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COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

PROGRAM ANNOUNCEMENT/SOLICITATION NO./CLOSING DATE/if not in response to a program announcement/solicitation enter NSF 14-1

NSF 14-1 **11/03/14**

FOR NSF USE ONLY

NSF PROPOSAL NUMBER

FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S) (Indicate the most specific unit known, i.e. program, division, etc.)

AST - ADVANCED TECHNOLOGIES & INSTRM, (continued)

DATE RECEIVED	NUMBER OF COPIES	DIVISION ASSIGNED	FUND CODE	DUNS# (Data Universal Numbering System)	FILE LOCATION
				806345617	

EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN)

742652689

SHOW PREVIOUS AWARD NO. IF THIS IS
☐ A RENEWAL
☐ AN ACCOMPLISHMENT-BASED RENEWAL

IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? YES ☐ NO ☒ IF YES, LIST ACRONYM(S)

NAME OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE

University of Arizona

AWARDEE ORGANIZATION CODE (IF KNOWN)

0010835000

ADDRESS OF AWARDEE ORGANIZATION, INCLUDING 9 DIGIT ZIP CODE

888 N Euclid Ave
TUCSON, AZ 85721-0001

NAME OF PRIMARY PLACE OF PERF

University of Arizona

ADDRESS OF PRIMARY PLACE OF PERF, INCLUDING 9 DIGIT ZIP CODE

University of Arizona

AZ ,857210001 ,US.

IS AWARDEE ORGANIZATION (Check All That Apply) (See GPG II.C For Definitions)
☐ SMALL BUSINESS ☐ MINORITY BUSINESS
☐ FOR-PROFIT ORGANIZATION ☐ WOMAN-OWNED BUSINESS

☐ IF THIS IS A PRELIMINARY PROPOSAL THEN CHECK HERE

TITLE OF PROPOSED PROJECT **Continued Development of the HEAT telescope at Ridge A, Antarctica**

REQUESTED AMOUNT	PROPOSED DURATION (1-60 MONTHS)	REQUESTED STARTING DATE	SHOW RELATED PRELIMINARY PROPOSAL NO. IF APPLICABLE
$ **885,449**	**36** months	**10/01/15**	

THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW

☐ BEGINNING INVESTIGATOR (GPG I.G.2)
☐ DISCLOSURE OF LOBBYING ACTIVITIES (GPG II.C.1.e)
☐ PROPRIETARY & PRIVILEGED INFORMATION (GPG I.D, II.C.1.d)
☐ HISTORIC PLACES (GPG II.C.2.j)
☐ VERTEBRATE ANIMALS (GPG II.D.6) IACUC App. Date _____
PHS Animal Welfare Assurance Number _____
☒ FUNDING MECHANISM **Research - other than RAPID or EAGER**

☐ HUMAN SUBJECTS (GPG II.D.7) Human Subjects Assurance Number _____
Exemption Subsection _____ or IRB App. Date _____
☐ INTERNATIONAL ACTIVITIES: COUNTRY/COUNTRIES INVOLVED (GPG II.C.2.j)

☒ COLLABORATIVE STATUS
Not a collaborative proposal

PI/PD DEPARTMENT
Astronomy

PI/PD POSTAL ADDRESS
933 N. Cherry Ave

Tucson, AZ 85721
United States

PI/PD FAX NUMBER
520-621-1532

NAMES (TYPED)	High Degree	Yr of Degree	Telephone Number	Email Address
PI/PD NAME **Craig A Kulesa**	**PhD**	**2002**	**520-621-6540**	**ckulesa@email.arizona.edu**
CO-PI/PD **Christopher K Walker**	**PhD**	**1988**	**520-621-8783**	**cwalker@as.arizona.edu**
CO-PI/PD				
CO-PI/PD				
CO-PI/PD				

CERTIFICATION PAGE

Certification for Authorized Organizational Representative (or Equivalent) or Individual Applicant

By electronically signing and submitting this proposal, the Authorized Organizational Representative (AOR) or Individual Applicant is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding conflict of interest (when applicable), drug-free workplace, debarment and suspension, lobbying activities (see below), nondiscrimination, flood hazard insurance (when applicable), responsible conduct of research, organizational support, Federal tax obligations, unpaid Federal tax liability, and criminal convictions as set forth in the NSF Proposal & Award Policies & Procedures Guide,Part I: the Grant Proposal Guide (GPG). Willful provision of false information in this application and its supporting documents or in reports required under an ensuing award is a criminal offense (U.S. Code, Title 18, Section 1001).

