

IceCube-Gen2 Calibration Workshop

Report of Contributions

Contribution ID: 1

Type: **not specified**

Continuous calibration of scintillators after deployment

Friday, 9 April 2021 08:30 (25 minutes)

Present on a proposed plan for the continuous in-situ calibration of the surface scintillator panels.

Primary author: KAUER, Matt (University of Wisconsin–Madison)

Presenter: KAUER, Matt (University of Wisconsin–Madison)

Session Classification: Surface

Contribution ID: 2

Type: **not specified**

Calibration of surface radio antennas after deployment

Friday, 9 April 2021 09:20 (25 minutes)

In this talk I will discuss how we can do in situ calibration of the surface radio antennas and present the work that has been done so far with the prototype antennas deployed at the South Pole.

Primary author: DUJMOVIC, Hrvoje (Karlsruhe Institute of Technology)

Presenter: DUJMOVIC, Hrvoje (Karlsruhe Institute of Technology)

Session Classification: Surface

Contribution ID: **3**

Type: **not specified**

LED Flashers in Gen2

Wednesday, 7 April 2021 10:40 (20 minutes)

Are they any good?

Primary author: RONGEN, Martin (RWTH Aachen University)

Presenter: RONGEN, Martin (RWTH Aachen University)

Session Classification: Optical/acoustic

Contribution ID: 4

Type: **not specified**

Calibrating IceCube track reconstructions by using DM-Ice coincidence events using 2012-2020 data

Wednesday, 7 April 2021 10:00 (20 minutes)

DMIce-17 comprises of two 8.5kg NaI(Tl) scintillator crystals located beneath the IceCube array. We demonstrate that it is possible to distinguish muons detected in DMIce-17 from background, and then use this to determine the coincidence rate between high energy tracks measured in IceCube and said muons for data covering 2012-2020. Finally, we discuss how this may be used to improve the track reconstruction of IceCube.

Primary authors: Dr KATORI, Teppei (King's College London); CLARK, Rogan (King's College London); KAUER, Matt (University of Wisconsin–Madison); HUBBARD, Antonia (University of Wisconsin–Madison)

Presenter: Dr KATORI, Teppei (King's College London)

Session Classification: Optical/acoustic

Contribution ID: 5

Type: **not specified**

Simulation of radio signals from air showers measured by in-ice radio antennas [Time: 10+3]

Thursday, 8 April 2021 11:01 (13 minutes)

We give an overview of the current state of the simulation of radio signals from air showers measured by in-ice radio antennas. We start with a short summary about the propagation of in-air radio emission into ice, and then focus on the propagation of the particle shower itself through ice. The Corsika Monte Carlo code was used to simulate the in-air part of air showers, which was combined with the Geant4 simulation toolkit for its propagation through ice. We discuss the general features of the in-ice particle cascade and give a parameterization of both the longitudinal particle development as well as the lateral cascade front distribution. We conclude air-shower induced in-ice particle cascades are very similar to neutrino induced in-ice particle cascades, indicating that air showers could serve as an in-situ calibration source for neutrino observatories. We show first Monte Carlo estimates of the expected radio signal coming from this in-ice particle cascades. Finally, we give a short status update on Corsika 8, which aims to include the simulation of radio signals from air showers measured by in-ice radio antennas.

Primary authors: DE KOCKERE, Simon (Vrije Universiteit Brussel); DE VRIES, Krijn (Vrije Universiteit Brussel); HUEGE, Tim (Karlsruhe Institute of Technology); LATIF, Uzair (University of Kansas); VAN EIJNDHOVEN, Nick (Vrije Universiteit Brussel)

Presenter: DE KOCKERE, Simon (Vrije Universiteit Brussel)

Session Classification: Radio

Contribution ID: 6

Type: **not specified**

Calibration of the Radio Components for the Surface Array at KIT

Friday, 9 April 2021 08:55 (25 minutes)

I will present the individual calibration of all the components in the radio electronics chain. This will focus only on the calibration carried out at KIT.

Primary author: TURCOTTE, Roxanne (Karlsruhe Institute of Technology)

Presenter: TURCOTTE, Roxanne (Karlsruhe Institute of Technology)

Session Classification: Surface

Contribution ID: 7

Type: **not specified**

Calibration of the Gen2 in-ice arrays using the surface array

Friday, 9 April 2021 10:40 (25 minutes)

Summary of idea on how the Gen2 surface array can contribute to the calibration of the in-ice arrays. In particular, the surface array provides an in-situ measurement of the cosmic-ray flux, which is the source of the atmospheric backgrounds in the in-ice.

