low-energy and LHC measurements for analyzing SUSY is discussed.

Fri 11:00-12:30 / 57

Measurement of Permanent Electric Dipole Moments of Proton, Deuteron and Light Nuclei in Storage Rings

Autor Joerg Pretz[1]

[1] *RWTH Aachen*

Korrespondenzautor: pretz@physik.rwth-aachen.de

Permanent Electric Dipole Moments (EDMs) of fundamental particles violate both time invariance and parity. Assuming the CPT theorem, this implies CP violation. The CP violation of the Standard Model is orders of magnitude too small to be observed experimentally in EDMs in the foreseeable future. It is also way too small to explain the asymmetry in abundance of matter and anti-mattter in our universe. Hence, other mechanisms outside the realm of the Standard Model are searched for and could result in measurable EDMs.

EDM experiments with charged hadrons are proposed at storage rings where polarized particles are exposed to an electric field. If an electric dipole moment exists the spin vector will experience a torque resulting in a change of the original spin direction which can be determined with the help of a polarimeter. Although the principle of the measurement is simple, the smallness of the expected effect makes this a challenging experiment requiring new developments in various experimental areas.

Complementary efforts to measure EDMs of proton, deuteron and light nuclei are pursued at Brookhaven National Laboratory and at Forschungszentrum J\"ulich with with an ultimate goal to reach a sensitivity of $10^{-29}e$·cm.

Thu 9:00-10:30 / 58

The hyperfine structure of antihydrogen

Autor Eberhard Widmann[1]

[1] *Stefan Meyer Institute*

Korrespondenzautor: eberhard.widmann@oeaw.ac.at

Low-energy antiprotons are an ideal tool to study fundamental symmetries, especially CPT symmetry, by the precision spectroscopy of exotic atoms containing an antiproton. The investigation of the hyperfine structure of such atoms allows first of all the determination of the antiproton magnetic moment, the most precise value of which was obtained recently by the ASACUSA collaboration at the Antiproton Decelerator of CERN [1], albeit with a precision of order 10^-3.

As a next step, ASACUSA is preparing an experiment to measure the ground-state hyperfine structure GS-HFS of antihydrogen, which promises much higher accuracy because the corresponding quantity for hydrogen is measured to relative precision of 10^−12 in the hydrogen maser. In a first phase a beam of polarized antihydrogen atoms [2] formed by a so-called cusp trap [3] will be used, which will allow the determination of the GS-HFS to better than 10^-6. This accuracy will already be enough to observe an influence of the finite size of the antiproton, provided the magnetic moment of the antiproton is measured independently in a Penningtrap, as it is planned by two other groups at the AD. In a second phase the Ramsey method of separated oscillatory fields will be used to increase the precision by one order of magnitude.

Within the AEgIS collaboration SMI will pursue a third phase, using the ultra-low energy antiproton beam to increase the precision further and to work towards the ultimate goal of performing GS-HFS measurements with an atomic fountain of laser-cooled antihydrogen atoms.

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Tue 9:00-10:30 / 59

QCD studies and discoveries with e+e- colliders and future perspectives

Autor Sören Lange[1]

[1] *Universität Giessen*

Korrespondenzautor: soeren.lange@exp2.physik.uni-giessen.de

Observations of new charmonium(-like) and bottomonium(-like) states (sometimes refered to as “XYZ” states) at e+e- colliders have changed our picture of quarkonia systems as QCD bound states. Potential models with a linear confinement ansatz, which were able to predict many conventional states with an accuracy of ~1 MeV, absolutely fail in describing many of the new states. Symmetries play an important role e.g. in the determination of the quantum numbers (such as charge conjugation in the radiative decays) or in trying to explain surprising properties such as isospin violation. It will also be discussed, how future experiments (Panda, Belle II) can help to understand the nature of these states.

Tue 11:00-13:30 / 62

Standard Model limits at LHC: QCD aspects

Autor Eric Laenen[1]

[1] *Nikhef/University of Amsterdam*

Korrespondenzautor: eric.laenen@nikhef.nl

I review the impressive recent progress towards the present state of the art in the understanding and application of perturbative QCD to Standard Model processes.

