



**ESO**

European Organization for Astronomical Research in the Southern Hemisphere  
 Organisation Européenne pour des Recherches Astronomiques dans l'Hémisphère Austral  
 Europäische Organisation für astronomische Forschung in der südlichen Hemisphäre

## MAD Science Demonstration runs 1 & 2 Data Guidelines

The MAD Science demonstration runs 1 & 2 took place in Paranal from November 24<sup>th</sup> to December 1<sup>st</sup>, 2007 and from January 7<sup>th</sup> to 14<sup>th</sup>, 2008.

The data taken during those nights are publicly available worldwide.

The approved observing programs with the corresponding targets are listed in table 1:

PI	Program	Target (Band)	Comments/Status
H. Bouy, M. Petr-Gotzens	A new census of 3 young associations: Trappetium, Lambda Ori and Sigma Ori	Trappetium Field 1 (H,K)	Completed
		Trappetium Center Field (H,K)	Completed
		Trappetium Filed 2 (H,K)	Completed
		Lambda Ori (H,K)	Completed
		Sigma Ori Filed 1 (H,K)	Completed
		NGC 2362 (H,K)	Completed
G. Bono, E. Marchetti	Nailing down the second parameter problem in NGC 288	NGC 288 (K,J)	Completed
A. Calamida	Deep into the lower main sequence of the globular cluster NGC 3201	NGC 3201 (K,J)	Completed
R. Davies	Testing the astrometric and photometric accuracy of MCAO data	Davies Field (K)	Completed
C. Evans	The massive star cluster at the core of 30 Doradus	R136 (K,H)	Completed
R. Gilmozzi	The MAD Deep extragalactic Field	MAD DF (K)	Almost completed
S. Ortolani	Unveiling hidden globular clusters in the Milky Way disk	MWGC (K,J)	Completed
G. Piotto	Deep AO observations of crowded stellar fields	47 Tuc	Not executed
B. Rocheau, H. Sana	Clusters in the Carina region	Trumpler 14 a (K,H)	Completed
		Trumpler 14 b	Not executed
I. Smail	High resolution Ks band imaging of COSMOS	Cosmos (K)	Partially executed
E. Tolstoy	Magellanic Cloud Clusters	NGC 1928 (K,H,J)	Completed
		NGC 371	Not executed
S. Vicente	Deep high spatial resolution HK observations of "giant" proplyds	NGC 2244 (K)	Completed
		NGC 2264 (K)	Completed
		NGC 3372	Not executed

**Table 1: Approved MAD SD 1 & 2 programs. Look at the MAD SD page for retrieving the PDF file containing the original proposals.**



**ESO**

European Organization for Astronomical Research in the Southern Hemisphere  
Organisation Européenne pour des Recherches Astronomiques dans l'Hémisphère Austral  
Europäische Organisation für astronomische Forschung in der südlichen Hemisphäre

## DATA description

Please note that MAD data are not completely VLT compatible. As such, the files generated by the instruments have somewhat basic headers, which lack some of the information needed for data reduction. One example is the band (filter), which has no corresponding header keyword. In order to supply the missing information we used a special file naming convention:

Label\_filter\_object\_cameraPosition\_sequenceNumber\_day\_repetition.fits

Where:

**Label** – unique label for each target

**Filter** – K,H or J

**Object** – either o=science pointing or s=sky position pointing

**Camera position** – pX where X corresponds to a jitter position (0,1,2,3...)

**Sequence Number** – nX where X corresponds to a consecutive image obtained on the same position (X=0,1,2,3,...). It is the equivalent of NINT.

**Day** – day of the year when the image was taken (e.g 329=2007-11-25)

**Repetition** – non-consecutive repetition of the same setting.

e.g. *BO11\_H\_o\_p2\_n0\_330\_0001.fits* and *BO11\_H\_o\_p2\_n0\_330\_0002.fits* are two images taken the same night (2007-11-26) of the Trapezium Field 1, in H band , 3<sup>rd</sup> jitter position on the object .

