Manual

DA30 Software

DA30 Software Manual v3.0

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Document History

Version	Date	Edited by	Description
1.0	2014-01-30	MLq	First version.
1.1	2014-02-28	MLq	Corrections and additional details SES 1.3.2 is renamed to SES 1.4.0.
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1 INTRODUCTION

The DA30 software is an add-on to the SES program version 1.4.0 and later that includes a revised camera data flow. The DA30 software controls the deflectors in the DA30 lens and creates 3-dimensional transformed detector data sets from angular resolved measurements using the CCD camera as well as the spin detectors.

This guide describes the main structure of the DA30 software, how to get started, and how to run the DA30 software in SES 1.4.0.

2 OVERVIEW

2.1 System Requirements

The SES program with the DA30 software can be run in 64 bits and 32 bits Windows 7 operating systems. The computer has to be dedicated for DA30 operation. The standard PC for the R4000 spectrometer is not powerful enough. A multi-core processor, fast writing capacity using a solid state disc as well as a powerful graphics board for real time monitoring the data set are all necessary for successful DA30 operation.

2.2 SES Sub-folders

The dedicated sub-folders for DA30 files as well as the revised camera data flow are stated in Table 1. All sub-folders reside in the main SES directory. A detailed description of the files are found in the chapters below.

Table 1: DA30 and the new data flow sub-folders.

Sub-folder	Files
/dll/DA30	Dll libraries for DA30 functionality
/dll/DA30/lua	Lua package of dll libraries and executable files
/dll/detector/detector_graph	Dll libraries for the revised camera data flow
/dll/Qt	Qt package of dll libraries
/dll/Qt/plugins/designer	Additional dll libraries for DA30 Qt graphics
/ses_scripts	General Lua scripts for Lua access in SES
/ses_scripts/DA30	Lua scripts for DA30 control

2.3 Camera Data Flow

Figure 1 shows a block diagram of the software components in the SES 1.3.1 traditional camera data flow together with the revised SES 1.4.0 data flow for DA30 to highlight the features of the new data flow. The Basler drivers in the revised data flow are part of the default configuration of SES DA30 but this data flow can also run CMU drivers if needed. That is useful when jumping between old and new SES installations.
The structure of the revised data flow is very much improved for higher speed and extended image transformation.

