# NOEMA

## Observing Capabilities and Current Status

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This document is updated twice a year to reflect the capabilities of the interferometer at the time of the *Call for Proposals* publication. Non-trivial changes with respect to the previous version are marked in red. Note that this document contains active links marked with a `different font` for easy access to the documentation, e.g. on the `NOEMA web pages`. The full links are also given on the last page of this document.

## Contents



# 1 NOEMA News

The Dual-Band (DB) observing mode for simultaneous Band 3 (1 mm) and Band 1 (3 mm) observations is available as a regular mode for the upcoming winter semester. Fig. 1 presents first-light spectra obtained with this mode. For the upcoming winter semester, unlike before, the representative frequency can no longer be selected in the 3 mm band, but must instead be defined in the 1 mm band. Consequently, proposals requesting the DB mode will be scheduled in the atmospheric conditions needed for 1 mm observing. Since dual-band observations require more observatory resources than single-band observations, proposals requesting this mode must include a compelling scientific justification demonstrating that observations in both bands are essential to achieve the proposed science goals.

In recent years, excellent atmospheric phase stability has consistently been available already at the beginning of the winter observing semester. To take advantage of these conditions, the A configuration will therefore be scheduled at the beginning of the upcoming winter observing semester. Limited periods in the B configuration will be scheduled immediately before, and possibly also after, the A configuration. The intermediate C configuration will consequently be shorter than in previous winter semesters and will be available under pre-spring conditions. Proposers should take this scheduling into account when considering Sun avoidance constraints and selecting observing frequencies, particularly for projects targeting the upper part of Band 3 ($> 260,$GHz).

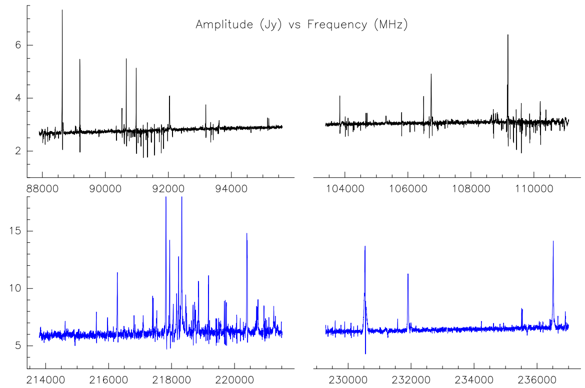


Figure 1: First light on the proto-planetary nebular AFGL 618 taken with the DB observing mode. The spectra obtained in the two ∼7.8 GHz wide sidebands, averaged over the two polarizations, for Band 3 (1 mm; *blue*) and Band 1 (3 mm; *black*), respectively, are shown for one baseline.

Table 1: Configuration schedule for the winter period

| Conf | Scheduling Period |
|---|---|
| 12B | November/December |
| 12A | December – February |
| 12C | March – April |
| 10D | April – May |

# 2 Conditions for the next Semester

## 2.1 General

For the upcoming winter semester, NOEMA will operate primarily in three configurations (A, C and D). The full 12-antenna array will be available in the A and C configurations, while the 10-antenna array will be used in the D configuration due to scheduled antenna maintenance. The B-configuration will be available for a very short time of about one to two weeks so that only a limited number of proposals will be accepted for this configuration.

The preliminary schedule is outlined in Table 1. Adjustments to the provisional configuration planning (Table 1) will be made according to the need for technical time, proposal pressure, weather conditions, and other contingencies. The configuration schedule in Table 1 should be taken as a rough guideline, in particular for astronomical targets that cannot be observed during parts of the winter semester because of sun avoidance constraints (see Section 3.10). The latter can be easily verified for each target using the GILDAS package ASTRO.

Two correlator modes for each PolyFiX correlator will be available which both cover the full bandwidth offered by NOEMA: one at 2 MHz spectral resolution that can be combined with additional high-spectral resolution windows at 62.5 kHz spacing, and one at 250 kHz spectral resolution.

The winter semester is well suited for high frequency (1 mm) and high angular resolution observations (see also Section 3.2). A significant amount of time will be also available for lower frequencies (2 mm & 3 mm) and lower angular resolution observations. Note that high angular resolution observations in configurations A (and B) are currently not offered in the summer semester.

Please be aware that proposals focusing on extensively-studied extragalactic fields like COSMOS and GOODS-North significantly increase the competition for observing time, especially for sources within the Local Sidereal Time (LST) range between roughly 07h and 17hunlike (see Fig. 2).

Science targets that are suitable for self-calibration, are circumpolar, or allow flexible scheduling by requesting ANY configuration are particularly encouraged (see Section 2.2 for more details).

Please do not hesitate to contact the NOEMA Science Operations Group (SOG) at sog@iram.fr for any question and/or support for the preparation of a proposal.