As another example: the series of frames:

*CA\_K\_o\_p0\_n0\_329\_0001.fits*

*CA\_K\_o\_p0\_n0\_329\_0002.fits*

*CA\_K\_o\_p0\_n0\_329\_0003.fits*

*CA\_K\_o\_p0\_n0\_329\_0004.fits*

*AC\_K\_o\_p0\_n0\_329\_0005.fits*

Correspond to 5 frames of the MAD Deep Field taken on 2007-11-25 on the science field in K band for the same camera position (p0). The corresponding sky frames are:

*CA\_K\_s\_p0\_n0\_329\_0001.fits*

*CA\_K\_s\_p0\_n0\_329\_0002.fits*

*CA\_K\_s\_p0\_n0\_329\_0003.fits*

*CA\_K\_s\_p0\_n0\_329\_0004.fits*

*CA\_K\_s\_p0\_n0\_329\_0005.fits*

Calibration data have a slightly different naming convention. There are three types of labels, corresponding to the three types of calibration data taken with MAD:

1. **Dark frames** – usually taken every day for the DIT (detector integration time) used for science and other calibrations.  
These files are named *calib\_dark\_DIT\_p0\_nX\_day\_00XX.fits* For example, *calibd\_dark\_0.8\_p0\_n3\_329\_0001.fits* is a dark frames with integration time of 0.8 sec. All darks are taken at camera position 0 (p0 corresponding to center field, x=0,y=0)
2. **Twilight sky flat fields** – usually taken each night, during twilight, but not always, depending on weather conditions and opportunity. The files are named *calib\_flat\_filter\_p0\_nX\_day\_00XX.fits*. The filter is either K, H or J. All images are taken with the telescope at zenith and the IR camera fixed at position 0 (p0)



## ESO

European Organization for Astronomical Research in the Southern Hemisphere  
Organisation Européenne pour des Recherches Astronomiques dans l'Hémisphère Austral  
Europäische Organisation für astronomische Forschung in der südlichen Hemisphäre

3. **Standard star images** – open loop observation of a standard star. 5 frames in 5 different telescope positions: the IR camera was kept fixed in position 0 (p0) and the offsets manually given to the telescope. Only one frame per offset (n0). The files are named: *calib\_std\_filter\_p0\_n0\_day\_00XX.fits*

### DATA Retrieval Science data

The packages are made by target. MAD data are:

Target (Band)	Label
Trapetium Field 1 (H,K)	BO11
Trapetium Center Field (H,K)	BO1c
Trapetium Filed 2 (H,K)	BO12
Lambda Ori (H,K)	BO2
Sigma Ori Field 1 (H,K)	BO4
NGC 2362 (H,K)	BO3
NGC 288 (K,J)	MA
NGC 3201 (K,J)	CA
Davies Field (K)	DA
R136 (K,H)	EV
MAD DF (K)	GI
MWGC (K,J)	OR
Trumpler 14 a (K,H)	SA
Cosmos (K)	SM
NGC 1928 (K,H,J)	TO1
NGC 2244 (K)	VI1
NGC 2264 (K)	VI2

### Calibration Data

Calibration data are collected into two packages, one for SD run 1 (November 2007) and one for SD run 2 (January 2008).



**ESO**

European Organization for Astronomical Research in the Southern Hemisphere  
Organisation Européenne pour des Recherches Astronomiques dans l'Hémisphère Austral  
Europäische Organisation für astronomische Forschung in der südlichen Hemisphäre

### Nightlogs

Manual logs were taken each night to record the activities and any useful comments. The users can download the logs in simple txt ASCII format for each night from the MAD SD page.

<b>Night</b>	<b>Day of the year</b>	<b>File</b>
2007-11-24	328	Logfile_2007-11-24.txt
2007-11-25	329	Logfile_2007-11-25.txt
2007-11-26	330	Logfile_2007-11-26.txt
2007-11-27	331	Logfile_2007-11-27.txt
2007-11-28	332	Logfile_2007-11-28.txt
2007-11-29	333	Logfile_2007-11-29.txt
2007-11-30	334	Logfile_2007-11-30.txt
2008-01-07	008	Logfile_2008-01-07.txt
2008-01-08	009	Logfile_2008-01-08.txt
2008-01-09	010	Logfile_2008-01-09.txt
2008-01-10	011	Logfile_2008-01-10.txt
2008-01-11	012	Logfile_2008-01-11.txt
2008-01-12	013	Logfile_2008-01-12.txt
2008-01-13	014	Night lost to weather. No log file



**ESO**

European Organization for Astronomical Research in the Southern Hemisphere  
 Organisation Européenne pour des Recherches Astronomiques dans l'Hémisphère Austral  
 Europäische Organisation für astronomische Forschung in der südlichen Hemisphäre

In addition, please find below a night-by-night breakdown by target:

<b>SD Run #1</b>	<b>SD Run #2</b>
<b>24 Nov 2007</b> Twilight Flat – K – not useful STD star – S677D (K) GI – MAD DF (K) BO4 – Sigma Ori Field 1 (K) VI2 – NGC 2264 (K)	<b>07 Jan 2008</b> twilight Flats -K STD Star – P533D (K) EV – R136 (K) DA – Davies Field (K)
<b>25 Nov 2007</b> Twilight Flat – K STD star – S677D (K) MA – NGC 288 (K) TO1 – NGC 1928 (K) BO3 – NGC 2362 (K)	<b>08 Jan 2008</b> EV – R136 (H and K) BO1c – Trappetium Center (K and H) CA – NGC 3201 (J)
<b>26 Nov 2007</b> Twilight Flat – J STD star – S677D (J) PI – 47 Tuc (J) – no data MA – NGC 288 (J) GI – MAD DF (K) DA – Davies Field (K)	<b>09 Jan 2008</b> twilight Flats – H STD Star – P533D (H) BO1c – Trappetium Center (H) TO1 – NGC 1928 (H) DA – Davies Field (K) SM – COSMOS (K)
<b>27 Nov 2007</b> Twilight flat – K STD star – S677D (K) GI – MAD DF (K) EV – R136 (K)	<b>10 Jan 2008</b> Twilight Flat – J STD Star – P533D (J and K) BO12 – Trappetium Field 2 (K and H) CA – NGC 3201 (K) DA – Davies Field (K)
<b>28 Nov 2007</b> Twilight flats – K – not useful Derotator tests STD Star – S677D (K) GI – MAD DF (K) BO11 – Trappetium Field 1 (K) VI1 – NGC 2244 (K)	<b>11 Jan 2008</b> STD Star – P533D (H) BO11 _ Trappetium Field 1 (H) DA- Davies Field (K) SA – Trumpler 14a (K and H)
<b>29 Nov 2007</b> STD Star – S677D (K) GI – MAD DF (K) BO2 – Lambda Ori (K)	<b>12 Jan 2008</b> Twilight Flat – J STD Star P533D (J) TO1 – NGC 1928 (J) OR – MWGC (J and K) SM – COSMOS (K)
<b>30 Nov 2007</b> Twilight Flat – H STD star – S677D (H and K) GI – MAD DF (K) BO2 – Lambda Ori (H) BO4 – Sigma Ori (H) BO3 – NGC 2362	<b>13 Jan 2008</b> Telescopes did not open due to bad weather conditions. No observations



# ESO

European Organization for Astronomical Research in the Southern Hemisphere  
Organisation Européenne pour des Recherches Astronomiques dans l'Hémisphère Austral  
Europäische Organisation für astronomische Forschung in der südlichen Hemisphäre

## Additional Notes on the data

- 1) **Light leak:** as it was explained in the phase 2 document of the MAD SD, the IR Camera, CAMCAO, suffers from a form of light leak. The amount of light and the pattern seen on the frames depend on the position of the camera, the DIT and the observing conditions (the brightness of the sky, the time of observations, etc). It is not possible to perfectly correct for that, but the effects can be minimized by taking sky frames sequences, close in time to the science observations, with the same set of camera positions used for the science (remember that CAMCAO moves on a x,y stage to cover the full 2' circular field).
- 2) **Rotation:** the MAD derotator suffers from some lag problems. As a consequence, frames on the same object, especially when observed close to zenith, can be rotated with respect to each other and one has to be careful when co-adding the images. Since most of the MAD applications involve dense stellar field, we have found out that, although time consuming, the rotation, shift-and-add technique delivers excellent results.
- 3) **Keywords:** MAD is a non-standard VLT instrument, and as such its headers are different, and much shorter than those of other VLT instruments. In particular note the following:
  - a. There is no filter keyword, since the filter wheel is moved by hand. One has to rely on the ORIGFILE keyword to check the filter. Note that for Dark frames this information is not needed. Dark frames were taken with a special blocking filter, named Blank #8.
  - b. DIT and NDIT keywords are present and have the usual meaning. The NINT keyword is not available. The consecutive exposure sequence number is also in the ORIGFILE (n0, n1, etc)
  - c. IRCP.ALPHA and IRCP.DELTA give the coordinates of the IR camera position in arcseconds on sky. Those coordinates correspond to the IRCALIST and IRCDLIST observers specified for their observations. Note that each different camera position is also indicated in the ORIGFILE as the label pX (p0,p1,etc).

## Contacts

For any clarification on MAD SD data please contact:

Paola Amico: [pamico@eso.org](mailto:pamico@eso.org)

Jorge Melnick: [jmelnick@eso.org](mailto:jmelnick@eso.org)