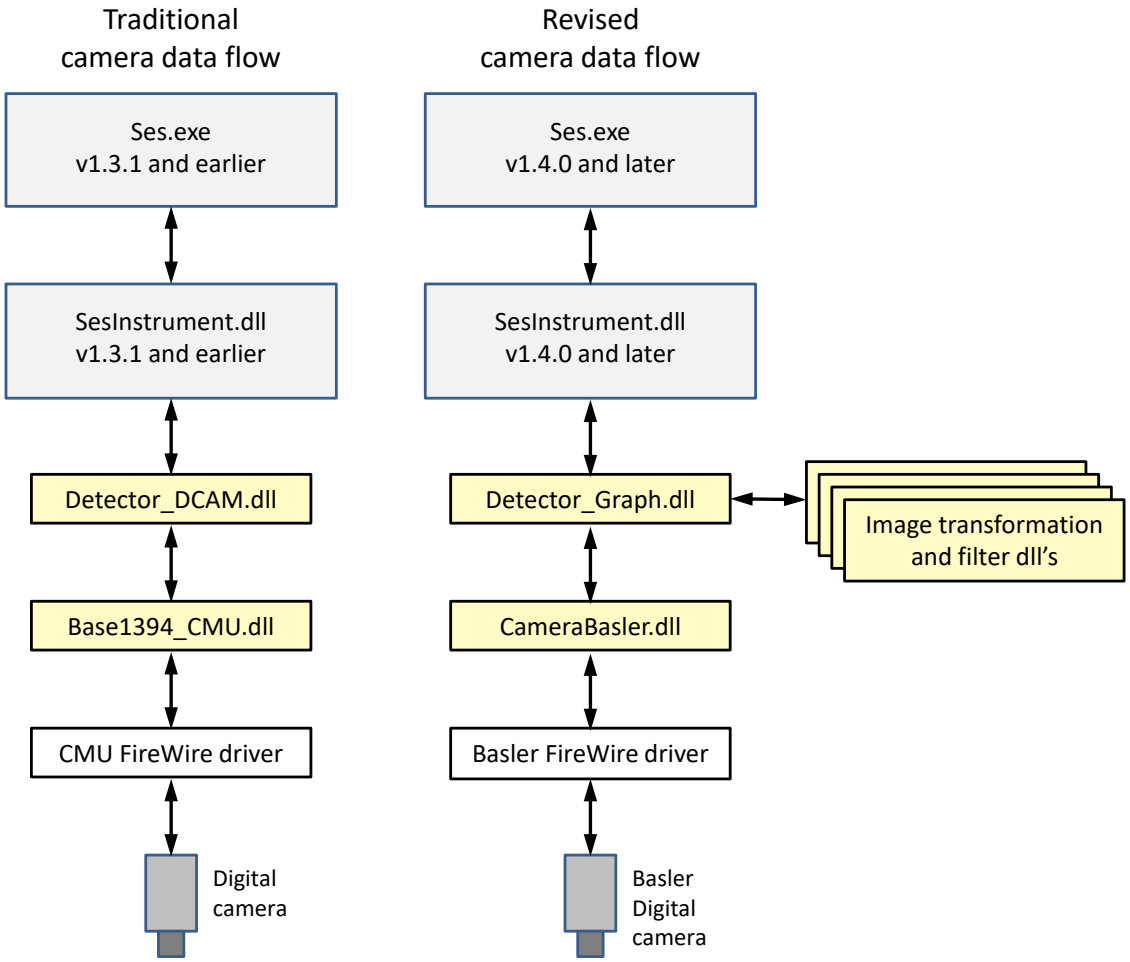

Figure 1. Traditional and revised camera data flows

2.4 DA30 Software

Figure 2 shows a brief overview of the DA30 software. The grey boxes belong to the traditional SES program and the red boxes represent the add-on software that is needed for DA30. The green box is a symbol for the Lua "universe", *i. e.* the memory space where Lua applications share data.

