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Report of Contributions

https://indico.nikhef.nl/e/3266

Contribution ID: **1** Type: **not specified**

The LHCb upgrade and its physics prospects for LHC Run 3

Friday, 4 November 2022 10:30 (35 minutes)

Presenter: PELLEGRINO, Antonio

Contribution ID: **2** Type: **not specified**

An Effective (Field Theory) Pathway to the New Standard Model

Friday, 4 November 2022 11:15 (40 minutes)

The ultimate goal of particle physics is uncovering a fundamental theory which allows the coherent interpretation of phenomena taking place at all energy and distance scales. The Effective Field Theory framework is particularly powerful in this respect, in that it makes possible a model-independent, theoretically consistent interpretation of particle physics data measured by a range of different experiments. In talk I present recent progress in global analyses of LHC data in terms of the Standard Model Effective Field Theory, in particular focusing on the combination of Higgs, electroweak, and top quark production measurements. I will also discuss how to construct optimally-sensitive observables for EFT fits with machine learning and the interplay between EFT effects and proton structure when interpreting high-pT LHC measurements.

Presenter: ROJO, Juan

Contribution ID: **3** Type: **not specified**

New Perspectives onto the Universe in the Multi-messenger astro era

Friday, 4 November 2022 16:15 (40 minutes)

Since the revolutionary discovery of gravitational wave (GW) emission from a binary black hole merger in 2015, the remarkable GW detectors LIGO, Virgo and KAGRA have detected ninety compact object mergers. These events are transforming modern astronomy. In particular, the first binary neutron star merger, dubbed GW170817, was observed in both gravitational and electromagnetic radiation, thus opening up a new era in multimessenger astrophysics. The multi-messenger characterisation of such an event has enabled major advances into diverse fields of modern physics from gravity, high-energy and extragalactic astrophysics, nuclear physics, to cosmology. In this talk, I will discuss my work in strong-field gravity astrophysics and how combining observations, theory and experiment have been key in making progress in this field. I will present the challenges and the opportunities that have emerged in multi-messenger astrophysics, and what the future holds in this new era.

Presenter: NISSANKE, Samaya (University of Amsterdam)

Contribution ID: **4** Type: **not specified**

Quantum Computation and Natural Language Processing

Friday, 4 November 2022 19:00 (40 minutes)

Quantum computers hold great future promise for performing more energy efficient and especially faster calculations for various complex problems by making use of algorithms with quantum speed-up. The most famous of these is the so-called Grover search algorithm. One, maybe less known, research area where quantum computers may possible become of great importance is Artificial Intelligence (AI) and in particular Natural Language Processing (NLP). In this talk we will try to explain why this is the case and will also present some first proof-of-principle calculations on the superconducting quantum computer publicly available through the IBM Quantum Experience, with the ultimate aim of applying Grover's algorithm to the NLP task of question answering. We also explicitly show the limitations of the present-day noisy quantum computers due to decoherence processes.

Presenter: STOOF, Henk (Utrecht University)

Contribution ID: **5** Type: **not specified**

Detection and characterization of strongly-lensed gravitational waves

Friday, 4 November 2022 12:00 (20 minutes)

Like light, gravitational waves can be deflected by massive objects along their travel path from source to observer. Depending on the mass of the lens, the wave can get distorted, magnified, or split into multiple potentially detectable images. The latter case is called strong lensing and happens when the characteristic size of the lens is much larger than the gravitational-wave wavelength. In this case, one would observe several images with the same frequency evolution but magnified, time-shifted, and with a possible overall phase shift. This phenomenon is expected to be observed in the coming years and could lead to new tests of general relativity, the identification of the host galaxy for binary black hole mergers, and tests of cosmology. However, because of the growing number of events over the year, the detection of strongly-lensed images represents a major challenge. Indeed, for O(1000) unlensed events, one has to analyze all the possible pairs, making for O($5\text{x}10^5$) pairs to analyze. This requires the development of fast and precise tools for their identification. In addition, the presence of the extended unlensed background leads to a high probability of false alarms, making it difficult to identify genuinely lensed events. Here, we present GOLUM, a framework able to do fast and precise parameter estimation for lensed events, reducing significantly the background compared to other fast methods. We also show how the inclusion of lens models can help in the identification of lensed events in an unlensed background for a realistic observation scenario.

