



AraSimQC and Public Simulation Sets

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Purpose of AraSimQC

- Allow a quick visual comparison between:
 - Different versions and releases of AraSim
 - Different detector configurations and station number
- Allow the user to easily browse all histograms of variables from all classes
- Automatically generate general purpose simulation sets for each new version/ release of AraSim
- Create website for easy viewing of AraSim output (plots, simulation sets, etc)



Purpose of AraSimQC (cont)

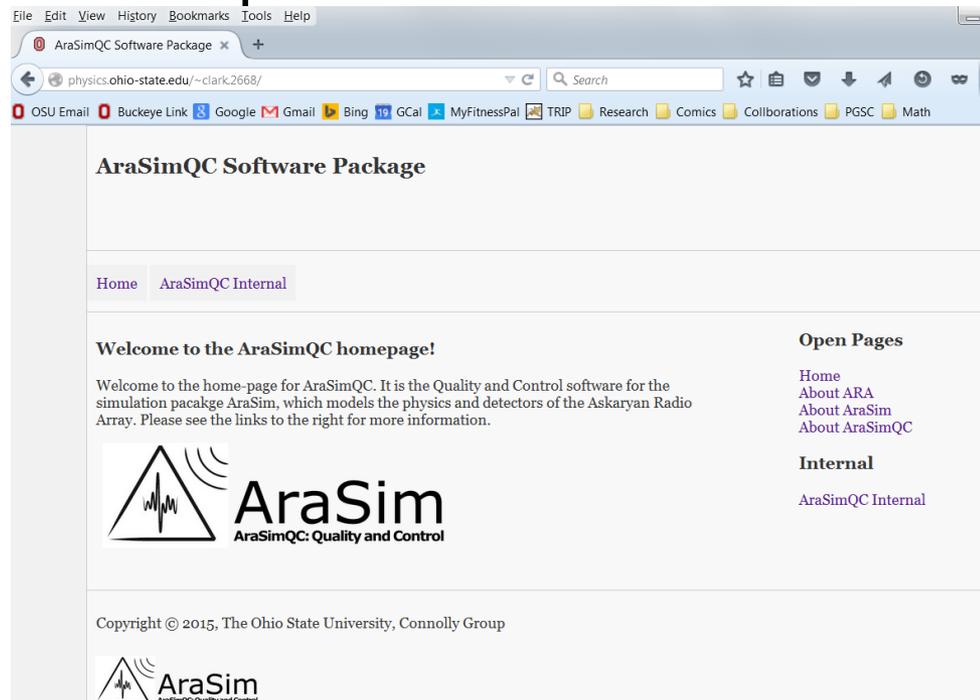
- AraSimQC:
 - Is a collection of interlocking bash scripts
 - Checks for updates to AraSim (releases and trunks)
 - Generates a set of output plots when changes are found
- AraSimQC automatically posts these to a website for viewing
- AraSimQC saves the simulation output so it can be downloaded and re-used later for general purposes

Work closely with Kaeli Hughes, who writes IcemcQC, the software package for the ANITA (Antarctic Impulse Transient Antenna) Experiments. Huge thanks to Dr. Carl Pfendner for mentorship and support during the development of both AraSimQC and IcemcQC.



Website: Feel Free to Follow Along

- Website home:
<http://ara.physics.ohio-state.edu/arasimqc>
- All internal pages require the general collaboration username and password





Goals of AraSimQC

- Runs automatically—minimize human supervision
- Modular design
- Resource efficient: utilizes PBS/qsub for batch processing of simulations
- Multiple checks for errors throughout; thorough logging of errors and progress
- Easy to update as collaboration needs evolve



History of AraSimQC

- Born out of a need to keep track of the rapid changes to the AraSim code
 - ARA Collaboratoin has 10+ global partners
 - AraSim generally sees 2-3 trunk updates per month
- May-August 2014: initial code designed and written by graduate Khalida Hendricks May-August 2014 at OSU
- September 2014-present: further modifications and development maintained by Brian Clark and Kaeli Hughes (IcemcQC) also at OSU



If Code Updates are Found:

- AraSimQC download and runs the latest versions of AraSim (both releases and trunks)
- It makes a standard set of plots
- It uploads these plots to a website for viewing



If Code Updates are NOT Found:

- AraSimQC checks to see if a new plotting program has been added since the last run
- If yes, new plots are generated for all existing trunks and releases
- These updates are appended to the website