Certification Regarding Conflict of Interest

The AOR is required to complete certifications stating that the organization has implemented and is enforcing a written policy on conflicts of interest (COI), consistent with the provisions of AAG Chapter IV.A.; that, to the best of his/her knowledge, all financial disclosures required by the conflict of interest policy were made; and that conflicts of interest, if any, were, or prior to the organization's expenditure of any funds under the award, will be, satisfactorily managed, reduced or eliminated in accordance with the organization's conflict of interest policy. Conflicts that cannot be satisfactorily managed, reduced or eliminated and research that proceeds without the imposition of conditions or restrictions when a conflict of interest exists, must be disclosed to NSF via use of the Notifications and Requests Module in FastLane.

Drug Free Work Place Certification

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent), is providing the Drug Free Work Place Certification contained in Exhibit II-3 of the Grant Proposal Guide.

Debarment and Suspension Certification

(If answer "yes", please provide explanation.)

Is the organization or its principals presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency? Yes ☐ No ☒

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) or Individual Applicant is providing the Debarment and Suspension Certification contained in Exhibit II-4 of the Grant Proposal Guide.

Certification Regarding Lobbying

This certification is required for an award of a Federal contract, grant, or cooperative agreement exceeding $100,000 and for an award of a Federal loan or a commitment providing for the United States to insure or guarantee a loan exceeding $150,000.

Certification for Contracts, Grants, Loans and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:
(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, 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.
(2) If any funds other than Federal appropriated funds have been paid or will be paid 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 this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, ''Disclosure of Lobbying Activities,'' in accordance with its instructions.
(3) The undersigned shall require that the language of this certification 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.

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 section 1352, Title 31, U.S. Code. 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.

Certification Regarding Nondiscrimination

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is providing the Certification Regarding Nondiscrimination contained in Exhibit II-6 of the Grant Proposal Guide.

Certification Regarding Flood Hazard Insurance

Two sections of the National Flood Insurance Act of 1968 (42 USC §4012a and §4106) bar Federal agencies from giving financial assistance for acquisition or construction purposes in any area identified by the Federal Emergency Management Agency (FEMA) as having special flood hazards unless the:
(1) community in which that area is located participates in the national flood insurance program; and
(2) building (and any related equipment) is covered by adequate flood insurance.

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) or Individual Applicant located in FEMA-designated special flood hazard areas is certifying that adequate flood insurance has been or will be obtained in the following situations:
(1) for NSF grants for the construction of a building or facility, regardless of the dollar amount of the grant; and
(2) for other NSF grants when more than $25,000 has been budgeted in the proposal for repair, alteration or improvement (construction) of a building or facility.

Certification Regarding Responsible Conduct of Research (RCR)
(This certification is not applicable to proposals for conferences, symposia, and workshops.)

By electronically signing the Certification Pages, the Authorized Organizational Representative is certifying that, in accordance with the NSF Proposal & Award Policies & Procedures Guide, Part II, Award & Administration Guide (AAG) Chapter IV.B., the institution has a plan in place to provide appropriate training and oversight in the responsible and ethical conduct of research to undergraduates, graduate students and postdoctoral researchers who will be supported by NSF to conduct research. The AOR shall require that the language of this certification be included in any award documents for all subawards at all tiers.

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CERTIFICATION PAGE - CONTINUED

Certification Regarding Organizational Support

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that there is organizational support for the proposal as required by Section 526 of the America COMPETES Reauthorization Act of 2010. This support extends to the portion of the proposal developed to satisfy the Broader Impacts Review Criterion as well as the Intellectual Merit Review Criterion, and any additional review criteria specified in the solicitation. Organizational support will be made available, as described in the proposal, in order to address the broader impacts and intellectual merit activities to be undertaken.