## 2.2 Self Calibration

Self-calibration is a powerful process by which the quality and accuracy of astronomical data obtained can be improved. It corrects tropospheric phase fluctuations and calibration uncertainties when combining data from different array configurations and epochs, significantly enhancing image dynamic range and scientific robustness. Here are a few simple criteria to check whether self-calibration is possible:

- high-precision absolute astrometry is not required

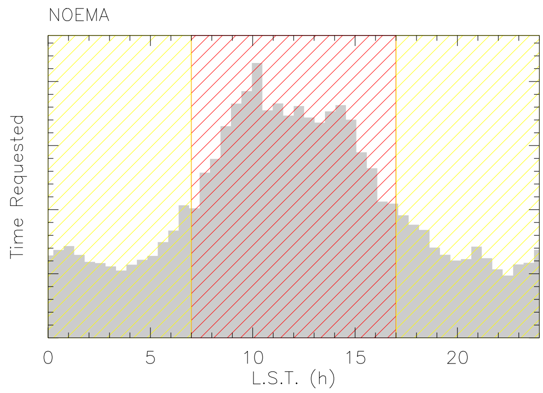


Figure 2: Distribution of requested time for all NOEMA proposals averaged over the past observing winter semesters.

- sources should preferable have a simple and compact structure
- sources should have bright continuum emission with a minimum brightness of 4-5 mJy at 90 GHz, 9-10 mJy at 140 GHz, and 15-20 mJy at 230 GHz to achieve sufficiently high SNR for self-calibration

These criteria may vary depending on the specific scientific goals of your project and the morphological complexity of the sources. In your proposal, please indicate on the technical sheet in PMS whether, in your view, the scientific objectives allow for self-calibration given the above criteria (i.e. tick the corresponding box "yes", "no", "maybe").

### 2.3 Proposal Handling

The following scheme for high priority and backup projects will be applied: all A-rated projects and the **already started sub-parts** of B-rated programs from the upcoming winter semester will be carried over into the forthcoming observing semester. In case of doubts whether or not to re-submit a project from the on-going summer observing period, please get in touch with the Local Contact assigned to your project or with NOEMA's Science Operations Group (sog@iram.fr).

Investigators who wish to check the status of their project may consult the `interferometer observing plan` on the IRAM website, which is updated daily.

## 3 General Proposal Considerations

Please give high importance to the quality of your proposal. NOEMA is a powerful, but complex instrument, and proposal preparation requires special care, especially in light of its new capabilities. In particular, your proposal should not only justify the scientific interest, but also the need for NOEMA. Proposers should note in their application whether the same or a similar proposal was or is intended to be submitted to another observatory, in which case a special justification is required to explain why NOEMA time is needed.

### 3.1 Proposal Category

Proposals should be submitted through `PMS` for one of the four categories

STANDARD: Proposals that ask for a total of less than 100 h of observing time and for the standard capabilities of NOEMA's current status (see the following sections).

LARGE PROGRAM: All proposals requesting more than 100 h of observing time are considered large programs (LP). Under the current Call for Proposals, certain rules apply (see the `Large Program Policy` on the IRAM web site for general details). Since NOEMA continues to develop new capabilities it is to be expected that some of these will become available during the "lifetime" of a Large Program (LP), usually spanning over several observing semesters. The requested time and/or observing strategy may be reviewed and adapted in response to needs of the proposers, and the enhanced array capabilities. As the DB observing mode is still undergoing operational optimization, it will not yet be available for Large Programs. The maximum amount of total observing time accepted and scheduled for NOEMA LPs is limited to less than 50% of the total scheduled observing time. PIs who want to submit a new LP are strongly encouraged to get in touch with the NOEMA Science Operations Group (sog@iram.fr) well before the deadline to discuss the observational feasibility of their LP.

TIME FILLER: Proposals that can be considered as backup projects to fill in periods where the atmospheric conditions do not allow mapping, to fill scheduling gaps, or even to fill in periods

Table 2: Receiver characteristics

| | Band 1 | Band 2 | Band 3 |
|---|---|---|---|
| $F_{LO1}$ range/[GHz]$^\star$ | 82.000–107.700 | 138.616–171.256 | 207.744–264.384 |
| $F_{sky}$ range/[GHz]$^\star$ | 70.384–119.316 | 127.000–182.872 | 196.128–276.000 |

$^\star$ Guaranteed LO1 frequency ranges per offered band. The LO1 frequency is the center frequency between the USB and LSB that can both be simultaneously observed in one tuning (see Fig 4). The center frequency of the USB (LSB) is separated by $+(-)7.744$ GHz from the LO1 frequency. With an effective width of 7.744 GHz per sideband the lowest and highest sky frequencies that can be covered per tuning are therefore $F_{sky}=F_{LO1}\pm11.616$ GHz. The lowest and highest LO1 frequencies per band define the $F_{sky}$ ranges that are guaranteed under this Call.
$^{\star\star}$ for LSB and USB.

when only a subset of the standard antenna configurations are available. A perfect time filler would aim at a low frequency detection on a circumpolar source. These proposals will be carried out on a "best effort" basis.

