TF-4 Community Meeting

Report of Contributions

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

Introduction, the Roadmap, purpose of the meeting, timeline, results of survey

Tuesday, May 16, 2023 9:00 AM (30 minutes)

Presenters: JORAM, Christian (CERN); KRIZAN, Peter (Jozef Stefan Institute (SI))

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

RF timer and RF timer-based electron, photon, and heavy ion sensors

Wednesday, May 17, 2023 9:00 AM (15 minutes)

We propose a new radio frequency timer of keV energy electrons. By converting a time distribution of incident electrons to a hit position distribution on a circle, ellipse or spiral, by means of the radio frequency fields laying in the range 500-1000 MHz, this device achieves extremely precise timing. Streak Cameras, based on similar principles, routinely operate in the ps and sub-ps time domain, but have substantial dead time associated with the readout system. Here, we present a new type of RF timing technique, where the position sensor, consisting of microchannel plates and a delay-line anode, position information produces in the form of a ~ns duration pulses and readout can be realized by using regular electronics. Measurements made with sub-ps duration laser pulses, synchronized to the radio frequency power, produced a timing resolution of ~10 ps. This ultra-high precision technique has potential applications in a large variety of scientific devices.

Requested length

10 minutes

Author: Dr MARGARYAN, Amur (A. I. Alikhanyan National Science Laboratory (Yerevan Physics Institute))

Co-authors: Prof. APRAHAMYAN, Ani (A. I. Alikhanyan National Science Laboratory (Yerevan Physics Institute)); Dr KAKOYAN, Vanik (A. I. Alikhanyan National Science Laboratory (Yerevan Physics Institute))

Presenter: Dr MARGARYAN, Amur (A. I. Alikhanyan National Science Laboratory (Yerevan Physics Institute))

Session Classification: Session 5

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

TORCH time-of-flight detector

Tuesday, May 16, 2023 5:35 PM (25 minutes)

The TORCH detector is a proposed large-area time-of-flight detector, which aims to enhance the particle identification performance of the LHCb experiment in the 2-15 GeV/c momentum range. The detector concept comprises 18 quartz radiator modules, which combined span the 6m-by-5m detector acceptance. The modules must be supported by a light-weight structure. Charged particles passing through the modules produce Cherenkov photons that are propagated to the periphery of the detector by total internal reflection, where they are detected by fast-timing photon-detectors. A highly polished quartz radiator is needed to preserve the photon Cherenkov angle. In order to reach the desired performance, individual photons need to be timed to around 70 picoseconds. The leading candidates for the photon detectors are MCP-PMTs and SiPMs. Both technologies require further R&D to meet the needs of the project. While targeted at LHCb, the TORCH concept could also be exploited in other planned experiments.

Requested length

20 minutes

Author: BLAKE, Thomas (University of Warwick)

Presenter: BLAKE, Thomas (University of Warwick)

Session Classification: Session 4

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

A compact RICH for future Higgs Factory experiments

Tuesday, May 16, 2023 3:40 PM (15 minutes)

Charged hadron identification up to high momentum is attracting increasing attention for experiments at a future Higgs Factory, both for the identification of Higgs decays and for the world-class flavour physics programme enabled by the enormous statistics foreseen at the Z. A compact RICH has been designed for such experiments, with a target of 20 cm radial extent and material budget of only a few percent of X_0. It involves an array of over a thousand similar hexagonal RICH cells tiling the barrel and endcaps, with dual radiators: silica aerogel and (currently) unpressurised C_4F_{10} gas. The design is being integrated into the FCC software framework for study with full simulation. Its development would profit from a wide range of R&D studies: compact, high efficiency sensors with sub-mm pixels sensitive to single photons (currently SiPMs assumed); alternative environmentally-friendly radiator gases; large-area high clarity aerogel tiles; lightweight spherical mirrors and vessel.

