



NORTH AMERICAN ARC
ALMA Regional Center

North American
ALMA Science
Center



Development Upgrades of the Atacama Large Millimeter/submillimeter Array (ALMA)

Cycle 5 CALL FOR STUDY PROPOSALS

This Call is to invite proposals to conduct studies of ideas that may be further developed and implemented in a subsequent funding cycle. The primary aims of this Call for Study Proposals are to:

- encourage the flow of development ideas from the North American ALMA community into the ALMA Development Program Plan,
- support the development of conceptual and detailed designs by the North American ALMA community for possible future inclusion in the ALMA Development Program Plan, and
- support ALMA-relevant, long-term research and development by the North American community.

The completed studies will be used, together with similar studies from the other ALMA partners, to prepare and implement the ALMA Development Plan. Limited funding is available from NRAO to support North American-based studies and will be allocated on a competitive basis. Studies partly or fully supported from external sources are also solicited and, if presented, will be considered in the preparation of the ALMA Development Plan.

SECTION 1.0 ALMA DEVELOPMENT: A SCIENCE SUSTAINABILITY PROGRAM

1.1 PROGRAM DEFINITION

The Atacama Large Millimeter/submillimeter Array (ALMA), an international astronomy facility, is a partnership of Europe, North America and East Asia in cooperation with the Republic of Chile. ALMA is funded in Europe by the European Organization for Astronomical Research in the Southern Hemisphere (ESO), in North America by the U.S. National Science Foundation (NSF) in cooperation with the National Research Council of Canada (NRC) and the National Science Council of Taiwan (NSC), and in East Asia by the National Institutes of Natural Sciences (NINS) of Japan in cooperation with the Academia Sinica Institute of Astronomy and Astrophysics (ASIAA) in Taiwan.

ALMA Operations are led on behalf of Europe by ESO, on behalf of North America by the NRAO, which is managed by Associated Universities, Inc. (AUI), and on behalf of East Asia by the National Astronomical Observatory of Japan (NAOJ). The Joint ALMA Observatory (JAO) provides the unified leadership and management of the ALMA Observatory. The JAO coordinates the ALMA Development Program, its goal being to effectively manage the technological evolution of the ALMA facility. Periodically, solicitations (“calls”) are issued by each of the international partners to identify and fund development initiatives (“upgrades”) which will enhance the performance of the ALMA facility. The implementation of ALMA upgrades will be assigned on a competitive basis.

Upgrade priorities are science-driven, and are established by the collective input from the ALMA Science Advisory Committee (ASAC), the ALMA Management Team (AMT), and their respective subcommittees. Upgrades typically progress through three successive phases of development, and correspond to an increasing level of technology readiness. The principal phases are:

- a. general and strategic studies (including scientific justification, specification, and outline costing),
- b. prototype/pre-production, and
- c. full production and implementation.

The North American ALMA partnership typically funds conceptual studies (hereafter referred to as “Studies”) every year. Prototype/pre-production and full production initiatives (hereafter referred to as “Projects”) are typically funded every two (2) years. Calls for Projects will be governed by, and conducted through a different (albeit similar) process. All members of the North American ALMA partnership, and the North American radio astronomy community at-large, are invited to participate in the ALMA Development Program.

In this context, this Call solicits Study proposals for the FY2018 program cycle (Cycle 5). Applicants may answer this Call by requesting full (or partial) support to conduct a Study or by stating their intention to submit an ALMA upgrade study based on existing work, perhaps funded from other sources. NRAO/AUI will oversee this process on behalf of the North American partnership. This document, together with the accompanying “*Study Proposal Template*”, provides all information required to prepare and submit a Study Proposal.

In the context of this Call, goals are expressed as general capabilities, and the content of a Study Proposal should represent a potential solution to one, or more, of these goals.