SPECIAL: Exploratory proposals, whose scientific interest justifies the attempt to use the array beyond its standard capabilities. This category includes, for example, non-standard frequencies for which the tuning cannot be guaranteed, non-standard configurations, special needs with respect to calibration and more generally all non-standard observations. These proposals will be carried out on a "shared-risk" basis. PIs interested in special programs must contact the Science Operations Group (sog@iram.fr) well before the deadline to discuss feasibility and observing strategies.

The proposal category will have to be specified on the PMS web form and should be carefully considered by the proposers.
Within each of these categories, observations in Band 1, 2, and 3 can be requested, which are described in more detail in Section 3.5 and in Table 2.
**Short spacing observations** on the 30-meter telescope should be directly requested on the interferometer proposal web form through PMS. A separate proposal for the 30-meter telescope is not required. The interferometer proposal form contains a box, labeled "Request for 30m short spacings" which should then be checked. The user will automatically be prompted to fill in an additional paragraph in which the need for short spacing data should be justified. It is essential to provide all observational details, including size and type of map, rms noise, spectral resolution, receiver, and time requested. The following documents may help to prepare your short spacing observations: this `Presentation` (especially page 44 for a brief summary) given at the 11th Interferometry School and this `Technical Report`.

## 3.2 Array Configurations

For the upcoming winter semester, NOEMA will operate primarily in three configurations (A, C, and D). The B-configuration will be available during a small time window toward the end of November and the beginning of December and may also be scheduled between the A and C configurations. Proposals, requesting this B-configuration should focus on detection and simple mapping[1] projects asking for low observing frequencies (<150GHz) and sources that can be self-calibrated and/or are circumpolar.
A detailed description of the beams expected for all four configurations (A,B,C,D) and their combinations, and for sources at different declinations is provided `here`.
Roughly 50% of the observing time available for the A-configuration is expected to be usable for projects in the 3 mm band using self-calibration techniques. The remaining 50% of the observing time available in the two most extended configuration is estimated to be roughly split up into 30% for standard projects in the 3 mm and 2 mm bands and 20% in the 1 mm band.
The configurations can be used in different combinations to achieve complementary sampling of the uv-plane to reduce sidelobe levels, to reach the desired angular resolution and to increase sensitivity. Select the ANY bullet in the proposal form if the scientific goals can be reached with any of the offered configurations or their subsets. There is a possibility to restrict the choice of configurations, e.g., to C or D, if your project qualifies only for ANY of the more compact configurations. The ANY bullet is however only available if "Point source detection" is selected for the respective technical sheet in PMS.

[1] Single field or small mosaics

We especially encourage projects for low frequencies (i.e., requesting observing frequencies below 160 GHz) and projects in all three bands that allow for self-calibration techniques on the main scientific targets.

## 3.3 Observing Modes

## 3.4 Dual-band observations

The dual-band observing mode entered scientific operations in January 2026, marking a major milestone in the evolution of NOEMA. This new capability was made possible by a dedicated investment from the Max-Planck-Society. Its full capabilities are still being explored, additional features such as for example frequency phase transfer (FPT), wide-band multi-frequency synthesis, and improved atmospheric water vapor monitoring will be introduced progressively as part of its continued development.
All twelve NOEMA antennas are equipped with receivers allowing for simultaneous observations in Band 1 (3 mm) and Band 3 (1 mm) with full bandwidth, dual polarization, and access to all backend modes available for single-band observations thanks to the two identical correlators PolyFiX-1 and PolyFiX-2. Both PolyFiX correlators can thereby be configured independently with different spectral resolutions, e.g., the 250 kHz spectral resolution mode at 3 mm (PolyFiX-1) and, in parallel, the 2 MHz spectral resolution mode combined with 62.5 kHz resolution windows at 1 mm (PolyFiX-2).
Key applications are spectral line surveys, galaxy redshift searches, and simultaneous observations of several transitions of important molecular gas tracers such as $^{12}$CO and its isotopologues, HCN, $HCO^+$, and many more molecular lines. This will enable detailed analyses of excitation and chemical conditions in a large variety of astronomical sources, as well as the determination of the spectral energy distribution through continuum emission. Another key application is the observation of astronomical events that can vary on shorter timescales than what would be possible by observations performed sequentially, first in one band then in the other. This will allow tracing observational signatures and temporal variations in transient phenomena such as gamma-ray bursts and solar system bodies, and will be particularly valuable for multi-messenger studies of energetic cosmic events.

