

OB preparation guidelines for MUSE NFM Science Verification observations

This memo provides a short description of the requirements for the preparation of MUSE NFM OBs for Science Verification (SV) **only**.

Basic instructions:

- OBs must be prepared with the latest version of [P2PP \(3.4.3\)](#). Instructions related to the P2PP installation can be found [here](#). Users should refer to the [P2PP User Manual](#) for a general overview of the P2PP and generic instructions on the preparation of OBs and scheduling containers.
- Exposure time can be defined with the current [MUSE ETC](#) and by using the desired image quality as input parameter.
- Users are expected to be already familiar with the [MUSE User Manual](#)

Specific instruction for SV:

The NFM is only offered in combination with the Nominal filter that provides the following wavelength coverage: **480-578 nm and 605-930 nm**. The wavelength gap between 578nm and 605nm is due to the Na notch filter.

Observations with the NFM require the use of a NGS with magnitude in the range **$5 \leq H \leq 14$** located up to 3.35" from the field center as shown in the Figure 1.

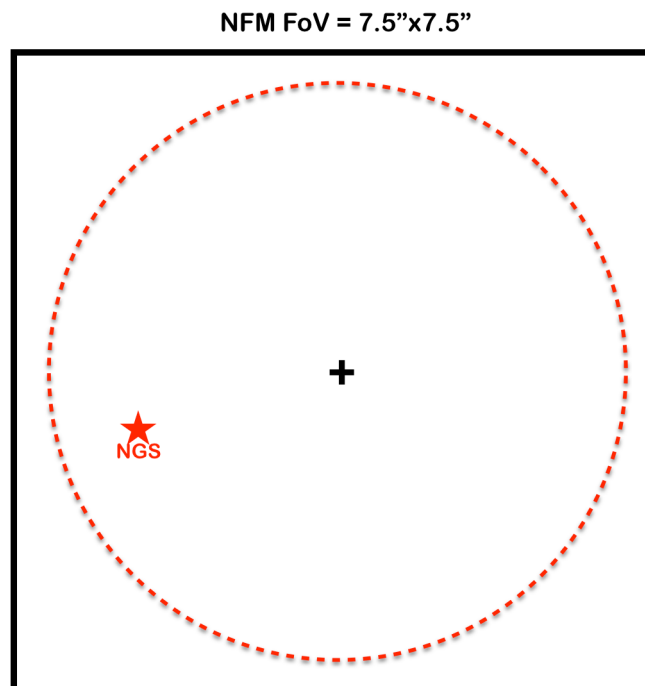


Figure 1: The black square refers to the instrument FoV, while the red circle of 3.35" radius shows the patrol field of the WFS where the NGS must be located. The black cross marks the instrument field center.

This means that the distance between your science target and the NGS can be as large as 6.69" (i.e. $2 \times 3.35''$). However, when designing the observations one should consider that if the distance between the science object and the NGS is larger than 3.35" the *OB target coordinates* should correspond to the instrument field center and not to the science object RA and DEC (see Figure 2).

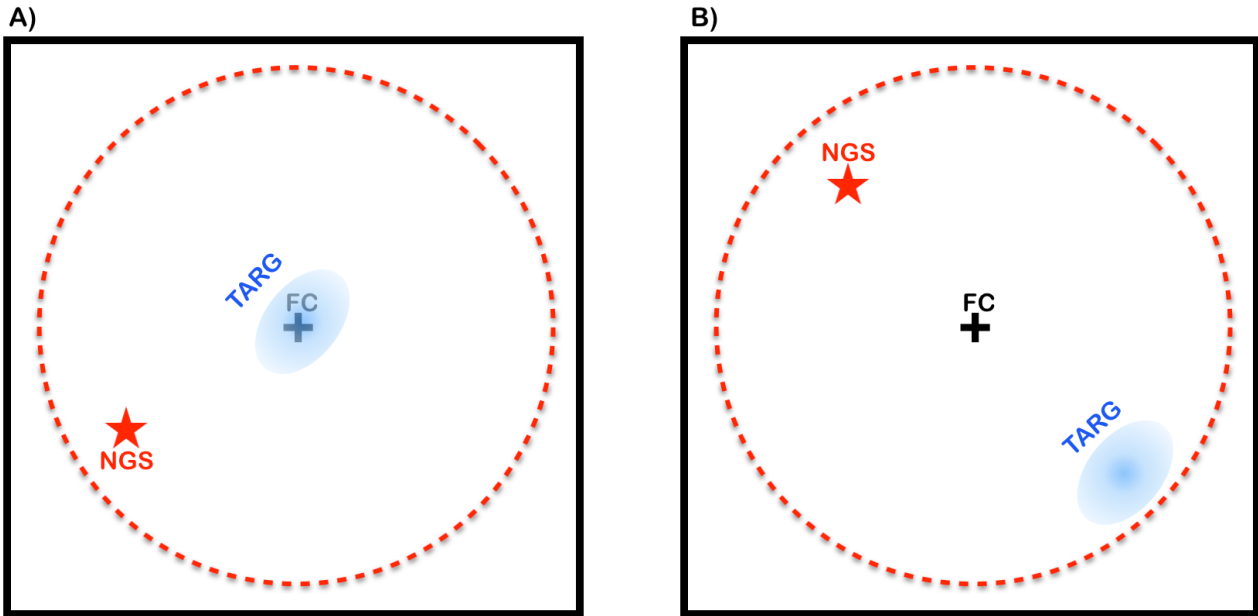
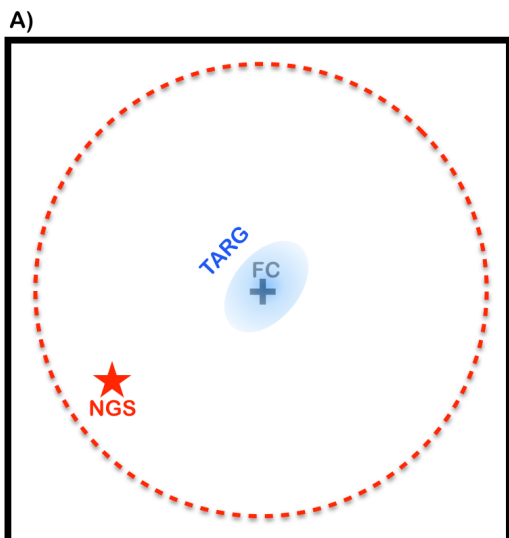


