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

**Scope of Work**

**University of Alberta**

**Juan Pablo Yáñez**

**Ph.D Scientists** (Faculty Scientist/Post Doc Grads): **3** (2 1 1)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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 | YANEZ, JUAN PABLO | | Online Filter (PnF) | Oscillations WG co-chair |  | 0.25 |  |  |  |  | 0.25 |
|  | **YANEZ, JUAN PABLO Total** | | |  |  | **0.25** |  |  |  |  | **0.25** |
|  | MOORE, ROGER | | Detector calibration | DOM efficiency with cosmic muons |  |  |  |  |  | 0.10 | 0.10 |
|  |  | | Online Filter (PnF) | TFT board member |  | 0.10 |  |  |  |  | 0.10 |
|  | **MOORE, ROGER Total** | | |  |  | **0.10** |  |  |  | **0.10** | **0.20** |
|  |  | |  |  |  |  |  |  |  |  |  |
|  | **UofA KE Total** | | |  |  | **0.35** |  |  |  | **0.10** | **0.45** |
| PO | HIGNIGHT, JOSHUA | | Simulation production | Production of GENIE signal simulation for low-energy analyses |  |  |  | 0.25 |  |  | 0.25 |
|  |  | | Simulation production | GENIE-icetray maintainer |  |  |  |  | 0.05 |  | 0.05 |
|  |  | | Reconstruction | Level-3 processing maintainer for the LE group |  |  |  | 0.05 |  |  | 0.05 |
|  |  | | Online Filter (PnF) | Reconstruction & Systematics WG co-chair |  | 0.25 |  |  |  |  | 0.25 |
|  | **HIGNIGHT, JOSHUA Total** | | |  |  | **0.25** |  | **0.30** | **0.05** |  | **0.60** |
|  |  | |  |  |  |  |  |  |  |  |  |
|  | **UofA, PO Total** | | |  |  | **0.25** |  | **0.30** | **0.05** |  | **0.60** |
| GR | SARKAR, SOURAV (PhD) | | Simulation production | PYTHIA event generator implementation and maintenance |  |  |  |  | 0.15 |  | 0.15 |
| GILLCRIST, DAVID (MSc) | | Detector calibration | DOM efficiency with cosmic muons |  |  |  |  |  | 0.50 | 0.50 |
|  | **UofA GR Total** | | |  |  |  |  |  | **0.15** | **0.50** | **0.65** |
| CS | RAJEWSKI, JAMIE | Distributed computing resources | | Management of ComputeCanada allocation |  |  | 0.40 |  |  |  | 0.40 |
| Core software | | Updating and maintaining compatibility of tools |  |  |  |  | 0.10 |  | 0.10 |
| **UofA Total** | | |  |  |  | **0.60** | **0.40** | **0.30** | **0.30** | **0.60** | **2.20** |

**Faculty:**

**Full:** Juan Pablo Yanez, Roger Moore

**Associate (Gen2):** Carsten Krauss, James Pinfold

**Scientists and Post Docs:**

Joshua Hignight: Simulation production for low energy studies

**Ph.D. Students:**

Sourav Sarkar (PhD): Grid Operations Team (Analysis focus: neutron capture from high-energy hadronic showers)

**Diploma/Master Students:**

David Gillcrist (MSc): DOM efficiency with cosmic muons (Analysis focus: neutrino oscillations with DeepCore)

**Undergraduates:** 3 students.

**Computing Support:**

Jamie Rajewski (Computer Scientist): Manage Compute-Canada resources. Tools updates.

**Explanation:**

The IceCube group at the UofA is funded via a Canadian Natural Science and Engineering Research Council (NSERC) Discovery Subatomic Projects grant. The group is funded until spring 2019; a new application for a 3-year grant is being submitted later this year. The grant is meant to support IceCube and IceCube-Gen2 activities at the University of Alberta and Queens University. The level of support is for 2-3 full-participant faculty (Clark, Moore and Yanez) and 2 associate faculty (Krauss, Pinfold). Also supported is one postdoc (Hignight), up to 3 graduate students and 4 undergraduate students at the University of Alberta.

**Description of service work and planned analysis:**

The Alberta group is focused on analyses involving data from DeepCore, as well as searching for beyond the Standard Model phenomena on high energy atmospheric neutrinos.

* Joshua is in charge of producing signal simulation for low-energy studies, maintaining the interface that does this and he is also co-convener of the reconstruction and systematics WG. His analysis efforts focus on the next generation of neutrino oscillation studies with DeepCore.
* Sourav is working on creating simulation tools allowing the detailed study of very high-energy showers in IceCube, obtained with Geant4 well above its original energy limit. He has started looking at the signature that di-muons leave in the experiment, targeting neutrino “trident” events.
* David has started taking over the measurement of DOM efficiency with cosmic muons, which needs to be updated for the new ice models and the new knowledge of anisotropy and DOM by DOM SPE templates.
* Jamie has taken over the responsibility of making the Compute Canada systems available to the collaboration via glide-ins. He will also take care of updating tools to be compatible with python3.
* The undergraduates next summer will work on topics like reconstruction/minimization studies and optical calibration devices.

**Computing Resources**

Compute-Canada resources have been established as a primary simulation production resource for the IceCube collaboration. In 2019, a resource allocation of 1934 CPU-years and 40 GPU-years from Compute-Canada was awarded to support IceCube activities. “Pyglidein” clients are running in the CPU portion of Compute-Canada systems since July this year. We also have an IceCube dedicated high-performance GPU cluster based on TITAN X(p) and 1080Ti GPUs in April 2018 with 144 GPUs online, also accepting jobs via pyglideins. Our service activities are centred on the simulation production and reconstruction developments with these resources, and calibration efforts.

GPU types:  
\* 40 GPU-years on Tesla P100 [Compute Canada] – local use  
\* 144 GPU-years on TITAN X(p)/1080Ti [IceCube dedicated cluster] – collaboration

**Computing Resources**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **2019** | | **2020** | |
|  | **CPU Cores** | **GPU Cards** | **CPU Cores** | **GPU Cards** |
| **IceCube** | 1200 guaranteed of 1934 total | 144 TITAN X(p)/1080 Ti | 1200 guaranteed of 1934 total | 144 TITAN X(p)/1080 Ti |