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IOP Institute of Physics

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The DarkSide-20k photodetection system

Agnes P[1], Collaboration T
[1]Gssi

The DarkSide-20k experiment, currently under construction at the Gran Sasso Laboratory (LNGS), represents a significant advancement in the field of direct Dark Matter (DM) detection. Utilizing a liquid argon dual-phase time projection chamber (LArTPC) with a 20-tonne fiducial mass, DarkSide-20k is designed to extend the sensitivity limits in the search for Weakly Interacting Massive Particles (WIMPs), a leading dark matter candidate. The experiment represents the first large-scale deployment of SiPMs for light detection in this field in preference to PMTs, with the experiment containing ~26 square metres of FBK NUV-HD-Cryo triple dose SiPMs for the detector and veto. We will discuss high level experimental design, the light detection design implementation, perspectives on production operations using SiPMs and their performance.

High Energy Astrophysical Neutrinos: An Overview

Ahlers M

Neutrino astronomy has achieved a number of milestones in the past decade. The IceCube Observatory discovered a diffuse flux of TeV-PeV neutrinos in 2013. Neutrino emission at the observed flux level has been predicted from a variety of sources. However, none of these candidate sources has been unambiguously identified as the origin of IceCube's observation. Recent evidence of neutrino emission from the gamma-ray blazar TXS 0506+056 as well as the Seyfert galaxy NGC 1068 might be the first glimpses of extragalactic neutrino point-sources. IceCube has also now observed a neutrino glow of the Milky Way, consistent with model predictions of cosmic ray diffusion in our Galaxy. Very recently, the KM3NeT telescope announced the discovery of an ultra-high-energy neutrino with an energy exceeding 100 PeV, the most energetic astrophysical neutrino observed so far. I will give an overview of these results and their interpretation in terms of multi-messenger astronomy.

Recent results from the LUX-ZEPLIN (LZ) dark matter experiment

Al Musalhi A

LUX-ZEPLIN (LZ) is a dark matter direct detection experiment operating over a kilometre underground at the Sanford Underground Research Facility in Lead, South Dakota, USA. At its core, the LZ detector consists of a dual-phase xenon time projection chamber, with an active volume containing 7 tonnes. This talk will cover the recent world-leading results from the primary LZ search for weakly interacting massive particles (WIMPs), as well as reporting on the current status of the experiment and searches for other new physical phenomena.

Search for HNLs, vector-like quarks and vector-like leptons in ATLAS+CMS

Almond J

The search for physics beyond the Standard Model (BSM) remains a key priority of the LHC program. Among the promising candidates are heavy neutral leptons (HNLs), vector-like quarks (VLQs), and vector-like leptons (VLLs), which arise in a variety of BSM scenarios, including neutrino mass generation mechanisms and composite Higgs models. In this talk, I will present the latest results from ATLAS and CMS on searches for HNLs, VLQs, and VLLs, covering a broad set of final states and leveraging both prompt and displaced signatures, as well as leptonic and hadronic decay channels.

Antineutrinos in SNO+

Andringa S[1]
[1]LIP

SNO+ is a multi-purpose low energy neutrino experiment, taking data at SNOLAB, Canada. The antineutrino flux at this location comes predominantly from nuclear reactors at 240 km, 340 km and 350 km, which induce clear oscillation patterns in the visible energy spectrum. It is complemented, below 3 MeV, with geoneutrinos from the thick North American crust. SNO+'s measurement of the neutrino squared mass difference, Δm^2_{12}, is the second-most precise to date, surpassing that obtained by combining all solar neutrino data. This presentation will discuss the challenges overcome in previous and current antineutrino measurements of SNO+, and the sensitivity prospects with continuation of data-taking in an evolving liquid scintillator detector.

Recent B-physics results at CMS

Azzurri P[1]
[1]for the CMS Collaboration
The talk will discuss recent flavor physics results at the CMS experiment, including precise CPV measurements and searches for rare heavy-flavor decays, testing lepton flavor universality and probing new physics.

Understanding accelerator-based (anti)neutrino fluxes: Hadron production measurements at NA61/SHINE

Ren L[1]
[1]University Of Colorado Boulder

Current and future accelerator-based neutrino experiments require precise estimations of their (anti)neutrino fluxes. The (anti)neutrino flux uncertainty primarily arises from insufficient precision in understanding of primary and secondary hadron-nucleus interactions in the target and beamline materials. Aiming to reduce the accelerator-based (anti)neutrino flux uncertainty, the NA61/SHINE experiment at CERN has developed a dedicated program to measure hadron production in various hadron-nucleus interactions using thin and replica targets. This contribution will present the latest results and ongoing hadron production measurements in NA61/SHINE, the impact of NA61/SHINE results on reducing neutrino flux uncertainty, as well as our plans following the Long Shutdown 3 of the accelerator complex at CERN.

ATLAS+CMS+LHCb experimental highlights on mW, sin2θeff, and αs from Z->$\ell\ell$

Balli F

This presentation will discuss the most recent results from the ATLAS, CMS and LHCb collaborations regarding the measurements of the W mass, the weak mixing angle and the strong coupling from Z->$\ell\ell$ events.
In the last year, significant improvements on the precision of the experimental measurements of these observables have been achieved. The talk will show how this was realized and end with outlook considerations on future results.

The NOvA Test Beam Program

Bannister E

The NOvA (NuMI Off-Axis electron neutrino Appearance) Experiment is a long-baseline neutrino oscillation experiment composed of two functionally identical detectors, a 300 ton Near Detector, and a 14 kton Far Detector separated by 809 km and placed 14 mrad off the axis of the NuMI neutrino beam created at Fermilab. This configuration enables NOvA's rich neutrino physics program, which includes measuring neutrino mixing parameters, determining the neutrino mass hierarchy, and probing CP violation in the leptonic sector. The NOvA Test Beam experiment deployed at Fermilab between 2018 and 2022 used a scaled-down 30 ton detector to analyze tagged beamline particles. The beamline selected and identified electrons, muons, pions, kaons, and protons with momenta ranging from 0.4 to 1.8 GeV/c, as understanding how the detector responds to these particles found in the final state of neutrino interactions is crucial. In this talk, we will describe the highlights and challenges of the NOvA Test Beam program, and present preliminary results from studies of particle response in the NOvA Test Beam detector.

Forward neutrinos at colliders

Barr A

One of the most interesting developments in collider physics is far-forward detectors that can detect the weakly-coupled particles produced abundantly in hadron decays. These experiments, which are shielded from the LHC interaction points, can study multi-TeV-energy neutrinos and search for light, weakly-coupled new particles. Recent results include the observation of electron and muon collider neutrinos, measurements of the muon and electron neutrino interaction cross sections in the TeV energy range, and searches for weakly-coupled BSM particles. This talk will discuss these early results from these initial experiments, and discuss the prospects for a dedicated Forward Physics Facility suitable for dark sector, neutrino, and BSM physics at the HL-LHC.

Solar neutrinos from the CNO cycle: Borexino results and solar physics implications

Basilico D

Our Sun is powered by the fusion of hydrogen into helium occurring in the solar core via two distinct reaction sequences: the dominant proton-proton (pp) chain and the secondary Carbon-Nitrogen-Oxygen (CNO) cycle. Solar neutrinos are emitted along several distinct reactions of both cycles, each one characterized by a specific energy spectrum and flux: they are the only direct probe of the energy production mechanism of the Sun and the stars.

Borexino was a solar neutrino detector based on 280 tons of ultrapure liquid scintillator, located at the Laboratori Nazionali del Gran Sasso, Italy. Over fourteen years of data taking, Borexino completed the spectroscopy of solar neutrinos emitted from the pp chain reactions and measured the flux from the Carbon-Nitrogen-Oxygen (CNO) cycle.

This talk summarizes Borexino's measurements of CNO solar neutrinos and their implications for solar physics. Indeed, the combination of these CNO flux measurements with the 7Be and 8B fluxes outcomes previously obtained by Borexino allows to infer information about the solar metallicity, and also, for the first time, to evaluate the abundance of Carbon and Nitrogen relative to Hydrogen in the solar core with solar neutrinos.

SBND-PRISM: Sampling Multiple Off-Axis Neutrino Fluxes with the SBND Detector

Del Tutto M

The Short-Baseline Near Detector (SBND) is a 112-ton liquid argon time projection chamber serving as the near detector of the Short-Baseline Neutrino Program at Fermilab. Positioned just 110 meters and not perfectly aligned with the neutrino source, SBND benefits from a unique geometric advantage: neutrinos that traverse the detector come from different angles with respect to the beam axis. This feature is known as “SBND-PRISM,” which enables SBND to effectively sample multiple neutrino fluxes within a single detector configuration, taking advantage of the precise tracking and calorimetric capabilities of the SBND liquid argon time projection chamber detector. In this talk, we will explore some of the physics opportunities unlocked by SBND-PRISM and highlight its potential for precision measurements and new physics searches.

Searches for physics beyond the Standard Model with the MicroBooNE experiment

Evans J

MicroBooNE is an 85-tonne active mass liquid argon time projection chamber (LArTPC) at Fermilab. The detector, which has an excellent calorimetric, spatial and energy resolution, has collected beam data from two different beamlines between 2015 and 2020, as well as cosmic ray data when no neutrino beam was running. These characteristics make MicroBooNE a powerful detector not just to explore neutrino physics, but also for Beyond the Standard Model (BSM) physics. Additionally, MicroBooNE is investigating the observed low energy excess (LEE) of single electromagnetic shower events reported by the MiniBooNE experiment with various searches across a number of channels the anomalous excess may originate in. This talk will discuss various newly published BSM and LEE search results as well as explore future MicroBooNE searches.

Detection of an Ultra-High-Energy Neutrino Event with KM3NeT

Bendahman M

On behalf of the KM3NeT Collaboration

KM3NeT comprises two detectors under construction in the Mediterranean Sea: ARCA, designed for high-energy cosmic neutrinos, located near Sicily at a depth of 3450 meters, and ORCA, optimized for neutrino oscillation studies, situated at 2450 meters depth off the coast of Toulon. Both detectors consist of vertical detection lines, each equipped with optical modules containing photomultiplier tubes. Despite being under construction, these detectors are actively taking data, providing first results that indicate their potential for future studies in multi-messenger astrophysics.
On February 13, 2023, the KM3NeT/ARCA detector recorded KM3-230213A, an ultra-high-energy neutrino event with an estimated energy of 220 PeV. This event represents the most energetic neutrino detected, strongly suggesting a cosmic origin.
In this talk, the KM3NeT's latest result on the ultra-high-energy neutrino event KM3-230213A will be presented, describing its detection technique, reconstruction, and significance assessment. Possible astrophysical sources, including extragalactic and cosmogenic origins, will be discussed. Additionally, its implications for future observations with KM3NeT will be highlighted.

NOvA Three Flavour Neutrino Oscillation results

Bezerra T[1]
[1]University Of Sussex

The NOvA experiment, a long-baseline neutrino oscillation experiment, employs a two-detector scheme and Fermilab's NuMI beam. Functionally identical near and far detectors are positioned off-axis relative to the NuMI beam. This setup achieves a narrow-band energy flux concentrated at approximately 2 GeV. A predominantly muon (anti)neutrino beam travels 810 km to be detected at the far detector. The near detector serves to mitigate systematic uncertainties and constrain the flux composition. The experiment's setup is optimal for measuring muon neutrino disappearance and electron neutrino appearance within the context of the three-neutrino flavour paradigm, enabling the probing of neutrino oscillation parameters such as the large neutrino mixing angle θ23, the neutrino mass ordering, and the CP-violating phase, a parameter that quantifies the difference in behaviour between neutrinos and antineutrinos. These inquiries hold significant interest for both theoretical and experimental research. In this presentation, we will present the most recent results from three-flavour neutrino oscillation measurements utilising 10 years of NOvA data.

Searches for supersymmetric particles with ATLAS+CMS

Bhatti Z

Supersymmetry (SUSY) provides elegant solutions to several problems in the Standard Model, and searches for SUSY particles are an important component of the LHC physics program. The direct production of electroweak SUSY particles, including sleptons, charginos, and neutralinos, is a particularly interesting area with connections to dark matter and the naturalness of the Higgs mass. Naturalness arguments also favour supersymmetric partners of the gluons and third-generation quarks with masses light enough to be produced at the LHC. This talk will highlight the most recent results of searches performed by the ATLAS and CMS experiment for supersymmetric particles, considering both electroweak and strong production modes. With increasing mass bounds on more classical MSSM scenarios other variations of supersymmetry become increasingly interesting. Results for compressed, non-minimal, and R-parity violating scenarios and recent interpretations in the context of the pMSSM are also presented.

The (semi)-leptonic decays of charmed mesons at BESIII

Bianchi F, BESIII Collaboration C

BESIII has collected 20.3 and 7.33 fb^-1 of e+e- collision data samples at 3.773 and 4.128-4.226 GeV, respectively, presenting a unique opportunity to test the non-perturbative nature of QCD in the charm sector.
We will present the first experimental study of D(s)*+ to l+ nu and the improved measurements of |Vcd|, |Vcs|, Ds+/D+ decay constant in Ds+/D+ -> mu+ nu and tau+ nu. Furthermore, we will provide a comprehensive overview of the most precise experimental results for D(s) -> K, D -> pi, and Ds -> eta(‘) transition form factors.
As for the studies of four- and five-body semi-leptonic decays D(s)-> hh l+ nu and hhh l+ nu, we investigate scalar (a0, f0, sigma), vector (K*, phi), axial vector (K1, b1) particles on the hadron spectrum. The experimental studies of D -> a0(980), D -> sigma, D -> K*, Ds -> f0(980), and Ds -> phi form factors will be presented.

Searches for hidden sectors and lepton flavour violation in kaon decays at NA62

Blazek T

Rare kaon decays are among the most sensitive probes of both heavy and light new physics beyond the Standard Model description thanks to high precision of the Standard Model predictions, availability of very large datasets, and the relatively simple decay topologies. The NA62 experiment at CERN is a multi-purpose high-intensity kaon decay experiment, and carries out a broad rare-decay and hidden-sector physics programme. NA62 has collected a large sample of K^+ decays in flight during Run 1 in 2016-2018, and the ongoing Run 2 which started in 2021. Recent NA62 results on searches for hidden-sector mediators and searches for violation of lepton number and lepton flavour conservation in kaon decays based on the Run 1 dataset are presented. Future prospects of these searches are discussed.

Recent Advancements in Machine Learning Techniques Utilised by NOvA

Booth A

NOvA is a long-baseline neutrino oscillation experiment with an extensive physics program, most notably delivering world-leading measurements of neutrino cross-sections, PMNS parameters and neutrino mass splittings. NOvA was the first experiment in High Energy Physics to apply convolutional neural networks as a tool for classifying neutrino interaction types and continues to employ machine learning extensively in its physics analyses today. This talk will cover recent advancements in the areas of primary neutrino vertex position finding and energy reconstruction along with ongoing efforts to enhance the interpretability, robustness, and performance of NOvA's classifiers.

