

EXHIBIT E



National Science Foundation
 4201 Wilson Boulevard
 Arlington, VA 22230
 www.nsf.gov

COOPERATIVE AGREEMENT(CA)

AWARD: PHY-0612811

EFFECTIVE DATE:

February 1, 2007

EXPIRATION DATE:

January 31, 2012

PROJECTED TOTAL AWARD FUNDING:

(Subject to availability of funds)
 \$45,000,000

CUMULATIVE AMOUNT:

\$18,000,000

SOLICITATION:

(Incorporated by reference, as amended)

NSF 04-23

GPG: Grant Proposal Guide - Use if no Program
 Announcement number is required

CFDA NUMBER:
 47.049

OTHER AWARDS UNDER THIS PROGRAM:

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AWARDEE:

Columbia University

PROJECT TITLE:

US ATLAS Operations: Empowering US Universities for Discoveries at the Energy Frontier

PROJECT ABSTRACT:

<https://www.fastlane.nsf.gov/servlet/showaward?award=0612811>

Principal Investigator(s)

Proposal No.

Institution (s)

P. Michael Tuts

PHY-0612811

Columbia University

NSF Contact Information:

Financial/Administrative questions: e-mail your NSF Grants and Agreements Official, Jason M. Madigan, at jmadigan@nsf.gov or call the Division at 703-292-4333.

Programmatic questions: e-mail your NSF Program Officer, Morris Pripstein, at mpripste@nsf.gov or call the Program Division at 703-292-7376.

This CA is entered into between the United States of America, represented by the National Science Foundation (NSF), and the above named Awardec 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 Awardec. The Awardec 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 Awardec's request to draw down funds under this CA will represent acceptance by the Awardec 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=NSF99999FATC003

Award Specific FATC:

The Foundation authorizes the awardee to enter into the proposed contractual arrangements and to fund such arrangements with award funds up to the amount indicated in the approved budget. Such contractual arrangements should contain appropriate provisions consistent with Article 9 of the FATC

For Financial/Administrative questions specific to this cooperative agreement, please contact the NSF Grants and Agreements official, Jason Madigan, at 703-292-4333 (jmadigan@nsf.gov).

Programmatic Terms and Conditions (PTC):

General PTC:

http://www.nsf.gov/publications/pub_summ.jsp?ods_key=NSF0423TPTC000

Award Specific PTC:

1. Project Description

a. The ATLAS (A Toroidal LHC ApparatuS) Project is a collaborative experiment that is internationally funded. It involves the

European Organization for Nuclear Research (CERN) that has undertaken construction of a new high energy physics research facility, the Large Hadron Collider (LHC) at its laboratory site outside Geneva, Switzerland. The facility includes the LHC accelerator and two large detectors: ATLAS and CMS (Compact Muon Solenoid).

b. U.S. national involvement in the operation of the ATLAS experiment is referred to as the U.S. ATLAS Research program, which is jointly supported by NSF and the Department of Energy (DOE). U.S. support for operations includes contributions to the maintenance and operation (M&O) of the detector, development and maintenance of the needed U.S. software and computing (S&C) infrastructure, and research and development towards possible upgrades of the detector for higher luminosity operation. Such activity will allow U.S. physicists to participate fully in the scientific research program of the LHC.

2. Project Governance

a. 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

b. The agencies oversight is provided by a Joint Oversight group (JOG), co-chaired by senior managers from the two agencies. The NSF and DOE LHC Program Officers report to the JOG, which meets at least semiannually to review progress of the project and pending issues related to the project. The LHC Program officer in the Division of Physics at NSF spearheads the NSF oversight of the program and interfaces with other parts of the NSF. U.S. ATLAS has established a program project office at the Brookhaven National Laboratory with a Program Director and Deputy Director, one of whom is from Columbia University and the other from the laboratory. Although funding for the U.S. ATLAS program is being provided by both DOE and NSF, this CA addresses only the NSF funded U.S. ATLAS activities undertaken by Columbia University.

c. Columbia University is the Awardee institution and is responsible for U.S. ATLAS; the Awardee accepts the overall supervision, financial and reporting oversight responsibilities for the NSF funded portion of the U.S. ATLAS Research Program. The Awardee will assume primary oversight responsibility for managing the NSF funding allocated to the U.S. institutions collaborating on the M&O of components and subsystems of U.S. ATLAS and on the S&C activities of U.S. ATLAS, as well as on the research and development towards possible detector upgrades. A detailed list of these activities is documented in, and the program will be operated in accordance with the U.S. ATLAS Research Program Management Plan.

3. Reporting Requirements

a. The NSF Awardee will provide regular reports to NSF on an annual basis. In addition, quarterly reports are to be provided, as specified in the Research Program execution plan, with the Annual report being in lieu of the 4th quarter report.

b. The awardee will submit all required reports via FastLane using the appropriate reporting category. For any type of report not specifically mentioned in FastLane, the Awardee will use the Interim Reporting function to submit reports. The reports will consist of: a summary of work accomplished during the reporting period including major scientific and technical accomplishments; an assessment of current or anticipated problem areas and corrective actions; and all progress in the area of project governance.

4. Awardee Support of Ongoing NSF Management and Oversight

a. The Research Program Execution Plan governs the execution of the U.S. ATLAS program and describes in detail the roles and responsibilities of the officers.

b. The PI will monitor performance of subawardees, including managing all performance related issues, and will serve as the project point of contact for the NSF Cognizant Program Officer, including notification of any critical project management issues such as changes in key personnel, cost, schedule, and funding profile prior to implementation of such changes.

c. NSF and DOE, through the Joint Oversight Group (JOG), will conduct M&O and S&C Reviews at least twice a year. The first reviews of the year shall be comprehensive reviews while the second reviews will be half-day, minireviews. NSF and DOE program managers will review project management, cost and schedule objectives; technical experts will review subsystems in the comprehensive reviews. These reviews will be held on mutually agreed upon dates and locations.

Change History

Prior Expiration Dates:

Per Amendment 002 on
02/05/2008: January 31, 2012
Per Amendment 001 on
07/19/2007: January 31, 2012
Per Original Award on
02/28/2007: January 31, 2012

Prior Awarded Funding Amount:

Per Amendment 002 on
02/05/2008: \$9,000,000
Per Amendment 001 on
07/19/2007: \$4,500,000
Per Original Award on
02/28/2007: \$4,500,000