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

**Scope Of Work**

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| **University of Alberta**  **Darren Grant**  **Ph.D Scientists** (Faculty Scientist/Post Doc Grads) : **3** (2 1 2) |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Labor Cat.** | **Names** | **WBS L3** | **Tasks** | **WBS 2.1** | **WBS 2.2** | **WBS 2.3** | **WBS 2.4** | **WBS 2.5** | **Grand Total** |
| Program Management | Detector Maintenance & Operations | Computing & Data Management | Triggering & Filtering | Data Quality, Reconstruction & Simulation Tools |
| KE | GRANT, DARREN | Administration | PubComm Chair | 0.35 |  |  |  |  | 0.35 |
|  |  | Engineering and R&D support | Co-convenor for PINGU | 0.35 |  |  |  |  | 0.35 |
|  | **GRANT, DARREN Total** | |  | **0.70** |  |  |  |  | **0.70** |
|  | KOPPER, CLAUDIO | Reconstruction/ Analysis tools | Icetray framework maintenance |  |  |  |  | 0.05 | 0.05 |
|  |  |  | Maintenance of clsim direct photon propagation tool |  |  |  |  | 0.10 | 0.10 |
|  |  | Simulation Production | Simulation coordination board member |  |  | 0.10 |  |  | 0.10 |
|  |  |  | GPU computing resources |  |  | 0.10 |  |  | 0.10 |
|  |  | Physics Filters | Co-convener Diffuse WG |  |  |  | 0.25 |  | 0.25 |
|  |  | Engineering and R&D support | Lead in-ice high-energy extension | 0.15 |  |  |  |  | 0.15 |
|  |  | TFT Coordination | L2 manager |  |  |  | 0.10 |  | 0.10 |
|  | **KOPPER, CLAUDIO Total** | |  | **0.15** |  | **0.20** | **0.35** | **0.15** | **0.85** |
| PO | WEAVER, CHRIS | Simulation Production | High energy event generator (leptoninjector), PMT simulation, atmospheric flux library |  |  | 0.40 |  |  | 0.40 |
|  |  | Simulation Production | Simulation production site manager at Compute Canada Resource Allocation |  |  | 0.20 |  |  | 0.20 |
|  | **ALBERTA, PO Total** | |  |  |  | **0.60** |  |  | **0.60** |
| GR | Nowicki, Sarah | Simulation Production | Clsim photon table production |  |  | 0.25 |  |  | 0.25 |
|  |  | Simulation Production | Compute Canada Resource Allocation |  |  | 0.20 |  |  | 0.20 |
|  | Wood, Tania | Reconstruction/ Analysis tools | Calibrations with LED and minimum ionizing muons |  |  |  |  | 0.35 | 0.35 |
|  | **ALBERTA GR Total** | |  |  |  | **0.45** |  | **0.35** | **0.80** |
| **ALBERTA Total** | |  |  | **0.85** |  | **1.25** | **0.35** | **0.50** | **2.95** |

**Faculty:**

Darren Grant, Claudio Kopper

**Scientists and Post Docs:**

Chris Weaver: high-energy event generator development (the “LeptonInjector” project); PMT simulation and development of an atmospheric flux library (“NewNuFlux”). Simulation production site manager at Compute Canada Resource

**Ph.D. Students:**

Tania Wood (PhD): Calibration working group (detector systematics with LEDs) (Analysis focus – low-energy atmospheric neutrino flux)

Sarah Nowicki (PhD): Simulation production – WestGrid computing; muon table production. (Analysis focus – neutrino oscillations with DeepCore)

**Diploma/Master Students: 3 new MSc students started September 2015.**

**Undergraduates:** 4 summer students.

**Explanation:**

A Canadian Natural Science and Engineering Research Council (NSERC) Discovery Subatomic Projects grant was just renewed for a 2 year period to support IceCube and IceCube-Gen2 activities at the University of Alberta and University of Toronto.  The level of support is for 3 full-participant faculty (Clark, Grant, Kopper) and 3 associate faculty (Krauss, Moore, Pinfold).  Also supported are Benedikt and Chris plans for up to 5 PhD students (in this time) and 4 undergraduate students at the University of Alberta.

**Description of planned analysis:**

The Alberta group has focused thus far on analyses involving data from DeepCore and the development of the PINGU project. Tania’s PhD thesis is the measurement of the atmospheric neutrino flux at energies to ~10 GeV with DeepCore. Sarah is currently working on semi-infinite muon spline tables and simulation production on WestGrid and will complete her PhD thesis on a test of maximal theta\_atm mixing with the 5-year DeepCore dataset. The undergraduates this summer have worked on the measurement of DOM efficiency with stopped muons, trigger efficiency studies of PINGU and a direct fitter with simulation. With the addition of Kopper as tenure-track faculty, this analysis program will grow significantly to include studies of high-energy neutrino searches and design studies for the high-energy detector extension.

**Description of Service work**

Compute-Canada resources have been established as a primary simulation production resource for the IceCube collaboration. In 2015, a resource allocation of nearly 1000 CPU-years and 70 GPU-years from Compute-Canada was awarded to support IceCube activities. In particular, this allocation provides guaranteed GPU and CPU resources for the collaboration. Our service activities are centred on the simulation production and reconstruction developments with these resources, and calibration efforts.  In 2015, our resource allocation from Compute Canada for IceCube was doubled from the 2014 values.

**Computing Resources**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **2016** | | **2017** | |
|  | **CPU Cores** | **GPU Cards\*** | **CPU Cores** | **GPU Cards\*, \*\*** |
| **IceCube** | 1054.8 | 40.57 | 1250 | 164 |
| **PINGU** | 1336.6 | 24.25 | 1250 | 82 |
| **Gen2** | 16 | 16 | 288 | 82 |

\*GPUs in nominal IceCube units

\*\* We note that Claudio’s CFI proposal for a GPU computing cluster has been successful (announced last month).  We anticipate the cluster coming online late FY2016.