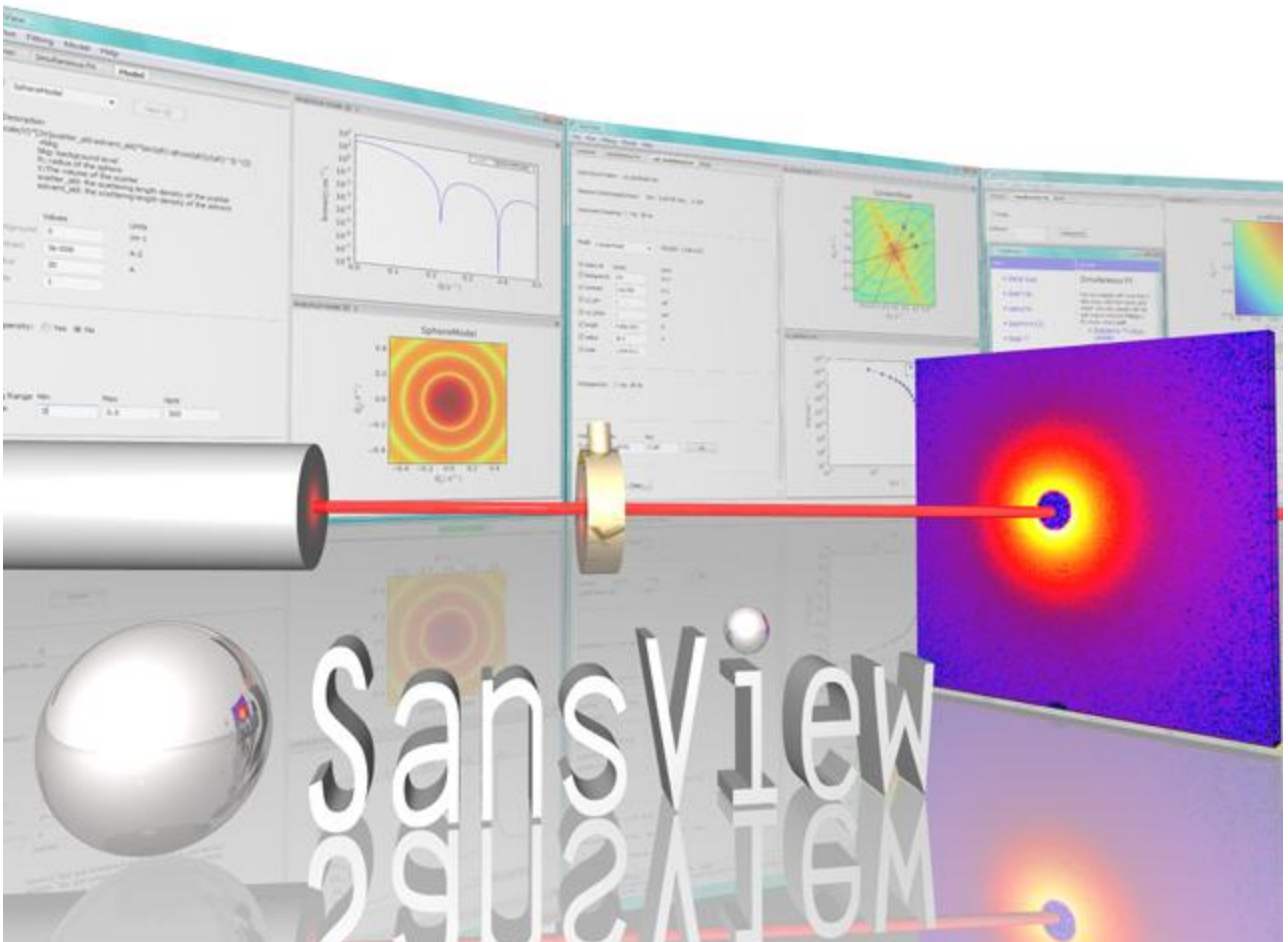




SansView 2.0



DANSE/SANS Group  
University of Tennessee



This software was developed by the University of Tennessee as part of the Distributed Data Analysis of Neutron Scattering Experiments (DANSE) project funded by the US National Foundation.

SansView 2.0

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\*If you use this program to do productive scientific research that leads to publication, we ask that you acknowledge use of the program by citing the following paper in your publication:

**"This work benefited from DANSE software developed under NSF award DMR-0520547."**

*G. Alina, P. Butler, J. Cho, M. Doucet, and P. Kienzle,  
"SANS analysis software", to be published.*



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## Introduction

An application for SANS oriented system modeling and data analysis.  
Oct , 2011: version 2.0 is released .

### Roadmap:

SansView is a new application provided to the community to generate feedback. It is part of a broader effort to provide analysis tools to the SANS community. In providing this application, we hope to learn about the analysis needs of the users. We are interested in suggestions in two areas:

- Functionality: what functionality would you like to see in an analysis application for SANS
- Ease-of-use: how would you improve the user interface

### Main Features:

- Simultaneous fit of a number of different sets of SANS data with/without the constraints.
- Loading and displaying 1D and 2D data in various formats.
- Batch fitting.
- Support P(r) inversion (via. indirect Fourier transform).
- Supporting polydispersity and /or orientational distribution for virtually all built-in model functions.
- Supporting pinhole or slit smearing for 1d and pinhole smearing for 2d.
- Supporting various 2D averaging methods : Circular, Sectorslicer, Annulus, Boxsum, BoxQx and BoxQy.
- Supporting a number of standard models and model-independent functions including form factor and structure factor functions and their multiplications as well as reflectivity models.
- Supporting the invariant calculation.
- User sets Qrange (Qmin and Qmax) for both 1D and 2D data for fitting and modeling.
- User sets a mask for 2d so that fitting takes account only unmasked data into the calculation.
- The user can set a custom weighting for fitting.
- Include a Python shell.

### Installation and Usage:

Currently the installer is supported only on the Windows : Windows XP (PC), Vista (PC), and Mac (OSX10.4, 10.5) were tested.

### Contact us:

You can visit the SansView web page at: <http://danse.chem.utk.edu/sansview.html>  
Comments? Bugs? Requests? Help? Write to us at [sansdanse@gmail.com](mailto:sansdanse@gmail.com)

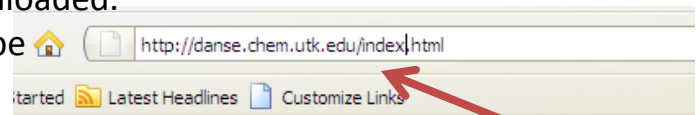


## How to install

1. Go to our DANSE Small Angle Neutron Scattering Project web page, <http://danse.chem.utk.edu/index.html>.

Click on the “SansView 2.0” get to our release page where the SANSVIEW installer can be downloaded.

Also, the SansView tutorial can be found at the same site.

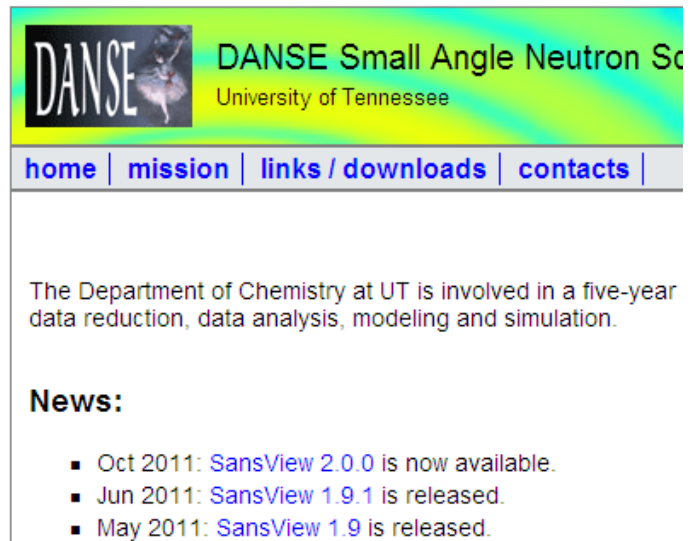


(NOTES for Windows (XP) users.)

- If you are a guest user for the computer, you need write permission to write. Otherwise, the installation will fail.
- We recommend to uninstall the previous version before installing this new version (2.0.0).

### Download:

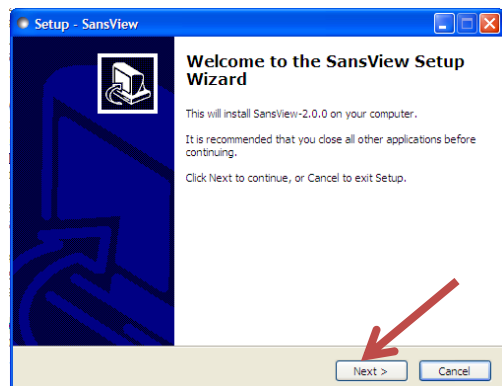
- New version:  
[SansView-2.0.0 \(WIN\)](#) : Windows installer  
[SansView-2.0.0 \(OSX\)](#) : Mac OSX installer
- Tutorial: [SansView tutorial \(pdf format\)](#): all
- Documentation:  
[Description of the model functions \(pdf format\)](#)  
[UTM Diagrams showing external and internal](#)



2. Once “setupSansView-2.0.0.exe is downloaded, open the installer and follow the steps as directed.

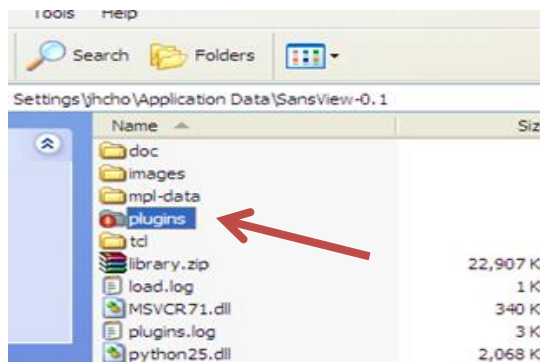
Note: If you are not an administrator for that PC/MAC, select the destination folder where you have permission to write (like your home Desktop). Otherwise, the installation will simply fail.

If you have the previous version installed, we recommend to uninstall it using the uninstaller in its sansview folder before installing the newer version.



## How to install (continued)

- Once the SansView is installed, some samples of 1D and 2D data files can be found inside the “test” folder in the SansView folder (/Content/Resources/test/ for Mac). This allows you to follow this tutorial session without having your own data set.



- The “plugins” folder also includes two example python files (testmodel\_2.py and testmodel.py) so that users can rewrite their own model function. The file modified should be renamed as saving. Modify the arrowed lines for your own functions. Each file can hold one model function and more than one function file can be saved in this way. See Appendix or the example files in the plugins folder of the SansView folder for more details.

```

1 """
2     Test plug-in model
3 """
4 from sans.models.pluginmodel import ModelIDPlugin
5
6 import math
7
8
9 # Your model HAS to be called Model
10 class Model(ModelIDPlugin):
11     """ Class that evaluates a cog(x) """
12     """
13     """
14     ## Name of the model
15     name = "A+Bcos(2X)+Csin(2X)"
16
17     def __init__(self):
18         """ Initialization """
19         ModelIDPlugin.__init__(self, name=self.name)
20
21         ## Parameters definition and defaults
22         self.params = {}
23         self.params['A'] = 0.0
24         self.params['B'] = 1.0
25         self.params['C'] = 0.0
26
27         ## Parameter details [units, min, max]
28         self.details = {}
29         self.details['A'] = ['', -1e16, 1e16]
30         self.details['B'] = ['', -1e16, 1e16]
31         self.details['C'] = ['', -1e16, 1e16]
32
33     def function(self, x = 0.0):
34         """ Evaluate the model
35             @param x: input x
36             @return: function value
37         """
38         return self.params['A']+self.params['B']*math.cos(2.0*x)+self.params['C']*math.sin(2.0*x)
39

```

## I. Loading 1D, 2D data, and SansView project

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I-1. Click on “Load Data” from the File menu (Fig. I-1).

Note: If the data contains a  $q=0$  point, the point will be excluded.

I-2. Locate your data file and click on the “Load Data” button (Fig. I-2)  
(You can choose either 1D or 2D data in this way).

File extension types that can be loaded are:

- i) for 1d data: txt, asc, dat , CANSASxml or w/o extension,
- ii) for 2d data: ASC and DAT in NIST 2D format, and sans files.