Primary author: SCHROEDER, Frank (University of Delaware / Karlsruhe Institute of Technology)

Presenter: SCHROEDER, Frank (University of Delaware / Karlsruhe Institute of Technology)

Session Classification: Surface

Contribution ID: 8

Type: **not specified**

In-situ calibration device for the measurement of the snow accumulation and the index-of-refraction profile [Time: 10+3]

Thursday, 8 April 2021 10:22 (13 minutes)

High-precision neutrino energy reconstruction requires a real time monitoring of the firm properties (snow accumulation h and the index-of-refraction profile $n(z)$). In this talk, I will present a design for an in-situ calibration device applicable to an IceCube-Gen2 radio array, consisting of two shallow emitter antennas and a receiver at 15m depth. The optimal configuration of the emitters, that yields the best reconstruction in h and a two-parameter $n(z)$ model, is determined. A simplified version of this technique has already been tested in-situ at one ARIANNA station at the Ross Ice Shelf to continuously measure the snow accumulation.

Primary author: BEISE, Jakob (Uppsala Universitet)

Presenters: BEISE, Jakob (Uppsala Universitet); GLASER, Christian (Uppsala Universitet)

Session Classification: Radio

Contribution ID: 9

Type: **not specified**

Calibrating the IceCube's optical array with cosmic ray events

Friday, 9 April 2021 10:15 (25 minutes)

This talk summarizes what we did before for AMANDA and IceCube using cosmic ray events measured by SPASE-2 and IceTop. Calibrations and associated systematics a surface array may provide for Gen2 optical array will be outlined for discussion.

Primary author: Prof. BAI, Xinhua (South Dakota School of Mines and Technology)

Presenter: Prof. BAI, Xinhua (South Dakota School of Mines and Technology)

Session Classification: Surface

Contribution ID: 10

Type: **not specified**

Gen2 - Optical calibration / in-situ POCAM?

Wednesday, 7 April 2021 10:30 (10 minutes)

We would like to initiate a discussion about potential calibration possibilities in Gen2. One option we would like to investigate is an adapted / in-situ integrated POCAM-like light source inside the standard Gen2 module.

Primary authors: HENNINGSEN, Felix (Universität München); PERTL, Tobias (Universität München); Ms KHERA, Nikhita (Universität München); SPANNFELLNER, Christian (Technische Universität München); RESCONI, Elisa (Universität München); GEILEN, Leonard (Universität München)

Presenters: HENNINGSEN, Felix (Universität München); PERTL, Tobias (Universität München); Ms KHERA, Nikhita (Universität München); SPANNFELLNER, Christian (Technische Universität München); RESCONI, Elisa (Universität München); GEILEN, Leonard (Universität München)

Session Classification: Optical/acoustic

Contribution ID: 11

Type: **not specified**

Dust logging in gen2

Wednesday, 7 April 2021 09:05 (25 minutes)

We discuss the development of a new dust logger for gen2, including reviewing basic capabilities needed to provide the tilt map critical for event energy resolution and plans for exploration of advanced features to expand the dust logger science case.

Primary authors: JONES, Benjamin (University of Texas at Austin); BENZVI, Segev (University of Rochester)

Presenters: JONES, Benjamin (University of Texas at Austin); BENZVI, Segev (University of Rochester)

Session Classification: Optical/acoustic

Contribution ID: **12**

Type: **not specified**

Intro and Gen2 Schedule

Wednesday, 7 April 2021 08:00 (10 minutes)

Intro and Gen2 Schedule

Primary author: WILLIAMS, Dawn (University of Alabama)

Presenter: WILLIAMS, Dawn (University of Alabama)

Session Classification: Optical/acoustic

Contribution ID: 13

Type: **not specified**

Gen2 Camera-based calibration system

Wednesday, 7 April 2021 08:40 (25 minutes)

Ideas and objectives for the Gen2 Camera-based calibration system

Primary authors: ROTT, Carsten (University of Utah); TOENNIS, Christoph; KANG, Woosik (Sungkyunkwan University); ROELLINGHOFF, Gerrit (Sungkyunkwan University); LEE, Jiwoong (SKKU)

Presenter: ROTT, Carsten (University of Utah)

Session Classification: Optical/acoustic

Contribution ID: 14

Type: **not specified**

Acoustic Modules for Gen2

Wednesday, 7 April 2021 08:10 (30 minutes)

The acoustic calibration system is due to its large range and high accuracy a promising candidate for the geometry calibration of the Gen2 detector. The technical design of the acoustic module and the acoustic receivers are presented and the performance of the acoustic system and strategies for the calibration of the Gen2 detector are discussed.

