

NuFact 2022

Salt Lake City, Utah, United States

July 31st – Aug. 6th, 2022

The 23rd International Workshop on Neutrinos from Accelerators

LOCAL ORGANIZING COMMITTEE

Rebecca Corley (University of Utah)
Paolo Gondolo (University of Utah)
Carsten Rott (Co-chair, University of Utah)
Pearl Sandick (University of Utah)
Joshua Spitz (University of Michigan)
Yue Zhao (Co-chair, University of Utah)

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WORKING GROUP CONVENERS

WG1: Neutrino Oscillations

Adam Aurisano (University of Cincinnati, USA)
Mark Scott (Imperial College, UK)
Jian Tang (Sun Yat-Sen University, China)

WG2: Neutrino Scattering Physics

Adi Ashkenzi (Tel Aviv University, Israel)
Tatsuya Kikawa (Kyoto University, Japan)
Raul González Jimenez (Complutense University of Madrid, Spain)

WG3: Accelerator Physics

Natalia Milas (ESS, Sweden)
Tsunayuki Matsubara (J-PARC, KEK)
Katsuya Yonehara (FNAL, USA)

WG4: Muon Physics

Yuki Fujii (University of Tsukuba, Japan)
Gavin Hesketh (University of Oxford, UK)
Yuri Oksuzian (ANL, USA)

WG5: Neutrinos beyond PMNS

Koun Choi (IBS, CUP, South Korea)
Richard Ruiz (UC Louvain, Belgium)
Tim Shoemaker (Virginia Tech, USA)

WG6: Detectors

Jonathan Asaadi (University of Texas, USA)
Davide Sgalaberna (CERN, Switzerland)
Nishimura Yasuhiro (Keio University, Japan)

WG7: Inclusion, Diversity, Equity, Education, & Outreach

Elen Bechtol (UW Madison, USA)
Francesca Dordet (INFN, Cagliari, Italy)
Migisa Hiroshima (University of Toyama, Japan)

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H. H. H. (University of Texas, USA)
H. H. H. (University of Texas, USA)
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Tadashi Koseki (KEK, Japan)
Yoshitaka (Osaka University, Japan)
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Frederik Wauters (University of Mainz, Germany)
Un-ki Yang (Seoul National University, Korea)

Introduction of Working Group 6 (Detectors)

Yasuhiro NISHIMURA (Keio University)

on behalf of WG6 conveners

Davide Sgalaberna (ETH Zurich),

Yasuhiro Nishimura (Keio University),

Jonathan Asaadi (University of Texas Austin)

1/Aug/2022, 23rd NuFact 2022

Working Group 6 - Detectors -

- WG6 is dedicated to various technical aspects; technologies of detectors, electronics, data acquisition and handling, techniques of analysis, calibration, simulation, ..
- The first WG6 sessions at NuFact2021.
 - WG6 started from NuFact 2020→2021.
- 37 presentations at NuFact2022
 - 3 plenary talks, 28 talks in parallel sessions (17 talks in WG6, 11 talks in joint sessions) and 6 posters for WG6

Challenges by means of Technologies

- Kick-start detector talks at NuFact 2019

- Overview of new detector technologies for neutrino experiments (Zhimin Wang)

https://indico.cern.ch/event/773605/contributions/3498132/attachments/1899075/3134119/WANGZM_Overview_of_new_detector_technology_for_neutrino_experiments_final.pdf

Presented by Zhimin Wang

Face to the Challenges

Few MeV neutrinos from reactors
Few 100MeV to a few GeV in long-baseline experiments
UHE cosmogenic neutrinos...

Scintillator Detectors
Noble Liquid Detectors
Water Cherenkov Detectors
Ice Detectors
Photodetectors
Calorimetry
Gas Detectors
Silicon/Germanium Detectors
Superconducting Detectors
Quantum Sensors

Low energy threshold
Low background
Large mass

High efficiency
Better Reconstruction
Fast timing
PID

Beam-generated Fluxes
Directional detectors for low-energy neutrinos
Precise measurement of vertex substructure in neutrino scattering

High voltage delivery
Cold electronics design

Accelerator neutrinos
Reactor neutrinos
Cosmogenic Neutrinos

(Micro-)electronics
Calibration systems
Trigger and Data Acquisition
(Automated) event reconstruction
Computing and Machine Learning

Challenges on technologies to extend various ν/μ physics reach

Requirements in Future Experiments

- High intensity ν/μ beam \rightarrow High rate detection
- Wide energy range in various neutrino sources
 - Better triggering and computing
 - Lower energy threshold and lower background
- High statistics with large mass detection volume
 - \rightarrow High precision measurement
 - Precise measurement of interactions
 - High resolutions and high detection efficiency
 - Better calibration

Innovative detector concepts are desired.