The format of txt 1d files should consist of 2 to 4 columns of  $Q$ ,  $I$ , ( $dI$ ,  $dQ$ ) in order, where  $dQ$  is the instrumental resolution in  $Q$  and assumed to be originated by pinhole geometry.

For 2D data, NIST  $q$ -map format is currently standard but most of the header lines can be removed except the last line, and also only first three columns ( $Q_x$ ,  $Q_y$ , and  $I$ ) are required as shown in an example data file, SILIC010\_noheader\_3col.DAT in test folder.

I-3. Fig. I-3 shows an example of 1 D and 2D plots of the loaded data.

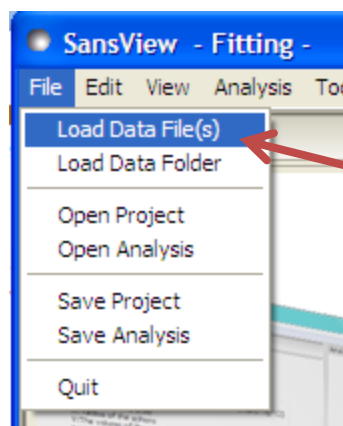


Fig. I-1

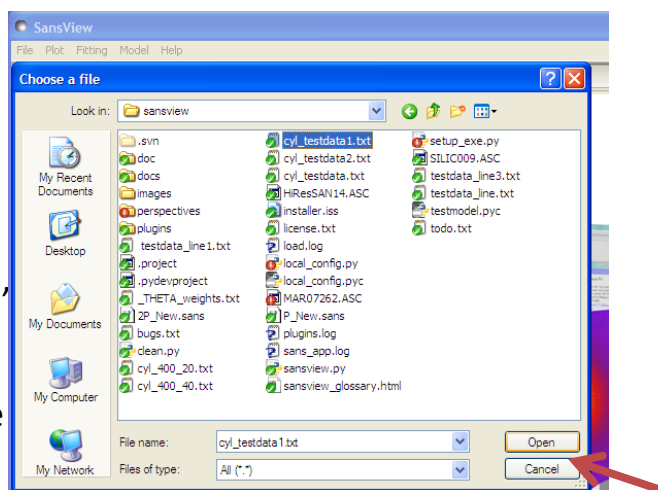


Fig. I-2 Multiple data files can be chosen by pressing Ctrl key and clicking pointer on the files.

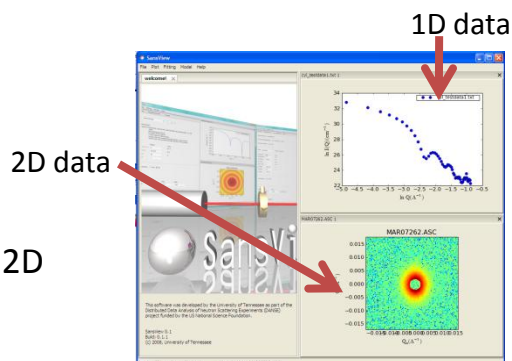


Fig. I-3

## I. Loading 1D and 2D data

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I-4. Example data files: Use a text editor such as WordPad to look at the supporting data formats .

- i) 1-D data: testdata\_line\*.txt, circular\_test\*.txt, cyl\_400\_\*.txt, cyl\_testdata\*.txt, PolySpheres.txt, sphere\_\*.txt, and latex\_smeared.xml
  - ← Even if existed, the headers are ignored except CANSASxml files.
- ii) 2-D data: MAR07262.ASC, SILIC010\_\*.DAT, P\_New.sans, and HiResSANS14.ASC.
  - ← The  $dI$  is assumed to be  $\sqrt{I}$  for the 2d data from \*.DAT files (NIST 2d qmap data).
- iii) Orientational distribution (custom) 'array' data: \_phi\_weights.txt.
- iv) Polydispersity (custom) 'array' data: \_radius\_dist.txt.
- v) Beam profile data for 'Slit Size Calculator': beam profile.DAT.

I-5. SansView has its own file formats to save and open either a whole project (.svs) or a subproject (i.e., one analysis; for example, .fitv for fitting, .inv for invariant, and .prv for pr-inversion computation). Use the open/save project/analysis in the File menu.

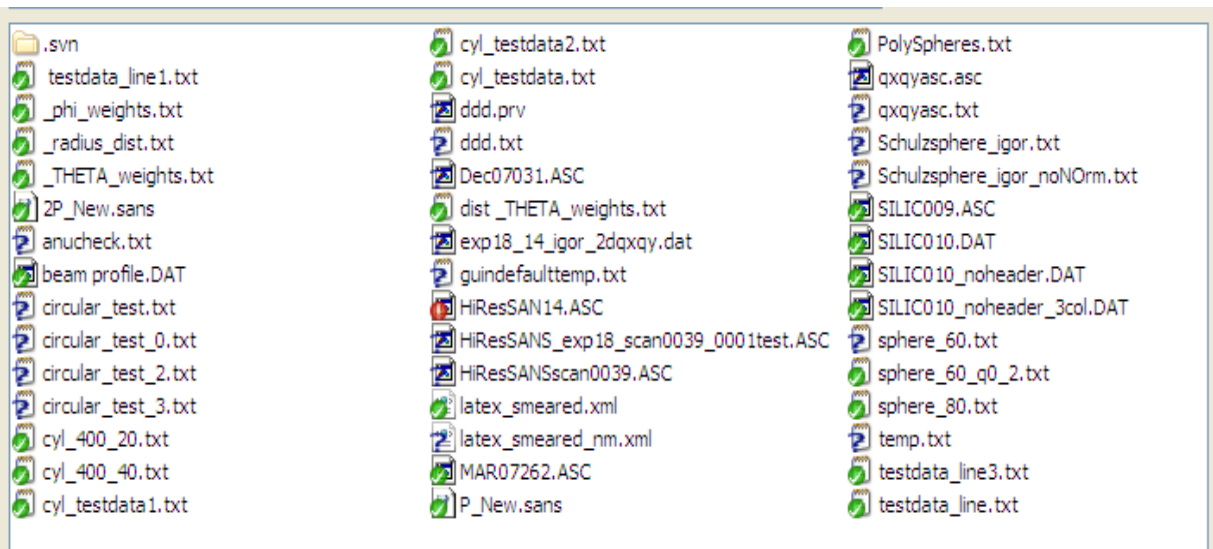


Fig. I-4. Example data files in a test folder

## II. Analysis and tool

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### II-1. Analysis:

Currently, the SansView provides **model fitting**, **invariant computation**, and **P(r) inversion**. Each of the control panels can be switched and accessible via switching the item in the 'Analysis' menu in the menu bar. With the Data Explorer ON, use the 'Send to' button to set a data set to a analysis panel after a data set is loaded. With the Data Explorer OFF, it will automatically set the data into the current Analysis panel.

### II-2. Tool:

- i) **SLD Calculator**: To calculate the neutron (and X-ray) scattering length density (SLD) of a molecule. The method is provided via 'Help' menu.
- ii) **Slit Length Calculator**: This tool is generally for X-ray users to calculate the slit size (FWHM/2) for smearing data using their half beam profile data (*SAXSess: For example, see I-4 v.*). We assume that the slit size given is FWHM/2 in the slit smear calculation.
- iii) **Kiessig Calculator**: a simple tool to convert a q value to a real space value (i.e., thickness or size).
- iv) **SANS Resolution calculator**: to estimate dQ (instrumental resolution at a given q value(s)). See 'Calculator Help' in the menu bar for details.

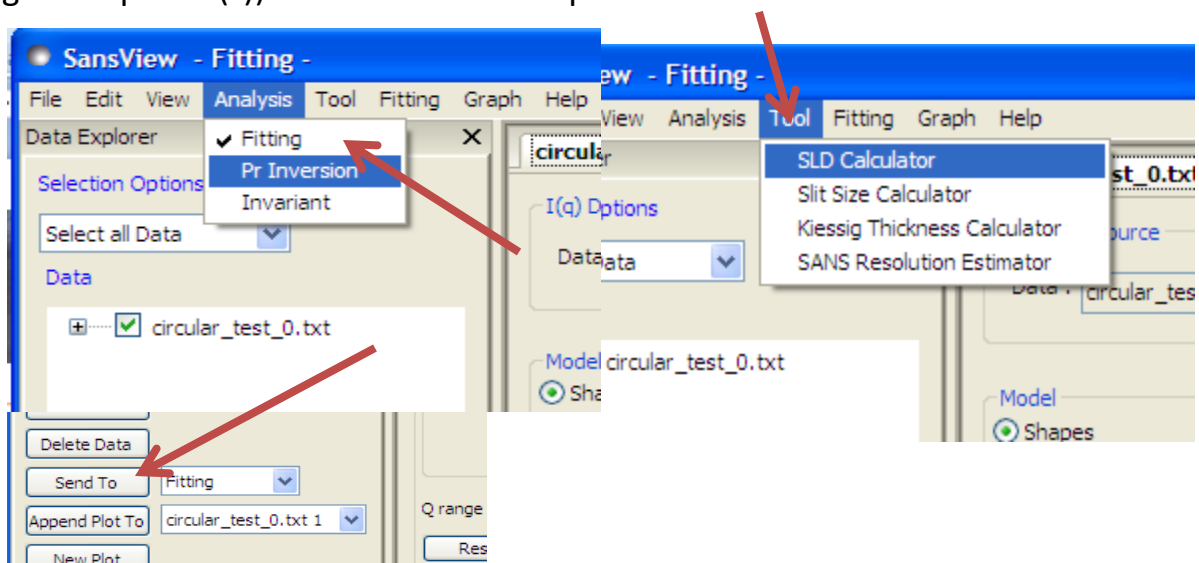


Fig. II-1. Analysis and Tool menu



### III. Data fitting: 1D and 2D data; Single fit

III-1. Method I] If a data is already plotted, highlight the data symbols by locating your mouse pointer to it (Fig. III-1). (For 2D, just right-click on 2D data image plot.) Then, select “Select data for fitting” (Fig. III-2).

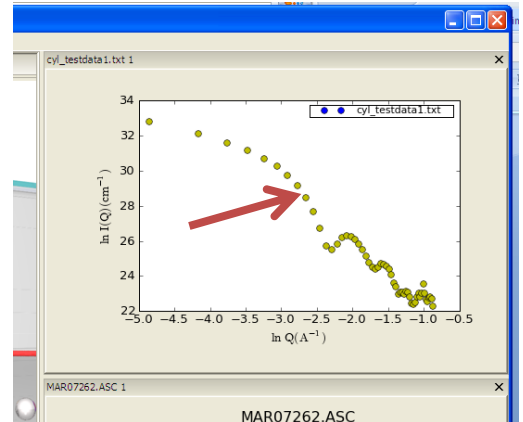


Fig. III-1

III-2. Method II] With Data Explorer ON, select a data set by checking it from the data tree. And press the ‘Send to’ button (Fig. III-3).

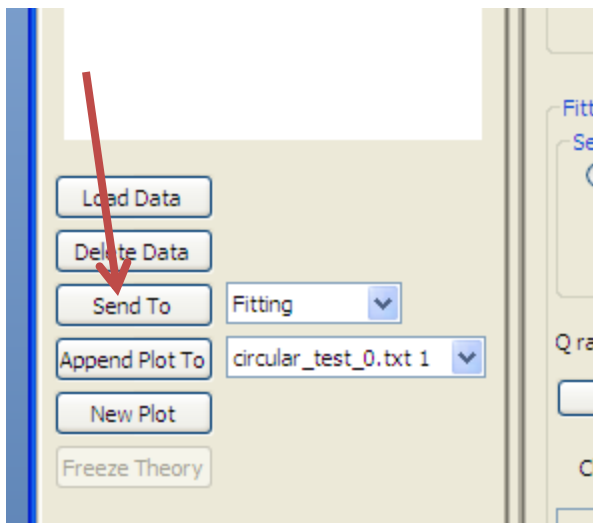


Fig. III-3

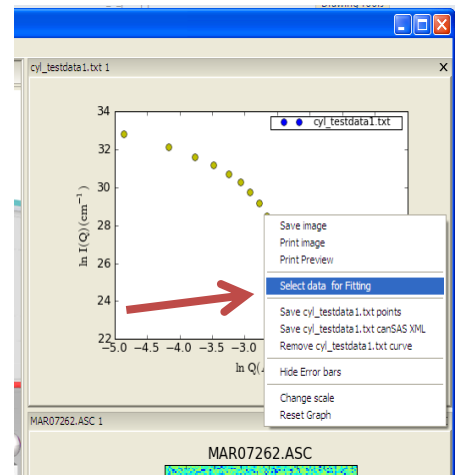


Fig. III-2

III-3. Method III) Turn the Explorer OFF, and load a data from the File menu. It will automatically set the data into a control panel in the current analysis.