Total Automation

- Procedure is totally automatic
- Run by an automated account on OSU computing cluster
- Performed once per week by a chron job
- Manual mode possible: useful if you want to make a bunch of plots for a selected revision



Website Features: Plot Comparison

- Home -> AraSimQC Internal -> Plots Comparison



- Is the primary end product of AraSimQC
- Allows easy comparison of a plot across revisions, station configurations, and energies of AraSim
- Useful “All Plots” feature, which will show you all of the plots associated with a single class
- Can easily download a PNG or PDF copy of each plot

First, select the parameters that will be **shared** between the two plots.

Select Class: **Primaries** ▾

Select Plot: **posnu** ▾

The description of the plotted variable will appear below (if available):

Now, select the parameters for the **first** plot.

Select ARA Configuration: **ARA 1** ▾

Select Energy (eV): **10e18** ▾

Select Revision Number: **Release 1.0** ▾

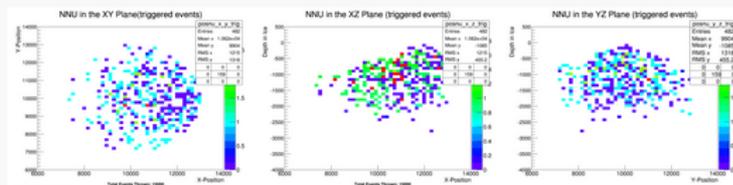
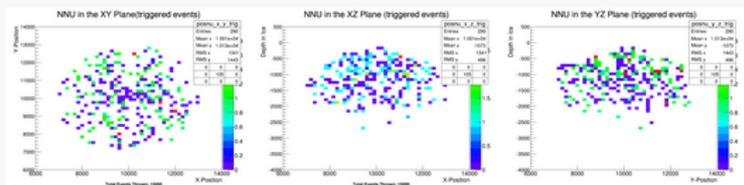
Finally, select the parameters for the **second** plot.

Select ARA Configuration: **ARA 7** ▾

Select Energy (eV): **10e19** ▾

Select Revision Number: **Trunk 510** ▾

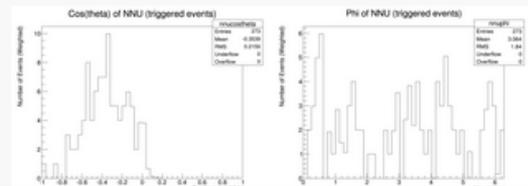
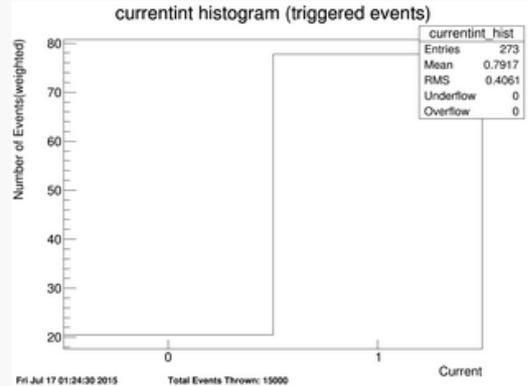
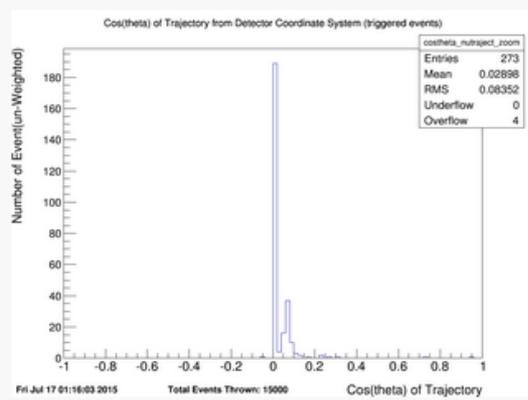
Compare!