A direct probe of neutrino compositness

Borrello M[1,3], Costa M[2], Redigolo D[3]
[1]University Of Florence, [2]Perimeter Institute for Theoretical Physics, [3]INFN, Sezione di Firenze

The origin of Majorana neutrino masses suggests the existence of a sterile neutrino sector, which may be either too heavy or too weakly coupled to the Standard Model (SM) to be detected in the near future. The inverse seesaw mechanism provides a testable framework where the coupling between the sterile sector and the SM is large enough to allow direct experimental probes. In this context, it is crucial to explore whether the sterile sector is a weakly or strongly coupled theory and to identify methods to distinguish between these possibilities.

We propose a novel experimental probe for neutrino coupling with a strongly coupled sterile sector, based on the distinctive signature of neutrino disintegration into "dark jets" in high-energy neutrino scattering with electrons and nucleons. We investigate scenarios where the disintegration rate is dominated by events in which the dark jet invariant mass is well above the confinement scale, and we compute production rates within the conformal window. In this regime, we derive a new bound from NuTeV neutral current measurements and assess the expected sensitivity of upcoming experiments, such as DUNE and SHiP. We compare these bounds with the more standard searches of sterile state in meson and EW gauge boson decays (see Figure attached).

The unique signals discussed here offer a new experimental signature for future neutrino experiments, presenting both challenges in optimizing signal-to-background discrimination and a promising avenue for identifying composite neutrino interactions.

The CROSS experiment on 100Mo neutrinoless double beta decay: status and physics reach

Buchynska M[1], on behalf of the CROSS colaboration
[1]Universite Paris-Saclay, CNRS/IN2P3, IJCLab

Cryogenic particle detectors offer a promising approach for investigating neutrinoless double beta decay ($0\nu\beta\beta$), as demonstrated by the successful performance of previous experiments such as CUORE, CUPID-0, and CUPID-Mo. However, advancing bolometric technology is crucial for achieving higher sensitivity in future $0\nu\beta\beta$ decay experiments.

CROSS (Cryogenic Rare-event Observatory with Surface Sensitivity) is dedicated to optimizing bolometric techniques for next-generation $0\nu\beta\beta$ decay experiments, focusing on isotopes ^{100}Mo and ^{130}Te. Located at the Laboratorio Subterráneo de Canfranc (LSC) in Spain, the final CROSS demonstrator consists of 36 Li_2MoO_4 crystals (32 enriched in ^{100}Mo) and 6 TeO_2 crystals enriched in ^{130}Te [1], arranged in three towers. The design of the structure is tuned to minimize the background contribution [2].

Each crystal faces a silicon or germanium wafer equipped with a Ge thermistor allowing simultaneous detection of scintillation light and phonon signal. Because of the lower light yield of α particles compared to β/γ, this technique provides effective rejection of the α background.

Additionally, we exploit the Neganov-Trofimov-Luke effect to enhance the signal-to-noise ratio in the light detectors, which have been developed in the framework of the CryoLux project. Combined with a relatively fast signal (rise time ~ 0.5 ms), this significantly improves the rejection of random coincidences from $2\nu\beta\beta$ decay, one of the dominant background sources in $0\nu\beta\beta$ decay experiments using ^{100}Mo nuclei.

CROSS will be a competitive experiment for the search for $0\nu\beta\beta$ decay in ^{100}Mo, with the potential to improve the worldwide limit for this isotope. With a ^{100}Mo mass of 4.9 kg and an expected two-year live time, according to our background simulation, CROSS will achieve sensitivity to the $0\nu\beta\beta$ half-life $9.36*10^{24}$ years at the 90% C.L., corresponding to bounds on the effective Majorana mass in the range 126-213 meV.

[1] JINST 19 (2024) P09014
[2] JINST 19 (2024) P09013

RELICS: Search for Coherent Elastic Neutrino-Nucleus Scattering from reactor neutrinos using LXeTPC

Cai C

The precise measurement of Coherent Elastic Neutrino-Nucleus Scattering (CEvNS) cross-sections is of great importance for advancing neutrino physics and probing beyond-the-Standard-Model phenomena. However, the detection of CEvNS signals is challenged by low-energy background interference. The Liquid Xenon Time Projection Chamber (LXeTPC), which has demonstrated excellent sensitivity to low-energy interactions below 1 keV in dark matter searches, presents a highly promising technology for CEvNS detection. The Reactor neutrino Liquid xenon Coherent Scattering experiment (RELICS) utilizes LXeTPC technology to search for CEvNS events induced by reactor neutrinos at energies on the order of ~MeV. This presentation outlines recent advancements in the development of the RELICS experiment, highlighting progress in detector design, background suppression, and sensitivity optimization for CEvNS detection.

Unveiling the Majorana Nature of Neutrinos: First 0νββ Results from LEGEND-200

Calgaro S

The search for neutrinoless double beta (0νββ) decay probes the Majorana nature and absolute mass scale of neutrinos. As a lepton-number-violating process, the discovery of 0νββ decay could help explain the matter-antimatter asymmetry observed in the Universe. The LEGEND collaboration aims to push the sensitivity of ^{76}Ge-based 0νββ experiments to 3σ half-life discovery sensitivities of about 10^{28} yr through a staged approach. The first phase, LEGEND-200, began operations at Laboratori Nazionali del Gran Sasso in Italy in Spring 2023, employing 142 kg of high-purity germanium detectors enriched in ^{76}Ge. By combining an exposure of 61.0 kg·yr with data from previous Ge-based experiments, GERDA and MAJORANA DEMONSTRATOR, the highest half-life sensitivity to date in the search for 0νββ decay has been achieved. In this talk we will highlight the performance of LEGEND-200 and present the first 0νββ decay results obtained from the initial year of data taking.

This work is supported by the U.S. DOE and the NSF; the LANL, ORNL, and LBNL LDRD programs; the European ERC and Horizon programs; the German DFG, BMBF, and MPG; the Italian INFN; the Polish NCN and MNiSW; the Czech MEYS; the Slovak SRDA; the Swiss SNF; the UK STFC; the Canadian NSERC and CFI; the LNGS, SNOLAB, and SURF facilities.

Searches for dark sector particles at Belle and Belle II

Robertson S

The Belle and Belle~II experiment have collected samples of e^+e^- collision data at centre-of-mass energies near the $\Upsilon(nS)$ resonances. These data have constrained kinematics and low multiplicity, which allow searches for dark sector particles in the mass range from a few MeV to 10~GeV. Using a 426~fb^{-1} sample collected by Belle~II, we search for inelastic dark matter accompanied by a dark Higgs. Using a 711~fb^{-1} sample collected by Belle, we search for $B\to h + \mathrm{invisible}$ decays, where h is a π, K, D, D_{s} or p, and $B\to Ka$, where a is an axion-like particle.

Latest results from the CUORE experiment

Schmidt B, Submission by B. Schmidt (CUORE speakersboard) on behalf of the collaboration. C

The Cryogenic Underground Observatory for Rare Events (CUORE) is the first bolometric experiment searching for 0νββ decay that has successfully reached the one-tonne mass scale. The detector, located at the LNGS in Italy, consists of an array of 988 TeO_2 crystals arranged in a compact cylindrical structure of 19 towers. CUORE has been collecting data continuously at ~10 mK since 2017, achieving a 90% uptime and amassing over 2.5 tonne-years of TeO_2 exposure. In March 2024 the collaboration released the most recent result of the search for 0νββ, corresponding to two tonne-year TeO_2 exposure. This is the largest amount of data ever acquired with a solid state cryogenic detector, which allows for further improvement in the CUORE sensitivity. In this talk, we will present the current status of the CUORE search for 0νββ with the updated statistics of two tonne yr exposure. This statistics also allows for one of the most detailed background reconstructions in the field and enables a precision measurement of the Te-130 2νββ decay half-life. Furthermore, it provides the basis for the sensitivity estimates of the future upgrade of CUORE with scintillating Li_2MoO_4 detectors in CUPID.

Higgs Cross Sections measurements by ATLAS and CMS

Cappati A

This talk presents the most recent results for the measurement of Higgs boson cross sections obtained by the ATLAS and CMS Collaborations. Results of different production modes and decay channels are covered, offering an overview of the status of our knowledge of the Higgs boson. Also results from the study of the double Higgs boson production are reported.

Gravitational Waves: An Overview

Cardoso V

We celebrate a decade of gravitational wave astronomy. One of the most remarkable achievements concerns tests of General Relativity and of the nature of compact objects. Gravitational collapse in Einstein's theory leads to black holes, leaving behind a geometry with light rings, ergoregions and horizons. These peculiarities are responsible for uniqueness properties and energy extraction mechanisms that turn black holes into ideal laboratories of strong gravity, of particle physics (yes!) and of possible quantum-gravity effects. I will review some of the things we learned during the last ten years.

Higgs self couplings

Chiesa M

Higgs self-couplings are directly linked to the shape of the Higgs potential. In the Standard Model, these couplings are entirely determined by the Higgs boson's mass and its vacuum expectation value (VeV). However, this is not in general the case in Beyond the Standard Model (BSM) theories. Experimentally determining these self-couplings could either reveal deviations from the SM or help constrain a broad range of BSM models. This talk will provide a theoretical overview of the Higgs trilinear and quartic couplings.

Measurements and boson polarization studies with VBS processes in ATLAS

Conventi F

This talk reports recent measurements of vector boson scattering processes in the ATLAS experiment. These results provide stringent tests of the Higgs mechanism and offer a new avenue for precision tests of the SM as well as MC modelling. In addition, recent probes of boson polarization states with VBS processes are discussed.

Measurements of Solar Neutrinos in the SNO+ Detector

Cookman D[1]
[1]King's College London
The SNO+ experiment is a large multi-purpose neutrino detector, currently filled with liquid scintillator. Its size, depth, and low background levels offer a great window for observing solar neutrinos. The principle interaction mechanism for solar neutrinos in the detector is neutrino-electron elastic scattering. From these events, we have made measurements of the solar Boron-8 neutrino flux, as well as a measurement of the neutrino oscillation parameter θ_12. We will show results from fitting the data down to an energy threshold of 2.5 MeV. We will also present evidence for charged-current interactions of solar electron neutrinos on Carbon-13 nuclei in the detector via a delayed coincidence technique. This used an analysis methodology that can confidently reject cosmogenic backgrounds.

Discovery of Astrophysical Tau Neutrinos with IceCube.

Cowen D

Energetic astrophysical neutrinos, discovered by IceCube a few years after it started data taking, produced shower- and track-like signatures in the detector fiducial volume. The track-like events were created by muon (anti-)neutrino interactions. Several years later, IceCube detected an astrophysical neutrino whose signature was an energetic particle shower consistent with being an electron anti-neutrino interacting at the Glashow resonance energy. To discover third-family astrophysical tau neutrinos, whose charged current interactions produce two particle showers separated by the distance traveled by the short-lived tau lepton, IceCube used machine learning techniques to select events whose combination of tau decay length, shower energies, direction and interaction vertex allowed us to distinguish them from single-shower events produced by other astrophysical neutrino flavor interactions and various other backgrounds. We have ruled out the absence of astrophysical tau neutrinos at greater than five sigma significance.

Results on top quark mass, properties and cross section with ATLAS+CMS

Cristinziani M

In this contribution the most recent results in top-quark physics at the LHC are reviewed. In particular, new ATLAS results on top-quark properties and the production of top-quarks are shown. This includes studies of the $t\bar{t}$ production threshold region, the top-quark mass measurment at large transverse momentum, as well as the first observation of quantum entanglement in top-quark pair events and tests of lepton-flavour universality.

Shaping Scientific Futures: The Journey of the African School of Physics

Darve C

The African School of Fundamental Physics and Applications (ASP) is a biennial program that promotes advanced training in physics and related disciplines for African university students. Launched in 2010, ASP brings together top international scientists and talented students from across Africa for an intensive three-week school focused on theoretical and experimental physics, computing, and applied sciences such as medical physics.

In addition to its academic program, ASP includes outreach activities for high school students and teachers, as well as policy forums to foster dialogue between scientists and decision-makers. Its mission is to strengthen research capacity in Africa, inspire young scientists, and promote science as a key tool for sustainable development.

ASP contributes to building a network of future African leaders in science and supports the integration of African researchers into the global scientific community. It is a model of inclusive, collaborative education that demonstrates the transformative power of science across borders.

The SABRE South Experiment at the Stawell Underground Physics Laboratory

Dastgiri F, Collaboration S

SABRE is an international collaboration that will operate similar particle detectors in the Northern (SABRE North) and Southern Hemispheres (SABRE South). This innovative approach distinguishes possible dark matter signals from seasonal backgrounds, a pioneering strategy only possible with a southern hemisphere experiment. SABRE South is located at the Stawell Underground Physics Laboratory (SUPL), in regional Victoria, Australia. SUPL is a newly built facility located 1024 m underground (∼2900 m water equivalent) within the Stawell Gold Mine and its construction has been completed in 2023.

SABRE South employs ultra-high purity NaI(Tl) crystals immersed in a Linear Alkyl Benzene (LAB) based liquid scintillator veto, enveloped by passive steel and polyethylene shielding alongside a plastic scintillator muon veto. Significant progress has been made in the procurement, testing, and preparation of equipment for installation of SABRE South. The SABRE South muon detector and the data acquisition systems are actively collecting data at SUPL and the SABRE South's commissioning is planned to be completed by the end of 2025.

This presentation will provide an update on the overall progress of the SABRE South construction, its anticipated performance, and its potential physics reach.

XLZD: A Future Dark Matter and Rare Physics Observatory

Cottle A

The XLZD collaboration will develop a next-generation experiment to search for WIMP dark matter down to the neutrino fog. This will feature a 60+ tonne dual-phase xenon time projection chamber, widely recognised as the leading technology for the direct detection of dark matter. Building on the successes of the currently operational XENONnT and LZ experiments, as well as the R&D performed by the DARWIN collaboration, XLZD will be designed to limit radioactivity to below the irreducible neutrino background and operate to reach up to 1000 tonne-years of exposure. XLZD will not only be definitive for the WIMP paradigm, but will have competitive sensitivity to the neutrinoless double-beta decay of Xe-136 as well as a range of other neutrino physics. This talk will discuss the status of the project as well as its physics reach, with particular focus on the pre-construction programme underway in the UK.

Neutrino cosmology with three years of DESI data

Elbers W

The Dark Energy Spectroscopic Instrument (DESI) collaboration is conducting a five-year survey to collect more than 40 million galaxy and quasar redshifts. Recently, the collaboration presented measurements of baryon acoustic oscillations (BAO) based on 14 million redshifts from the first three years of observations. In addition to setting stringent new constraints on the dark energy equation of state, the cosmic matter density, and the amplitude of fluctuations, DESI data also provide the strongest current limits on the sum of the neutrino masses when combined with information from the cosmic microwave background. In this talk, I will give an overview of the status of neutrino cosmology, with a focus on the latest cosmological constraints on the neutrino masses and the number of neutrino species. I will assess the agreement between cosmological and laboratory constraints and discuss the implications for neutrino physics and cosmology.