Primary authors: GÜNTHER, Christoph (RWTH Aachen); Dr ZIERKE, Simon (RWTH Aachen); Dr HEINEN, Dirk (RWTH Aachen); BOROWKA, Jürgen (RWTH Aachen); SCHARF, Maximilian (RWTH Aachen); Prof. WIEBUSCH, Christopher (RWTH Aachen); Dr WEINSTOCK, Lars (RWTH Aachen)

Presenter: GÜNTHER, Christoph (RWTH Aachen)

Session Classification: Optical/acoustic

Contribution ID: 15

Type: **not specified**

Introduction to In-Ice Neutrino Radio-detection Calibration

Thursday, 8 April 2021 08:00 (5 minutes)

I'll give a brief introduction for the workshop day on calibration of the IceCube Gen2 in-ice radio array for detection of neutrinos

Primary author: HALLGREN, Allan (Uppsala Universitet)

Presenter: HALLGREN, Allan (Uppsala Universitet)

Session Classification: Radio

Contribution ID: 16

Type: **not specified**

Discussion: what do we need for Gen2 Phase II proposal and Gen2 PDR?

Wednesday, 7 April 2021 11:00 (30 minutes)

Discussion: what do we need for Gen2 Phase II proposal and Gen2 PDR?

Primary author: WILLIAMS, Dawn (University of Alabama)

Presenter: WILLIAMS, Dawn (University of Alabama)

Session Classification: Optical/acoustic

Contribution ID: 17

Type: **not specified**

Calibration procedure for the hardware of RNO-G [Time: 10+3]

Thursday, 8 April 2021 10:48 (13 minutes)

Description of the test and calibration procedure for the hardware of the radio neutrino detector RNO-G: the three types of amplifier boards, which will be used in the detector, were tested with a vector network analyzer and in a temperature chamber.

Primary author: CATALDO, Maddalena (DESY Zeuthen)

Presenter: CATALDO, Maddalena (DESY Zeuthen)

Session Classification: Radio

Contribution ID: **18**

Type: **not specified**

General discussion of PDR

Currently a time blocker for earnest discussion of PDR structure and responsible parties (from a calibration perspective)

Contribution ID: **20**

Type: **not specified**

Discussion

Friday, 9 April 2021 11:05 (25 minutes)

PDR structure, responsible parties and tentative goalposts?

Session Classification: Surface

Contribution ID: 21

Type: **not specified**

Lessons learnt from radio detection of air showers [Time: 10+3]

Thursday, 8 April 2021 11:14 (13 minutes)

We will review calibration efforts as performed in radio air shower arrays (such as AERA and LOFAR) and will discuss what we can learn from this for Gen2.

Primary authors: NELLES, Anna (DESY Zeuthen); GLASER, Christian (Uppsala Universitet)

Presenter: GLASER, Christian (Uppsala Universitet)

Session Classification: Radio

Contribution ID: 22

Type: **not specified**

Characterisation and pre-calibration of the scintillation detectors of the IceTop surface enhancement

Friday, 9 April 2021 08:05 (25 minutes)

The IceCube Collaboration plans to upgrade IceTop with scintillation detectors augmented by radio antennas. A full prototype hybrid station was installed near the center of the IceTop array.

The station features custom-designed DAQ electronics and consists of three radio antennas, sensitive in the MHz region and eight scintillation detectors, each having an active area of 1.5 m^2 plastic scintillators, coupled via wavelength-shifting fiber and read out by a Silicon Photomultiplier (SiPM). The enhancements also provide R&D experience for the next generation (IceCube-Gen2) detectors.

This talk will focus on the necessary characterisation and calibration measurements of the scintillation detector components before they are assembled and will explain the methods to define the efficiency and performance of the scintillators before deployment at the South Pole. In addition, it will be shown how the determination of the temperature-sensitive operational parameters is realized in the lab as contribution for enabling a temperature-independent and therefore homogeneous detector array, realized by control loops.

Primary author: HUBER, Thomas (Karlsruhe Institute of Technology)

Presenter: HUBER, Thomas (Karlsruhe Institute of Technology)

Session Classification: Surface

Contribution ID: 23

Type: **not specified**

Passive sources of radio calibration [Time: 8+0]

Thursday, 8 April 2021 08:56 (8 minutes)

In this talk, I will introduce potential passive sources (i.e. ones that operate without any intervention from us) that might be useful for calibration of a radio array. Such sources include satellites, radiosondes as well as potentially airplanes and snowmobiles.