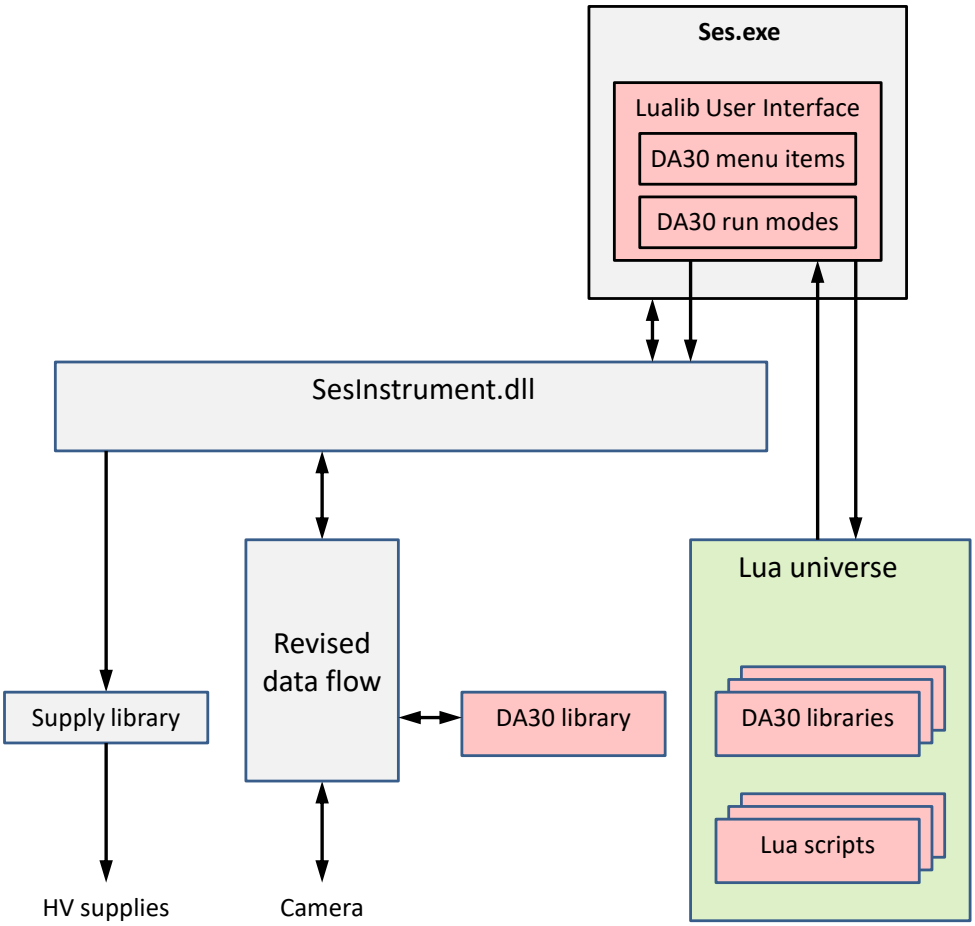

Figure 2. DA30 software overview

3 GETTING STARTED

3.1 Installation

The following software packages have to be in place on the PC for DA30 operation.

- Serial USB driver
- Firewire or Ethernet camera driver depending on camera type
- NIDAQ drivers (in the spin application cases)
- Lua
- Qt
- SES program 1.4.0 or later with DA30 add-on software

Note: 32-bit and 64-bit software components of SES should not be mixed!
The 32-bit version of SES (and all its dlls) can be installed on both Windows 7 32-bit and Windows 7 64-bit but the 64-bit version of SES (and all its dlls) can only be installed on Windows 7 64-bit.

The serial USB, camera communication and NIDAQ drivers are installed on all spectrometer computers in the Scienta factory as part of the standard SES installation. The latest versions can be downloaded from the Scienta Omicron FTP server. The Lua script language and Qt graphical package files are all included in the DA30 distribution package, so they do not need to be installed separately. The rest of the SES and DA30 installation is done according to the following steps:

1. Execute the SES DA30 msi installer file (SES version 1.4.0 or higher), follow the instructions, and the installation is done. If you choose to copy the settings from an old SES installation, continue with the following steps after the installation.
2. Start SES DA30 by double clicking on the Ses.exe icon.
3. Make sure that the detector library Detector_Graph.dll is installed in the Instrument Installation dialog (accessed from Install/Instrument under the SES main menu).
4. Make sure that the appropriate supply and signal libraries for your setup are installed in the Instrument Installation dialog.
5. If the DA30 menu is not present in the main menu, add **lualib.dll** in the User Interfaces dialog (accessed from Setup/User Interfaces under the SES main menu).
6. Exit SES and restart it.
7. Check that the DA30 menu appears in the SES main menu.
8. Exit SES.

3.2 Starting

SES 1.4.0 with DA30 software is started by double clicking on the Ses.exe icon in the SES folder (or the SES 1.4.0 shortcut at the desktop). The DA30 features are then accessed from the SES main menu or the Sequence editor.

4 RUNNING MEASUREMENTS

4.1 Introduction

Manual deflection of the DA30 lens and some control functions are found in the DA30 menu under the SES main menu. DA30 functionality is also added in the View menu that gives access to a Lua command prompter and a graphic 3-D viewer displaying the DA30 data set. In the Sequence editor, two special run modes are added for DA30 acquisition scans.

4.2 DA30 Menu

Figure **3** shows the DA30 drop-down menu under the SES main menu. The DA30 menu appears when the Lualib.dll is installed as a user interface.

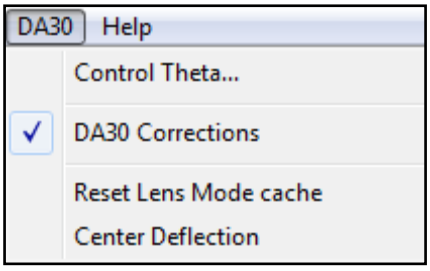

Figure 3. DA30 Menu

4.2.1 DA30 Menu Items

Table 2 describes the functionality of the DA30 menu items.

Table 2. DA30 Menu Items.

Menu Item	Description
Control Theta...	Opens the Control Theta dialog
DA30 Corrections	Toggles the DA30 camera image correction on and off.
Reset Lens Mode Cache	Resets the lens mode parameters in Lua when the lens mode is changed. Implemented mainly for test purposes.
Center Deflection	Puts the deflector voltages to values so that no deflection of the electrons is achieved.

