

DSN Radio Astronomy and Radar Science Proposal and Scheduling Process

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I. Introduction and Summary

This document documents the process for use of the Deep Space Network (DSN) for radio astronomy or radar science observations. The process includes a proposal element and a scheduling element with the following features:

- Proposals are peer reviewed for scientific merit.
- Proposals are evaluated for technical justification, suitability for use of DSN equipment, including use of unique aspects of the DSN.
- Proposals are evaluated for their feasibility for DSN scheduling, given the primary commitment of the DSN to provide Telemetry, Tracking, and Command (TT&C) services to space missions.
- Investigators leading approved proposals for DSN science observations are required to report on observations that were actually conducted, referencing what was originally proposed and scheduled.
- Investigators using the DSN for radio astronomy or radar science are required to submit a report within 3 months of the completion of their observation campaign documenting the measurements that were planned, scheduled, and carried out. The report should include a summary of preliminary results from the observations. If the campaign is lasting more than 12 months, the Investigator is required to support an annual continuation review, including providing a status report within 6 months of the first observation of the campaign, to document progress achieved and plans going forward. Continuation of the observation campaign is contingent on a successful outcome of the continuation review.
- Once a proposal is selected and scheduled, the Investigator may, only if approved by the DSN Science Point of Contact (POC), repurpose up to 10% of their scheduled observation time if the modification is to conduct observations that are closely aligned with the original science, as proposed. Investigators desiring to make adjustments to the observing schedule must work only through the POC, and should not contact the DSN scheduler team nor other investigators directly.
- If additional DSN time becomes available for Radio Astronomy, the DSN Scheduler will incorporate the schedule changes and assign the time to an appropriate investigation, in consultation with, and with approval from, the DSN Science POC.

II. Radio Astronomy

DSN antennas can be used in a standalone capacity or in conjunction with other antennas as part of a very long baseline interferometry (VLBI) observation. Three constraints apply to all proposals to use the DSN for radio astronomy:

- The primary use of DSN antennas is for spacecraft TT&C. While every effort will be made to accommodate radio astronomy requests that require time critical observations or observations at specific epochs, such observations can be challenging to schedule given the TT&C needs of the more than three dozen missions that depend upon the DSN.
- DSN antenna schedules are intended to be published 16 weeks (4 months) in advance of execution. Inputs to the scheduling process would then be needed 6 months in advance. Therefore, radio astronomy proposals for use of the DSN should be submitted at least **9 months** in advance to allow time for appropriate review and evaluation.
- All proposals to use one or more DSN antennas for radio astronomy must specify how the proposed observations require or make use of some unique capability of the DSN. This is a factor that is considered in the proposal evaluation.

There are three different categories of radio astronomical observations, which affect where proposals should be sent for evaluation and how approved projects appear on the DSN schedule.

A. Ground-Based Radio Astronomy (GBRA)

Proposals for DSN GBRA observations must be evaluated for scientific merit by independent peers or science-knowledgeable individuals selected or recognized by the DSN. Three different merit reviews are considered acceptable for proposals:

- Submission and evaluation within the DSN;
- Submission to and independent peer review by another research institution that conducts a comparable review process (e.g., NASA, National Radio Astronomy Observatory, NSF);
- Submission to and independent peer review by the JPL Research & Technology Development (R&TD) program.

A.1 GBRA DSN Proposals

Proposals are accepted **twice per year, with the following deadlines: October 15, April 15.**

Proposals shall contain two key elements:

Scientific motivation that describes the scientific objective(s) of the proposed DSN observations. This description should be understandable and compelling to a science-knowledgeable reviewer who may not be a specialist in the specific area of study.

Technical and feasibility justification that describes the required observational parameters needed to achieve the desired scientific objective(s) and how the proposal makes use of the DSN to achieve the scientific objectives. Typical parameters might include sensitivity, spectral resolution, and number of epochs; the actual set of technical parameters is left to the discretion of the proposer, but the set described should be sufficient to allow a reviewer to assess the technical feasibility of the proposed observations with the DSN. Since DSN antenna time for radio astronomy observational campaigns is constrained by space mission use of the DSN and such space mission use can be dynamic, the proposal should include a discussion on why the proposed observations are feasible with the DSN, and how the science quality of the proposed investigation would be affected if less than 100% of the requested DSN time were to be ultimately granted. The proposal should include a schedule showing key milestones associated with the work, including observational campaign, data analysis, and reporting (including publication) of results. A uniqueness statement is also required that describes the uniqueness of the DSN antenna (or antennas) for conducting the observations and achieving the scientific objectives.