Requested length

10 minutes

Author: FORTY, Roger (CERN)

Presenter: FORTY, Roger (CERN)

Session Classification: Session 3

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

Development of RICH software using GPUs

Tuesday, May 16, 2023 3:15 PM (25 minutes)

Simulation of optical photons take a significant amount of CPU time in many HEP experiments. GPUs have been used efficiently by the industry for ray tracing photons. Recently the JUNO neutrino experiment showed that a speedup factor of 1650 in the simulation of a Cherenkov detector can be achieved using GPUs. This level of improvement is impossible to obtain by other means.
The software interface package used by JUNO was adapted in LHCb to simulate a simple RICH system, as a proof of principle. Further developments are planned towards implementing this for the LHCb-RICH detector. This technology can be beneficial for different experiments that need to simulate optical photons. It can also facilitate future implementations of particle identification software in the GPUs such as those foreseen for LHCb.
The status and future prospects of this software will be described. Issues related to software maintenance also will be addressed.

Requested length

20 minutes

Author: EASO, Sajan (STFC - Rutherford Appleton Lab. (GB))

Presenter: EASO, Sajan (STFC - Rutherford Appleton Lab. (GB))

Session Classification: Session 3

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

Silicon Photosensors in Ring Imaging Cherenkov detectors

Tuesday, May 16, 2023 9:30 AM (25 minutes)

Ring Imaging Cherenkov detectors are moving towards new photodetection technologies for exploring more accurate timing and amplitude resolutions. Silicon photomultipliers (SiPMS) can play such a role, played by photomultiplier tubes until now. SiPMs measure single photon signals with time resolutions up to picoseconds. Their photodetection efficiency surpasses the photomultiplier tubes, reaching up to 50% (in Near Ultra-Violet SiPMs, 60%). The SiPM's fill factor was a problem in the early times of SiPMs, but it has enhanced to 90% nowadays. The main SiPM drawbacks are temperature dependency and high dark count rates. We are investigating methodologies for temperature effect compensation in SiPMs and new trigger systems for readout electronics.

Requested length

20 minutes

Authors: PAULY, Christian (Bergische Universitaet Wuppertal (DE)); PENA RODRIGUEZ, Jesus (Bergische Universität Wuppertal)

Presenter: PENA RODRIGUEZ, Jesus (Bergische Universität Wuppertal)

Session Classification: Session 1

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

Compact and Modular Ring Imaging Cherenkov Detector: Design and Performance

Tuesday, May 16, 2023 3:55 PM (25 minutes)

A compact and modular ring imaging Cherenkov (mRICH) detector has been developed to provide K/π separation over a momentum coverage of 3 to 10 GeV/c, and an e/π separation of up to 2.5 GeV/c within the Electron-Ion Collider Generic R&D Consortium. The mRICH detector consists of an aerogel block, a Fresnel lens, a flat-mirror set, and a photosensor plane. The first prototype of this detector was successfully tested at Fermi National Accelerator laboratory (FNAL) in 2016 for verifying the detector work principles. The results of the first beam test were published in NIMA in 2017. The second prototype test was performed in 2018 at FNAL with a much improved optical design and photosensor integration. In September 2021, the third mRICH beam-test was carried at Jefferson Laboratory (JLab). In this talk, the results from the JLab test will be presented together with future plans of the continued mRICH R&D activities.

Requested length

20 minutes

Author: Prof. HE, Xiaochun (Georgia State University)

Presenter: Prof. HE, Xiaochun (Georgia State University)

Session Classification: Session 3

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

Single-photon imaging detector based on MCP with integrated CMOS pixelated anode

Tuesday, May 16, 2023 12:25 PM (25 minutes)

We present the development of a single-photon detector based on a vacuum tube equipped with transmission photocathode, microchannel plate and a CMOS pixelated active read-out anode. The Timepix4 ASIC, developed by the Medipix4 Collaboration, is used as anode, and consists in an array of 512x448 pixels, 55µmx55µm each. The ASIC features 70e- equivalent noise charge, a maximum rate of 2.5Ghits/s, and allows time-stamping with a resolution better than 100ps. The very low noise of the electronics allows to operate the MCP at low gain, leading to a longer detector lifetime. An ASIC encapsulated inside the vacuum tube allows for on-detector signal processing and digitization with a very-high channel density (about 230 thousand channels) reducing the number of external interconnections (about 200). The detector uses a data-driven architecture and produces up to 160 Gb/s data that will be handled by a high-throughput FPGA-based external electronics with flexible design.