Primary author: JANQUART, Justin

Co-authors: Prof. VAN DEN BROECK (Utrecht University and Nikhef); Dr MOORE , Anupreeta (The Inter-University Centre for Astronomy and Astrophysics (IUCAA),); Dr HARIS, K. (Utrecht University); Dr HANNUKSELA, Otto A. (The Chinese University of Hong Kong)

Presenter: JANQUART, Justin

Session Classification: Parallel

Contribution ID: **6** Type: **not specified**

Measurement of electroweak Z(νν)γjj production and limits on anomalous quartic gauge couplings in ATLAS

Friday, 4 November 2022 12:20 (20 minutes)

Measurements of multiboson production at the LHC probe the electroweak gauge structure of the Standard Model for contributions from anomalous couplings. Processes involving quartic gauge boson couplings are of particular significance. In this talk, recent ATLAS results on the measurement of electroweak production of a Zγ pair in association with two jets when Z decays to neutrinos producing missing transverse energy are presented.

Primary author: PYATIIZBYANTSEVA, Diana

Presenter: PYATIIZBYANTSEVA, Diana

Session Classification: Parallel

Contribution ID: **7** Type: **not specified**

Status of frequency dependent squeezing for Advanced Virgo Plus

Friday, 4 November 2022 12:20 (20 minutes)

As one of the essential upgrades from the Third Observation run(O3) to the Forth Observation run(O4), frequency-dependent squeezing(FDS) aims to reduce the quantum noise, both the shot noise and radiation pressure noise, of the gravitational wave detectors. FDS combines the frequency independent squeezing(FIS), already applied in the O3 run, with a detuned 300m Fabry Perot cavity built at the beginning of the O4 commissioning period. This talk will give a brief introduction to the AdV+ FDS system and the latest results of the FDS measurement.

Primary author: GUO, Yuefan

Presenter: GUO, Yuefan

Session Classification: Parallel

Contribution ID: **8** Type: **not specified**

Fingerprinting CP-violating New Physics with Rare B Meson Decays

Friday, 4 November 2022 12:00 (20 minutes)

Of all the particle decays that could be studied in the search for new physics beyond the Standard Model (SM), few are as promising as the rare B meson decays. In recent years, these decays have shown anomalies, tensions between SM predictions and experimental data. If these are signs of new physics, the key question is what type of new physics could be causing the anomalies. Interestingly, such new physics could also contain new sources of CP violation. In this talk, I will show how measurements of CP violation in rare B decays can help identify the underlying new physics.

Primary author: REHULT, Anders

Co-authors: FLEISCHER, Robert; VOS, Keri (Maastricht University); MALAMI, Eleftheria

Presenter: REHULT, Anders

Session Classification: Parallel

Contribution ID: **9** Type: **not specified**

New collider searches for dark photon

Friday, 4 November 2022 14:20 (20 minutes)

The dark photon is a well-motivated new particle, arising from a renormalizable interaction with the photon field. This so-called vector portal can lead to a dark sector, which can contain candidates for dark matter. In this talk, I discuss searches for dark photons at photon-electron colliders, with applications to LUXE and a future Gamma Factory, and electron-positron colliders, with a focus on Belle II. We found that photon beam dump offers a novel search strategy for dark photons, while bump hunting can be a viable strategy at a Gamma Factory. We have studied displaced vertices from dark photon decays at Belle II and modeled the background for such a signal. Belle II has excellent sensitivity to such dark photon signals and can probe them in an unexplored region of the parameter space using already collected data.

