NATIONAL SCIENCE FOUNDATION
4201 Wilson Boulevard
Arlington, VA 22230
www.nsf.gov

COOPERATIVE AGREEMENT (CA)

AWARD: PHY-1719277	**EFFECTIVE DATE:**	October 1, 2018
	EXPIRATION DATE:	September 30, 2023

PROJECTED TOTAL AWARD FUNDING:

(Subject to availability of funds) $22,983,529

CUMULATIVE AMOUNT:

$4,731,506

SOLICITATION:

(Incorporated by reference, as amended)

NSF 16-566

Division of Physics: Investigator-Initiated Research Projects

CFDA NUMBER: 47.049

OTHER AWARDS UNDER THIS PROGRAM:

Show List of Awards

AWARDEE: University of Wisconsin-Madison

PROJECT TITLE: IceCube Gen2 Phase 1: an IceCube Extension for Precision Neutrino Physics and Astrophysics

PROJECT ABSTRACT: https://www.fastlane.nsf.gov/servlet/showaward?award=1719277

Principal Investigator (s)	Proposal No.	Institution (s)
Kael D. Hanson	PHY-1719277	University of Wisconsin-Madison
Dawn Williams		
Douglas F. Cowen		
Tyce R. DeYoung		Michigan State University

NSF Contact Information:

Financial/Administrative questions: e-mail your NSF Grants and Agreements Official, Kristin B. Spencer, at kspencer@nsf.gov or call the Division at 703-292-4585.

Programmatic questions: e-mail your NSF Program Officer, James J. Whitmore, at jwhitmor@nsf.gov or call the Program Division at 703-292-8908.

This CA is entered into between the United States of America, represented by the National Science Foundation (NSF), and the above named Awardee pursuant to the authority of the National Science Foundation Act of 1950, as amended (42 USC 1861-1875). This CA is provided electronically to the Awardee. The Awardee is responsible for full compliance with all Programmatic and Financial/Administrative Terms and Conditions as initially stated or as updated over the life of this CA. The Awardee's request to draw down funds under this CA will represent acceptance by the Awardee of all Terms and Conditions of the CA. The Authorized Organizational Representative (AOR) will be electronically notified of any changes to these Terms and Conditions and is encouraged to immediately review these changes and contact the Grants and Agreements Official or Program Officer within thirty days with any questions.

Financial/Administrative Terms and Conditions (FATC):

General FATC:
http://www.nsf.gov/publications/pub_summ.jsp?ods_key=NSF99999FATC004

Award Specific FATC:

Part 1. Award Specific Financial and Administrative Terms and Conditions (FATC)

1.1. Terms and Conditions Incorporated by Reference, Deviations and Order of Precedence

a. Terms and Conditions Incorporated by Reference. At time of award, all activities under this CA are subject to NSF's Cooperative Agreement-Financial and Administrative Terms and Conditions (CAFATC), and the Cooperative Agreement Modifications and Supplemental Financial and Administrative Terms and Conditions (CAFATC) for Major Multi-User Research Facility Projects and Federally Funded Research and Development Centers, hereafter referred to as the CAFATC Supplement, available in full text at https://www.nsf.gov/awards/managing/co-op_conditions.jsp.

b. Deviations from the CAFATC and CAFATC Supplement. To meet the specific needs and requirements of this CA, any deviations are provided in full text herein. Any subsequent changes shall be incorporated by amendment.

c. Order of Precedence. The award-specific terms and conditions of this CA, Parts 1 and 2, take precedence over the CAFATC Supplement. The CAFATC Supplement takes precedence over the CAFATC.

1.2. Term of Agreement. The term of this CA ends on September 30, 2023 unless otherwise amended.

1.3. Funding. Contingent on the conduct of this award, NSF intends to provide up to $22,983,324 in funding over the term of this award, of which $20,127,513 is baseline funding and $2,855,811 is contingency.

a. Contingency. The total contingency budget of $2,855,811 is hereby approved. Use of contingency funds shall be in accordance with Article 2.6, paragraph c., 'Configuration Management and Use of Contingency.' The Awardee shall manage allocations from the contingency budget against the cumulative allocated and against the total contingency budget, and report status to NSF in accordance with Article 2.5, 'Reporting Requirements.'

b. Anticipated Funding Profile. NSF will specify approved allocations to the baseline and to budget contingency, with cumulative totals for each, by amendment to this award. Funding provided will be based on award performance and contingency use. The planned schedule of funding is as follows:

FYI	Baseline	Contingency	Total
FY18	$4,069,959	$664,979	$4,734,938
FY19	$5,130,419	$575,002	$5,705,421
FY20	$3,638,072	$362,229	$4,000,301
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FY22	$3,985,016	$788,853	$4,473,869
Total	$20,127,513	$2,855,811	$22,983,324

c. Funding Awarded to Date (funding only the Project Office activities for 6 months, 10/01/2018 - 03/31/2019)

FY	Baseline	Contingency	Total
FY18	$1,024,762	$0	$1,024,762

d. Of the funding awarded for FY2018, $1,024,762 is available for expenditure on the effective date of this award. Contingency is not included in this amount and is not authorized during the initial six-month Project Office setup.