The Cycle 5 Call for Study Proposals seeks to enhance, or develop new means to, the following general capabilities:

- sensitivity,
- angular resolution,
- field of view,
- spectral coverage,

- simultaneous frequency coverage,
- imaging quality,
- accuracy of amplitude,
- accuracy of phase,
- accuracy of polarization,
- flexibility, and
- usability.

Study topics of particular interest are set forth in APPENDIX A. While Proposers are encouraged to align their interests with these goals, they should not be construed as hard constraints. Novel ideas for new or enhanced scientific capabilities are welcome.

I.3 CURRENT PROGRAM STATUS

The first North American ALMA Development Program cycle began in FY2012. Six (6) Studies were funded and two Studies were accepted on a “no cost” basis; i.e., work is performed and provided as an “in kind” contribution. Three of the six (3 of 6) funded Studies were internal (North American ALMA partnership) awards; the other three (3) were external awards to various academic institutions. All of the funded Studies completed at the end of FY2013 (September 30, 2013).

The Second North American ALMA Development Program cycle began in FY2014. Six (6) Studies were funded. Three of the six (3 of 6) funded Studies were internal (North American ALMA partnership) awards; the other three (3) were external awards to various academic institutions. Three (3) of the funded Studies completed in December 2014 while three (3) have no cost extensions to complete their Studies.

The Third North American ALMA Development Program cycle began in FY2015. Seven (7) Studies were funded. Two of the seven (2 of 7) funded Studies were internal (North American ALMA partnership) awards; the other five (5) were external awards to various academic institutions. The start dates of these Studies were delayed until Q2 FY2016 due to a temporary suspension of FY2015 ALMA Development activities while a new Cooperative Agreement was finalized between the National Science Foundation and Associated Universities, Inc. (managing agency of the NRAO).

The Fourth North American ALMA Development Program cycle began in FY2017. Six (6) Studies were funded. Two of the six (2 of 6) funded Studies were internal (North American ALMA partnership) awards; the other four (4) were external awards to various academic institutions. These studies commenced October 1, 2016 to fit within the Fiscal Year 2017 funding envelope of the ALMA Development Program.

The North American ALMA Development Program seeks to maintain a portfolio of Studies that balances internal and external awards, technology readiness, cost, and risk.

SECTION 2.0 CYCLE 5 CALL FOR STUDY PROPOSALS

2.1 CYCLE 5 CALL RELEASE DATE

The release date for the Cycle 5 Call for Study Proposals is March 01, 2017. The period of performance for funded Studies will run from the award date

(October 2, 2017) to no later than September 30, 2018 (one year) for General Studies and no later than September 30, 2019 (two years) for Strategic Studies.

2.2 PROPOSALS FROM NRAO EMPLOYEES

Prospective NRAO Proposers must use the New Ideas Notification Form on the NRAO PMD Webpage. The New Ideas Notification Form must be submitted and approved by the Director before proceeding with preparation of a formal Study Proposal. Prospective NRAO Proposers are encouraged to prepare and submit the New Ideas Notification Form as soon as possible.

NRAO Proposers will follow the standard NRAO proposal development process, and the proposal document set must be approved by the Director's Office, AUI, and NSF prior to submission. Please allow adequate time for this process.

2.3 NOTICE OF INTENT

Prospective Proposers are requested to submit a **Notice of Intent no later than March 20, 2017**. Please communicate your intent, and intended proposal category, online, by going to the [Cycle 5 webpage](#). Submitting a *Notice of Intent* will ensure that Proposers are included in the mailing list for replies to Proposers' questions and other correspondence related to the Cycle 5 Call for Study Proposals. **A Proposer's Notice of Intent is non-binding.**

2.4 CYCLE 5 PROPOSAL DEADLINE

The deadline (closing date) is May 01, 2017. Proposals received after the deadline may be rejected, at NRAO's sole discretion. Requests to postpone the deadline will not be considered.