Requested length

10 minutes

Authors: SAPUTI, Alessandro (Universita e INFN, Ferrara (IT)); COTTA RAMUSINO, Angelo (Universita e INFN, Ferrara (IT)); FRANZOSO, Edoardo (Universita e INFN, Ferrara (IT)); ROMOLINI, Gabriele (Universita e INFN, Ferrara (IT)); ALOZY, Jerome Alexandre (CERN); FIORINI, Massimiliano (Universita e INFN, Ferrara (IT)); CAMPBELL, Michael (CERN); Dr BIESUZ, Nicolo Vladi (Universita e INFN, Ferrara (IT)); BALLABRIGA SUNE, Rafael (CERN); BOLZONELLA, Riccardo (University of Ferrara and INFN); CAVALLINI, Viola (Universita e INFN, Ferrara (IT)); LLOPART CUDIE, Xavi (CERN)

Presenter: FIORINI, Massimiliano (Universita e INFN, Ferrara (IT))

Session Classification: Session 2

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

R&D efforts to mitigate radiation damage in SiPMs for the dual-radiator RICH at the EIC

Tuesday, May 16, 2023 9:55 AM (15 minutes)

SiPMs are the baseline photodetector technology for the dual-radiator RICH detector at the EIC. They offer significant advantages being insensitive to the high magnetic field at the expected location. However, SiPMs are not radiation tolerant.

The current R&D tests whether the increase in DCR can be mitigated to maintain single-photon performance with current SiPM technology in a moderately hostile (< 10^{11} 1-MeV n_{eq}/cm^2) radiation environment . Irradiation campaigns have been performed on commercial and prototype sensors to quantify radiation damage and recovery. Different mitigation strategies (cooling, annealing, gating) have been tested. The main recovery strategy plans to use high-temperature cycles delivered via SiPM Joule self-heating.

Upcoming and future R&D will consolidate the strategies towards the successful exploitation of SiPMs for RICH at the EIC. These activities could be considered within DRD4. There is also significant interest in R&D contributions on new SiPM developments (ie. backside illumination, 3D integration).

Requested length

10 minutes

Authors: ANTONIOLI, Pietro (Universita e INFN, Bologna (IT)); PREGHENELLA, Roberto (INFN, Bologna (IT))

Co-authors: TUVE, Cristina (Universita e INFN, Catania (IT)); DE GRUTTOLA, Daniele (Salerno University and INFN); TASSI, Enrico (Universita della Calabria e INFN (IT)); BARION, Luca (Universita e INFN, Ferrara (IT)); RIGNANESE, Luigi Pio (Universita e INFN, Bologna (IT)); CAPUA, Marcella (Universita della Calabria e INFN (IT)); CONTALBRIGO, Marco (Universita e INFN, Ferrara (IT)); FUNICELLO, Nicola (Universita e INFN, Salerno (IT)); FAZIO, Salvatore (Universita della Calabria e INFN (IT))

Presenter: PREGHENELLA, Roberto (INFN, Bologna (IT))

Session Classification: Session 1

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

R&D on MCP-PMTs for High Intensity Kaon experiments at CERN SPS

Tuesday, May 16, 2023 12:50 PM (15 minutes)

The R&D project proposed is within the High-Intensity-Kaon-Experiment (HIKE), a high-intensity fixed-target kaon experiment at CERN SPS exploring the precision frontier of the SM in a complementary and synergic way LHC. The R&D goal is an application of photo-detector technology for ultra-fast timing single-photon detection with extended lifetime, and has synergies with the requirements of next-generation experiments foreseen at HL-LHC. To achieve excellent PID performances that will be crucial for HIKE physics exploitation, the kaon-identification detector must withstand high-intensity beams (~200MHz K^+ rate) and hit rates (~10 MHz/cm^2) and deliver a 15ps time resolution and 95% PID efficiency. MCP-PMT technology is currently explored for this R&D project. However, the MCP-PMT lifetime and linearity at high rates imposed by the working conditions in HIKE pose unprecedented challenges not yet addressed by manufactures. MCP-PMTs with two-layers ALD-coating are a viable solution, if requirements on lifetime and stability at high rates are met.