### III. Data fitting : 1D and 2D data; Single fit (continued)

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III-4. Select a model type of interest.

Right click on the arrow of the model drop box, and choose the model function to fit(Fig. III-4)

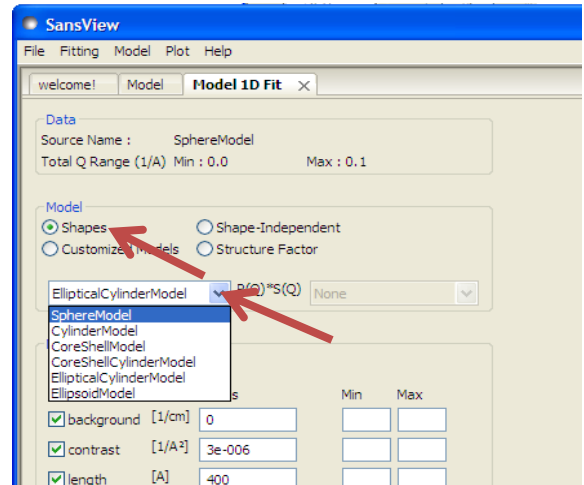


Fig. III-4

III-5. Adjust the parameter values so that you have a model calculated (green) curve as closed to the data as possible (Fig. III-5).

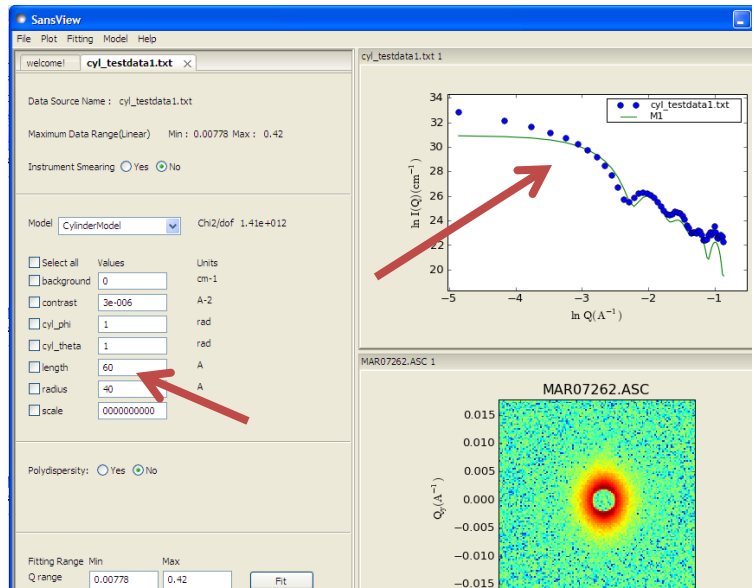


Fig. III- 5

### III. Data fitting : 1D and 2D data; Single fit (continued)

III-6. Select parameters to fit by checking the box. (Fig. III-6).

III-7. Setting custom smearing w/o dQ data is available in the panel. The pinhole or slit smear can be set. Note: If pinhole smear is set, temp. increasing dQ data will be generated by linear interpolation from the min to the max value as Q increases.

: 2D smear is extremely time consuming (NOT recommended to use it for fitting.)

III-8. Adjust Q range of data for fitting (optional) (Fig. III-6).

III-9. Q range can be reset to the default values by clicking the reset button (Fig. III-6).

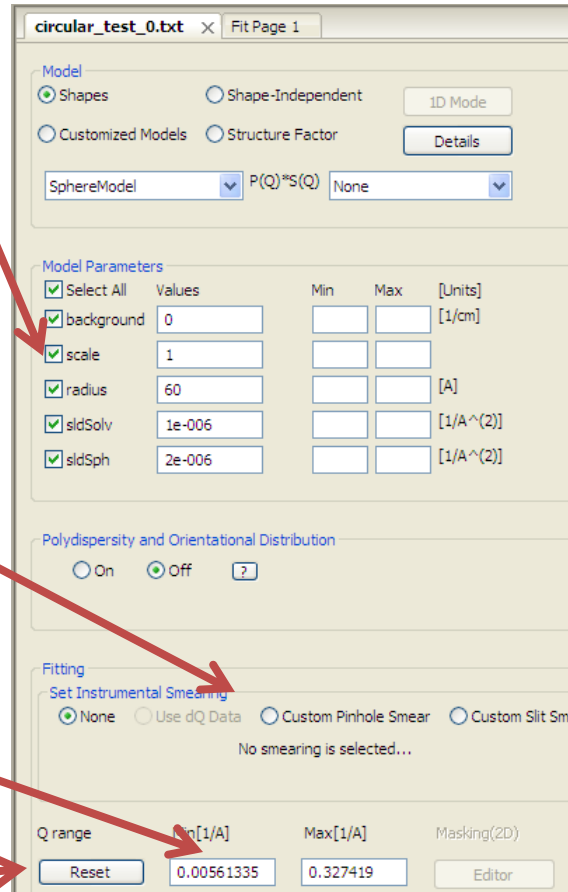


Fig. III-6

III-10. (Optional) You can switch Simple Fit (LeastSq from Scipy ) or Complex Fit (ParkMC) fitting engine by selecting or deselecting “Park” in the Fitting menu (Fig. III-7).

\*Note that the simple fit uses Levenberg–Marquardt algorithm, and the complex fit employs ParkMC to find a global minimum in chi2 space (longer run time).

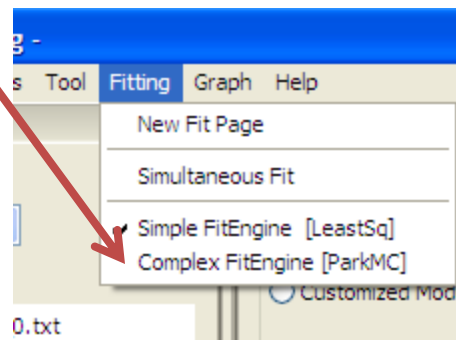


Fig. III-7

III-11. Click on the “Fit” button (Fig. III-6) at the bottom of the control panel.

### III. Data fitting : 1D and 2D data; Single fit (continued)

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III-12. If the fitting is successful, the fitting errors and chi2 will show up in the panel, and there will be nice consistency between the fitted curve and your data. ((Fig. III-8).

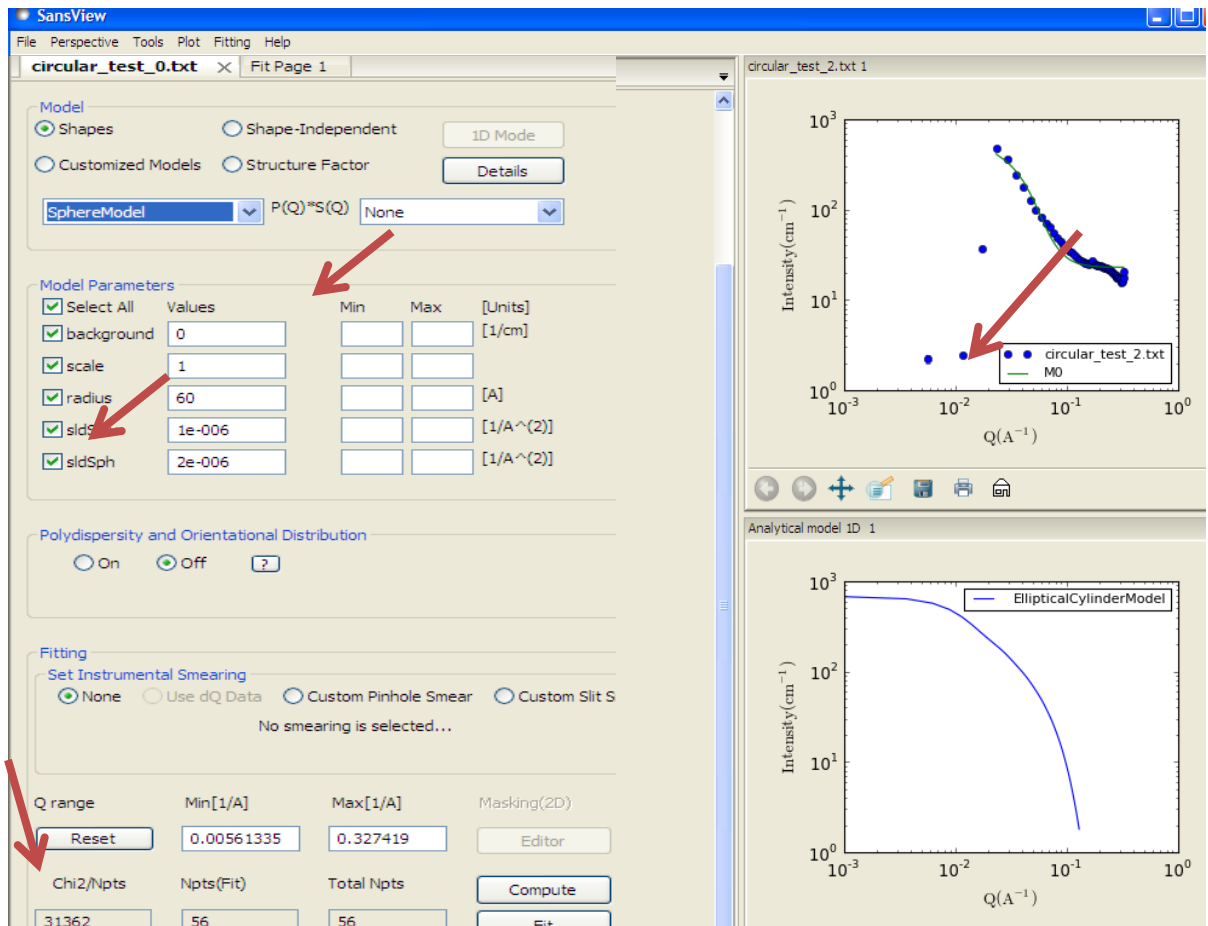


Fig. III-8

III-13. If the fitting is not successful, you can play more with other model functions by choosing another model function (see Step III-4), or polydispersity parameters which will show up by clicking on "polydispersity" "yes" check box . (Fig. III-8): For polydispersity parameters, a good value of Nsigmas is between 2.5 and 5, where Nsigmas tells how much portion of the function from the center is taken account for the polydispersion averaging ( 2 times sigma, 3 times, etc). Npts is the number of points taken for the averaging. The PD = Sig/mean. And Sig is the STD of the distribution function (also see Sect. X-12).

### III. Data fitting : 1D and 2D data; Single fit (continued)

III-14. The fitting panel (and model panel) can be bookmarked by right-clicking on the panel and choosing bookmark in the popup menu ( or from bookmark icon in the toolbar. Once the panel is bookmarked, it can be recalled later by right-clicking on the panel and choosing the model name in the popup menu (Fig. III-9). (Note that once the bookmark is recalled, you may loose the previous panel that you were working on unless it was already bookmarked.)

