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How to propose for the IRAM 30m telescope

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Abstract

General guidelines are provided for the preparation of proposals for observations with the 30m telescope, operated by the Institut de Radioastronomie Millimétrique (IRAM). The online tools used throughout the proposal preparation procedure are described, as well as a set of software tools, developed by IRAM, to identify optimal observing setups and integration time requirements for the proposed projects. The description is concluded by a brief overview of the IRAM archive, which may contain useful data to perform or augment the data analysis of the pursued scientific projects. The presented information and accompanying url links shown in the list of references are valid as of October 2024. Although the proposal preparation procedure remains relatively stable with time, updated version of all relevant documents and procedures can be found at the IRAM's website (https://iram-institute.org).

1 Introduction

The 30m telescope, operated by the Institut de Radioastronomie Millimétrique (IRAM) and located on Pico Veleta of Sierra Nevada, is a versatile instrument that is constantly used to carry our very sensitive spectral line and continuum observations in the mm and submm wavelength range (70–370 GHz / 3–0.8 mm). Scientific projects carried out by 30m telescope observations cover a wide range of topics, from studies of solar system bodies and the interstellar medium to extragalactic research in the low and high redshift Universe. Moreover, through synergies with the NOEMA interferometer of IRAM and as a key antenna in the Event Horizon Telescope (EHT) VLBI array, the 30m telescope is used to study the Universe in high resolution.

The lifecycle of any scientific project usually starts with a proposal to request observing time at a given telescope with the aim to gather more information on the studied sources. Below I give a short overview of the procedure to prepare and submit an observing proposal

for the IRAM 30m telescope. Although the general guidelines remain more or less the same over time, this is a dynamic procedure and some modifications may arise in the future. For an updated version of all relevant documents and procedures, the reader is advised to consult IRAM's website (https://iram-institute.org).

2 Call for Proposals

Observations with the IRAM 30m telescope are organized in two scheduling periods per year: the summer semester, running from June 1 to November 30, and the winter semester, running from December 1 to May 31. Both periods are accompanied by a Call for Proposals (CfP) with deadlines around mid-March and mid-September, respectively. Typically, the calls are issued about 3 weeks before the corresponding deadline. Other than the exact deadline, the CfP document contains a lot of useful information such as special considerations due to the latest status of the observatory or LST ranges and observing modes that are underused and hence encouraged to be proposed for. In parallel, IRAM accepts Director's Discretionary Time (DDT) proposals, e.g. for urgent or Target-of-Opportunity (ToO) observations throughout the year, in case they fulfill certain criteria [1]. The call for proposals website can be currently accessed at [2].

3 IRAM Proposal Management System

The life cycle of any 30m telescope proposal starts at the Proposal Management System (PMS) website: [3]. As soon as the CfP is issued for a given semester, a proposal form becomes immediately available at the PMS website, where the proposed projects can be described in detail.

The proposal form asks for a basic description of each proposal (title, author list, category and abstract), with special attention given at the proposal history. This is particularly useful for identifying proposals that are focused on the continuation of an ongoing project towards a new research direction or that are being resubmitted due to partial or total failure to observe them in earlier semesters due to technical issues or weather restrictions.

The provided information are further complemented by technical details regarding the proposed project, such as the list of sources to be observed, scheduling constraints (e.g. based on the visibility of the above targets from the 30m telescope site) and the requested observing setups. The latter outline the intended use of the 30m telescope in terms of frequency tuning, spectral resolution and bandwidth, observing mode (e.g. tracking or mapping/rastering) or background subtraction mode (e.g. position switch or frequency switch).

The proposal form is concluded by a field to include an optional PI note, e.g. in case the proposal is connected to the completion of a PhD project, and the upload of the proposal document itself. The proposal document is comprised by two pages devoted to the scientific and technical justification and two extra pages for supporting material such as figures, tables and references. A dedicated template is provided in LaTeX format with specific guidelines for the preparation of the proposal document.

As an appropriate reference, IRAM has compiled the *30m observing capabilities document*, which contains all necessary information to support the preparations of observing proposals, especially with respect to their technical details. Its contents include descriptions of the telescope, the available frontends, backends, observing modes and software developed in-house to prepare observations and reduce the gathered data. The 30m observing capabilities document is updated for each CfP (current version can be found at [4]), with main changes and current organizational aspects highlighted in red. It also contains many links to go into further detail about any subject presented.

4 Observing setups and time estimates

In direct relation to the fine-tuning and optimization of the observing proposals, IRAM provides a series of software tools to identify the optimal observing setup and integration time requirements for a given project. Here the main tools relevant to this procedures are briefly described.