Requested length

10 minutes

Author: ROMANO, Angela (University of Birmingham (GB))

Presenter: ROMANO, Angela (University of Birmingham (GB))

Session Classification: Session 2

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

Direct detection of charged particles with SiPMs

Wednesday, May 17, 2023 9:40 AM (15 minutes)

Recent studies demonstrated that SiPMs are highly suited in directly detecting charged particles(ref.1-2).The reason is traced back to the abundant production of Cherenkov photons when a MIP passes through the SiPM's protection layer.This leads to a significant increase in the firing SPADs number,resulting in:
1. efficiency close to 100%
2. excellent timing performance, reaching 20-30 ps or less
3. high noise-rejection capability, thanks to the large signals.
To build upon these findings,we propose four directions for further development:
- better quantify the number of photons produced with different resin thickness and material
- determine the optimal SPAD/SiPM dimensions to improve timing performances
- improve SIPM radiation tolerance, in synergy with other DRD4 projects
- develop a custom FEE for timing
This research can pave the way for SiPM applications in space and HEP for direct charge particles in TOF, and new RICH-TOF combined systems.

[1]F.Carnesecchi,et al.,JoI-17(P06007)(2022) https://doi.org/https://dx.doi.org/10.1088/1748-0221/17/06/P06007
[2]F.Carnesecchi,et al.,EPJ-Plus-138,337(2023) https://link.springer.com/article/10.1140/epjp/s13360-023-03923-4

Requested length

10 minutes

Author: ANTONIOLI, Pietro (Universita e INFN, Bologna (IT))

Co-authors: CARNESECCHI, Francesca (CERN); NANIA, Rosario (Universita e INFN, Bologna (IT))

Presenters: CARNESECCHI, Francesca (CERN); ANTONIOLI, Pietro (Universita e INFN, Bologna (IT)); NANIA, Rosario (Universita e INFN, Bologna (IT))

Session Classification: Session 5

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

Status and perspectives of SiPMs at FBK

Tuesday, May 16, 2023 10:10 AM (25 minutes)

Thanks to the continuous improvement of their performance, SiPMs are now considered for the upgrades of several, big physics experiments, ranging from High-energy Physics to rare events physics, to astroparticle physics. However, considering that the incremental improvements between subsequent generations of SiPMs are reaching saturation, a deeper redesign of the photon detector as a whole, including photosensor and readout electronics, is needed. FBK is working on the development of the next-generation of SiPMs, with a strong focus on 3D integration, such as SiPMs featuring medium-to-fine-pitch Through Silicon Vias (TSVs) and Backside-illuminated (BSI) devices. A fine segmentation of the sensitive area in separated mini-SiPMs will reduce output capacitance and optimize signal integrity and timing. BSI-SiPMs will potentially bring additional advantages, such as a PDE close to 100%, enhanced radiation hardness, single-cell connection to the readout electronics and a uniform light entrance window, suitable for the most advanced optical stacks.

Requested length

20 minutes

Author: GOLA, Alberto (Fondazione Bruno Kessler)

Presenter: GOLA, Alberto (Fondazione Bruno Kessler)

Session Classification: Session 1

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

TRD based on highly segmented solid state detectors

Wednesday, May 17, 2023 9:15 AM (25 minutes)

TRDs are commonly used in PID applications, exploiting the threshold Lorentz factor for TR emission. Since TR X-rays have energies from a few keV to a few tens of keV, TRDs are usually equipped with gaseous detectors.

