

Writing Effective Telescope Proposals

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1 Introduction

A telescope proposal is effectively your “visa application” to use any of the largest telescopes in the World. In real life, if your visa application is turned down, your travel plans are either wrecked totally or, at the least, delayed significantly! Without a successful telescope application, your thesis-completion timetable, your future job prospects, maybe even your whole career in astronomy, can be seriously jeopardized! Put this way, it surely pays all of us to think a little about not only what we want to use a telescope for, but how we go about obtaining the observing time to make our plans a reality?

Now, it is (hopefully) unlikely that one could present a poor scientific idea in such a way that it will obtain observing time on any telescope. However, it is certainly true that a wonderful scientific idea can have its chances of getting telescope access severely reduced should the relevant proposal be poorly presented, contain descriptive deficiencies that devalue your case, give a poor justification for the match of project to the telescope, request options not available at the relevant observatory, or have any one of a multitude of other possible shortcomings.

My own competence (or incompetence) to present this talk comes from varied experience over many years;

- Firstly, as a referee of observing proposals for a major radio-astronomical national facility.
- Secondly, as a member of the Arecibo Scheduling Advisory Committee over the past 15 years.
- Thirdly, as a long-time submitter of (often outstandingly unsuccessful) telescope proposals.

Here, I hope to be able to say at least a few things that you will consider when next you put together a telescope proposal of your own. I stress that what I will suggest represents my subjective thoughts on the subject, and I encourage you to question my ideas and replace as many as you wish with your own preferred options.

2 Proposal Deadlines

Let us look first at a very general consideration. There is nothing more frustrating than missing the proposal deadline for the telescope with which you were about to earn your Nobel Prize! My own record was to have a proposal fail to be accepted for a particular deadline because

internet latency caused it to arrive just a few seconds late! For that reason, I have trawled the web, and present here a list of the proposal deadlines (or lack of them in two cases) for some of the world’s largest single-dish telescopes which solicit proposals. Heed my warning that this is unlikely to be totally correct, and it is certainly not complete.

Table 1: Single-Dish Proposal Deadlines

Telescope	Annual Deadlines
Arecibo 305-m	February 1st, June 1st, October 1st
ARO 12-m & SMT	February, August
CSO 10.4-m	May 31st, October 31st
Effelsberg 100-m	February 1st, June 1st, October 1st
GBT 100-m	February 1st, June 1st, October 1st
Hartebeesthoek 26-m	No fixed deadlines
IRAM 30-m	March, September
JCMT 15-m	March 15th, September 15th
Nançay	May, November
Nobeyama 45-m	Nov 4th (+ Dec 22nd for “short proposals”), Sept 1st (?)
Onsala 20-m/25-m	April 15th, October 15th
Ooty ORT	No fixed deadlines
Parkes 64-m	June 15th, December 15th

Now, despite the very best of intentions, most of us finish up preparing our proposals at the very last moment. I would guess that 80–90% of all proposals arrive on the last day before a deadline. I would just say here that, apart from the fear of an internet outage ruining your plans, remember that most proposal referees will be sent the proposals numbered in the order in which they were received by the Observatory. Let me ask you, would you rather your proposal were evaluated by a fresh enthusiastic referee, basking in the pleasure of fulfilling his public service role, or a jaded evaluator trying to keep his attention focussed despite the 50+ proposals he has already been through, (and likely getting grumpier and grumpier with each successive one.) My advice is, “Post early for Christmas!”

3 An Example: The Telescope Proposal System at Arecibo

Proposal deadlines at Arecibo are midnight on February 1st, June 1st and October 1st of each year, or at midnight on the next working day if the deadline would otherwise fall on

a weekend or holiday. Proposals should be submitted electronically. One is requested to first complete and submit a cover sheet specifying the technical details of the proposal, and providing an abstract of the project and its aims (not exceeding 150 words). This is followed up by submitting a PostScript file containing the full scientific and technical justification for the proposed observations. Note that the scientific and technical justification has a maximum length of 3 pages, although more space is allowed for a long-term (1–2 yr duration) or large (requesting more than 300–400 hr of observing time.) Large proposals are subject to a more intense review process. If you have an urgent proposal aimed (say) at a target of opportunity, then there is no deadline for submission, and evaluation is dealt with internally.

