Gen2 Radio Array Calibration WS

Increasing need for calibration!

- The IceCube Gen2 in-ice radio array builds on experience from ARA and ARIANNA (+ RICE, ANITA) and from RNO-G (under construction)

- Important to know methods, challenges and solutions as used in these arrays
  → Some of the presentations focus on this

IceCube Gen2 Radio array is <u>expected to detect</u> a neutrino flux, thus even more dependent on good calibration than previous arrays

-> Need to increase our efforts on best calibration of the Gen2 RA

Increasing need for calibration!

Need to increase our efforts on best calibration of the Gen2 RA ….

- Do we know with which precision we need to determine the detector parameters?

- What is the scientific impact of parameters that are poorly known?

- Simulation studies are needed on to answer these questions

Knowledge needed to spend resources efficiently

   Unfortunately no presentation on this today, not there yet

Radio Review Report

Some excerpts from the report:

- …….review panel notes that for the PDR costing should include realistic estimates for calibration, …………

- ….. not clear if the deep radio transmitters currently installed in IceCube or to be installed in the IceCube Upgrade will be part of the calibration program …….

- …..made clear what the requirement is for global time calibration between IceCube/Gen2 optical and Gen2 radio.

Radio Review Report

Also from the report, relevant to calibration:

- capability of background identification
- Pinpointing the sources of UHE neutrinos
- good angular resolution less than a few degrees
- Pointing resolution of ~ 3 deg
- Energy resolution
  - sufficient energy resolution to measure the spectrum
  - dominated by inherently unknown inelasticity of neutrino-nucleus interactions. …. smaller effect on electron neutrino CC interactions and possibly events with multiple showers detected.
  - Shower energy resolution **itself** should be quantified.

All statistical and systematic uncertainties and their impact should be included   (in the PDR)

What needs to be calibrated in the RA?

Antennas!

- In situ is the relevant information……. But hard to get for all cases, so needs lab test, test in anechoic chambers, numerical modelling.

- In situ properties may be station dependent.

- Geometry, positions and orientations (LPDA)

Electronics chain

- Amplifiers, cables, variations with temps, volts …… mainly lab work

- Field verification, changes?

- Timing calibration within station, between stations? to other parts of IceCube?

Ice properties

- Refractive index vs depth, snow accumulation, RF channeling ('horizontal propagation', density variation layers), birefringence…….

Time schedule for today

Many suggestions in response to my call!

- This is very good, shows high interest, many ideas and willingness to share experiences from work with installed systems

- Unfortunately time available/contribution relatively short

- A few suggested contributions could not be accommodated

- Time for presentation (p) and for discussion (d) indicated in Indico: [Time: p+d]

- Presenters located across globe, from Japan to California……., and some teach! But remember presentations are recorded, if you want to see them later

NOTE

Tomorrow is for Surface Array

Includes upward radio for CR

Common aspects and possibilities for calibration with in-ice RA?

Find the time and join!