FDP Cost Reimbursement Research Subaward Agreement

Federal Awarding Agency: National Science Foundation (NSF)

Pass-Through Entity (PTE):	**Subrecipient:**
Board of Regents of the University of Wisconsin System on Behalf of the University of Wisconsin - Madison	THE PENNSYLVANIA STATE UNIVERSITY
PTE PI: KAEL HANSON	Sub PI: Douglas Cowen
PTE Federal Award No: 1719277 - PHY	Subaward No: 0000000032

Project Title: IceCube Gen2 Phase 1: an IceCube Extension for Precision Neutrino Physics and Astrophysics

Subaward Period of Performance (Budget Period): Start: 04/01/2019 End: 09/30/2023	Amount Funded This Action (USD): $ 358,417.00
Estimated Project Period (if incrementally funded): Start: 04/01/2019 End: 09/30/2023	Incrementally Estimated Total (USD): $ 0

Terms and Conditions

1. PTE hereby awards a cost reimbursable subaward, as described above, to Subrecipient. The Statement of Work and budget for this Subaward are as shown in Attachment 5. In its performance of Subaward work, Subrecipient shall be an independent entity and not an employee or agent of PTE.
2. Subrecipient shall submit invoices not more often than monthly and not less frequently than quarterly for allowable costs incurred. Upon the receipt of proper invoices, the PTE agrees to process payments in accordance with this Subaward and 2 CFR 200.305. All invoices shall be submitted using Subrecipient's standard invoice, but at a minimum shall include current and cumulative costs (including cost sharing), Subaward number, and certification, as required in 2 CFR 200.415 (a). Invoices that do not reference PTE Subaward number shall be returned to Subrecipient. Invoices and questions concerning invoice receipt or payments shall be directed to the party's Financial Contact, shown in Attachment 3A.
3. A final statement of cumulative costs incurred, including cost sharing, marked "FINAL" must be submitted to PTE's Financial Contact, as shown in Attachment 3A, not later than **60** days after the Project Period end date. The final statement of costs shall constitute Subrecipient's final financial report.
4. All payments shall be considered provisional and are subject to adjustment within the total estimated cost in the event such adjustment is necessary as a result of an adverse audit finding against the Subrecipient.
5. Matters concerning the technical performance of this Subaward shall be directed to the appropriate party's Principal Investigator as shown in Attachments 3A and 3B. Technical reports are required as shown in Attachment 4.
6. Matters concerning the request or negotiation of any changes in the terms, conditions, or amounts cited in this Subaward, and any changes requiring prior approval, shall be directed to each party's Authorized Official Contact, as shown in Attachments 3A and 3B. Any such change made to this Subaward requires the written approval of each party's Authorized Official, as shown in Attachments 3A and 3B.
7. The PTE may issue non-substantive changes to the Period of Performance and budget Unilaterally Unilateral modification shall be considered valid 14 days after receipt unless otherwise indicated by Subrecipient when sent to Subrecipient's Authorized Official Contact, as shown in Attachment 3B.
8. Each party shall be responsible for its negligent acts or omissions and the negligent acts or omissions of its employees, officers, or directors, to the extent allowed by law.
9. Either party may terminate this Subaward with 30 days written notice to the appropriate party's Authorized Official Contact, as shown in Attachments 3A and 3B. PTE shall pay Subrecipient for termination costs as allowable under Uniform Guidance, 2 CFR 200, or 45 CFR Part 75 Appendix IX, as applicable.
10. By signing this Subaward, including the attachments hereto which are hereby incorporated by reference, Subrecipient certifies that it will perform the Statement of Work in accordance with the terms and conditions of this Subaward and the applicable terms of the Federal Award, including the appropriate Research Terms and Conditions ("RTCs") of the Federal Awarding Agency, as referenced in Attachment 2. The parties further agree that they intend this Subaward to comply with all applicable laws, regulations and requirements.

By an Authorized Official of Pass-through Entity:	By an Authorized Official of Subrecipient:
Name: Robert Gratzl	Name: Penny L. Brewer, CRA
Title: Assistant Director of Contracts	Title: Associate Director, Office of Sponsored Programs
Date: 10/7/2019	Date: 10/04/2019

Attachment 1
Certifications and Assurances

Subaward Number:
0000000062

Certification Regarding Lobbying (2 CFR 200.450)
By signing this Subaward, the Subrecipient Authorized Official certifies, to the best of his/her knowledge and belief, that no Federal appropriated funds have been paid or will be paid, by or on behalf of the Subrecipient, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement in accordance with 2 CFR 200.450.