The detailed rules and regulations can be found at;

<http://www.naic.edu/~astro/proposals/proposal.shtml>

After the deadline, all proposals are subdivided into Astronomy (A), Pulsar (P), Planetary Radar (R) and Aeronomy (T) and sent off for refereeing by different groups of anonymous (non-NAIC/Cornell) referees (5 for A proposals, 4 for P, 4 for R, and 3 for T). Each referee returns a grade of 0 – 9 (“reject” through “absolutely fabulous”) for each of the proposals sent to him/her, and also a recommendation as to what percentage of the requested time they feel is actually needed to successfully complete the experiment as laid out. They also send comments and criticisms re-the proposal, which are passed in their entirety to the proposer unless the referee requests differently. We ask the referees to make their comments as detailed as possible for cases where they rank a proposal below average, so the proposers have suggestions as to how their proposal can be improved for resubmission, should they choose to do so.

Next, a meeting of the Arecibo Scheduling Advisory Committee (ASAC) is called. This consists of about 5 local Arecibo staff members, and an external member, included as a guarantee of “fair play”; the current external member is Jim Condon of NRAO. ASAC members read all of the proposals, consider the gradings and other recommendations of the referees, perform a technical audit of a proposal’s suitability for observations with Arecibo. and Weighing all these factors up, they allocate each proposal a “broad ranking” and recommend to our scheduler, Héctor Hernández, the amount of observing time to grant should the proposal get scheduled. On occasion, ASAC will seek clarification on some point or other from a proposal P.I. before confirming or modifying the grade, and communicating it to the proposers.

The “broad rankings” which can be allocated to a proposal are;

- A:** The proposal will be scheduled, and will remain active until that happens.
- B:** The proposal will be scheduled only if time is available. If not scheduled within the next two 4-month scheduling periods, the proposers will need to resubmit.
- C:** The proposal is unlikely to be scheduled. The proposers are invited to submit a revised version.

4 Preparing Your Proposal

Before preparing the proposal that could change your whole life, make sure that you are well informed. Read the proposal rules and regulations, and make sure that you fully understand what is required of you. Make sure that not only do you understand the peculiarities of the highly eccentric Arecibo telescope, but that you are right up to date with the latest developments in Arecibo. Information on the telescope can be found on our web pages at <http://www.naic.edu>, (some of it even up to date!) If you can't find what you want there, or fear that it needs updating, always feel free to e-mail an appropriate person at Arecibo and ask. For example, at <http://www.naic.edu/~astro/RXstatus/rcvrtabz.shtml> you will find a list of all our receivers, with links to more detailed descriptions and performance parameters. Next to each receiver is the name of a "Friend of that receiver". If you are worried about the currentness of the information, or wish to know any other details, do not hesitate to e-mail the "Friend".

5 Is this the Right Proposal at the Right Telescope?

Before writing the proposal and expending a fair amount of your valuable time, ask yourself the following questions;

- Is this proposal worth writing? Are the observations you have in mind really going to answer any important scientific question? Will your project contribute more to our global astronomical knowledge base than most of the others that will be received for the same deadline? I find a good approach to answering such question is to play "Devil's Advocate", and ask myself the nastiest of questions that I can imagine the nastiest of referees dredging up to thwart my plans!
- Have the observations been done before? There is no more humiliating way to be caught out than for the referee to comment that, "Smith & Jones did that with similar sensitivity in 1994!" Of course, if it HAS been done before, but you are proposing to do it BETTER, then that could be a different kettle of fish. However, in you proposal you will need to detail by how much, and in what way, you are going to improve matters, and what will be gained by the improvement.
- Do you need to use Arecibo to perform this project? Arecibo is a heavily oversubscribed instrument, particularly if you wish to observe between $18 \text{ hr} < \text{R.A.} < 20 \text{ hr}$. Consider the sensitivity issues, the angular resolution, the frequencies, etc., and ask yourself if Arecibo is your best choice. Maybe there is another telescope around where you could complete this project with similar (or even better) results, and with much higher chances of your proposal being accepted? An example that I remember was an observer wanting to measure the flux densities of a sample of weak sources, that were clearly close to the confusion level at Arecibo, Wonderful VLA project (with that telescope's high angular resolution), but definitely a dodgy one here.

6 The Scientific Justification

This section of your proposal is central to everything else. You can make the most of your ideas by the way you present them, but nothing will compensate for an inadequate scientific case. Remember that some ten people will be reading your proposal (with 4/5 of these giving the crucial referees' votes that are "thumbs up or down" to what you want to do.) Of those people, and even among the actual referees, one or two may be experts in your field, (while others won't be.) Thus, you must have sufficient detail in your proposal to convince all that your case is strong, and that the project is perfectly suited to Arecibo. However, also include a succinct introduction to the topic so that non-experts can understand and evaluate your arguments. After you have written your scientific justification, reread it and then reread it again to see if it is coherent, straightforward, and as clear as it possibly can be. Try it out on colleagues both from within your field and from outside, and whose opinions you respect. *Conciseness with inclusivity* counts for everything. Remember that you are not writing great literature, but competing for time on the world's biggest radio telescope.

