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

**Scope of Work**

**Yale University**

**Reina Maruyama**

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

|  |  |  |  |  |  |  |  |  |  |
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| **Labor Cat.** | **Names** | **WBS Level 3** | **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 | Reina Maruyama | Supernova System | Supernova DAQ |  | 0.05 |  |  |  | 0.05 |
|  | Simulations Programs | Supernova simulation tools |  |  |  |  | 0.05 | 0.05 |
|  | Reconstruction / Analysis Tools | Coincident events between IceCube and DM-Ice |  |  |  |  | 0.05 | 0.05 |
|  | **Reina Maruyama Total** | |  |  | **0.05** |  |  | **0.10** | **0.15** |
| PO | Matthew Kauer | Detector Maintenance & Ops | Run Coordinator |  | 0.50 |  |  |  | 0.50 |
|  | **Matthew Kauer Total** | |  |  | **0.50** |  |  |  | **0.50** |
| GR | Benedikt Riedel | Simulation Programs | Supernova simulation tools |  |  |  |  | 0.20 | 0.20 |
|  | Supernova System | Supernova DAQ |  | 0.15 |  |  |  | 0.15 |
|  | **Benedikt Riedel Total** | |  |  | **0.15** |  |  | **0.20** | **0.35** |
| GR | Antonia Hubbard | Reconstruction / Analysis Tools | Coincident events between IceCube and DM-Ice, characterization of untriggered IceCube events |  |  |  |  | 0.25 | 0.25 |
|  | **Antonia Hubbard Total** | |  |  |  |  |  | **0.25** | **0.25** |
| **Yale Total** | | |  |  | **0.70** |  |  | **0.55** | **1.25** |

**Faculty:**

Reina Maruyama – Supernova DAQ and Simulation tools, dark matter search, coincidence with DM-Ice

**Scientists and Post Docs:**

Matthew Kauer – Run coordinator

**Grad Students:**

Benedikt Riedel – Supernova simulation tools development, supernova DAQ development, characterization of low energy events untriggered in IceCube, IceCube’s supernova sensitivity

Thesis/analysis topics: Signals and Backgrounds Supernova Detection with IceCube

Antonia Hubbard – Development of coincidence searches between IceCube and DM-Ice, characterization of low energy events untriggered in IceCube

Thesis/analysis topics: Backgrounds for DM-Ice: Coincidence Events Between IceCube and DM-Ice

**Overall summary of M&O responsibilities and analysis topics**

The PI at Yale, Reina Maruyama has recently moved from UW-Madison to Yale University. Her graduate student, Ben Riedel, is leading the effort to incorporate simulation of low energy supernova neutrinos into the IceSim framework. Per agreement with UW-Madison, Ben will obtain his PhD from Wisconsin however Maruyama will supervise him until he graduates. He is also coupling the Supernova DAQ into the framework.  For his thesis, he will analyze the supernova data.  The postdoc, Matt Kauer, is working 50% as the run coordinator and 50% on DM-Ice.  Antonia Hubbard (NSF Graduate Fellow) is looking for coincidence events between DM-Ice and IceCube. These coincident events offer opportunities for improving reconstruction and low energy threshold studies. As the transition to Yale completes, the PI plans to continue her work in supernova detection and explore synergies between IceCube and DM-Ice with Yale students and postdocs. Funding to support this work will be sought from NSF and other sources.