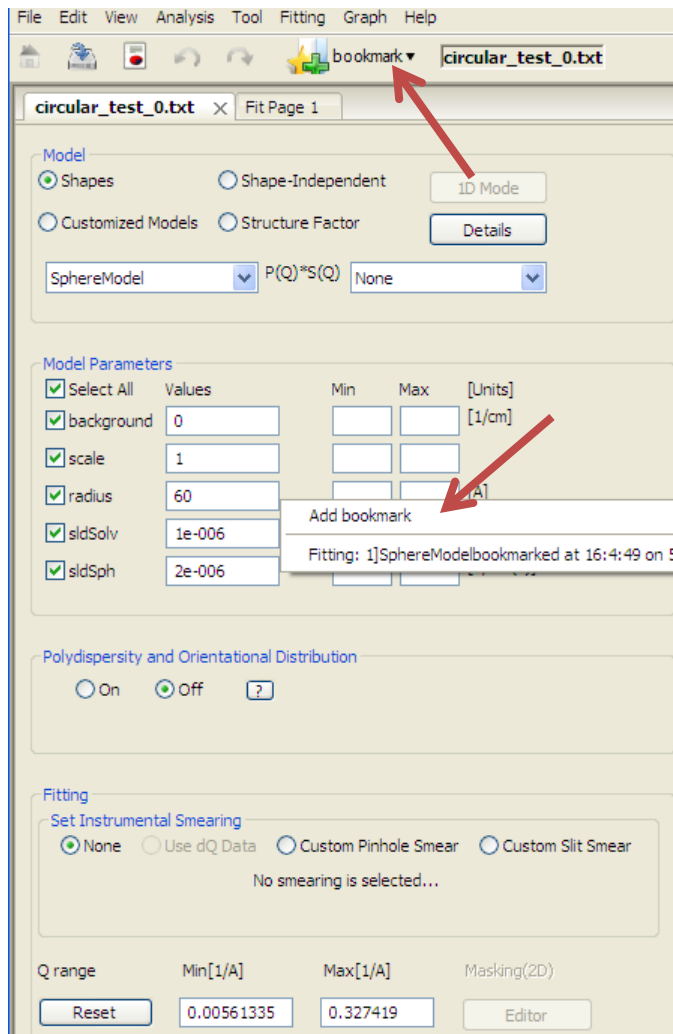


Fig. III-9

### III. Data fitting : 1D and 2D data; Single fit (continued)

III-15. It is possible that the fitting results return with an error, especially when the initial model parameters do not work with your data. This case, some functionalities of the panel may not work. You can delete the fitting panel by clicking on the “x” mark beside of the panel title, and always make a new fitting panel by (Step III-1 - 3) (Fig. III-10).

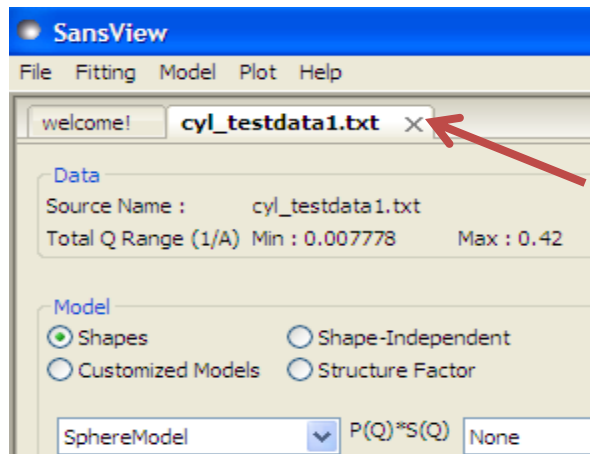


Fig. III-10

III-16. **2D mask editor**: Mask editor for 2D data is available by clicking Editor button in the panel (Fig. III-11). Select the shape of mask, move the slicer lines where the mask should be placed, and then push the button ‘Add’ or ‘Erase’ to finish the masking. You also can reset/clear the mask you had using the corresponding button. After done, simply close the window by clicking X mark at the top-corner (Fig.III-12). Then, the model fitting/calculation (and the model plot) will be masked.

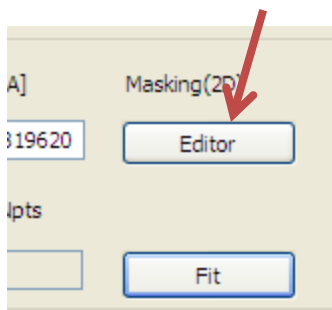


Fig. III-11

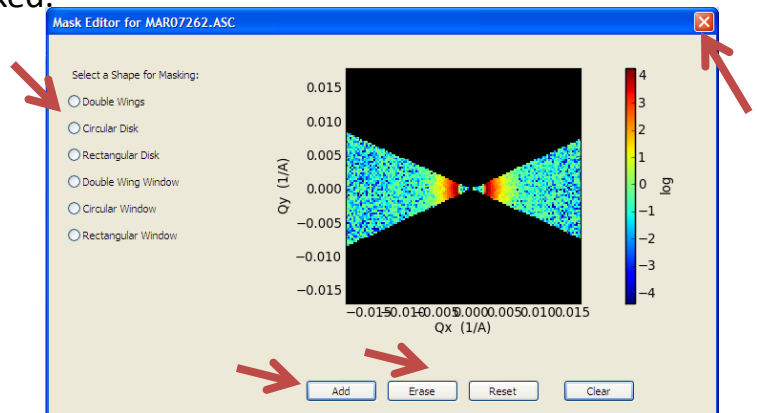
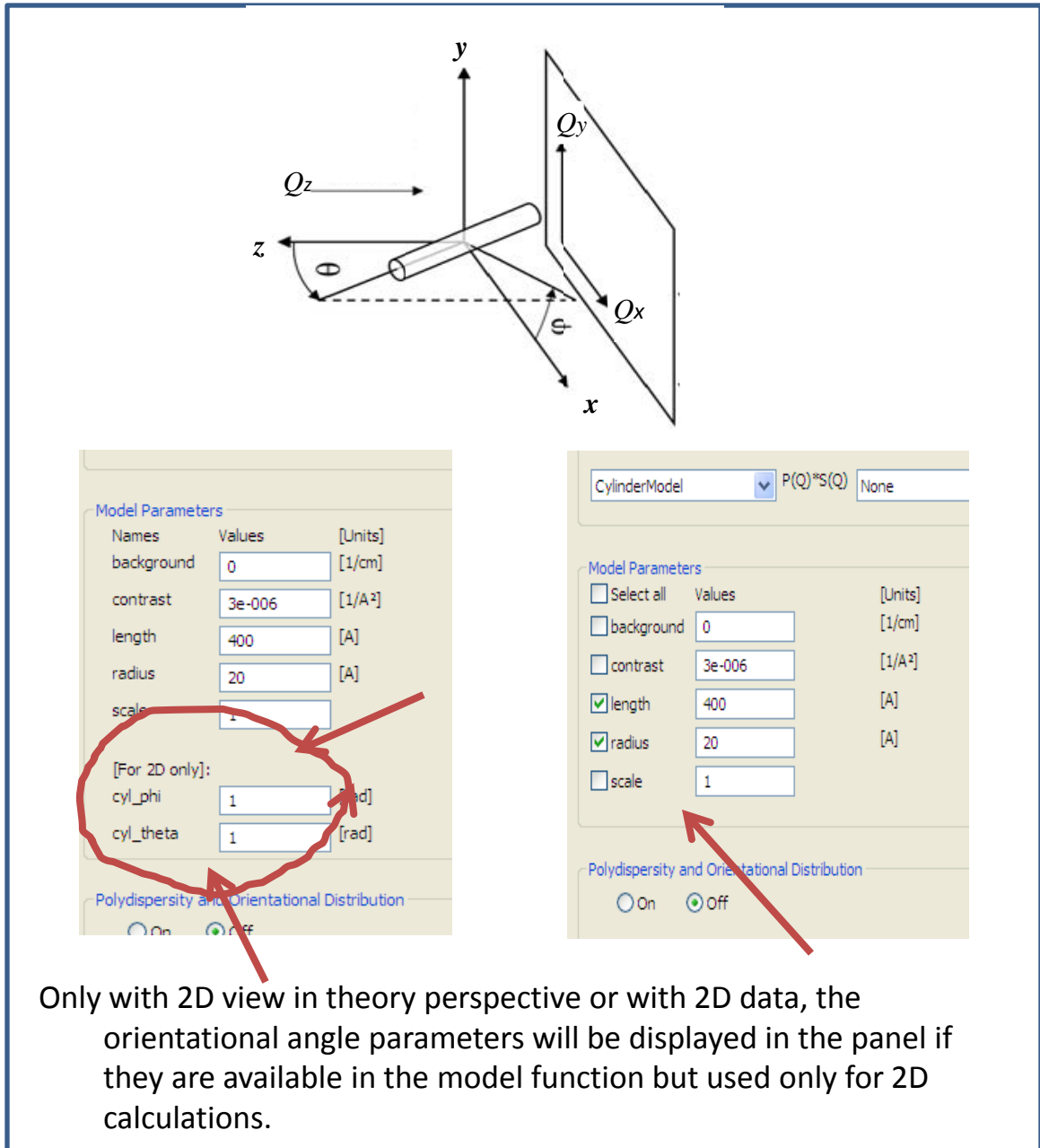


Fig. III-12

### III. Data fitting : 1D and 2D data; Single fit (continued)

III-17 A geometry of the cylinder model (2D) is shown in (Fig. III-13). See model functions in the Help menu (of the SansView Application) for other models.



Only with 2D view in theory perspective or with 2D data, the orientational angle parameters will be displayed in the panel if they are available in the model function but used only for 2D calculations.

Fig. III-13

## IV. Data fitting; Simultaneous fit

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IV-1. The simultaneous fit uses the complex fit engine (Park).

IV-2. Repeat Step III-1 to III-6 to load the data set(s). Make sure that all adjustable parameters are checked including the parameters you want to constrain for the simultaneous fitting.

IV-3. Open the simultaneous fit panel by clicking on “Simultaneous Fit” in the Fitting menu (Fig. IV-1). The complex FitEngine will be set automatically.

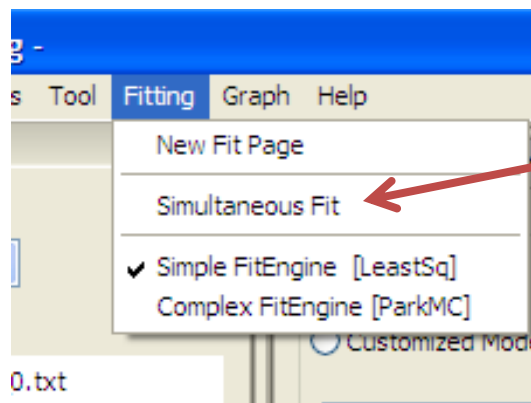


Fig. IV-1

IV-4. Make sure that you know the model fitting function name labeled in your data plot (green curve): It is automatically named as M0, M1, M2,...

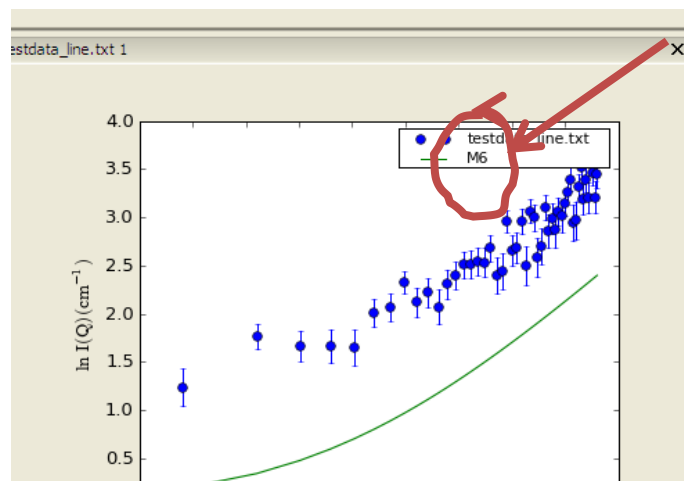


Fig. IV-2



## IV. Data fitting; Simultaneous fit (continued)

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IV-5. Assuming your model describes your data well, in the Simultaneous Fit panel, click on the check box on your models corresponding to your data to fit or click on the Models check box to select all of them (Fig. IV-3).

(The easy setup option is useful when one wants to fit a USANS data and a SANS data simultaneously with one model. For example, select M1 and M2 in the dropdown boxes and click the 'Set All' button. It will generate a number of constraints that equalize all the fittable parameter values of M1 to those of M2 (see IV-6 for another method). )

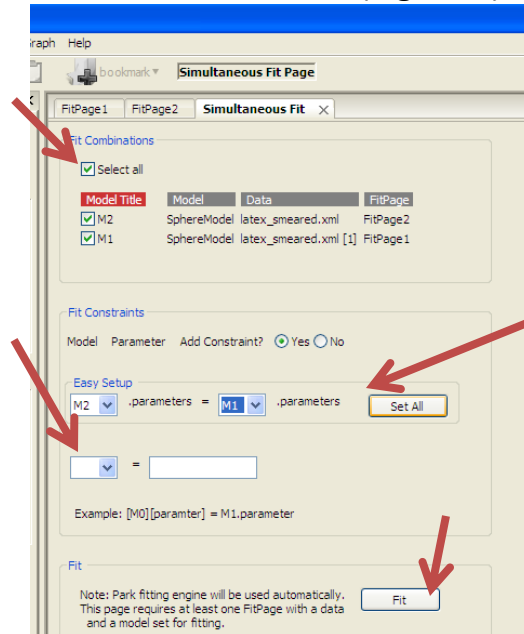


Fig. IV-3

IV-6. Click "Yes" to "Add constraints".