Primary author: DEACONU, Cosmin (University of Chicago)

Presenter: DEACONU, Cosmin (University of Chicago)

Session Classification: Radio

Contribution ID: 24

Type: **not specified**

Advanced Propagation: Greenland FDTD Case Study and the Potential for Parabolic Equation Modeling [Time: 8+4]

Thursday, 8 April 2021 09:24 (12 minutes)

This talk covers two topics related to “advanced” radio propagation (i.e. not raytracing). The first describes the use of finite-difference time-domain (FDTD) modeling to describe a radio dataset from Greenland and the second describes the potential application of parabolic equation (PE) modeling for in-ice studies. Unlike FDTD, PE is tractable over larger scales, but still leaves much to be demonstrated for this application.

Primary author: DEACONU, Cosmin (University of Chicago)

Presenter: DEACONU, Cosmin (University of Chicago)

Session Classification: Radio

Contribution ID: 25

Type: **not specified**

Calibrating In-Ice Antennas: Lessons Learned from ARA [Time: 13+4]

Thursday, 8 April 2021 10:05 (17 minutes)

I will discuss the process used to calibrate the antennas at ARA Station 5, as well as the relative uncertainties introduced in the process. I will also discuss my recommendations for calibrating future in-ice radio detectors using lessons learned from ARA Station 5.

Primary authors: HUGHES, Kaeli (University of Chicago); THE ARA COLLABORATION

Presenter: HUGHES, Kaeli (University of Chicago)

Session Classification: Radio

Contribution ID: 26

Type: **not specified**

In-situ calibration and anechoic chamber measurement for radio antenna development [Time: 13+4]

Thursday, 8 April 2021 08:05 (17 minutes)

In this talk, we will present the Chiba group's effort to developing an in-ice radio antenna model and slim antenna design for the future detector. We present the overview of the results from in-air antenna measurement done at the anechoic chamber and in-situ calibration performed at the ARA detector to measure the angular gain pattern of the antenna. The response of antenna in both environments was studied by the XFDTD simulation. As a result, the empirical antenna model was developed based on data. We also summarized the development of the slim antenna that was designed to deploy by RAM drill and the in-situ measurement performed at the South pole. Finally, we discuss the in-situ behavior of the ARA detector that we observed.

Primary author: KIM, Myoungchul (Chiba University)**Presenter:** KIM, Myoungchul (Chiba University)**Session Classification:** Radio

Contribution ID: 27

Type: **not specified**

Water Tank Testing and Calibration

Wednesday, 7 April 2021 10:20 (10 minutes)

In this brief talk, I will summarize the objectives/ideas behind the water tank to be built at Harvard in collaboration with the MIT and King's college groups.

Primary author: Prof. ARGUELLES DELGADO, Carlos (Harvard University)

Presenter: Prof. ARGUELLES DELGADO, Carlos (Harvard University)

Session Classification: Optical/acoustic

Contribution ID: 28

Type: **not specified**

On unexplained features in ARA and other data, ice properties and goals [Time: 13+4]

Thursday, 8 April 2021 08:22 (17 minutes)

Current understanding of RF ice properties will be summarized, highlighting both anomalous experimental data and/or gaps in our current modeling.

Primary author: BESSON, David (University of Kansas)

Presenter: BESSON, David (University of Kansas)

Session Classification: Radio

Contribution ID: 29

Type: **not specified**

Plans for radio transmitters in distant holes in the Gen2 radio array [Time: 13+4]

Thursday, 8 April 2021 08:39 (17 minutes)

We address radio array calibration options for IceCube Gen2, as well as RNO-G efforts that will inform the IC Gen2 dedicated pulser layout and design. We also discuss a calibration-tower+hole (CATH) proposal to redundantly measure ice properties over neutrino-like geometries, as well as provide signal averaging to elucidate weak RF ice features.