2.5 ELIGIBILITY

NRAO welcomes proposals or expressions of interest from members of the North American ALMA Operations partnership and their at-large, radio astronomy communities.

Proposers who do not require financial support to complete the Study are also invited to respond to this Call. If no support is requested, the final Study will be subject to review in the same manner as funded proposals before being considered for inclusion in the ALMA Development Plan.

The Principal Investigator need not be an astronomer.

2.6 FUNDING

For Cycle 5, two types of Studies will be considered:

Strategic Study: a mid-scale, two-year investigation of an emerging technology of specific, strategic interest that is tightly aligned with "[A Roadmap for Developing ALMA](#)". May lead to a Development Project.

General Study: a small-scale, one-year investigation of an emerging technology of general interest. May lead to a Development Project.

Award pool – a total of three million U.S. dollars (\$3.0M) is available for funding Cycle 5 Studies. As a guideline, the NRAO expects to fund several Studies. No

individual General Study will be funded in excess of two hundred thousand U.S. dollars (\$200K), and no individual Strategic Study will be funded in excess of four hundred thousand U.S. dollars (\$400K). Applicants may contribute funds from independent sources, combine them with solicited Study funds, and thereby pursue more aggressive goals.

Disclaimer - the entirety of available funds will not necessarily be awarded; acceptance of the Study proposal and granting an Agreement for the Study does not imply that the upgrade will be implemented at the Observatory as part of the ALMA Development Plan. Nor, if selected as part of the Development Plan, will the institution or consortium which carried out the Study be automatically selected to undertake the next phase of the development process.

2.7 AMENDMENTS TO THE CYCLE 5 CALL FOR STUDY PROPOSALS

NRAO reserves the right to issue amendments to the present Call for Study Proposals at any time prior to the Deadline for the submission of Proposals (May 01, 2017.) Any such amendment will be communicated to all Prospective Proposers that have submitted a *Notice of Intent*.

2.8 VALIDITY DATE OF CYCLE 5 STUDY PROPOSALS

A proposal submitted to this Call for Study Proposals shall bind the Proposer to the contractual terms, conditions and total cost presented therein, until September 30, 2018 for General Studies and September 30, 2019 for Strategic Studies; i.e., no amendments to the Proposal within this period of time will be accepted without the express consent of the NRAO.

2.9 CLARIFICATION OF STUDY PROPOSALS

NRAO reserves the right to ask Proposers for clarifications of their Proposal(s) during the evaluation period. Proposer responses, addressed to Laura Jensen, ALMA Development Program Manager (<mailto:ljensen@nrao.edu>), must be received within three (3) business days of dispatch of the request, if no other period is stated.

2.10 AMENDMENT, WITHDRAWAL OR RESUBMISSION OF STUDY PROPOSALS

Requests for amendment, withdrawal or resubmission of the Proposal will be granted if the Proposer can complete the associated action before the Deadline.

2.11 INTELLECTUAL PROPERTY MANAGEMENT

Confidentiality of NRAO Information - Release of confidential ALMA documentation and drawings may be requested by the Proposer and will be contingent upon execution of a *Mutual Non-Disclosure Agreement* available for review at the [Cycle 5 webpage](#) (refer to the “Post Award Documents” table.)

Confidentiality of Proposer Information - Proposers may wish, in connection with work contemplated under the Proposal, to disclose confidential information to NRAO personnel. To protect the confidentiality of such information, a Proposer may ask NRAO to enter into a *Mutual Non-Disclosure Agreement*.

Intellectual Property (IP) Rights - Proposers’ IP rights pertaining to technical data, copyrightable material, patents, and utilization of subject inventions are subject to the

terms of the NRAO's standard *Subrecipient Agreement* and any negotiated amendments thereto.

