IRAM NOEMA interferometer

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 an easy access to documentation, e.g. on the `NOEMA web pages`. The full links are also given on the last page of this document.

1 Progress of NOEMA

1.1 News

Scientific observations at NOEMA were maintained at a high efficiency level since the beginning of the COVID-19 health crisis in March this year, even during the lockdown period in France. The pandemic did, however, delay by about one to two months the completion and commissioning of Antenna 11, and antenna retrofit and maintenance activities. Antenna 11 will join the array for commissioning around mid-August. The retrofit on two additional first generation antennas and the standard antenna maintenance, initially planned to start in April, are expected to be completed by the end of the current summer observing semester. Full NOEMA with 12 antennas and baselines ranging up to ∼1700 m is still foreseen to be available by the end of 2021.

2 Conditions for the next Winter Semester

During the course of the winter semester, we plan to schedule three configurations. The number of available antennas is dependent on maintenance and antenna retrofit activities. A preliminary configuration schedule for the winter period is outlined in Table 1. As Antenna 11 is yet to be commissioned at the time of the publication of this document and given the challenges of the COVID-19 pandemic, proposals for the upcoming winter semester should be planned for configurations based on a conservative 10-antenna array at this moment. Adjustments to this provisional configuration planning will be made according to the availability of all eleven antennas, commissioning requirements in the frame of NOEMA, 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 period because of sun avoidance constraints.

Table 1: Configuration Schedule for the Winter period

Conf	Scheduling Priority
C	November – January
A	January – February
C	February – March
D	March – May

The winter semester is very well suited for high frequency (1 mm) and high angular resolution observations (see also Section 2.3). Nevertheless, we also encourage the submission of proposals that ask for observations at lower frequencies (2 mm & 3 mm) and lower angular resolution for which a significant amount of time will be invested. Please indicate in your proposal if your scientific targets allow for self-calibration and hence a more flexible scheduling. Observations in Band 4 will not be offered this semester.

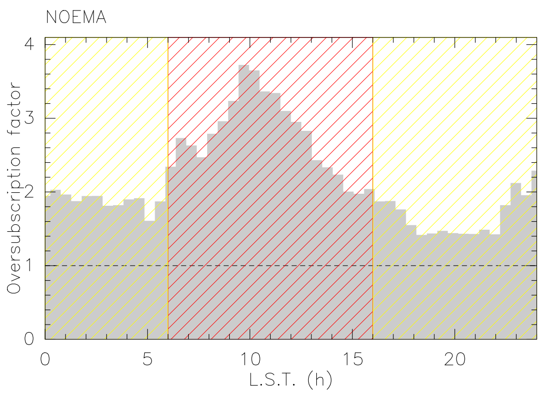

Figure 1: Oversubscription factor averaged over all NOEMA proposals of the past two winter semesters.

Over the past years, NOEMA has seen a significant increase in extragalactic proposals, particularly targeting the high-redshift galaxies from popular deep fields such as COSMOS or GOODS-North. This has resulted in a high pressure in LST ranges roughly between 06h and 16h in each of the past semesters while other LST ranges show less pressure (see Fig. 1). We hence encourage the submission of projects targeting sources in the lower pressure LST ranges and allowing for more flexible scheduling (i.e. asking for sky frequencies in the range ∼75-110 GHz at 3 mm or below 150GHz at 2 mm as well as ANY configuration).

Due to the COVID-19 health crisis, no A-rated or started B-rated projects from the current summer observing semester will automatically be carried over to the winter semester. However, we expect to complete a large majority of the started projects from the current summer semester. The same rules will also apply for the upcoming winter semester.

Investigators who wish to check the status of their project may consult the `interferometer schedule` on the IRAM website. This page is updated daily.

2.1 General Proposal Considerations

Please give high importance to the quality of your proposal. The NOEMA interferometer 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.

Don't hesitate to contact the NOEMA Science Operations Group (sog@iram.fr) in case of doubts and for questions related to the preparation of a proposal.

2.2 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).

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 when only a subset of the standard antenna configurations are available. 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 guaranteed 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 "best effort" basis. PIs interested in special programs should contact the science operation group (sog@iram.fr) well before the deadline to discuss feasibility and observing strategies.

