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

**Scope of Work**

**Sungkyunkwan University**

**Carsten Rott**

**Ph.D Scientists** (Faculty Scientist/Post Doc Grads): **2** (1 1 5)

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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** | **WBS 2.6** | **Grand Total** | |  |
| Program Coordination | Detector Maintenance & Operations | | | Computing & Data Management | Data Processing & Simulation | | Software | Calibration |  |
|  | ROTT, CARSTEN | Education & Outreach | Outreach | | 0.05 |  | | |  |  | |  |  | 0.05 | |  |
|  |  | Administration | PubComm member | | 0.10 |  | | |  |  | |  |  | 0.10 | |  |
|  | **ROTT, CARSTEN Total** | | |  | **0.15** | |  |  | | |  |  |  | **0.15** |  | |
| PO | TOENNIS, CHRISTOPH | Ice Properties | | Anisotropy Measurement with Spice hole camera |  | | 0.2 |  | | |  |  |  | 0.20 |  | |
|  | **TOENNIS, CHRISTOPH Total** | | |  |  | | **0.20** |  | | |  |  |  | **0.20** |  | |
| GR | IN, SEONGJUN | Detector Monitoring | | Detector Monitoring |  | | 0.03 |  | | |  |  |  | 0.03 |  | |
|  | Online Filter | | Online filter development & testing (Low-up filter) |  | | 0.20 |  | | |  |  |  | 0.20 |  | |
| **IN, SEONGJUN Total** | | |  |  | | **0.23** |  | | |  |  |  | **0.23** |  | |
| Seokmin Choi | Detector Monitoring | | Detector Monitoring |  | | 0.03 |  | | |  |  |  | 0.03 |  | |
| Choi**, Seokmin Total** | | |  |  | | **0.03** |  | | |  |  |  | **0.03** |  | |
| Minjin Jeong | Detector Calibration | | Online filter development & testing (Full Sky Starting Filter) |  | | 0.2 |  | | |  |  |  | 0.2 |  | |
| **Jeong Minjin Total** | | |  |  | | **0.20** |  | | |  |  |  | **0.20** |  | |
| Woosik Kang | Detector Monitoring | | Detector Monitoring |  | | 0.03 |  | | |  |  |  | 0.03 |  | |
|  | Ice Properties | | Photon tracking / ice-properties calibration |  | |  |  | | |  |  | 0.20 | 0.20 |  | |
| **Woosik Kang Total** | | |  |  | | **0.03** |  | | |  |  | **0.20** | **0.23** |  | |
| **SUNGKYUNKWAN Total** | | | | | **0.15** | | **0.69** |  | | |  |  | **0.20** | **1.04** |  | |