SECTION 3.0 VIABILITY OF PROPOSALS

3.1 STUDY CATEGORIES

The North American ALMA Development Program seeks to maintain a portfolio of Studies that also balances development of:

- a. **advanced techniques** – for example, advanced data processing/analysis tools, advanced calibration methods, or innovative observing modes;
- b. **advanced hardware** – for example, advanced receiver cartridge components, cryogenic cooling apparatus, or test and measurement equipment; and
- c. **advanced software** – for example, advanced user interfaces, data reduction and analysis routines, or data imaging routines.

The Cycle 5 Call does not emphasize, or prefer, one Study category over another.

3.2 STUDY PROPOSAL CONTENT

Viable proposals will define an approach, or approaches, to new or enhanced scientific capabilities of the ALMA Observatory. The manner of approach may be direct (by enabling new science) or indirect (e.g., by improving operations reliability, efficiency or calibration accuracy). The Call does not identify specific science cases to be addressed by the Study, nor does it include a set of technical specifications. These topics must form part of the proposal itself.

Potential Studies may vary enormously in terms of scientific gain, technical maturity, difficulty, cost, and timescale. Very different levels of detail will therefore be appropriate for the Studies.

SECTION 4.0 PREPARATION OF CYCLE 5 STUDY PROPOSALS

The Study Proposal shall be composed in accord with the *Study Proposal Template* available at the [Cycle 5 webpage](#) (refer to the “*Study Proposal Documents*” table). **Proposals that do not make use of, or conform to the format and conventions of this template will not be considered.**

Even if financial support is not requested for the Study, financial data (contributions in kind) must be included in order to assess all Proposals fairly in the context of the ALMA Development Plan.

The Study Proposal shall not exceed twenty (20) pages in length. Curriculum Vitae and Appendices are excluded from the page count.

SECTION 5.0 SUBMITTAL OF CYCLE 5 STUDY PROPOSALS

Submit the completed Cycle 5 Study Proposal (**with signatures**), in “.pdf” format, online at the [Cycle 5 webpage](#) (refer to the “*Submitting a Cycle 5 Study Proposal*” section.)

SECTION 6.0 EVALUATION OF CYCLE 5 STUDY PROPOSALS

6.1 EVALUATION PROCESS

Evaluation will be conducted by a committee of non-NRAO reviewers with the technical input of disinterested persons familiar with ALMA technical matters (reference **Figure 1**, on following page.) The membership of the Review Committee will be determined by NRAO management, with the consent of the National Science Foundation. Members of these groups who are involved in competing proposals will be recused from judging their own, or closely-related, proposals.