Recently, new techniques for measuring the TR with solid state detectors have been successfully implemented. High-granularity semiconductor pixel or microstrip detectors provide spatial separation of the TR photons and ionization losses, even with limited radiator-detector distances. These detectors may be the basis for novel devices combining precise tracking and PID properties. The presence of a magnetic field could enhance the separation between TR photons and dE/dx losses.

Highly segmented solid state detectors have high efficiency of the TR X-ray detection. Simultaneous measurements of the TR X-ray energies and production angles may significantly improve the PID capabilities and allow to extend the application of TRDs to hadron separation in the TeV momentum region.

Requested length

20 minutes

Author: MAZZIOTTA, Nicola (Universita e INFN, Bari (IT))

Co-author: LOPARCO, Francesco (Universita e INFN, Bari (IT))

Presenter: MAZZIOTTA, Nicola (Universita e INFN, Bari (IT))

Session Classification: Session 5

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

CMOS SPAD

Tuesday, May 16, 2023 11:45 AM (15 minutes)

The increasing requirements for sub-mm/mm photon sensor cells made of 10-50 um array of single photon avalanche diodes (SPAD) imply higher levels of integration. Standard CMOS processes provide a mature and reliable technology, which allows the co-integration of SPADs and electronics at low costs. A 50% photon detection efficiency has been obtained with timing resolution of about 80 ps FWHM in a 110 nm CMOS technology. Advantages of CMOS SPADs are: light detection and readout on a single chip (simple mechanics, lower cost suitable for mass production); each SPAD can read out individual cells and bad SPADs can be turned off to reduce overall noise (trade-off between active area and noise). CMOS SPAD developments for high-energy physics could find applications for large instrumented surfaces highly segmented (e.g., RICH).

Requested length

10 minutes

Author: MAZZIOTTA, Nicola (Universita e INFN, Bari (IT))

Presenter: MAZZIOTTA, Nicola (Universita e INFN, Bari (IT))

Session Classification: Session 2

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

A combined SiPM-based TOF+RICH detector

Tuesday, May 16, 2023 6:00 PM (15 minutes)

A detector aiming to perform combined measurements of Time-of-Flight and Cherenkov photon angles is under development. The device consists of a proximity focusing RICH detector equipped with SiPMs as Cherenkov photon sensors. A 1 mm thin fused silica slab, acting as a second Cherenkov radiator, is coupled to the SiPMs for precise timing measurements due to the Cherenkov photoelectron statistics. The Cherenkov photons emitted by a charged particle traversing the fused silica slab result in a cluster of up to ten contiguous fired SiPMs (of 1x1 mmˆ2 size). Simulations and preliminary results from a beam test campaign anticipate a time resolution better than 20 ps by averaging over the SiPMs' stop times. The optimization of the two Cherenkov radiator refractive indices, the optical couplings, the SiPM's size, PDE and SPTR and the readout electronics is crucial in order to achieve the desired Cherenkov angle and time resolutions.

Requested length

10 minutes

Author: ALTAMURA, Anna Rita (Universita e INFN, Bari (IT))

Co-authors: DI MAURO, Antonello (CERN); NAPPI, Eugenio (Universita e INFN, Bari (IT)); VOLPE, Giacomo (INFN); PAIC, Guy (Universidad Nacional Autonoma (MX)); MAZZIOTTA, Nicola (Universita e INFN, Bari (IT)); NICASSIO, Nicola (Universita e INFN, Bari (IT))

Presenters: ALTAMURA, Anna Rita (Universita e INFN, Bari (IT)); NAPPI, Eugenio (Universita e INFN, Bari (IT))

Session Classification: Session 4

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

Integrated housing for Silicon Photomultipliers for future Ring Imaging Cherenkov photo-detectors

Tuesday, May 16, 2023 10:35 AM (15 minutes)

Silicon Photo-Multipliers (SiPM) are attractive photo-sensors for many different applications. SiPM with improved robustness to radiation could be used for future particle detectors in high radiation environments, operating at a sufficiently low temperature and with regular annealing procedures to mitigate the high noise due to the absorbed radiation dose.
A modular housing solution, based on fully autonomous functional units integrating together all required functions, including passive cooling, has been successfully installed in LHCB/RICH upgrade-I. The evolution to active cooling for SiPM is being studied: a module with high fill-factor housing for O(2mm) pixel size multi-channel SiPM devices, capable to tessellate a large area maximizing the geometrical acceptance, providing integrated local active cooling of the sensors (possibly heating for annealing), with capability to operate in a wide range of temperatures, managing the high channel density for all the front-end/back-end readout electronics and all other required ancillary systems for autonomous operation.

