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

**Scope of Work**

**Michigan State University**

**Tyce DeYoung**

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

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Labor Cat.** | **Names** | **WBS L3** | **Tasks** | **Funds Source** | **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 | DeYOUNG, TYCE | Education & Outreach | Education & Outreach | Inst. In-Kind | 0.05 |  |  |  |  |  | **0.05** |  |
|  |  | Administration | Executive committee | Inst. In-Kind | 0.05 |  |  |  |  |  | **0.05** |  |
|  | **DeYOUNG, TYCE Total** | |  |  | **0.10** |  |  |  |  |  | **0.10** |  |
|  | MAHN, KENDALL | Simulation Software | Integration/development of GENIE for low energy systematics | Inst. In-Kind |  |  |  |  | 0.05 |  | **0.05** |  |
|  | **MAHN, KENDALL Total** | |  |  |  |  |  |  | **0.05** |  | **0.05** |  |
| PO | TBD | Simulation Production | Simulation Production | Inst. In-Kind |  |  |  |  |  |  |  |  |
|  |  | Central Computing Resources | Simulation production site manager at MSU/Condor integration | NSF M&O Core |  |  |  |  |  |  |  |  |
|  | **PO TBD Total** | |  |  |  |  |  |  |  |  |  |  |
| GR | NEER, GARRETT | Detector calibration | In-situ DOM sensitivity calibration/angular response from muon neutrinos | Inst. In-Kind |  |  |  |  |  | 0.25 | **0.25** |  |
|  |  | Education & Outreach | IceCube Masterclass | Inst. In-Kind | 0.05 |  |  |  |  |  | 0.05 |  |
|  | **NEER, GARRETT Total** | |  |  | **0.05** |  |  |  |  | **0.25** | **0.30** |  |
| GR | RYSEWYK, DEVYN | Detector Monitoring | Monitoring Shifts | Inst. In-Kind |  | 0.03 |  |  |  |  | **0.03** |  |
|  | Education & Outreach | Education & Outreach, IceCube Masterclass | Inst. In-Kind | 0.10 |  |  |  |  |  | **0.10** |  |
| **RYSEWYK, DEVYN Total** | |  |  | **0.10** | **0.03** |  |  |  |  | **0.13** |  |
| GR | MICALLEF, JESSIE | Education & Outreach | IceCube Masterclass | Inst. In-Kind | 0.05 |  |  |  |  |  |  |  |
|  | **MICALLEF, JESSIE Total** | |  |  |  |  |  |  |  |  |  |  |
| **MSU Total** | |  |  |  | **0.30** | **0.03** |  |  | **0.05** | **0.25** | **0.63** |  |

Michigan State contributions to the maintenance and operations of IceCube include:

**Faculty:**

Tyce DeYoung – Exec. comm., outreach, 100% IceCube

Kendall Mahn – low energy systematics/GENIE, 5% IceCube (95% GENIE, T2K, DUNE)

**Scientists and Post Docs:**

PO TBD – simprod, distributed computing, other contributions TBD once candidate is identified

**Ph.D. Students:**

Garrett Neer Reco/analysis tools: DOM calibration using neutrino-induced muons. Education and outreach: IceCube Masterclass

Thesis/Analysis topics: dark matter search using LE and ME contained events

Devyn Rysewyck Detector monitoring: shift. Education and outreach: SP Experiment jury, Science Fest Q&A, IceCube Masterclass

Thesis/Analysis topics: Extended Galactic source search, IceACT R&D

Jessie Micallef currently TA, plan to join strike team once done with coursework

Education and outreach: IceCube Masterclass

Thesis/Analysis topics: Next-generation oscillation analysis

**Computing Resources:**

**MSU Pledged Computing Resources**

|  |  |  |
| --- | --- | --- |
|  | **2017** | |
|  | **CPU Cores** | **GPU Cards** |
| **IceCube** | 500\* | 8\* |
| **PINGU** |  |  |
| **Gen2** |  |  |

**\*as simprod by policy does not carry out low energy signal production, the primary computational task for low energy physics, these resources will be available for IceCube multi-institutional computing but not necessarily under simprod**

**Computing Resources Typically Available**

|  |  |  |
| --- | --- | --- |
|  | **2017** | |
|  | **CPU Cores** | **GPU Cards** |
| **IceCube** | 1000 (est.) | 200 (est.) |
| **PINGU** |  |  |
| **Gen2** |  |  |

The Michigan State IceCube group has access to several large computing clusters maintained and administered by the Michigan State High Performance Computing group and the Institute for Cyber-Enabled Research, comprising a total of approximately 15,600 computing cores, including 80 Tesla K20c and 200 Tesla K80 GPU cards. Of these, 728 cores 8 K80 GPUs are dedicated to IceCube. Actual availability will be very substantially higher for jobs with durations less than 4 hours, but cannot be accurately estimated until simprod begins sending processing jobs to MSU.

The average computational resources provided for common processing is roughly 500 CPUs and 150 GPU cards.  Peak levels are approximately 3000 CPUs and 300 GPU.

**Note:** The activities and staffing levels in this MoU are appropriate for the six-month period beginning Sept 1, 2017.