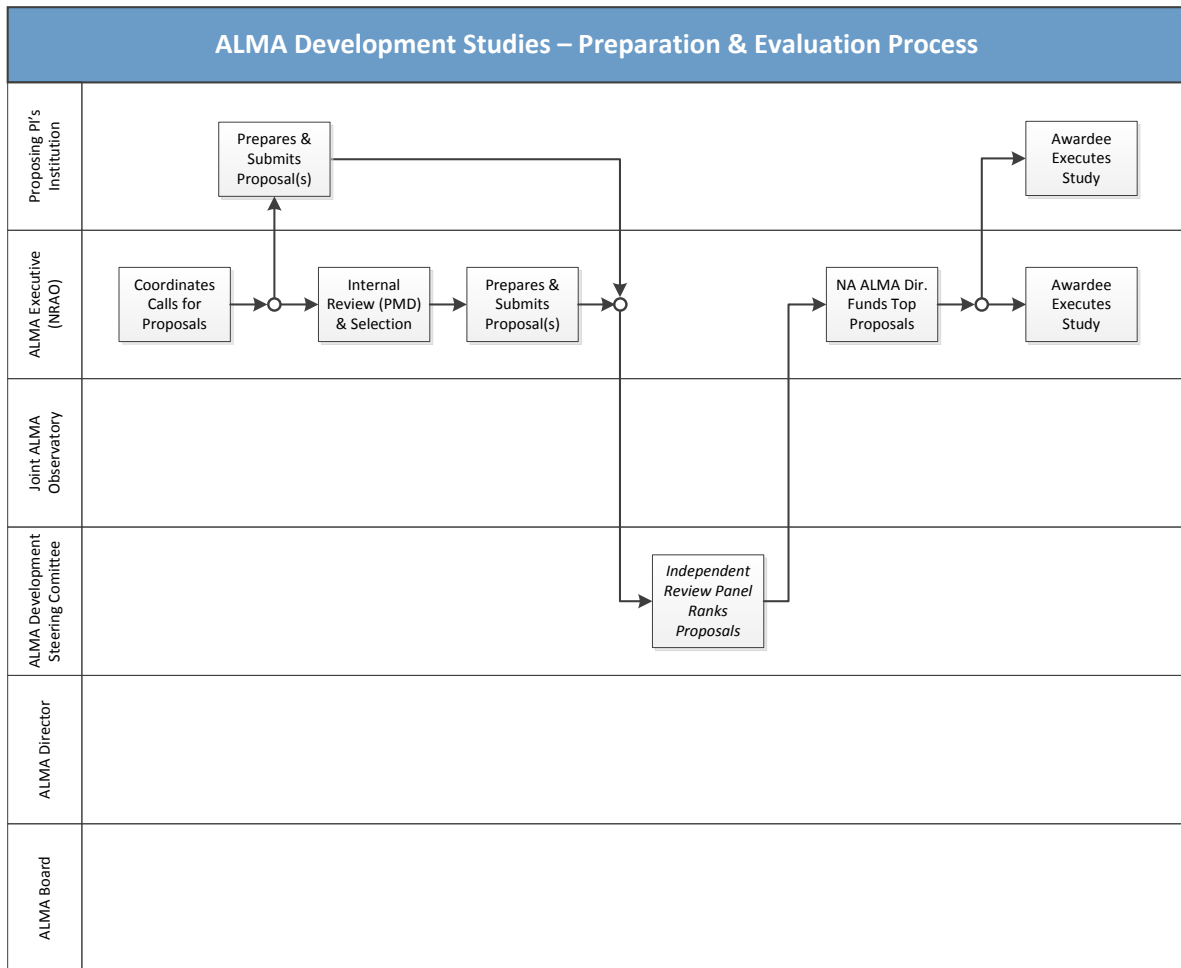


Figure 1: ALMA Development Studies – Preparation & Evaluation Process.

6.2 EVALUATION CRITERIA

Evaluation of Proposals will be made using an evaluation matrix (or “scorecard”) based on the following criteria:

- alignment with 2030 Pathway to developing ALMA;
- strength of the scientific case for the proposed ALMA upgrade concept;
- quality of the upgrade conceptual design;

- technology readiness (the aim is to support a range of upgrades including both those which can be implemented rapidly and those requiring longer-term research and development);
- strength of the consortium organization (if applicable);
- qualifications of key personnel;
- technical expertise, past experience and technical facilities in the participating Institutes;
- assessed level of risk inherent in the proposed design (the aim is to support a range of upgrades including both those which are judged to be low risk, high reward and those judged to be high risk, high reward);
- strength of the scientific team supporting the Study;
- level of support guaranteed by collaborating institutions (if applicable); and
- budgeted cost of the Study.

6.3 NO INFORMATION (“BLACK OUT”) DURING EVALUATION PROCESS

NRAO staff will not respond to questions about proposals or proposal status during the evaluation and selection period. NRAO reserves the right to eliminate from the evaluation any Proposer contravening this provision.

6.4 RESULTS AND NOTIFICATION OF AWARD AGREEMENT

Proposers will be informed, in writing, of the Cycle 5 Call for Study Proposals results no later than July 31, 2017. Decisions will be made in consultation with, and the consent of, the National Science Foundation. Rejection decisions cannot be appealed, and NRAO will not enter into correspondence on decision rationale.