1) Project Office expenditures will be in accordance with the Project Readiness Plan, which is hereby incorporated as part of the Awardee's proposal.

2) Remaining funding will be authorized for expenditure pending satisfactory completion of initial project management office setup. The Awardee may request an increase in the expenditure limit by demonstrating satisfactory progress and the need for additional funding. The request must be sent by email to the cognizant Program Officers and NSF Grants and Agreements Officer. Any increase in the expenditure limit will be implemented by amendment to this agreement.

e. Approval by the cognizant NSF Program Officer, and implementation by the Awardee of any project or schedule change, shall not constitute a basis for an increase in funding for this Cooperative Agreement, nor be interpreted as an amendment increasing the award term.

f. Segregation of Funds. Funding provided under this CA shall be used solely for the work identified herein and may not be reprogrammed or reallocated to any other award under any circumstances.

1.4. Property and Equipment. Tangible Property means property of any kind except intangible property and debt instruments. Title to all tangible property and equipment purchased or fabricated with NSF funds under this award shall vest as follows:

a. Title shall vest in the Awardee upon acquisition when the equipment is designated for research and development activities that are conducted by the Awardee and is not intended to be incorporated into, built, or necessary for the operation, maintenance or enhancement of the ice drill. All equipment acquired in accordance with this clause shall be subject to the Article of the CAFATC entitled 'Equipment.'

b. Title shall vest in the Government upon acquisition when the equipment is intended to be incorporated into, built, or necessary for the operation, maintenance or enhancement of the ice drill. In addition to the CAFATC Supplement article entitled 'NSF-Owned Equipment and Real Property,' all Government equipment acquired under this agreement shall be subject to the requirements set forth below:

c. Legal title to all tangible property furnished by NSF or acquired from other Government agencies shall remain with the Government, unless otherwise specified in writing by the NSF Property Administrator.

d. Title to Government property shall not be affected by the incorporation or attachment thereof to any property not owned by the Government, no shall any Government property lose its identity by reason of affixation to any reality.

e. All contracts and any subawards issued or awarded with respect to performance of this agreement shall include provisions regarding the determination of title to equipment acquired by the contractor or the subrecipient in accordance with this clause.

1.5. Contracts. To the clause, 'Contract Requirements' of the CAFATC Supplement, add the following (internally numbered):

d. Prior to entering into any Time & Materials (T&M) type of contract, agreement or purchase order, the Awardee will submit a detailed cost/performance monitoring plan to the NSF Program Officers and Agreements Officer. The Plan must show that the Awardee has in place the requisite oversight and monitoring of the contractor to ensure planned funding exists and is sufficient to meet forecasted level of effort, required notifications and limitations or stops are included in the contract to prevent overruns and 'at-risk' situations, and that contractor time and effort reporting and deliverables will be verified. The Awardee will include regular updates on the status of any T&M contracts in its reports to the NSF Program Officer.

Programmatic Terms and Conditions (PTC):

General PTC:
http://www.nsf.gov/publications/pub_summ.jsp?ods_key=NSF16566TPTC000

Award Specific PTC:

Part 2. Award Specific Programmatic Terms and Conditions (PTC)

2.1 Project Description. Embedded deep in the ice cap at the South Pole, the IceCube Neutrino Observatory (ICNO) is the world's unique, largest, and most sensitive high energy neutrino telescope. It is a one-billion-ton detector that uses the deep Antarctic ice as a medium to detect high energy atmospheric and astrophysical neutrinos. Most of the neutrinos observed by IceCube exhibit energies in the range expected for atmospheric neutrinos that originate from decays of elementary particles produced in extensive air showers by cosmic rays coming from nearby sectors of the Milky Way Galaxy. While these can be used to measure the fundamental properties of neutrinos, astrophysical neutrinos at higher energies are key probes of the high-energy phenomena in the Universe. Because of their unique properties, neutrinos pass almost freely through even dense volumes of space and are not deflected by galactic or extra-galactic magnetic fields and traverse the photon-filled universe unhindered. Thus, neutrinos provide direct information about the dynamics and interiors of the powerful cosmic objects that may be the origins of high energy cosmic rays: supernovae, black holes, pulsars, active galactic nuclei and other extreme extragalactic phenomena. This award will fund the deployment of seven additional strings of photon sensors in the deep, clear Antarctic ice at the bottom center of IceCube, forming the IceCube Gen2 Phase 1 extension ("Phase 1").