Certification Regarding Federal Tax Obligations

When the proposal exceeds $5,000,000, the Authorized Organizational Representative (or equivalent) is required to complete the following certification regarding Federal tax obligations. By electronically signing the Certification pages, the Authorized Organizational Representative is certifying that, to the best of their knowledge and belief, the proposing organization:
(1) has filed all Federal tax returns required during the three years preceding this certification;
(2) has not been convicted of a criminal offense under the Internal Revenue Code of 1986; and
(3) has not, more than 90 days prior to this certification, been notified of any unpaid Federal tax assessment for which the liability remains unsatisfied, unless the assessment is the subject of an installment agreement or offer in compromise that has been approved by the Internal Revenue Service and is not in default, or the assessment is the subject of a non-frivolous administrative or judicial proceeding.

Certification Regarding Unpaid Federal Tax Liability

When the proposing organization is a corporation, the Authorized Organizational Representative (or equivalent) is required to complete the following certification regarding Federal Tax Liability:

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that the corporation has no unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability.

Certification Regarding Criminal Convictions

When the proposing organization is a corporation, the Authorized Organizational Representative (or equivalent) is required to complete the following certification regarding Criminal Convictions:

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that the corporation has not been convicted of a felony criminal violation under any Federal law within the 24 months preceding the date on which the certification is signed.

AUTHORIZED ORGANIZATIONAL REPRESENTATIVE	SIGNATURE	DATE
NAME		

TELEPHONE NUMBER	EMAIL ADDRESS	FAX NUMBER

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COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S) - continued from page 1
(Indicate the most specific unit known, i.e. program, division, etc.)

PLR - Antarctic Astrophys&Geosp Sci
AST - ASTRNMY & ASTRPHYS RES GRANTS

PROJECT SUMMARY

Overview:

Based on the results of an NSF-funded design study in 2006 and successful deployment in 2012, we propose the next development stage for the High Elevation Antarctic Terahertz (HEAT) telescope, a robotic, 0.6-meter THz observatory at the summit of the Antarctic plateau. HEAT operates from 158 to 609 microns, and observes the brightest, most diagnostic spectral lines from the Galaxy. It is tasked with the dual purpose of performing site testing and leading-edge terahertz astronomy. HEAT was deployed in 2012 with the University of New South Wales' PLATeau Observatory (PLATO-R) to Ridge A, the driest, calmest and clearest point on the summit. The facility operates with no direct human contact for a year at a time between servicing missions, with commands and data being transfered to and from the experiment via satellite daily. The site is truly exceptional, and HEAT has already made the most sensitive large-scale spectroscopic maps at 370 and 200 microns wavelength, unveiling a population of CO-dark molecular clouds and new regions where molecular clouds may be forming. With an established facility, we propose here the next level of instrument development, namely the augmentation of a hot electron bolometer (HEB) receiver operating at 4K, whose increased sensitivity will allow the facility to map the Galaxy more than 10 times faster. This effort is the second part of a longer term plan for the facility. This proposal requires fieldwork in the Antarctic.

Intellectual Merit :

The HEAT telescope forges entirely new capabilities for ground based infrared & submillimeter astronomy which otherwise would be unachievable except via expensive airborne or space-based platforms. HEAT and PLATO-R represent a new generation of polar instrumentation that permits the excellent conditions available from remote sites like Ridge A to be harnessed without the costs and hazards associated with manned operations. The unparalleled stability, exceptional dryness, low wind and extreme cold make Ridge A a site without equal for astronomy at infrared & submillimeter wavelengths. HEAT observes in the far infrared, where most crucial astrophysical spectral diagnostics of the formation of galaxies, stars, planets, and life are found. HEAT is addressing timely and fundamental questions about the evolution of the interstellar medium and star formation. In particular, through large-scale Galactic surveys, the measurement and impact of the Galactic environment on the life cycles of interstellar clouds and their relation to star formation are being realized. Proposed upgrades of mixer, local oscillator, low-noise amplifier, cryogenic, and DSP technologies will play essential roles in future terahertz observatories. This pioneering mission paves the way for future astronomical investigations from the high plateau and beyond.