Primary authors: PHAN, Anh Vu (Radboud University); Prof. JAECKEL, Joerg (Heidelberg University)

Presenter: PHAN, Anh Vu (Radboud University)

Session Classification: Parallel

Contribution ID: **10** Type: **not specified**

Demonstrators of the ATLAS HGTD

Friday, 4 November 2022 12:20 (20 minutes)

The high-luminosity (HL) phase of the Large Hadron Collider (LHC) will start in 2029 and will be able to deliver an integrated luminosity up to 4000 fb-1 A direct consequence of this update will be to deal with high event rate i.e within the same bunch crossing, an average of 200 proton-proton collisions is estimated (against 50 in Run3) with 1.44 vertices/mm. Distinguishing between collisions occurring very close in space but separated in time will be one of the biggest challenges.

In order to improve the performance of the ATLAS detector in the forward region, the High Granularity Timing Detector (HGTD) is being constructed. Located between the tracker (ITk) and the end-cap calorimeters, it will provide a time resolution of 30ps (50ps) per track at the beginning (end) of the HL-LHC.

During the R&D phase, a set of intermediate prototypes are constructed which will, later, be regrouped into a realistic demonstrator in order to validate some aspects of the integration. In this talk, the current demonstrators will be shown : one investigates the mechanics and cooling aspects while the second one focuses on the electronics and data acquisition (DAQ) aspects.

Primary author: MISSIO, Marion

Presenter: MISSIO, Marion

Session Classification: Parallel

Contribution ID: **11** Type: **not specified**

Combined SMEFT interpretation of Higgs and electroweak measurements

Friday, 4 November 2022 12:00 (20 minutes)

Standard Model Effective Field Theory (SMEFT) provides a great framework to interpret combined measurements in order to spot the presence of physics beyond the Standard Model at energies that we cannot yet reach with our instruments. Measurements of cross sections, branching ratios and kinematic distributions can be combined in the SMEFT framework to ultimate test the SM without making any strong assumptions on the nature of the new physics we are looking for. I will present the results of the SMEFT interpretation of a combination of Higgs and Electroweak observables using data collected by the ATLAS detector during Run-2. This combination has been made with observables from the Higgs sector and the electroweak sector. Eight precision observables from LEP have also been included with the LHC measurements.

Primary author: VISIBILE, Andrea

Presenter: VISIBILE, Andrea

Session Classification: Parallel

Contribution ID: **12** Type: **not specified**

Time is of the essence: Depleted Monolithic Silicon Sensors

Friday, 4 November 2022 14:20 (20 minutes)

The ultimate goal for tracking detectors is the combination of excellent spatial resolution, low material budget, high radiation tolerance and excellent timing resolution for the ultimate tracking performance.
Many different approaches are taken to reach this goal, with CMOS based silicon detectors providing one of the most promising angles of approach.
The Nikhef Detector R&D group, as a part of the CERN RD50-CMOS collaboration, works on the development of radiation hard monolithic detectors based on a $150\,\mathrm{nm}$ High Voltage CMOS process by LFoundy and investigates their viability for future particle physics experiments.
As part of the ongoing developments, the newest prototype, the RD50-MPW3 was completed recently. The RD50-MPW3 consists of a 64×64 pixel matrix arranged in a 32 double-columns. The $62\,\mu\mathrm{m}$ pixels include both the analog front-end as well as the digital readout unlike its predecessor that consisted of 8×8 pixels of $60\,\mu\mathrm{m}$ pixel pitch that only included the analog front-end.

In this talk I will present an overview of the activities of the Nikhef Detector R&D group in determining the achievable time resolution of the MPW2 predecessor chip as well as first results of the current MPW3 prototype.

Primary author: KRAEMER, Uwe (DR&D)

Presenter: KRAEMER, Uwe (DR&D)

Session Classification: Parallel

Contribution ID: **13** Type: **not specified**

Tidal response from scattering and the role of analytic continuation

Friday, 4 November 2022 14:00 (20 minutes)

The tidal response of a compact object is a key gravitational-wave observable encoding information about its interior. This link is subtle due to the nonlinearities of general relativity. We show that considering a scattering process bypasses challenges with potential ambiguities, as the tidal response is determined by the asymptotic in- and outgoing waves at null infinity. As an application of the general method, we analyze scalar waves scattering off a nonspinning black hole and demonstrate that the low-frequency expansion of the tidal response reproduces known results for the Love number and absorption. In addition, we discuss the definition of the response based on gauge-invariant observables obtained from an effective action description, and clarify the role of analytic continuation for robustly (i) extracting the response and the physical information it contains, and (ii) distinguishing high-order post-Newtonian corrections from finite-size effects in a
binary system. Our work is important for interpreting upcoming gravitational-wave data for subatomic physics of ultradense matter in neutron stars, probing black holes and gravity, and looking for beyond-standard-model fields.