The SNO+ experiment

Falk E[1]
[1]University Of Sussex
SNO+ is a multi-purpose low-energy neutrino experiment located at SNOLAB, Canada. In addition to a flagship neutrinoless double decay search using 130^Te, our physics programme includes solar, reactor and geoneutrinos as well as astro and supernova neutrinos. Currently taking data in our liquid-scintillator phase, we are getting ready to begin tellurium loading. This presentation will give an overview of the experiment, its current status and performance characteristics, highlighting some of our physics results to date and discussing our plans and prospects going forward.

Measurements of electroweak penguin decays at Belle and Belle II

Robertson S

The Belle and Belle~II experiments have collected a 1.1~ab^{-1} sample of $e^+ e^-\to B\bar{B}$ collisions at a centre-of-mass energy corresponding to the $\Upsilon(4S)$ resonance. These data, with low particle multiplicity and constrained initial state kinematics, are an ideal environment to search for rare electroweak penguin and radiative B decays. Results include those related to the following decays: $b\to s^+\nu\bar{\nu}$; $B\to K^{(*)}\tau^+\tau^-$; and $B^0\to K^{0}_{\rm S}\tau^+\ell^-$, where ℓ is an electron or muon.

Neutrino Interaction Measurements with the SBND Experiment

Papadopoulou A

The Short-Baseline Near Detector (SBND) is a 112-ton scale Liquid Argon Time Projection Chamber (LArTPC) neutrino detector positioned in the Booster Neutrino Beam at Fermilab, as part of the Short-Baseline Neutrino (SBN) program. The detector is currently collecting neutrino beam data. Located only 110 m from the neutrino production target, SBND is exposed to a very high flux of neutrinos and will collect millions of neutrino interactions each year. This huge number of neutrino interactions, with the precise tracking and calorimetric capabilities of LArTPC, enables a wealth of cross section measurements to be made with unprecedented precision. In addition, SBND has the unique characteristic of being remarkably close to the neutrino source and not perfectly aligned with the neutrino beamline, in such a way that allows sampling of multiple neutrino fluxes using the same detector, a feature known as SBND-PRISM. SBND-PRISM can be utilized to study distinctive neutrino-nucleus interactions channels. This talk will motivate the SBND cross-section physics program, present ongoing measurement efforts, and discuss prospects for the rich program ahead.

Probing Charged Lepton Flavour Violation at the LHCb experiment

Vos K[1], Frau G
[1]LHCb

Charged Lepton Flavour Violation (cLFV) refers to flavour-changing interactions among charged leptons, which are highly suppressed in the Standard Model (SM) and thus remain below current experimental sensitivity. Searching for cLFV is a powerful probe for Beyond the Standard Model (BSM) physics. Recently, the LHCb collaboration has conducted extensive searches for various lepton-flavour violating processes in semileptonic b-quark decays as well as leptonic tau decays. These searches have provided valuable bounds in the parameter space of numerous New Physics (NP) models.

Probing Charged Lepton Flavour Violation at the LHCb experiment

Frau G[1]
[1]University Of Manchester

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Searching for muon to electron conversion in COMET

Fujii Y[1]
[1]Imperial College London

The COMET experiment aims to search for neutrinoless muon conversion into an electron using muonic atoms.
This process is forbidden in the Standard Model of particle physics assuming massless neutrinos. However neutrinos are massive, the mechanism to explain such tiny masses of neutrinos are not well understood.
This indicate the existence of new physics beyond the SM, and many BSM models predict that muon-to-electron conversion to occur within the range experimentally achievable.
In COMET, the mu-e conversion will be searched with 100 times better sensitivity than the current upper limit set by SINDRUM II, in its first stage at Japan Proton Accelerator Research Complex (J-PARC), JAPAN.
COMET Phase-II will follow with further 100 times improved sensitivity.
In this talk, current preparation status of the experiment as well as future prospects will be presented.

New experiment for two neutrino emission double beta decay using Zirconium-96

Fukuda Y, Moriyama S, Hiraide K, Ogawa I, Gunji T, Kurosawa S, Nakano Y

ZICOS is one of the future experiments for neutrinoless double beta decay. The target nuclei is ^{96}Zr. In order to achieve the sensitivity of half-life over 10^{27} years, ZICOS will use tons of ^{96}Zr, and need to remove ^{208}Tl background events as observed by KamLAND-Zen with one order of magnitude using the topology of Cherenkov light. For this purpose, we are planning to observe about 300 events of two neutrino emission double beta decay per year for 2\nu-ZICOS detector. Here, we present the status this experiment which will start observation in this autumn at Kamioka mine.

Charm experimental results

Gersabeck E

Charm physics is a very active field and has attracted a lot of attention since the discovery of mixing in charm mesons first in 2007 through a combination of measurements, and established firmly later in 2012 by a single unambiguous measurement done by the LHCb experiment. The observation of CP violation in charm in 2019 and the observations of several interesting states containing charm quarks in the last decade strengthened further the interest in charm physics. This talk will focus on the recent experimental results in charm physics, overall progress, and future directions. I will discuss advances in several active research areas: from searches for CP violation and measurements of neutral charm meson mixing parameters, to production of charm particles, and lifetime measurements, etc.

Exploring CEvNS with NUCLEUS Experiment

Giammei M[1]
[1]Infn - Roma Tor Vergata

Coherent Elastic Neutrino-Nucleus Scattering (CEvNS) is a weak neutral current process where the neutrino interacts with the nucleus as a whole. The CEvNS cross section is several orders of magnitude larger than that of other low-energy neutrino interactions, even though the single outcome of this process is a very small nuclear recoil.

The first CEvNS observation was reported 43 years after its theoretical prediction in 1974, and since then CEvNS has emerged as a powerful probe of diverse physics scenarios, especially within the realm of electroweak interactions. This has inspired a global effort to detect the small nuclear recoil produced by these interactions. Within this world-wide search, this talk will present the NUCLEUS experiment which seeks to achieve high-precision CEvNS measurements using neutrinos from the Chooz nuclear power plant. The NUCLEUS experiment employs cryogenic calorimeters featuring gram-scale $CaWO_4$ and Al2O3 detectors with transition-edge sensors. These detectors have demonstrated exceptional energy resolution, detecting nuclear recoils as low as 20 eV, about two orders of magnitude smaller than those detectable by competitor experiments, providing unique opportunities to detect the tiny nuclear recoil produced by the neutrino interaction.

However, the background level at the experimental site, called “Very Near Site”, must be kept under control through a complex system of active and passive shielding.

In this talk I will present the challenges and perspectives on NUCLEUS, giving an overview of its current status.

Recent results from the KATRIN experiment

Goupy C[1,2]
[1]Technical University of Munich, [2]Max Planck Institute for Nuclear Physics

Determining the absolute mass scale of the neutrino is one of the pressing questions in particle physics and cosmology. The Karlsruhe Tritium Neutrino (KATRIN) experiment probes the effective electron anti-neutrino mass by precisely measuring the tritium beta-decay spectrum near the endpoint. By combining a high-intensity gaseous molecular tritium source with a high-resolution electrostatic spectrometer using magnetic adiabatic collimation, KATRIN was able to set a world-leading upper limit of $m < 0.45$ eV / c^2 (90% CL).

In this talk, I will present insights into the analysis of the first five measurement campaigns leading to this result.
Moreover, the talk will also give an outlook on KATRIN's ability to explore the existence of light sterile neutrinos.

Dark matter and dark sector searches in the first KM3NeT data

Gozzini S[1]
[1]IFIC, CSIC-UV

KM3NeT is a multi-purpose neutrino observatory composed of underwater Cherenkov arrays with different geometries. Currently, two KM3NeT detectors are under construction in the Mediterranean Sea: ORCA, a compact and dense detector optimised for the high-statistic measurement of atmospheric neutrino physics, and ARCA, a set of two telescopes instrumenting a cubic kilometre to catch rare fluxes of extraterrestrial neutrinos. During its modular installation phase KM3NeT records data promptly upon deployment. KM3NeT has an excellent performance in the reconstruction of coordinates, energy and flavour of neutrino events, and covers an energy range from the GeV to tens of PeV, opening up to a broad physics case. Both ARCA and ORCA search for neutrinos produced in pair annihilations of dark matter, characterising the signature from sources such as the Sun and the Galactic Centre. KM3NeT also investigates indirect effects of physics beyond the Standard Model expectations, through modifications induced to the flavour oscillation pattern of atmospheric neutrinos, such as non-standard interactions and neutrino quantum decoherence. The signature of heavy neutral fermions can be searched looking for double-cascade events at GeV energies, exploiting the large volume (7 Mtons) densely instrumented by ORCA in its final configuration, having avaliable 1.6 Mtons of recorded data.

Status and Commissioning of the JUNO Experiment

Grassi M[1]
[1]University Of Padua

JUNO is a neutrino experiment aiming to detect antineutrinos emitted from nuclear reactors and from the inner layers of the Earth, as well as neutrinos from galactic and extragalactic sources. It features a 20 kton target mass made of organic liquid scintillator (LS), monitored by more than 40000 photosensors. JUNO aims to shed light on several open questions in fundamental particle physics and astrophysics. At end of 2024 the detector construction was completed, and the detector was filled with water. Starting from February 2025 the water is being replaced by LS.

This talk will review the commissioning activities carried out during the filling phase, as well as the detector performance evaluated before the beginning of the filling.

Flavour & Precision Forecast

Greljo A

Precision flavor physics is entering a new era, with recent measurements stress-testing the Standard Model and sharpening the search for new physics. Ongoing experiments, including LHCb and Belle II, will push exploration to new heights, opening new avenues for theoretical developments within and beyond the Standard Model. This talk will highlight key results, open questions, and future directions shaping the field, with a long-term outlook toward the possibilities offered by a future circular collider.

Delayed Electron Mitigation in the RELICS Experiment with Deep Neural Network based Position Reconstruction

Guo X

Delayed electrons (DEs) constitute a significant background in the search for Coherent Elastic Neutrino-Nucleus Scattering (CEvNS) events within the RELICS experiment. These DEs are predominantly emitted following large energy depositions and exhibit strong spatiotemporal correlations with such signals. Muon-induced DE pileups have been identified as the dominant background for CEvNS detection in the RELICS experiment. To mitigate these backgrounds, we have developed advanced algorithms leveraging deep neural networks enhanced with domain adversarial features, enabling high-resolution position reconstruction. In this talk, I will introduce this approach which improves the rejection efficiency by exploiting the precise spatiotemporal correlations between DEs and muon tracks.

Searches for Dark Matter with the ATLAS and CMS Experiments at the LHC

Hamdaoui H

The presence of a non-baryonic Dark Matter (DM) component in the Universe is inferred from the observation of its gravitational interaction. If Dark Matter interacts weakly with the Standard Model (SM) it could be produced at the LHC. The ATLAS and CMS Collaboration has developed a broad search program for DM candidates in final states with large missing transverse momentum produced in association with other SM particles (light and heavy quarks, photons, Z and H bosons, as well as additional heavy scalar particles) and searches where the Higgs boson provides a portal to Dark Matter, leading to invisible Higgs decays. The results of recent searches on 13 TeV pp data from the LHC, their interplay and interpretation will be presented.

Neutrinoless double beta decay overview

Han K

Neutrnoless double beta decay has been at the forefront of neutrino physics for the last few dacades. The experimental observation of such a process would confirm the Majorana nature of the neutrinos and imply the violation of lepton number conservation. In this talk, I will give an overview of recent progress with special focus on the latest developments since the last WIN conference.

Dark Matter Searches with the DarkSide-20k Detector

Haranczyk M[1]
[1]DarkSide 20k Collaboration

The DarkSide-20k detector is currently under construction at the LNGS laboratory in Italy and is a crucial part of the Global Argon Dark Matter Collaboration's (GADMC) plan to probe the dark matter parameter space down to and into the neutrino fog. DarkSide-20k is a two-phase Time Projection Chamber with low-radioactivity acrylic walls and optical readout using Silicon Photomultipliers (SiPMs). The inner detector volume is nested within two veto detectors. Notably, DarkSide-20k will be filled with 50 t (20 t fiducial) of Underground Argon, effectively minimizing the cosmogenically produced background from Ar-39. Unique technical solutions have been developed to ensure good sensitivity to both low-mass and high-mass dark matter candidates in direct detection searches. We will discuss the design, implemented background reduction techniques, expected sensitivity, and the current status of DarkSide-20k

Searches for BSM Physics with NOvA

Horoho T[1]
[1]University Of Virginia
High-intensity particle beams and large-volume detectors are hallmarks of long-baseline neutrino experiments like NOvA. These same features provide access to physics Beyond the Standard Model, allowing them to search for non-standard neutrino interactions and new particles. We present highlights of some of NOvA's searches for BSM physics, including dark matter, magnetic monopoles, and the neutrino magnetic moment.

Searching for the Muon's Electric Dipole Moment by A Compact Frozen-Spin Trap

Hu T[1]
[1]Shanghai Jiao Tong University

The permanent electric dipole moment (EDM) of a fundamental particle breaks both parity (P) and time-reversal (T) symmetries, implying the violation of charge-parity (CP) symmetry, assuming CPT invariance. With the current experimental sensitivities, an observation of a non-zero muon EDM is a signature of CP-violating physics beyond the Standard Model (BSM), which would not only impose stringent constraints on BSM parameter spaces but could also provide crucial insights into resolving the observed matter-antimatter asymmetry in the universe. The muEDM experiment at Paul Scherrer Institute will, for the first time, search for the muon EDM using the Frozen-Spin technique within a compact storage trap. The key aspect of the experiment is to utilize the high effective electric field, $E \simeq 165$ MV/m, to cancel the anomalous spin precession g-2 as muons orbit in solenoid storage within a magnetic field of B=3T. A non-zero EDM would cause the muon spin to precess in a plane orthogonal to its motion, leading to a characteristic signature: an asymmetry in the decay positron counts over time, observed between the upstream and downstream directions relative to the magnetic field. By employing muons with a momentum of p=125 MeV/c, the experiment aims to achieve a sensitivity of 6×10^{-23} e cm, surpassing the current direct limit by more than four orders of magnitude.

To achieve this unprecedented sensitivity, the experiment relies on a suite of specialized detectors designed to precisely track muon behavior. Among them, a trigger detector is developed to provide a trigger signal that is needed to activate the short magnetic pulse that deflects the muon's trajectory into a stable orbit within the weakly focusing field region. To ensure optimal performance, the detector is engineered for maximum efficiency while minimizing multiple scattering and the time between the muon entering the storage solenoid and the generation of the trigger signal.

This talk will summarize the principle, current status, and timeline of the experiment at PSI.

Searches for high mass BSM physics at ATLAS and CMS

Kaczmarska A

Many theories beyond the Standard Model (SM) have been proposed to address several of the SM shortcomings, often predicting new particles which can be searched for at the LHC. This can include extended Higgs sectors, DM, and various exotic BSM models. This talk will cover several related searches, focusing on high mass new physics.

