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

**Scope of Work**

**RWTH Aachen**

**Christopher Wiebusch**

**Ph.D Scientists** (Faculty Scientist/Post Doc Grads Master): **2** (1 0 8 13)

|  |  |  |  |  |  |  |  |  |  |  |
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| **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 | WIEBUSCH, CHRISTOPHER | 2.1.4 Education & Outreach | AIS3 | 0.2 |  |  |  |  |  | 0.20 |
|  |  |  |  |  |  |  |  |  |  |  |
|   | **WIEBUSCH, CHRISTOPHER Total** |  | **0.20** |  |  |  |  |  | **0.20** |
| PD | N.N. |  |  |  |  |  |  |  |  |  |
|   | **N.N.** |  |  |  |  |  |  | 0.0 |
| GR | HAACK, CHRISTIAN | 2.5.3. Reconstruction | Lollipop Fit |  |  |  |  | 0.20 |  | 0.20 |
|  |  | 2.5.2. Simulation Software | Monopole Noise Simulation Tool |  |  |  |  | 0.05 |  | 0.05 |
|  |  | 2.6.1. Detector Calibration | Detector Geometry Calibration |  |  |  |  |  | 0.05 | 0.05 |
|  | REIMAN, RENE | 2.3.4. Distributed Computing Resources | Grid Operations Team |  |  | 0.20 |  |  |  | 0.20 |
|  | 2.4.1 Offline Data Production | Moon Sample Processing |  |  |  | 0.05 |  |  | 0.05 |
|  | 2.4.1 Offline Data Production | Moon Filter Verification |  |  |  | 0.05 |  |  | 0.05 |
|  | 2.4.1 Offline Data Production | Diffuse-sample for PS analyses |  |  |  | 0.10 |  |  | 0.10 |
|  | RONGEN, MARTIN | 2.6.2 Ice Properties | Hole Ice & bulk ice calibration |  |  |  |  |  | 0.30 | 0.30 |
|  | 2.6.1. Detector Calibration | Geometry Calibration |  |  |  |  |  | 0.10 | 0.10 |
|  | Schumacher, Lisa | 2.5.4 Science Support tools | Skylab maintenance |  |  |  |  | 0.20 |  | 0.20 |
|  | 2.4.1. Offline Data Production | HE muondata for IC/Auger/TA coinc. analyses |  |  |  | 0.10 |  |  | 0.10 |
|  | Schaufel, Merlin  | 2.1.2 Engineering & R&D support | IceAct Hardware R&D | 0.30 |  |  |  |  |  | 0.30 |
|  | 2.5.2 Simulation Software | IceAct/IceCube/IceTop MonteCarlo |  |  |  |  | 0.10 |  | 0.10 |
|  | 2.6.1 Detector Calibraton | IceTop & IceCube Calibration with IceAct |  |  |  |  |  | 0.10 | 0.10 |
|  | 2.2.6 Surface detectors | IceAct Monitoring |  | 0.20 |  |  |  |  | 0.20 |
|  | Stettner, Jöran | 2.5.4 Science Support tools | NNMFIT tool for diffuse profile likelihood fits  |  |  |  |  | 0.10 |  | 0.10 |
|  | 2.4.3 Public data products | Millipede scans for HE muondata for IC/Auger/TA coinc. analyses |  |  |  | 0.10 |  |  | 0.10 |
|  | 2.4.2 Simulation Production | Simulation production for consistent MC spanning IC-79-IC-86-5 (relevant after pass 2 is completed) |  |  |  | 0.10 |  |  | 0.10 |
|  | 2.4.1. Offline Data Production | Diffuse sample production |  |  |  | 0.05 |  |  | 0.05 |
|  | 2.3.4. Distributed Computing Resources | OSG Site RWTH |  |  | 0.10 |  |  |  | 0.10 |
|  | 2.5.4 Science Support tools | Diffuse Model Repository |  |  |  |  | 0.05 |  | 0.05 |
|  | Erik Ganster | 2.3.5.Simulation production | MC Production for global diffuse fit |  |  |  |  |  | 0.20 | 0.20 |
|  | 2.5.4 Science Support tools | NNMFIT tool for diffuse profile likelihood fits  |  |  |  |  | 0.05 |  | 0.05 |
|  | 2.1.4  | AIS3 | 0.05 |  |  |  |  |  | 0.05 |
|  | Lasse Halve | 2.2.4. Detector Monitoring | Detector monitoring shifts contact from Aachen  | 0.05 |  |  |  |  |  | 0.05 |
|  | 2.1.4 Education & Outreach | AIS3 | 0.05 |  |  |  |  |  | 0.05 |
|  | 2.1.4 Education & Outreach | Netzwerk Teilchenwelt | 0.05 |  |  |  |  |  | 0.05 |
|  | GR | Detector Monitoring | Detector monitoring shifts |  | 0.12 |  |  |  |  | 0.12 |
|  | **GR Total** |  |  | **0.55** | **0.32** | **0.30** | **0.55** | **0.75** | **0.75** | **3.22** |
|  | **RWTH Total:** |  |  | **0.75** | **0.32** | **0.30** | **0.55** | **0.75** | **0.75** | **3.42** |

