OATo Technical Report nr. 142

CorMagICS 1.0 – CorMag Instrument Control Software

A control and data acquisition software for the CorMag Spectropolarimeter

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Rel. 1.0 Rev. 0 Date: 2010-10-01

Document Management

Date	Issue	Revision	Released by	Comments
2010-09-27	1.0	0	G. Capobianco	OATo Technical Report nr. 142

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Software Release chronology

CorMagics 1.0 released on date 2010-06-29

Software requirements

CorMagICS require a desktop or laptop PC with the follows requirements:

RAM: min 256 MB (1GB or more suggested) OS: Windows 2000/XP/Vista/7 Software: NI LabVIEWTM 9.02 USB port

List of Acronyms

CCD: Charge Coupled Device C&DAQ: Control and Data Acquisition CorMag: Coronal Magnetograph CorMagICS: CorMag Instrument Control Software LC: Liquid Crystal LCTF: Liquid Crystal Tunable Filter LCTP: Liquid Crystal Tunable Filter ACVR: Liquid Crystals Variable Retarder OS: Operative System PC: Personal Computer RAM: Random Access Memory ROI: Region Of Interest USB: Universal Serial Bus

Abstract

The purpose of this technical report is to describe the software developed for the C&DAQ of the CorMag instrument. The current release is the 1.0. The software has been developed in NI LabVIEWTM 9.0. This is compatible with the Windows XP/Vista/7 operative systems for desktop and laptop computers. This release was used during the total solar eclipse of 2010 and for the instrumental tests and for pre and post eclipse calibrations.

Software objectives

The main objective of this software is the control of the devices that composes the CorMag instrument and the data acquisition. Two operative mode are provided: the manual control and a sequential mode C&DAQ that allow the user to run a script that sequentially configure the instrument and acquire the frame.

CorMag Electronically Controlled Devices

The CorMag is composed by the two device controlled by PC:

- The LCTP and
- The CCD Camera

These devices are not described here.

Software installation

No software installation (except NI LabVIEW 9.0) is required. You just need to copy and paste the folder containing CorMagICS1.0.vi and all its subdir in your PC or laptop.

GUI description

The screenshot of the main page of the CorMagICS software is shown in Figure 1. On the right side there are the buttons for Manual Mode, Sequential Mode and Exit. Below there is the log of the operations. In the middle there is the frame acquired and on the left side there are the current parameters for the LCTP and for the CCD camera.

CorMagICS 1.0 - CorMag Instrument Control Software rel. 1.0



Figure 1 – Screenshot of the CorMagICS 1.0 Main page

Check and Initialize devices

Running the software, automatically check if the two devices are connected (Figure 2) and initialize the connected device to these values:

CCD Camera:

- Exposure type: Light frame;
- Exposure Time: 1000 ms;
- X Binning: 1;
- Y Binning: 1;
- X Width: 1024;
- X Offset: 0;
- Y Width: 1024;
- Y Offset: 0;
- TDI Rate: 0 µs;
- Frame Transfer: 3.3 MPPs;
- CCD Temperature: -30 C.

- Background Flush Sensor: Active.

LCTF:

- Wavelength: 5303.0 Å;
- LCTP Rotation: 0 deg.

The blue led indicator show when default values are applied to the devices (Figure 3).



Figure 2 – Check connected devices and initialization



Figure 3 – Initialization of the devices to the default values

The actual settings of the devices are shown in the monitors as shown in Figure 4.