Thu 11:00-12:30 / 63

Towards a high-precision measurement of the magnetic moment of the antiproton

Autor Stefan Ulmer[1]

[1] *RIKEN Advanced Science Institute*

Korrespondenzautor: stefan.ulmer@cern.ch

We observed spin-flips with a single proton for the first time and measured the particle's magnetic moment with a relative precision of 8.9e-6. The developed techniques can be directly transferred to measure the magnetic moment of the antiproton, which can be improved by more than a factor of 100. By application of the so-called double Penning trap technique, we finally aim at a measurement with a relative precision of 1e-9, and thus, a millionfold improvement of the antiproton's magnetic moment.
In my talk I will present the current status of the experiment and describe our activities towards a high precision measurement of the magnetic moment of the antiproton.

Wed 9:00-10:30 / 64

First results from the NPDGamma experiment at the Spallation Neutron Source

Autor Ricardo Alarcon[1]

[1] *Arizona State University*

Korrespondenzautor: ralarcon@asu.edu

The NPDGamma experiment aims to measure the parity-odd correlation between the neutron spin and the direction of the emitted photon in neutron-proton capture. A parity violating asymmetry (to be measured to 10^{-8}) from this process can be directly related to the strength of the hadronic weak interaction between nucleons, specifically the $\Delta I = 1$ contribution. The experiment has been commissioned and is presently taking production data at the Fundamental Neutron Physics beam line at the Spallation Neutron Source at ORNL. The gamma-ray asymmetries from the parity-violating capture of cold neutrons on ^{35}Cl and ^{27}Al were measured, to check for systematic effects, false asymmetries, and backgrounds. Preliminary results for the measurements with ^{35}Cl and ^{27}Al will be presented as well as first results obtained up to now with the liquid parahydrogen target.

Wed 11:00-12:30 / 65

The Qweak Experiment: A search for physics beyond the Standard Model via a measurement of the proton's weak charge.

Autor Michael Gericke[1]

[1] *University of Manitoba*

Korrespondenzautor: mgericke@physics.umanitoba.ca

The Qweak collaboration recently completed a two year long program of measurements, with the aim of making a precision measurement of the parity violating analyzing power from elastic scattering of 1.16 GeV, longitudinally polarized, electrons on protons at very low Q^2. At low momentum transfer, the measured asymmetry is directly related to the weak charge of the proton $Q^p_W = 1 - 4\sin^2\theta_W$. The Standard Model makes a firm prediction for the size of the weak charge, based on the "running" of the weak mixing angle $\sin^2\theta_W$. Qweak constitutes the first precision measurement of this quantity and provides a test for physics beyond the Standard Model, at a mass scale of about 2 TeV. A 2400 hour measurement of the asymmetry at $Q^2 = 0.028\ \mathrm{GeV}^2$, using a beam current of 150 μA at 85\% polarization on a 0.35 m long liquid hydrogen target determines the weak charge of the proton with a 4\% combined statistical and systematic error. In the absence of new physics, the experiment provides a 0.3\% determination of $\sin^2(\theta_W)$, making this a very competitive measurement of the weak mixing angle. Qweak was installed and comissioned during the summer and Fall of 2010 in Hall C, at Jefferson Laboratory, began data collection in November 2010, and conluded data collection on May 18, 2012. I would like to provide a basic overview of the physics that is being addressed and present a description of the experiment, along with some diagnostic data describing the performance of the apparatus, as well as a first look at some production data (preliminary and blinded).

Introduction / **66**

Welcome

Autor Hans Wilschut[None]

Korrespondenzautor: wilschut@kvi.nl

Introduction / **67**

Dark Symmetries

Korrespondenzautor: marciano@bnl.gov

Introduction / **68**

Progress in antihydrogen, antiproton and measurement of lepton moments

Korrespondenzautor: gabrielse@physics.harvard.edu

Tue 9:00-10:30 / **71**

Light meson decays: QCD and fundamental symmetries

Korrespondenzautor: kupsc@tsl.uu.se

The key for understanding the low energy QCD is chiral symmetry. This approximate symmetry allows for construction of a successful systematic approach to low energy QCD. The main application of this theory are processes involving light pseudoscalar mesons.