Each proposal shall identify a Principal Investigator (PI), who is ultimately responsible for all aspects of the proposal and for its successful execution, should it be selected. There may be additional Investigators named on the proposal. Proposals shall be up to four pages in length, on 8.5 x 11 inch paper, with 1-inch margins on the top, bottom, and sides of each sheet, 12 point text, single-spaced. Send proposals electronically in MS-Word or PDF format to stephen.m.lichten@jpl.nasa.gov and a hard copy shall also be sent to the current DSN science Point of Contact:

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Following receipt of a proposal, the proposal will be reviewed and assessed as follows:

- 1) The DSN Science point of contact (DSN POC) shall convene subject matter experts to review the proposal scientific content. In lieu of a DSN science review and evaluation, if a scientific review is being conducted by an outside, independent organization or by the JPL R&TD process, a copy of that review should be sent to the JPL POC within 1 month of the proposal receipt deadline.

- 2) The proposal will also be reviewed for DSN scheduling feasibility, given the existing commitments of the DSN to provide TT&C support to more than three dozen missions.
- 3) The proposal will also be reviewed for technical feasibility and DSN uniqueness, given current DSN capabilities and plans for DSN equipment modifications or improvements.

For items 2) and 3), the DSN POC will consult with the DSN schedulers and with DSN Engineering to assess schedule constraints and equipment capabilities.

Proposals will be scored in the above three areas, with 1 being the lowest and 10 the highest.

The DSN POC will communicate to the proposal PI one of the following categorizations:

- Category 1. The proposal has high scientific priority, high DSN feasibility, makes high use of DSN uniqueness, and has been selected for DSN scheduling in the next 3-12 months.
- Category 2. The proposal has high scientific high priority but is on a waiting list for DSN scheduling due to its lower scheduling feasibility, or because of DSN equipment work that will need to be completed first to make the observations feasible. Proposals may also be rated Category 2 when there is not a high degree of DSN uniqueness. This means that the proposal may be scheduled when feasible but will have to wait until there is a better match between requested and available DSN time and capabilities.
- Category 3. The proposal has good scientific value but its science rating was not high enough to result in Category 1 or 2 slotting. Category 3 proposals may be scheduled for DSN observations, however, before Category 1 and 2 proposals, if DSN time becomes available that is a good match to the Category 3 proposal request that cannot be straightforwardly or efficiently utilized by Category 1 or 2 proposals.
- Category 4. The proposal is not rated strongly enough in science to be scheduled in the DSN; or the feasibility is so low or far off in the future that the proposal will not be scheduled; or DSN uniqueness is not high enough to justify use of DSN resources for this research. Category 4 proposals require a resubmittal at a later time for reconsideration.

Since the primary function of the DSN is NASA space mission support, and since only a small fraction of DSN antenna time is typically made available for radio astronomy, proposals that require lengthy and large observational campaigns will be assessed carefully for feasibility.

A.2 Other (non-DSN) Merit Review

For external reviews of proposals that include DSN GBRA – for instance, proposals in response to NASA solicitations or proposals to JPL’s R&TD Program -- a copy (or summary) of that review and selection information should be sent to the JPL POC within 1 month of the DSN proposal receipt deadline. The PI must still provide sufficient information about the scheduling and

technical requirements of the proposal, and its unique use of DSN capabilities, so that the DSN can assess scheduling, technical feasibility, and DSN uniqueness.

The DSN POC will assess the completeness of the external review and assign an equivalent rating for the scientific content of the proposal. The DSN POC will also obtain an assessment for the scheduling and technical feasibility of the proposal, based on the information provided by the PI. The proposal will then be assigned one of the four Categories as described above.

A.3 Reporting and Continuation Reviews

Investigators using the DSN for radio astronomy or radar science are required to submit a report within 3 months of the completion of their observation campaign documenting the measurements that were planned, scheduled, and carried out. The report should include a summary of preliminary results from the observations.

A Continuation Review will be required for accepted proposals within one year after proposal acceptance or 6 months after the first observations, whichever comes first, if the effort is intended to continue for more than one year. **These Continuation Reviews are then required on an ongoing 6-month basis.** For the Continuation Review, the PI is required to include a summary showing observations as originally proposed, observations that were scheduled, observations that were completed, and results (including papers or presentations) to date. The Continuation Review should include material that justifies continuation of the experiment with additional DSN observations.

A.4 GBRA Schedule Changes

If additional DSN time becomes available for Radio Astronomy, the DSN Scheduler will incorporate the schedule changes and assign the time to an appropriate investigation, in consultation with, and with approval from, the DSN Science POC.

Investigators must include the POC on all communications with DSN Scheduling and with other Investigators or Missions regarding time assignments for their investigations.