Ultra-light Dark Matter Limits from Astrophysical Neutrino Flavor

Katori T[1], Argüelles C[2], Farrag K[3]
[1]King's College London, [2]Harvard University, [3]Chiba University

Ultra-light dark matter is a class of dark matter models where the mass of the dark matter particle is very small and the dark matter behaves as a classical field pervading our galaxy. If astrophysical neutrinos interact with ultra-light dark matter, these interactions would produce a matter potential in our galaxy which may cause anomalous flavour conversions. Recently, IceCube high-energy starting event flavour measurements are used to set stringent limits on isotropic Lorentz-violating fields under the Standard-Model Extension framework. We apply the IceCube Lorentz violation limits to set limits on neutrino - ultra-light dark matter couplings. We assume the dark matter field undergoes fast oscillations in our galaxy, yielding neutrino interactions with dark matter that broaden and smear the observed flavour structure of astrophysical neutrinos at IceCube. The constraints we obtain are an order of magnitude tighter than current and future terrestrial neutrino experimental limits. The sensitivity of ultra-light dark matter can be further improved in the near future by new particle identification algorithms in IceCube and the emergence of next-generation neutrino telescopes.

Measurement of TeV-scale muon neutrino cross sections using atmospheric neutrinos in Super-Kamiokande

Bhuiyan N[1], Katori T[1]
[1]KCL

We present measurements of the muon neutrino charged-current (CC) cross section using atmospheric neutrinos observed in Super-Kamiokande (SK). This analysis utilises upward-going muons produced from neutrino interactions in the Earth beneath the detector, ensuring a clean sample with minimal cosmic-ray muon contamination. The reported cross section measurement extends to 5 TeV, bridging the gap in neutrino data between accelerator-based experiments and neutrino telescopes. We present results from 4269 live days of the detector, offering important constraints on neutrino interaction models in high-energy neutrino studies.

Water-based quantum dots liquid scintillator for neutrino physics

Katori T[1], Rakovich S[1], Zhao M[1]
[1]King's College London

Liquid scintillators are typically composed from organic compounds dissolved in organic solvents. However, usage of such material is often restricted due to fire safety and environmental reasons. Because of this, R&D of water-based liquid scintillators is of extreme relevance; yet, no such scintillators have been made commercially available as yet. Here, we investigate an alternative, water-based quantum dots liquid scintillator. Pre-determined and controllable optical properties of the quantum dots, as well as the existence of large libraries of established protocols for their dispersion in aqueous solutions, make them an attractive option for nuclear and particle physics applications. We characterize the optical properties of water-based quantum dots liquid scintillator and find that most of its optical properties are preserved upon quantum dots' phase transfer into water, through the addition of an oleic acid hydrophilic layer. Using the developed scintillator, the time and charge responses from atmospheric muons are measured, highlighting the practical viability of water-based quantum dots liquid scintillators for nuclear and particle physics, special interest on neutrino physics.

Outer Detector System R&D for Hyper-Kamiokande

Katori T[1]
[1]King's College London
The Hyper-Kamiokande detector is the third generation of highly successful water Cherenkov neutrino detectors at the Kamioka Observatory in Japan (Nobel Prize in Physics, 2002 and 2015). The outer detector system is designed to fully cover the fiducial volume of around 200 kton of ultrapure water and tag incoming particles, mainly atmospheric muons and neutrino-induced muons. In this talk, we will describe the design and R&D efforts for the Hyper-Kamiokande outer detector system in detail.

Study of Atmospheric Neutrino Oscillation in JUNO

Khatun A[1]
[1]Université Libre de Bruxelles

The Jiangmen Underground Neutrino Observatory (JUNO), located in China, is a state-of-the-art neutrino experiment currently in the commissioning phase. Using a 20-kiloton liquid scintillator detector with approximately 78% light coverage, JUNO is designed to achieve exceptional precision in measuring neutrino oscillation parameters and resolving the neutrino mass ordering. While reactor neutrinos are its primary focus, JUNO's capabilities extend to detecting atmospheric neutrinos at GeV energy levels. These high-energy neutrinos offer a unique opportunity to study the effects of Earth's matter on neutrino oscillations, providing a complementary channel to enhance its core scientific objectives. This presentation will provide the latest updates on JUNO's advancements in atmospheric neutrino detection.

Neutrinoless Double Beta Decay Search in the SNO+ Experiment

Kroupova T[1]
[1]University of Pennsylvania

Among its diverse physics objectives, the primary goal of the SNO+ experiment is to investigate the nature of neutrinos through the search for neutrinoless double beta decay ($0\nu\beta\beta$) in tellurium-130. The upcoming phase of the experiment will involve loading natural tellurium into the detector's liquid scintillator to enable this search. The sensitivity to the $0\nu\beta\beta$ process will benefit significantly from the large detector volume, low-background conditions, and deep underground location at SNOLAB. This talk will outline the $0\nu\beta\beta$ programme in SNO+ for the forthcoming tellurium-loaded phase, including anticipated background levels and developed analysis techniques, with particular emphasis on projected sensitivity and the outlook for the future.

Neutron Tagging From Neutrino Interactions in DUNE-ND 2x2 Prototype

Kufatty G

The Deep Underground Neutrino Experiment (DUNE) is a long-baseline neutrino oscillation experiment that aims to measure CP violation in the leptonic sector and determine the neutrino mass ordering with very high significance. It consists of two detector complexes that rely on liquid argon time projection chamber (LArTPC) technology to observe neutrino interactions. One of the detectors will be situated near the neutrino source, while the other will be placed 1.5 km underground and 1300 km away from the source. LArTPCs provide excellent particle identification and calorimetry; however, detecting neutrons is challenging, as they do not leave direct ionization signals in LArTPCs. Neutrons can carry away up to 25% of the neutrino energy, introducing a significant uncertainty in DUNE measurements. The DUNE near detector (ND) features a novel modular LArTPC with pixelated charge readout, which enhances event reconstruction. The modular design enables precise correlation between ionization signals and light signals in a high-rate environment, improving the identification of delayed energy depositions from neutrons in neutrino interactions. We introduce a neutron tagging technique using the 2x2 Demonstrator, a small-scale prototype of the DUNE ND LArTPC. The analysis utilizes Monte Carlo simulations and deep-learning techniques to identify neutron-induced energy depositions and reconstruct low-energy activity

Measurements of Higgs-fermion interactions at ATLAS+CMS

Lai N

This talk reviews recent ATLAS and CMS Run 2 analyses of Higgs–fermion interactions. It covers H→bb measurements in VH and ttH production, new constraints on the charm Yukawa from VH(cc), ttH(cc) and cH(γγ) channels, and the first evidence for H→μμ. A CP-structure study of the top–Higgs Yukawa coupling in ttH and tH production is also presented.

Results from the T2K Experiment

Holin A[1]
[1]RAL-STFC

T2K is a long-baseline neutrino experiment aimed at carrying out precision measurements of neutrino and antineutrino oscillations. The (Anti)neutrinos are produced by the J-PARC accelerator and their spectrum is measured at the ND280 near detector, and then at the Super-Kamiokande far-detector, in Kamioka, 295km away. As well as neutrino oscillations, T2K can use the ND280 detector to make precision measurements of neutrino cross-sections close to the neutrino beam source. T2K's most recent results will be presented, featuring world-leading sensitivities on the search of Charge-Parity violation, by comparing oscillation measurements of neutrinos and antineutrinos. The results include data collected with first Gd-loading at the far detector. Combinations of T2K results with experiments such as NOvA and Super-Kamiokande will be shown.

Search for New Resonances with ATLAS+CMS

Lee J[1]
[1]Seoul National University

Searches for new resonances remain a major focus of the LHC physics program, offering potential windows into physics beyond the Standard Model. In this talk, I will present a survey of recent results from the ATLAS and CMS collaborations focused on heavy resonances decaying to pairs of leptons, bosons, jets, top quarks, or exhibiting unconventional signatures.. Using the Run 2 dataset at 13 TeV, these analyses explore a wide range of theoretical models, including heavy vector bosons, Kaluza-Klein gravitons, and extended Higgs sectors, and related models. Particular attention will be given to the latest reconstruction and selection techniques that have pushed the sensitivity of searches into more challenging mass and width regimes. By combining results across complementary final states and employing novel analysis strategies, we aim to provide the most comprehensive constraints yet on new resonance production at the energy frontier.

Latest results in the JSNS2 experiment

Lee D[1]
[1]Kek

The JSNS2 (J-PARC Sterile Neutrino Search at the J-PARC Spallation NeutronSource) experiment is searching for neutrino oscillations over the baseline of 24 meters with Δm2 near 1 eV square.
We took the long physics runs in 2021-2024 with 4.9e22 of Proton On Target by J-PARC.
Data analysis of this new dataset is on-going and preliminary results using side bands and the signal region based on the 2022 physics run.
Furthermore, we completed the construction of the far detector of the 2nd phase of the experiment (JSNS2-II).
In this presentation, we will show the details.

The status of the muon g-2 theory in 2025

Lehner C

The Muon g-2 Theory Initiative has just completed the second whitepaper, summarizing the standard model theory calculation for the muon g-2 as it stands in May of 2025. There have been major developments since the first whitepaper from 2020 which will be explained in my talk.

Results from global EFT fits from ATLAS+CMS

Levin A[1]
[1]Peking University

The contribution will report on recent results on global EFT fits of the CMS data are presented, with particular focus on a dimension-6 SMEFT interpretation of the measurements performed in the electroweak sector of the Standard Model, including results built upon likelihoods constructed from reconstructed-level information and properly including all correlations among the various input channels.

Testing Bell inequalities and probing quantum entanglement at future colliders

Li Q

We present here the prospects of detecting quantum entanglement and the violation of Bell inequalities in $H \to ZZ \to 4\ell$ events at a potential future muon collider or electron collider. We show that the spin density matrix of the Z boson pairs can be reconstructed using the kinematics of the charged leptons from the Z boson decays. Once the density matrix is determined, it is straightforward to obtain the expectation values of various Bell operators and test the quantum entanglement between the Z boson pair.
https://arxiv.org/abs/2408.05429 https://arxiv.org/abs/2410.17025

Nuclear Physics Measurement in PandaX-4T

Li C

The PandaX-4T detector uses dual-phase xenon time projection chamber technology with ultra-high sensitivity and extremely low background. It captures five-dimensional information for each decay event: time, energy, and three-dimensional positions. While primarily used in astrophysics for dark matter exploration, NLDBD, and neutrino studies (both solar and supernova), it also enables nuclear physics measurements—particularly Rn decay chain analysis. During 212Pb calibration, 220Rn from a 228Th source enters the detector and undergoes sequential alpha decays to 216Po and then to 212Pb. The five-dimensional data allows precise pairing of 220Rn and 216Po decay events, making it possible to measure 216Po lifetime. Additionally, the PandaX-4T detector can precisely measure the half-life of 136Xe DBD across a broad energy spectrum, utilizing large statistics and an accurate background model.

The hadronic decays of charmed mesons at BESIII

Bianchi F, BESIII Collaboration C

BESIII has collected 20.3 and 7.33 fb^-1 of e+e- collision data samples at 3.773 and 4.128-4.226 GeV, which provide the largest dataset of DDbar and DsDs pairs in the world, respectively.
We will present the measurement of branching fractions of fifteen Ds+ hadronic decays using a global fit and highlight our recent advancements in amplitude analyses of D+ to Ks pi+ eta, D to pi pi eta, D+ to KsKspi+, D+ to K-pi+pi+pi0, Ds+ to pi+pi+pi-pi0, and Ds+ to pi+pi+pi-pi0pi0. In these amplitude analyses, we observe the D+ to Ks a0(980)+, D to a0(980) pi, and Ds+ to omega rho+ decays, along with deviations in the branching fractions of phi decays from the PDG average.
Furthermore, our presentation will include the latest measurements of quantum-correlated DD decays, including the CP-even fraction of D0 to pi+pi-pi0, K+K-pi0, K+K-pi+pi-, and pi+pi+pi-pi-.

Prospects of detecting diffuse supernova neutrino background at JUNO

Li G

The Jiangmen Underground Neutrino Observatory (JUNO) is a 20-kton multi-purpose liquid scintillator detector designed with the primary goals of determining the neutrino mass ordering and achieving precision measurements of neutrino oscillation parameters. The detector construction was completed at the end of 2024. It is currently being filled with liquid scintillator, and the process is expected to conclude by this summer.

JUNO’s large target mass makes it a highly promising detector for detecting the diffuse supernova neutrino background (DSNB). Using the inverse beta decay channel, JUNO is expected to observe a few events per 20 kton-year within a golden energy window of [12, 30] MeV, depending on the DSNB models. However, the dominant background, arising from atmospheric neutrino neutral current interactions, is more than an order of magnitude higher than the expected DSNB signal. To address this challenge, advanced pulse shape discrimination techniques have been developed to suppress this background effectively.

In this talk, I will discuss the key components of the analysis and the prospects for DSNB detection at JUNO.

Now and future of the kaon physics program at J-PARC

Lin C

One of the major efforts in kaon physics is to search for New Physics via the KL→πνν decay, because it is very rare and precisely predicted in the Standard Model. KOTO is the dedicated experiment to study the KL→πνν decay and has reached the worldwide best limit on its branching ratio 2.2 × 10^(-9) (90% confidence level), which is approximately two orders of magnitudes larger than the theoretical prediction. In order to further explore the regime sensitive to New Physics, the KOTO-II experiment aims to reach a 5-σ discovery of the KL→πνν decay or New Physics implication. The roadmap toward this experimental goal will be presented in this talk.

Logarithmic EW corrections at one-loop

Lindert J

For energies above the electroweak scale next-to-leading order electroweak (NLO EW) corrections are logarithmically enhanced. Such corrections can yield significant distortions in tails of kinematic distributions of crucial LHC processes, or alter the dynamics of astrophysical processes. In this talk I present a fully automated implementation of NLO EW corrections in the logarithmic approximation in the amplitude generator OpenLoops. This implementation is fully general, largely model independent, supports the computation of EW corrections to resonant processes, and it is suitable for extensions to higher-loop level. Investigating a large set of representative LHC processes including vector-boson and top-quark production processes we find excellent agreement between the logarithmic approximation and full one-loop results in observables where the assumptions of the EW Sudakov approximation are fulfilled.

Beyond Standard Model Neutrino Oscillation Results from NOvA

Lister A[1], Aurisano A[2]
[1]University Of Wisconsin - Madison, [2]University of Cincinnati

With detectors at both Fermilab and Ash River, Minnesota, in the United States, NOvA was built to investigate the intricate properties of neutrinos, with a principal emphasis on active three-flavor neutrino mixing phenomena. Comprising two functionally identical detectors, NOvA is able to characterize the neutrino beam with the Near Detector located 1 km below ground at Fermilab and measure oscillations with the Far Detector, located 810 km away and 14 mrad off the beam axis in Northern Minnesota. With this dual-baseline construction, NOvA probes not only the standard three flavor scenario, but also exotic oscillations scenarios including sterile neutrinos and non-standard interactions (NSI).