6.1 A few Do's and Don'ts!

- It is very unlikely that the referees will follow up any of the references you quote in the text, but including the most important references will show them (and especially the couple of experts) that you are on top of your field, and abreast of developments. There is nothing worse than appearing out of date in a field whose frontier you are claiming to be able to roll back. Above all, don't attach reprints/preprints. These will NOT be sent on to the referees, and would doubtless irritate them if they were.
- Don't try to "blind the referees with science"! Keep it clear and simple.
- If you are resubmitting, make sure that you have answered the referees' previous criticisms successfully, while not removing or negating that part of the proposal that was satisfactory the first time.
- If your experiment is expected to lead on to further research, give a short description of expected developments.
- If these observations are part of a larger project, specify what other observations are being made in addition to the presently proposed ones. Also state what is the status of those observations; i.e. have they already been made, has time been granted elsewhere for them, are you awaiting the verdict of other proposal evaluations, or will you be submitting additional proposals either here or elsewhere? If the latter two, will your proposed Arecibo observations be useful alone if the other pending/prospective proposal evaluations turn out to be negative?
- If you may only determine an upper limit in your experiment, justify if you can why this would be scientifically important.

- Consider whether the flexibility of the telescope and its equipment will allow you to get “more bang for your buck” by acquiring complementary data to your main objective. An example would be the occasions on which an HI proposal has also proposed to observe the main- and/or satellite-lines of the OH molecule simultaneously, given the availability of unused spectrometer boards. Usually a real long shot, but the OH data comes at no extra expense but a little disc space, and analysis time. An extreme case is “commensal” (or “piggy-back”) observing, where a second (or more) project is invited to propose separately to share the observing time via parallel usage of two separate back ends. Providing that both projects stand the test of refereeing in their own right, the Observatory can only welcome the chance to see its telescope producing double the useful data in the same amount of time.
- If you intend to include any color figures in your proposal, make sure that the referees will receive the proposal in a form where the figures will appear in color. Nothing is worse than being told that you should note the difference between the red and blue lines when both appear to be black! If the referees will receive only “black and white” versions, modify your figure (say by using different line formats, or symbols.)

7 Technical Justification

This should again be *clear and concise*. The basic technical details of your proposed observations, (time request, receiver, frequencies, backends, special requests, RFI considerations, target list criteria), will be entered in the cover sheet, and this section seeks to elaborate on, and justify, these choices. Especially, make sure that you have COMPLETE consistency between the cover sheet and the technical justification section. It is surprising how often a cover sheet will request (say) 55 hr observing, and the justification conclude that 75 hr are needed. Under these circumstances, you will usually receive a maximum of 55 hr!

It is always a good idea to specify how you intend to deal with data reduction, especially if code development is required, stressing that expertise exists in this area among your project team (assuming that it does!) Mention of data archiving and public availability may also be of relevance.

7.1 A few Do’s and Don’ts!

- Demonstrate that the observations you are proposing are capable of achieving the signal-to-noise ratio that you deem necessary. For this you will need to specify source strengths. Alternatively, specify the noise level it is required to reach should you be proposing a “detection experiment”/search. Be careful to use the correct formula for estimating the time needed to reach your required signal-to-noise ratio. For example, proposers occasionally overlook the extra factor of 2 in the noise ripple expected on a spectrum obtained by position switching as opposed to total-power observing, or the $\sqrt{2}$ better

signal-to-noise expected from averaging orthogonal polarizations from a dual-polarization receiver!

- When arriving at your time request, include an amount for reasonable “overheads” such as set-up time at the beginning of each run, slew time between sources, calibration time, time loss if a radar blanker is used, and efficiency factors in the observing procedure employed. Examples of the latter are “turn-around” time when performing “on-the-fly” (OTF) mapping, or the one-minute gap between ON and OFF phases when making Arecibo position-switched observations.
- Specify all relevant experimental parameters so that the referees can fully check your request. This includes such things as total bandwidth of your spectral window, channel width required on the final spectrum and numbers you assumed in your estimates such as system temperature or SEFD, 3- or 9-level sampling, etc.
- When proposing mapping, give details of the scanning pattern, the telescope drive speeds to be used, sampling considerations such as the spacing between adjacent scans.
- Above all, be reasonable! If the referees feel that the proposer has significantly “padded” their time request above that actually required, they are likely not just to recommend less than 100% of the requested time allocation, but to allow the resultant feeling that “sharp practice” or incompetence are on display to influence the grade they allot!
- If you are proposing commensal observing, do not forget to fully detail how your project dove-tails with the other commensal component, and specify which project is “primary” and hence calls the shots during the observations.
- Make sure that you are not committing a “howler”. Popular examples are requesting;
 - a) to observe sources outside of the Arecibo declination range,
 - b) to observe frequencies for which a receiver does not exist, e.g. wanting to detect HI absorption in a galaxy at $z \sim 0.4$ at Arecibo,
 - c) observing at the exact frequencies of unblankable, uncoordinated RFI signals,
 - d) being unaware of system limitation, e.g. requesting simultaneous observations at 8.2 and 9.9 GHz (note, at present only a 1 GHz-wide band can be brought down from the dome on the optical fibers.)
- If you are proposing observations for which the exact celestial location is not important, (say making a “blind” survey of galaxies or a search for high-latitude pulsars), find out what are the least over-subscribed pieces of sky at the telescope. If you are graded “B”, this could mean the differences between being scheduled or not.