Requested length

10 minutes

Authors: CARDINALE, Roberta (INFN e Universita Genova (IT)); MINUTOLI, Saverio (INFN e Universita Genova (IT)); PETROLINI, Alessandro (University of Genova and INFN); SERGI, Antonino (INFN e Universita Genova (IT)); YANG, YH (Infn e university of Genova)

Presenter: CARDINALE, Roberta (INFN e Universita Genova (IT))

Session Classification: Session 1

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

KM3NeT: Pushing the Boundaries of Photo-detection with Unprecedented Photomultipliers Deployment

Tuesday, May 16, 2023 12:00 PM (25 minutes)

KM3NeT, with the largest number of photodetectors ever built, operates with 20,000 3" PMTs submerged underwater. Ongoing efforts aim to integrate more PMTs into the Digital Optical Module (DOM), totaling around 200,000 PMTs. 10,000 PMTs have undergone detailed characterization, informing the development of an enhanced 3" PMT model by Hamamatsu. The upgraded model exhibits improvements in dark counts, timing precision, and suppression of spurious pulses. ECAP in Erlangen conducted initial tests, and a new photosensors testing lab in Caserta plays a pivotal role in advancing PMT understanding. The lab studies quantum efficiency, time properties, and noise characteristics. Dedicated facilities include a pool for sea water testing, a hyperbaric chamber for deep-sea pressure tests, and a climatic chamber for aging and stress tests. These findings benefit KM3NeT and broader scientific research.

Requested length

20 minutes

Authors: KALEKIN, Oleg; MIGLIOZZI, Pasquale (INFN - Napoli); SIMONELLI, Andreino

Presenter: SIMONELLI, Andreino

Session Classification: Session 2

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

Large area multichannel plate PMTs with picosecond resolution

Tuesday, May 16, 2023 2:05 PM (15 minutes)

Multichannel plate photon detectors (MCP-PMTs) have excellent intrinsic time resolutions of order 50 picoseconds. Large area picosecond PMTs were initiated in 2009 by the LAPPD collaboration and these devices are now commercially produced at Incom Inc. LAPPDs can be operated at high gain, have single photon sensitivity low dark count rates and good quantum efficiency, and thus are a promising technology for photon detectors for LHCb upgrade II, but have also application in neutrino experiments, medical physics and security. With their large active area these devices have excellent potential to become a cost effective photon sensor with fast timing. Many groups including us are currently characterising LAPPDs in close collaboration with the industrial partner. R&D challenges include the rate capability, the lifetime and pixellated readout. An high rate HRPPD has recently become available from the vendor, which has promising properties and needs to be evaluated.

Requested length

10 minutes

Authors: OLIVA, Federica (University of Edinburgh); MUHEIM, Franz (The University of Edinburgh (GB)); GAMBETTA, Silvia (The University of Edinburgh (GB))

Presenters: OLIVA, Federica (University of Edinburgh); MUHEIM, Franz (The University of Edinburgh (GB)); GAMBETTA, Silvia (The University of Edinburgh (GB))

Session Classification: Session 3

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

The LHCb RICH Upgrade II

Tuesday, May 16, 2023 4:45 PM (25 minutes)

The LHCb experiment is planning a phase II Upgrade to fully exploit the potential of Hi-Lumi LHC. Starting from Run5, the LHCb experiment is expected to operate with a 50-fold increase in luminosity compared to its original design. The RICH system at LHCb is in charge of delivering charge particle identification over a wide momentum range: 2.6-100 GeV. The RICH1 and RICH2 detectors have been operated since 2008 and underwent a major Upgrade during LS2. The unprecedented conditions expected for Upgrade II will require a brand new upgrade to the RICH system to cope with the extremely harsh conditions, requiring significant improvements in the resolution of the reconstructed Cherenkov angles and reduction in the peak occupancy. This ambitious programme requires the re-design of the optical system, the increase of granularity and the employment of timing. The key elements towards this improvement will be presented together with the ongoing R&D programme.