If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or intending to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the Subrecipient shall complete and submit Standard Form -LLL, "Disclosure Form to Report Lobbying," to the PTE.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 U.S.C. 1352. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

Debarment, Suspension, and Other Responsibility Matters (2 CFR 200.213 and 2 CFR 180)
By signing this Subaward, the Subrecipient Authorized Official certifies, to the best of his/her knowledge and belief that neither the Subrecipient nor its principals are presently debarred, suspended, proposed for debarment, declared ineligible or voluntarily excluded from participation in this transaction by any federal department or agency, in accordance with 2 CFR 200.213 and 2 CFR 180.

Audit and Access to Records
Per 2 CFR 200.501- 200.521, Subrecipient certifies that it will provide notice of any adverse findings which impact this Subaward and will provide access to records as required by parts 2 CFR 200.336, 200.337, and 200.201 as applicable. If Subrecipient is not subject to the Single Audit Act, then Subrecipient will provide notice of the completion of any required audits and provide access to such audits upon request.

Program for Enhancement of Contractor Employee Protections (41 U.S.C 4712)
Subrecipient is hereby notified that they are required to: inform their employees working on any federal award that they are subject to the whistleblower rights and remedies of the pilot program; inform their employees in writing of employee whistleblower protections under 41 U.S.C §4712 in the predominant native language of the workforce; and include such requirements in any agreement made with a subcontractor or subgrantee.

The Subrecipient shall require that the language of the certifications above in this Attachment 1 be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

Use of Name
Neither party shall use the other party's name, trademarks, or other logos in any publicity, advertising, or news release without the prior written approval of an authorized representative of that party. The parties agree that each party may use factual information regarding the existence and purpose of the relationship that is the subject of this Subaward for legitimate business purposes, to satisfy any reporting and funding obligations, or as required by applicable law or regulation without written permission from the other party. In any such statement, the relationship of the parties shall be accurately and appropriately described.

Attachment 2
Federal Award Terms and Conditions

Subaward Number: 0000000032

Required Data Elements

The data elements required by Uniform Guidance are incorporated in the attached Federal Award.

Federal Award Issue Date	FAIN	CFDA No.
09/18/2018	1719277	47.049

CFDA Title: Mathematical and Physical Sciences

Key Personnel Per NOA:

This Subaward Is:

☒ Research & Development ☒ Subject to FFATA

General Terms and Conditions

By signing this Subaward, Subrecipient agrees to the following:

1. To abide by the conditions on activities and restrictions on expenditure of federal funds in appropriations acts that are applicable to this Subaward to the extent those restrictions are pertinent. This includes any recent legislation noted on the Federal Awarding Agency's website:
   https://nsf.gov/pubs/policydocs/pappg17_1/index.jsp
2. 2 CFR 200 and 2 CFR 2500.
3. The Federal Awarding Agency's grants policy guidance, including addenda in effect as of the beginning date of the period of performance or as amended found at:
   http://www.nsf.gov/bfa/dias/policy/grants.jsp
4. Research Terms and Conditions, including any Federal Awarding Agency's Specific Requirements found at:
   https://www.nsf.gov/awards/managing/rtc.jsp except for the following :
   a. No-cost extensions require the written approval of the PTE. Any requests for a no-cost extension shall be directed to the Financial Contact shown in Attachment 3A, not less than 30 days prior to the desired effective date of the requested change.
   b. Any payment mechanisms and financial reporting requirements described in the applicable Federal Awarding Agency Terms and Conditions and Agency-Specific Requirements are replaced with Terms and Conditions (1) through (4) of this Subaward; and
   c. Any prior approvals are to be sought from the PTE and not the Federal Awarding Agency.
   d. Title to equipment as defined in 2 CFR 200.33 that is purchased or fabricated with research funds or Subrecipient cost sharing funds, as direct costs of the project or program, shall vest in the Subrecipient subject to the conditions specified in 2 CFR 200.313.
   e. Prior approval must be sought for a change in Subrecipient PI or change in Key Personnel (defined as listed on the NOA).
5. Treatment of program income: Additive

This section intentionally left blank

Special Terms and Conditions:

Copyrights:

Subrecipient Shall Grant to PTE an irrevocable, royalty-free, non-transferable, non-exclusive right and license to use, reproduce, make derivative works, display, and perform publicly any copyrights or copyrighted material (including any computer software and its documentation and/or databases) first developed and delivered under this Subaward solely for the purpose of and only to the extent required to meet PTE's obligations to the Federal Government under its PTE Federal Award.