The 3+1 sterile oscillation model is an extension of the standard three flavor oscillation paradigm which includes an extra neutrino mass and flavor eigenstate, where the new flavor state does not interact with the weak force. NSI are an extension of the neutrino matter effect, including off-diagonal terms, which augment the phenomenology of the three flavor oscillation paradigm. This talk summarizes recent beyond-the-Standard-Model neutrino oscillation results from NOvA, including a search 3+1 sterile oscillations that utilizes charged current muon neutrino and neutral current selections in a two-detector fit procedure to place robust limits on multiple sterile mixing parameters, and a search for NSI utilizing charged current muon and electron neutrino samples in both neutrino and antineutrino beam modes.

Into the Neutrino Fog: Latest Results from the XENONnT Experiment

Liu K

The XENONnT experiment, operational since 2020, is a leading effort in the search for Weakly Interacting Massive Particles (WIMPs), employing a 5.9-tonne liquid xenon target and world-leading low electronic recoil background. Solar neutrinos, particularly the B8 neutrinos, interact via coherent elastic neutrino-nucleus scattering (CEvNS), creating signals similar to dark matter interactions, a challenge known as the "neutrino fog." The XENONnT detector, with its high exposure and low background, also provides a unique platform to study this interaction.

This presentation will provide an overview of the experiment and insights into its latest results, including searches for WIMPs, B8 CEvNS, and Light WIMPs. It will highlight novel low-threshold analysis techniques, such as accidental coincidence background suppression and multidimensional statistical modeling, which enhance sensitivity to low-energy NR physics signals.

Higgs CP properties and EFT measurements from ATLAS+CMS

Lu Y

This talk presents precise measurement of the CP properties of the Higgs boson using the full dataset collected in pp collisions at 13 TeV during Run 2 and at 13.6 TeV during Run 3 of the LHC. The measurements are performed in various Higgs boson production and decay modes, as well as their combinations. Observation of deviations between these measurements and Standard Model (SM) predictions would be a sign of possible new phenomena beyond the SM.

SMEFT with Higgs Field Curvature

Manton N[1]
[1]Damtp, Cambridge University

An extension of the electroweak field theory is constructed where the Higgs scalar geometry is the projective space CP^2 rather than the usual flat space C^2. The theory has the standard gauge group SU(2)*U(1), and a partially realised global SU(3) symmetry. The curvature of CP^2 leads to additional terms in the Lagrangian, as is typical in a SMEFT, with the leading terms of dimension 6. Predictions of deviations from Standard Model results are made, and depend on just one large mass parameter M (inversely related to the CP^2 curvature). Experimental constraints on the W-boson to Z-boson mass ratio, and on the correlation between fermion masses and Yukawa couplings of the Higgs boson imply that M is at least a few TeV. The proposed theory has some similarity to that of Alonso, Jenkins and Manohar, where Higgs custodial SO(4) symmetry is partially preserved. This work is based the author's "A CP^2 SMEFT", JHEP (to appear).

Experimental proof of principle of the Neutrino Tagging technique at NA62

Marchevski R

Neutrino tagging is a new experimental approach for accelerator based neutrino experiments. The method consists in associating a neutrino interaction with the meson decay (i.e. $\pi^\pm\to\mu^\pm \nu_\mu$ or $K^\pm\to\mu^\pm \nu_\mu$) in which the neutrino was originally produced. The properties of the neutrino can then be estimated kinematically from the decay incoming and outgoing charged particles. The reconstruction of these particles relies on the recent progress and developments in silicon particle detector technology. The method is particularly suited to study neutrino interactions at short baseline experiments, and preliminary works indicate that they could also be used to study neutrino oscillations at long baseline experiments. A proof-of-principle of this method has been performed using the NA62 experiment as a miniature tagged neutrino experiment. The intense Kaon beam of NA62 abundantly produces neutrinos through the $K^+\to\mu^+ \nu_\mu$decay. The two spectrometers of the experiment are used to reconstruct the K^+ and μ^+ and the neutrino interaction is detected in the 20 ton of liquid krypton of the electro-magnetic calorimeter. The results of the analysis based on the data collected in 2022 are presented, where one tagged neutrino candidate has been detected for the first time in history.

Multiboson production in ATLAS+CMS

Marozzo G

This talk reviews recent measurements of multiboson production using CMS data at sqrt(s) = 13 and 13.6 TeV. Inclusive and differential cross-sections are measured using several kinematic observables.

Research activities for a next generation neutrino mass measurement: KATRIN++

Marsteller A

The absolute value of the neutrino mass plays an important role in cosmology, and is a critical missing parameter of the Standard Model. Observing the kinematics of beta decays offers a uniquely model-independent access to the neutrino mass, which is complementary to stringent constraints from neutrinoless double beta decay and cosmological observations.

Using this method, the Karlsruhe Tritium Neutrino (KATRIN) experiment has improved the upper bound on the incoherent sum of neutrino masses down to m_beta < 0.45 eV (90% C.L.), with its full data set, acquired by then end of 2025, targeting a final sensitivity of < 0.3 eV.
In order to further improve this sensitivity down to the 0.05 eV level, which will allow cross-validation of the other mass measurement approaches, and answer the question of normal or inverted neutrino mass ordering, fundamentally new technological developments are necessary.
Under the umbrella of the envisioned next-generation neutrino mass experiment KATRIN++, research and development activities around an atomic tritium source and the differential measurement of electron energies is being carried out. Important R&D milestones in the coming years are large-scale demonstrators for atomic tritium and differential detection methods, leveraging the infrastructures of the Tritium Laboratory Karlsruhe and the operational KATRIN beamline.

In this contribution, I will present the current concept for KATRIN++ with a focus on the ongoing R&D efforts. This includes advancements in preparing an atomic hydrogen source for operation with tritium, and related efforts in developing neutral beam analytics.
Recent results on the differential detection of electrons using magnetic microcalorimeters (MMC), as well as their potential and challenges for use as the detector technology of KATRIN++ will be discussed.
These efforts represent a collaborative effort beyond the current KATRIN collaboration to push the boundaries of current technology in neutrino mass research, paving the long-term way for future discoveries.

First results from the NEXT-100 detector and future plans

Martínez Lema G

The NEXT experiment aims to detect neutrinoless double beta decay in ^{136}Xe using a high-pressure gas Time Projection Chamber (TPC) with electroluminescent amplification. In 2022, the physics program of NEXT-White, a ~5 kg detector, was successfully completed with the first double beta decay measurements. The collaboration has since begun operating NEXT-100, a detector twice the size in each dimension that will hold ~100 kg of xenon at 15 bar. Located at Laboratorio Subterráneo de Canfranc (LSC), NEXT-100 aims to demonstrate quasi-background-free conditions for this technology at the 100 kg scale. The NEXT-100 TPC is instrumented with 60 PMTs for calorimetry and detection of the primary scintillation signal and with 3584 SiPMs for extracting the topological signature of the events. The detector concluded the commissioning stage in early 2025 at a reduced pressure of 4 bar and is currently concluding a calibration run. This run at 4 bar will be succeeded by a ~3-year low-background run at ~10 bar. In this presentation, we will report the status of the detector, summarize the main results from the commissioning and calibration runs, and outline the plans for the next stage of operation.

A Magnetised High-Pressure Gaseous Argon TPC for the DUNE Near Detector

Martínez López F

The Deep Underground Neutrino Experiment (DUNE) is a next-generation neutrino experiment that will consist of a near detector (ND) complex placed at Fermilab, several hundred meters downstream of the neutrino production point, and a larger far detector (FD) to be built in the Sanford Underground Research Facility (SURF), approximately 1300 km away. DUNE will record neutrino interactions from an accelerator-produced beam (the LBNF multi-megawatt wide-band neutrino beam planned for Fermilab) arriving at predictable times, but will also aim to detect rare events such as supernova neutrinos, potential nucleon decays and other beyond the Standard Model phenomena. The main role of the DUNE ND is constraining the systematic uncertainties in the neutrino oscillation measurements by characterising the energy spectrum and composition of the neutrino beam, as well as performing precision measurements of neutrino cross sections. The plan for DUNE is to be built using a staged approach with two main phases. While the Phase I programme is sufficient for early physics goals, Phase II upgrades in ND, FD, and beam are essential to reach the designed sensitivity for the neutrino oscillation analyses. In particular, the Phase II ND upgrade to a magnetised high-pressure gaseous argon TPC surrounded by an electromagnetic calorimeter (ECal) and a muon tagger is essential for controlling systematic uncertainties. The gaseous argon provides low detection thresholds, which would allow detailed measurements of nuclear effects at the interaction vertex using the same material as the FD. Additionally, the magnetic field and the ECal would enable efficient particle identification and momentum and charge reconstruction. This talk presents an overview of the capabilities of ND-GAr, the ongoing R&D efforts, and the studies assessing detector design choices to optimise its physics performance.

Current Status and Future Prospects of the Three-Neutrino Mixing Framework

Martinez Soler I[1]
[1]Durham University

Over the past decade, significant experimental efforts have been dedicated to measuring the parameters governing neutrino evolution. These efforts span a diverse range of sources, including solar, atmospheric, accelerator, and reactor neutrinos. The integration of these results into global analyses has been pivotal in examining the consistency among datasets and providing a comprehensive description of neutrino evolution.

In this talk, I will present the latest findings from our global analysis, highlighting the major uncertainties and tensions observed across various datasets. Additionally, I will explore the potential of a combined analysis of atmospheric neutrino experiments, encompassing Super-Kamiokande, Hyper-Kamiokande, IceCube-Upgrade, and ORCA. By addressing shared systematic uncertainties—such as those arising from flux and neutrino-water interactions—alongside the unique uncertainties of each experiment, our study predicts transformative advances by 2030. These include determining the octant of θ_{23} with 99% confidence, establishing the neutrino mass ordering with a significance greater than 5σ, and providing critical insights into the CP-violating phase (δ_{CP}) in the leptonic sector.

Neutrino-argon cross-section measurements from the MicroBooNE experiment

Evans J

MicroBooNE is a liquid argon time projection chamber (LArTPC) neutrino detector located along the Fermilab Booster Neutrino Beam and 8 degrees off-axis to the Neutrinos at the Main Injector beam. MicroBooNE collected data from both beams accumulating a large neutrino-argon scattering dataset with a mean neutrino energy of approximately 0.8~GeV. Understanding neutrino-argon interactions is crucial for the next generation of neutrino oscillation experiments including DUNE. MicroBooNE has developed pioneering methodologies and novel reconstruction tools in order to benchmark models at very high sensitivity across the interaction phase space, including for ultra-rare channels. This talk will give an overview of the most recent MicroBooNE neutrino interaction results. These measurements provide invaluable datasets for constraining backgrounds and improving the modelling of neutrino scattering critical for the broader LArTPC neutrino physics program.

HH searches and Higgs-self couplings measurements by ATLAS+CMS

Montereali F

In the Standard Model,the ground state of the Higgs field is not found at zero but instead corresponds to one of the degenerate solutions minimising the Higgs potential. In turn, this spontaneous electroweak symmetry breaking provides a mechanism for the mass generation of nearly all fundamental particles. The Standard Model makes a definite prediction for the Higgs boson self-coupling and thereby the shape of the Higgs potential. Experimentally, both can be probed through the production of Higgs boson pairs (HH), a rare process that presently receives a lot of attention at the LHC. In this talk, the latest HH searches by the ATLAS experiment are reported, with emphasis on the results obtained with the full LHC Run 2 dataset at 13 TeV. Non-resonant HH search results are interpreted both in terms of sensitivity to the Standard Model and as limits on the Higgs boson self-coupling and the quartic VVHH coupling. The Higgs boson self-coupling can be also constrained by exploiting higher-order electroweak corrections to single Higgs boson production. A combined measurement of both results yields the overall highest precision, and reduces model dependence by allowing for the simultaneous determination of the single Higgs boson couplings. Additionally, extrapolations of recent HH results towards the High Luminosity LHC upgrade are also discussed. Many new physics models predict the existence of resonances decaying into two bosons, including the Higgs boson or new scalar S bosons making these important signatures in the search for new physics. Searches for HH or SH resonances have been performed in various final states. In some of these searches, jet substructure techniques are used to disentangle the hadronic decay products in highly boosted configurations. Recent ATLAS searches with Run 2 data collected at the LHC and explains the experimental methods used, including vector- and Higgs-boson-tagging techniques are presented.

BSM Multi-Higgs: Collider Phenomenology and Electroweak Phase Transitions

Naskar W

In this talk, I shall discuss the phenomenological prospects of neutral triple Higgs production compared to di-Higgs production across various Higgs-sector extensions (R2HDM, C2HDM and N2HDM), all within the context of a strong first-order electroweak phase transition. Our analysis reveals that scalar sector resonance contributions can significantly enhance triple Higgs production, despite the small Standard Model (SM) baseline expectation. Notably, one can identify potential enhancements up to 40 times the SM predictions, underscoring the importance and feasibility of experimental efforts at the High-Luminosity LHC (HL-LHC) and FCC-hh. This investigation not only motivates experimental pursuits but also sheds light on the thermal history of our universe, offering valuable insights into fundamental physics and the evolution of the cosmos.

The KM3NeT neutrino telescope: status and recent results

Navas S, KM3NeT Collaboration o

The KM3NeT multi-site detector is designed to detect and study cosmic neutrinos and their sources in the Universe, as well as to improve the measurement of the neutrino properties. The research infrastructure, currently under construction, consists of two underwater Cherenkov neutrino telescopes located at two abyssal sites in the Mediterranean Sea: KM3NeT-ARCA, off Portopalo di Capo Passero (Sicily, Italy) at a depth of 3500 m, is optimised for the search of astrophysical neutrino sources in the TeV-PeV range; KM3NeT-ORCA, at a depth of 2500 m off Toulon (France), is optimised to study atmospheric neutrinos in the GeV-TeV range.

The instruments consist of vertical detection lines (DUs), arranged in a 3D array, each containing 18 optical modules with 31 photomultiplier tubes that detect Cherenkov light signals. KM3NeT-ARCA aims at a volume of 1 km3 of instrumented water volume (230 DUs) and KM3NeT-ORCA to a mass of 7 Mton (115 DUs). While both telescopes are collecting data in a partial configuration, they are producing high-impact physics results like the observation of an Ultra High Energy neutrino of astrophysical origin. This
demonstrates their great potential for the coming years.

In this contribution, of the main physics results already obtained with ARCA and ORCA in both, astrophysics and neutrino oscillations, will be reported, as well as an overview of the expected performances of the full detectors.

LiquidO: Particle Imaging in Opaque Media

Navas-Nicolás D[1]
[1]Ciemat

Breaking the paradigm of transparency, the LiquidO collaboration introduces a novel approach to particle detection. LiquidO uses an opaque medium with a short scattering length to confine light near its point of origin, capturing it with a dense grid of wavelength shifting fibers read by SiPMs and fast electronics. This enables highly efficient particle identification, allowing event-by-event topological discrimination of positrons, electrons and gamma events.

With its strong background rejection capability and the possibility of loading dopants at high concentrations, since transparency is no longer required, LiquidO paves the way for a wide range of new physics measurements across high-energy, nuclear, medical, and accelerator physics, many of which are under active exploration. In this talk, we will share the results from a 10-litre opaque liquid scintillator prototype, validating LiquidO's imaging principle, and explore its physics potential with a larger detector.