For example isospin breaking decay of eta mesoninto three pions provide precise constraints for ratios of the light quark masses and allow to study elementary processes of the low energy strong interactions: pi-pi interactions.

Some of the rare decay modes of pi0 and eta mesons allow to test the fundamental symmetries and search for physics beyond the Standard Model.

Wed 16:00-17:40 / 72

Single Ion Spectroscopy for Atomic Parity Violation

Autor Mayerlin Nunez Portela[1]

Co-Autoren: Amita Mohanty [1]; Gerco Onderwater [1]; Hans Wilschut [1]; Klaus Jungmann [1]; Lorenz Willmann [1]; Rob Timmermans [1]

[1] *KVI*

Korrespondenzautor: nunez@kvi.nl

A single trapped ion opens a promising path for a measurement of atomic parity violation (APV). Since the sensitivity of the APV grows stronger than the third power of the atomic number Z, a single Ra ion is an excellent candidate for APV experiments, enabling a precise measurement of the electroweak mixing angle in the Standard Model of particle physics. Online laser spectroscopy of 209-214Ra+ isotopes in a linear Paul trap provided information on transitions wavelengths and hyperfine structure required for the interpretation of an APV measurement in Ra+. Current experiments are focused on trapping and laser cooling of few Ba+ ions as a precursor for Ra+. Ba ions are trapped and laser cooled in a precision hyperbolic Paul trap as a test. Work towards single ion trapping of Ra+ is in progress.

Tue 11:00-13:30 / 84

T-violating moments of light nuclei

Korrespondenzautor: devries@kvi.nl

Electric dipole moments (EDMs) break parity and time-reversal (T) symmetry and, by the CPT-theorem, CP-symmetry. If measured they are unambigious signs of new physics, since CP-violation in the quark mixing matrix predict EDMs orders of magnitude away from current experimental limits. The SM also contains the QCD vacuum angle (the theta term) whose value is unknown but strongly limited by neutron EDM experiments. This smallness leaves room for T-violation from physics beyond-the-SM which, at the Standard Model scale, can be captured by effective dimension-six operators such as quark EDMs, and quark and gluon color-EDMs. Triggered by various experimental proposals to measure with high accuracy the EDMs of the nucleon and light nuclei directly, I focus here on some important open questions: Is it possible to pinpoint the dominantant source of T-violation from these hadronic and nuclear EDM measurement? Can we separate the theta term from physics beyond-the-SM? If so, can we also separate the various beyond-the-SM sources?
I answer these questions by applying chiral effective theory. Different fundamental sources of T-violation transform differently under chiral symmetry and, at energies below the QCD phase-transition, induce different T-violating interactions among pions, nucleons, and photons. These differences in hadronic interactions give rise to a different pattern of hadronic observables. I give results on the T-odd moments of the nucleon, deuteron, helion, and triton, calculated within this framework, and discuss how their measurements could point towards the fundamental mechanism of T-violation.

Tue 14:00-15:30 / 86

CP Violation at LHCb

The LHCb experiment carries out precision measurements of CP asymmetries in the heavy quark sector in order to look for signs of physics beyond the Standard Model.
If present, new physics amplitudes can interfere with SM processes and affect CP asymmetry observables such that they might deviate from predicted CKM values. The LHCb program includes a wide search for CP observables in different B-decay topologies.
In this talk several recent B-decay results will be presented as well as a charming surprise.

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TBA

Korrespondenzautor: f.maas@gsi.de

Thu 11:00-12:30 / 91

The Search for Neutrinoless Double Beta Decay

Korrespondenzautor: gratta@stanford.edu

Fri 9:00-10:30 / 93

Mu2e: A High-Sensitivity Charged Lepton Flavor-Violating Search at Fermilab

Korrespondenzautor: miller@bu.edu

The Mu2e Experiment will search for coherent, neutrino-less conversion of muons into electrons in the field of a nucleus, with a sensitivity improvement of a factor of 10,000 over existing limits. Such a charged lepton flavor-violating reaction probes new physics complementary to the LHC and can reach a scale
unavailable by direct searches at either present or planned high energy colliders. The design of the muon beamline and spectrometer. A scheme by which the experiment can be mounted in the present Fermilab accelerator complex will be described.