Subrecipient grants to PTE the right to use any written progress reports and deliverables created under this Subaward solely for the purpose of and only to the extent required to meet PTE's obligations to the Federal Government under its Federal Award.

Data Rights:

Subrecipient grants to PTE the right to use data created in the performance of this Subaward solely for the purpose of and only to the extent required to meet PTE's obligations to the Federal Government under its PTE Federal Award.

Data Sharing and Access (Check if applicable):

☐ Subrecipient agrees to comply with the Federal Awarding Agency's data sharing and access requirements as reflected in the NOA (or in the special terms below) and the Data Management/Sharing Plan submitted to the Federal Awarding Agency and attached.

Promoting Objectivity in Research (COI):

Subrecipient must designate herein which entity's Financial Conflicts of Interest policy (COI) will apply: Subrecipient

If applying its own COI policy, by execution of this Subaward, Subrecipient certifies that its policy complies with the requirements of the relevant Federal Awarding Agency as identified herein: NSF - NSF PAPPG Chapter IX.A

Subrecipient shall report any financial conflict of interest to PTE's Administrative Representative or COI contact, as designated on Attachment 3A. Any financial conflicts of interest identified shall, when applicable, subsequently be reported to Federal Awarding Agency. Such report shall be made before expenditure of funds authorized in this Subaward and within 45 days of any subsequently identified COI.

Work Involving Human or Vertebrate Animals (Select Applicable Options)

■ No Human or Vertebrate Animals

This section left intentionally blank.

Human Subjects Data (Select One) Not Applicable

This section left intentionally blank

Additional Terms

For subawards that include participant support costs, invoices must identify all participant support costs requested for reimbursement. Please refer to the participant support guidance within2 CFR § 200.456 - Participant support costs and within the National Science Foundation Proposal & Award Policies & Procedures Guide (PAPPG).

Attachment 3A
Pass-Through Entity (PTE) Contacts

Subaward Number: 0000000032

PTE Information

Entity Name: Board of Regents of the University of Wisconsin System on Behalf of the University of Wisconsin - Madison

Legal Address: Research and Sponsored Programs, Suite 6401
21 North Park Street
Madison, WI 53715-1218

Website: https://www.rsp.wisc.edu/

PTE Contacts

Central Email: https://www.rsp.wisc.edu/

Principal Investigator Name: KAEL HANSON

Email: kael.hanson@wisc.edu Telephone Number: 608-890-0540

Administrative Contact Name: Kurt McMillen

Email: outgoingsubs@rsp.wisc.edu Telephone Number: 608-262-3822

COI Contact email (if different to above): coiprogram@research.wisc.edu

Financial Contact Name: Ann Pahnke

Email: apahnke@wisc.edu Telephone Number: 608-262-0181

Email invoices? (●) Yes ( ) No Invoice email (if different):

Authorized Official Name: Kim Moreland

Email: outgoingsubs@rsp.wisc.edu Telephone Number: 608-262-3822

PI Address:

1150 UNIVERSITY AVE
4207 CHAMBERLIN HALL, THOMAS C
MADISON, WI 53706

Administrative Address:

Research and Sponsored Programs, Suite 6401
21 North Park Street
Madison, WI 53715

Invoice Address:

Research and Sponsored Programs, Suite 6401
21 North Park Street
Madison, WI 53715

Attachment 3B

Subrecipient Contacts

Subaward Number: 0000000032

Subrecipient Information for FFATA reporting

Entity's DUNS Name: THE PENNSYLVANIA STATE UNIVERSITY

EIN No.: 246000376

Institution Type: Other

DUNS: 003403953

Currently registered in SAM.gov: (•) Yes ( ) No

Exempt from reporting executive compensation: (•) Yes ( ) No *(if no, complete 3Bpg2)*

Parent DUNS:

This section for U.S. Entities:

Congressional District: 05

Zip Code Look-up

Zip Code+4: 16802-7000

Place of Performance Address

110 TECHNOLOGY CENTER BLDG
UNIVERSITY PARK, PA 16802

Subrecipient Contacts

Central Email: osp@psu.edu

Website: research.psu.edu

Principal Investigator Name: Douglas Cowen

Email: dfc13@psu.edu

Telephone Number: 814-863-5943

Administrative Contact Name: Karen Little

Email: kas394@psu.edu

Telephone Number: 814-863-1831

Financial Contact Name: Richard Killian, Director Research Accounting

Email: Res-Acct@psu.edu

Telephone Number: 814-865-7525

Invoice/Payment Email: Res-Acct@psu.edu

Authorized Official Name: John W. Hanold, Associate VP for Research and Director, OSP

Email: osp@psu.edu

Telephone Number: 814-865-1372

Legal Address:

110 TECHNOLOGY CENTER BLDG
UNIVERSITY PARK, PA 16802-7000

Administrative Address:

Same as above.