Associated top quark production including EFT interpretations with ATLAS+CMS

Obeso Menéndez M

The top quark plays a central role in the Standard Model (SM) of particle physics, and detailed studies of its production mechanisms are essential for testing the SM and probing potential signs of new physics. In particular, processes involving associated top quark production provide unique sensitivity to deviations from SM predictions, especially when interpreted within the framework of effective field theories (EFT). Both CMS and ATLAS have developed comprehensive analyses targeting these channels, yielding increasingly precise measurements and constraints. In this talk, recent results on associated top quark production and their interpretation in the context of EFT will be presented.

CEvNS Overview

Papoulias D[1]
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Coherent elastic neutrino–nucleus scattering (CEvNS) is the neutrino process with the largest cross section at low energies, yet it was only recently observed. It has now been measured exploiting neutrinos from pion decay-at-rest, nuclear reactors, and the Sun. These data open new opportunities to probe both Standard Model (SM) parameters and physics beyond the SM (BSM). In this talk, I will review the current status of CEvNS phenomenology and discuss several implications for low-energy electroweak physics. Among the SM tests, I will comment on the determination of the weak mixing angle at low-momentum transfer and on neutron distributions in nuclei. Regarding BSM physics, I will discuss implications for nonstandard neutrino interactions, sterile neutrinos, and electromagnetic properties, comparing CEvNS-based constraints to existing ones from other facilities/observables.

Alleviating the present tension between T2K and NOνA with neutrino New Physics at source

Pasquini P, Cherchiglia A, Peres O, Rodrigues F, Rossi R, Souza E

Since neutrino oscillation was observed, several experiments have been built to measure its parameters. NOνA and T2K are two long-baseline experiments dedicated to measuring mainly the mixing angle θ_{23}, the charge-parity conjugation phase $\delta_{\rm CP}$, and the mass ordering. However, there is a tension in current data. The T2K allowed region is almost excluded by the NOνA result at the 90% confidence level. We propose a non-standard interaction (NSI) in neutrino production to relieve this tension. The NSI is computed through quantum field theory (QFT) formalism, where we derive perturbative analytical formulae considering NSI in the pion decay. Within this new approach, we can alleviate NOνA and T2K tension as seen in the figure. A NSI complex parameters of order 10^{-3} is enough to diminish the tension between the two data sets. We show the new phase has a degeneracy to the Dirac CP phase of the form $\delta_{\rm CP} \pm \phi= 1.5\pi$ being a possible source of violation of charge-parity symmetry.

Status of the Short-Baseline Near Detector at Fermilab

Paton J

The Short-Baseline Near Detector (SBND) is one of the Liquid Argon Time Projection Chamber (LArTPC) neutrino detectors positioned along the axis of the Booster Neutrino Beam (BNB) at Fermilab, and is the near detector in the Short-Baseline Neutrino (SBN) Program. The detector completed commissioning and began taking neutrino data in the summer of 2024. SBND is characterized by superb imaging capabilities and will record around 2 million neutrino interactions per year. Thanks to its unique combination of measurement resolution and statistics, SBND will soon carry out a rich program of neutrino interaction measurements and novel searches for physics beyond the Standard Model (BSM). As the near detector, it will enable the full potential of the SBN sterile neutrino program by performing a precise characterization of the unoscillated event rate and constraining BNB flux and neutrino-argon cross-section systematic uncertainties. In this talk, the physics reach, current status, and future prospects of SBND are discussed.

Latest results from the g-2 experiment

Price J

The g-2 experiment at Fermilab finished data taking in 2023, and using the complete dataset presented the world's most precise measurement of the anomalous Magnetic Dipole Moment of the muon on June 3rd 2025. I will present a brief overview of the experimental technique, the improvements that were made during running, and the final analysis, including some of the larger systematic uncertainties. Two further talks in the Tuesday afternoon parallels, by Yonghao Zeng and Rene Reimann, will contain further details of the analysis. The result will be compared to the latest theory initiative prediction, which was published on May 28th 2025, the details of which will be presented directly after my talk in g-2 theory talk, by Christoph Lehner.

Status update on the SuperNEMO double-beta-decay experiment

Basharina-Freshville A[1]
[1]University College London

SuperNEMO is a double-beta-decay experiment, whose isotope-agnostic tracker-calorimeter architecture has the unique ability to track trajectories and energies of individual particles. If the hypothesised lepton-number-violating process, neutrinoless double-beta decay (0νββ), is discovered, this full topological event reconstruction will be the only way to determine the mechanism, giving SuperNEMO a vital role in the international 0νββ programme. The SuperNEMO Demonstrator at LSM, France, is now collecting double-beta-decay data from a 6.3kg Se-82 ββ source. The detector serves as proof of concept for many novel developments to the tracker-calorimeter technology, which could be used in a scaled-up version with similar neutrino-mass sensitivity to next-generation experiments.

In addition, the Demonstrator is uniquely placed to make detailed studies of the Standard Model double-beta-decay process (2νββ) that produces two electrons, invisible neutrinos and, for some nuclear transitions, photons. By studying the electrons' and photons' energies and the angles between their trajectories at the emission point, SuperNEMO will be able to investigate nuclear processes indistinguishable to other technologies. For example, we can study decays to excited nuclear states, and provide constraints on the axial coupling constant, g_A. Precise measurement of the observables of 2νββ decays allows searches for beyond-the-Standard-Model effects like exotic 0νββ modes, Lorentz-violating decays and bosonic neutrino processes.

Combining Cyclotron Radiation Emission Spectroscopy and Atom Trapping for Next-generation Neutrino Mass Experiment Project 8

Reimann R

The Project 8 experiment aims to probe the absolute neutrino mass through direct kinematic measurements of the tritium beta decay spectrum using cyclotron radiation emission spectroscopy (CRES). The low-frequency apparatus (LFA) should demonstrate the coexistence of CRES electron detection and an atomic trap, while increasing the effective volume and lowering the background magnetic field compared to previous CRES experiments. To that end, the LFA consists of a cylindrical cavity that reads out the CRES electron radiation, and a composed magnetic field. The magnetic field consists of a carefully tuned uniform background field with a superimposed magnetic bottle trap to confine the CRES electrons within the detection region. In addition, a high-order multipole magnet adds a strong field only near the wall to confine the cold tritium atoms whose decay provides the electrons for CRES. In this contribution, we present the design of the apparatus and discuss its sensitivity to the absolute neutrino mass.

Improved understanding of the magnetic field in the Fermilab Muon g–2 experiment

Reimann R

The muon magnetic anomaly, which arises from quantum loop effects, provides one of the most stringent tests of the Standard Model of Particle Physics since it is measured and theoretically predicted with extremely high precision. The measurement principle is based on the difference between the anomalous spin precession frequency of spin-polarized muons and a high-precision measurement of the magnetic field environment using nuclear magnetic resonance (NMR) techniques, expressed by the (shielded) proton spin precession frequency. To achieve the ultimate goal of 140 ppb precision, the magnetic field in the storage region of the muons needs to be known with a total uncertainty of less than 70 ppb. Three devices are used to measure the magnetic field in the Muon g–2 storage ring: (a) an absolute calibrated NMR probe, (b) a movable array of NMR probes that can be pulled through the storage region of the muons and (c) a set of NMR probes in the vicinity of the storage region. In this talk, we present the measurement and tracking principle of the magnetic field and point out the improvements implemented in the final measurement runs.

Cabibbo-Kobayashi-Maskawa matrix related measurements at Belle and Belle II

Robertson S

The Belle and Belle~II experiments have collected a 1.1~ab^{-1} sample of $e^+ e^-\to B\bar{B}$ collisions at a centre-of-mass energy corresponding to the $\Upsilon(4S)$ resonance. These data allow measurements of $CP\!$ violation and the Cabibbo-Kobayashi-Maskawa matrix elements in B-meson decay. In particular, we measure the CP-violating phase ϕ_1/α and $\left|V_{cb}\right|$. In addition, we present constraints on the branching fractions of $B^+\to\ell^+\nu~(\ell=\mu,~\tau)$, which are related to $\left|V_{ub}\right|$.

Astroparticle Forecast

Sala F

I will provide a personal overview on the status and prospects of astroparticle physics

First observation of reactor antineutrinos by coherent scattering with CONUS+

Sanchez Garcia E

The CONUS+ experiment observed for the first time a CEvNS signal (395+-106) in the fully coherent regime with low-energy neutrinos produced in nuclear reactors. For this purpose, four 1 kg point-contact HPGe detectors with extremely low energy threshold of 160 eV were operated at the Leibstadt nuclear power plant (Switzerland), at a distance of about 21 m from the reactor core. The detector performance and first CONUS+ results will be presented in this talk. Additionally, the future of CONUS+ will be discussed, in particular the last CONUS+ upgrade to double the detector mass.

Measurements of the Higgs boson properties from diboson final states

Azzurri P[1]
[1]for the CMS Collaboration

An important aspect of the Higgs boson physics programme at the LHC is to determine all the properties of this particle, including its mass, which is a free parameter in the SM, its width, CP properties and polarization states of the decay products. This presentation will discuss the latest developments in measurements of the Higgs boson properties, with the data collected by the CMS experiment.

Progress of the Muon Collider Study

Schulte D

Muons offer a unique opportunity to build a compact high-energy electroweak collider at the 10 TeV scale. A Muon Collider enables direct access to the underlying simplicity of the Standard Model and unparalleled reach beyond it.
It will be a paradigm-shifting tool for particle physics representing the first collider to combine the high-energy reach of a proton collider and the high precision of an electron-positron collider, yielding a physics potential significantly greater than the sum of its individual parts. A high-energy muon collider is the natural next step in the exploration of fundamental physics after the HL-LHC and a natural complement to a future low-energy Higgs factory.
Such a facility would significantly broaden the scope of particle colliders, engaging the many frontiers of the high energy community.
The last European Strategy for Particle Physics Update and later the Particle Physics Project Prioritization Panel in the US requested a study of the muon collider, which is being carried on by the International Muon Collider Collaboration. The presentation will cover the state of the work on accelerator design and technology, and the proposed R&D that can make the muon collider a reality.

Illuminating the Low-Energy Frontier: Novel Calibration Methods for the KeV-Scale in the LUX-ZEPLIN Experiment

Siniscalco J

While the microphysics of xenon in dual-phase TPCs is generally well understood, fully characterising the behaviour of nuclear recoils at keV-scale energies presents a series of challenges that contribute to many uncertainties in this regime. As the interest in low-mass WIMPs and astrophysical signals that manifest at these lower energies grows, the necessity to develop robust techniques to validate the detector response in this regime becomes more evident.
Thanks to its unique ability to calibrate in-situ using low-energy deuterium-deuterium (DD) reflector neutrons, the LUX-ZEPLIN experiment is well positioned to provide valuable insight to our models by producing high-statistics datasets of low-energy nuclear recoils. However, there are still many challenges to distilling these data into a final set of parameters describing the detector response, ranging from ensuring the events being collected are of high quality, to developing the appropriate infrastructure to perform fits on the often complex topologies of low-energy neutron recoils. In this talk, I will illustrate the techniques that are being developed to successfully analyse these datasets and the ways in which they have been useful in informing the response of the detector at lower energies.

Measurement of B^0 lifetime in ATLAS

Vivarelli I[1], ATLAS speaker TBD
[1]INFN and Università, Bologna

This talk will present the currently most precise measurement of the B^0 meson lifetime using 140 fb^{-1} of 13 TeV pp collision data of the ATLAS experiment, along with measurements of the average decay width Γ_d and the ratio of B^0 and B^0_s widths Γ_d/Γ_s.

First Cavity Cyclotron Radiation Emission Spectrometer for the Project 8 neutrino mass experiment

Stachurska J

Project 8 is a next-generation experiment aiming to directly measure the neutrino mass using the tritium endpoint method with a targeted sensitivity of 40 meV. To achieve this goal, Project 8 pioneered Cyclotron Radiation Emission Spectroscopy (CRES), a non-destructive method of measuring the differential energy spectrum of decay electrons. Following the successful proof-of-concept experiments on a small scale in a waveguide, we are now further developing the technique to simultaneously increase precision and detection volume in our current pathfinder, the Cavity CRES Apparatus (CCA). In the cavity, the emission of the electron's cyclotron radiation is enhanced on-resonance, increasing the signal-to-noise ratio and allowing for the scaling of the detector to very large volumes. We will present the CCA, which is currently being commissioned at the University of Washington and will establish CRES in a resonant cavity environment at a frequency of 26 GHz. With a modest detection volume of 20 cm^3, the CCA will validate the cavity design for our upcoming m^3-scale Low Frequency Apparatus (LFA) operating at 560 MHz, thus informing the future phases of Project 8, as well as demonstrate sub-eV electron energy resolution (at 18.6 keV) with CRES for the first time.

A short-baseline neutrino beam for high-precision cross-section measurements

Pupilli F[1]
[1]INFN-Padova
The poor knowledge of neutrino cross sections at the GeV scale will represent the main systematic uncertainty for the next-generation oscillation experiments. SBN@CERN is a proposal for a short baseline neutrino beam with proper instrumentation along the beamline and in the decay tunnel to enable flux monitoring at the percent level and to provide a neutrino energy determination independent of final state particle reconstruction at the neutrino detector. As a result, it eliminates the two primary sources of systematic uncertainty in cross-section measurements: flux normalization and energy bias caused by nuclear effects. We will discuss the design of the beamline, the proposed technology for its instrumentation together with results of prototyping activities and possible scenarios for its implementation at CERN. We will also show the physics potential of such a facility, with particular emphasis on cross-sections relevant to DUNE and Hyper-Kamiokande.

Charmed baryon decays at BESIII

Bianchi F, BESIII Collaboration C

BESIII has accumulated 4.5 fb^-1 of e+e- collision data within the 4.6 and 4.7 GeV energy range, which provide the largest dataset of Lambda_c- Lambda_c pairs in the world.
Our presentation will include the observation of a rare beta decay of the charmed baryon Lambda_c+ -> n e+ nu with a Graph Neural Network and the first measurement of the decay asymmetry in the pure W-boson-exchange decay Lambda_c+ -> Ξ0 K+, as well as the branching fraction measurements of the inclusive decays Lambda_c+->X e+ nu and Lambda_cbar- -> nbar X.
Furthermore, we will present the results of the partial wave analysis of Lambda_c+ to Lambda pi+ pi0, and Lambda_c+ to Lambda pi+ eta Lambda, Our presentation will also include branching fraction measurements of Cabibbo-suppressed decays, including Lambda_c+ to p pi0, and the measurements of KS-KL asymmetries in the Lambda_c+ decays.