Broader Impacts :

HEAT's key project is to map, with great sensitivity and precision, portions of the Southern Galactic Plane in the spectral light of the dominant coolants of the interstellar medium. Already, comprehensive science products from the survey and its collaborations are being freely made available to the astronomy & aeronomy community with no proprietary period. These survey products enhance the value of numerous contemporary surveys and represent the ideal 'finder scope' for ALMA. The wide-field terahertz surveys provided by HEAT place Herschel, ALMA, SOFIA and balloon-borne observations in a broader, richer context. Other beneficiaries include Legacy programs from Spitzer & Herschel, HI and CO surveys of the Galactic Plane, and the 2MASS & UKIDSS infrared sky surveys. HEAT will serve both as a scientific and technological pathfinder for contemporary and future suborbital and space-based missions. As a portable, accessible terahertz observatory, the HEAT telescope transforms into an outstanding educational and outreach tool. Furthermore, the HEAT project uniquely captures the kind of high adventure spirit that attracts many to science in the first place, and we aim to provide video and photographic documentation of our experience for everyone via PBS's NOVA program. Finally, the design and fabrication of HEAT has been an interdisciplinary team effort involving students from astronomy, optical sciences, and electrical engineering. Astronomical instrumentation is becoming ever more complex, requiring the talents of many individuals to bring them to fruition. Providing students with both technical training and team-work experience increases their probability of success, both in science and in society.

SUMMARY PROPOSAL BUDGET

YEAR 1

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION
University of Arizona

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Craig Kulesa

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Craig A Kulesa - Associate Astronomer**	4.00	0.00	0.00	**19,377**	
2. **Christopher K Walker - Professor**	0.50	0.00	0.00	**5,333**	
3.					
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	**0**	
7. (**2**) TOTAL SENIOR PERSONNEL (1 - 6)	4.50	0.00	0.00	**24,710**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**1**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	2.00	0.00	0.00	**24,270**	
3. (**1**) GRADUATE STUDENTS				**15,087**	
4. (**2**) UNDERGRADUATE STUDENTS				**2,400**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**66,467**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**23,609**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**90,076**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
4K dual closed-cycle cryostat $ **45,000**					
Diamond-turned THz telescope optics **34,000**					
HEB mixers **31,671**					
Others (See Budget Comments Page…) **37,500**					
TOTAL EQUIPMENT				**148,171**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				**2,100**	
2. FOREIGN				**1,300**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**0**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**2,640**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**18,450**	
TOTAL OTHER DIRECT COSTS				**21,090**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**262,737**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
MTDC Base -- IDC at 53.0% effective 7/1/2015 (Rate: 53.0000, Base: 80266) (Cont. on Comments Page)					
TOTAL INDIRECT COSTS (F&A)				**56,855**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**319,592**	
K. RESIDUAL FUNDS				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				**319,592**	

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI/PD NAME
Craig Kulesa

ORG. REP. NAME*

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

 ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

SUMMARY PROPOSAL BUDGET COMMENTS - Year 1

**** D- Equipment**
PLATO-R replacement modules (Amount: $ 30000)
ROACH2 FFT spectrometer (Amount: $ 7500)
**** I- Indirect Costs**
MTDC Base -- IDC at 53.5% effective 7/1/2016 (Rate: 53.5000, Base 26755)

SUMMARY PROPOSAL BUDGET

YEAR 2

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION: **University of Arizona**