Figure 4 – Monitor of the settings

CCD Monitor:

- The **Connection** led is on if the device is correctly found;
- The **Device** string show the name of the device as write in the firmware;
- The **ExpType** show the current exposition type. This can be "normal" if the frame is a light frame or "dark" if the frame is a dark frame;
- **ExpTime[ms]** is the current exposure time in milliseconds;
- FrameTran[MPPS] show the frame transfer speed in Mega Pixels Per Seconds;
- **X Bin** is the horizontal binning;
- **Y Bin** show the vertical binning;
- **TDIRate[usec]** show the TDI rate in microseconds;
- **XWidth** is the width of the frame;
- **XOffset** is the starting read pixel;
- **YWidth** is the height of the frame;

- **YOffset** is the starting read pixel;
- Four LEDs show the status of the device. The first one (blue) is "on" when the device is in the "default" status; the second one (green) is "on" when background flush sensor is activate (by default); The third one (green) is "on" when the device is in use; the fourth (red) is "on" when an error occurs.
- On the right side of the frame there are 4 indicators. The first one show the time in ms before the closure of the shutter; the second one the number of rows transferred; the third one the power of the cooler (in percentage) and the fourth, the current temperature in Celsius.

LCTF Monitor:

- The **Connection** led is on if the device is correctly found;
- The **Device Number** show the number of the USB device;
- The **Wavelength**[A] show the current wavelength where the filter is centered;
- The **Rotation [deg]** indicator display the rotation of the LCTP in degrees;
- **Temperature [C]** show the current temperature of the device.
- Four LEDs show the status of the device. The first one (blue) is "on" when the device is in the "default" status; the second one (green) is "on" when the software read the temperature; The third one (green) is "on" when the device is in use; the fourth (red) is "on" when an error occurs.

After the initialization the software is ready for data acquisition and wait that the user select the operative mode.

Manual Mode

The manual mode allows the manual control of the connected devices. The user-defined parameters are:

LCTF:

- Wavelength in Angstrom;
- LCTP Rotation in deg;

CCD Camera:

- Exposure Time in milliseconds (ExpTime[ms]);
- Frame Transfer in Mega Pixels per Second (FTransf[MPPS]);
- Horizontal Binning (XBinning);
- Vertical Binning (YBinning);

- TDI Rate in µs (TDI Rate[us]);
- X Width;
- Y Width;
- X Offset;
- Y Offset;
- Exposure Type (Exp Type). The two mode are Normal or Dark.
- Background Flush Sensor.

Others:

- Opal Type (Opal);
- Orientation of the pre-polarizer (Prepol).

In order to change the parameters, after the selection of new value(s), the "Change" button for LCTF or CCD Camera must be pressed. The commands for data acquisition are under the frame. Pressing the relative button is possible to start the acquisition (**Acquire**), abort the acquisition (**Abort Exposure**) and manually open/close the shutter (**Open/Close Shutter**). Video mode is currently disabled (**Video Mode**).

The picture in Figure 5 shows the screenshot of this mode. A click on "Manual" button closes this mode and goes back to the main page.



Figure 5 – Screenshot of the manual mode operations

Sequential Mode

This modality allows the selection of a script used by the software to sequentially apply the relative parameters to the instrument and to acquire the data. By pressing the "**Sequential**" button in the main page, the user can select the script to be run (Figure 6).



Figure 6 – Sequential mode, selection of the script

After the selection of the script (the structure is reported in Appendix A), the software checks if this is compatible with the format required and after that it is ready to start with the sequence. Before starting the sequence, the software asks for an input from the user..

During the sequence, the user can abort the script by clicking the "**Abort**" button (Figure 7), otherwise, when the sequence is complete, the software goes automatically back to the main page. The user can check the current values on the monitors of the CCD and of the LCTF. The maximum and the minimum counts of the last frame are also displayed.



Figure 7 – Script in execution

Data Output

All the acquired frames are automatically saved in fits file standard. More details are reported in Appendix B.

APPENDIX A – The script files

The script files need to have an extension .seq. This files are simply ASCII files.