Primary authors: CRECI, Gastón (Utrecht University); Dr STEINHOFF, Jan (Max-Planck-Institute for Gravitational Physics (Albert-Einstein-Institute)); HINDERER, Tanja (Utrecht University)

Presenter: CRECI, Gastón (Utrecht University)

Session Classification: Parallel

Contribution ID: **14** Type: **not specified**

Bs –> K form factors and their impact on CKM elements

Friday, 4 November 2022 15:30 (20 minutes)

The probabilities for flavour transitions between quarks via the weak interaction are parametrised by the different elements of the Cabibbo-Kobayashi-Maskawa (CKM) matrix. There is a long standing puzzle related to these, in which the elements that describe the up-bottom (*Vub*) and charm-bottom (*Vcb*) transitions show a tension when determined in exclusive decays (when the final state is completely known) or inclusive decays (generic final states). Recently, the LHCb collaboration measured the *Bs –> K mu nu* decay and determined the ratio *| Vub / Vcb |* using theoretical inputs. In order to determine these CKM elements from the experimental analysis, the form factors for the transition *Bs –> K* are required. In this talk, I will discuss this new form factor determination and focus on how to improve it. Specifically, I will discuss an ongoing new light-cone sum rule (LCSR) approach to the calculation of these form factors such that they can be extrapolated and fitted to lattice QCD results to get the most precise theoretical prediction for these form factors.

Primary author: BOLOGNANI, Carolina (Maastricht University)

Presenter: BOLOGNANI, Carolina (Maastricht University)

Session Classification: Parallel

Contribution ID: **15** Type: **not specified**

Measuring the atmospheric tau-neutrino appearance with KM3NeT

Friday, 4 November 2022 14:00 (20 minutes)

Since the discovery of anomalies in the solar and atmospheric neutrino fluxes over 20 years ago, it has been firmly established by neutrino experiments around the world that neutrinos are massive particles and that the neutrino flavour eigenstates constitute linear super-positions of the neutrino mass eigenstates.
Most statistical power in constraining this massive three-neutrino paradigm is provided by investigations into ν_e and ν_μ disappearance and by $\nu_\mu \rightarrow \nu_e$ appearance.
However, the $\nu_\mu \rightarrow \nu_\tau$ appearance channel can also be observed, offering another complementary data set to test the model.

The Cubic-Kilometer Neutrino Telescope (KM3NeT) is expected to measure over 3000 charged-current tau-neutrino interactions per year arising from atmospheric neutrino oscillations.
This data sample will yield an unprecedented opportunity not only to measure the total cross-section for tau-neutrino interactions, but also to test models beyond the standard massive three-neutrino paradigm.

In this talk I will sketch the prospects for measuring the atmospheric tau-neutrino appearance with KM3NeT and highlight some of the unique challenges associated with distinguishing this channel. In addition, I will outline the prospects of a template fitting procedure currently being developed for the measurement.

Primary author: JISSE JUNG, Bouke

Co-author: JONG, Maarten de

Presenter: JISSE JUNG, Bouke

Session Classification: Parallel

Contribution ID: **16** Type: **not specified**

How well can we constrain modified gravitational wave propagation with strong lensing?