Fri 11:00-12:30 / 95

The electric dipole moment of the neutron

Korrespondenzautor: peter.fierlinger@tum.de

Fri 16:00-17:40 / 96

Cold Highly Charged Ions in a Cryogenic Paul Trap

Autor Oscar Versolato[1]

Co-Autoren: Alexander Windberger [1]; Joachim Ullrich [2]; José Crespo López-Urrutia [1]; Maria Schwarz [1]; Michael Drewsen [3]; Piet Schmidt [4]

[1] *Max-Planck-Institut für Kernphysik*

[2] *Max-Planck-Institut für Kernphysik, and Physikalisch-Technische Bundesanstalt*

[3] *Department of Physics and Astronomy, University of Aarhus*

[4] *Physikalisch-Technische Bundesanstalt, and Institut f\"ur Quantenoptik, Leibniz Universit\"at Hannover,*

Korrespondenzautor: oscar.versolato@mpi-hd.mpg.de

Narrow optical transitions in highly charged ions (HCIs) are of particular interest for metrology and fundamental physics. Atomic clocks could exploit the low susceptibility of HCIs to external electric fields. The highest sensitivity for a changing fine structure constant ever predicted for a stable atomic system is found in Ir^{17+}. However, spectroscopy of HCIs is hindered by the large ($\sim 10^6$ K) temperatures at which they are produced and trapped. An unprecedented improvement in such laser spectroscopy can be obtained when HCIs are cooled down to the mK range in a linear Paul trap. We have developed a cryogenic linear Paul trap in which HCIs will be sympathetically cooled by Be^+ ions. Optimized optical access for laser light is provided while maintaining excellent UHV conditions. The Paul trap will be connected to an electron beam ion trap (EBIT) which is able to produce a wide range of HCIs. This EBIT will also provide the first experimental input needed for the determination of the transition energies.

Tue 9:00-10:30 / 97

Quest for the QCD phase diagram in extreme environments

Autor Kenji Fukushima[1]

[1] *Keio University*

Korrespondenzautor: fuku@rk.phys.keio.ac.jp

Hot and dense matter out of quarks and gluons forms various status with external parameters such as the temperature, the chemical potential, the magnetic field, etc turned on and changed. The phase trasitions are characterized by realization of symmetries but the phase structure highly depends on the dynamical properties of matter. In this talk I will focus particularly on recent developments in the understanding of phase transitions based on the knowledge on confinement in the vacuum in the Landau gauge. Also I will talk about some speculative identification of the ground state of quark matter in the limit of strong magnetic field.

Fri 9:00-10:30 / 98

Search for Charged Lepton Flavor Violation with Muons at J-PARC

Autor Yoshitaka KUNO[1]

[1] *Osaka University*

Korrespondenzautor: kuno@phys.sci.osaka-u.ac.jp

We would like to describe an experiment, called COMET, to search for muon to electron conversion in a muonic atom at J-PARC. This process is charged lepton flavor violating. Recently we have taken a staging approach, and COMET Phase-I will be mentioned in more details. This has received supportive endorsement from the J-PARC PAC and J-PARC review committees. We are hoping that COMET Phase-I will start data taking in 2016/17. Also as R&D for COMET, we will mention a highly intense muon source, called MuSIC, which has been constructed at Osaka University. It has demonstrated the pion capture system required to carry out COMET.

