**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 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 | SULIVAN, GREG | Administration | M&O 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 |  |  | 0.1 |  |  |  | 0.1 |
|   | Online Filter (PnF) | Filter requests, bandwidth, TFT Board Member. IceTray | NSF M&O |   | 0.1 |   |  |   |  | 0.1 |
|   | **BLAUFUSS, ERIK Total** |  |  | **0.05** | **0.3** | **0.1** | **0.10** |  |  | **0.55** |
| PO | OLIVAS, ALEX | Detector Maintenance & Operations | SW Coordinator – Detector M&O | NSF M&O |   |   0.35 |  |  |  |  | 0.35 |
|  |  | Administration | ICC member | Base Grants | 0.05 |  |  |  |  |  | 0.05 |
|  |  | Computing & Data Management | SW Coordinator – Core Software | NSF M&O |  |  | 0.20 |  |  |  | 0.20 |
|  |  | Reconstruction | 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** | **0.35** | **0.25** |  | **0.25** |  | **0.90** |
|  | Larson, Michael  | Simulation | Low Energy tools | Base Grants |  |  |  | 0.05 |  |  | 0.05 |
|  | Reconstruction  | Neutrinos source WG technical lead software/likelihood | Base Grants |  |  |  |  | .20 |  | 0.20 |
|   |  | Online Filter (PnF) | Near Real time alerts/GRB | Base Grants |   | 0.1 |   |   |   |  | 0.1 |
|   | **Larson, Michael Total** |  |  |  | **0.1** |  | **0.05** | **0.20** |  | **0.35** |
| GR | John Evans | Online Filter (PnF) | Near Real time alerts/GRB | Base Grants |  | 0.1 |  |  |  |  | 0.1 |
|   | **TBD Total** |  |  |  | **0.1** |  |  |  |  | **0.1** |
|   | 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 | Base Grants |  | 0.35 |  |  |  |  | 0.35 |
|   | **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** | **1.26** | **0.35** | **0.15** | **0.45** |  | **3.36** |

**UPGRADE**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Labor Cat.** | **Names** | **WBS L3** | **Tasks** | **Funds Source** | **WBS 1.6** | **Grand Total** |
| Data Systems |
| KE | SULIVAN, GREG | Administration | Upgrade planning | Inst. In-Kind | 0.04 | 0.04 |
|   | **SULIVAN, GREG Total** |  |  | **0.04** | **0.04** |
|   | **UMD KE Total** |  |   | **0.04** | **0.04** |
| SC | BLAUFUSS, ERIK   | Administration | L2 Manager | NSF M&O Core/NSF Upgrade |  0.45 | 0.45 |
|   | **BLAUFUSS, ERIK Total** |  |  | **0.45** | **0.45** |
| PO | OLIVAS, ALEX | SW Coordinator | Offline software and simulation upgrade coordination | NSF M&O/NSF Upgrade |  0.1 | 0.1 |
|   | **OLIVAS, ALEX Total** |  |  | **0.1** | **0.1** |
| **UMD Total** |  |  |  | **0.59** | **0.59** |

**Faculty:**

Greg Sullivan (L,+) – Former Spokesperson, MREFC L2 for 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, Upgrade L2 for Data Systems, ROC committee

Michael Larson – Neutrino source WG Technical lead for software and likelihood, Online – near real time GRB analysis, Extending point source sample to low energy GRECO data set

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

**Ph.D. Students:**

Liz Friedman – Core Software, Datasets for filter testing, Detector R&D

 Thesis/Analysis topics: GRB, Realtime Alerts and response

John Evans – starting work on realtime alerts

 Thesis: Started Fall 2019, topic not yet selected

Jason Fan - beginning student, working on likelihood and multi-messenger fits to data

 Thesis: Started Spring 2020, topic not yet selected

**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
* IceCube Upgrade L2 manager for Data systems and M&O integration
* 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 |