Select and type the constraints between two sets of fitting parameters (Fig. 18); eg.,  $[M0][radius] = M1.radius$ , or  $[M0][radius] = 2 * M1.radius + M1.length$ . For more constraint box, click on Add button. Or click on Remove button when it is not applicable.

IV-7 Once all constraint setups are done, click the Fit button to perform fit.

IV-8. When the fitting is finished, the progress bar at the bottom of window will disappear (Fig. IV-4).

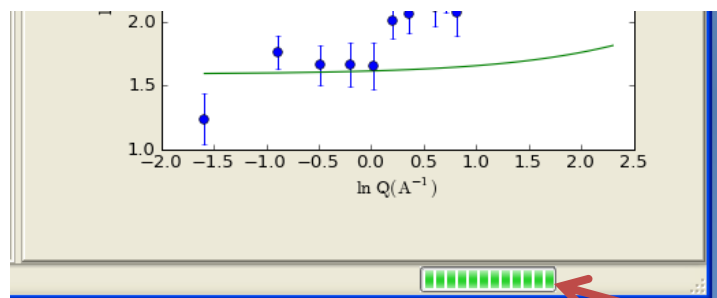


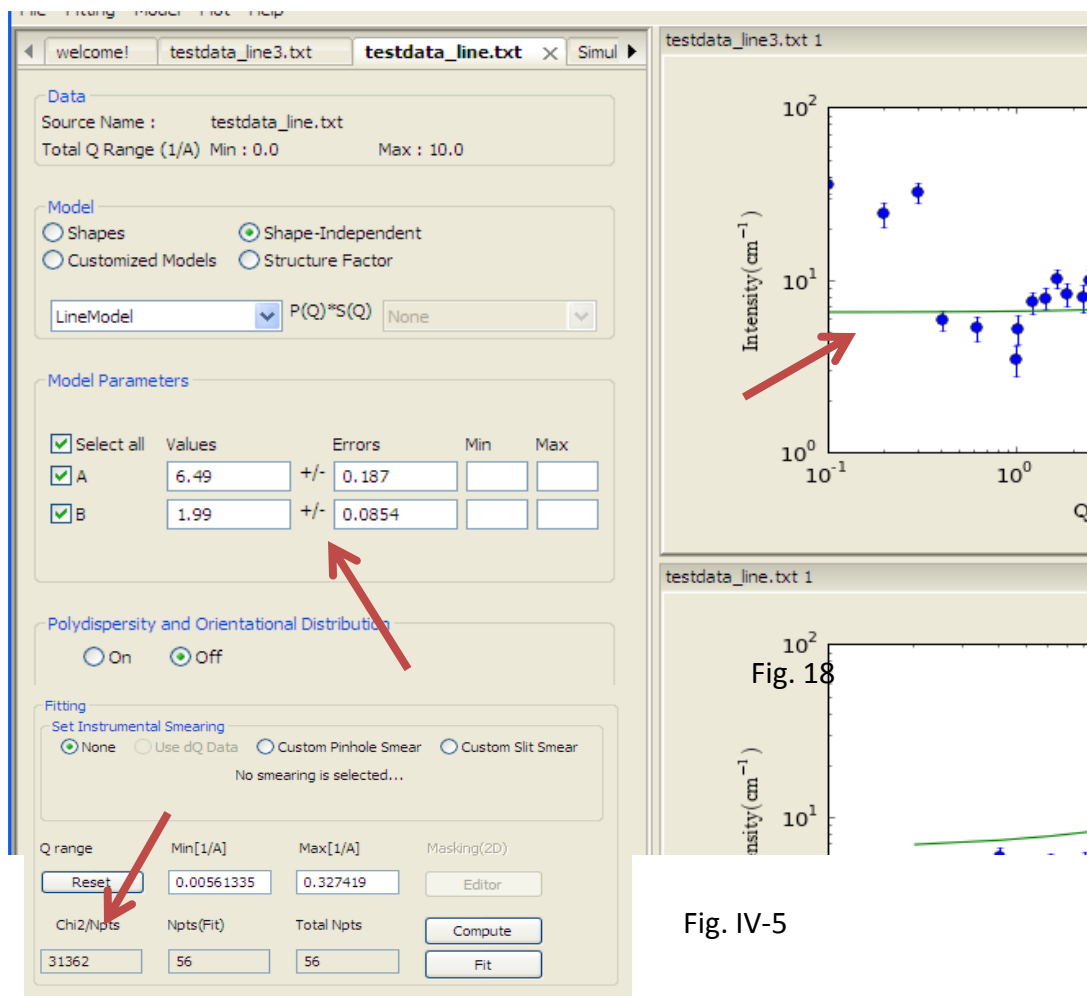
Fig. IV-4

## IV. Data fitting; Simultaneous fit (continued)

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IV-9. Go back to the Fit panel, and inspect the results (Fig. IV-5).

Note: Currently the errors of constrained parameters will not be displayed well, but can be calculated by applying the equation of your constraints.



IV-10. If the fitting results return with an error at the bottom of the control panel, close the Simultaneous Fit panel (in the same way shown in Step IV-3), and repeat it again with different initial values of your parameters.

## V. Data fitting; Batch fit

V-1. Load multiple data sets (see Fig. I-2).

V-2. Click the batch mode and click the “send to (Fitting)”. It will make a plot of only one of data and a BatchPage. Adjust the parameter values with the best guess.

Those values (if checked for fit) will be used as initial values when fitting each data set as a default. If one wants them to be propagated from the previous results (of another data if any), one can select “Chain Fitting” option under the ‘Fitting’ menu in the menu bar. Otherwise, just make sure that the menu is unchecked.

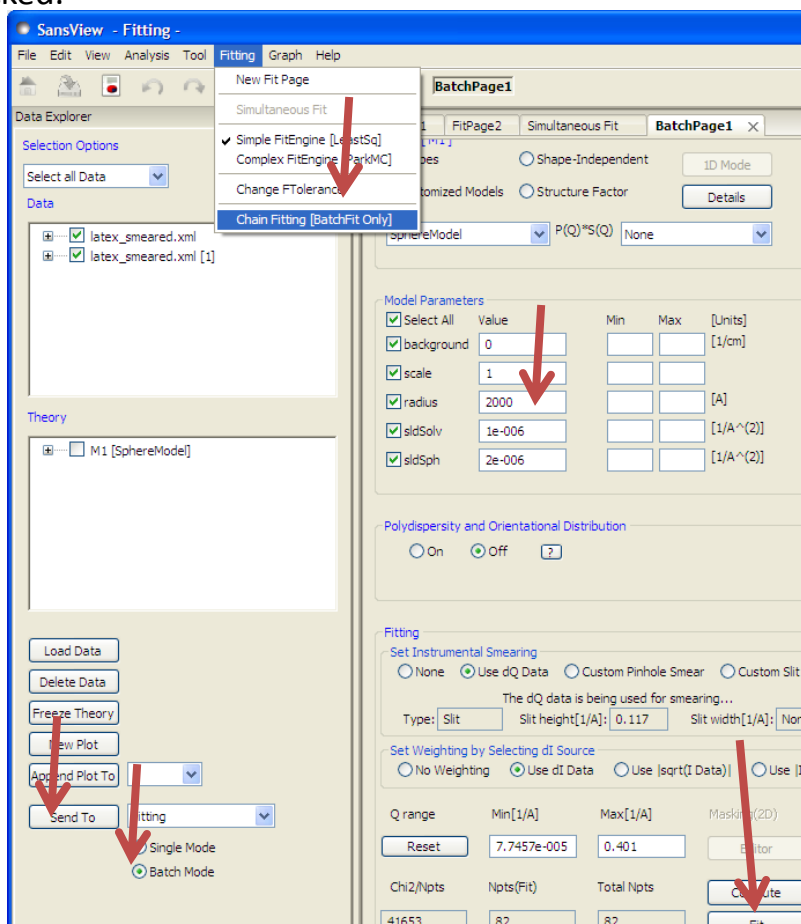


Fig. V-1

V-3. Once ready, simply click the ‘Fit’ button in the Batch page. The results will show up in the Grid Window. More details about the Batch fit can be found in the ‘Help’/ ‘Fitting Help’ in the menu bar of the SansView window.

## VI. Model calculation w/o data

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VI-1. Without a data set, one can use a default 'Fit Page' or an additional 'Fit Page' just for modeling. A new Fit Page can be created by selecting the 'New Fit Page' from the 'Fitting' menu (Fig. VI-1).

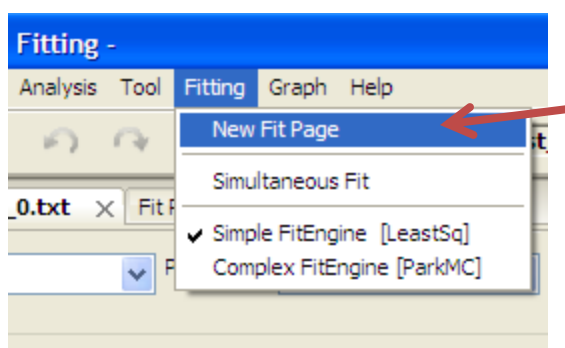


Fig. VI-1

VI-2. In the Fit Page, one can select a model function by selecting another from "Model" combo-box. Also, Q range and the number of points of the calculation can be adjusted by users. the model description and parameter inputs are also provided (Fig. VI-2).

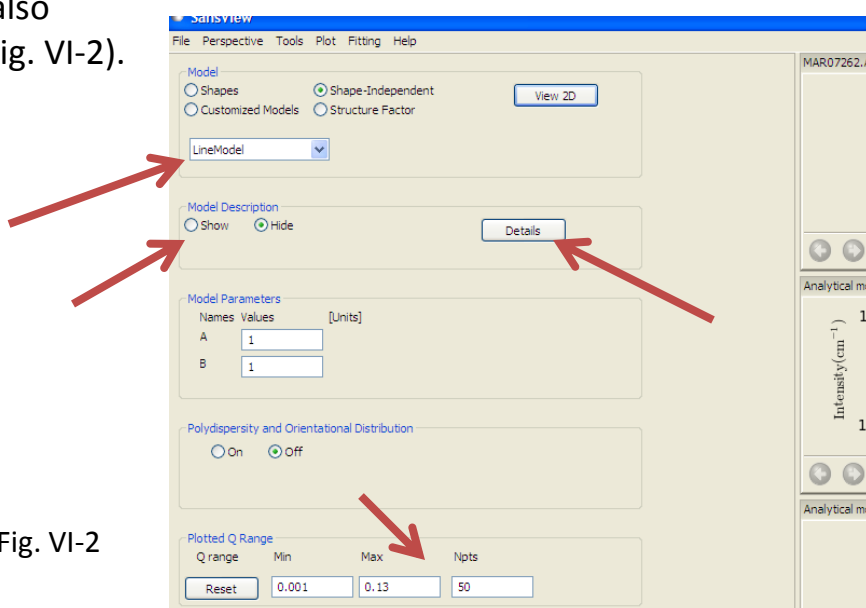


Fig. VI-2

## VI. Model calculation (continued)

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VI-3. 2D model plot panel can be open by clicking the “1D Mode” button, and it will automatically be updated afterward together with 1D plot as the input values are changed (Fig. VI-3).