2.2. Scope of the Award. Specifically, the Awardee will work to accomplish the following:

a. Drill: Full development and operation of the hot water drill system in support of the IceCube Upgrade array installation. Includes resurrection of available Enhanced Hot Water Drill (EHWD) equipment; design, procurement, and construction of new drill subsystems that, together with EHWD equipment, satisfies the project's drilling requirements; integration, verification, and testing of the drill system and its subsystems; and field operation of the drill system to deliver required installation borehole specifications.

b. Optical modules: Development and production of up to 700 deep-ice optical sensor modules, including refurbished IceCube Digital Optical Modules, dual-phototube large effective area modules, and segmented sensors modules with 24 3" PMTs. These devices all also carry on-board calibration equipment for module and ice characterization.

c. Cables: This category is responsible for the physical and electronic systems providing the interface between new sensor and calibration instrumentation and ICL/station infrastructure (power, communications for control and readout, global timing). Deliverables include the physical cables and structures to which new instruments are connected, the surface readout electronics, software, and firmware, and the systems for connecting these readout electronics to the station network and power system and the IceCube master clock.

d. Calibration Devices: This category is responsible for calibrating and characterizing the detector, which consists of both modules and ice. The deliverables are well characterized modules which meet the high level design requirements of the IceCube upgrade for stability and performance, and improved measurements of the modules and the ice relative to our current knowledge of the detector.

e. Integration with IceCube: This element is responsible for the seamless integration of all new systems from the IceCube upgrade project into the existing IceCube detector maintenance/operations structures. This includes integration with online software systems, databases, offline software components, simulation software packages, and computing infrastructure needed to support this effort.

2.3 Project Governance. The Awardee will ensure that an efficient and effective project governing structure is in place throughout the award period to support all critical or significant project activities.

a. Project Management and Staff Reporting

1) Overall Organization. The IceCube Neutrino Observatory (ICNO) is a collaborative effort between the University of Wisconsin (hereafter, the Awardee) and an international IceCube Collaboration (the Collaboration). The National Science Foundation (NSF) provides funding for U.S. activities and overall program oversight.

2) ICNO Upgrade Organization. The Awardee's ICNO Upgrade Organization is responsible for reliable overall management, construction of the IceCube Phase 1 Upgrade to the IceCube detector, data management, and the full exploitation of the IceCube scientific program. The ICNO Upgrade Organization is located within UW's Wisconsin IceCube Particle Astrophysics Center (WIPAC). The WIPAC is the primary interface to the university administrative and support systems and includes people whose salaries are paid by the university, including accounting, purchasing, human resources, and other general administrative support. The Upgrade Organization has six primary elements: Quality Engineer, Safety Engineer, Project Engineer, Project Controls Manager, Production Manager and Logistics. The Upgrade Organization must interact closely and coordinate the upgrade efforts with the overall ICNO management.

3) Engineering configuration control. Configuration Management will be exercised through the existing Engineering Change Control process that applies to all design aspects of the project. Change requests will be reviewed by Systems Engineering, then approved for change pending budgetary review.

4) Budget change control. Budget control will be exercised through the existing Change Control Board (CCB) that reviews and makes recommendations to the Principal Investigator on the disposition of budgetary Change Requests submitted for its consideration. The CCB is chaired by the Project Manager and includes all major account managers.

b. International partners

1) DESY-Zeuthen (Germany) - mDOM production, data acquisition electronics, cables

2) TU Munich (Germany) - Precision Optical Calibration Module (POCAM)
3) Muenster Universitat (Germany) - mDOM mechanical design
4) Chiba University (Japan) - Optical sensors, D-EGGs
5) Sungkyunkwan University (S. Korea) - Camera system

c. Major Subawards. As proposed by the Awardee and approved by NSF, major subawards at the time of this award are as follows:

1) Michigan State University - Communications power timing, detector simulation
2) Penn State University - Data acquisition firmware, electronics
3) University of Alabama - Calibration coordination; commissioning
4) University of Maryland - Data filtering, software, IceCube integration

d. Agency contact. The ICNO/Gen2/Phase1 PI will serve as point-of-contact for the cognizant NSF Program Officers, including providing notification of any critical project management issues.

2.4. Planning Requirements. The Awardee shall provide a detailed Annual Work Plan (AWP) for the coming fiscal year for the approval of the NSF Program Officer within three months following the award. The AWP should include goals/objectives, activity-based budget that traces the budget for the coming year (to extent possible) and schedule for work to be performed to the current project baseline. The AWP should also include a Basis of Estimate for planned expenditures and labor.

2.5 Reporting Requirements

a. In addition to the requirement for an annual report, the Awardee will provide ad hoc and regular reports as designated by the NSF cognizant Program Officer. Content, format, and submission timeline will be established by the NSF cognizant Program Officer. The Awardee will submit all required reports via research.gov using the appropriate reporting category; for any type of report not specifically mentioned in research.gov the Awardee will use the 'Interim Reporting' function to submit reports.

b. Monthly financial and technical status reports are to be provided to the NSF Program Officers. Reports shall address the following:

1) Schedule status relative to high level milestones with explanation for variances.