4.3 View Menu

Figure 4 shows the View drop-down menu under the SES main menu.

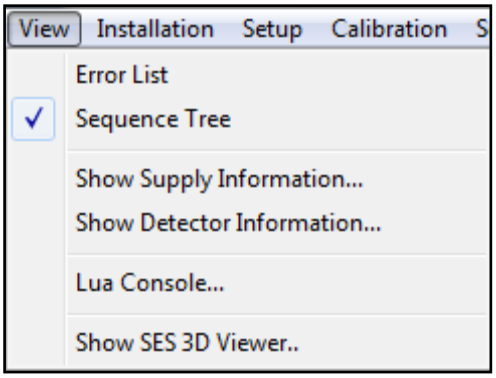

Figure 4. View Menu

4.3.1 View Menu Items

Table 3 describes the functionality of the DA30 menu items in the View menu.

Table 3. View Menu Items for DA30.

Menu Item	Description
Lua Console...	Opens the Lua command prompter window
Show SES 3D Viewer...	Opens the SES 3D Viewer for DA30 data

4.4 Control Theta Dialog

4.4.1 Description

The Control Theta dialog offers static control of the deflection in the DA30 lens for a given angular mode.

4.4.2 Access

From the DA30 menu, select the Control Theta command. (**DA30 ⇨ Control Theta…**)

4.4.3 Deflection

The DA30 lens deflection can be set in the Control Theta dialog (see Figure 5) from the Theta X and Y fields, but also by dragging and dropping the cross sign in the graphical view. The cross indicates the outgoing direction of the electrons from the sample that passes through the centre of the analyzer entrance slit. The circle indicates the angular acceptance for the particular lens mode shown in the LensMode field. The lens mode is taken from the selected lens mode in the Voltage Calibration window.

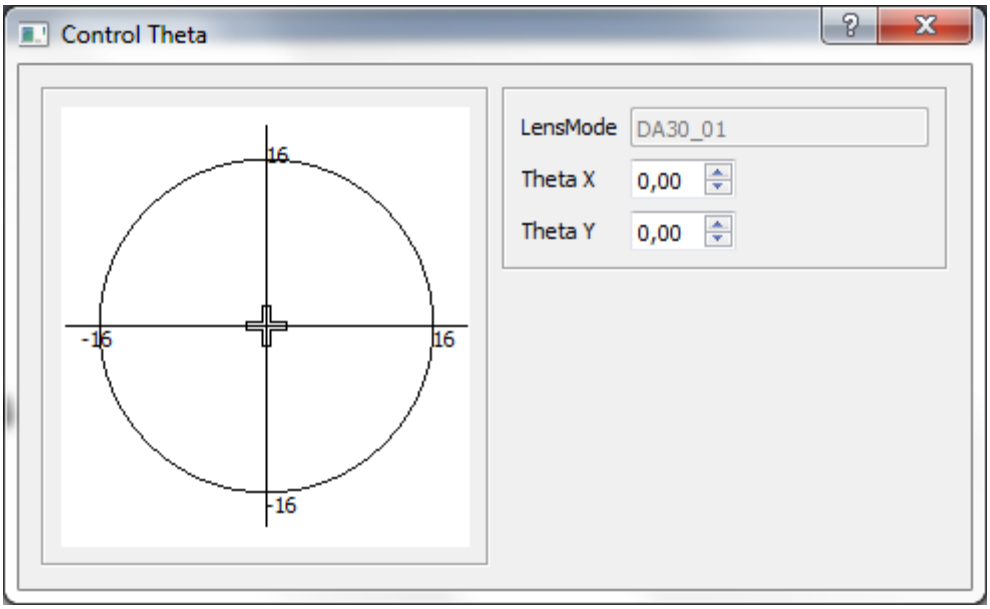

Figure 5. Control Theta dialog

4.5 Lua Console Dialog

4.5.1 Description

The Lua Console dialog allows for direct communication between the user and the Lua universe. The dialog is a basic text command window where Lua commands can be entered. Note however that this feature is primarily meant for experienced Lua users and SES programmers and not for normal SES users.