Payment Address:

227 W. Beaver Ave., Suite 401
State College, PA 16801-4819

Attachment 3B-2

Highest Compensated Officers

Subaward Number: 0000000032

Subrecipient:

Institution Name: THE PENNSYLVANIA STATE UNIVERSITY

PI Name: Douglas Cowen

Highest Compensated Officers

The names and total compensation of the five most highly compensated officers of the entity(ies) must be listed if the entity in the preceding fiscal year received 80 percent or more of its annual gross revenues in Federal awards; and $25,000,000 or more in annual gross revenues from Federal awards; and the public does not have access to this information about the compensation of the senior executives of the entity through periodic reports filed under section 13(a) or 15(d) of the Securities Exchange Act of 1934 (15 U.S.C. §§ 78m(a), 78o(d)) or section 6104 of the Internal Revenue Code of 1986. See FFATA § 2(b)(1) Internal Revenue Code of 1986.

Officer 1 Name:

Officer 1 Compensation:

Officer 2 Name:

Officer 2 Compensation:

Officer 3 Name:

Officer 3 Compensation:

Officer 4 Name:

Officer 4 Compensation:

Officer 5 Name:

Officer 5 Compensation:

Subaward Number: 0000000032

Attachment 4
Reporting and Prior Approval Terms

Subrecipient agrees to submit the following reports (PTE contacts are identified in Attachment 3A):

Technical Reports:

☐ Monthly technical/progress reports will be submitted to the PTE's Principal Investigator within 15 days of of the end of the month.

☐ Quarterly technical/progress reports will be submitted within 30 days after the end of each project quarter to the PTE's Principal Investigator

☒ Annual technical / progress reports will be submitted within 60 days prior to the end of each budget period to the PTE's Principal Investigator . Such report shall also include a detailed budget for the next Budget Period, updated other support for key personnel, certification of appropriate education in the conduct of human subject research of any new key personnel, and annual IRB or IACUC approval, if applicable.

☒ A Final technical/progress report will be submitted to the PTE's Principal Investigator within 60 days of the end of the Project Period or after termination of this award, whichever comes first.

☒ Technical/progress reports on the project as may be required by PTE's Principal Investigator in order for the PTE to satisfy its reporting obligations to the Federal Awarding Agency.

Prior Approvals:

Carryover:
Carryover is automatic

Other Reports:

☒ In accordance with 37 CFR 401.14, Subrecipient agrees to notify PTE's Financial Contact 60 days after Subrecipient's inventor discloses invention(s) in writing to Subrecipient's personnel responsible for patent matters. The Subrecipient will submit a final invention report using Federal Awarding Agency specific forms to the PTE's Financial Contact within 60 days of the end of the Project Period to be included as part of the PTE's final invention report to the Federal Awarding Agency.

A negative report is required: No

☐ Property Inventory Report (only when required by Federal Awarding Agency), specific requirements below.

Other Special Reporting Requirements:

Subaward Number: 0000000032

Attachment 5
Statement of Work, Cost Sharing, Indirects & Budget

Statement of Work

○ Below ◉ Attached, 1 pages

If award is FFATA eligible and SOW exceeds 4000 characters, include a *Subrecipient Federal Award Project Description*

Budget Information

Indirect Information Indirect Cost Rate (IDC) Applied	59.86 %	**Cost Sharing**	No
Rate Type: Modified Total Direct Costs		If Yes, include Amount: $	

Budget Details

○ Below ◉ Attached, 3 pages

Budget Totals

Direct Costs	$ 224,205.00
Indirect Costs	$ 134,212.00
Total Costs	$ 358,417.00

All amounts are in United States Dollars

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

UW Project#: 144-AAD7628

Statement of Work
1 April 2019 through 30 September 2023

Pennsylvania State University

The PSU group's primary responsibilities and contributions to "IceCube Gen2 Phase 1: an IceCube extension for precision neutrino physics and astrophysics" are as follows:

1. Design, debug, and implement the data acquisition firmware resident in the on-board FPGA in each DOM. Choose appropriate FPGA for the application.
2. Design, debug and implement the FPGA-resident self-testing firmware.
3. Evaluate performance of firmware for timing and other critical Data Acquisition (DAQ) functions using small-scale test facility at Penn State.
4. Provide on- and off-site firmware and electronics expertise/support for collaborators using modules in the course of Phase 1 construction.
5. Provide on- and off-site firmware support during deployment and commissioning at South Pole.
6. Participate in internal and external project reviews.