2) Earned Value Management report at Level 2 of the Work Breakdown Structure (WBS). Present and discuss variances and plans for recovery when they exceed -10%.

3) Contingency Management report including contingency usage for the reporting period, update of its graphical presentation as a percentage of costs to go, and forecasts on potential future contingency liens for the project.

4) Summary of risk management activities for the reporting period.

5) Report all Configuration Management and Change Control Board Actions for the reporting period, including status of the project scope relative to science and design/as-built capability of the system.

6) Report on contractor activities and performance status for contracted amounts exceeding $250K.

7) Discussion of any other issues relevant to project performance.

8) Environmental Health and Safety report, including training and environmental compliance and site use (e.g. permits, agreements, or other arrangements).

c. Project Readiness Plan Deliverables. The Awardee will provide the deliverables as described in the Project Readiness Plan for the approval of the NSF Program Officers. Approval is required prior to NSF's authorization to draw additional funding, unless NSF determines that sufficient progress has been made to allow a portion of that funding to be released for use by the Awardee for activities under this award.

2.6 Project Oversight

a. Commitment and Cooperation. The Awardee will ensure full commitment and cooperation among the governing structure components, and all project staff during all ongoing NSF project management and oversight activities.

b. Annual Review. The project progress will be reviewed annually during the corresponding panel reviews of the related award for ICNO Operations & Management.

c. Configuration Management and Use of Contingency. Prior approval of the cognizant NSF Program Officer is required for:

1) Configuration changes increasing the overall program baselines for cost by more than $250,000 or revising a Level 1 schedule milestone by more than 1 month. Level 1 schedule milestones are to be established by concurrence of the NSF Program Officer with submittal of the Annual Work Plan.

2) Requests for use of cost contingency exceeding $150,000. Note: In the event of an emergency that threatens imminent harm to life or property, NSF authorizes the Awardee to use contingency exceeding $100,000. NSF must be informed with a detailed rationale as soon as practicable and no later than 24 hours of the emergency.

2.7 Key Personnel. In addition to the requirements regarding change in PI under the PAPPG Chapter VII.B and the CAFATC incorporated herein, the position(s) specified below are considered essential to the work being performed hereunder. Any proposed change or substitution must be submitted, in advance, and with all necessary documentation, to the NSF Program Officer for review and approval. No changes may be implemented without prior formal written approval by the NSF Grants & Agreements Officer:

Principal Investigator
Co-Principal Investigators
Project Manager

National Science Foundation
2415 Eisenhower Avenue, Alexandria, Virginia 22314, USA
Tel: 703-292-5111, FIRS: 800-877-8339 | TDD: 703-292-5090

Charlie Giese

From: kspencer@nsf.gov
Sent: Tuesday, February 12, 2019 1:21 PM
To: RSP - NSF
Subject: Award Id : 1719277, PI: Hanson

NATIONAL SCIENCE FOUNDATION
4201 Wilson Boulevard
Arlington, VA 22230
www.nsf.gov

AWARD NOTICE

Date: February 12, 2019
Project Title: IceCube Gen2 Phase 1: an IceCube Extension for Precision Neutrino Physics and Astrophysics
PI: Kael D. Hanson, Dawn Williams, Tyce R. DeYoung, Douglas F. Cowen
Awardee: The University of Wisconsin - Madison
Award No. (FAIN): 1719277, Amendment 001
Increment: 1923367
DUNS ID: 161202122

The purpose of this amendment is to 1) provide incremental funding for the referenced award and 2) incorporate by reference the Agency's revised Award Terms and Conditions.

1) Accordingly, as recommended by the Program Officer, FY 2019 funding in the amount of $5,705,421 is hereby provided for IceCube Gen2 Phase 1, for October 1, 2019-September 30, 2020. Of this amount, $5,130,419 is base funding and $575,002 is contingency, for a total of $5,705,421. The limitation on expenditure of $1,024,762 in base year funding remains in effect until otherwise amended.

2) The Agency's Award Terms and Conditions (CA-FATC and CA-FATC Supplement) have been revised, effective February 12, 2019 and are hereby incorporated by reference in this award. The terms and conditions are available in full text at https://www.nsf.gov/awards/managing/co-op_conditions.jsp.

The award, with this amendment, now totals $10,436,927.