As the optical throughput in the two bands in the dual band mode are not yet fully determined in operation, we specifically encourage projects which rather seek simultaneous and good uv-coverage than maximum sensitivity in the respective bands. Such projects naturally benefit fully from the multiplex advantage of this mode. The time estimator has been upgraded as compared to previous version to produce more realistic time estimates for the respective dual band integration depths which are expected to be somewhat longer than in single band mode to reach the same sensitivity.
The new dual-band observing mode must be selected and configured in the same technical sheet in PMS for the upcoming winter observing semester proposal deadline. Proposers will need to choose the representative frequency in Band 3 (1 mm), constraining the necessary weather conditions for the requested observations. Please click on `this link` for more information.
The necessity of the dual-band mode must be scientifically justified for both frequencies. Observations will be conducted until the requested sensitivities in both observing bands will be reached.
The usage of the dual-band mode with one of the two bands only as a free bonus will not be possible, considering the increased observatory resources required for DB mode observations.

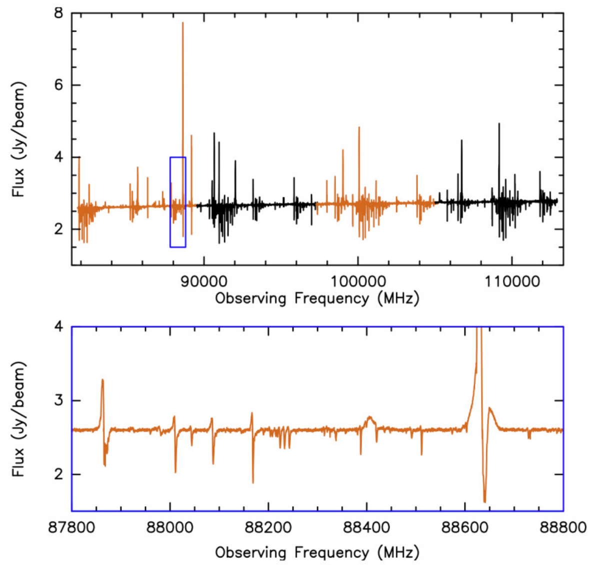


Figure 3: *Top panel:* Spectrum taken with NOEMA during the commissioning of the new frequency cycling mode on the carbon-rich proto-planetary nebula AFGL 618 with the LO at 93.5 GHz (orange) and 101.2 GHz (black), using the 250 kHz spectral resolution mode of PolyFiX and dual polarization. *Bottom panel:* A zoom onto the blue box indicated in the top panel.

### 3.4.1 Frequency Cycling

As of the winter 2024/2025 observing semester, the frequency cycling mode is available as a standard observing mode for band 1 (3mm). This new feature enables observations to cover a larger frequency range than what is achievable with a single frequency tuning.

The mode enables cyclic frequency switching over (currently) two neighboring tuning frequencies in band 1 (3mm) within a single observing track. This flexibility supports observations across multiple spectral configuration of the correlator with customizable cycle integration times. The primary advantage of this feature is the ability to conduct nearly simultaneous observations over wide frequency ranges under almost identical conditions (an example is given in Fig. 3). This capability leads to the generation of high-quality broadband spectra characterized by high relative calibration accuracy and uniform noise levels, along with synthesized beam sizes that primarily scale with frequency, given the quasi-identical uv-coverages.

The new mode is particularly suited for scientific goals that necessitate spectral data over large frequency ranges. Key applications include searching for galaxy redshifts through spectral line identification, conducting unbiased spectral surveys of galactic sources, leveraging data to determine spectral energy distributions more effectively, and observing transient events and phenomena that evolve over timescales of hours.

For the upcoming semester, this mode will be offered for observations in Band 1 (3 mm), with two tunings separated by 7.744 GHz by which it will be possible to cover contiguous frequency ranges of nearly 32 GHz. Observations will be conducted with a single spectral configuration of the correlator, offering spectral resolutions of 2 MHz or 250 kHz. Using in addition the high spectral window mode of 62.5 kHz has currently not yet been commissioned and will be hence available only on a shared-risk basis. The switching times between tuning frequencies can be tailored from a few minutes to several calibration cycles to meet specific scientific objectives.

The frequency cycling mode can currently not be combined with the DB mode.

The frequency cycling mode needs to be selected in PMS if this mode is requested for the proposal. PMS thereby allows to associate the two requested frequencies to the same technical sheet. A reference frequency will need to be selected in order to constrain the necessary weather conditions for the requested observations. Please click on `this link` for more information.

Researchers interested in utilizing the frequency cycling observation mode and seeking assistance to ensure their proposals align with the mode's technical requirements are encouraged to reach out to the NOEMA Science Observations Group (sog@iram.fr).

## 3.5 Receivers

All NOEMA antennas are equipped with 2SB receivers allowing to observe in three separate observing bands, providing low noise performance and excellent stability. The receivers provide two orthogonal linear polarizations in all three bands. Each of the two polarizations delivers a bandwidth of 7.744 GHz in the lower sideband (LSB) and the upper sideband (USB) simultaneously. The sky frequency ranges that can be covered in each band and further receiver characteristics are given in Table 2.

Receiver tuning will preferentially be done on a fixed LO frequency grid of 500 MHz step width on which the receiver performance is optimized. Tunings that deviate from this tuning grid (see also Section 3.6.1) are allowed, e.g., if not all desired lines can be covered when sticking to the grid.