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| **Labor Cat.** | **Names** | **WBS L3** | **Tasks** | WBS 1.1 | WBS 1.2 | WBS 1.3 | WBS 1.4 | WBS 1.5 | WBS 1.6 | **Grand Total** |
| Project Office | Gen2 enhanced hot water drill | DeepIce Sensor Modules | Comms Power Timing (CPT) | Charcterization and Calibration | M&O data Systems Integration |
| KE | WIEBUSCH, CHRISTOPHER | 2.1.1. Administration | Acoustic devices coordination | 0.10 |  |  |  |  |  | 0.10 |
|  |  | 2.1.1. Administration | mDOM PMT testing coordination | 0.10 |  |  |  |  |  | 0.10 |
|   | **WIEBUSCH, CHRISTOPHER Total** |  | **0.20** |  |  |  |  |  | **0.20** |
| PD |  |  |  |  |  |  |  |  |  |  |
|   |  |  |  |  |  |  |  |  |
| GR | Halve, Lasse | 1.3.1. mDOM | PMT aceptance tests(mDOM) |  |  | 0.4 |  |  |  | 0.4 |
|  | 1.5.1.Module Calibration | dEgg/mDOM Calibrations |  |  |  |  | 0.1 |  | 0.1 |
|  | Zierke, Simon | 1.3.3. pDOM | Acoustic receivers |  |  | 0.1 |  |  |  | 0.1 |
|  | RONGEN, MARTIN | 1.3.1. mDOM | PMT aceptance tests(mDOM) |  |  | 0.1 |  |  |  | 0.1 |
|  | 1.5.2.Calibration | Flasher/Inclinometers |  |  |  |  | 0.2 |  | 0.2 |
|  | Heinen, Dirk | 1.5.3 array calibration | Acoustc calibration system |  |  | 0.05 |  |  |  | 0.05 |
|  | Weinstock, Lars | 1.3.5 Special devices | Acoustic Pingers |  |  | 0.3 |  |  |  | 0.3 |
|  | **GR Total** |  |  |  |  | **0.95** |  | **0.30** |  | **1.25** |
|  | **RWTH Total:** |  |  | **0.20** |  | **0.95** |  | **0.30** |  | **1.45** |