Motivation of WG6 activities

- Essential to improve our experimental techniques
 - Expect useful discussion to maximize the potential of upcoming experiments with improved techniques
 - ▶ Quick and efficient communication among experiments
 - ▶ Sharing the latest information
 - To develop the next generation of instrumentation in new regimes with new capabilities for future experiments after several decades beyond next programs
 - ▶ Innovative idea in long-term plan

Presentation and discussion on new experimental techniques at WG6 are important for coming projects.

Scope of WG6

- Beam → WG3: Accelerator Physics

- Detectors

- Electronics

- Calibration

- DAQ

- Data handling

- Simulation platform

- Analysis framework

- Reconstruction

- Systematics

- Statistics

and so on

Hardware

Software and computing

Common interest among experiments:
Intelligent trigger,
GPU computing,
Machine learning

Scope of WG6

- Detectors

- Detector design and engineering (cavern, tank, vessel, etc.)
- Ar/Xe, Liquid/Gas, Single/Dual, pixelated readout, bubble
- Water Cherenkov detector, with Gd, water-base scintillator
- Scintillator and optical enhancement
 - ▶ Liquid, plastic segmentation, inorganic crystal, wavelength shifting, etc.
- Near detector components
 - ▶ Magnetized / non-magnetized active target
 - ▶ Movable detectors (PRISM, etc.)
- Detection technique
 - ▶ Photodetectors, gas detectors, tracking detectors, solid state detectors, ...

- Electronics

- Trigger, HV, FPGA, ASIC, synchronization, communication, durability, evaluation, ...

Plenary Talks on Detectors

- Plenary session 8:50am 5/Aug (Fri)
- **Neutrino event reconstruction and Machine Learning** (Kazuhiro Terao)
Remarkable technique on analyses
- **Scintillator detectors** (Minfang Yeh)
Basic detector technologies
- **Challenges in the construction of large neutrino detectors: the JUNO case** (Michele Montuschi)
Facility / Infrastructure for large detectors

Construction Challenges



Hyper-Kamiokande

June 2022

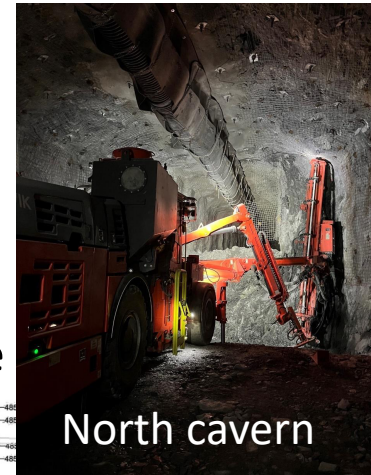
Reached dome center



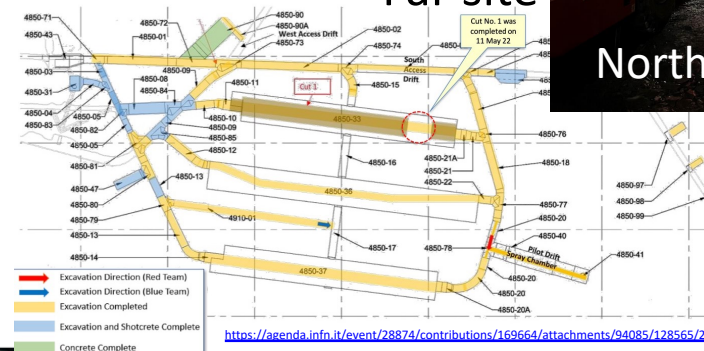
<https://www.shikoku-tokushu.co.jp/en/kyokai/001/>



Far site



North cavern



https://agenda.infn.it/event/28874/contributions/169664/attachments/94085/128565/220707_ICHEP_DUNEOverview.pdf

July 2022



https://agenda.infn.it/event/28874/contributions/169677/attachments/94099/128988/JUNO_ICHEP2022_Rt.pdf



ProtoDUNE
at CERN
(Single/Dual phase)

1/Aug/2022

Introduction to WG6 Detectors (Nishimura)

9

WG6 Parallel Sessions

5 parallel sessions

- 14pm 2/Aug (Tue) Hyper-K and IceCube detectors
 - 4 talks about Photodetectors and Electronics
- 16pm 2/Aug (Tue) Quick talks for WG6 posters
 - Including virtual presentation
- 16:10pm 4/Aug (Thu) DUNE/SBND/ARIANDE+
 - 4 talks about Liquid argon detectors (incl. trigger, readout)
- 11:15am 5/Aug (Fri) Near detectors
 - 4 talks about T2K/DUNE Near detector, Xe TPC
- 14:30pm 5/Aug (Fri) IceCube/MicroBooNE, JUNO, ICARUS
 - 5 talks about Calibration, Reconstruction, ..

