Guide to Observing with MOIRCS

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Introduction

This document describes how to prepare an OPE file for MOIRCS.
Please also refer to the following web site before your observation. The following page describes the FOV of MOIRCS, an observation strategy of standard stars, and a guide to exposure time.

http://www.naoj.org/Observing/Instruments/MOIRCS/index.html

There, you will also find a template OPE file with typical sequences for deep imaging and standard star observations.
Questions regarding MOIRCS should be directed to Ichi Tanaka (ichi@naoj.org).

Guidelines

(1) We recommend a 9-point (8-point and the center) dither pattern with a 15” diameter.
(2) Typical values of individual exposure times are 100-180 seconds for *J*-band, 20-40 seconds for *H*-band, and 50-90 seconds for *K*s-band. It is recommended that the maximum pixel count of your target should be below 20000 ADU per readout.
(3) You can use coadds at each dither point to reduce overhead due to individual frame transfer time. In case fringe patterns or sky backgrounds vary rapidly, we recommend reducing the number of coadds. Also, if an object image extends because of tracking error since we can’t use the auto guider in imaging mode, it is recommended to reduce the number of coadds. Please refer to Table 1.
(4) The suitable brightness range of standard stars is from 12.5 mag to 14 mag.
(5) Please select a focusing field where more than 10 bright (12-18 mag) stars exist and are distributed over the entire FOV of MOIRCS. Globular clusters are preferable. It is recommended that the field is near your target.
(6) On average, about 16 GB (1000 frames) of data are generated each night.

Table 1: Examples of overheads for imaging mode

[Overhead] = [Typical exposure time] * [coadds] / [Overhead Time]

Filter	Overhead	Exposure time per readout [s]	Number of coadds	Total exposure time per frame [s]
J	22 %	180	1	180
	33 %	120	1	120
H	63 %	30	4	120
	82 %	20	6	120
*K*s	32 %	80	2	160
	42 %	50	3	150

MOIRCS Abstract Commands

1. Object definition and target acquisition:

(1) Please define the object name parameters for your targets in the parameter definition part at the beginning of your OPE file. The target coordinate specifies the center of the MOIRCS FOV and the position angle is given counterclockwise as shown in Figure 1.

Example:

AS15=OBJECT="AS15-1 Standard" RA=064037.90 DEC=091841.0 EQUINOX=2000.0 PA=0.0

(The words between " " will become the OBJECT keyword value in the FITS header)

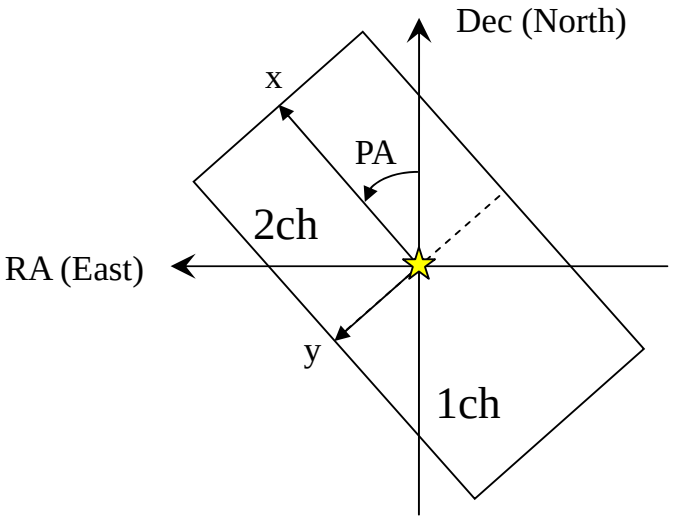

Figure 1. Definition of the position angle (PA) used in OPE file: PA =0 when Channel 2 x-axis is to the North.

(2) Target acquisition command is “SETUPFIELD”.

