SD session – GCOS (June 11, 2023)

Mass sensitivity increase (Ben Flaggs, Delaware)

* Using Auger EAS libraries, looking at the contributions of a bunch of observables in Auger to the figure of merits for composition separation (p-Fe, etc…)
* Muon and Xmax together gives the most contributions to the figure of merit
* He-O separation (around 10 EeV) will require a very good detector combination to maximize the merit factor. If the figure of merit remains small, one can always select on the tails, but then less stat.
* CORSIKA EAS libraries at various altitudes / look at results in different altitude levels / TB of data will need to be stored

SD detectors – discussion:

Detector solutions:

* Water Cherenkov (WCD) [one-layer/two-layers/nested]
* Scintillator (S) [collection of 1D layers or a specially designed 3D type detectors]
* Combinations: WCD+S, S+WCD, WCD+S+WCD, S+WCD+S…
* Use of absorption layers (pre-cast concretes, Pb, …)
* Others?

Further Discussion: No need to down select at this point. There is plenty of time and we need to assess what AugerPrime (including RD), DNN/ML, etc… will be able to deliver, what the science case will end up being. Will we need to do better than Auger? There are some constraints on costs, deployment, etc… The detectors should be cheap if we want 10,000+. Offline simulation access for GCOS (TB request): simulation challenge in a common framework. Non-Auger member working with Offline? GCOS GitLab space with open-source software.

Optical sensors and light collections:

* PMTs, SiPMs…
* Winston cones, optical fibers…

SWGO unit detector design (Hazal Goksu, MPI Heidelberg)

Options:

* Aquamate company: water bladder and large tanks made of separate parts (Metal)
* Rotomolded tanks
* Lake design with floating bladders
* Material for the bladders / liners provided by Layfield (Canada)
* Hot air welding to make them watertight
* Dual layer bladder design, several options being looked at to separate the volumes. PMT location separate or “back-to-back” (one looking up to the top volume, one looking down to the bottom volume).

Light concentrators (Juan Aguilar, ULB)

* SiPM + LC to maximize light collection efficiency – there are some tradeoffs.
* Winston cones can do 3-5x light concentration. WC is the best 2D concentrator, but a bit more complex in 3D.
* There are other concentrators, e.g. inelastic concentrators, inelastic+elastic concentrators. 3D is never as good as 2D.

Further discussion: SiPMs are small, that’s a downside. Also noise. Winston cones in water may require some development, but it should work. Some development in DUNE using WC and a light trapping filter (using wavelength shifting). Other ideas: wavelength shifting plates or collections of fibers.

Prototypes:

* Nijmegen: Segmented tank with KM3NET DOM
* Mines: Double liner w/ or w/o scintillators and/or 3D scintillator assembly
* Delaware: RD option for IceCube (at TA)
* Tests in the northern hemisphere at TA is a possibility (Auger@TA hexagon, Ice Cube@TALE)