To view the change, please access your award at:

[https://www.fastlane.nsf.gov/researchadmin/emailLoginHome.do?awardId=1719277&amendmentId=001]

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AWARD NOTICE

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Project Title: IceCube Gen2 Phase 1: an IceCube Extension for Precision Neutrino Physics and Astrophysics
PI: Kael D. Hanson, Dawn Williams, Tyce R. DeYoung, Douglas F. Cowen
Awardee: The University of Wisconsin - Madison
Award No. (FAIN): 1719277, Amendment 001
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NATIONAL SCIENCE FOUNDATION

Award Notice

Award Number (FAIN): 1719277

Managing Division Abbreviation: PHY

Amendment Number: 003

AWARDEE INFORMATION

Award Recipient: University of Wisconsin-Madison
Awardee Address: 750 UNIVERSITY AVENUE ROOM 202 MADISON, WI 537061490
Official Awardee Email Address: nsf@rsp.wisc.edu
Unique Entity Identifier (DUNS ID): 161202122

AMENDMENT INFORMATION

Amendment Type: Other Admin No Fund Actions
Amendment Date: 06/25/2019
Amendment Number: 003
Proposal Number: Not Applicable
Amendment Description:

The purpose of this amendment is to 1) lift the spending limitation currently in place, and 2) approve the proposed Project Manager under 2.7, Key Personnel.

Accordingly, as recommended by the NSF Program Officers, this award is amended as follows:

1) The limitation on expenditure is hereby removed. The Awardee may expend funds, including contingency, in accordance with the approved Annual Work Plan.

2) Effective July 1, 2019 the Project Manager for this award is Farshid Feyzi.

Except as modified by this amendment, the award terms and conditions remain unchanged.

AWARD INFORMATION

Award Number (FAIN): 1719277
Award Date: 09/18/2018
Award Period of Performance: Start Date: 10/01/2018 End Date: 09/30/2023
Project Title: IceCube Gen2 Phase 1: an IceCube Extension for Precision Neutrino Physics and Astrophysics
Managing Division Abbreviation: PHY
Award Instrument: Cooperative Agreement
Research and Development Award: Yes
Funding Opportunity: NSF 16-566 Division of Physics: Investigator-Initiated Research Projects
CFDA Number and Name: 47.049 Mathematical and Physical Sciences

FUNDING INFORMATION

Amount Obligated by this Amendment: $0.00
Total Intended Award Amount: $22,983,529.00
Total Approved Cost Share or Matching Amount: $0.00
Total Amount Obligated to Date: $10,436,927.00

PROJECT PERSONNEL

Principal Investigator: Kael D Hanson	**Email:** kael.hanson@icecube.wisc.edu	**Institution:** University of Wisconsin-Madison
Co-Principal Investigator: Douglas F Cowen	**Email:** cowen@phys.psu.edu	**Institution:** Pennsylvania State Univ University Park
Co-Principal Investigator: Tyce R DeYoung	**Email:** deyoung@pa.msu.edu	**Institution:** Michigan State University
Co-Principal Investigator: Dawn Williams	**Email:** drwilliams3@ua.edu	**Institution:** University of Alabama Tuscaloosa

NSF CONTACT INFORMATION

Awarding Official Name: Kristin B. Spencer
Awarding Official Email: kspencer@nsf.gov
Managing Program Officer Name: Jonathan James Whitmore
Managing Program Officer Email: jwhitmor@nsf.gov

GENERAL TERMS AND CONDITIONS

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CA-FATC
This award is subject to the Cooperative Agreement Financial & Administrative Terms and Conditions (CA-FATC), dated 02/12/2019, available at https://www.nsf.gov/awards/managing/co-op_conditions.jsp.

To view the Award Document in FastLane go to:https://www.fastlane.nsf.gov/researchadmin/emailLoginHome.do?awardId=1719277&amendmentId=003

FATC AND PTC

Financial and Administrative Terms and Conditions (FATC)

Part 1. Award Specific Financial and Administrative Terms and Conditions (FATC)

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c. Funding Awarded to Date (funding only the Project Office activities for 6 months, 10/01/2018 - 03/31/2019)

FY Baseline Contingency Total
FY18 $1,024,762 $0 $1,024,762

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Programmatic Terms and Conditions (PTC)

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2.1 Project Description. Embedded deep in the ice cap at the South Pole, the IceCube Neutrino Observatory (ICNO) is the world's unique, largest, and most sensitive high energy neutrino telescope. It is a one-billion-ton detector that uses the deep Antarctic ice as a medium to detect high energy atmospheric and astrophysical neutrinos. Most of the neutrinos observed by IceCube exhibit energies in the range expected for atmospheric neutrinos that originate from decays of elementary particles produced in extensive air showers by cosmic rays coming from nearby sectors of the Milky Way Galaxy. While these can be used to measure the fundamental properties of neutrinos, astrophysical neutrinos at higher energies are key probes of the high-energy phenomena in the Universe. Because of their unique properties, neutrinos pass almost freely through even dense volumes of space and are not deflected by galactic or extra-galactic magnetic fields and traverse the photon-filled universe unhindered. Thus, neutrinos provide direct information about the dynamics and interiors of the powerful cosmic objects that may be the origins of high energy cosmic rays: supernovae, black holes, pulsars, active galactic nuclei and other extreme extragalactic phenomena. This award will fund the deployment of seven additional strings of photon sensors in the deep, clear Antarctic ice at the bottom center of IceCube, forming the IceCube Gen2 Phase 1 extension ("Phase 1").