A.5 Target of Opportunity (ToO) Proposals

Target of Opportunity (ToO) proposals are focused requests for limited amounts of DSN antenna time for radio astronomy that represent an opportunity to address a late-breaking or new discovery and urgently require DSN antenna time to be allocated with little lead time, where the typical proposal process would be too lengthy. ToO can be submitted at any time to the DSN POC in the same format as regular proposals, except that ToO are limited to one page. The DSN POC will endeavor to have ToO requests evaluated in an expedited manner within 1 month of receipt. Approved ToO will then be worked into the DSN observing schedule as soon

as possible on a best efforts basis, with the understanding that ToO are of limited duration and may have higher priority than more routine DSN radio astronomy measurements. In some instances, the POC may reassign some GBRA time slots to accommodate a ToO.

B. European VLBI Network and Global VLBI (EGS)

The DSN antennas at the Madrid Complex can participate in very long baseline interferometry (VLBI) observations through the European VLBI Network (EVN) or the Global VLBI array. Historically, the DSN has also cooperated with the Very Long Baseline Array (VLBA).

Observers desiring participation of a DSN antenna in an EVN or Global VLBI experiment should follow the processes described by the EVN, <http://www.evlbi.org/> . Approval from the appropriate organization is generally sufficient peer review for the scientific assessment part of the DSN review. The POC may request additional information in some cases. The proposal will then be assigned one of the four Categories as described above.

C. Host Country Radio Astronomy (HCRA)

As part of the agreement between NASA and the Kingdom of Spain for the operation of the Madrid Complex, and between NASA and the Commonwealth of Australia for the operation of the Canberra Complex, DSN antennas can be utilized for independent scientific investigations.

Australia The Australia Telescope National Facility (ATNF) oversees Host Country Radio Astronomy, and proposals to use the DSN as part of Australian host country observations should be directed to the ATNF <https://www.atnf.csiro.au> .

Spain The Centro de Astrobiología, under the Instituto Nacional de Tecnica Aeroespacial, oversees Host Country Radio Astronomy, and proposals to use the DSN as part of Spanish host country observations should be directed to Dr. Ricardo Rizzo (ricardo@cab.inta-csic.es).

After review by the host country, the PI should arrange for the evaluation to be transmitted to the DSN POC along with scheduling and technical requirements, and DSN uniqueness information, so that the DSN POC can determine scheduling and technical feasibility. The proposal will then be assigned one of the four Categories as described above.

D. Project Scheduling

For Category 1 proposals, the DSN Science POC transmits to the DSN Radio Astronomy scheduler team the activity (GBRA, EGS, or HCRA) and an identifier and any relevant scheduling constraints (e.g., a range of times in which the source is above the horizon). The POC may request specific from the PI DSN view times and other viewing constraints to facilitate the DSN antenna time scheduling. The DSN Radio Astronomy scheduler then works within the scheduling constraints for DSN-supported space missions to determine the observing times for

the Radio Astronomy investigation. The POC will work with the scheduler team to reconcile the requested observation slots from the multiple science investigations, with the available time. Once tracks are scheduled, the PI is notified of the scheduled tracks. The DSN POC will assemble a prioritized “wait list” of Category 2 proposals in conjunction with the DSN scheduler team so that if an appropriate scheduling opportunity opens up and the required DSN equipment is available, the proposal can be scheduled on short notice. A prioritized list of Category 3 proposals will also be prepared as a second tier wait list in case time becomes available and no Category 2 proposal can make use of it.

Once the radio astronomy observations have been scheduled, it is mandatory that the observation slots be utilized only for the specific observations that were proposed and scheduled. If a request is made to the POC and the request is approved, up to 10% of the allocated time may be repurposed by the Investigator as long as the observation will still be used for a science investigation that is closely related to what was originally proposed. Investigators should not contact one another nor should they contact the schedulers directly to request such adjustments; instead, they must contact the POC to request a change. All schedule changes must be worked directly through the POC.

III. Radar Astronomy

The DSN has a long history of conducting radar astronomical observations, and the DSN maintains the Goldstone Solar System Radar (GSSR), one of only two planetary radars in the world. There are two approaches to proposing radar astronomical observations with the DSN:

A. DSN Science Evaluation

Individuals may submit a proposal directly to the DSN, following the procedures outlined for Ground-Based Radio Astronomy above. Proposers should follow the guidance outlined for Radio Astronomy, with the Technical Justification and DSN uniqueness aspects of their proposal describing any specific radar requirements for their proposed observations, as well as uniqueness considerations for use of the DSN. The DSN review process will result in an assignment to one of the four Categories, as described above for GBRA.

B. Non-DSN Science Evaluation

Solar System Observations (SSO) is element C.6 of the Research Opportunities in Space and Earth Sciences (ROSES) NASA solicitation. PI's may submit proposals through NASA ROSES, through JPL's internal R&TD process, or through other non-DSN avenues. Following a non-DSN proposal evaluation and selection, the PI should transmit to the DSN POC the proposal and its

evaluation along with other information so that the POC can evaluate scheduling and technical feasibility, DSN uniqueness, and can slot the proposal into the four Categories listed above.

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