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

**Scope of Work**

**Chiba University**

**Shigeru Yoshida**

**Ph.D Scientists** (Faculty Scientist/Post Doc Grads): **5** (3 2 0)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Labor Cat.** | **Names** | **WBS L3** | **Tasks** | WBS 2.1 | WBS 2.2 | WBS 2.3 | WBS 2.4 | WBS 2.5 | WBS 2.6 | **Grand Total** |
| Program Coordination | Detector Maintenance & Operations | Computing & Data Management | Data Processing & Simulation | Software | Calibration |
| KE | YOSHIDA, SHIGERU | Reconstruction | Maintain Romeo, EHE Simulations, Calibration using Standard Candles |  |  |  |  | 0.20 |  | 0.20 |
|  |  | Reconstruction | EHE online pipeline for follow-up observations |  |  |  |  | 0.15 |  | 0.15 |
|  |  | Real-Time Alerts | Realtime Oversight Committee member |  | 0.05 |  |  |  |  | 0.05 |
|  | **YOSHIDA,SHIGERU Total** | |  |  | **0.05** |  |  | **0.35** |  | **0.40** |
|  | KEIICHI MASE | Reconstruction | Maintain Romeo, EHE Simulations, Maintain reconstruction projects (Portia), MC/Data comparison for EHE-filtered and IceTop events, Standard Candle Analysis |  |  |  |  | 0.20 |  | 0.20 |
|  |  | Detector Calibration | Calibration WG co-chair |  |  |  |  |  | 0.15 | 0.15 |
|  |  | Ice Properties | Calibration WG co-chair |  |  |  |  |  | 0.10 | 0.10 |
|  |  | Administration | Member of ICC | 0.10 |  |  |  |  |  | 0.10 |
|  | **KEIICHI MASE Total** | |  | **0.10** |  |  |  | **0.20** | **0.25** | **0.55** |
|  | ISHIHARA, AYA | Online Filter (Pnf) | EHE filter |  | 0.15 |  |  |  |  | 0.15 |
|  |  | Reconstruction | Maintain Portia and the SC data filtering |  |  |  |  | 0.15 |  | 0.15 |
|  | **ISHIHARA, AYA Total** | |  |  | **0.15** |  |  | **0.15** |  | **0.30** |
|  | **KE Total** | |  | **0.10** | **0.20** |  |  | **0.70** | **0.25** | **1.25** |
|  | Lu, Lu | Real-Time Alerts | Maintenance of IceCube realtime analysis system |  |  | 0.20 |  |  |  | 0.20 |
|  |  | Distributed Computing Resources | Grid Operations Team |  |  | 0.20 |  |  |  | 0.20 |
|  |  | Simulation Production | Special background simulation production (Corsika) |  |  | 0.20 |  |  |  | 0.20 |
|  | **LU, LU Total** | |  |  |  | **0.60** |  |  |  | **0.60** |
|  | MAKINO, YUYA | Simulation Production | High energy Corsika simulation production with Sibyll 3.2 and EPOS |  |  | 0.20 |  |  |  | 0.20 |
|  | **MAKINO, YUYA Total** | |  |  |  | **0.20** |  |  |  | **0.20** |
|  | **PO Total** | |  |  |  | **0.80** | **0.0** |  | **0.0** | **0.80** |
| GR |  |  |  |  |  |  |  |  |  |  |
|  | **CHIBA GR Total** | |  |  |  |  |  |  |  |  |
| **CHIBA Total** | |  |  | **0.10** | **0.20** | **0.80** | **0.0** | **0.70** | **0.25** | **2.05** |

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 and CLsim, 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**, **Lu Lu** maintain this activity to have better understanding of the DOM response and the ice propaties. **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 calibration WG (**K.Mase**), 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, **S.Yoshida** is serving as a contact person and maintainer on the 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. He also serves as a member of Realtime Oversight Group to ensure functions of the online processing for sending alerts. **A.Ishihara** provided the initial baseline algorithm for this program. **Lu Lu** is now in charge of maintaining the online EHE selection program.

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 – Calibration WG co-chair, maintain Romeo and EHE simulation, MC/Data comparison for high-energy events, flasher/Standard candle analysis for detector calibration

Aya Ishihara –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.

**Scientists and Post Docs:**

Lu Lu – detector development and simulation study for IceCube gen2. The contact point for the grid computing.

Analysis topics: Multi-flavor PeV spectrum analysis.

Yuya Makino – high energy Corsika simulation production with Sibyll 3.2 and EPOS to cover energy range from 100 TeV to 100 EeV.

Thesis/Analysis topics: Not assigned at the moment

**Ph.D. Students:**

Thesis/Analysis topics: Not at the moment

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**Remarks on the Gen2 related activity**

Chiba is working on the new optical detectors, D-Egg, for IceCube-gen2. **Aya Ishihara** leads the development of the D-Egg and spend a significant fraction of her time for this project. **Yuya Makino** is responsible for testing and calibrating all the devices. **Ryo Nakai** (Post doc ) is responsible for developing the front-end electronics and partly help PMT characterization. **Lu Lu** is working on the Gen2-related simulation study. Thus a major fraction of available resources from Chiba has now been channeled into the IceCube-gen2 and IceCube upgrade.

**Computing Resources**

Chiba has 16 computational nodes and 196 cores in total. They are all intel Xenon machines and the latest one’s specification is Xeon E5-2667 v2 with the frequency of 3.3 GHz.

There are also two GPU nodes and one has two nvidia Tesla K40 and another has two Tesla K80, so 6 cores in total.

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