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

**Scope of Work**

**University of Maryland**

**Greg Sullivan**

**Ph.D Scientists** (Faculty Scientist/Post Doc Grads): **5** (3 3 1)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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 | ICC member  | Base Grants | 0.05 |  |  |  |  |  | 0.05 |
|  | Simulation Production | Simulation Production site manager | Base Grants |   |   |   | 0.10 |  |  | 0.10 |
|  | Core Software | Support Core Software | NSF M&O |  |  | 0.25 |  |  |  | 0.25 |
|   | Online Filter (PnF) | Filter requests, bandwidth, TFT Board Member. IceTray | NSF M&O |   | 0.30 |   |  |   |  | 0.30 |
|   | **BLAUFUSS, ERIK Total** |  |  | **0.05** | **0.50** | **0.25** | **0.10** |  |  | **0.90** |
| PO | OLIVAS, ALEX | Detector Maintenance & Operations | SW Coordinator – Detector M&O | NSF M&O |   |   0.45 |  |  |  |  | 0.45 |
|  |  | Administration | ICC | Base Grants | 0.05 |  |  |  |  |  | 0.05 |
|  |  | 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 Simulation | NSF M&O |  |  |  |  | 0.25 |  | 0.25 |
|  |  | Core Software | Support Core Software | Inst. In-Kind |   |  |  0.05 |   |  |  | 0.05 |
|   | **OLIVAS, ALEX Total** |  |  | **0.05** | **0.45** | **0.25** |  | **0.25** |  | **1.00** |
|  | TBD (replacing John Felde) | Online Filter (PnF) | GRB WG co-chair | Base Grants |  | 0.0 |  |  |  |  | 0.0 |
|  | Reconstruction  | Develop & test reconstruction | Base Grants |  |  |  |  | 0.0 |  | 0.0 |
|   |  | Online Filter (PnF) | Implement near real time system and analysis | Base Grants |   | 0.0 |   |   |   |  | 0.0 |
|   | **FELDE, JOHN Total** |  |  |  | **0.0** |  |  | **0.00** |  | **0.0** |
|  | CHEUNG,ELIM | Reconstruction  | Low energy Reco./ Analysis tools | Base Grants |  |  |  |  | 0.05 |  | 0.05 |
|  |  | Online Filter (PnF) | Online Filter Testing | Base Grants |   | 0.125 |  |   |   |  | 0.125 |
|   | **CHEUNG, ELIM Total** |  |  |  | **0.125** |  |  | **0.05** |  | **0.175** |
| GR | TBD (replacing Ming Song) | Online Filter (Pnf) | Real-time & near real time alerts | Base Grants |  | 0.0 |  |  |  |  | 0.0 |
|   |  | Engineering and R&D | Detector R&D | Base Grants |  |  |  |  | 0.0 |  | 0.0 |
|   | **SONG, MING Total** |  |  |  | **0.0** |  |  | **0.0** |  | **0.0** |
|   | FREIDMAN, LIZ | Engineering and R&D Support | Detector R&D | Base Grants | 0.25 |   |  |   |  |  | 0.25 |
|  | Online Filter (Pnf) | Real-time & near real time alerts |  |  | 0.25 |  |  |  |  | 0.25 |
|   | Online Filter (Pnf) | Datasets for filter testing & common MC datasets | Base Grants |   | 0.10 |   |  |   |  | 0.10 |
|   | **FREIDMAN, LIZ Total** |  |  | **0.25** | **0.35** |  |  |  |  | **0.60** |
|   |  UMD GR | Detector Monitoring | Monitoring shifts | Base Grants |   | 0.06 |   |   |   |  | 0.06 |
|   | **UMD GR Total** |  |  |  | **0.06** |  |  |  |  | **0.06** |
| **UMD Total** |  |  |  | **1.15** | **1.485** | **0.50** | **0.10** | **0.30** |  | **3.535** |

**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 – Former Analysis Coordinator, TFT board Member, PnF, IceTray, SVN repository, Operations Group, ICC

 Analysis topics: GRB, real time alerts

TBD to replace – Online – near real time GRB analysis

Elim Cheung – Offline Processing development & testing, Simulation

 Thesis/Analysis topics: Neutrino Oscillations

John Felde Analysis topics: GRB, Real time alerts, Neutrino Oscillations

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

 Analysis topics:

**Ph.D. Students:**

TBD to replace

Ming Song – Filtering and Detector R&D

 Thesis/Analysis topics: Multi-messenger transient & GRB search

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

 Thesis/Analysis topics: GRB

**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 48 GPU boards (24 GTX980, 24 GTX1080) 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. Maryland also provides resources to host and maintain a 64 GPU card system for UW.

**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. First ½ of GPU cluster purchased by UMD ($80k) and maintained with help from UMD
6. hosting and maintaining an additional 64 GPU cards provided from UW for MC production

*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 Maryland-IceCube system occupies 10 rack spaces with additional space set aside for possible expansion.

Host to UW GPU system of 8 GPU systems for 64 GPU cards.

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**

|  |  |  |
| --- | --- | --- |
|  | **2017** | **2018** |
|  | **CPU Cores**  | **GPU Cards** | **CPU Cores** | **GPU Cards** |
| **IceCube**  | 350 guaranteed of 750 total | 24 (GTX980) +24 (GTX1080) | 350 guaranteed of 1000 total | 48(GTX980/1080)+ 64 new GPU cards hosting for UW |