2.2. Scope of the Award. Specifically, the Awardee will work to accomplish the following:

a. Drill: Full development and operation of the hot water drill system in support of the IceCube Upgrade array installation. Includes resurrection of available Enhanced Hot Water Drill (EHWD) equipment; design, procurement, and construction of new drill subsystems that, together with EHWD equipment, satisfies the project's drilling requirements; integration, verification, and testing of the drill system and its subsystems; and field operation of the drill system to deliver required installation borehole specifications.

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e. Integration with IceCube: This element is responsible for the seamless integration of all new systems from the IceCube upgrade project into the existing IceCube detector maintenance/operations structures. This includes integration with online software systems, databases, offline software components, simulation software packages, and computing infrastructure needed to support this effort.

2.3 Project Governance. The Awardee will ensure that an efficient and effective project governing structure is in place throughout the award period to support all critical or significant project activities.

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1) Overall Organization. The IceCube Neutrino Observatory (ICNO) is a collaborative effort between the University of Wisconsin (hereafter, the Awardee) and an international IceCube Collaboration (the Collaboration). The National Science Foundation (NSF) provides funding for U.S. activities and overall program oversight.

2) ICNO Upgrade Organization. The Awardee's ICNO Upgrade Organization is responsible for reliable overall management, construction of the IceCube Phase 1 Upgrade to the IceCube detector, data management, and the full exploitation of the IceCube scientific program. The ICNO Upgrade Organization is located within UW's Wisconsin IceCube Particle Astrophysics Center (WIPAC). The WIPAC is the primary interface to the university administrative and support systems and includes people whose salaries are paid by the university, including accounting, purchasing, human resources, and other general administrative support. The Upgrade Organization has six primary elements: Quality Engineer, Safety Engineer, Project Engineer, Project Controls Manager, Production Manager and Logistics. The Upgrade Organization must interact closely and coordinate the upgrade efforts with the overall ICNO management.

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b. International partners

1) DESY-Zeuthen (Germany) - mDOM production, data acquisition electronics, cables
2) TU Munich (Germany) - Precision Optical Calibration Module (POCAM)
3) Muenster Universitat (Germany) - mDOM mechanical design
4) Chiba University (Japan) - Optical sensors, D-EGGs
5) Sungkyunkwan University (S. Korea) - Camera system

c. Major Subawards. As proposed by the Awardee and approved by NSF, major subawards at the time of this award are as follows:

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2) Penn State University - Data acquisition firmware, electronics
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a. In addition to the requirement for an annual report, the Awardee will provide ad hoc and regular reports as designated by the NSF cognizant Program Officer. Content, format, and submission timeline will be established by the NSF cognizant Program Officer. The Awardee will submit all required reports via research.gov using the appropriate reporting category; for any type of report not specifically mentioned in research.gov the Awardee will use the 'Interim Reporting' function to submit reports.

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6) Report on contractor activities and performance status for contracted amounts exceeding $250K.

7) Discussion of any other issues relevant to project performance.

8) Environmental Health and Safety report, including training and environmental compliance and site use (e.g. permits, agreements, or other arrangements).

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Principal Investigator
Co-Principal Investigators
Project Manager

NATIONAL SCIENCE FOUNDATION

Award Notice

Award Number (FAIN): 1719277

Managing Division Abbreviation: PHY **Amendment Number:** 004

AWARDEE INFORMATION

Award Recipient: University of Wisconsin-Madison
Awardee Address: 750 UNIVERSITY AVENUE ROOM 202 MADISON, WI 537061490
Official Awardee Email Address: nsf@rsp.wisc.edu
Unique Entity Identifier (DUNS ID): 161202122

AMENDMENT INFORMATION

Amendment Type: Other Admin No Fund Actions
Amendment Date: 01/27/2020
Amendment Number: 004
Proposal Number: Not Applicable
Amendment Description:

The purpose of this amendment is to make administrative corrections to the text of the award.

Accordingly, as recommended by the NSF Program Officers, the following corrections are now in effect:

1.) Under 1.2. Term of Agreement, add the following:

Project Years are defined as follows:

Project Year 1: October 1, 2018 – September 30, 2019

Project Year 2: October 1, 2019 – September 30, 2020

Project Year 3: October 1, 2020 – September 30, 2021

Project Year 4: October 1, 2021 – September 30, 2022

Project Year 5: October 1, 2022 – September 30, 2023

2.) Under 1.3.a., Funding, FY18 base funding provided was $4,066,527, or $3,432 less than the approved amount of $4,069,959. The remaining $3,432 will be provided with the approved FY 2020 base funding of $3,638,072 for a total base funding amount of $3,641,504. Contingency remains the same. The total funding in FY 2020 will increase from $4,000,301 to $4,003,733. Cumulative funding for the award will remain the same. In addition, the Baseline amount for FY22 is hereby corrected from $3,985,016 to $3,685,016. All other amounts for FY22 funding are the same.