## 3.6 PolyFiX correlators

NOEMA offers two identiccal correlators, PolyFiX-1 and PolyFiX-2, enabling simultaneous observations in Band 1 (3 mm) and Band 3 (1 mm) with all twelve antennas. Both correlators have exactly the same capabilities and can be configured independently, allowing for the selection of different spectral resolution modes in the two observing bands.

Each PolyFiX correlator processes a total instantaneous bandwidth of ∼15.5 GHz per polarization by combining the two 7.744 GHz wide sidebands (the *upper* and *lower* sideband) for up to twelve antennas and one frequency band. At present, the two correlators cannot be connected to the same frequency band. The centers of the two sidebands are separated by 15.488 GHz. Each sideband is composed of two adjacent *basebands* of ∼3.9 GHz width, called *inner* and *outer* baseband (see Fig. 4). In total, there are thus eight basebands per frequency band, which are fed into each correlator. The default spectral

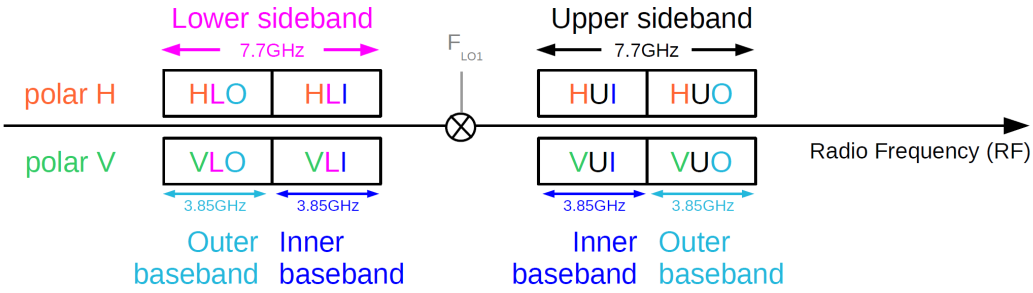


Figure 4: Basebands fed to the correlators

resolution is 2 MHz[2] throughout the 15.488 GHz effective bandwidth per polarization. For this low resolution mode, up to sixteen high-resolution *chunks* can be selected in each of the eight basebands (i.e. up to 128 chunks in total). Each of these has a width of 64 MHz and a spectral resolution of 62.5 kHz[2].

Alternatively, the 250 kHz[2] correlator mode of PolyFiX is available. Similar to the low resolution 2 MHz correlator mode, it covers the full 7.744 GHz bandwidth per sideband in dual polarization but at a significantly increased spectral resolution of 250 kHz. This mode cannot be combined with the very high spectral resolution windows at 62.5 kHz.

Please note that there is a "20 MHz wide confusion area" ($\equiv$ LO2 zone) around the center of each sideband, i.e., in between the inner and outer basebands. Due to the filter response of the correlator, the noise level is in addition increased by up to a factor of two within a width of $\pm$50 MHz around the center in each sideband. Important spectral lines of interest should therefore not be placed in this region (see also pages 19 and 20 in `this PolyFiX tutorial`).

Observations of very strong, steep-sided spectral lines require special care in the choice of the spectral resolution. The so-called spectral leakage[3], a numerical effect inherent to the spectral processing using discrete Fourier transforms (FFT), shows up as, e.g., spurious wings for sharp spectral features (like galactic maser lines); sharp in this context means that the ratio between the noise and/or emission levels in adjacent channels attains $-13.3$ dB (i.e., $\simeq$0.05). These strong lines should hence be observed with the highest currently offered spectral resolution of 62.5 kHz to minimize this effect.

#### 3.6.1 ASTRO

For simple PolyFiX spectral setups using only the 2 MHz or the 250 kHz spectral resolution full bandwidth mode, `PMS` can be used directly to prepare the frequency tuning and correlator setup in the respective technical sheet. For more complex setups, i.e. those using high spectral resolution windows or those needing an off-grid tuning, the ASTRO software should be used to set up the receiver and correlator configuration. A description of the PolyFiX correlator and of the commands provided in ASTRO to prepare the correlator configuration can be found in `this PolyFiX tutorial`. Please use the `latest version of GILDAS` (at least not earlier than jul26).

The essential ASTRO commands are:

- `TUNING`: receiver tuning
- `BASEBAND`: selection of baseband(s)
- `SPW`: selection of chunks to define high resolution spectral windows
- `PROPOSAL`: exports a script that needs to be uploaded to `PMS`

Receiver tuning is done on a fixed grid of LO frequencies, spaced by 500 MHz throughout each receiver band, on which the receiver performance is optimized. For a correct receiver tuning, either the source LSR velocity or the redshift is needed, or the (red)shifted frequencies should be used directly. In the latter case, the redshift (or LSR velocity) has to be set to zero in the source command. Also, the frequencies of molecular lines from the standard

[2] in case of PolyFiX, an FX correlator, the spectral response corresponds to a sinc$^2$ function, so that the theoretical spectral resolution is equivalent to 0.88 of the channel spacing. In practice, the effective spectral resolution, i.e. the best one that can be used for the final spectral data, is the channel spacing.