Friday, 4 November 2022 14:00 (20 minutes)

Just like light waves, gravitational waves (GWs) can undergo gravitational lensing. When the characteristic size of the lens is much larger than the wavelength of the GWs, the phenomenon is referred to as strong lensing. Strong lensing produces multiple copies of the same gravitational wave event which arrive at the detector as repeated signals. When the source is quadruply lensed, we can localize it up to sub-arcsecond precision by using simultaneous constraints from gravitational waves and electromagnetic observations. In this work, we show that such precise localization could help us probe theories of gravity beyond General Relativity (GR). In particular, we consider the set of beyond GR theories in which the propagation equation of GW differs from GR by a friction term. Therefore, the luminosity distance measured using GW will also be different from GR. In this work, we show that quadruply lensed gravitational wave events could provide us with competitive against existing bounds on such theories beyond GR.

Primary author: NAROLA, Harsh (Utrecht University)

Co-authors: JANQUART, Justin; MALIYAMVEETTIL, Haris; Dr MASTROGIOVANNI, Simone; Dr HAEGEL, Leïla; HANNUKSELA, Otto A. (The Chinese University of Hong Kong); VAN DEN BROECK (Utrecht University and Nikhef)

Presenter: NAROLA, Harsh (Utrecht University)

Session Classification: Parallel

Contribution ID: **17** Type: **not specified**

Ion optical simulation for the NEXT solenoid separator

Friday, 4 November 2022 14:20 (20 minutes)

The NEXT project aims to study Neutron-rich, EXotic, heavy nuclei produced in multi-nucleon Transfer reactions[1]. Transfer products of interest will be focused and separated from unwanted by-products and unreacted primary beam by a 3T solenoid magnet with an 87-cm wide bore.

We developed a Python code to simulate the traces of ions through the magnetic field of the solenoid magnet. The purpose of the simulation is to define the optimum settings of the separator in order to acquire the highest transmission yields and strongest background suppression.

In my contribution, I will explain the different steps of the simulations of realistic ion trajectories through the magnetic field. I will present the results obtained for a few selected multinucleon transfer products which are of interest for nuclear astrophysics.

References

[1] J. Even et al., Atoms 10 (2022) 59.

Primary author: SOYLU, Arif (VSI/RUG)

Co-authors: CHEN, Xiangcheng (University of Groningen); EVEN, Julia (University of Groningen); SAIKO, Vyacheslav (Flerov Laboratory of Nuclear Reactions, JINR); KARPOV, Alexander (Flerov Laboratory of Nuclear Reactions, JINR); SAREN, Jan (University of Jyväskylä); UUSITALO, Juha (University of Jyväskylä)

Presenter: SOYLU, Arif (VSI/RUG)

Session Classification: Parallel

Contribution ID: **18** Type: **not specified**

Searching for ultra-high energy neutrinos at the Pierre Auger Observatory

Friday, 4 November 2022 14:40 (20 minutes)

The Pierre Auger Observatory is the world's largest cosmic ray detector array. It measures the properties of cosmic rays above 10^{17} eV with an array of 1600 water Cherenkov detectors (WCD) spread over an area of $3000\ \mathrm{km}^2$ overlooked by 27 Fluorescence Detectors. The WCD array can also detect neutrinos above 10^{17} eV. No neutrinos have been detected so far, leading to upper limits on their flux at the highest energies. Radio Detector (RD) antennas are currently being installed on top of the WCDs as a part of the AugerPrime upgrade, which will enhance the sensitivity of the Pierre Auger Observatory to ultra-high energy neutrinos by allowing us to detect the radio emission they produce in the 30-80 MHz band. Seven RD stations have been taking data over the last three years. A new trigger algorithm is being developed to include information from the RD. I will present the concept for this trigger, the current status of its development, and the first results of its performance on neutrino simulations.

Primary author: SAHARAN, Mohit

Co-authors: GALEA, Cristina; Prof. DE JONG, Sijbrand

Presenter: SAHARAN, Mohit

Session Classification: Parallel

Contribution ID: **19** Type: **not specified**

Generating template banks for gravitational waves searches in exotic binary black hole regions

Friday, 4 November 2022 15:50 (20 minutes)