One of the main issues to be addressed in the proposal technical justification is the suitable observing setup, e.g. in terms of frequency tuning and spectral resolution, in accordance to the scientific goals of the project. Using the ASTRO package of the GILDAS software suite [5], developed by IRAM, this can be done with a set of only a few commands. Working with a default or custom-made catalog of the emission/absorption lines of interest, the user can sample a wide range of frontend and backend combinations, in both single- and double-band modes (i.e. using one or two frontends simultaneously), to optimize the observing setup according to the proposal scientific goals. An example is shown in Fig. 1.

In addition, ASTRO can be used to calculate the visibility of the targeted sources from the 30m telescope site at any given observing date. This is useful to identify any possible scheduling constraints and preferred LST ranges for the project. An example is shown in Fig. 2. Extensive documentation for ASTRO (or any other GILDAS package) can be found at the GILDAS homepage here: [5].

Another key parameter of any observing proposal is the observing time required to reach its scientific goals. This depends on a variety of factors such as the atmospheric transparency at the targeted frequency and based on the weather conditions, quantified by the amount of precipitable water vapor (pwv) in the atmosphere, the required spectral resolution, the necessary noise root mean square (rms) to reach the wished detection significance level and the sky area to be covered. IRAM is offering readily available tools in the form of *observing time estimators* for both receivers at the telescope, namely the Eight MIxer Receiver (EMIR) and the New IRAM KID Array 2 (NIKA2), to minimize the effort required to calculate the necessary observing time for each target in the proposal [6, 7].

In the case of EMIR, the observing time estimator is provided as an online tool which gets updated for each CfP. The users can fine-tune the time estimator options and parameters to match the goals of their proposals. As a result, the tool returns a table of observing time estimates to reach the target noise rms across different switch modes and weather conditions (atmpospheric pwv levels). As soon as the user selects a time estimate from the table, a

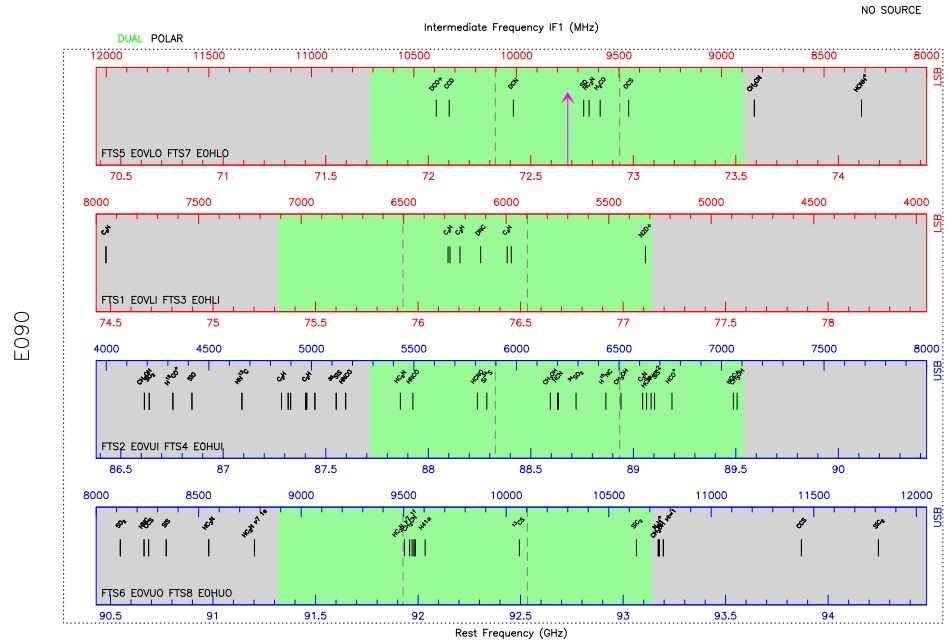

Figure 1: Example plot of an observing setup using the ASTRO package. The exact frequency ranges are shown as horizontal rectangles for all four parts covered by the lower and upper side-bands (LSB and USB, respectively) of the E090 (3 mm) receiver (frontend). The frequency coverage of the selected backend, in this case the high-resolution (50 kHz) setup of the Fast Fourier Transform Spectrometer (FTS) backend, is shown by the parts highlighted in green. A set of known line frequencies are marked within each band by labeled vertical lines.