[3] the spectral response of PolyFiX corresponds to a sinc$^2$ function causing artificial peak sidelobes at a level of $-13.3$ dB in neighboring channels which is called spectral leakage.

line catalogue in ASTRO that can be plotted over the spectrum (by setting `set lines on` in ASTRO) have to be redshifted by hand, i.e., a revised molecular catalogue needs to be uploaded in ASTRO (with `catalogue myfile.lin /LINE`) in that case. For more details see the internal help for the different ASTRO commands and `this PolyFiX tutorial`.

A typical session in ASTRO would be:

```
! Define a source with LSR velocity
SOURCE MYSOURCE EQ 2000 09:11:39.786 -
                30:53:29.257 LSR 7.0

! choice of receiver tuning
TUNING 232.686 LSB 7500
! ASTRO will shift the IF centering by
! 180.6 MHz to match the tuning grid
! unless the option /FIXED_FREQ is used
! that allows off-grid tunings

TUNING 232.686 LSB 7319.4 /ZOOM
! Plots the selected receiver band only

BASEBAND /MODE 2000 62.5
! select all 8 basebands in the low
! 2 MHz resolution mode, allowing to
! define in addition the high spectral
! resolution windows at 62.5 kHz

! define and display high resolution
! spectral windows (central frequency
! and width specified)
SPW /FREQUENCY 244.9 0.2
SPW /FREQUENCY 245.6 0.2
SPW /FREQUENCY 232.686 0.03
SPW /FREQUENCY 230.538 0.08
SPW /FREQUENCY 231.15 0.3
!
! Or for the 250 kHz mode use
BASEBAND /MODE 250
...

PROPOSAL /FILE MyFile.astro
! write the series of commands
! to set up the instrument;
! THE MyFile.astro NEEDS TO BE
! UPLOADED TO PMS
```

The `TUNING` command produces a plot showing the full 15.488 GHz bandwidth covered by both sidebands. The TUNING command checks that the LO frequency is located on the 500 MHz-spaced tuning grid. If this is not the case, the command moves the tuned frequency to a neighboring IF center frequency that matches the grid. The option /FIXED_FREQ can be used to ignore the tuning grid (e.g., if using the tuning grid does not cover all desired lines with the proposed tuning or if a contiguous spectral scan is requested).

`PMS` will only load ASTRO scripts created with the PROPOSAL command (which uses the NOEMA OFFLINE syntax). This will allow `PMS` to show spectral coverages in a consistent way for any kind of project (including line markers at the correct rest frequency for redshifted sources for instance).

In order to select the 250 kHz resolution full bandwidth mode, you may want to use in ASTRO, `BASEBAND /MODE 250`, as described above. This mode cannot be combined with any high spectral resolution windows at 62.5 kHz spectral resolution but the more coarse 2 MHz spectral resolution will automatically be available in addition to the 250 kHz resolution.

Please note that all ASTRO setups used for proposals in semesters S21 or older cannot simply be copied and will need to be recreated for any new proposal in `PMS` or with ASTRO using the new syntax for the `BASEBAND` command and uploaded again to `PMS`. `PMS` will not automatically upgrade ASTRO scripts copied from an older proposal and will issue a warning if an ASTRO spectral line setup is uploaded using the old syntax. Please use the `latest GILDAS version` (at least jul26 or later).

In order to facilitate the preparation of a technical sheet in PMS requiring the DB mode with simultaneous tunings in Band 1 (3 mm) and Band 3 (1 mm) or the frequency cycling mode line with two contiguous frequency tunings in Band 1 (3 mm), an example of ASTRO commands are given below (see also `this PolyFiX tutorial`):

```
! Define first a source (full source or
! only LSR/Doppler with SOURCE /DOPPLER)
SOURCE TEST EQ 2000 10:10:10 10:10:10 LSR 10
! Command source reset the FEBE register
!
! Define the first FEBE (FrontEndBackEnd)
! configuration
TUNING 105
BASEBAND /MODE 2000 62.5
SPW /FREQ 105 0.2
SPW /FREQ 88 0.4
! Save the config in the register
FEBE ADD
!
```

```
! Define the next FEBE
TUNING 230
BASEBAND /MODE 2000 62.5
SPW /FREQ 230.5 0.5
SPW /FREQ 213 0.7
! Save the config in the register
FEBE ADD
!
! Check what is saved:
FEBE LIST
! Create the ASTRO SCRIPT to be uploaded
! to PMS
PROPOSAL /FEBE /FILE MyFile
!
! Load and modify the first FEBE
FEBE LOAD 1
PLOT
!
! select some baseband (does not change
! the mode, keep previous SPW)
BASEBAND L
! Add a new SPW
SPW /FREQ 93 0.4
FEBE SAVE
! Update FEBE #1 in the register
!
! Change the Baseband mode
BASEBAND /MODE 250
! Save the FEBE as new one (#3)
FEBE ADD
FEBE LIST
!List of tunings defined for current source:
!TEST LSR 10.000 km/s
!Saved #1 Band1 105.000 GHz
!         - PFX Mode: 2000, 62.5kHz
!Saved #2 Band3 230.000 GHz
!         - PFX Mode: 2000, 62.5kHz
!Saved #3 Band1 105.000 GHz
!         - PFX Mode: 2000, 250kHz
!
! reate another script with FEBE #2 and #3
PROPOSAL /FEBE 2 3 /FILE MyFile2
!
! Prepare a spectral survey and add the
! resulting FEBE to the register
SPECSWEEP 250 /NTUNING 2 78  /ADD
!
! Create a third script to observe in
! Freq cycling mode:
PROPOSAL /FEBE 4 5 /FILE MyFile3
!
```