Accordingly, the table at 1.3.a. is replaced with the following:

FYI	Baseline	Contingency	Total
FY18	$4,066,527	$664,979	$4,731,506
FY19	$5,130,419	$575,002	$5,705,421
FY20	$3,641,504	$362,229	$4,003,733
FY21	$3,604,047	$464,748	$4,068,795
FY22	$3,685,016	$788,853	$4,473,869
Total	$20,127,513	$2,855,811	$22,983,324

Except as modified by this amendment, the award conditions remain unchanged.

AWARD INFORMATION

Award Number (FAIN): 1719277
Award Instrument: Cooperative Agreement
Award Date: 09/18/2018
Award Period of Performance: Start Date: 10/01/2018 End Date: 09/30/2023
Project Title: IceCube Gen2 Phase 1: an IceCube Extension for Precision Neutrino Physics and Astrophysics
Managing Division Abbreviation: PHY
Research and Development Award: Yes
Funding Opportunity: NSF 16-566 Division of Physics: Investigator-Initiated Research Projects
CFDA Number and Name: 47.049 Mathematical and Physical Sciences

FUNDING INFORMATION

Amount Obligated by this Amendment: $0
Total Intended Award Amount: $22,983,529
Total Approved Cost Share or Matching Amount: $0
Total Amount Obligated to Date: $10,436,927

PROJECT PERSONNEL

Principal Investigator: Kael D Hanson	**Email:** kael.hanson@icecube.wisc.edu	**Institution:** University of Wisconsin-Madison
Co-Principal Investigator: Douglas F Cowen	**Email:** cowen@phys.psu.edu	**Institution:** Pennsylvania State Univ University Park
Co-Principal Investigator: Tyce R DeYoung	**Email:** deyoung@pa.msu.edu	**Institution:** Michigan State University
Co-Principal Investigator: Dawn Williams	**Email:** drwilliams3@ua.edu	**Institution:** University of Alabama Tuscaloosa

NSF CONTACT INFORMATION

Awarding Official Name: Kristin B. Spencer
Awarding Official Email: kspencer@nsf.gov

Managing Program Officer Name: Jonathan James Whitmore
Managing Program Officer Email: jwhitmor@nsf.gov

GENERAL TERMS AND CONDITIONS

This Cooperative Agreement (CA) is entered into between the United States of America, represented by the National Science Foundation (NSF), and the above named Awardee pursuant to the authority of the National Science Foundation Act of 1950, as amended (42 USC 1861-1875). This CA is provided electronically to the Awardee. The Awardee is responsible for full compliance with all Programmatic and Financial/Administrative Terms and Conditions as initially stated or as updated over the life of this CA. The Awardee's request to draw down funds under this CA will represent acceptance by the Awardee of all Terms and Conditions of the CA. The Authorized Organizational Representative (AOR) will be electronically notified of any changes to these Terms and Conditions and is encouraged to immediately review these changes and contact the Grants and Agreements Official or Program Officer within thirty days with any questions.

CA-FATC
This award is subject to the Cooperative Agreement Financial & Administrative Terms and Conditions (CA-FATC), dated 02/12/2019, available at https://www.nsf.gov/awards/managing/co-op_conditions.jsp.

Major Research Facilities and FFRDCs
This award is subject to the NSF CA Modifications and Supplemental Financial & Administrative Terms and Conditions for Major Multi-User Research Facility Projects and Federally Funded Research and Development Centers, dated 02/12/2019, available at https://www.nsf.gov/awards/managing/co-op_conditions.jsp.

To view the Award Document in FastLane go to: https://www.fastlane.nsf.gov/researchadmin/emailLoginHome.do?awardId=1719277&amendmentId=004

FATC AND PTC

Financial and Administrative Terms and Conditions (FATC)

Part 1. Award Specific Financial and Administrative Terms and Conditions (FATC)

1.1. Terms and Conditions Incorporated by Reference, Deviations and Order of Precedence

a. Terms and Conditions Incorporated by Reference. At time of award, all activities under this CA are subject to NSF's Cooperative Agreement-Financial and Administrative Terms and Conditions (CAFATC), and the Cooperative Agreement Modifications and Supplemental Financial and Administrative Terms and Conditions (CAFATC) for Major Multi-User Research Facility Projects and Federally Funded Research and Development Centers, hereafter referred to as the CAFATC Supplement, available in full text at https://www.nsf.gov/awards/managing/co-op_conditions.jsp.

b. Deviations from the CAFATC and CAFATC Supplement. To meet the specific needs and requirements of this CA, any deviations are provided in full text herein. Any subsequent changes shall be incorporated by amendment.

c. Order of Precedence. The award-specific terms and conditions of this CA, Parts 1 and 2, take precedence over the CAFATC Supplement. The CAFATC Supplement takes precedence over the CAFATC.