**Master Students M&O Contribution:**

|  |  |  |  |  |  |  |  |  |  |  |
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| **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 |
| Master |  |  |  |  |  |  |  |  |  |  |
| JONSKE, Frederik | 2.6.1. Detector Calibration | Detector Geometry Calibration |  |  |  |  |  | 0.1 | 0.1 |
| Böttcher, Jakob | 2.5.2. Simulation Software | Monopole Noise Simulation Tool |  |  |  |  | 0.3 |  | 0.3 |
| Philippen, Saskia | 2.4.1 Offline Data Production | Moon Sample Processing |  |  |  | 0.1 |  |  | 0.1 |
| 2.4.1 Offline Data Production | Moon Filter Verification |  |  |  | 0.1 |  |  | 0.1 |
| 2.6.1. Detector calibration | Verification of detector pointing with Moon shadow |  |  |  |  |  | 0.1 | 0.1 |
| 2.5.3. Reconstruction | Benchmarking and Optimization of track reconstruction with Moon shadow |  |  |  |  | 0.1 |  | 0.1 |
| Zöcklein, Marit | 2.1.4 Education & Outreach | AIS3 | 0.05 |  |  |  |  |  | 0.05 |
|  | BUSCHER, Johannes | 2.1.2 Engineering & R&D support | IceAct Cone Testing Setup | 0.1 |  |  |  |  |  | 0.1 |
|  | **Master Students Total** |  | **0.15** |  |  | **0.20** | **0.40** | **0.20** | **1.15** |

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| Project Office | Gen2 enhanced hot water drill | DeepIce Sensor Modules | Comms Power Timing (CPT) | Charcterization and Calibration | M&O data Systems Integration |
| Master | Shefali | 1.3.5 Special devices | Acoustic Pingers |  |  | 0.3 |  |  |  | 0.3 |
| JOPPE Robert | 1.3.1. mDOM | PMT aceptance tests(mDOM) |  |  | 0.5 |  |  |  | 0.5 |
|  | KELLERMANN, Moritz | 1.3.3. pDOM | Acoustic receivers |  |  | 0.3 |  |  |  | 0.3 |
|  | **Master Students Total** |  |  |  | **1.1** |  |  |  | **1.1** |

**Faculty:**

Christopher Wiebusch

**Scientists and Post Docs:**

 **(**Jan Auffenberg left in July 2019)

**Ph.D. Students:**

Rene Reimann Thesis topic : Cosmic neutrino sources

Martin Rongen IceCube Gen2 R&D, Calibration, Thesis Topic: Calibration

Christian Haack Thesis Topic: Cosmic neutrino sources, Galactic Plane

Lisa Schumacher Auger,TA,IceCube Correlation and angular correlation analysis

Jöran Stettner Multi year diffuse analysis and dark matter decay

Merlin Schaufel IceAct

Lasse Halve mDOM (PMTs) & Nu nubar flux measurement

Erik Ganster Diffuse Analysis (tbd) & IceAct-7 Analysis

**Non-signing Scientists**

 Dirk Heinen Acoustic Calibration System
 Simon Zierke Acoustic Calibration System

 Lars Weinstock Acoustic Calibration System

**Diploma/Master Students**

Marit Zöcklein Seasonal variation of atmospheric neutrinos

Moritz Kellermann Acoustic receivers

Shefali Acoustic Pingers

Jakob Böttcher Magnetic monopoles

Timo Stürwald Magnetic Monopoles

Philipp Muth CR Neutrino Correlation

Frederik Jonske Geometry Calibration

Johannes Buscher Light Cones for IceAct

Pratush Malik Neutrino – Source Correlation

Marit Zöcklein Seasonal Variations atm. Nu

Patrick Heix Seasonal Variations Atm. Nu

Saskia Philippen Moon Shadow

Robert Joppe PMT Setup

**Computing Resources**

|  |  |
| --- | --- |
|  | **2019** |
|  | **CPU Cores** | **GPU Cards** |
| Pledged resources in the IceCube common cluster | ~27700 (shared resources) | 44 (shared resources) |

GPU Cards: NEC GPS 12G4Rg-1, 2 x Tesla P100, CPU E5-2650v4 @ 2.2 GHz

GPU Cards: NEC HPC1812RG-7, 1 x Tesla P100 , CPU E7-8860v4 @ 2.2 GHz

GPU Cards: Bullx R425-E2, 2 x NVIDIA Quadro 6000, CPU: X5650 @ 2.67 GHz

CPU Cores: X5675 @ 3.0GHz and X7550 @ 2.0GHz and E5-2650v4 @ 2.2 GHz