4.5.2 Access

From the View menu select the Lua Console command. (**View ⇨ Lua Console…**)

4.5.3 Lua Commands

Lua commands can be entered at the prompter in the Lua Console dialog (see Figure 6).

Figure 6. Lua Console dialog

4.6 SES 3D Viewer Dialog

4.6.1 Description

The SES 3D Viewer dialog controls the SES 3D Viewer window that opens automatically in parallel to the dialog. The SES 3D Viewer shows the DA30 data set in different views.

4.6.2 Access

From the View menu select the SES 3D Viewer command. (**View ⇨ SES 3D Viewer…**)

4.6.3 Viewer Control

Figure 7 shows the SES 3D Viewer dialog that controls how the 3D Viewer window (see Figure 8) shows the data set from a given DA30 measurement. From two drop-down menus the type of cuts in the data set and colour scheme can be selected.
The range of intensities shown by the viewer is selected by the Low and High drag bars.
For each view of a cut, the range of the cut dimension is set by two dragbars in the bottom of the dialog. The upper bar represents the low limit and the lower bar represents the high limit. When dragging the upper bar, the lower bar follows. This is convenient when moving a slice with constant width.

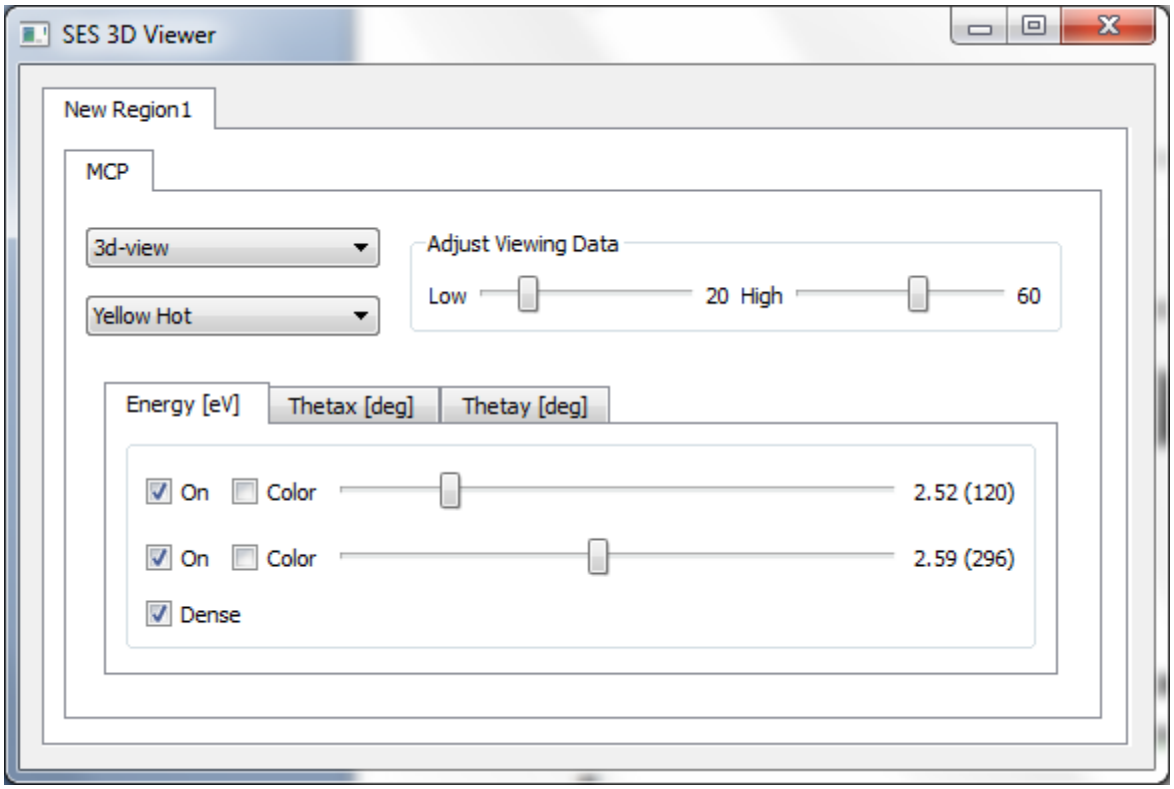

Figure 7. SES 3D Viewer dialog

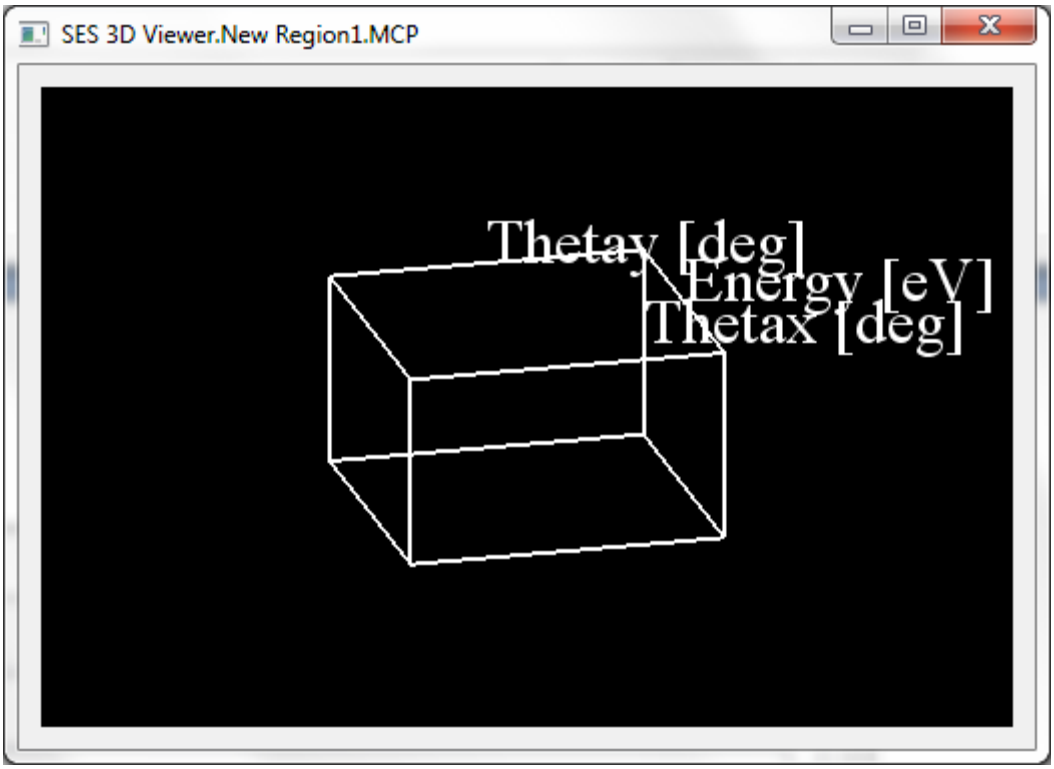

Figure 8. SES 3D Viewer window

5 OUTPUT FILES

5.1 General

The output file from a DA30 measurement is a zipped archive containing three types of files. Each measurement region in the sequence is represented by a binary data file together with a configuration text file that holds the measurement parameters. The size and limits of all data sets are stored separately in one common configuration text file.
The data file can be opened by dedicated macros in the Igor Pro data analysis software that are able to select, sort and display the DA30 data in two and three dimensions.

5.2 Library Setup

DA30 requires that the luafs.dll is installed as the file interface library in the File Options dialog (see Figure 9) that is accessed from the Sequence Editor. The zip-format should be selected in the Saved File Format field.