Large Program: Under the current Call for Proposals, certain restrictions still apply (see the `Large Program Policy` on the IRAM web site for general details). In the frame of NOEMA's construction, additional antennas and more capabilities of the correlator are expected to become available during the "lifetime" of a Large Program, usually spanning over several observing semesters. For the current Call for Proposals, the observing time request should be based on the availability and performance of **the ten-element array**. We might adjust it and/or review the observing strategy in response to PI needs and enhanced array's capabilities. In addition, less than the standard

Table 2: Winter configurations for ten antennas

Name	Stations									
10A	W27	W23	W08	E68	E24	E16	E03	N46	N29	N20
10C	W23	W20	W09	E23	E18	E10	E03	N20	N17	N11
10D	W12	W08	W05	E10	E04	N17	N13	N09	N05	N02

50% of the total scheduled observing time will be reserved for *Large Programs* using NOEMA at this point. This restriction is necessary to account for the significant investment of technical time still needed to bring the NOEMA project to its full completion in the upcoming years as well as the large number of already running GTO[1] projects.

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 2.4 and in Table 3.

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 30-meter 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 give here 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 23 for a brief summary) given at the 10th Interferometry School and this Technical Report. For further assistance, please contact the Science Operations Group (sog@iram.fr).

2.3 Array Configurations

Three main configurations (A, C and D) are planned, providing the best possible coverage of the uv-plane (see Table 2).

The general properties of these configurations are (numbers refer to a source at 20° declination):

- A alone is well suited for mapping or size measurements of compact, strong sources. It provides a resolution of $\sim 1.0''$ at 100 GHz, $\sim 0.4''$ at 230 GHz.
- C provides a fairly complete coverage of the uv-plane and is well adapted to combine with D for low angular resolution studies ($\sim 2.6''$ at 100 GHz, $\sim 1.1''$ at 230 GHz). C alone ($\sim 2''$ at 100 GHz, $\sim 0.9''$ at 230 GHz) is also well suited for snapshot and size measurements, and for detection experiments at low source declination.
- D alone is best suited for deep integration and coarse mapping experiments (resolution $\sim 3.9''$ at 100 GHz and $\sim 1.7''$ at 230 GHz). This configuration provides both the highest sensitivity to extended structures and the lowest atmospheric phase noise.

The three configurations can be used in different combinations to achieve complementary sampling of the uv-plane, and to improve on angular resolution and sensitivity. Mosaicing is usually done with D or CD, but the combination ACD can also be requested (e.g. for high resolution mosaics). Check the ANY bullet in the proposal form projects if the scientific goals can be reached with any of the three configurations or their subsets. There is a possibility on the PMS web form to restrict the choice of configurations, e.g., to C or D, if your project qualifies for ANY of the more compact configurations. However, the ANY bullet is only available if the "Point source detection" was selected for the respective technical sheet in PMS.

2.4 Receivers

All NOEMA antennas are equipped with 2SB receivers, providing low noise performance and excellent long-term stability. The receivers provide two orthogonal linear polarizations in all three bands. Each of the two polarizations delivers a bandwidth

[1]guaranteed-time observations

Table 3: Receiver characteristics

	Band 1	Band 2	Band 3
F_{LO1} range/[GHz]*	82.000–107.700	138.616–171.256	207.744–264.384
F_{sky} range/[GHz]*	70.384–119.316	127.000–182.872	196.128–276.000
T_{rec}/[K]**	25–45	35–55	40–70
G_{im}/[dB]	-15-...-10	-15...-10	-15 ... -10

* 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 2). 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}±11.616 GHz. The lowest and highest LO1 frequencies per band define the F_{sky} ranges that are guaranteed for this call.
** for LSB and USB.

of 7.744 GHz in the lower sideband (LSB) and upper sideband (USB) simultaneously. The sky frequency ranges that can be covered in each band and further characteristics are given in Table 3.

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 2.7.1) are still allowed but an explanatory statement should then be added to the "technical justification" in the proposal.

2.5 Sensitivity

Investigators will be asked in PMS to specify the requested telescope time for each Technical Sheet. Based on the NOEMA performance at the time of publication of this document, PMS calculates the corresponding 1 sigma point-source sensitivity *for one representative frequency*. The representative frequency has to be within the frequency range 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. Please note, that due to the large bandwidth and the dual-sideband mode, the noise can vary significantly with frequency in the available frequency range. Especially, if one of the sidebands is close to a receiver band edge, 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 noise across the entire 15.488 GHz bandwidth to calculate the *continuum* sensitivity.

Since 2019, the *proposal* sensitivity estimator is not offered anymore in ASTRO[2]. A new online sensitivity estimator is made available `on this link` instead, which is identical to the one used in PMS. This online tool has been developed to facilitate the preparation of your proposals. However, to keep it simple and user friendly, approximations had to be made so that certain values (e.g., angular resolutions) have only indicative nature 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**.