Example:

```
SETUPFIELD    $DEF_IMG $AS15
```

2. Filter setup commands:

Filter setting parameters for some typical filter configurations are already prepared in the header part of the OPE file.

```
DEF_DARK=GRISM=BP
DEF_IMJ=FILTER_A=J FILTER_B=CSL GRISM=HOLE
DEF_IMH=FILTER_A=H FILTER_B=CSL GRISM=HOLE
DEF_IMKS=FILTER_A=KS FILTER_B=CSL GRISM=HOLE
```

Filter change command is “SETUPOBE”. See the examples below.

(1) Setup for dark frames

```
SETUPOBE    $DEF_IMG    $DEF_DARK
```

(2) Setup for a *J*-band observation

```
SETUPOBE    $DEF_IMG    $DEF_IMJ
```

(3) Setup for an *H*-band observation

```
SETUPOBE    $DEF_IMG    $DEF_IMH
```

(4) Setup for a *Ks*-band observation

```
SETUPOBE    $DEF_IMG    $DEF_IMKS
```

3. Fieldcheck commands:

You can use the command “CHECKFIELD” for the quick check of your field.

Example:

```
FIELDCHECK $DEF=IMG EXPTIME=30 SKYSUB=YES
```

If SKYSUB parameter is set to YES, an image on target position and subsequently a “sky” image that is taken after 20” offset (default) are continuously acquired. By subtracting the second image from the first image, you can see faint objects.

3. Telescope offset commands:

You may want to change the layout of the FOV then use the command “TELOFFSET”.

Example:

(1) To move *the position of targets* by dx=10 (arcsec) and dy=20 (arcsec).

TELOFFSET $DEF_TOOL DX=10.0 DY=20.0 AUTOGUIDE=NO

(See Figure 2)

(2) To change position angle by 10 (degree).

PAOFFSET $DEF_TOOL DPA=10.0 AUTOGUIDE=NO

(See Figure 3)

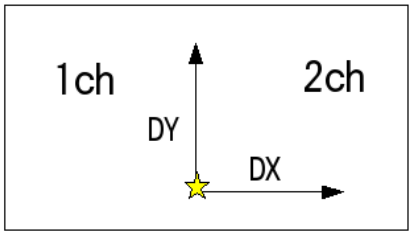

Figure 2. Direction of DX and DY of TELOFFSET in a FITS image

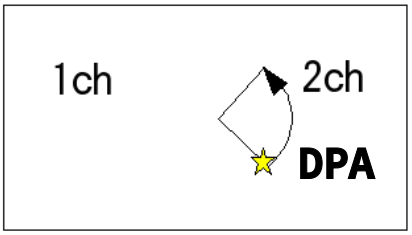

Figure 3. Direction of DPA of PAOFFSET in a FITS image

4. Data acquisition command:

The science exposure is done using the command “GETOBJECT”. The command has a number of control parameters as described in Table 2. It is the observer’s responsibility to determine a suitable value for each parameter.

Example:

GETOBJECT $DEF_IMG EXPTIME=50.0 NEXPOSURE=1 COADDS=3 DITHNUM=8 DITHCENTER=YES DITHLENGTH=15.0 DITHANGLE=0 DATTYPE=OBJECT

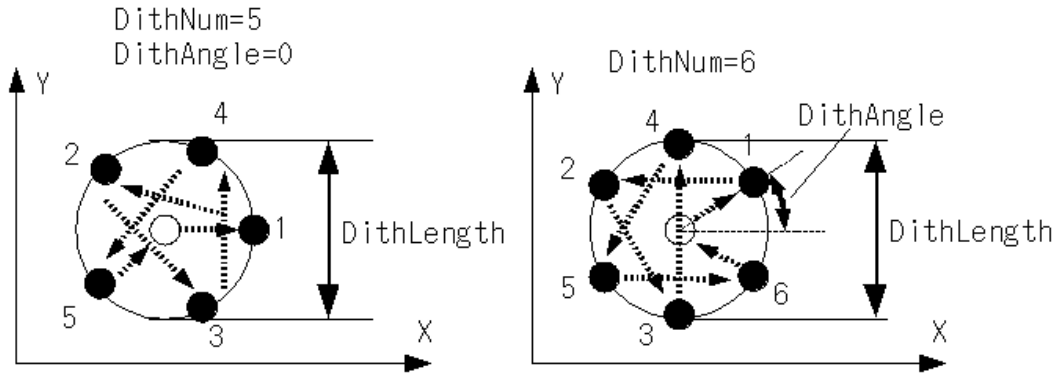

Figure 4. Dither pattern of GETOBJECT: If you assign DITHCENTER=YES, the image at the center position is taken first and a total of (DITHNUM+1) images are taken for each dither pattern.