Requested length

20 minutes

Author: GAMBETTA, Silvia (The University of Edinburgh (GB))

Presenter: GAMBETTA, Silvia (The University of Edinburgh (GB))

Session Classification: Session 4

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

R&D on rad-hard SiPM by INFN groups of LHCb/RICH collaboration

Tuesday, May 16, 2023 11:15 AM (15 minutes)

Silicon Photomultipliers (SiPMs) can be very promising devices in the field of photodetection thanks to their interesting features regarding the photoresponsivity, the efficiency, the temporal and spatial resolution and the relatively low cost. Unfortunately, up to now, the performances of these devices are very sensitive to damages caused by radiation. For this reason, the INFN groups members of the LHCb/RICH collaboration are currently working in synergy with the italian company FBK on the development of innovative SiPMs with improved characteristics in terms of radiation damage. In this view, different rad-hard prototypes with different shapes, cell pitch and electric field will be tested and fully characterized at different conditions of operations, before and after irradiation, by the labs involved. These studies will lead to the definition of the best solution for the production of SiPM with rad-hard characteristics.

Requested length

10 minutes

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Presenter: COTTA RAMUSINO, Angelo (Universita e INFN, Ferrara (IT))

Session Classification: Session 2

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

SiPM development for the TOP detector upgrade of the Belle II experiment

Tuesday, May 16, 2023 11:30 AM (15 minutes)

Many improvements in SiPM production technology have been achieved in the last few years. Using SiPM as a photodetector is one option for the next TOP detector upgrade of the Belle II experiment. The characterization of SiPMs from several producers is ongoing at the INFN/University Padova laboratory at different temperatures down to -40 degrees. The selected SiPMs are the last available generation with 1x1 mm2 and 3x3 mm2 dimensions and different cell sizes from different producers. Eight 1x1 mm2 SiPMs have been irradiated in November 2022 at INFN-LNL, additional 3x3 mm2 SiPMs will be irradiated in July 2023. The degradation of the SiPMs characteristics has been measured for different irradiation levels up to 5x10ˆ11 neutrons/cm2. Plans for SiPM development in collaboration with FBK have been included in the AIDAinnova project together with the JSI Ljubliana institute, and inside a Research Project (PRIN) submitted to the Italian Ministry of Research.

Requested length

10 minutes

Authors: TORASSA, Ezio (Universita e INFN, Padova (IT)); DAL CORSO, Flavio (Universita e INFN, Padova (IT)); STROILI, Roberto (Università degli Studi di Padova & INFN)

Presenter: TORASSA, Ezio (Universita e INFN, Padova (IT))

Session Classification: Session 2

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

The R&D of Fast MCP-PMT for High Energy Physics Detectors

Tuesday, May 16, 2023 2:20 PM (15 minutes)

The Micro-Channel Plate (MCP) is a specially crafted microporous plate with millions of independent channels, which have secondary electron emission capability. The MCP could be used as electronic multiplier amplifier in PMTs. There are two types of MCP Photomultiplier tube (MCP-PMT), large-area electrostatic focusing PMTs (LPMT) and small size proximity focusing PMTs (FPMT) respectively. The LPMT always used in the large scalar neutrino detector for large area photocathode. The small size FPMT is widely used in high energy physics for its fast response, strong anti-interference ability. The MCP-PMT Collaboration Group in China has successfully developed the LPMT for JUNO in 2017, and plan to research a new type of FPMT with multi-anode readout. The FPMT prototypes have been produced with 50ps time resolution, and also the 8X8 anode for the position resolution. We will introduce some design of the FPMTs for the time measurement, and performance with different readout channels.