## 3.7 Sensitivity

Investigators will be asked in PMS to specify the requested telescope time for each Technical Sheet. PMS calculates the corresponding 1-sigma point-source sensitivity *for one representative frequency.* The representative frequency has to be within the frequency range covered by the setup, and for high spectral resolution projects within one of the high resolution spectral windows that are selected in the respective technical sheet. The representative frequency can be different from the actual tuning frequency. It should be noted that the combination of wide bandwidth and dual-sideband operation can lead to significant variations in thermal noise across the observed frequency range, between its lower and upper ends. This is especially the case, if one of the sidebands is close to a receiver band edge and/or in the wing of an atmospheric absorption line, where significant differences in the noise can occur within and between the sidebands. This should be taken into consideration when setting the representative frequency for each tuning. Please note that PMS takes into account variations of the system temperature across the 15.488 GHz bandwidth to calculate the *continuum* sensitivity.

In order to facilitate the preparation of your proposals, an online sensitivity estimator is available on this link, which is identical to the one used in PMS. Please note that this online tool uses a number of approximations to keep it simple and user friendly. Some values (e.g., angular resolutions and brightness sensitivities) are therefore only indicative and are not guaranteed as such.

Investigators should specify and justify the telescope times and corresponding point-source sensitivities in the "technical justification" of their proposal. **Please verify that your numbers match throughout the proposal**.

## 3.8 Track-Sharing Mode

Each technical sheet, i.e. frequency tuning, can be connected to several sources in PMS. In case that sources sharing the same tuning, are reasonably close to each other, and need reasonably short integration times, PMS allows the PI to specify a track-sharing mode (**please check the track-sharing box in the technical sheet in PMS**), which will result in a lower overall telescope time due to reduced overheads. Please note that PMS will issue a warning should the maximum distance between the track-shared sources exceed the recommended 15 degrees and/or should the number of track-shared sources be larger than 15. These limitations have been chosen, among other reasons, to allow for gain calibrators that can still be reasonably close to all sources, and to reduce observing overheads due to slewing and calibration needs. However, the feasibility of track-sharing is not guaranteed even if no warning is given by `PMS`. Doppler tracking will be done by default on the mean LSR velocity of the targets. Users should check that the spectral lines of the two targets with the highest velocity difference to the mean velocity will not move out of the selected frequency range, which is especially important with respect to the frequency coverage of the selected high spectral resolution chunks. Therefore, special care has to be applied when configuring the spectral setup.

## 3.9 Source Coordinates and Velocities

The interferometer operates in the equatorial J2000.0 coordinate system. Please do not forget to specify the exact coordinates and either LSR velocities or redshifts for the sources. The source list must contain all the sources (and only those sources) for which observing time is requested. The list must adhere to the standard sexagesimal notation. Source coordinates and velocities must be correct: wrong or incomplete source coordinates are a potential cause for proposal rejection.

Any replacement of sources after proposal submission must be justified and is contingent to approval by the IRAM Director.

Please note that targets below a declination of $-30$ degrees are not observable from the NOEMA site as their elevations hardly exceeds $\geq$10 deg during a reasonably long LST range. Sources between declinations of $-30$ and $-25$ degrees are very difficult to observe as they do not rise much above 10 degrees in elevation and suffer from heavy antenna shadowing along the North-South track; if you are considering observing such sources please contact the Science Operations Group well before the deadline (sog@iram.fr) to discuss feasibility and observing strategies.

## 3.10 Sun Avoidance

For optimal antenna performance, a sun avoidance circle is enforced at 32 degrees from the sun.

## 3.11 Technical pre-Screening

All proposals will be reviewed for technical feasibility in parallel to being made available to the members of the program committee. Please help in this task by submitting technically precise proposals. Note that your proposal must be complete and exact: the source position and velocity, as well as the requested frequency setup must be correctly given.