An example is the follow:

```
LCTF_Wavelength=[5303.2;5303.3;5303.4;5303.5;5303.8;5303.6;5302.9;5301.7;5302.4;5302.5;5302.6]
LCTF_Rotation=[0;0;10;10;20;20;30;30;40;40;50]
```

CCD_ExpType=[N;N] //Normal,Dark CCD_ExpTime=[20000;10000] //ms CCD_FrameTransf=[H;H] //High, Low CCD_XBin=[1;1] CCD_YBin=[1;1] CCD_TDIRate=[0;0] //microsec CCD_XWidth=[1024;1024] CCD_XOffset=[0;0] CCD_YWidth=[1024;1024] CCD_YOffset=[0;0] CCD_BackgroundFlush=[T;T] //True or False

Opal=None;
Prepol=0;

For each Wavelength (LCTF_Wavelength) in Angstrom, the user need to set a relative value of rotation in degrees (LCTF_Rotation). In the previous example, the first have is for the values of wavelength and rotation of 5303.2 Å and 0 deg, the 3rd for 5303.4 Å and 10 deg and so on. For each couple of LCTF parameters is possible to acquire one or more frame(s) defined by the values:

CCD_ExpType, CCD_ExpTime, CCD_FrameTransf, CCD_XBin, CCD_YBin, CCD_TDIRate, CCD_XWidth, CCD_XOffset, CCD_YWidth, CCD_YOffset, CCD_BackgroundFlush.

Also for the parameters of the CCD camera, the user have to set the same number of values for each parameter, cause for each exposure is applied the relative value of all the parameters (the first series of frames will be acquired in the previous example, with this values:

CCD_ExpType=N CCD_ExpTime=20000 CCD_FrameTransf=H CCD_XBin=1 CCD_YBin=1 CCD_TDIRate=0 CCD_XWidth=1024 CCD_XOffset=0 CCD_YWidth=1024 CCD_YOffset=0 CCD_BackgroundFlush=T

The values of every parameters have to be inside the square brackets and separated by ";" character.

APPENDIX B – Data output structure

The frames acquired are automatically saved in fits standard format. The filename is:

CorMagImage_YYYY.MM.DD.hh.mm.ss.fits,

Where: YYYY = year; MM = month; DD = day hh = hour (0-23); mm = minutes (0-59); ss = seconds(0-59).

i.e. CorMagImage_2010.07.11.18.57.20.fits

The frames are 1024x1024 pixels with depth of 16 bit. The header of the fits files have the follow keywords:

SIMPLE =	T/Conform to FITS Standard	(Mandatory for fits standard)
BITPIX =	16/Number of bits per pixel	(Mandatory for fits standard)
NAXIS =	2/Number of axes in the image	(Mandatory for fits standard)
NAXIS1 =	1024/Length of the first axis (columns)	(Mandatory for fits standard)
NAXIS2 =	1024/Length of the second axis (rows)	(Mandatory for fits standard)
EXTEND =	Т/	
FILENAME='CorMa	gImage_2010.07.'/Name of the fits file	
INSTRUM =	CorMag/Instrument name	
TELESC = 'Focal	:800;Aperture:60/Telescope parameters in mm	
DETECTOR=ProLin	e PL1001 FWRev:2/Detector description	
HPIXSIZE=	24/Horiz Pixel Size in micron	
VPIXSIZE=	24/Vert Pixel Size in micron	
CCDTEMP =	-37/Temperature of the ccd in C	
OBSEQ =	31/Sequential number of data acquisition	
EXPTIME =	8000,00/Exposure time in milliseconds	
LCTFWAVE=	5303,00/LCTF Wavelength [A]	
LCTFTEMP=	24,38/LCTF Temperature in °C	
LCTFROT =	120,00/LCTF Rotation in deg	
DATETIME= '2010	/07/11 18:50:24'/Date/Time of file generation (UT)	
XBINNING=	1/Binning along X axis	
YBINNING=	1/Binning along Y axis	
PREPOL =	'None'/Position of prepolarizer	
OPAL =	'None'/Opal type	
END		

The files are automatically saved in the folder [CorMagICS HOME]/Data.

In the same folder is also saved the log file.

APPENDIX C – Software printout

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CorMagICS vers. 1.0







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LCTFReadTemperature.vi

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InitDAQCamera.vi

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Display Message to User

Display Message to User Displays a standard dialog box that contains an alert or a message for users.

This Express VI is configured as follows:

Message:



Read_and_Format_Seq_File.vi

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GetCCDTempAndCoolerPower.vi

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