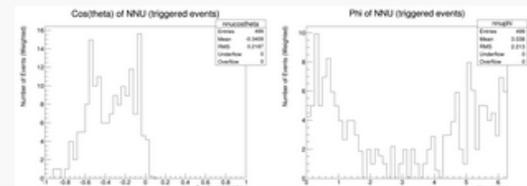
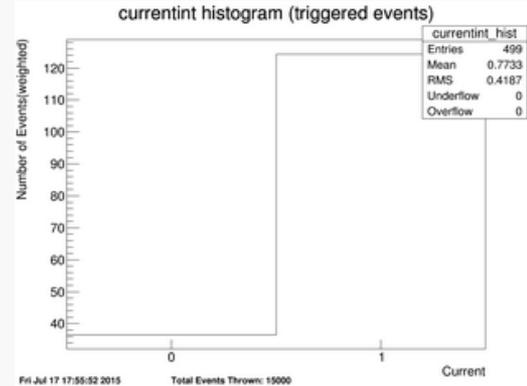
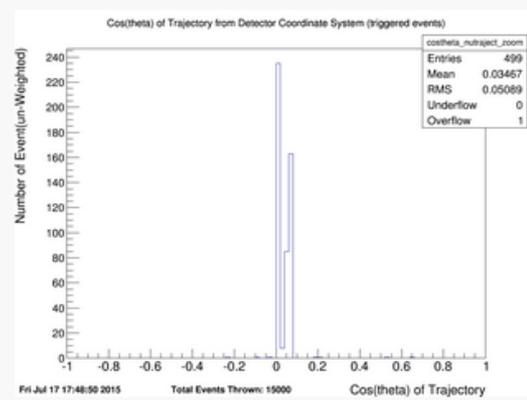
All Plots List For First Selection

ARA Configuration: Single Station, Energy: 10e18 , Class: Primaries, Revision: rel_1.0



All Plots List For Second Selection

ARA Configuration: 7 Stations, Energy: 10e19 , Class: Primaries, Revision: trunk_512





Doxygen Comment Support

- Doxygen is a tool available for generating program documentation from annotated C++ sources (also does PHP, Java, Python, etc.)
- Parses source files (header files, .cc files, etc), figures out class structure and code comments, and outputs them in easy formats
- The full doxygen documentation for AraSim is available: Home -> AraSim, link at bottom of page

Home AraSimQC Internal

AraSim

AraSim is a software package used by the Askaryan Radio Array (ARA) collaboration to simulate the detector response of the physical array located in Antarctica. Because neutrinos are difficult to detect, simulating the neutrinos, their interactions, and the detector helps the ARA collaboration to test the design and function of ARA without having to wait for large numbers of physical neutrinos to actually be detected.

AraSim provides details of simulated ultra-high energy (UHE) neutrino interactions, including neutrino absorption in the Earth, the radio Cherenkov signal spectrum, the signal's propagation through the Antarctic ice, and modelling properties of the detector.

For documentation on the AraSim software package, please click [here](#) (password protected).

Open Pages

Home
[About ARA](#)
[About AraSim](#)
[About AraSimQC](#)

Internal

[AraSimQC Internal](#)



Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

Antenna	
Antenna_r	
Antenna_string	
ARA_station	
RayTrace::attenuationModel	A class providing a description of the attenuation length for radio signals in the ice
basicAttenuationModel	
constantRefractiveIndex	
Counting	
Detector	
EarthModel	
Efficiencies	
Event	
exponentialRefractiveIndex	Implements an exponential parameterization for the ice index of refraction
RayTrace::fullRayPosition	A structure for tracking intermediate coordinates during a ray-trace
IceModel	
IdealStation	
RayTrace::indexOfRefractionModel	A class providing a description of the index of refraction of the ice
InstalledStation	
Interaction	
inverseExponentialRefractiveIndex	
RayTrace::minimalRayPosition	A structure for tracking intermediate coordinates during a ray-trace
negligibleAttenuationModel	Implements an attenuation model with no attenuation
Parameters	
pathPrinter< positionType >	
RayTrace::pathRecorder< positionType >	
pathStore_test< positionType >	
pathStore_vector< positionType >	
Position	
RayTrace::positionRecordingWrapper< positionType >	For internal use by TraceFinder
Primaries	
quadraticRefractiveIndex	
Ray	
RayTrace::indexOfRefractionModel::RayEstimate	
RayTrace::rayPosition	A structure for tracking intermediate coordinates during a ray-trace
RaySolver	



Doxygen Comment Support (cont)

- The AraSimQC website displays “hint boxes” that give the meaning of plotted variables
- These definitions are generated by the doxygen comments found in the AraSim code itself
- An AraSimQC module parses the class header for the doxygen flags, outputs comments in method friendly to jQuery processing

Select Class: Primaries

Select Plot: r_in

The description of the plotted variable will appear below (if available):

position where neutrino enters the earth

Now, select the parameters for the **first** plot.