CLOUD: fundamental reactor antineutrino physics using the novel LiquidO detection technology

Griffith C[1]
[1]University Of Sussex

The CLOUD collaboration is pioneering the first fundamental research reactor antineutrino experiment using the novel LiquidO technology for event-wise antimatter tagging. The experimental setup is envisioned to be an up to 10 tonne detector, filled with an opaque scintillator and crossed by a dense grid of wavelength-shifting fibres. The detector is planned to be located at EDF-Chooz at around 35 m from the core of one of the most powerful European nuclear plants, with minimal overburden. Detecting of order 10,000 antineutrinos daily and with a high (≥100) signal-to-background discrimination, CLOUD aims for the highest precision of the absolute flux, along with explorations of beyond the Standard Model physics. Subsequent phases plan to exploit metal-doped opaque scintillators for further detection demonstration, including exploring the potential for surface detection of solar neutrinos.

Detector Calibration for the Short-Baseline Near Detector at Fermilab

SBND Collaboration

The Short-Baseline Near Detector (SBND) is a 112-ton liquid argon time projection chamber (LArTPC) serving as the near detector of the Short-Baseline Neutrino Program at Fermilab. SBND aims to make precise measurements of neutrino-argon interactions, necessitating an extensive calibration program for the LArTPC to ensure precision/accuracy in these measurements. This talk describes the use of cosmogenic, radiogenic, and neutrino interaction activity with both Monte Carlo simulation and data in calibrating the SBND subsystems of the Time Projection Chamber (TPC), Photon Detection System (PDS), and Cosmic Ray Tagger (CRT). We will highlight some of the preliminary calibration results including electronics calibration, electron lifetime, and gain calibration.

The T2K ND280 Near detector upgrade

Holin A[1]
[1]RAL-STFC

T2K is a long-baseline neutrino experiment which measures neutrino and antineutrino oscillations by observing the JPARC neutrino beam close to its source using the ND280 detector, and then far away using the Super-Kamiokande detector. The ND280 near detector at J-PARC plays a crucial role to minimise the systematic uncertainties related to the neutrino flux and neutrino-nucleus cross-sections.
ND280 has been recently upgraded with a new suite of sub-detectors: a high granularity target with 2 million optically-isolated scintillating cubes read out by wavelength shifting fibres and 55000 Multi-Pixel Photon Counters (SuperFGD); two horizontal Time-Projection Chambers instrumented with resistive Micromegas, and 6 panels of scintillating bars for precise time-of-flight measurements. The new detectors were installed in 2023-2024. Results from data collected with a neutrino beam will be shown, and the performance of the upgraded detector will be discussed.

Supernova Pointing Capabilities of DUNE

Shen J

The detection of neutrinos from a core-collapse supernova offers a unique opportunity for multimessenger astronomy, enabling rapid identification of the progenitor star. The Deep Underground Neutrino Experiment (DUNE) is well-positioned to provide a precise determination of the supernova direction through electron-neutrino charged-current interactions on argon and elastic neutrino-electron scattering. In this talk, I will present results from a study that introduces a novel reconstruction method, including the newly developed “brems flipping” technique, to improve pointing accuracy. I will discuss the expected performance of DUNE’s directional reconstruction for a supernova at 10 kpc, showing that the pointing resolution can reach 3.4° (6.6°) at 68% coverage for a 40 kton (10 kton) fiducial mass, and explore the impact of misidentification in interaction classification. These results demonstrate DUNE’s excellent capability to provide rapid and precise supernova localization, enhancing multimessenger follow-up efforts.

Neutrino mass and Cosmic Neutrino Background with PTOLEMY experiment

Virzi F

Neutrinos of the Cosmic Neutrino Background are the oldest detectable relic particles, originating one second after the Big Bang; as such, their mere detection would represent a milestone through the validation of our Standard Cosmological Model. This is the aim of the PTOLEMY collaboration which is proposing and validating a technique to measure neutrinos of meV level. The detector is the outcome of the development and integration of novel experimental methods, in particular the tritium atomic target on graphene, the new concept electromagnetic spectrometer and the single electron radio-frequency emission detection. The PTOLEMY collaboration is currently building the first complete high precision measurement module to be operated in Laboratori Nazionali del Gran Sasso (Italy) with a first stage physics goal to measure the neutrino mass from the tritium beta spectrum endpoint. The current status and outlook of the project is presented.

The search for neutrinoless double beta plus decay with the NuDoubt++ experiment

Wakely S

In 1937, Ettore Majorana hypothesised a mechanism by which a fermion could be its own anti-particle. Such a Majorana fermion must have mass and carry no charge. The phenomenon of neutrino oscillation proves neutrinos to have mass, as they also carry no known charge, neutrinos could be Majorana fermions.
One method to test this is the search for neutrinoless double beta decay. Double beta decay is a rare nuclear decay process where two neutrons(protons) simultaneously decay into two protons(neutrons) with the emission of two electrons(positrons) and two anti-neutrinos(neutrinos). If neutrinos are Majorana fermions, double beta decay could occur without the emission of neutrinos. While most studies have focused on the emission of two electrons, advances in scintillator technology now make it possible to study double positron emission. These new technologies improve particle identification and background rejection, opening the door to investigate less common decay modes.
The NuDoubt++ experiment will use an innovative hybrid opaque scintillator loaded with double beta decay isotopes and paired with novel light read-out techniques to search for such processes. This design will make it possible to separate signal from background using event topology and the ratio of Cherenkov to scintillation light. We expect to discover two-neutrino double beta plus decay modes within 1 tonne-week exposure and will be able to probe neutrinoless double beta plus decays at several orders of magnitude improved significance compared to current experimental limits.

EM Shower Identification Reconstruction with Testbeam 2023 at the FASERnu experiment

Wang Y

This project focuses on the performance evaluation of the Electromagnetic Shower Module (EM Shower Module) for the FASERν experiment at the LHC, utilizing data from the Testbeam 2023 experiment. The primary goal is to develop and optimize methods for electromagnetic shower identification and reconstruction within this novel detector technology. This includes: (1) enhancing electromagnetic shower discrimination techniques to improve electron identification efficiency and muon misidentification rejection; (2) optimizing electromagnetic shower reconstruction algorithms to achieve high precision in reconstructing shower position, direction, and energy; (3) exploring the application of the shower profile variables for particle identification and energy resolution optimization; (4) developing dedicated data analysis methods and software tools for future module performance evaluations; and (5) conducting a comprehensive systematic error analysis to assess the reliability of the performance evaluation results and guide future module optimization. The anticipated outcome is a detailed performance evaluation report for the EM Shower Module, providing crucial experimental data and technical guidance for the FASERν experiment's electromagnetic calorimeter design and future applications of this technology in high-energy physics experiments.

Atmospheric neutrino oscillations with the IceCube Upgrade

Weldert J[1]
[1]JGU Mainz

The IceCube Upgrade is an extension of the IceCube neutrino telescope aiming to better detect atmospheric neutrinos down to a few GeV. It will consist of 7 additional strings instrumented with more than 100 newly developed optical modules each. More than 600 of these additional optical sensors will be embedded in more than 2 Mt of the most transparent deep Antarctic ice. The denser module spacing in combination with the multi-pmt instrumentation of the new modules will significantly increase the detection efficiency and resolution for GeV-scale neutrino interactions. This will also improve our ability to observe matter effects on neutrino oscillations. In addition, refined calibration measurements are expected to improve the energy as well as the directional resolution of the whole IceCube detector. In this talk, we will give an overview of the IceCube atmospheric neutrino oscillation efforts and present the IceCube Upgrade sensitivities to various atmospheric neutrino oscillation analyzes.

Non-beam physics at Hyper-Kamiokande

Wilson J

Hyper Kamiokande (HK) is a next generation neutrino experiment currently being constructed in Japan. In addition to long baseline oscillation measurements, the 260 kton Water Cherenkov far detector is designed to study a range of extra-terrestrial neutrino sources and will also search for proton decay. In this talk, I will present solar neutrino analysis projections, including day-night asymmetry and sensitivity to the low energy spectrum upturn, along with the potential for Supernova measurements using HK. I will also discuss the experiment's capability to extend the proton decay search by an order of magnitude beyond current limits.

An overview of plasma wakefield acceleration for particle physics

Wing M

Plasma wakefield acceleration is a disruptive technology that promises to reduce the footprint of particle accelerators of the future. A laser or particle beam can induce the movement of free electrons in plasma that yields electric fields orders of magnitude greater than is possible in conventional radio-frequency accelerators. These electric fields can be used to accelerate particle bunches to high energies over shorter distances or even higher energies than is currently possible. There are many facilities and experiments worldwide investigating plasma wakefield acceleration with goal of transforming this into a useable technology. The latest results will be reviewed covering highest achieved energy gains, preservation of beam quality, stability and repeatability. Concepts for future colliders based on plasma wakefield acceleration, such as HALHF and ALIVE, will also be discussed including the current baseline, R&D challenges and possible performance.

Neutrino astronomy across stellar timescales at Super-Kamiokande

Xu B[1]
[1]Tsinghua University

The Super-Kamiokande (SK) advances our understanding of neutrinos across stellar timescales, from the stable emission of solar neutrinos during the Sun's main sequence to the potential detection of neutrinos from distant Si-burning stars and supernovae.

We measured the flux and energy spectrum of solar neutrinos with high precision, confirming the MSW effect and setting stringent limits on potential periodic variations to reaffirm the stability of the solar core. We developed advanced event selection techniques to suppress cosmogenic backgrounds. Looking beyond the Sun, we installed a pre-supernova alert system with KamLAND and an upgraded real-time supernova monitor. With Gd doped, we explored the detection of anti-neutrinos with higher efficiency, laying the groundwork for future observations of supernova neutrinos.

SBND Detector Commissioning and Early Performance

Yates L

The Short-Baseline Near Detector (SBND) is a 112-ton Liquid Argon Time Projection Chamber (LArTPC) neutrino detector located in the Booster Neutrino Beam (BNB) at Fermilab, and is the near detector in the Short-Baseline Neutrino (SBN) Program. The detector has now been commissioned and began data-taking in 2024. This talk will cover the process of commissioning the detector, including the TPC, Photon Detection System (PDS), Cosmic Ray Tagger (CRT), and trigger systems. I will also show preliminary results demonstrating its capabilities and early performance. SBND excelled in achieving several technical goals, including very low noise in the TPC readout system and early verification of the synchronization of the detector readout system, with lessons learned that can benefit future LArTPC experiments as well.

Beyond the Standard Model in Electroweak Symmetry Breaking

You T

The apparent failure of naturalness at the LHC may herald a paradigm shift in fundamental physics. New theoretical approaches and a next generation of future colliders will be necessary to uncover the underlying theory beyond the Standard Model. I will review the concept of naturalness and speculate on potential outcomes at future colliders for understanding the puzzle of the electroweak hierarchy problem.

Measurement of 214Pb β decay branching ratio with PandaX-4T

Yuan Z

Dark matter and neutrino experiments have extremely high requirements for the accuracy of background models. The spectral features of 214Pb β decay to 214Bi (ground and excited states) remain uncharacterized, presenting critical uncertainties for LXe based rare event searches. Utilizing the PandaX-4T detector, a 3.7 tonne LXe time projection chamber with homogeneous 214Pb distribution, we implement a spatially resolved, total-absorption calorimetric methodology to perform the first in situ measurement of the 214Pb decay spectrum. This work provides essential spectral constraints for LXe detector background models, directly enhancing sensitivity to weakly interacting rare events.

Measurement of the Muon Anomalous Precession Frequency in the Muon g-2 Experiment at Fermilab

Zeng Y[1]
[1]Tsung-Dao Lee Institute, Shanghai Jiao Tong University

The Fermilab Muon g-2 experiment aims to measure the muon anomalous magnetic moment, $a_\mu=(g-2)/2$, with an unprecedented precision goal of 0.14 parts per million (ppm), providing a stringent test of the Standard Model. The first result from Run-1, published in 2021, was followed by the Run-2/3 result in 2023, achieving a record-breaking uncertainty of 0.20 ppm. The ongoing analysis of Runs 4, 5, and 6 is expected to further improve both statistical and systematic precision, bringing the experiment closer to this target. This talk will focus on the measurement of the anomalous precession frequency, ω_a, a key component in determining a_μ. Major improvements in the latest runs include the implementation of quadrupole radio-frequency (RF) fields, which significantly reduce coherent betatron oscillations (CBO) and other beam dynamics effects. Additionally, improved beam modeling and a more precise determination of systematic uncertainties are expected to further reduce the total uncertainty. These advancements, together with the increased dataset, set the stage for the most precise determination of a_μ to date.

Differential inclusive single W/Z measurements sensitive to PDFs, EFT in ATLAS+CMS

Zhao Z

This talk reports recent differential measurements of single W or Z bosons in the ATLAS experiment for both on-shell and off-shell scenarios, which provide sensitive inputs to improve the constraints on PDFs and relevant EFT Wilson coefficients.

Posterboard Allocations

Poster board no.	First Name	Last Name	Paper Title
1	Mariia	Buchynska	CUPID, the next-generation $0\nu\beta\beta$ bolometric experiment
2	Ben	Cattermole	Simulating LiquidO detectors for prototype research and development
3	Max	De Carlos Generowicz	Muon tracking in a LiquidO opaque scintillator detector
4	Jess	Lock	Characterisation of a planar opaque LiquidO detector with cosmic-ray muons
5	Adam	Wong	AntiMatter-OTech: A large scale LiquidO neutrino detector for reactor monitoring
6	Jeff	Hartnell	Multi-Faceted GeV Neutrino Detection in LiquidO
7	Vanessa	Cerrone	Neutrino oscillation physics in JUNO
8	Neetu Raj Singh	Chundawat	Imaginarity as a resource in Neutrino Systems
9	Alec	Habig	The Supernova Early Warning System (SNEWS) v2.0: a supernova neutrino alert and followup system
10	Lorenzo	Lastrucci	Real-time Wiener Deconvolution Algorithm on FPGA for Neutrino Physics
11	Tianyou	Li	Search for new physics with charm rare decays at BESIII
12	Eva	Sabater	Rock muons at the DUNE near detector
13	Mario	Schwarz	Unveiling the Majorana Nature of Neutrinos: Towards LEGEND-1000
14	Trinity	Stenhouse	Modelling Radiogenic Backgrounds for Future Dark Matter Searches at XLZD
15	Benjamin	Tam	The SNO+ Tellurium Deployment Programme
16	Jianyong	Zhang	Precision measurement of the branching fraction for the decay $\psi(2S)\rightarrow\tau^{+}\tau^{-}$

CUPID, the next-generation 0νββ bolometric experiment

CUPID Collaboration, Loaiza P

Neutrinoless double-beta decay, 0νββ, is a key process to address some of the major outstanding issues in particle physics, such as the lepton number conservation and the Majorana nature of the neutrino. Several efforts have taken place in the last decades in order to reach higher and higher sensitivity on its half-life. The next-generation of experiments aims at covering the Inverted-Ordering region of the neutrino mass spectrum, with sensitivities on the half-lives greater than 10^{27} years. Among the exploited techniques, low-temperature calorimetry has proved to be a very promising one, and will keep its leading role in the future thanks to the CUPID experiment. CUPID, CUORE Upgrade with Particle Identification, will search for the neutrinoless double-beta decay of ^{100}Mo and will exploit the existing cryogenic infrastructure as well as the gained experience of CUORE, at the Laboratori Nazionali del Gran Sasso in Italy. Thanks to scintillating $Li_2{}^{100}MoO_4$ crystals coupled to light detectors, CUPID will have simultaneous readout of heat and light that will allow for particle identification, and thus a powerful alpha background rejection. With a background index of 10^{-4} counts/keV/kg/y, 240 kg isotope mass, 5 keV FWHM energy resolution and 10 live-years of data taking, CUPID will have a 3σ discovery sensitivity of 1.0 10^{27}yr, corresponding to a mββ range of 12–21 meV.