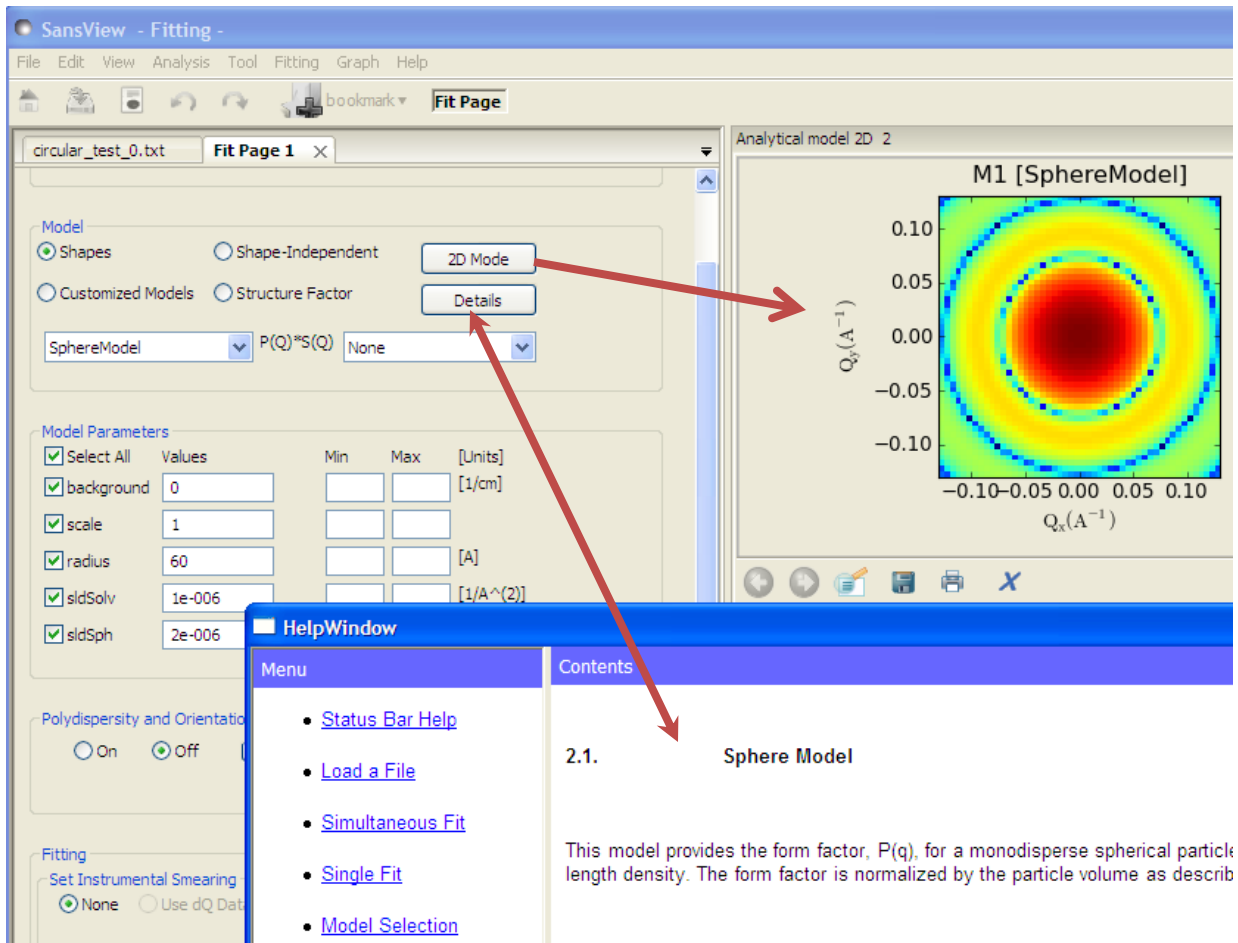


Fig. VI-3

VI-4. User resets the model panel by selecting a new model from the “Model” menu, and also can delete any control panel by clicking on “x” mark beside of the panel name at the top right side corner. By clicking the Save button, the panel can also be saved and open later from the Fitting menu in the menu bar or by right-clicking and selecting it from the panel.

## VII. 2D averaging

VII-1. Once user has a 2D plot, 2D averaging is ready to go.

VII-2. Locate the mouse pointer anywhere in the 2D image, and select one of averaging methods (Sector, Annulus, Boxsum or Box average) by right-click-holding the mouse and by locating the pointer.

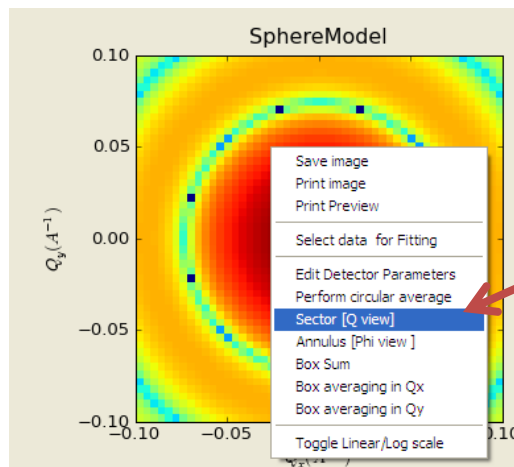


Fig. VII-1

VII-3. Use your mouse to hold and to drag the small cursor in the line to perform an average the area between lines or inside lines (except the circular average). Depending on the kinds of averaging features, the cursor movement is restricted to fit the geometry of the area to perform the averaging.

VII-4. If the error bars block the averaged 1D plot, right-click on the highlighted 1D plot and choose "hide error bars".

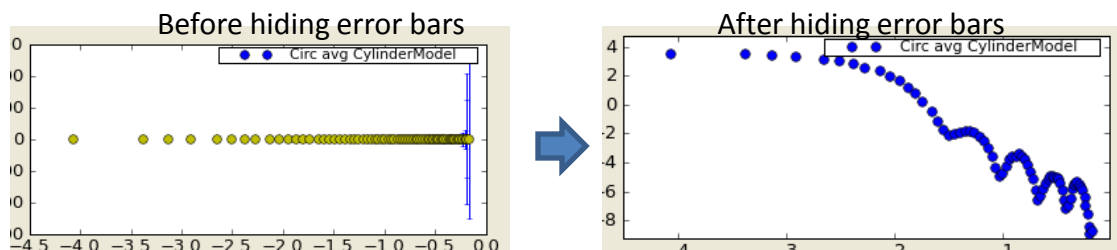


Fig. VII-2

## VII. 2D average (continued)

VII-5. Some screen shots below show the shape of averaging area that we support.

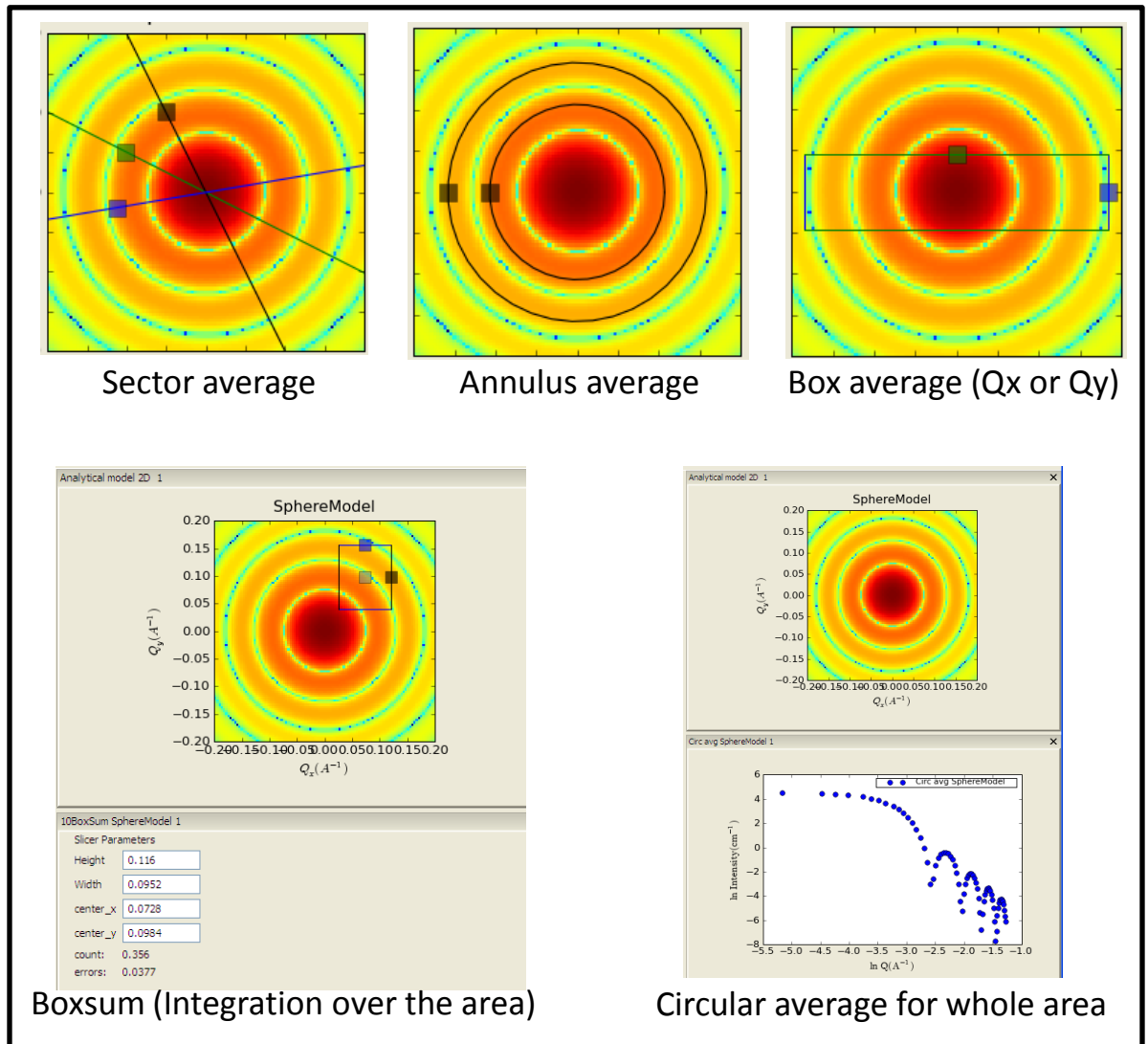


Fig. VII-3

## VIII. Save data and print plots

VIII-1. Currently saving a plot panel snapshot is supported in png, pdf, ps, and eps formats. Method 1: Right-clicking on anywhere inside 1D and 2D plot will bring the context menu box. Select “Save image”, “Print image”, or “Print Preview” of interest (Fig. VIII-1). Method 2: Click on the icon at the bottom of the plots.

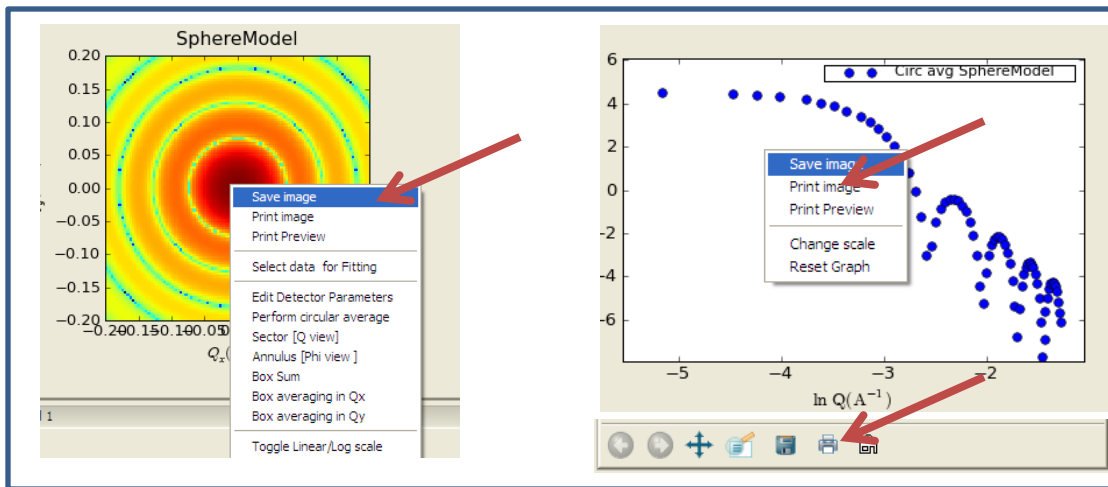


Fig.VIII-1

VIII-2. The data points in the plot can be saved in the txt and CanSAS xml (DAT for 2D) formats. Move mouse to the data points to highlight the symbols. Then, right-click on the highlighted data points. In the context menu, select “Save Points as a File” (Fig. VIII-2).

