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

**Scope of Work**

**University of Maryland**

**Greg Sullivan**

**Ph.D Scientists** (Faculty Scientist/Post Doc Grads): **6** (3 3 4)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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 | SULIVAN, GREG | Administration | M&O/Upgrade planning | Inst. In-Kind | 0.30 |   |   |   |   |  | 0.30 |
|  | Administration | ExecCom member | Inst. In-Kind | 0.20 |   |   |   |   |  | 0.20 |
|   | **SULIVAN, GREG Total** |  |  | **0.50** |  |  |  |  |  | **0.50** |
|  | HOFFMAN, KARA | Engineering and R&D Support | Detector R&D | Inst. In-Kind | 0.20 |   |   |   |   |  | 0.20 |
|   | **HOFFMAN, KARA Total** |  |   | **0.20** |  |  |  |  |  | **0.20** |
|   | UMD KE | Education & Outreach | E&O | Inst. In-Kind | 0.10 |   |   |   |   |  | 0.10 |
|   | **UMD KE Total** |  |   | **0.10** |  |  |  |  |  | **0.10** |
| SC | BLAUFUSS, ERIK   | Online Filter (PnF) | Maintain PnF Software and Online Filters | NSF M&O Core |   | 0.20 |   |   |   |  | 0.20 |
| Administration | Analysis Coordinator | Base Grants | 0.25 |  |  |  |  |  | 0.25 |
|   | Administration | Analysis Coordinator | NSF M&O | 0.15 |   |   |  |   |  | 0.15 |
|   | Online Filter (PnF) | Filter requests, bandwidth, TFT Board Member. IceTray | NSF M&O |   | 0.30 |   |  |   |  | 0.30 |
|   | **BLAUFUSS, ERIK Total** |  |  | **0.40** | **0.50** |  |  |  |  | **0.90** |
| PO | OLIVAS, ALEX | Detector Maintenance & Operations | SW Coordinator – Detector M&O | NSF M&O |   |   0.45 |  |  |  |  | 0.45 |
|  |  | Computing & Data Management | SW Coordinator – Core Software | NSF M&O |  |  | 0.20 |  |  |  | 0.20 |
|  |  | Data Quality, Reconstruction & Simulation Tools | SW Coordinator – Data Quality, Reconstruction and Sim. Programs | NSF M&O |  |  |  |  | 0.25 |  | 0.25 |
|  |  | Core Software | Support Core Software | Inst. In-Kind |   |  |  0.10 |   |  |  | 0.10 |
|   | **OLIVAS, ALEX Total** |  |  |  | **0.45** | **0.30** |  | **0.25** |  | **1.00** |
|  | FELDE, JOHN | Online Filter (PnF) | GRB filters | Base Grants |  | 0.20 |  |  |  |  | 0.2 |
|  | Reconstruction  | Develop & test reconstruction | Base Grants |  |  |  |  | 0.10 |  | 0.1 |
|   |  | Online Filter (PnF) | Implement near real time system and analysis | Base Grants |   | 0.30 |   |   |   |  | 0.3 |
|   | **FELDE, JOHN Total** |  |  |  | **0.50** |  |  | **0.10** |  | **0.6** |
|  | CHEUNG,ELIM | Reconstruction  | Low energy Reco./ Analysis tools | Base Grants |  |  |  |  | 0.25 |  | 0.25 |
| GR |  | Online Filter (PnF) | Online Filter Testing | Base Grants |   | 0.125 |  |   |   |  | 0.125 |
|   | **CHEUNG, ELIM Total** |  |  |  | **0.125** |  |  | **0.25** |  | **0.375** |
|   | SONG,MING | Engineering and R&D Support | Detector R&D | Base Grants | 0.50 |   |  |   |   |  | 0.5 |
|   | **SONG, MING Total** |  |  | **0.50** |  |  |  |  |  | **0.5** |
|   | MAUNU,RYAN  | Online Filter (PnF) | Online Filter Testing | Base Grants |   | 0.125 |   |   |   |  | 0.125 |
|   | Reconstruction  | Reco./ Analysis tools | Base Grants |   |   |   |   | 0.125 |  | 0.125 |
|   | Simulation Production | Simulation Production site manager | Base Grants |   |   |   | 0.20 |  |  | 0.20 |
|   | **MAUNU, RYAN Total** |  |  |  | **0.125** |  | **0.20** | **0.125** |  | **0.45** |
|   | FREIDMAN, LIZ | Core Software | Core Software | Base Grants |   |   |  |   |  0.125 |  | 0.125 |
|   | Online Filter (Pnf) | Datasets for filter testing & common MC datasets | Base Grants |   | 0.10 |   |  |   |  | 0.10 |
|   | **FREIDMAN, LIZ Total** |  |  |  | **0.10** |  |  | **0.125** |  | **0.225** |
|   |  UMD GR | Detector Monitoring | Monitoring shifts | Base Grants |   | 0.06 |   |   |   |  | 0.06 |
|   | **UMD GR Total** |  |  |  | **0.06** |  |  |  |  | **0.06** |
| **UMD Total** |  |  |  | **1.70** | **1.86** | **0.30** | **0.20** | **0.85** |  | **4.91** |