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: **Craig Kulesa**

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Craig A Kulesa - Associate Astronomer**	6.00	0.00	0.00	**30,024**	
2. **Christopher K Walker - Professor**	1.00	0.00	0.00	**11,018**	
3.					
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	**0**	
7. (**2**) TOTAL SENIOR PERSONNEL (1 - 6)	7.00	0.00	0.00	**41,042**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**3**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	8.00	0.00	0.00	**48,093**	
3. (**1**) GRADUATE STUDENTS				**15,585**	
4. (**2**) UNDERGRADUATE STUDENTS				**2,479**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**107,199**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**34,775**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**141,974**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
1.5 THz Local Oscillator, Virginia Diodes $ **80,000**					
4K dual closed-cycle cryostat **45,000**					
PLATO-R replacement modules **30,000**					
TOTAL EQUIPMENT				**155,000**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				**2,169**	
2. FOREIGN				**1,343**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**0**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**2,727**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**15,965**	
TOTAL OTHER DIRECT COSTS				**18,692**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**319,178**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
MTDC Base -- IDC at 53.5% effective 7/1/2016 (Rate: 53.5000, Base: 156385)					
TOTAL INDIRECT COSTS (F&A)				**83,666**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**402,844**	
K. RESIDUAL FUNDS				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				**402,844**	

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI/PD NAME: **Craig Kulesa**

ORG. REP. NAME*

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INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

 ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

SUMMARY PROPOSAL BUDGET

YEAR 3

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION
University of Arizona

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Craig Kulesa

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Craig A Kulesa - Associate Astronomer**	6.00	0.00	0.00	**31,015**	
2. **Christopher K Walker - Professor**	1.00	0.00	0.00	**11,381**	
3.					
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	**0**	
7. (**2**) TOTAL SENIOR PERSONNEL (1 - 6)	7.00	0.00	0.00	**42,396**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**1**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	2.00	0.00	0.00	**12,949**	
3. (**1**) GRADUATE STUDENTS				**16,099**	
4. (**2**) UNDERGRADUATE STUDENTS				**2,561**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**74,005**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**26,073**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**100,078**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				**2,241**	
2. FOREIGN				**1,387**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**0**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**2,817**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**2,480**	
TOTAL OTHER DIRECT COSTS				**5,297**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**109,003**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **MTDC Base -- IDC at 53.5% effective 7/1/2016 (Rate: 53.5000, Base: 100954)**					
TOTAL INDIRECT COSTS (F&A)				**54,010**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**163,013**	
K. RESIDUAL FUNDS				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				**163,013**	

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI/PD NAME
Craig Kulesa

ORG. REP. NAME*

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INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

 ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

SUMMARY PROPOSAL BUDGET

Cumulative

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION: **University of Arizona**

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: **Craig Kulesa**

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Craig A Kulesa - Associate Astronomer**	16.00	0.00	0.00	**80,416**	
2. **Christopher K Walker - Professor**	2.50	0.00	0.00	**27,732**	
3.					
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	**0**	
7. (**2**) TOTAL SENIOR PERSONNEL (1 - 6)	18.50	0.00	0.00	**108,148**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**5**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	12.00	0.00	0.00	**85,312**	
3. (**3**) GRADUATE STUDENTS				**46,771**	
4. (**6**) UNDERGRADUATE STUDENTS				**7,440**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**247,671**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**84,457**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**332,128**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.) **$ 303,171**					
TOTAL EQUIPMENT				**303,171**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				**6,510**	
2. FOREIGN				**4,030**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**0**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**8,184**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**36,895**	
TOTAL OTHER DIRECT COSTS				**45,079**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**690,918**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
TOTAL INDIRECT COSTS (F&A)				**194,531**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**885,449**	
K. RESIDUAL FUNDS				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				**885,449**	

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI/PD NAME: **Craig Kulesa**

ORG. REP. NAME*

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

C ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

BUDGET JUSTIFICATION

A. SENIOR PERSONNEL

4.0 calendar months of salary is requested for PI Craig Kulesa in Year 1, and 6.0 months per year in Years 2 and 3. His base salary is $58,131 per 12-month fiscal year.

0.5 summer months of salary is requested for Co-PI Christopher Walker in Year 1 and 1.0 summer months per year in Years 2 and 3. His base salary is $92,582 per 9-month academic year.

4.0, 6.0, and 2.0 calendar months of salary in years 1, 2 and 3 respectively is requested for Systems Engineering Lead, Abram Young. His base salary is $72,800 per 12-month fiscal year.

B. OTHER PERSONNEL

Partial funding for 3 years is requested for one graduate student (base salary $36,177) engaged in Ph.D. thesis research under this project. One semester of academic year support, plus 50% (1.5 months) summer salary is requested.