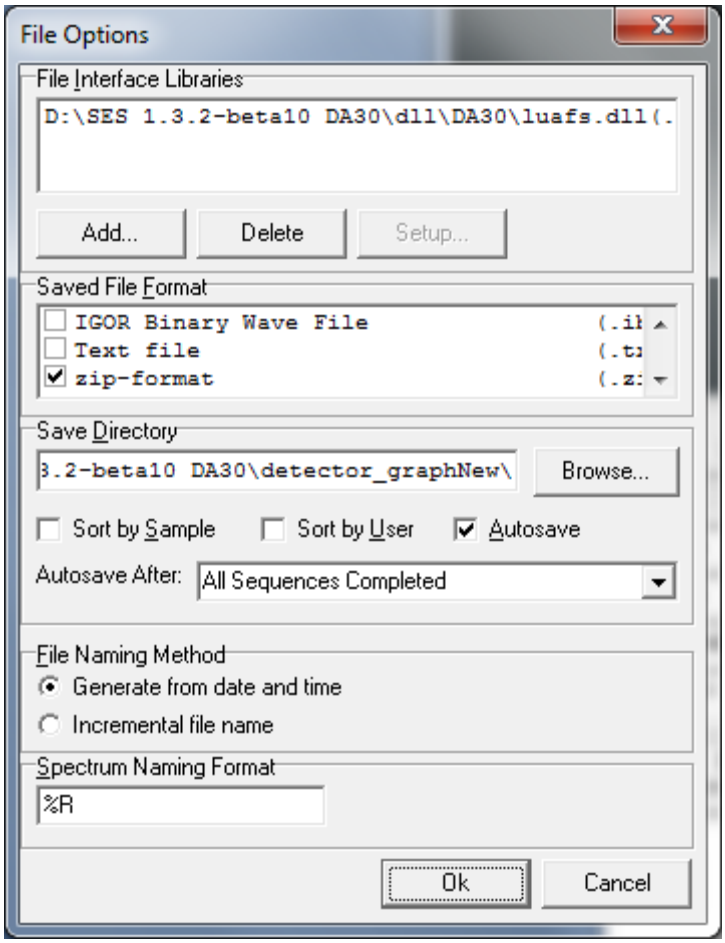

Figure 9. File Options dialog

5.3 Format

5.3.1 Zip Archive

The three file types in a zipped DA30 output archive are described in Table 4.

Table 4. File types in a DA30 output archive.

File	Description
RegionName.ini	Measurement parameters in text format for a specific region in a sequence. RegionName is equal to the region name given in the Sequence Editor.
RegionName_0.bin	DA30 measurement data in binary format for a specific region. RegionName is equal to the region name given in the Sequence Editor. The number 0 is incremented for each iteration of the region.
viewer.ini	Common configuration file in text format for all regions in the sequence, holding the size and limits for the data sets. This file is a copy of the temporary viewer.ini file in the work folder that is used by the DA30 3D Viewer.

5.3.2 Binary Data Format

The data organization of the binary output file is described in Table 5. The data is stored row by row in a stream of two-dimensional Energy-Theta X images. The data items are single precision floating point real values. The letters i, j, and k correspond to the last indexes of the three-dimensional data array.

Table 5. DA30 output file format.

Data(0,0,0)	Data(1,0,0)	Data(2,0,0)	…	Data(i,0,0)
Data(0,1,0)	Data(1,1,0)	Data(2,1,0)	…	Data(i,1,0)
Data(0,2,0)	Data(1,2,0)	Data(2,2,0)	…	Data(i,2,0)
…	…	…	…	…
Data(0,j,0)	Data(1,j,0)	Data(2,j,0)	…	Data(i,j,0)
Data(0,0,1)	Data(1,0,1)	Data(2,0,1)	…	Data(i,0,1)
Data(0,1,1)	Data(1,1,1)	Data(2,1,1)	…	Data(i,1,1)
Data(0,2,1)	Data(1,2,1)	Data(2,2,1)	…	Data(i,2,1)
…	…	…	…	…
Data(0,j,1)	Data(1,j,1)	Data(2,j,1)	…	Data(i,j,1)
Data(0,0,2)	Data(1,0,2)	Data(2,0,2)	…	Data(i,0,2)
Data(0,1,2)	Data(1,1,2)	Data(2,1,2)	…	Data(i,1,2)
Data(0,2,2)	Data(1,2,2)	Data(2,2,2)	…	Data(i,2,2)
…	…	…	…	…
Data(0,j,2)	Data(1,j,2)	Data(2,j,2)	…	Data(i,j,2)
…	…	…	…	…
…	…	…	…	…
…	…	…	…	…
…	…	…	…	…
…	…	…	…	…
Data(0,0,k)	Data(1,0,k)	Data(2,0,k)	…	Data(i,0,k)
Data(0,1,k)	Data(1,1,k)	Data(2,1,k)	…	Data(i,1,k)
Data(0,2,k)	Data(1,2,k)	Data(2,2,k)	…	Data(i,2,k)
…	…	…	…	…
Data(0,j,k)	Data(1,j,k)	Data(2,j,k)	…	Data(i,j,k)

5.4 Igor Pro

5.4.1 Macros

The DA30 macros should be placed in a subfolder named chunkLoader under the Users Procedures folder in the main Igor Pro folder. Shortcuts to all macros should be placed in the Igor Procedures folder in the main Igor Pro folder. The macros are described in Table 6.