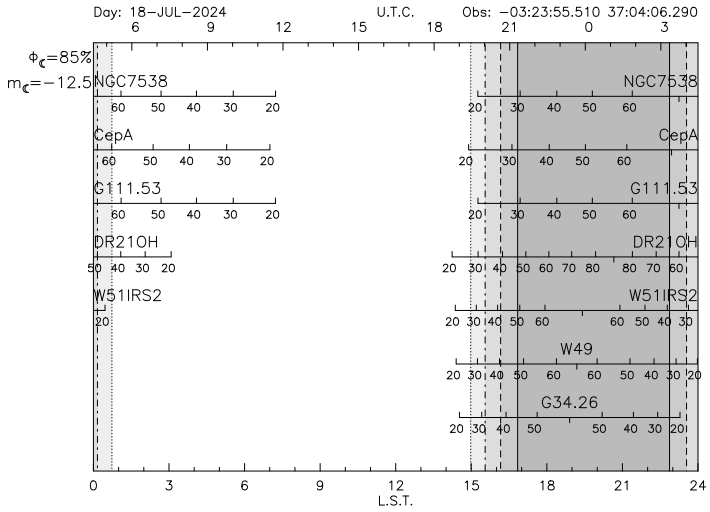

Figure 2: Example visibility plot using the ASTRO package. The visibility ranges are shown as horizontal lines, marked by the elevation of each target along the day (with a minimum of 20° in this case). Twilight and night times are marked with the grey-shaded areas. The top and bottom axes are marked in UTC and LST scaling, respectively. The selected date and observatory coordinates are shown in the header.

piece of text is generated with the general description of the selected parameters and the final observing time estimate, including overheads e.g. time needed for receiver tuning or telescope slewing. This generated piece of text can be added directly in the proposal technical justification. The updated online time estimator tool for EMIR can be accessed at [6] as well as embedded as a separate tab in the proposal form on the PMS website [3].

In the case of NIKA2, the observing time estimator is provided as a standalone Python script. The parameters corresponding to the scientific goals of the project are provided as arguments when running the script. The result is an extensive justification of the calculated observing time based on the input parameters, printed on the terminal window, as well as short pieces of text that can be used directly in the proposal technical justification. Note that the script results include time estimates when using NIKA2 in polarization mode. More details are provided in an accompanying document, together with more general observing guidelines such as the optimization of NIKA2 map sizes to mitigate effects like detector instabilities or telescope tracking errors. The latest version of the Python script and the accompanying guidelines document can be found at [7].

5 Putting everything together

As soon as all aspects of the proposal have been worked out, it is time to put everything together. The scientific and technical justifications, along with their supporting material, are merged into the proposal document. The document is then uploaded to the PMS website and as soon as all the necessary information are filled out, the proposal can be successfully submitted.

The post-submission steps include a technical pre-screening of the proposal, to make sure that it is feasible to reach its scientific goals with the available equipment and within the requested observing time. At this stage, the proposal is also checked for any possible duplications with existing data obtained by the 30m telescope that may already or soon be available in the IRAM archive (depending on the proprietary period of each project, see Section 6) as well as for any possible overlap of the requested sky area to be covered with protected fields. Finally, the proposal evaluation is carried out by IRAM Program Committee and the results are communicated with the authors within a few weeks after the proposal deadline.

6 IRAM archive

During the proposal preparation process, it is suggested to check the IRAM data archive for any overlap with the requested observations. In that case, archival data can be requested to perform or augment the data analysis of a given project. Calibrated data from Large Programs (>100 hrs of observing time, spread over a maximum of three years) are directly available at [8], after a proprietary period of 18 months. In the case of normal projects, the scan headers are uploaded at a dedicated CDS database to ease searching through the archive. The CDS database can be accessed at [9] and the uploaded headers correspond to any projects observed since September 2009. In case any useful observations have been identified

in the headers database, the corresponding data can be requested after a proprietary period of 3 years. If used in a consequent publication, the PI team and relevant publications from the original project should be properly acknowledged and cited. Requests for archival data can be addressed to isda@iram.fr.

Finally, for any questions throughout the proposal preparation process, please contact the 30m Science Operations Group at sog@iram.es.

Good luck with the proposal preparation!

References

[1] https://iram-institute.org/science-portal/proposals/directors-discretionary-time/

[2] https://iram-institute.org/science-portal/proposals/call-for-proposals/

[3] https://oms.iram.fr/oms/pms

[4] https://www.iram.fr/GENERAL/calls/w24/30mCapabilities.pdf

[5] https://www.iram.fr/IRAMFR/GILDAS/

[6] https://oms.iram.fr/tse/

[7] https://publicwiki.iram.es/Continuum/TimeEstimatorScriptGuideW2023

[8] https://iram-institute.org/science-portal/data-archive/

[9] http://vizier.cds.unistra.fr/viz-bin/VizieR-3?-source=B/iram/30m