During the Year 2 development of the new cryogenic receiver systems, one month of an electrical engineer and one month of a mechanical engineer is requested. The costing is based on the average salary of a departmental electrical and mechanical engineer ($60,000 and 70,000 per 12-month fiscal year, respectively).

200 hours of undergraduate student research support is requested each year (base rate $12/hour).

C. FRINGE BENEFITS

The following university-approved fringe benefit rates were applied to each labor category:

- Faculty/Appointed Personnel: 28.6%
- Classified Staff: 47.8%
- Graduate Students: 63.3% composed of:
  - 13.3% for health/dental/life insurance
  - 50.0% for tuition remission (exempt from indirect cost charges)
- Undergraduate Students: 2.1%

D. CAPITAL EQUIPMENT

Based on the successful design and construction of the 50-Kelvin HEAT cryostat, Universal Cryogenics will be consigned to construct the two next-generation 4K instrument cryostats. Their quotation for a dual-cryocooler cryostat is $45,000 per system, commensurate with the $26,000 for the current single-stage version. One system will be delivered in year 1, with a second identical system in year 2. They will recycle the Sunpower CT cryocoolers from the prototypes.

A 1.5 THz Local Oscillator source will be purchased in year 2 from Virginia Diodes Inc. to operate the Hot Electron Bolometer mixer receivers. They are the only commercial supplier of such THz systems. Their quotation for a single unit is $80,000.

SRON will provide two quasioptical Hot Electron Bolometer mixers to the HEAT project for a total of 25,000 EUR, or 31671 USD at the current exchange rate.

A ROACH2-based spectrometer system, identical to one purchased in the prototype system, will be purchased from Digicom in year 1. Their quote is for $7,500 for the ROACH2 FPGA board,

ADC boards, and 10 Gbit ethernet boards. Digicom is the only commercial supplier of the ROACH2 systems.

We will purchase replacement engine modules for PLATO-R from the University of New South Wales (UNSW), the designer and manufacturer of PLATO-R. The total cost for two complete engine modules ready to be installed into PLATO-R is $30,000 and is based on a breakdown of the current actual costs for the individual components. We will purchase one replacement set of 2 engines in each of years 1 and 2.

Finally, only one of the two HEAT telescopes has precision-machined diamond-turned aluminum mirrors. We will task NiPro Optics, the manufacturer of the first precision set for the currently- deployed telescope, to construct a duplicate mirror set for the second telescope. The quoted cost for diamond turning and lightweighting all three mirrors is $34,000.

E. TRAVEL

Domestic

Funds are requested for one domestic conference (typically AAS, SPIE, or SCAR) for two personnel (typ. one graduate student and one mentor) for five days each year. Travel funds requested include roundtrip airfare (@ $400/trip), lodging (@ $100/night), and per diem (@ $50/day). Conference registration fees are detailed under 'Other Direct Costs' in accordance with University of Arizona cost classification practices.

International

To support the annual servicing mission to Antarctica, travel funding support for per diem (@$50 USD/day) and lodging (@$100 USD/day) is requested for 2 personnel for 5 days in Christchurch, New Zealand.

F. OTHER DIRECT COSTS

Funds are requested in each year for research supplies and work-flow/data capture and telecommunications expenses required for the conduction of this investigation. These operational items represent the material costs of creating, replicating, archiving, distributing and presenting all project related data, documentation, reporting, and analysis that are directly related to this project. Such material costs include, but are not limited to, disk drives, poster printer costs, and design and analysis software.

Funds are requested for operational repairs to the HEAT telescope and its cryogenic, receiver, electronics, and optomechanical systems. Costing is based on the replacement costs of repairs during the first two years of operating HEAT at Ridge A, including replacement of instrument control computers, solid state storage, and power supplies.

Funds are requested in years 1 and 2 for augmenting the HEAT electronics control boards used to operate the more advanced receiver system proposed here. The costs listed are based on the actual costs incurred during the previous design and prototyping efforts.

Funds are requested for two domestic conference registrations per year, typically one student and one mentor.