Table 6. Igor Pro macros for DA30.

Macro	Description
buildMask.ipf	Macro for test of DA30 functionality. Generates a test pattern.
chunkLoader.ipf	Creates the DA30 Loader menu item and the Chunk Loader Control Panel that are accessed from the Igor Pro main menu
DA_indexBoundaryCheck.ipf	Support functions to the chunkLoader macro.
extractPlane.ipf	Reduces 3D information to 2D.
load3Doverview.ipf	Reads data from the binary DA30 data file
loadDimAndScales.ipf	Reads parameters from the viewer.ini configuration file

5.4.2 Chunk Loader Control Panel

5.4.2.1 Description

The Chunk Loader Control panel gives the user opportunity to define how to select, sort and present the content of the binary data file.

5.4.2.2 Access

From the DA30 loader menu under the Igor Pro main menu, select the chunkLoaderControl command. (**DA30 loader ⇨ chunkLoaderControl…**)

5.4.2.3 Chunk Loader Control

The limits in three dimensions for the data "chunk" of interest can be entered in the Chunk Loader Control Panel. The Chunk Loader Control Panel is shown in Figure 10.

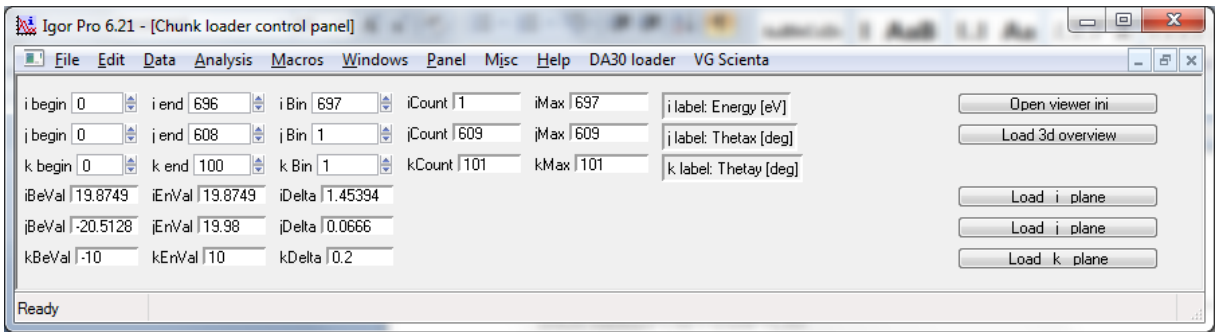

Figure 10. Chunk Loader Control Panel in Igor Pro

- The i, j, and k notation corresponds to the three dimensions of the data set.
- The Begin and End entry fields define the lower and upper index limits of the data chunk.
- The BeginVal and EndVal info fields show the real values of the Begin and End data.
- The Bin entry fields define how many original data channels that should be "binned", *i. e.* accumulated into each displayed channel.
- The Delta info fields show the real channel widths of the binned data.
- The Count info fields show the numbers of binned channels within the corresponding limits.
- The Max info fields show the number of original data channels within the corresponding limits (Max becomes the same as Count when Bin is set to 1).
- The Label info fields show the units of each dimension.
- The Open Viewer ini button reads the configuration parameters from the viewer.ini file into the panel fields.
- The Load 3D Overview button opens the binary data file that is pointed out by the viewer.ini file, extracts and displays a 3D data chunk.
- The Load i, j, and k Plane buttons open the binary data file that is pointed out by the viewer.ini file, extracts and displays a 2D data chunk.

6 APPLICATION NOTES

The following facts are essential to know for successful use of the DA30 spectrometer.

- The DA30 image transformation algorithms are made for straight analyzer entrance slits. Curved slits cannot be used.
- Narrow slits should be used to ascertain high momentum resolution

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