Wed 14:00-15:30 / 99

Astrophysical evidences for the variation of fundamental constants and proposals of laboratory tests

Autor Victor Flambaum[1]

[1] *University of New South Wales*

Korrespondenzautor: v.flambaum@unsw.edu.au

There are new results for the variation of the fine structure constant alpha based on the quasar absorption spectra data. These results indicate the variation of alpha in space [1]. The spatial variation can explain fine tuning of the fundamental constants which allows humans (and any life) to appear. We appeared in the area of the Universe where the values of the fundamental constants are consistent with our existence. There is an agreement between the results obtained using different telescopes and different redshifts. Also, now there are no contradiactions between the results obtained by different groups. These astrophysical results may be used to predict the variation effects for atomic clocks which are very small and require improvement of the sensitivity by 1-2 orders of magnitude. This improvement may be achieved using 229Th nuclear clocks where the effect of the variation is hugely enhanced. There are also enhanced effects in multiply charged ions [2], and certain atomic and molecular transitions.
I may also present new results on parity and time reversal (EDM) violation in atoms and molecules, and role of the W,Z,top-quark bags in bariogenesis [3].

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[1] J.K. Webb, J.A. King, M.T. Murphy, V.V. Flambaum, R.F. Carswell, M.B. Bainbridge, Phys. Rev. Lett. 107 (2011) 191101. J. A. King et al., accepted to MNRAS.
[2] J. C. Berengut, V. A. Dzuba and V. V. Flambaum,Phys. Rev. Lett. 105 (2010) 120801; Phys. Rev. Lett. 106 (2011) 210802.
[3] V. V. Flambaum, E. Shuryak, Phys. Rev. D82, 073019 (2010).

Mon 11:00-12:30 / 100

Muon (g-2): Inside or outside of the Standard Model?

Korrespondenzautor: roberts@bu.edu

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TBA

Mon 11:00-12:30 / 102

Lorentz and CPT violation in the Standard-Model Extension

Autor Ralf Lehnert[1]

[1] *Indiana University Center for Spacetime Symmetries*

Korrespondenzautor: rlehnert@gmail.com

Lorentz and CPT invariance are among the symmetries that can be investigated with ultrahigh precision in subatomic physics. Being spacetime symmetries, Lorentz and CPT invariance can be violated by minuscule amounts in many theoretical approaches to underlying physics that involve novel spacetime concepts, such as quantized versions of gravity. Regardless of the underlying mechanism, the low-energy effects of such violations are expected to be governed by effective field theory. This talk provides a survey of this idea and includes an overview of experimental effort in the field.

Thu 14:00-15:30 / 103

Direct Neutrino Mass Measurements

Autor Christian Weinheimer[1]

[1] *Institut für Kernphysik, University of Münster*

Korrespondenzautor: weinheimer@uni-muenster.de

Neutrino oscillation experiments give clear evidences that neutrinos mix and have non-zero masses. The value of the neutrino mass scale is very important for cosmology and the evolution of the universe as well as for nuclear and particle physics. The determination of the neutrino masses is being addressed by the analysis of cosmological data, by the search for neutrinoless double beta decay and by the direct neutrino mass search. The latter method does not require further assumptions on neutrino properties: Usually the endpoint region of a beta decay or an electron capture is investigated with high precision.

The KArlsruhe TRItium Neutrino experiment KATRIN is investigating the
endpoint region of the tritium beta decay to search directly for the absolute neutrino mass. Its main components are a windowless gaseous molecular tritium source, an electron transport and tritium elimination section and a huge spectrometer of MAC-E-Filter type followed by an electron detector. KATRIN's sensitivity on the neutrino mass is 200 meV. Currently the main spectrometer and the detector is being installed and commissioned at the Karlsruhe Institute of Technology KIT.

After an introduction in this talk the different components of KATRIN as well as various test experiments and the status of the commissioning of KATRIN will be presented. An outlook on future approaches, e.g. using cryogenic bolometers to investigate the electron capture of Ho-163 or the beta decay of Rh-187 will be given.

Thu 11:00-12:30 / 104

What can we learn from cosmology for particle physics?

Autor Mikhail Shaposhnikov[1]

[1] *Ecole Polytechnique Federale de Lausanne*

Korrespondenzautor: mikhail.shaposhnikov@epfl.ch

I will overview several hints which cosmology provides for physics
beyond the Standard Model and discuss possible solutions of
cosmological problems of the Standard Model.