Select ARA Configuration: ARA 1

Select Energy (eV): 10e18

Select Revision Number: Release 1.0

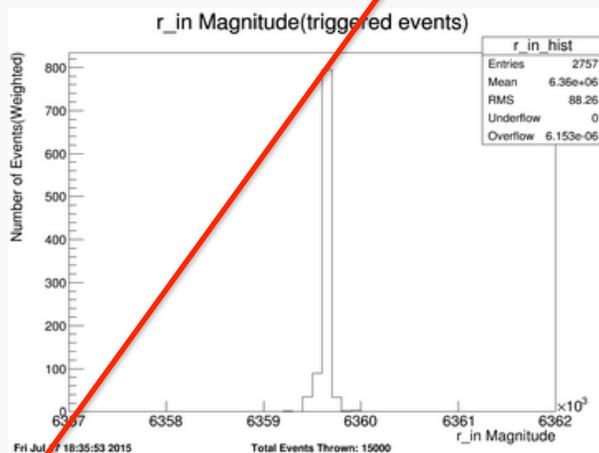
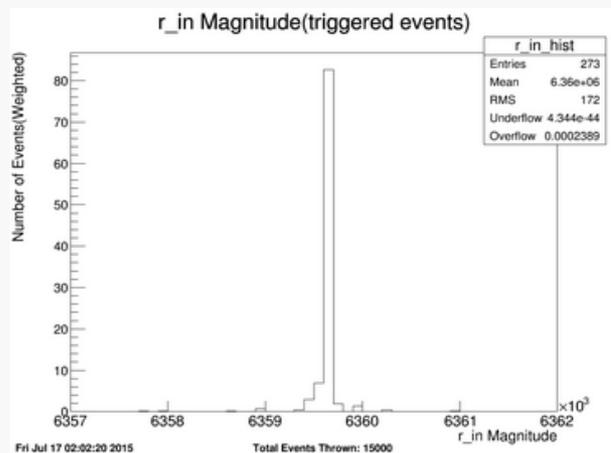
Finally, select the parameters for the **second** plot.

Select ARA Configuration: ARA 7

Select Energy (eV): 10e19

Select Revision Number: Trunk 512

Compare!



The description of the plotted variable will appear below (if available):

position where neutrino enters the earth

Description of selected plot appears



Adding Plots

- Adding new plots is straightforward; super-user places plotting programs in a specified directory—Done!
- All plotting programs must be C++ compilable programs
- Website supports the submission of plots by the collaboration—please help us make AraSimQC better!
- New plots submissions must include:
 1. List of all plotting programs
 2. List of all plots (can have more than one plot per program)
 3. Attach plotting programs and makefiles
- Link and detailed instructions are on the “plots request” page (Internal Home -> Plots Request)

Step 1: List Plotting Programs (.cc Files)

Below, list the names of the **program files** you are submitting. List one script per line.

Step 2: List Plot Titles

Below, list the titles of the **plots** you are submitting. List one plot per line.

Step 3: Attach Plotting Scripts and Makefiles

Below, attach the **plotting program** and corresponding **makefiles**. Please submit them as a single tarball or zip file.

Drop files or click here to upload



Website Features: Public Simulation Sets

- Simulations are resource intensive—need lots of time and computing power
- The AraSimQC output will serve as “publicly available” simulation sets (available to collaboration only)
 - Several energies (10^{17} through 10^{21}), option for input spectrum if requested
 - Several configurations (ARA1, ARA7)
- Coming soon: the simulation sets can be accessed via the OSU ARA website



Next Steps

- Addition of more classes and plots; your help is welcome and requested!
- Adding plots is a great project for a new student!



Please head to the website, try it out, and offer us comments on further improvements!

Thank you!

Questions? Comments?



Back-Up Slides



The AraSimQC Software Outline

1. AraSimQC and AraSimQCParameters.txt
2. AraSimQC Updater
3. AraSimQC Version
4. AraSimQC Setup
5. AraSimQC Submit
6. runAraSim
7. AraSimQC Plotter
8. AraSimQC Sorter
9. AraSimQC Website*
10. ArasimQC Comments*
11. AraSimQC Closeout

* = Auxiliary Modules



AraSimQC Software Flowchart