**Faculty:**

Greg Sullivan (L,+) – Former Spokesperson, Data Systems, ExecCom, ICB, Institution lead, Outreach, NGIC upgrade coordination

Kara Hoffman – filter development, Radio R&D, Outreach

Jordan Goodman – Coordination with Milagro/HAWC, Outreach

**Scientists and Post Docs:**

Erik Blaufuss – Analysis Coordinator, TFT board Member, PnF, IceTray, SVN repository, Operations Group

 Analysis topics: GRB

John Felde – Online – near realtime GRB analysis

 Analysis topics: GRB, Neutrino Oscillations

Alex Olivas – Tuesday Call co-convener, Software management, Simulation program coordinator, Software Coordinator

 Analysis topics:

**Ph.D. Students:**

Ming Song – Detector R&D

 Thesis/Analysis topics: GZK Neutrinos

Elim Cheung – Offline Processing development & testing, Simulation

 Thesis/Analysis topics: Neutrino Oscillations

Ryan Maunu – Filter development, Simulation production coordination

 Thesis/Analysis topics: GRB with Southern hemisphere muons

Liz Friedman – Core Software, Datasets for filter testing & common MC datasets

 Thesis/Analysis topics: TBD

**UMD General M&O (non-science) IceCube Responsibilities and Contributions:**

The Maryland Group’s major responsibilities and contributions towards maintenance and operations of the IceCube experiment include:

* Primary institutional responsibility for the maintenance of the online PnF filter system.
* Primary institutional responsibility for the maintenance of the IceTray analysis framework, SVN code repository and software package building.
* Major responsibility for the maintenance of the IceCube simulation package (IceSim).
* Software coordinator Alex Olivas
* The Maryland group maintains a computing cluster of about 750 cpu cores and 24 GPU boards (GTX980) with online disk storage of more then 350TB dedicated to IceCube activities. A minimum of 350 cpu cores and all GPUs are reserved for dedicated simulation production under the coordination of the IceCube simulation production manager.

**Institutional (UMD) resource contribution to Computing:**

The maintenance and operation of the computing cluster includes:

1. High quality Computing Space, cooling and power (provided by UMD)
2. Networking and high speed connectivity to the Internet (provided UMD)
3. System administration (.5 FTE sys-admin) (partial support by UMD)
4. Hardware maintenance on a 5-year replacement cycle of $40k/year (partial support by UMD).
5. GPU cluster purchased by UMD ($80k) and maintained with help from UMD

*1. & 2. Computing Space, cooling and power & Networking and high speed connectivity to the Internet*

***The University of Maryland provides high quality space, cooling and power.*** The IceCube group is provided essentially unlimited space in a modern HPC computing facility for research computing on campus. The facility is monitored 24/7 by provided technicians and we have 24/7 secure access. The current system occupies 10 rack spaces with additional space set aside for possible expansion. Maryland is a major hub for the Internet-2 backbone in the northeast US. *The University provides a 10 Gb/s fiber connection directly from the interenet-2 backbone into our cluster in the research computing facility.* In addition, the university provides a dedicated fiber between the research computing facility and our research group in the physics building.

*3., 4. & 5. System administration & Hardware maintenance on a 5-year replacement cycle*

***The University of Maryland provides $40k per year in funding to be used towards the total.*** The system administration is approximately .5 FTE and includes administration for the computing cluster as well as about 1 dozen workstations used by the PA group. The hardware maintenance for the compute cluster is $40k per year.

**Computing Resources**

|  |  |  |
| --- | --- | --- |
|  | **2016** | **2017** |
|  | **CPU Cores**  | **GPU Cards** | **CPU Cores** | **GPU Cards** |
| **IceCube**  | 350 guaranteed of 750 total | 24 (GTX980) | 350 guaranteed of 750 total | 48 (GTX980)\* |
| **PINGU** |  |  |  |  |
| **Gen2**  |  |  |  |  |

\* This upgrade to 48 boards is a tentative plan for next year if funds available.