1.2. Term of Agreement. The term of this CA ends on September 30, 2023 unless otherwise amended. Project Years are defined as follows (Amendment 004):

Project Year 1: October 1, 2018 – September 30, 2019

Project Year 2: October 1, 2019 – September 30, 2020

Project Year 3: October 1, 2020 – September 30, 2021

Project Year 4: October 1, 2021 – September 30, 2022

Project Year 5: October 1, 2022 – September 30, 2023

1.3. Funding. Contingent on the conduct of this award, NSF intends to provide up to $22,983,324 in funding over the term of this award, of which $20,127,513 is baseline funding and $2,855,811 is contingency.

a. Contingency. The total contingency budget of $2,855,811 is hereby approved. Use of contingency funds shall be in accordance with Article 2.6, paragraph c., 'Configuration Management and Use of Contingency.' The Awardee shall manage allocations from the contingency budget against the cumulative allocated and against the total contingency budget, and report status to NSF in accordance with Article 2.5, 'Reporting Requirements.'

b. Anticipated Funding Profile. NSF will specify approved allocations to the baseline and to budget contingency, with cumulative totals for each, by amendment to this award. Funding provided will be based on award performance and contingency use. The planned schedule of funding is as follows (Amendment 004):

FYI	Baseline	Contingency	Total
FY18	$4,066,527	$664,979	$4,731,506
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Total	$20,127,513	$2,855,811	$22,983,324

c. Funding Awarded to Date (funding only the Project Office activities for 6 months, 10/01/2018 - 03/31/2019)

FY Baseline Contingency Total
FY18 $1,024,762 $0 $1,024,762

d. Of the funding awarded for FY2018, $1,024,762 is available for expenditure on the effective date of this award. Contingency is not included in this amount and is not authorized during the initial six-month Project Office setup.

1) Project Office expenditures will be in accordance with the Project Readiness Plan, which is hereby incorporated as part of the Awardee's proposal.

2) Remaining funding will be authorized for expenditure pending satisfactory completion of initial project management office setup. The Awardee may request an increase in the expenditure limit by demonstrating satisfactory progress and the need for additional funding. The request must be sent by email to the cognizant Program Officers and NSF Grants and Agreements Officer. Any increase in the expenditure limit will be implemented by amendment to this agreement.

e. Approval by the cognizant NSF Program Officer, and implementation by the Awardee of any project or schedule change, shall not constitute a basis for an increase in funding for this Cooperative Agreement, nor be interpreted as an amendment increasing the award term.

f. Segregation of Funds. Funding provided under this CA shall be used solely for the work identified herein and may not be reprogrammed or reallocated to any other award under any circumstances.

1.4. Property and Equipment. Tangible Property means property of any kind except intangible property and debt instruments. Title to all tangible property and equipment purchased or fabricated with NSF funds under this award shall vest as follows:

a. Title shall vest in the Awardee upon acquisition when the equipment is designated for research and development activities that are conducted by the Awardee and is not intended to be incorporated into, built, or necessary for the operation, maintenance or enhancement of the ice drill. All equipment acquired in accordance with this clause shall be subject to the Article of the CAFATC entitled 'Equipment.'

b. Title shall vest in the Government upon acquisition when the equipment is intended to be incorporated into, built, or necessary for the operation, maintenance or enhancement of the ice drill. In addition to the CAFATC Supplement article entitled 'NSF-Owned Equipment and Real Property,' all Government equipment acquired under this agreement shall be subject to the requirements set forth below:

c. Legal title to all tangible property furnished by NSF or acquired from other Government agencies shall remain with the Government, unless otherwise specified in writing by the NSF Property Administrator.

d. Title to Government property shall not be affected by the incorporation or attachment thereof to any property not owned by the Government, no shall any Government property lose its identity by reason of affixation to any reality.

e. All contracts and any subawards issued or awarded with respect to performance of this agreement shall include provisions regarding the determination of title to equipment acquired by the contractor or the subrecipient in accordance

with this clause.

1.5. Contracts. To the clause, 'Contract Requirements' of the CAFATC Supplement, add the following (internally numbered):

d. Prior to entering into any Time & Materials (T&M) type of contract, agreement or purchase order, the Awardee will submit a detailed cost/performance monitoring plan to the NSF Program Officers and Agreements Officer. The Plan must show that the Awardee has in place the requisite oversight and monitoring of the contractor to ensure planned funding exists and is sufficient to meet forecasted level of effort, required notifications and limitations or stops are included in the contract to prevent overruns and 'at-risk' situations, and that contractor time and effort reporting and deliverables will be verified. The Awardee will include regular updates on the status of any T&M contracts in its reports to the NSF Program Officer.

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Co-Principal Investigators
Project Manager