Table 2: Parameters of GETOBJECT for imaging mode

Parameter	Default value	Description
PRD_SIZE	2048	The size of a partial readout area for each detector [pixel] (From 1 to 2048)
EXPTIME	0	Exposure time per readout [s]
COADDS	1	Number of coadds [-]
NDUMMYREAD	0	Command to reduce a reset anomaly (0 or 2)
AUTOGUIDE	NO	Use of the auto guider (YES or NO)?
DITHNUM	0	Number of points of a dither pattern [-]
DITHLENGTH	20.0	Width of a dither pattern [arcsec]. See Fig 4.
DITHANGLE	0	Position angle for a first dither position in degrees. See Fig. 4.
DITHCENTER	NO	Take an image at the center of a dither pattern in a dither sequence (YES or NO)? See Fig.4.
DATTYPE	OBJECT	Data type. (OBJECT / TEST / STANDARD_STAR)
NEXPOSURE	1	Number of images taken at each dither position

6. Telescope focusing command:

Note. Please refer to (5) of the “Observation” section in page 1.

```
FOCUSTELESCOPE   $DEF_TOOL EXPTIME=13.0 NEXPOSURE=1
NSTEP=9 Z=0.9250 DELTAZ=0.035 FOCUS_MODE=ANA
```

Description. This command changes a position of the secondary mirror and acquires an image at each focus position. The Z value specified in the FOCUSTELESCOPE command is a central value for the focus test. The step size of the focus test is given with DELTAZ (mm). This command provides a set of NSTEP images whose focus positions are defined with the values of Z and DELTAZ. If you use the "ANA" mode, the automatic seeing measurement program will calculate the best Z value and the result will appear on ANA display.

FITS Images

(1) The detector of Channel 1 has 3 dead pixel regions: a ~2” diameter circular region at the center, ~50” x 6” region at the bottom edge, and ~60” x 3”.5 region at the left edge.
(2) The detector of Channel 2 has a high gain region ~9” in width around the entire edge. The region sometimes also has a latent image.
(3) Each quadrant boundary has no data region with the width of 1 pixel for both chips.
(4) “EXPTIME” in a FITS header is the total exposure time (The exposure time per readout times the number of coadds). The counts in a FITS image show the sum of the counts of all readouts. “EXP1TIME” is the exposure time per readout.

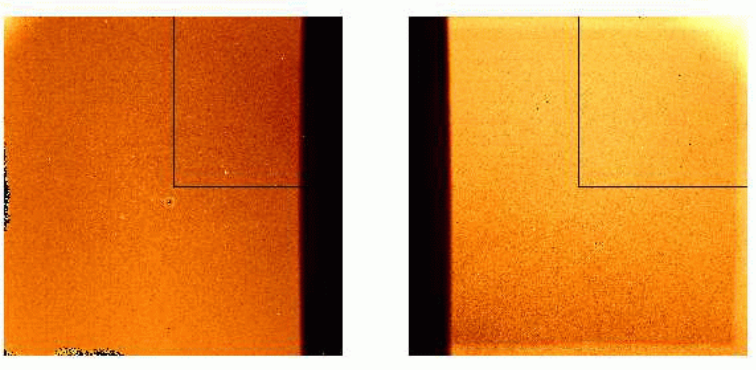

Figure 5. Raw FITS images of MOIRCS: The left is Channel 1 and the right is Channel 2. Please also refer the website at http://subarutelescope.org/Observing/Instruments/MOIRCS/index.html.