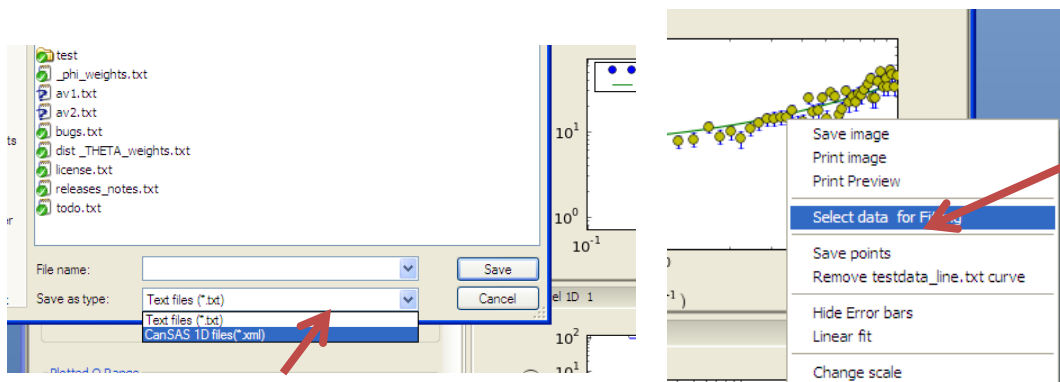


Fig. VIII-2



## IX. Pr inversion

Pr inversion is based on P. Moore, *J. Appl. Cryst.* (1980) 13, 168-175.  
This calculation method is available in a stand alone application (PrView).

Please see details at

[http://danse.chem.utk.edu/downloads/PrView0.2\\_tutorial.pdf](http://danse.chem.utk.edu/downloads/PrView0.2_tutorial.pdf)

In this tutorial, we will show how to switch between Fitting (or model calculations) and Pr inversion.

IX-1. Choose 'Pr inversion' from 'Analysis' in the menu (cf. , choose 'Fitting' to go back to model fitting panels).

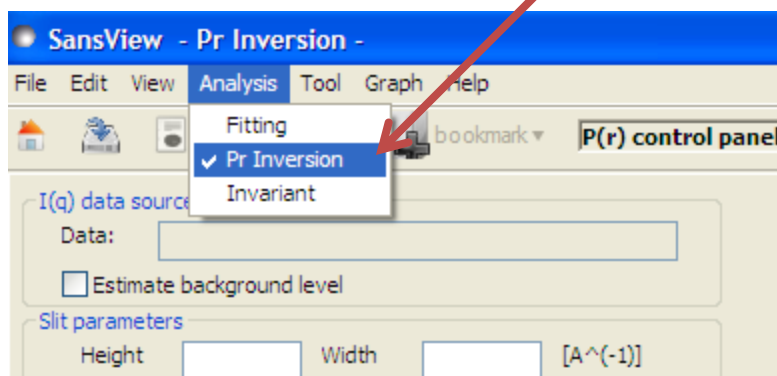


Fig. IX-1

IX-2. Use III-1, III-2, or III-3 step to load a data to the Pr control panel. And make sure the data name is shown in the panel.

Note that unlike Fitting, Pr Inversion allows only one control panel.

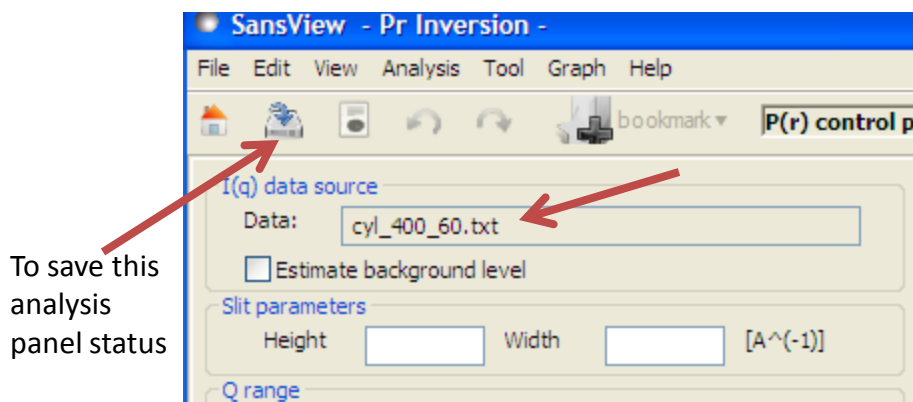


Fig. IX-2

## IX. Pr inversion (continued)

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IX-3. **Background estimate:** By checking the background estimate box, you can let the application fit a constant background value for your  $I(q)$  data.

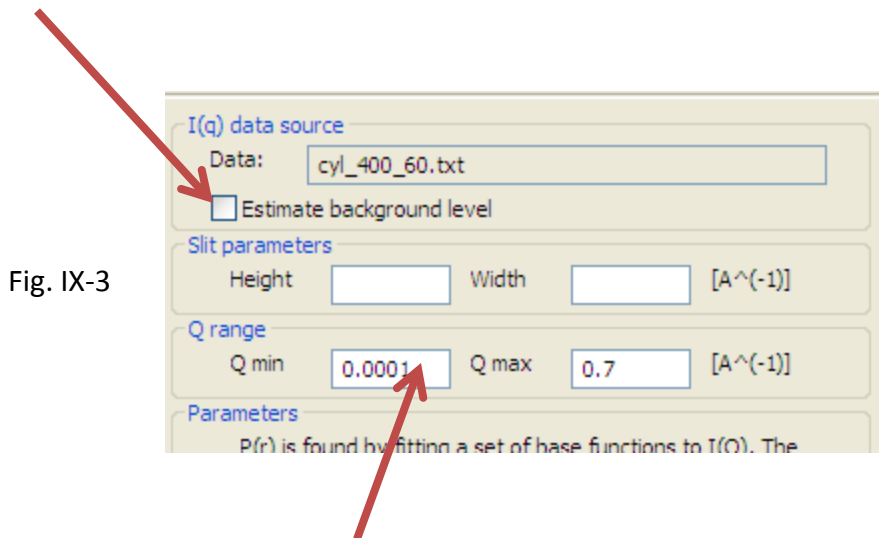


Fig. IX-3

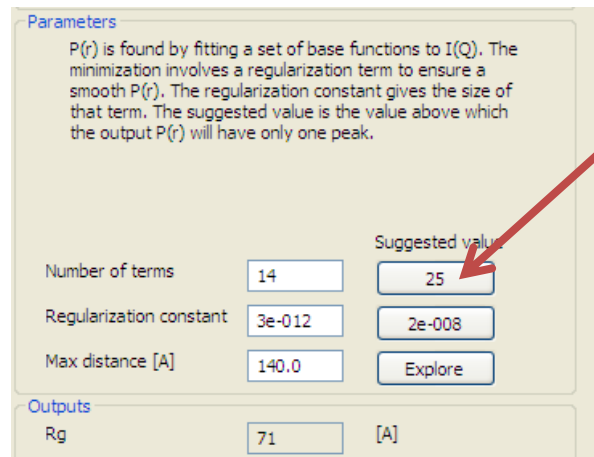
IX-4. **Q range:** Q range for the  $I(q)$  may be specify in the Q min and Q max text boxes.

IX-5. **Suggested values:** Estimates for the number of terms and the regularization constant are computed when the maximum distance or Q range is changed. When an estimate is available, a button with the value will be enabled. Click the button to accept the value.

IX-6. **Input parameters:**

- 1) Number of terms: number of terms in the expansion.
- 2) Regularization constant:  $\alpha$  parameter of the regularization term.
- 3) Max distance: maximum distance between any two points in the system.

Fig. IX-4



## IX. Pr inversion (continued)

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**IX-7. Output parameters:** Several output parameters are provided as figures of merit of the inversion process.

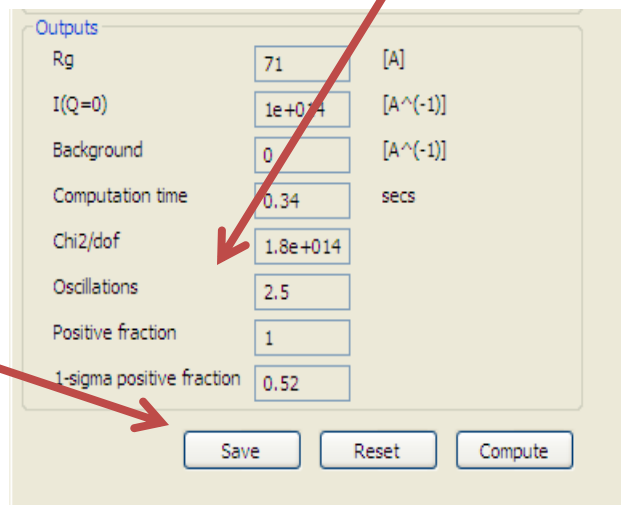
- 1)  $R_g$  and  $I(Q=0)$  are computed from the  $P(r)$  distribution.
- 2) Positive fraction: The fraction of the integral of the absolute value of  $p(r)$  that is positive.
- 3) 1-sigma positive fraction: The fraction of the integral of the absolute value of  $p(r)$  that is at least one standard deviation above zero.
- 4) Oscillations: The oscillation parameter is defined as

$$\frac{\int (dp(r)/dr)^2 dr}{\int (p(r))^2 dr}$$

Its value is 1.1 for a spherical system.

### IX-8. Buttons:

- 1) Save: To save the information and results in the panel into a file so that later it can be reloaded.
- 2) Reset: To reset the panel to the default.
- 3) Compute: To perform the Pr calculations.



Outputs		
$R_g$	71	[A]
$I(Q=0)$	1e+014	[A <sup>-1</sup> ]
Background	0	[A <sup>-1</sup> ]
Computation time	0.34	secs
Chi2/dof	1.8e+014	
Oscillations	2.5	
Positive fraction	1	
1-sigma positive fraction	0.52	

Buttons: Save, Reset, Compute

Fig. IX-5

**IX-9. P(r) plot:** Right clicking on the highlighted data points on locating mouse pointer to the data points in the  $P(r)$  plot panel, will provides a popup (context) menu. Then:

- 1) another set of  $P(r)$  data can be added into the plot by selecting 'Add  $P(r)$  data' from the menu
- 2) the number of the calculation points can be changed by selecting 'Change number of  $P(r)$  points' from the menu
- 3) scaling and normalization can be also done by choosing a proper menu in the same way.

**IX-10. Results:** Once the  $p(r)$  distribution has be computed, the  $I(Q)$  corresponding to the Fourier transform of that distribution is shown and compared with the input data.

## IX. Pr inversion (continued)

IX-11. **Explore Dmax:** Maximum distance (Dmax) can be examined by clicking the 'Explore' button next to the Max distance input box. New popup window will be open displaying  $\chi^2$  vs. Dmax as defaults. Exploring Dmax with other parameter spaces can be done by choosing the parameter in the combobox named 'Select a dependent variable' at the top of the window.