We introduce a novel method to generate a bank of gravitational-waveform templates of binary black hole (BBH) coalescences for matched-filter searches in LIGO and Virgo data. Unlike the standard approach, our method relies on a numerical metric approximation of the distance between templates, which makes the template placement orders of magnitude faster than with existing techniques.
Our method applies to a variety of different manifolds of signals and is particularly suitable for covering high dimensional spaces, such as those associated with precessing and/or eccentric waveforms.
We compare our method with the state-of-the-art stochastic placement code and we find that our code slightly overcovers the space, while achieving similar efficiency in recovering signals.
We use our publicly released code mbank to generate a precessing and an eccentric bank ready for production, both covering interesting and yet unexplored regions of the BBH parameter space. These two ready-to-use banks will facilitate the next generation searches for gravitational waves, hitherto unfeasible due to the prohibitive cost of bank generation.
We also discuss future improvements of our method using a Normalizing Flow model.

Primary author: SCHMIDT, Stefano

Co-authors: CAUDILL, Sarah; GADRE, Bhooshan (GRASP, Utrecht University)

Presenter: SCHMIDT, Stefano

Session Classification: Parallel

Contribution ID: **20** Type: **not specified**

New test of Lepton Flavour Universality with rare $\Lambda_b^0 \to \Lambda \ell^+ \ell^-$ decays at LHCb

Friday, 4 November 2022 14:40 (20 minutes)

Over the past few years, interest in the $b \to s\ell^+\ell^-$ transition has grown due to its contribution to measurements that show hints of lepton flavour universality violation. Lepton flavour universality (LFU) is the uniform behaviour of the electron, muon and tau leptons under the electroweak interaction and is an intrinsic characteristic of the Standard Model (SM). The $b \to s\ell^+\ell^-$ transition is governed by the Flavour Changing Neutral Current (FCNC) and is extremely suppressed in the SM, making this a rare decay. Hence, making this LFU measurement a sensitive test to possible extensions to the SM, collectively referred to as New Physics (NP). Yet, so far the measurements are limited to meson decays and thus Λ_b^0, the first baryon decay in which LFU will be measured, could provide further insight in the observed anomalies. The search of possible violation of LFU will be done by measuring R_Λ, the ratio between $\Lambda_b^0 \to \Lambda\mu^+\mu^-$ and $\Lambda_b^0 \to \Lambda e^+ e^-$ decays.

Primary author: DE BOER, Jan

Presenter: DE BOER, Jan

Session Classification: Parallel

Contribution ID: **21** Type: **not specified**

A deep learning pipeline for core-collapse supernova searches

Friday, 4 November 2022 15:30 (20 minutes)

Core-collapse supernova (CCSN) explosions are among the most energetic events in the Universe, and their detection in gravitational waves is a challenging task, yet to be achieved. In this work, we present a convolutional neural network-based pipeline to detect these kinds of signals, employing time-frequency images.
We train and validate our convolutional neural network using phenomenological waveforms, which mimic the waveforms obtained in 3D numerical simulations of CCSNe, embedded in O3 Gaussian detector noise. Furthermore, we tested its robustness by injecting signals from numerical relativity simulations in the real noise data taken by the Advanced LIGO-Virgo network during O3. With this algorithm we were able to identify signals from both our phenomenological template bank and from actual numerical 3D simulations of CCSNe.

Primary author: LOPEZ, Melissa

Presenter: LOPEZ, Melissa

Session Classification: Parallel

Contribution ID: **22** Type: **not specified**

VULCAN: Studying the fluorescence response of PTFE to incident VUV light in cryogenic conditions

Friday, 4 November 2022 15:50 (20 minutes)

Rare-event searches such as dark matter direct detection experiments rely on accurate detection of scintillation photons to observe signals from very low-energy events. It has been suggested that materials used in the construction of these experiments, such as PTFE, can fluoresce under excitation from the target material's scintillation light. This scintillation light is in the vacuum ultraviolet (VUV) region and is readily absorbed by molecules such as oxygen in the air presenting its own unique list of challenges when it comes to its manipulation. VULCAN (Vacuum ULtraviolet Characterisation At Nikhef) aims to measure the fluorescence and reflectivity of detector material samples under VUV light excitation at the temperatures experienced in these dark matter detectors. This will aid in the understanding of possible backgrounds introduced in such experiments and enable improved signal-to-noise ratios in analyses at low energies.