2.6 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 for instance 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

[2] The *detailed* sensitivity estimator, however, will still be available in ASTRO.

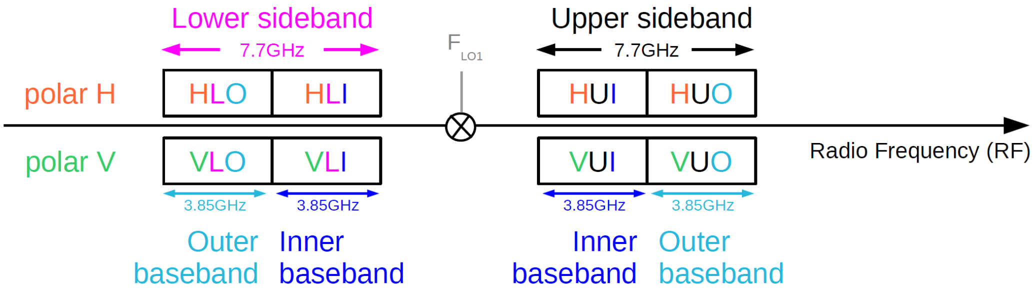

Figure 2: Basebands fed to the correlator

due to slewing and calibration needs. However, the feasibility of track-sharing is not guaranteed even if no warning is given by `PMS`. In particular, 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 selected high spectral resolution chunks. Therefore, special care has to be applied when configuring the spectral setup.

2.7 PolyFiX

PolyFiX can process a total instantaneous bandwidth of ∼ 31 GHz for up to twelve antennas that is split up into two polarizations in each of the two available sidebands (the *upper* and *lower* sideband). The centers of the two 7.744 GHz wide 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. 1). In total, there are thus eight basebands which are fed into the correlator. The channel spacing is 2 MHz[3] throughout the 15.488 GHz effective bandwidth per polarization. Additionally, 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, in the current implementation step of *PolyFiX*, a fixed channel spacing of 62.5 kHz[3]. A number of contiguous chunks defines one *spectral window (SPW)*.

Please note that there is a "non-exploitable, 20 MHz wide frequency area" (≡ 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 also increased by up to a factor of two within a width of ±50 MHz around the center in each sideband. Important lines should therefore not be placed in this region (see also pages 19 and 20 in `this PolyFiX tutorial`).

The observations of very strong, steep-sided spectral lines require special care in the choice of the spectral resolution. The so called spectral leakage[4], 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 −13.3dB (i.e., ≃0.05). These strong lines should hence be observed with the highest currently offered spectral resolution of 62.5 kHz to minimize this effect. In case of questions, please do not hesitate to contact the NOEMA SOG group (at sog@iram.fr).

2.7.1 ASTRO

For simple spectral *PolyFiX* setups using only the low spectral resolution, `PMS` can be used directly to prepare the frequency tuning and correlator setup of the respective technical sheet. However, for more complex setups especially those using high spectral resolution windows, the software ASTRO 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 `aug20` version (or later) of GILDAS.

[3] due to default signal apodization with a sinc^2 function, the effective spectral resolution is 1.772 times the channel spacing.

[4] PolyFiX uses a triangular (Bartlett) weighting function causing artificial peak sidelobes at a level of −13.3dB in neighboring channels which is called spectral leakage.

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 LSR velocity (or redshift) has to be set to zero in the source command. Also, the frequencies of molecular lines from the standard 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`). 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 TOTO 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
! 180.6MHz to match the tuning grid

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

BASEBAND
! select all 8 basebands

! 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
...
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 accept to 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 projects (including line markers at the correct rest frequency for redshifted sources for instance).

Old NOEMA ONLINE language scripts, i.e. those created by the SETUP command (e.g., from the W17 semester) can be converted by typing in ASTRO:

```
OBSERVATORY NOEMA ONLINE
@ MyOnLineScript.astro
PROPOSAL /FILE MyOfflineScript.astro
```

Note that the scripts uploaded to PMS during the W17 session have been automatically converted into OFFLINE syntax in PMS. They can thus be directly cut and paste within PMS.

2.8 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.

A later swap of targets is not foreseen for regular projects.

Please note that targets below a declination of −30 degrees are not observable from the NOEMA site as their elevations hardly exceeds ≥10 deg during a reasonably long LST range. Very low-declination sources between declinations of −30 and −25 degrees are very difficult to observe and they do not rise much above 10 degrees in elevation and suffer from heavy shadowing in the compact configurations; if you are considering to observe such a very low-declination source please contact the science operation group well before the deadline (at sog@iram.fr) to discuss feasibility and observing strategies.

