**IceCube Institutional Memorandum Of Understanding (MOU)**

**Scope of Work**

**Chiba University**

**Shigeru Yoshida**

**Ph.D Scientists** (Faculty Scientist/Post Doc Grads) : **6** (2 4 2)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Labor Cat.** | **Names** | **WBS L3** | **Tasks** | **WBS 2.1** | **WBS 2.2** | **WBS 2.3** | **WBS 2.4** | **WBS 2.5** | **Grand Total** |
| Program Management | Detector Maintenance & Operations | Computing & Data Management | Triggering & Filtering | Data Quality, Reconstruction & Simulation Tools |
| KE | YOSHIDA, SHIGERU | Reconstruction/ Analysis tools | Maintain Romeo, EHE Simulations, Calibration using Standard Candles |   |   |   |   | 0.20 | 0.20 |
| **YOSHIDA,SHIGERU Total** |  |  |  |  |  | **0.20** | **0.20** |
| KEIICHI MASE | Reconstruction/ Analysis tools | Maintain Romeo, EHE Simulations, Maintain reconstruction projects (Portia), MC/Data comparison for EHE-filtered and IceTop events, Standard Candle Analysis |   |   |   |   | 0.20 | 0.20 |
|  | Simulation productions | Generating background event simulation by Corsika |   |   |  0.20 |   |  | 0.20 |
|   | **KEIICHI MASE Total** |  |  |  | **0.20** |  | **0.20** | **0.40** |
| SC | ISHIHARA, AYA | Physics Coordination | Diffuse WG co-chair |  |  |  | 0.25 |  | 0.25 |
| Physics Filters | EHE filter  |  |  |  | 0.15 |  | 0.15 |
|  | Reconstruction/ Analysis tools | Maintain Portia and the SC data filtering  |  |  |  |  | 0.15 | 0.15 |
|   | **ISHIHARA, AYA Total** |  |  |  |  | **0.40** | **0.15** | **0.55** |
| PO | Matthew Relich | Reconstruction/Analysis tools | Standard Candle data analysis for calibrating DOM and ice |  |  |  |  | 0.15 | 0.15 |
|  |  | Reconstruction/Analysis tools | EHE online pipeline for gamma-ray follow-up |  |  |  |  | 0.15 | 0.15 |
|   | **RELICH, MATTHEW Total** |  |  |  |  |  | **0.30** | **0.30** |
|   | **PO Total** |  |  |  |  |  | **0.30** | **0.30** |
|  GR | CHIBA GR | Detector Monitoring | Detector Monitoring |   | 0.03 |   |   |   | 0.03 |
|   |   | Reconstruction/ Analysis tools | Improve the Ice Model, model of the non-linear PMT response for improving the saturation corrections |   |   |   |   | 0.20 | 0.20 |
|   | **CHIBA GR Total** |  |  | **0.03** |  |  | **0.20** | **0.23** |
| **CHIBA Total** |  |  |  | **0.03** | **0.20** | **0.40** | **1.05** | **1.68** |

Chiba was responsible for the PMT and EHE simulation programs and many of our service tasks are related to these business. The detector simulation project, Romeo, which is also responsible for the DOM’s acceptance calculation to be implemented in the Photonics, is maintained by our group (**S. Yoshida, K. Mase**) who includes one of the original authors of Romeo (**S. Yoshida**).

The detector calibration using the standard candle has also been on our priority to provide the collaboration with some key knowledge of our detector response. **K.Mase**, **S.Yoshida**, **M.Relich**, maintain this activity to have better understanding of the DOM response and the ice propaties. **M.Relich** works on the flasher and SC data for improving the IceCube's handling of saturated waveform signals. **A.Ishihara** maintains responsible for the SC data filtering to remove chance-coincident muon events for calibration analyses use.

Our other service activities include co-chair of diffuse-atmos WG, charge timing extractor module, Portia, (**A. Ishihara**), which is alternative to WaveReform for processing large pulses in DOM. This module has been frequently used in EHE and monopole analysis that must handle extremely luminous events. The EHE simulation framework/meta-project is maintained by **K. Mase** and **S. Yoshida**.

Chiba also works on EHE filters that contain most energetic population of IceCube events. The filtered data are compared with simulation (**A. Ishihara/S,Yoshida**) for confirming our detector response and its stability to high energy data.

Because the present EHE signal search procedures are not CPU-intensive, **M.Relich** is working on implementing the quasi-online signal selection pipeline for sending alerts to other astronomical instruments. The online search for extremely-high energy neutrinos allows IceCube to trigger follow-up observation by optical/gamma-ray telescopes. **A,Ishihara** provided the initial baseline algorithm for this program.

**T. Kuwabara** participates the effort to measure atmospheric neutrino fluxes. He also provides an interface to the SuperK collaboraion for unified analyses with their data.

Our analysis efforts are mainly focused in search for extremely-high energy neutrinos. **K.Mase** and the graduate students (**H.Ijiri**, **S.Ueyama**) are working on modeling the non-linear behavior of PMT responses with the new in-lab measurements. A successful model will be implemented in the new release of simulations for the collaboration use.

Chiba’s capability for MC data production has been improved. We work on ultra-high energy Corsika simulation and Juliet signal simulation. As network bandwidth from Japan to US is limited, we transfer data to Madison by shipping USB disks. **K. Mase** maintains this service activity.

**Faculty:**

 Shigeru Yoshida – maintain Romeo and EHE simulations, detector calibration

Keiichi Mase – maintain Romeo and EHE simulation, MC/Data comparison for high-energy events, flasher/Standard candle analysis for detector calibration

 **Scientists and Post Docs:**

 Aya Ishihara – Diffuse WG co-chair, maintain EHE simulation. MC/Data comparison for EHE-filtered events, maintain the reconstruction projects (Portia), and develop the suitable algorism for the online search of EHE neutrino signals.

 Analysis topics: IC40+59+79+IC86 combined EHE analysis

 Matthew Relich – ice/DOM calibrations with the standard candle and flasher data. EHE follow-up observation.

 Analysis topics: IC86 –EHE online analysis, PeV neutrino analysis

 Takao Kuwabara – Atomospheric  flux analysis

 Analysis topics: Atmospheric analysis with SK

Lu Lu – detector development and simulation study for IceCube gen2

 Analysis topics: none at the moment.

  **Ph.D. Students:**

 Shyunsuke Ueyama – Operation monitoring, modeling of the detector response to bright photons

Hiroto Ijiri – Detector calibration, testing for IceCube Gen2

 Thesis/Analysis topics: IC86 EHE analysis including improvements of the detector saturation