Primary author: BROOKES, Emily

Presenter: BROOKES, Emily

Session Classification: Parallel

Contribution ID: **23** Type: **not specified**

Correlations between strange hadrons in ALICE

Friday, 4 November 2022 15:50 (20 minutes)

Multi-strange baryons offer a unique opportunity to study the role of di-quark production in baryon formation processes. The Lund string fragmentation model is the most widely used description of hadron formation. In this model, the quarks that hadronize are produced through a phenomenon called string breaking, where the string is an analogy for the strong force that acts between two quarks. When the distance between these two quarks increases, the string may break by creating new pairs consisting of (anti-)quarks and, crucially, di-quarks. Since this production is local it will lead to correlations between baryons and other hadrons. We will present results from a Monte Carlo study using PYTHIA, an event generator based on the Lund model, and discuss how the correlations depend on the configuration of the simulation. We will also look at the feasibility to experimentally test the predictions.

Primary author: SPIJKERS, Rik

Presenter: SPIJKERS, Rik

Session Classification: Parallel

Contribution ID: **24** Type: **not specified**

Latest results of KamLAND-Zen: the most stringent limit on the half-life of neutrinoless double beta decay.

Friday, 4 November 2022 15:30 (20 minutes)

There is currently no proof that neutrinos and antineutrinos are different particles, contributing to the theory that neutrinos are in fact Majorana. We hope to verify the theory through neutrinoless double beta decay ($0\nu\beta\beta$), which could possibly take place in xenon. However, this process is extremely rare and therefore requires a super sensitive detector. The world leading experiment at the moment is KamLAND-Zen: a detector situated in a mine 1000m underground in Japan, where xenon-loaded liquid scintillator is used. In this talk it will become clear why KamLAND-Zen is the most sensitive detector today and what the main backgrounds are that still obscure the signal. In particular, I will treat the cosmic muon spallation background which is a problem in many experiments. Finally, I will present the recent findings of KamLAND-Zen where the inverted mass ordering region is probed for the first time.

Primary author: WEERMAN, Kelly

Presenter: WEERMAN, Kelly

Session Classification: Parallel

Contribution ID: **25** Type: **not specified**

Theoretical study of properties of radioactive molecules

Friday, 4 November 2022 14:40 (20 minutes)

Heavy diatomic molecules are currently considered to be among the most sensitive systems used in the search for the P,T-violating effects and in probing the Standard Model of particle physics. In certain molecules effects resulting from both parity violation and time-reversal violation (P,T - odd effects) are considerably enhanced with respect to atomic systems. The strength of these interactions grow with atomic number, nuclear spin and nuclear deformation. Molecules with atomic nuclear octupole deformation are sensitive for investigating of parity and time-reversal violating effects, in particular nuclear EDM or electric EDM. Diatomic molecules, like AcF and RaF, has been proposed to be sensitive to the various effects, for example, Schiff moment of the nucleus [1, 2]. Nowadays different laboratories plan to perform experimental study of radioactive molecules in order to measure isotopologue shifts, hyperfine structures and so on. Pursuing studies on AcF can also provide insight into dynamics of molecular extraction of Ac, as a pathway to delivering a wider range of actinium isotopes for experiments. This work aims to determine molecular properties of the RaF and AcF at the highest possible level of computational accuracy using the couple cluster in a relativistic framework. The ionization potential, excitation energies, and spectroscopic constants of AcF, RaF will be presented and the uncertainty of the predicted values will be discussed.

References
[1] D. Cho, K. Sangster, and E. Hinds. Phys. Rev. A, 44:164–164, 1991.
[2] V. Flambaum and V. Dzuba. Phys. Rev. A, 101:42504, 2020.

Primary author: KIUBERIS, Aleksandra (Van Swinderen Institute for Particle Physics and Gravity, Faculty of Science and Engineering, University of Groningen)

Presenter: KIUBERIS, Aleksandra (Van Swinderen Institute for Particle Physics and Gravity, Faculty of Science and Engineering, University of Groningen)

Session Classification: Parallel