2.9 Sun Avoidance

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

2.10 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.

2.10.1 Duplication Check

In order to ensure the most efficient use of the NOEMA interferometer, 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 not be accepted. Header information of PdBI/NOEMA observations later than December 1991 but before Oct 2018 (for this Call) can be found in the CDS VizieR catalogue (*Centre de Données astronomiques de Strasbourg*). In the future, PIs will be able to perform a duplication check of their proposals also against programs observed in more recent semesters. However, for this deadline we kindly ask PIs to contact the NOEMA science operations group at sog@iram.fr in case of doubts concerning duplication of observing programs from the last two years.

2.10.2 Protected Fields within GTO Programs

Investigators should take note of the following protections put in place for GTO programs when preparing their proposals:

- The **NIKA 2** protected GTO observing fields are fenced against **new continuum driven** observations with NOEMA; the field coordinates and sizes are given on this `NIKA 2 homepage link`
- All **MIOP** observing fields and sources are protected against any new observing requests for which the science goals are similar to those of the respective MIOP; click on the following `MIOP homepage link` for details on the protected fields and for the individual MIOP abstracts

Possible conflicts between GTO programs and new proposals will be flagged during the technical pre-screening and may result in the (partial or complete) rejection of the proposal. Investigators are hence expected to check their target coordinates against the protected GTO fields (see links given above) when preparing their proposal. The conflicted source(s) should be retracted or exchanged if science goals are identical with those of the GTO programs. In case a conflicted source is wished to be kept it must be demonstrated in the proposal that the scientific goals are significantly different from the GTO programs. For the upcoming winter semester, PMS will issue a general information when uploading or adding new sources to the proposal. The informations includes the links to the list of the coordinates for each GTO field, ordered by project name or RA. In the future, a direct coordinate check will be implemented for these GTO fields within PMS.

2.11 Non-standard Observations

If you plan to execute a non-standard program, please contact the Interferometer Science Operations Group (sog@iram.fr) 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 3).

2.12 Documentation

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

2.13 Local Contact

A local contact will be assigned to every A and B rated proposal that does not involve an in-house collaborator. He/she 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 a 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.

2.14 Data Reduction

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

- Due to the COVID-19 pandemic, face-to-face data reduction visits are still put on hold at the IRAM Grenoble headquarters. Until the situation evolves favorably, data reduction will be only supported remotely. Please check our webpages for regular updates. Similar to face-to-face data reduction visits, the assigned remote reduction weeks must be respected and extensions can be granted only in well justified and exceptional cases. Due to the large amount of observations perfomed at NOEMA and the impossibility to support data reduction during the lockdown period in France, a large number of unreduced projects has accumulated. Delays for data reduction may hence be longer than usual. Please get in touch with your local contact for further details.

- The remote data reduction schedule allows for a higher flexibility than face-to-face visits, but we still have to avoid the presence of more than two groups at the same time also for remote data reduction sessions due to the limited resources. Please contact us well in advance to organise 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, reduction 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**. However, any post-reduction processing like mapping, cleaning etc. is possible with locally installed GILDAS packages like mapping, class or greg.

Links to online documentation mentioned in the text:

NOEMA Web Pages:
http://iram-institute.org/EN/content-page-56-7-56-0-0-0.html

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

GILDAS Version aug20:
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://www.iram-institute.org/EN/content-page-412-7-57-412-0-0.html

Large Program Policy:
https://www.iram-institute.org/EN/content-page-414-7-57-412-414-0.html

Interferometry School Presentation on Short-Spacings:
http://www.iram-institute.org/medias/uploads/file/PDFs/IS-2018/pety-mosaicking.pdf

Technical Report on Short-Spacings:
http://www.iram-institute.org/medias/uploads/IRAM_memo_2008-2-short-spacings.pd

PolyFiX tutorial:
http://www.iram.fr/∼gildas/demos/astro/demo-astro-noema.pdf

The CDS VizieR catalogue:
PdBI (data before 2016)
http://vizier.u-strasbg.fr/viz-bin/VizieR-3?-source=B/iram/pdbi
NOEMA (data after 2016)
http://vizier.u-strasbg.fr/viz-bin/VizieR-3?-source=B/iram/noema

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

MIOP homepage link:
https://www.iram-institute.org/EN/content-page-415-7-57-412-415-0.html

NOEMA Documentation web pages:
http://www.iram-institute.org/EN/content-page-96-7-56-96-0-0.html

Current NOEMA capabilities:
http://www.iram.fr/GENERAL/calls/w20/NOEMACapabilities.pdf