Funds are requested for publication of findings in professional journals each year; estimated at 3 papers of 8 pages per year @ $110/page (Astrophysical Journal).

Shipping charges for equipment to/from Antarctica (commercial surface shipping to Port Hueneme, CA or air freight to Christchurch, New Zealand) is estimated at $3,000 USD annually, based directly on the average shipping cost incurred during the last two years of operation. Shipping costs in year 3 are estimated at $1,500 for the return of the experiment.

G. INDIRECT COSTS

The university-mandated indirect cost rate (IDC) was applied to all costs except capital equipment and 50.0% of the graduate student fringe benefit rate, which is tuition remission and exempt from IDC. This rate is 53.0% effective 7/1/2015, and 53.5% effective 7/1/2016. A flat spending profile puts 75% of Year 1 expenditures (10/2015 through 6/2016) in UA FY2016 (53.0%), and 25% in FY2017 (7/2016 through 9/2016, 53.5%). The calculated IDC for year 1 follows this profile. Years 2 and 3 follow the fixed 53.5% IDC rate.

*A cost inflation rate of 3.3% per year is applied to all eligible costs for years 2 and 3.

Title Continued development of the HEAT telescope at Ridge A
Organization *The University of Arizona*
PI, Co-PI *Craig A. Kulesa, Christopher K. Walker*
Sponsor/Program *NSF AST – Advanced Technologies and Instrumentation*
Performance Period *10/1/2015 – 9/30/2017*