SECTION 7.0 CONTRACTUAL REQUIREMENTS

7.1 FEDERAL FUNDING ACCOUNTABILITY AND TRANSPARENCY ACT (FFATA) COMPLIANCE

Each successful Proposer (hereafter referred to as the “Offerer”) will be a subrecipient to Federal Award number AST-1519126, entitled “Management and Operation of the National Radio Astronomy Observatory (NRAO)”, a Cooperative Agreement awarded to Associated Universities, Inc. by the National Science Foundation for the period April 1, 2016 to September 30, 2026. The Federal Award is identified under Code of Federal Domestic Assistance (CFDA) number 47.049, Mathematical and Physical Sciences, for R&D.

Subrecipients awarded twenty-five thousand dollars U.S. (\$25K) or more (likely all Subrecipients) will be required to complete a *Federal Funding Accountability and Transparency Act (FFATA) Subrecipient Profile Questionnaire* so NRAO can report subaward information to the FFATA Subrecipient Reporting System (FSRS) website, in accordance with the FFATA Act of 2006, the associated 2008 amendment, and the OMB Memorandum dated August 27, 2010.

The *FFATA Subrecipient Profile Questionnaire* is available for review at the [Cycle 5 webpage](#).

7.2 TERMS AND CONDITIONS

The principal Institution associated with each selected Proposal will be required to engage with the NRAO by means of a *Subrecipient Agreement* (available for review [Cycle 5 webpage](#)). This Agreement is subject to Article 8.a.4 of the current and future NSF Cooperative Agreement Financial & Administrative Terms and Conditions (CA-FATC) and as such, requires Subrecipients to follow the Federal laws, regulations, and provisions of the Federal Award. Subrecipients will also be bound by supplemental requirements imposed by the NRAO (and negotiated amendments thereto.)

7.3 REPRESENTATIONS AND CERTIFICATIONS

The principal Institution associated with each selected Proposal will be required to complete a *Representations & Certifications Form* (available for review at the [Cycle 5 webpage](#)). The completed form will represent and certify that the information provided (topics listed below) is current, accurate, and complete:

- labor surplus area status;
- type of business organization;
- Taxpayer Identification Number (TIN);
- Regular Dealer-Manufacturer classification;
- business size and type classification;
- Standard Industrial Classification (SIC) code; and
- compliance with other, miscellaneous Federal Acquisition Regulations.

The completed form becomes a part of the Purchase Order.

7.4 PURCHASE ORDERS

A single, fixed-price, Purchase Order (PO) will be issued for each selected Study. The PO will establish delivery and payment schedules, the latter based upon a mutually agreeable set of progress milestones. The Offerer shall commit to perform the Statement of Work (approved Study Proposal) in accord with first-class trade practices and within the prescribed time limits. Requests for no-cost extensions will be considered on a case-by-case basis.

SECTION 8.0 DELIVERABLES

The precise deliverables will vary between Studies, depending on such factors as:

- scientific justification: specific (e.g., a new receiver band) or generic (e.g., a calibration technique applicable to all observations);
- whether the Study is hardware or software oriented;
- technology readiness level (maturity);
- scope and scale of the Study; and
- cost.

In all cases, intermediate Progress Reports and a Closeout Report are required. The Purchase Order will clearly define the associated deliverables and delivery schedule.

8.1 PROGRESS REPORTS

Monthly feedback is required from the Study Principal Investigator in order for the NRAO to fulfill its management responsibilities, and to fulfill its obligations to the National Science Foundation Program Manager. This feedback shall be provided in a simple, one (1) page document, commonly known as a “4-Square”. Each quadrant of a 4-Square Progress Report addresses a specific aspect of Study performance (reference **Figure 2**, below).

Cost Performance: <i>actuals versus budget & explanation of variance(s).</i>	Technical Performance: <i>any technical issue(s) impeding Study progress.</i>
Schedule Performance: <i>work accomplished versus work planned (% complete).</i>	Risk Management: <i>threats to Study success and mitigating action plan.</i>

Figure 2: “4-Square” Progress Report Format.