Physics (Eberly College of Science) / The Pennsylvania State University
Ice Cube Gen 2 Phase 1 - Year 1
University of Wisconsin-Madison (National Science Foundation)
Project Dates: 04/01/2019 - 03/31/2020

	04/01/2019 - 03/31/2020	Total
Direct Costs		
Salaries (Category I)		
Cowen, Douglas F (Principal Investigator)	7,997	7,997
@ 4.84% of time 12 months (0.58 months)		
Anderson, Tyler Brooks (Research Associate)	79,859	79,859
@ 100% of time 12 months		
Other Professional TBD (Technician)	14,738	14,738
Total Salaries	102,594	102,594
Post Doctoral (Category V)		
Post Doctoral Scholar - TBD (Post Doctoral)	10,800	10,800
@ 21.60% of time 12 months (2.59 months) Year 1, @ 19.22% of time 12 months (2.31 months) Year 2		
Total Post Doctoral	10,800	10,800
Total Salaries and Wages	113,394	113,394
Fringe		
Category I @ 37.85%	38,832	38,832
Category V @ 23.52%	1,906	1,906
Category V @ 25.34%	684	684
Total Fringe	41,422	41,422
Total Salaries, Wages and Fringe	154,816	154,816
Modified Total Direct Costs		
Travel - Domestic	13,600	13,600
Travel - Foreign	24,000	24,000
Germany - Japan		
Travel - Foreign	0	0
Antarctica		
Materials & Supplies	31,789	31,789
Total Modified Total Direct Costs	224,205	224,205
Total Direct Costs	224,205	224,205
F&A Costs (MTDC basis)		
F&A Rate: 59.86%	134,212	134,212
Total Requested From Sponsor	358,417	358,417
Total Project Costs	358,417	358,417

Proposal: 62094
Generated by msr9 on: 09/17/2019
Created on 09/17/2019 and last updated on 09/17/2019

Budget Justification – Pennsylvania State University

Senior Personnel

Doug Cowen, PSU Principal Investigator, will supervise the effort to design, debug, test, and implement the data acquisition firmware resident in one or more FPGAs inside each module for the IceCube Upgrade. He will also participate in project management functions, including reviews.

Other Personnel

Dr. Tyler Anderson: With a postdoctoral researcher, Dr. Anderson will design, debug, test and implement the DAQ firmware, and provide firmware for module acceptance testing. The first two years of the project will involve intensive design work to provide firmware that can process the data from multiple PMTs within each module to insure that we meet the nanosecond-scale Phase 1 time-stamping and other operational requirements. This work will require precision test equipment at Penn State (see below for details) and relevant prototype module hardware (provided by collaborators producing the modules and module electronics).

Postdoctoral Researcher: The postdoctoral researcher will work with Dr. Anderson to provide the project with firmware as described above.

Technician: The technician will provide support to Dr. Anderson and the postdoc for the debugging and testing of the DAQ firmware and related electronics.

Dr. Anderson and the postdoctoral researcher will participate in project management and review meetings and provide on-site firmware support prior to and during deployment at the South Pole. Budget is based on current salary for Dr. Anderson and average rate for postdoctoral researchers in Physics.

Travel

Cowen, Anderson and the postdoctoral researcher will need to travel to participate in design verification and project reviews, and for commissioning activities and transition to operations. These trips are all domestic. These individuals will also need to travel internationally to work closely with our partners in Germany and Japan, where the modules are being designed and assembled. During the design stage in the first two project years, trips will be taken to insure that the firmware and the DAQ electronics hardware (being designed in Germany and Japan) are well synchronized and functioning together as required. During the following year the trips will support work with our collaborators during the module acceptance testing stage, when firmware will be needed to run self-tests of the on-board electronics and when we will need to insure full functionality of the firmware within the module and within a prototype string of modules. We budget approximately $1,700 per domestic trip, $3,000 per international trip, and $1,100 for expenses in transit to Antarctica (layovers in Christchurch, NZ). Travel costs are based on benchmark figures from the IceCube Project Office based on historical average costs for IceCube-related travel.