Requested length

10 minutes

Author: QIAN, Sen

Presenter: QIAN, Sen

Session Classification: Session 3

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

Metamaterials as radiators for PID detectors

Tuesday, May 16, 2023 2:35 PM (15 minutes)

Metamaterials have great promise to produce highly tunable radiators for particles to interact with. Such radiators would have uses in PID detectors any beyond. This talk will discuss some of the possible structures, and some of their potentially interesting uses. As well as some initial studies.

Requested length

10 minutes

Author: MCCANN, Michael Andrew (Imperial College (GB))

Presenter: MCCANN, Michael Andrew (Imperial College (GB))

Session Classification: Session 3

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

Controlling refractive index and reducing the GWP of Cerenkov gas radiators: challenge in an era of diminishing fluorocarbon availability

Tuesday, May 16, 2023 2:50 PM (25 minutes)

COMPASS and LHCb use C_4F_10 and CF_4 Cherenkov gas radiators. These Saturated FuoroCarbons (Cn_F(2n+2)) have high GWPs, however (5000-9000*CO_2) so there is impetus to reduce their consumption.
Oxygenated fluorocarbons (C_nF_2nO) can offer similar optical performance, with GWPs equivalent to CO2. Their GWPs are geometry-specific however: closed molecular rings containing an oxygen atom link have GWPs as high as SFCs, and should be avoided.
Legislation and market forces will limit FC availability, maybe leaving "holes"in the C_nF_x spectrum unfilled by C_nF_2nO equivalents. Blending low molar concentrations of heritage-stock higher-order SFCs or 3M NOVEC®5110: C5F10O (GWPzero) with light gases like nitrogen would reduce the radiator volume GWP "load".
Sound velocity monitoring was used for controlling real-time blending C5F12 with N2 in the SLD CRID. The technique could be valuable in future operation to meet the optical and low GWP constraints of future blended Cherenkov gas radiators. Examples are explored.

Requested length

20 minutes

Author: HALLEWELL, Gregory (Centre National de la Recherche Scientifique (FR))

Presenter: HALLEWELL, Gregory (Centre National de la Recherche Scientifique (FR))

Session Classification: Session 3

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

The Belle II ARICH upgrade plans

Tuesday, May 16, 2023 5:10 PM (25 minutes)

The Belle II experiment is planning an upgrade in early thirties to adapt the spectrometer for operation at an upgraded SuperKEKEB accelerator. In this context the ARICH detector, a proximity-focusing RICH with a two-layer (focusing) aerogel radiator will be upgraded. The main focus will be an upgrade of the photodetector with either SiPMs or MCP-PMTs and fast read-out electronics. A possible upgrade of the radiator is considered as well. In the proposed contribution, the elements of the upgrade will be presented together with the ongoing R&D program.

Requested length

20 minutes

Author: KORPAR, Samo (Jozef Stefan Institute (SI))

Presenter: KORPAR, Samo (Jozef Stefan Institute (SI))

Session Classification: Session 4

Contribution ID: **26** Type: **not specified**

Presentations of groups

Wednesday, May 17, 2023 10:50 AM (1h 25m)

Session Classification: Organisation 2

Contribution ID: **27** Type: **not specified**

Towards implementation of DRD4

Wednesday, May 17, 2023 1:40 PM (45 minutes)

Session Classification: Organisation 3

Contribution ID: **28** Type: **not specified**

Discussion on structure of DRD4, scope, work packages, common projects. Voting.

Wednesday, May 17, 2023 2:25 PM (45 minutes)

Session Classification: Organisation 3

Contribution ID: **29** Type: **not specified**

Resources, proposal, MoU, timeline, tentative contributions, next steps,

Wednesday, May 17, 2023 3:10 PM (45 minutes)

Session Classification: Organisation 3

Contribution ID: **30** Type: **not specified**

Organisation - Introduction

Wednesday, May 17, 2023 10:00 AM (20 minutes)

Requested length

Session Classification: Organisation 1