Joint Sessions

11 presentations in joint sessions related with WG6

- 11:20am 4/Aug (Thu) WG1+2+6 (Ballroom 2&3)
 - With neutrino oscillations, neutrinos scattering physics
 - 4 talks for Near detectors, scintillator tracker
- 14:20pm 4/Aug (Thu) WG1+6 (Ballroom 2&3)
 - With neutrino oscillations group
 - 4 talks for Machine Learning
- 16:10pm 5/Aug (Fri) WG4+6 (Ballroom Lobby, Cliff Lodge)
 - With muon physics group
 - 3 talks for Mu2e Detectors and machine learning


Poster Presentations

- At poster session 18:20-19:50pm 1/Aug (Mon)
 - **Gain calibration using dark hits in off-time region of regular data at JSNS2 experiment** (RyeongGyoon Park)
 - **Mass test setup for DUNE SiPMs characterization** (Marco Guarise), virtual presentation only on 2/Aug
 - **First light detection with an optical Time Projection Chamber** (Robert Amarinei)
 - **A High Rate Readout System for a High-Efficiency Cosmic Ray Veto for the Mu2e Experiment** (Simon Corrodi)
 - **Construction of a new scintillation tracker in T2K experiment** (Masaki Kawaue)
 - **Detectors of the Telescope Array Experiment** (Jihyun Kim)
- Short oral presentation for WG6 posters 16pm 2/Aug (Tue)
 - A few – 15 min / poster, flexible schedule

Timetable on 2 and 4/Aug


2/Aug (Tue)

Photodetectors

14:00	Multi PMTs at the Water Cherenkov Test Experiment/IWCD at Hyper-K	<i>Ryosuke Akutsu</i>
	Ballroom 3	14:00 - 14:20
	Options for PMT electronics at the Hyper-K far detector	<i>Shota Izumiyama</i>
	Ballroom 3	14:20 - 14:40
	Time generation and clock distribution for Hyper-Kamiokande	<i>Lucile Mellet</i> 
	Ballroom 3	14:40 - 15:00
	IceCube & SWGO Photodetectors	<i>Michael DuVernois</i>
15:00	Ballroom 3	15:00 - 15:20

Poster presenters

(Presentation time is tentative and flexible.)

16:00	Gain calibration using dark hits in off-time region of regular data at JSNS2 experiment (at WG6)	<i>RyeongGyoon Park</i>
	Ballroom 3	16:00 - 16:15
	A High Rate Readout System for a High-Efficiency Cosmic Ray Veto for the Mu2e Experiment (at WG6)	<i>Simon Corrodi</i>
	Ballroom 3	16:15 - 16:30
	First light detection with an optical Time Projection Chamber (at WG6)	<i>Mr Robert Amarinei</i>
	Ballroom 3	16:30 - 16:45
	Mass test setup for DUNE SiPMs characterization	<i>Marco Guarise</i> 
	Ballroom 3	16:45 - 17:00
17:00	Construction of a new scintillation tracker in T2K experiment (at WG6)	<i>Masaki Kawaue</i>
	Ballroom 3	17:00 - 17:15
	Detectors of the Telescope Array Experiment (at WG6)	<i>Jihyun Kim</i>
	Ballroom 3	17:15 - 17:30

4/Aug (Thu)


11:00 WG1+2+6 (ν osc., ν scattering & Detectors)

	The Path to Precision: Role of the DUNE Near Detectors	<i>Zoya Vallari</i>
	Ballroom 2&3	11:20 - 11:38
	SBND-PRISM: Sampling Multiple Off-Axis Neutrino Fluxes with the Same Detector	<i>Marco Del Tutto</i>
	Ballroom 2&3	11:38 - 11:56
12:00	Latest results on T2K Near Detector constraints for neutrino oscillation measurements	<i>Callum Wilkinson</i>
	Ballroom 2&3	11:56 - 12:14
	The T2K Near Detector upgrade	<i>Aoi Eguchi</i>
	Ballroom 2&3	12:14 - 12:32
	Total neutron cross section measurement on CH with a novel 3D-projection scintillator detector	<i>Ciro Riccio</i>
	Ballroom 2&3	12:32 - 12:50

14:00 WG1+6 (ν osc. & Detectors)