Year	Activities	Domestic	International	Antarctica
1	Module design verification, firmware development	8	8	0
2	Project readiness review, firmware development	4	2	0
3	Deployment readiness review, firmware implementation and verification	2	1	0
4	Commissioning	1	1	1
5	Transition to operations; final construction review	1	0	1

Materials and Supplies

We budget $45,426 for the purchase of test equipment needed for the design, debugging and integration testing of firmware in the context of the Phase 1 module electronics. This equipment includes a 1 GHz bandwidth oscilloscope, a pulse generator, power supplies, software licenses, and workstation.

Fringe Benefits

Fringe benefits are computed using the fixed rates of 37.85% applicable to Category I Salaries, 13.00% applicable to Category II Graduate Assistants, 7.86% applicable to Category III Salaries and Wages, 0.25% applicable to Category IV Student Wages, and 23.52% for Category V, Postdoctoral Scholars and Fellows, for fiscal year 2020 (July 1, 2019, through June 30, 2020). If this proposal is funded, the rates quoted above shall, at the time of funding, be subject to adjustment for any period subsequent to June 30, 2020, if superseding Government approved rates have been established. Fringe benefit rates are negotiated and approved by the Office of Naval Research, Penn State's cognizant federal agency.

F&A – On Campus Research

F&A rates are negotiated and approved by the Office of Naval Research, Penn State's cognizant federal agency. Penn State's current fixed on-campus rate for research is 59.86% of MTDC from July 1, 2018, through June 30, 2019. New awards and new competitive segments with an effective date of July 1, 2019, or later shall be subject to adjustment when superseding Government approved rates are established. Per 2 CFR 200 (Appendix III, Section C.7), the actual F&A rates used will be fixed at the time of the initial award for the duration of the competitive segment.

Subaward Number:
000000032

Attachment 6

Notice of Award (NOA) and any additional documents

◉ The following pages include the NOA and if applicable any additional documentation referenced throughout this Subaward.

○ Not incorporating the NOA or any additional documentation to this Subaward.

Charlie Giese

From: kspencer@nsf.gov
Sent: Tuesday, September 18, 2018 11:47 AM
To: RSP - NSF
Subject: Award Id : 1719277, PI: Hanson

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

AWARD NOTICE

Award Date: September 18, 2018
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
DUNS ID: 161202122

This is to inform you that your proposal for a Cooperative Agreement, 1719277, has been awarded. This award is expected to total $22,983,529.

Please view the award details at the following web address:

[https://www.fastlane.nsf.gov/researchadmin/emailLoginHome.do?awardId=1719277&amendmentId=000]

This award is subject to the Federal Funding Accountability and Transparency Act (FFATA) award term entitled, Reporting Subawards and Executive Compensation, which has been incorporated into the NSF Terms and Conditions referenced above.

If the awardee has any questions related to the pre-populated data associated with this award in the FFATA Subaward Reporting System, such questions should be submitted to: FFATTAReporting@nsf.gov or by phone to: (800) 673-6188.

The links within the award document include important terms and conditions. Your understanding of these terms and conditions is essential for effective management of the award.

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
FY21	$3,604,047	$464,748	$4,068,795
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: Monday, April 29, 2019 3:34 PM
To: RSP - NSF
Cc: amharris@nsf.gov; cowen@phys.psu.edu; deyoung@pa.msu.edu; Williams, Dawn Renee; Whitmore, James J.; kael.hanson@icecube.wisc.edu; kpigford@nsf.gov; oandrews@nsf.gov; salston@nsf.gov
Subject: NSF Award Notice for Award ID 1719277 - Amendment ID 002

NATIONAL SCIENCE FOUNDATION

Award Notice

Award Number (FAIN): 1719277

Managing Division Abbreviation: PHY

Amendment Number: 002

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: 04/29/2019
Amendment Number: 002
Proposal Number: Not Applicable
Amendment Description:

The purpose of this amendment is to increase the limitation on expenditure.

Accordingly, as recommended by the NSF Program Officers, the limitation on expenditure is hereby increased by $512,381 from $1,024,762 to $1,537,143. No part of this amount may be used for contingency unless authorized by amendment to this award.

Except as modified by this amendment, the award 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

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.

To view the Award Document in FastLane go to:https://www.fastlane.nsf.gov/researchadmin/emailLoginHome.do?awardId=1719277&amendmentId=002

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.

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
FY21 $3,604,047 $464,748 $4,068,795
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)

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.

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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.

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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:

1) Michigan State University - Communications power timing, detector simulation
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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

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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