### 3.11.1 Duplication Check

In order to ensure the most efficient use of NOEMA, proposals will be checked for duplication during the technical pre-screening. Unless scientifically justified, proposals that aim to reach the same goals as programs observed in previous semesters with similar or equivalent observing configurations with respect to target selection, observing frequency, angular resolution and sensitivity will be rejected. Header information of PdBI/NOEMA observations between December 1991 and December 2024 (for this Call) can be found in the CDS VizieR catalogue (*Centre de Données astronomiques de Strasbourg*). In the future, a tool will be available to perform a duplication check of proposals against programs observed in previous semesters. However, for this deadline PIs are kindly asked to contact the NOEMA Science Operations Group at sog@iram.fr in case of doubts concerning potential duplication of observing programs from the last years.

## 3.12 Non-standard Observations

If you plan to execute a non-standard program, please contact the NOEMA Science Operations Group (sog@iram.fr) well in advance of the deadline to discuss the feasibility and possible observing strategies. Non-standard observations are for example very large-field mosaics, projects that need special calibration (e.g., an RF bandpass calibration to better than a percent in order to detect a very weak line over a very strong continuum), or projects that target frequencies that may fall (slightly) out of the guaranteed tuning ranges (see Table 2).

# 4 Documentation

Documentation for NOEMA can be retrieved from the `NOEMA Documentation web page`. Detailed up-to-date information is available in the description of the `Current NOEMA capabilities` (i.e., this document).

# 5 Local Contacts

A Local Contact will be assigned to every A and B rated proposal that does not involve an in-house collaborator. The Local Contact will assist you in the preparation of the observing procedures and provide help to reduce the data.
Assistance (write to sog@iram.fr) is also provided before the deadline to help in the preparation of a proposal. Depending on the program complexity, IRAM may require an in-house collaborator instead of the normal Local Contact.

# 6 Data Reduction

Proposers should take the following into account with respect to the reduction of their data:

- Face-to-face data reduction visits to the IRAM Grenoble headquarters are welcome, but remote data reduction sessions are also offered. For both, face-to-face and remote data reduction sessions, the assigned reduction weeks must be respected and extensions can be granted in well justified and exceptional cases only. Please get in touch with your Local Contact for further details.

- The schedule for remote data reduction offers higher flexibility compared to in-person sessions. Due to the limited resources however, the number of concurrent data reduction sessions will be limited for both, remote and face-to-face sessions. Please contact us well in advance to organize your data reduction sessions.

- In certain cases, proposers can be provided with updates as their observations progress. This service does not replace a careful data reduction after completion of the project. Please contact your Local Contact or NOEMA's Science Operations Group (sog@iram.fr) if you are interested in observational updates.

- Given significant upgrades and developments of the GILDAS software, calibration of NOEMA data has to be currently done **using the most recent version of the GILDAS package CLIC on specific computers at the IRAM headquarters in Grenoble**. Any post-reduction processing like imaging, cleaning etc. using, e.g., MAPPING, CLASS, or GREG, is possible with locally installed GILDAS packages at the users' home institute.

# 7 Links to online documentation mentioned in the text

NOEMA Web Pages:
https://iram-institute.org/science-portal/noema/

The Proposal Management System PMS:
http://oms.iram.fr/pms

Latest GILDAS Version:
http://www.iram.fr/~gildas/dist/index.html

Online NOEMA sensitivity estimator:
https://oms.iram.fr/tse/#noema

Interferometer Schedule:
http://www.iram.fr/IRAMFR/PDB/ongoing-last.html

Large Programs:
https://iram-institute.org/science-portal/proposals/lp/

Large Program Policy:
https://iram-institute.org/science-portal/proposals/lp/policy/

Interferometry School Presentation on Short-Spacings:
http://www.iram.fr/GENERAL/calls/Jerome-Pety-Mosaicking.pdf

Technical Report on Short-Spacings:
https://www.iram.fr/GENERAL/calls/IRAM_memo_2008-2-short-spacings.pdf

NOEMA Beam characteristics:
https://www.iram.fr/GENERAL/calls/NOEMA-beams.pdf

PolyFiX tutorial:
http://www.iram.fr/GENERAL/calls/demo-astro-noema.pdf

The CDS VizieR catalogue:
PdBI (header information on data obtained before 2016)
http://vizier.u-strasbg.fr/viz-bin/VizieR?-source=B/iram/pdbi

NOEMA (header information on data obtained after 2016)
http://vizier.u-strasbg.fr/viz-bin/VizieR?-source=B/iram/noema

NIKA 2 homepage:
http://www.iram.es/IRAMES/mainWiki/Continuum/NIKA2/

MIOP homepage:
https://iram-institute.org/science-portal/proposals/lp/miop/

NOEMA Documentation web pages:
https://iram-institute.org/science-portal/noema/documentation/

Current NOEMA capabilities:
http://www.iram.fr/GENERAL/calls/w26/NOEMACapabilities.pdf