Primary author: BESSON, David (University of Kansas)

Presenter: BESSON, David (University of Kansas)

Session Classification: Radio

Contribution ID: 30

Type: **not specified**

IceCube-Gen2 Radio Array Surface Calibration: Opportunities from Unique Transmitter and Receiver Systems [Time: 8+4]

Thursday, 8 April 2021 09:04 (12 minutes)

Calibration of the IceCube-Gen2 radio array requires calibrations of the RF channels of stations, and constraining effects from the ice surrounding the channels. Regarding RF channel calibration, experience with ARA and ARIANNA has demonstrated the utility of fixed heartbeat calibration pulse units that probe RF channel response from a fixed location over time. Heartbeat units are operated by station electronics and are installed beneath the surface at locations horizontally separated from RF channels. There are advantages, however, to adding calibration measurements for constraining ice effects from temporary, above-surface fixed transmitters not connected to a station. In a recent publication, the ARIANNA collaboration presented a suite of measurements collected in Moore's Bay and at the South Pole by the RICE collaboration. These measurements revealed horizontal RF propagation over kilometer distances despite expectations given the index of refraction profile of the firn. The mathematics of ray-tracing suggests that horizontal propagation is forbidden in the absence of perturbations in the index of refraction profile. Similar measurements in Greenland also reveal this effect. Repeating such measurements for IceCube-Gen2 would add value by constraining horizontal propagation and attenuation in the actual ice in which the detector is deployed. Another technique that would add value beyond heartbeat units would make use of drone borne transmitters and receivers. Heartbeat units provide single-point azimuth and zenith measurements over time, but cannot probe angular parameter space. Proposed hybrid station designs will require calibration of the radiation pattern and polarization of deployed RF channels built from both dipole and LPDA antennas at different depths and orientations. Finally, drone borne transmitters and receivers would provide a unique opportunity to constrain horizontal variations in the RF attenuation length and birefringence over kilometer distances.

Primary author: Mr HANSON, Jordan (Whittier College)**Presenter:** Mr HANSON, Jordan (Whittier College)**Session Classification:** Radio

Contribution ID: 31

Type: **not specified**

Finite Difference Time-Domain Methods for Askaryan Propagation Modeling in IceCube-Gen2 [Time: 8+0]

Thursday, 8 April 2021 09:16 (8 minutes)

The radio array design of IceCube-Gen2 relies on an understanding of the propagation of Askaryan radiation from UHE neutrino signals through the South Pole firn. Classical ray-tracing techniques are implemented in our standard Monte Carlo package, NuRadioMC, to solve the problem of arrival angle and location of surface signals that have curved paths through a changing index of refraction. The classical solution is based on the connection between density and RF index of refraction, and may be derived analytically while introducing just two free parameters. The model does not account for observed horizontal propagation, and it does not account for wavelength-dependent effects. MEEP is a fast, parallel computational implementation of Maxwell's equations with a time-tested suite of electromagnetic field calculation tools in media with complex dielectric constants. Based on the FDTD approach, MEEP can be used to model RF antenna response, to predict electric field strength in complex propagation problems, including analytic Askaryan RF emission model radiation propagation through firn. Finally, note that the radio array of IceCube-Gen2 includes phased arrays of identical RF elements in an environment with potentially varying index of refraction. Tools like FDTD will have to be deployed to understand the effect of the varying index on phased array properties.

Primary author: Mr JORDAN, Hanson (Whittier College)

Presenter: Mr JORDAN, Hanson (Whittier College)

Session Classification: Radio

Contribution ID: 32

Type: **not specified**

Lessons learned from the calibration of ARIANNA surface station [Time: 10+3]

Thursday, 8 April 2021 10:35 (13 minutes)

In this short overview, we outline the primary challenges, remaining questions, and suggested recommendations for calibration activities associated with ice properties, antenna calibration, channel calibration, and system calibration. In addition to dedicated devices, some important calibration requirements can be met by external sources such as cosmic rays.

Presenter: BARWICK, Steve (University of California, Irvine)

Session Classification: Radio

Contribution ID: 33

Type: **not specified**

Lessons learned from the calibration of ARIANNA surface station

In this short overview, we outline the primary challenges, remaining questions, and suggested recommendations for calibration activities associated with ice properties, antenna calibration, channel calibration, and system calibration. In addition to dedicated devices, some important calibration requirements can be met by external sources such as cosmic rays.

Primary author: BARWICK, Steve (University of California, Irvine)

Presenter: BARWICK, Steve (University of California, Irvine)

Session Classification: Radio

Contribution ID: **34**

Type: **not specified**

Carsten group intro

Friday, 9 April 2021 10:10 (5 minutes)

Presenter: ROTT, Carsten (University of Utah)

Session Classification: Surface

Contribution ID: 35

Type: **not specified**

Introduction

Friday, 9 April 2021 08:00 (5 minutes)

Presenter: SCHROEDER, Frank (University of Delaware / Karlsruhe Institute of Technology)

Session Classification: Surface