	YEAR 1			YEAR 2			YEAR 3			3 YEAR TOTALS
	Year 1 Rate	Labor Hrs.	TOTAL YEAR 1	Year 2 Rate	Labor Hrs.	TOTAL YEAR 2	Year 3 Rate	Labor Hrs.	TOTAL YEAR 3	
PERSONNEL										
Appointed Personnel										
Kulesa, Craig – PI	$ 27.84	696	$ 19,377	$ 28.76	1,044	$ 30,024	$ 29.71	1,044	$ 31,015	$ 80,416
Walker, Christopher – Co-I	$ 66.66	80	$ 5,333	$ 68.86	160	$ 11,018	$ 71.13	160	$ 11,381	$ 27,732
Abram Young – systems lead	$ 34.87	696	$ 24,270	$ 36.02	1,044	$ 37,606	$ 37.21	348	$ 12,949	$ 74,824
Appointed Personnel Subtotal		*1,472*	*$ 48,979*		*2,248*	*$ 78,647*		*1,552*	*$ 55,345*	*$ 182,971*
Classified Staff Subtotal										
Electrical Engineer (1 mo, Y2)	$ 29.93	-	$ -	$ 30.92	160	$ 4,947	$ 31.94	-	$ -	$ 4,947
Mechanical Engineer (1 mo, Y2)	$ 33.52	-	$ -	$ 34.63	160	$ 5,540	$ 35.77	-	$ -	$ 5,540
Classified Staff Subtotal		*-*	*$ -*		*320*	*$ 10,487*		*-*	*$ -*	*$ 10,487*
Undergraduate Student										
Undergrad (summer)	$ 12.00	200	$ 2,400	$ 12.40	200	$ 2,479	$ 12.81	200	$ 2,561	$ 7,440
Undergraduate Student Subtotal		*200*	*$ 2,400*		*200*	*$ 2,479*		*200*	*$ 2,561*	*$ 7,440*
Graduate Students										
Graduate Research Assistant - AY (1 semester) @ 50% F	$ 22.61	400	$ 9,044	$ 23.36	400	$ 9,343	$ 24.13	400	$ 9,651	$ 28,038
Graduate Research Assistant - summer (1.5-months) @ 1	$ 26.05	232	$ 6,043	$ 26.91	232	$ 6,242	$ 27.79	232	$ 6,448	$ 18,734
Graduate Students Subtotal		*632*	*$ 15,087*		*632*	*$ 15,585*		*632*	*$ 16,099*	*$ 46,772*
Labor Subtotal		**2,304**	**$ 66,466**		**3,400**	**$ 107,199**		**2,384**	**$ 74,005**	**$ 247,670**
FRINGE BENEFITS - Rates effective 7/1/13 and beyond										
Faculty and Appointed Personnel @ 28.6%		$ 48,979	$ 14,008		$ 78,647	$ 22,493		$ 55,345	$ 15,829	$ 52,330
Classified Staff @ 47.8%		$ -	$ -		$ 4,947	$ 2,365		$ -	$ -	$ 2,365
Undergraduate Student @ 2.1%		$ 2,400	$ 50		$ 2,479	$ 52		$ 2,561	$ 54	$ 156
Graduate Students @ 63.3% (50.0% IDC exempt)		$ 15,087	$ 9,550		$ 15,585	$ 9,865		$ 16,099	$ 10,191	$ 29,607
Fringe Benefits Subtotal			**$ 23,609**			**$ 34,775**			**$ 26,073**	**$ 84,457**
Personnel Labor + ERE Totals			**$ 90,075**			**$ 141,974**			**$ 100,079**	**$ 332,127**
OTHER DIRECT COSTS										
OPERATIONS			**$ 21,090**			**$ 18,692**			**$ 5,297**	**$ 45,079**
Instrument/facility/data archive maintenance and repairs			$ 10,000			$ 10,000			$ 500	
Electronics upgrades to accommodate new receivers			$ 5,000			$ 2,500			-	
Conference Registration (2/year)			$ 450			$ 465			$ 480	
Publication costs charges (3 papers x 8 pages x $110 in each year)			$ 2,640			$ 2,727			$ 2,817	
Shipping costs to Antarctica and back			$ 3,000			$ 3,000			$ 1,500	
TRAVEL			**$ 3,400**			**$ 3,512**			**$ 3,628**	**$ 10,540**
2 persons: domestic conference, annual Antarctic deployment	Domestic	International		Domestic	International		Domestic	International		
Airfare ($400 roundtrip)	$ 800			$ 826			$ 854	$ -		
Lodging ($100/night x 4 nights)	$ 800	$ 800		$ 826	$ 826		$ 854	$ 854		
Per diem ($50/day x 5 days)	$ 500	$ 500		$ 517	$ 517		$ 534	$ 534		
Total per trip	$ 2,100	$ 1,300		$ 2,169	$ 1,343		$ 2,241	$ 1,387		
CAPITAL EQUIPMENT			**$ 148,171**			**$ 155,000**			**$ -**	**$ 303,171**
4K dual closed-cycle cryostat, 1 per telescope			$ 45,000			$ 45,000			-	
1.5 THz LO source, Virginia Diodes Inc			-			$ 80,000			-	
Two HEB mixers, SRON (25k EUR to USD)			$ 31,671							
ROACH2 FFT spectrometer plus 10Gbit ethernet & ADC boards			$ 7,500			-			-	
PLATO-R annual replacement modules			$ 30,000			$ 30,000				
Diamond-turned THz mirrors for existing 2nd telescope			$ 34,000			-			-	
Total Other Direct Costs			**$172,661**			**$177,204**			**$ 8,925**	**$358,791**
TOTAL DIRECT COSTS			**$ 262,736**			**$ 319,178**			**$ 109,004**	**$ 690,918**
INDIRECT COSTS – 52.5%, effective 7/1/14 53.0%, effective 7/1/15 53.5%, effective 7/1/16										
MTDC BASE = Total Direct Costs (TDC) less capital equipment, less Tuition Remission (50.0% of Graduate Student fringe), and on first $25K of **EACH** subcontract										
Flat spending profile puts 75% of MTDC of Y1 under UA FY2015 rates, 25% of Y1 under UA FY2016 rates. Similar for Y2. Y3 falls under UA FY2017 rates only.										
	MTDC Base	IDC		MTDC Base	IDC		MTDC Base	IDC		
Base (on salaries, operations, travel)	$ 107,021	$ 56,855		$ 156,385	$ 83,666		$ 100,954	$ 54,011		
Total Indirect Costs		**$ 56,855**			**$ 83,666**			**$ 54,011**		**$ 194,532**
TOTAL PROJECT COSTS		**$ 319,591**			**$ 402,844**			**$ 163,015**		**$ 885,450**