The Principal Investigator will complete those quadrants shaded in “blue”. A Progress Report template and detailed instructions on how to complete the Progress Report will be made available in a separate document.

8.2 CLOSEOUT REPORT

A Closeout Report is required at the conclusion of the Study. The Principal Investigator is expected to produce documentation that will enable evaluation of scientific and technical specifications, technology readiness level, implementation timeline (assuming follow-on Project funding), and approximate implementation costs. It is NRAO’s intent to publish the Closeout Report as a Memo in either the [ALMA Memo Series](#) or in the [NAASC Memo Series](#).

The Closeout Report shall include, at an appropriate level of detail:

- quantitative analysis of the key scientific drivers of the proposed upgrade, whether specific or generic, supported by simulations (where possible) and including comparisons with baseline ALMA capabilities;
- a proposed Technical Specification;
- a conceptual design, supported by appropriate analysis;
- a discussion of interfaces with the current configuration of the ALMA system and, if relevant, any new requirements;
- a proposed Consortium structure (if applicable) for the detailed design and

implementation of the upgrade, with information on the expertise and facilities at the different member institutes or industrial partners;

- a preliminary estimate of upgrade cost (labor, materials & services, and travel);
- a proposed Project schedule (prototype/pre-production or production); and
- Identification of technical and programmatic (schedule and cost) risks and a recommended risk mitigation plan.

Additional elements may be appropriate depending on the type and scope of the upgrade. A Closeout Report template and detailed instructions on how to complete the Closeout Report will be made available in a separate document.

SECTION 9.0 QUESTIONS PERTAINING TO THE CYCLE 5 CALL FOR STUDY PROPOSALS

An [informational meeting](#) will be held in Charlottesville, Virginia on March 15, 2017. Interested parties may attend via teleconference, videoconference, or in person, and are requested to communicate their intention to participate (preferably by close of business on March 03, 2017) to the North American ALMA Science Center at <mailto:almainfo@nrao.edu>.

Please submit questions concerning the present Call for Study Proposals, including any request for documentation referred to in this document, to the [ALMA Helpdesk](#) [use Knowledgebase: *Development Program*] by April 14, 2017. Queries will be directed to, and answered by, appropriate persons unassociated with this Call.

Questions shall, where possible, make reference to the specific section(s) of the solicitation document (“*Call for Study Proposals*”) requiring clarification. When answering, NRAO will forward replies, together with the questions received, to all Proposers who have submitted a Notice of Intent. Replies will also be posted to the [“Frequently Asked Questions” page](#) on the NRAO website.

SECTION 10.0 CYCLE 5 SCHEDULE SUMMARY - STUDIES

Milestone	Date	Reference Section
Release of Call for Study Proposals	2017 March 01	Section 2.1
Informational Meeting	2017 March 15	Section 9.0
Notice of Intent	2017 March 20	Section 2.2
Proposer's Questions Submitted <i>no-later-than</i>	2017 April 14	Section 9.0
Proposal Deadline	2017 May 01	Section 2.3
Notification of Awards	2017 July 31	Section 6.4
Validity Date of Study Proposals	2017 July 31	Section 2.8
Study Start Date	2017 October 02	Section 2.7
Study Completion Date (General Study)	2018 September 30	Section 2.1
Study Completion Date (Strategic Study)	2019 September 30	Section 2.1

APPENDIX A

STUDY TOPICS OF PARTICULAR INTEREST TO THE NA ALMA PARTNERSHIP

1. Larger bandwidths and improved receiver sensitivity: enabling gains in speed.
2. Longer baselines: enabling qualitatively new science.
3. Increasing wide field mapping speed: enabling greater mapping efficiency.
4. Improvements to the ALMA Archive: enabling gains in usability and impact for the Observatory.