	Machine Learning Techniques to Enhance Event Reconstruction in Water Cherenkov Detectors	<i>Nick Prouse</i>
	Ballroom 2&3	14:20 - 14:42
	Measurement of Atmospheric Muon Neutrino Disappearance using CNN Reconstructions with IceCube	<i>Shiqi Yu</i>
	Ballroom 2&3	14:42 - 15:04
15:00	Machine Learning Methods for Solar Neutrino Classification	<i>Alejandro Yankelevich</i>
	Ballroom 2&3	15:04 - 15:26
	Panoptic Segmentation for Particle Identification in ProtoDUNE-SP	<i>Carlos Sarasty</i>
	Ballroom 2&3	15:26 - 15:48

16:00 Liq. Ar detectors

16:00	The DUNE vertical drift TPC	<i>Oliver Lantwin</i> 
	Ballroom 3	16:10 - 16:30
	Photon Detection System (PDS) for DUNE low energy physics study and the demonstration of a few nanosecond timing...	<i>Ajib Paudel</i>
17:00	SBND Trigger System: General status and the configuration of the Analog Master Trigger Card	<i>Gabriela Vitti Stenico</i>
	Ballroom 3	16:50 - 17:10
	ARIADNE+: Large Scale Demonstration of Fast Optical Readout for Dual Phase LArTPCs at the CERN Neutrino Platform	<i>Adam Lowe</i>

Timetable on 5/Aug (Fri)

5/Aug (Fri)

Plenary

09:00	Neutrino event reconstruction and Machine Learning	<i>Kazuhiro Terao</i>
	Ballroom 2&3	08:50 - 09:20
	Scintillator detectors	<i>Minfang Yeh</i>
	Ballroom 2&3	09:20 - 09:50
10:00	Challenges in the construction of large neutrino detectors: the JUNO case	<i>Michele Montuschi</i>
	Ballroom 2&3	09:50 - 10:20

Near detectors

11:00	3D segmented scintillator neutrino detector SuperFGD for T2K experiment	<i>Christopher Mauger</i>
	Ballroom 3	11:15 - 11:35
	Characterisation of the ERAM detectors for the High Angle TPC of the T2K ND upgrade	<i>Claudio Giganti et al.</i>
	Ballroom 3	11:35 - 11:55
12:00	Demonstration of a novel, ton-scale, pixel-readout LArTPC for the DUNE Near Detector	<i>Dr Jeremy Wolcott</i>
	Ballroom 3	11:55 - 12:15
	The search for $\bar{\nu}_\mu \rightarrow \bar{\nu}_e$ with the NEXT time projection chamber	<i>Krishan Mistry</i>
	Ballroom 3	12:15 - 12:35

Calibration & others

14:00	Measuring solar neutrinos over gigayear timescales with paleo detectors	<i>Dr Natalia Tapia Arellano</i>
	Ballroom 3	14:20 - 14:38
	The Camera System for the IceCube Upgrade	<i>Woosik Kang</i>
	Ballroom 3	14:38 - 14:56
15:00	Energy Reconstruction and Calibration of the MicroBooNE LArTPC	<i>Dr Wanwei Wu</i>
	Ballroom 3	14:56 - 15:14
	Calibration strategy for the JUNO experiment	<i>Dr Davide Basilico</i>
	Ballroom 3	15:14 - 15:32
	Calibrating for Precision Physics in LArTPCs at ICARUS	<i>Gray Putnam</i>
	Ballroom 3	15:32 - 15:50

WG4+6 (Muon + Detectors)

16:00	Design, construction, and vertical slice performance tests of the Mu2e straw tracker	<i>Richard Bonventre</i>
	Ballroom Lobby, Cliff Lodge	16:10 - 16:40
17:00	The High-Efficiency Cosmic Ray Veto Detector for the Mu2e Experiment at Fermilab	<i>Simon Corrodi</i>
	Ballroom Lobby, Cliff Lodge	16:40 - 17:10
	Online machine learning based event selection for COMET Phase-I	<i>Yuki Fujii</i>
	Ballroom Lobby, Cliff Lodge	17:10 - 17:40

Enjoy WG6 sessions

- Second WG6 session in NuFact series
 - Please enjoy various technical topics
 - ▶ 15 min talk + 5 or 3 min discussion (20 or 18 min in total)
 - ▶ + Dedicated poster session
- Synergy with other WGs for technical discussion
 - Joint sessions with WG1 (Neutrino oscillation),
WG2 (Neutrino scattering physics), WG4 (Muon)
- Come to Ballroom 3 for the WG6 parallel Session