8 A Few General Comments

- Make it a practice NEVER to exceed the page limits. If you do, you are liable to antagonize the referees, even if the oversize proposal is still considered. Remember that

the referees may have 25+ proposals to read and inwardly digest. (ASAC members often have to do this for 50+ proposals!). They are not going to love you for giving them even more work. If you have exceeded the page limit in your draft, read through it carefully; you have probably included material that is not going to help your case?

- You will supply an abstract in the cover sheet, therefore I would avoid just repeating this at the head of the proposal body. Why use up your limited space repeating something, and by the time the referee realizes that he has read this twice, you may have irritated him considerably!
- It is always a good idea to get an uninterested third party to read through your finished proposal before submitting. It may not be as “finished” as you had thought. If you are not a native English speaker, try to get a native-English speaking colleague/friend to read through your proposal and make suggestions on style, etc. It would be a shame for the science not to shine brightly through the text.
- Do not use jargon, undefined acronyms, etc. These may be obvious to you, but not necessarily to the referees.

9 Student Participation

If you have (or are) a student associated with the project who will use the results towards their degree, don't forget to specify this at the appropriate place in the proposal cover sheet. All else being equal, this fact could tip the balance towards a greatly likelihood of being scheduled on the telescope for border-line cases.

10 When you get the Results of the Proposal Evaluation

Hopefully, you have obtained an ‘A’ grade, and all is set fair. However, do not be surprised if some of the referees say very nice things about your proposal, but allocate it only an average (or lower) grade! Never expect consistency from your referees; (though in your proposal, they will expect it from you!)

If your final grade is such that your proposal is unlikely to be scheduled before it vanishes from the active list, you may decide to resubmit it immediately with modifications to (hopefully) improve the situation. We ask our referees to provide more comprehensive comments for the proposals they rank at the lower end to aid the proposer in improving their case; sometimes the referees actually do so! Pain in the neck though it is, be prepared to sit down with an unsuccessful proposal, and take a good, hard, objective look at it, and the referees' comments. Decide if you want to spend more of your time and energy pursuing telescope time for this, whatever your aim was. If you do, try to understand the referees' comments, and try to see why they arrived at their conclusions. Then try to make sure this won't happen next time

round. While the referee may have drawn an incorrect conclusion, try to understand what led him to this.

You may, of course, feel that a referee has glaringly misunderstood your argument/s, and that this has unfairly damaged your chances of achieving access to the telescope. If you come to this conclusion, (and I recommend trying your argument out on another colleague or two first), then you can write to the Observatory Director laying out your case, and asking ASAC to take another look at your proposal and the grading; it might just improve matters for you. However, be very sure of your grounds, and be careful about contesting every perceived injustice. A reputation for “whingeing for whingeing’s sake” is not a help to one’s credibility.

11 An Excellent Guide to Preparing Good Proposals

Judith Irwin (Queen’s University, Kingston, Canada) wrote an excellent article on “Writing a Good Observing Proposal” in the early 90’s. While it was aimed at the community using the JCMT, it should be obligatory reading for all of us. This is available on the web at

<http://www.jach.hawaii.edu/JCMT/applying/goodprop.html>

12 And After your Observations

Not strictly to do with the proposal process at all, but it is unlikely to get a mention elsewhere this week! Please, please, please, after your A++-ranked proposal has been on the telescope, and observing completed, do fill in an Observer’s Comment Sheet, to be found on-line at;

http://www.naic.edu/science/feedback_set.htm

Many observers promise to, ”Fill it in once we get home”. This rarely is more than a noble sentiment. So, please take notes on things that go well and things that don’t during your run, of things that work well, and of things that blew up in your face. This is our best way of receiving your feedback, and knowing what to do to improve our telescope and its services to you. These comments do not go into a black hole; we do try to listen and act accordingly. Filling in a comment sheet is a small thing, but it is something that we ask back from you in return, we hope, for a successful and pleasant visit to Puerto Rico.