In our talk, we will present the current status of CUPID and outline the forthcoming steps towards the construction of the experiment.

Simulating LiquidO detectors for prototype research and development

Cattermole B[1]
[1]University Of Sussex

LiquidO is a novel detector technology that uses the stochastic confinement of light in an opaque medium to increase particle identification efficiency. To collect this light a lattice of wavelength-shifting fibres runs through the medium, which are then read out using SiPMs. The unique particle identification down to the MeV scale and subsequent background rejection capabilities of the LiquidO technology make it ideal for neutrino detection. LiquidO will be used in the AntiMatter-OTech detector, a reactor anti-neutrino experiment currently under development for installation at the Chooz nuclear power plant. At the University of Sussex we are building prototypes to help develop technology for this future detector. My research involves simulations of such detectors, built in a Geant4 based simulation toolkit called RATPAC 2. Alongside prototyping, these simulations are used to generate large event response datasets and study light propagation.

Neutrino oscillation physics in JUNO

Cerrone V[1]
[1]Padova University / INFN Padova

The Jiangmen Underground Neutrino Observatory (JUNO) is a multi-purpose neutrino experiment in South China, currently in the commissioning phase. Located in an underground laboratory beneath approximately 650 meters of rock overburden (equivalent to 1800 m.w.e.), the detector features a 20 kton liquid scintillator target inside a 35.4-meter-diameter spherical acrylic vessel. The central detector is equipped with 17,612 20-inch and 25,600 3-inch photomultiplier tubes, providing more than 75% total photocathode coverage.

JUNO's primary goal is to determine the neutrino mass ordering (NMO) using reactor antineutrinos emitted from two adjacent nuclear power plants on a baseline of approximately 52.5 km from the experimental site. Strategically positioned at the first solar oscillation maximum, where the kinematic phase $\Delta_{21} \approx \pi/2$, JUNO can simultaneously probe the effects of oscillations on both solar and atmospheric scales. It is the first experiment to address the unresolved NMO question through vacuum-dominated oscillations and to simultaneously investigate the effects of slow (Δm^2_{21}) and fast (Δm^2_{31}) oscillations.

With its unparalleled size and energy resolution of 3% at 1 MeV, JUNO aims to achieve sub-percent precision on three oscillation parameters: Δm^2_{31}, Δm^2_{21}, and $\sin^2 2\theta_{12}$. Additionally, JUNO will detect neutrinos generated by cosmic-ray showers interacting in the Earth's atmosphere, offering complementary sensitivity to the NMO independent of reactor antineutrinos. This contribution focuses on JUNO's oscillation physics potential, with a particular emphasis on the reactor antineutrino analysis.

Imaginarity as a resource in Neutrino Systems

Chundawat N, Alok A, Chall T, Li Y

We introduce the quantification of imaginarity in neutrino systems for the first time, treating them as quantum systems in coherent superposition within the framework of the recently established resource theory of imaginarity. Using measures such as the l1-norm and the relative entropy of imaginarity, we show that imaginarity is nonzero in two-flavor neutrino mixing, reaching its peak when quantum probabilistic features are maximized, specifically when transition and survival probabilities are approximately equal to 1/2. Extending our analysis to three-flavor mixing, we explore the impact of a nonzero CP-violating phase. Our results demonstrate that imaginarity in neutrino systems is not solely driven by the CP-violating phase but also emerges from the inherent quantum dynamics of neutrino mixing. This study sheds light on the fundamental role of complex numbers in quantum mechanics and positions neutrinos as a compelling platform for investigating imaginarity within a resource-theoretic approach.

Muon tracking in a LiquidO opaque scintillator detector

De Carlos Generowicz M[1]
[1]University Of Sussex
The LiquidO Consortium is bringing a novel approach to particle detection by using opaque scintillator to achieve self-segmentation down to the millimetre scale. Opacity via short scattering length stochastically confines scintillation photons close to the point of production and arrays of wavelength-shifting fibres trap and transmit the light to silicon photomultipliers. At Sussex, we use 64-fibre detector prototypes with a 3.2 mm fibre pitch. The prototypes are characterised with cosmic ray muons, and using a wax-based opaque scintillator a one-dimensional position resolution of 0.45 mm is achieved. This poster will discuss the muon tracking capabilities of a small-scale LiquidO detector, as well as compare the performance of the prototypes with transparent and opaque scintillator.

The Supernova Early Warning System (SNEWS) v2.0: a supernova neutrino alert and followup system

Habig A[1]
[1]University Of Minnesota Duluth

A core-collapse Supernova in our own galaxy will be visible in neutrinos in the world's neutrino and dark matter detectors. Neutrinos exit the star promptly, but photons appear ~hours later after the explosion's shock reaches the star's surface. SNEWS is an automated coincidence system that has been operational for two decades to provide an early alert. SNEWS2.0 has new infrastructure and the ability to do more than just a simple coincidence: public sub-threshold alerts; pointing to the supernova using inter-experiment triangulation; and searches for pre-supernova neutrinos. Multi-messenger followup is being organized along with a monitoring campaign of potential progenitors.

Multi-Faceted GeV Neutrino Detection in LiquidO

Hartnell J

We present a new technology and new techniques which provide unique capabilities for GeV-scale neutrino detection. Based on the LiquidO technology, our approach couples an opaque scintillator with a lattice of wavelength-shifting fibres, offers high-granularity images and provides precise energy, position, and timing measurements from the MeV to the GeV energy range in a scalable design. The key features of our approach include powerful particle identification capabilities aided by precise timing and spatial correlations, charge-sign identification, and the precise reconstruction of the final-state, are displayed in this poster. The expected performance of this new detection framework is comparable to the current state-of-the-art neutrino detector technologies, with the potential for unique additional capabilities.

Real-time Wiener Deconvolution Algorithm on FPGA for Neutrino Physics

Lastrucci L[1,2], Cerrone V[1,2], Grassi M[1,2]
[1]University of Padova, [2]INFN Padova

In the field of particle physics, experiments generate a substantial volume of data, which can be challenging to process in its entirety without preliminary scaling. This poster presents an advanced real-time Wiener deconvolution algorithm for applications in the field of neutrino physics. This algorithm has been implemented on a field-programmable gate array (FPGA) platform to speed up and enhance data processing. The algorithm has been designed to take advantage of the processing capabilities of the FPGA integrated into the readout boards of the Jiangmen Underground Neutrino Observatory (JUNO), with the goal of enabling real-time reconstruction of the signal generated by photomultipliers tubes (PMTs) when detecting neutrino interactions. This development is expected to enable the detection of low energy depositions, like those generated by transient astrophysical phenomena, that usually do not get saved because of the huge background affecting the low-end of the energy spectrum.

The poster will describe the main characteristics of the algorithm, including its capacity to manage high-throughput data streams with minimal latency, its adaptability and resilience in discerning the characteristics of the input data, and its performance evaluated on a JUNO electronics board. This study further demonstrates the potential of FPGA-based solutions to advance the field of neutrino physics.

Search for new physics with charm rare decays at BESIII

Bianchi F, BESIII Collaboration C

The BESIII experiment has collected 2.7 billion psi(3686) events, 10 billion J/psi events, 20 fb^-1 D meson pairs at 3.773 GeV, and 7.33 fb^-1 DsDs* events from 4.128 to 4.226 GeV. With the huge charm data samples, we can search for new physics with rare processes in charm hadron decays. In this talk, we report the search for FCNC decay in Ds+→h(h')e+e-, J/psi→D0gamma, J/psi→D0mu+mu-, lepton number violation process Ds+-→h-h0e+e+, phi-→pi+pi+e-e-, and J/psi weak decays containing D meson.

Characterisation of a planar opaque LiquidO detector with cosmic-ray muons

Lock J[1]
[1]University Of Sussex

LiquidO is a novel radiation detector concept which uses opacity to achieve self-segmentation of the detector volume. Optical fibres sit inside the opaque light-producing detection medium, such as scintillator, to collect the photons that have been stochastically confined near their point of production. The fibres allow for efficient transmission of the photons to photodetectors. With multiple LiquidO detector designs underway, this work focuses on a LiquidO cosmic-ray muon imaging detector. This detector has layers of 32 wavelength-shifting fibres in two perpendicular directions at a 5 mm pitch, read out both ends by silicon photomultipliers. The 16x16x5 cm3 detection volume holds 1.5 L of the wax-based opaque scintillator 'NoWaSH' with a sub-millimetre scattering length. This detector will probe the muon imaging capability of the LiquidO technology, allowing investigation into the performance of a LiquidO-based detector in muon tomography. The results obtained with this larger prototype will constitute an important advancement towards the application of LiquidO in cosmic-ray imaging.

Rock muons at the DUNE near detector

Sabater E[1]
[1]University Of Sussex
The Deep Underground Neutrino Experiment (DUNE) is a next generation long baseline neutrino oscillation experiment expected to start data taking in 2030. A 1.2 MW neutrino beam will travel 1300 km from LBNF at Fermilab to SURF in South Dakota where they will interact in the far detector. At a distance of 574 m from the neutrino source, the near detector (ND) will gather high statistics data to understand the neutrino flux before neutrino oscillations take place. As neutrinos travel through the Earth crust, they can interact with the rock before reaching the ND. These interactions can produce a muon, a particle that can travel a significant distance through rock, therefore reaching the ND and resulting in a source of background. An accurate simulation of the rock muon rate is key to fully characterising the LBNF spill, motivating choices in detector design and reconstruction software.

Unveiling the Majorana Nature of Neutrinos: Towards LEGEND-1000

Schwarz M

The LEGEND collaboration aims to achieve an unambiguous discovery of neutrinoless double beta ($0\nu\beta\beta$) decay, a lepton-number violating process with profound implications for particle physics, astrophysics, and cosmology. High-purity germanium (HPGe) detectors, enriched in ^{76}Ge, are operated in liquid argon, which serves both as a cryogenic and as an active shield, enabling a quasi-background-free search for $0\nu\beta\beta$ decay. LEGEND follows a staged approach, with the first phase, LEGEND-200, currently operational in Hall A of the Laboratori Nazionali del Gran Sasso (LNGS), utilizing up to 200 kg of enriched HPGe detectors. The second phase, LEGEND-1000, will scale up to 1000 kg and a new experimental infrastructure is scheduled for construction in Hall C of LNGS to start in 2026. This stage is designed to achieve a 3σ discovery sensitivity to the $0\nu\beta\beta$ decay half-life of about 10^{28} years, requiring the background at $Q_{\beta\beta}$ to be below 10^{-5} cts/(keV kg yr). Advancements towards LEGEND-1000 to reach the background goals include utilizing underground liquid argon (ULAr), larger-sized HPGe detectors, selecting more radiopure materials, an ASIC-based readout, and tagging cosmogenic Ge-77(m). In this talk we will give an overview of the LEGEND-1000 baseline design, address detector enclosures as mitigation for potential non-availability of ULAr, and discuss R&D for xenon-doped LAr enhancing Ge-77(m) tagging.

This work is supported by the U.S. DOE and the NSF; the LANL, ORNL, and LBNL LDRD programs; the European ERC and Horizon programs; the German DFG, BMBF, and MPG; the Italian INFN; the Polish NCN and MNiSW; the Czech MEYS; the Slovak SRDA; the Swiss SNF; the UK STFC; the Canadian NSERC and CFI; the LNGS, SNOLAB, and SURF facilities.

Modelling Radiogenic Backgrounds for Future Dark Matter Searches at XLZD

Stenhouse T

The XLZD collaboration aims to build the world's largest xenon time projection chamber (TPC), with unprecedented sensitivity to dark matter candidates and rare astrophysical signals, such as neutrinoless double beta decay and supernova neutrinos. To reach such a sensitivity, the characterisation of backgrounds from cosmic rays as well as the detector materials themselves are of utmost importance. In this work, Geant4 simulations are used to study interactions of xenon with various particles expected from radiogenic emissions from detector materials. This will be scaled using radio-assay measurements from detector materials to estimate background rates in XLZD considering different detector component choices. Further work aims to optimise design of the TPC to minimise backgrounds and lead to the highest projected sensitivity for the detector.

The SNO+ Tellurium Deployment Programme

Tam B[1]
[1]University Of Oxford

The SNO+ experiment is now preparing for the deployment of Te within the scintillator target medium using a novel chemical loading technique, thereby enabling a neutrinoless double beta decay search using Te-130. Numerous underground chemical purification plants have been commissioned to ensure that this technique is carried out with expected purification efficiency, stability, and process performance. This presentation will discuss the status of the Te deployment programme, as well as results from the initial test runs of the various process plant capabilities.

AntiMatter-OTech: A large scale LiquidO neutrino detector for reactor monitoring

Wong A[1]
[1]University Of Sussex

AntiMatter-OTech is an innovative project funded by the European Innovation Council and UK Research and Innovation with the goal of building the world's first large scale LiquidO based neutrino detector.

As opposed to traditional methods of neutrino detection using transparent scintillators, LiquidO relies on using an opaque scintillator, one with a short scattering length and long absorption length, to stochastically confine light around its origin of production.

The light produced is then readout using an array of wavelength shifting fibres and silicon photomultipliers. This method of neutrino detection holds several advantages, most notably a significant improvement in particle identification and vertex resolution. AntiMatter-OTech will be a 5-10 ton LiquidO detector located close to a reactor at the EDF Chooz-B nuclear power plant site in France. The main aims are to achieve a high precision antineutrino flux measurement with uncertainties below 1% and provide real-time monitoring of the nuclear reactor.

Precision measurement of the branching fraction for the decay $\psi(2S)\rightarrow\tau^{+}\tau^{-}$

Bianchi F, BESIII Collaboration C

Using $(2259.3 \pm 11.1)\times10^{6}$ $\psi(2S)$ events acquired with the BESIII detector, the branching fraction of $\psi(2S)\rightarrow\tau^{+}\tau^{-}$ is measured with improved precision to be $\mathcal{B}_{\psi(2S)\rightarrow\tau^{+}\tau^{-}}=(3.240~\pm~0.023~\pm~0.081)\times 10^{-3}$, where the first and second uncertainties are statistical and systematic, respectively, which is consistent with the world average value within one standard deviation. This value, along with those for the branching fractions of the $\psi(2S)$ decaying into $e^{+}e^{-}$ and $\mu^{+}\mu^{-}$, is in good agreement with the relation predicted by the sequential lepton hypothesis. Combining the branching fraction values with the leptonic width of the $\psi(2S)$, the total width of the $\psi(2S)$ is determined to be (287 $\pm$ 9) keV.