Figure 2: As in Fig.1, the black box refers to the NFM FoV, while the red circle marks the NGS patrol field. Left: the case in which the distance between target (TARG) and NGS is less than 3.35", so the target can be placed in the field center (FC). Right: the case in which the distance between target (TARG) and NGS is larger than 3.35", so the target must be placed away from the field center (FC) such as to guarantee that the NGS is kept within the patrol field.

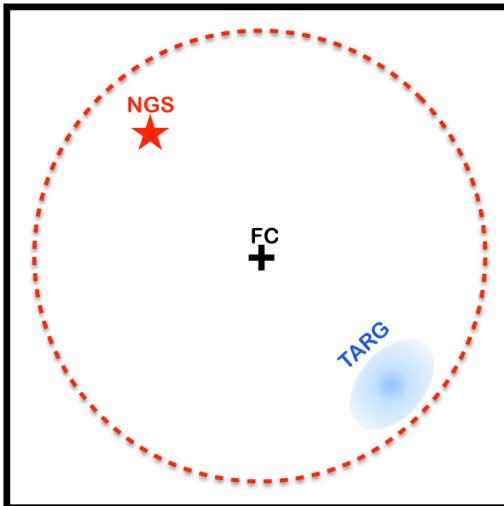
If the target is not the NGS, but its distance to it is within 3.35" (case A in Fig.2) then the target can be placed in the center of the FoV. In the OB, the *Target Right Ascension* and *Declination* do correspond to the science source RA and DEC (see Figure below).



Obs. Description	Target	Constraint Set	Time Intervals
Target			
Name	No name		
Right Ascension	00:00:00.000	RA(TARG) = RA(FC)	
Declination	00:00:00.000	DEC(TARG) = DEC(FC)	
Equinox	J2000		
Epoch	2000.0		
Class	Unknown		
Proper Motion RA	0.000000		
Proper Motion Dec	0.000000		
Diff. RA	0.000000		
Diff. Dec	0.000000		

On the other hands, when the distance between the science object and the NGS is larger than 3.35", one should NOT use as OB *Target Right Ascension* and *Declination* the object RA and DEC, but rather the coordinate of the field center as shown in the figure below.

B)



Obs. Description	Target	Constraint Set	Time Intervals
Target			
Name	No name		
Right Ascension	00:00:00.000	RA(FC)	
Declination	00:00:00.000	DEC(FC)	
Equinox	J2000		
Epoch	2000.0		
Class	Unknown		
Proper Motion RA	0.000000		
Proper Motion Dec	0.000000		
Diff. RA	0.000000		
Diff. Dec	0.000000		

OBs for NFM observations can only be prepared by using the following two templates:

- MUSE_nfm-ao_acq_LGS (Acquisition template)
- MUSE_nfm-ao_obs_genericoffsetLGS (Observing template)

In the acquisition template one needs to provide the coordinates and H magnitude of the NGS, and optionally the coordinates of the VLT-GS. The color of NGS should be left to its default value (i.e. "Color of on-axis guide object=0").

The science template for NFM is very similar to that used for the WFM (AO and NOAO). As for the WFM case, we suggest to break the total exposure time on source in sub-exposures, and applying a small dithering pattern and 90 degrees rotation between on-object exposures. The combination of small dithering pattern and 90 degrees rotations is currently the best strategy to reject comics, and obtain a more uniform combined dataset in terms of noise properties.

However, the following should be taken into account:

- The maximum size of the offset between two consecutive on-object exposures should not be larger than 0.2" (8 pixels)¹
- Rotation between consecutive offset exposures is only limited to the case in which target and NGS are the same object, and placed at the field center.
- If the science target is not the NGS, then rotation between exposures is not possible.

¹ The offsets between on-object exposures are performed with AO correction (i.e. lasers and NGS loops closed), therefore the offset between exposures must be kept small otherwise the loops would open.

- The offsets pattern for on-object exposures should always be designed such as to keep the NGS within 3.35" from the field center, otherwise the loop will open.

For each OB, users must provide finding charts compliant with the following requirements:

- 12"x12" size image centred on the OB coordinates
- the instrument FoV, the science target and NGS position should be clearly marked
- PI name, programme ID, OB name, field orientation and image scale should be also present.

ESO compliant finding charts can be prepared by using a dedicated version of the GuideCam tool, which allows to easily select a suitable NGS once the position of the science target is provided through the tool main GUI.

Detailed instructions on where to download and how to use the GuideCam tool will be provided by the User Support Department (USD) in the coming days.

Specifically, PIs of approved SV runs will be directly contacted by USD with further details regarding GuideCam tool.

Alternatively, MUSE ESO-compliant finding charts can be created by using [fcmaker](#) (Python 3 module). You can easily and quickly install the code using pip:

```
pip install fcmaker
```

However, because fcmaker is not an ESO supported tool, users should address possible questions related to this tool directly to the developer (see [fcmaker web page](#)).

Finally, should you have remaining doubts or questions, please do not hesitate to contact the [User Support Department](#). We will be happy to help you.