**IceCube Upgrade**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Labor Cat.** | **Names** | **WBS Level 3** | **Tasks** | | | **WBS 1.1** | | **WBS 1.2** | | **WBS 1.3** | | **WBS 1.4** | **WBS 1.5** | **WBS 1.6** | **Grand Total** | |  |
| Project Office | | Gen2 EHWD | | Deep Ice Sensor Modules | | Comms Power Timing | Calibration and Characterization | M&O Data Systems Integration |  |
| KE | ROTT, CARSTEN | 1.5.2.3 Camera and Light Detection | Lead - Camera and Light Detection | | | 0.2 | |  | |  | |  |  |  | 0.20 | |  |
|  | **ROTT, CARSTEN Total** | | |  | 0.2 | |  | |  | |  | |  |  | **0.20** |  | |
| PO | TOENNIS, CHRISTOPH | 1.5.2 Calibration Assemblies | | Design and test of mechanical camera holding structures |  | |  | |  | |  | | 0.25 |  | 0.25 |  | |
|  |  | 1.5.2 Calibration Assemblies | | Camera illumination board design and testing |  | |  | |  | |  | | 0.25 |  | 0.25 |  | |
|  |  | 1.5.2 Calibration Assemblies | | Camera testing and characterization |  | |  | |  | |  | | 0.10 |  | 0.10 |  | |
|  | **TOENNIS, CHRISTOPH Total** | | |  |  | |  | |  | |  | | **0.60** |  | **0.60** |  | |
| GR | KANG, WOOSIK | 1.5.2 Calibration Assemblies | | Camera simulations |  | |  | |  | |  | | 0.20 |  | 0.20 |  | |
|  | 1.5.3 Array Calibration | | Camera simulations - hole ice / scattering length |  | |  | |  | |  | | 0.30 |  | 0.30 |  | |
| **KANG, WOOSIK Total** | | |  |  | |  | |  | |  | | **0.50** |  | **0.50** |  | |
| Seokmin Choi | 1.5.2 Calibration Assemblies | | Camera testing and characterization |  | |  | |  | |  | | 0.5 |  | 0.50 |  | |
| Choi**, Seokmin Total** | | |  |  | |  | |  | |  | | **0.5** |  | **0.50** |  | |
| Gerrit Rollinghoff | 1.5.2 Calibration Assemblies | | Camera testing and characterization |  | |  | |  | |  | | 0.20 |  | 0.20 |  | |
| 1.5.2 Calibration Assemblies | | Final acceptance testing of cameras |  | |  | |  | |  | | 0.30 |  | 0.3 |  | |
| **ROLLINGHOFF Gerrit Total** | | |  |  | |  | |  | |  | | **0.50** |  | **0.50** |  | |
| Seongjin In | 1.5.2 Calibration Assemblies | | Camera testing and characterization |  | |  | |  | |  | | 0.20 |  | 0.10 |  | |
| **In Seongjin Total** | | |  |  | |  | |  | |  | | **0.20** |  | **0.20** |  | |
| **SUNGKYUNKWAN Total** | | | | | **0.20** | |  | |  | |  | | **2.30** |  | **2.50** |  | |

**Faculty:**

Carsten Rott – Institutional lead, Outreach, Publication committee member.

Lead for the IceCube upgrade effort on 1.5.2.3 Camera and Light

Detection

**Scientists and Post Docs:**

Christoph Toennis - Ice-property studies with the SPICE Core Camera system. Anisotropy Measurement with Spice hole camera

Design and test of mechanical camera holding structures for the IceCube Upgrade. Design and testing of the illumination board for the IceCube Upgrade camera system. Camera and illumination board testing and characterization.

Analysis topics: Search for secluded dark matter from the Sun.

**Ph.D. Students:**

Seongjin In - Detector monitoring, online filter development and testing 20% , maintains the LowUP Filter.

Thesis topic: Search for Solar Atmospheric Neutrinos with IceCube.

Minjin Jeong - Detector monitoring, maintenance of the FullSkyStarting Filter (FSS).

Thesis topic: Search for Dark Matter from Galaxy Clusters

Woosik Kang - Monitoring, Hole-ice and ice-property studies. Camera simulations.

Simulation for the IceCube Upgrade camera system for calibration.

Development of calibration measurements analyses and sensitivity

Thesis topic: TBD

**Diploma/Master Students:**

Seokmin Choi - Monitoring, SPICE Core Camera system. Analysis of camera data for the study of ice properties and Anisotropy Measurement with Spice hole camera.

MS Thesis: Characterization of the IceCube Upgrade camera system

Gerrit Rollinghoff - IceCube upgrade camera characterization measurements. Development

of analysis procedures and tests for Camera FAT tests at the integration

sites

MS Thesis: Solar Atm. Neutrinos Search during solar minimum

**Description of planned analysis:**

The SKKU group will focus on analyses involving data from DeepCore and physics feasibility studies for future dark matter and neutrino oscillation spectrometry analyses. The PhD student thesis topics are Solar dark matter and solar atmospheric neutrino searches using energy spectral information, and searches for high mass dark matter decays.

**Description of Service work**

The SKKU group will maintain and develop filters related to DeepCore and dark matter analyses. We will investigate hole ice properties with the goal to advance our understanding of individual DOMs and their local ice environment in studies using down-going muons and flasher data.

**IceCube Upgrade activities**

Development and testing the IceCube Upgrade camera system. Design of the

illumination system for the camera system. Calibration procedures for the

IceCube upgrade with cameras system.