Wed 14:00-15:30 / 105

Changing perspective on changing couplings

Autor Maxim Pospelov[1]

[1] *u of victoria*

Korrespondenzautor: pospelov@uvic.ca

I review theoretical status of some models that were invoked in connection with "change of couplings in time" and "Lorentz invariance violation", and give my personal perspective on this subject. I then argue that the scope of the present experimental program can be expanded, in particular in the direction embracing the search for the short-time transient effects using precise clocks and magnetometers.

Tue 11:00-13:30 / 106

EDMs and CP violation

Autor Adam Ritz[1]

[1] *University of Victoria*

Korrespondenzautor: aritz@uvic.ca

A brief review of the impact of searches for electric dipole
moments of nucleons, atoms and molecules on fundamental sources
of CP (or T) violation in nature. The focus will be on the use of effective field theory to disentangle the constraints on different fundamental CP-odd sources, and the implications of direct LHC exclusion limits on possible new physics at or near the electroweak scale.

Wed 16:00-17:40 / 107

Ultracold molecules - Nature as a broken mirror

Autor Steven Hoekstra[1]

Co-Autoren: Corine Meinema [1]; Joost Berg, van den [1]; Klaus Jungmann [1]; Sreekanth Mathavan [1]

[1] *KVI / University of Groningen*

Korrespondenzautor: s.hoekstra@rug.nl

The Standard Model of Particle Physics predicts that the effect of weak interactions in the nuclei of molecules results in parity violating observables. Parity violation has already been seen in atomic systems but not in molecules. We are currently building a setup that can detect parity violation in heavy diatomic molecules. Using a traveling-wave Stark decelerator we will decelerate and trap a

supersonically expanded molecular beam of SrF. Combined with molecular laser cooling this results in an ultracold cloud of SrF that can be used for high-precision spectroscopy measurements to reveal the parity violation signal. In the talk we will focus on the motivation for using SrF and discuss the current status of the experiment.

Public Lecture / 108

Escher and the Droste effect

When it comes to illustrating principles of symmetries in physics, the work of the Dutch artist M.C. Escher ranks very high. Escher had an intuitive approach; with the added level of interpretation by physicists and mathematicians his work becomes even more fascinating.

One of M.C. Escher's most intriguing works depicts a man standing in a gallery who looks at a print of a city that contains the building that he is standing in himself. This picture, with the title Print Gallery, contains a mysterious white hole in the middle.
http://www.artchive.com/artchive/e/escher/escher_gallery.jpg.html

Hendrik Lenstra and the speaker Bart de Smit have shown that well known mathematical results about elliptic curves imply that what Escher was trying to achieve in this work has a unique mathematical solution. This discovery opened up the way to filling the void in the print. With help from artists and computer scientists a completion of the picture was constructed at the Universiteit Leiden. The white hole turns out to contain the entire image on a smaller scale, which in the Dutch language is known as the Droste effect, after the Dutch chocolate maker Droste.
http://escherdroste.math.leidenuniv.nl/images/droste.jpg

In the talk the mathematics behind Escher's print and the process of filling the hole will be explained and visualized with computer animations.

Wed 11:00-12:30 / 109

A new measurement of the weak charge of the proton

Autor Frank Maas[1]

Co-Autor: Dominik Becker [2]

[1] *Helmholtz-Institut Mainz*

[2] *Johannes-Gutenberg Universität Mainz*

Korrespondenzautor: maas@uni-mainz.de

After a series of parity violation electron scattering experiments in order to explore the
strangeness content of the nucleon, we plan on a new, improved parity violation experiment where we will measure the weak charge of the proton with a
relative accuracy of 1.7%. This accuracy results in a measurement of the
effective electroweak mixing angle sin^2 theta_W of 1.5 per mille, in
accuracy comparable to the present accuracy stemming from measurements at the Z-pole. It can test new physics beyond the standard model
up to a scale Lambda = 6,4 TeV.
The measurement will be performed a low beam energy of 137 MeV up to
200 MeV with an Q^2 of 0.022 up to 0.049 (Gev/c)^2.
The expected accuracy will be discussed and the experimental strategy will be presented.