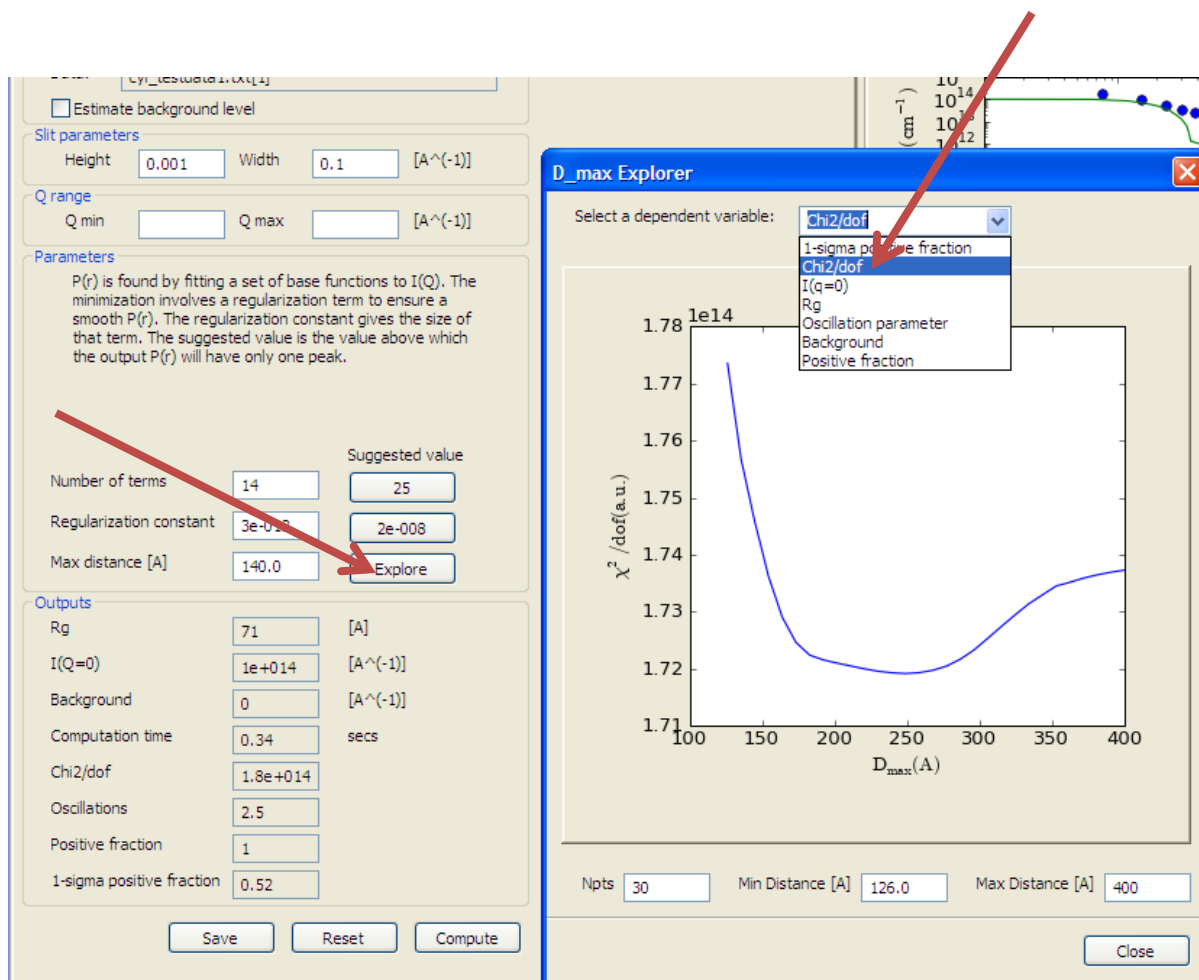


Fig. IX-6



## X. Invariant ( $Q^*$ )

### X-1. Theory

#### The scattering invariant ( $Q^*$ )

The scattering invariant ( $Q^*$ ) is a model-independent quantity that can be easily calculated from scattering data. For two phase systems, the scattering invariant,  $Q^*$ , is defined as the integral of the square of the wave transfer ( $q$ ) multiplied by the scattering cross section over the full range of  $q$ .  $Q^*$  is given by the following equation,

$$Q^* = \int_0^\infty (qg)I(q)dq$$

This model independent quantity ( $Q^*$ ) is calculated from the scattering data that can be used to determine the volume fraction and the specific area of the sample under consideration. These quantities are useful in their own right and can be used in further analysis. With this scattering invariant module users will also be able to determine the consistency of those properties between data. There is no real data defined from zero to infinity because they usually have a limited range.  $Q^*$  is not really computed from zero to infinity. Our maximum  $q$  range is  $1e-5 \sim 10$  ( $1/\lambda$ ). The lower and/or higher  $q$  range than data given can be extrapolated by fitting some data nearby.

The scattering invariant is computed as follow:

- $I(q) = I(q)$  w/o background : If the data includes a background, user sets the value to subtract the background for the  $Q^*$  computation.
- *Reset  $I(q) = I(q) * \text{scaling factor}$ ,  $\delta I(q) = \delta I(q) * \text{scaling factor}$*  : If non-zero scaling factor is given, it will be considered.
- Invariant:  $Q^* = \int_0^\infty (qg)I(q)dq$   
where,  $g = q$  for the pinhole geometry and  $g = q_v$ (the slit height) for the slit geometry which can be given in data or as a value.
- Higher  $q$ -region ( $\geq q_{\max}$  in data):  
Power law (w/o background term) function =  $C/q^4$  will be used  
where the constant  $C(=2\pi\Delta\rho S_v)$  is to be found by fitting part of data with the range of  $q_{N-m}$  to  $q_N$  ( $m < N$ ).
- Lower  $q$ -region ( $\leq q_{\min}$  in data):  
Guinier function =  $I_0 \exp(-R_g^2 q^2 / 3)$  where  $I_0$  and  $R_g$  are obtained by fitting, similarly to the high  $q$  region above.  
Power law can also be used.



## X. Invariant (continued)

**The volume fraction  $\phi$ :**

$$\phi(1-\phi) = \frac{Q^*}{2\pi^2(\Delta\rho)^2} \equiv A$$

where  $\Delta\rho$  is the SLD contrast of which value is given by users.

Thus,

$$\phi = \frac{1 \pm \sqrt{1-4A}}{2}$$

where  $0 \leq A \leq 1/4$  in order for these values to be physically valid.

**The specific surface area :**

$$S_v = \frac{2\pi\phi(1-\phi)C_p}{Q^*} = \frac{2\pi AC_p}{Q^*}$$

where  $A$  and  $Q^*$  are obtained from previous sections, and the Porod constant  $C_p$  is given by users.

**Definitions:**

$Q$  : the magnitude of neutron (or X-ray) momentum transfer vector.

$I(Q)$ : the scattering intensity as a function of the momentum transfer  $Q$ .

Invariant total is the sum of the invariant calculated from data's  $q$  range and the invariant resulting from extrapolation at a low  $q$  range and at a high  $q$  range if considered.

**Reference:**

Porod's chapter (2) from O. Glatter and O. Kratky, "Small Angle X-Ray Scattering", Academic Press, New York, 1982

Otto's web page: <http://physchem.kfunigraz.ac.at/sm/>

## XI. Invariant (continued)

### XI -2. GUI:

- i) Loading data to the panel: See Chapter III-1 and -2 but select 'Compute invariant' in the pop-up menu.
- ii) To subtract a background or/and to rescale the data, type the values in Customized Input box.
- iii) If you want to calculate the volume fraction and the specific surface, type the optional inputs in the customized input box, and then press 'Compute' button.
- iv) The invariant can also be calculated including the outside of the data Q range: To include the lower Q and/or the higher Q range, check in the enable extrapolation check box in 'Extrapolation' box. If the power law is chosen, the power (exponent) can be either held or fitted by checking the corresponding radio button. The Npts for fitting the data that is used for the extrapolation can be specified.
- v) If the invariant calculated from the extrapolated region is too large, it will warn in red at the top of the panel, which means that your data is not proper to calculate the invariant.
- vi) The details of the calculation is available by clicking the 'Details' button in the middle of the panel.

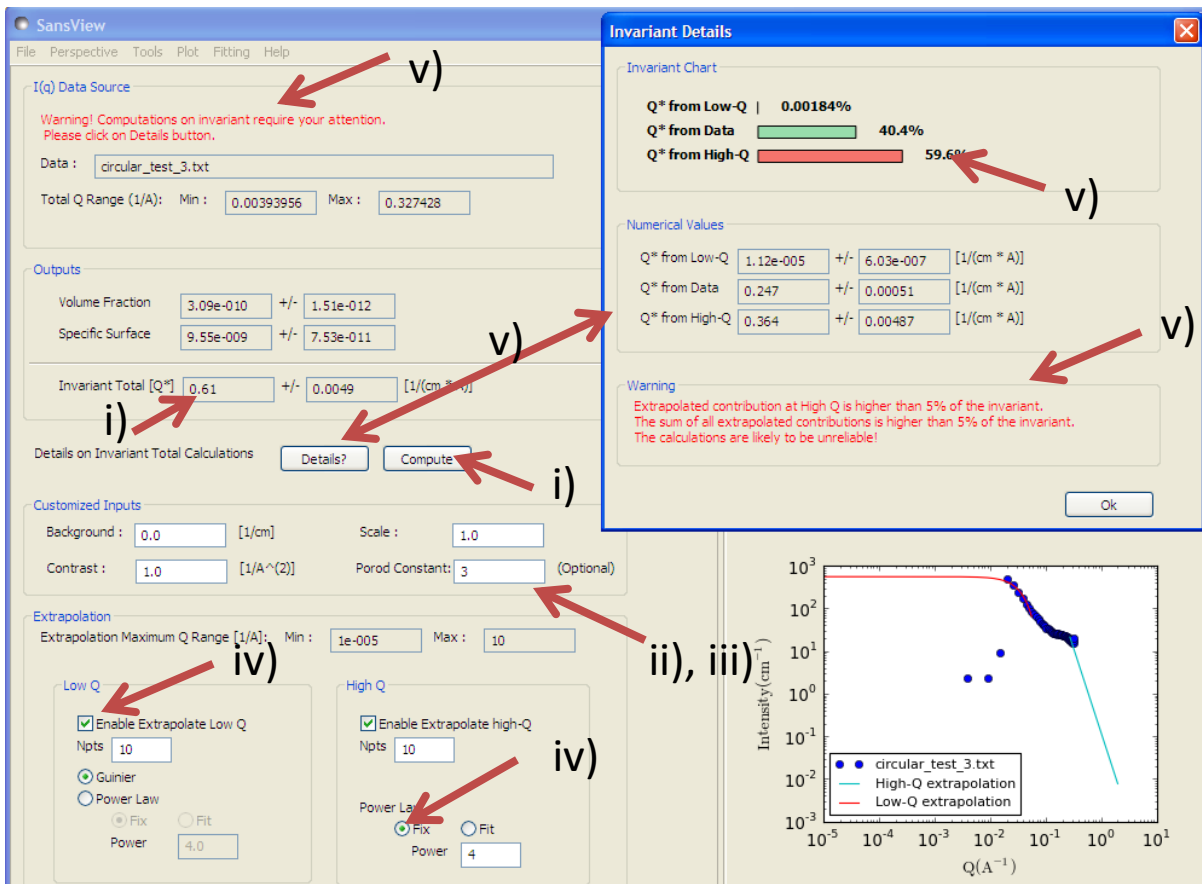


Fig. IX-1

## XII. Miscellaneous

### XII-1. Change scales or toggle Linear/ Log.

Right-click on 1D, 2D plot. Select “Change scale” or “Toggle Linear/Log scale” (Fig. XII-1).

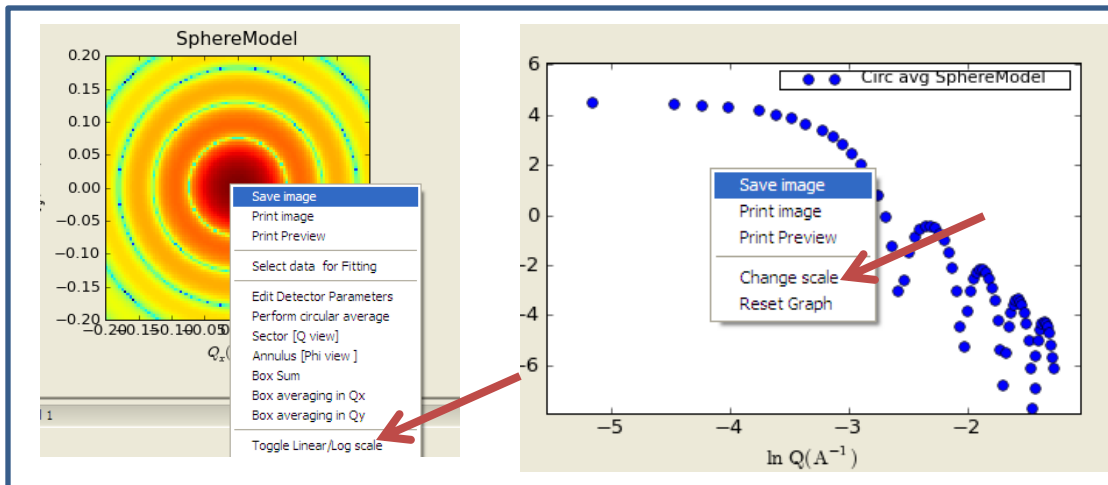


Fig. XII-1

### XII-2. Close an open plot panels: All plot panels can be closed by clicking the “x” mark at the top of window. In order to bring that panel back, go to the menu bar and select the panel to open under “Plot” menu (Fig. XII-2).

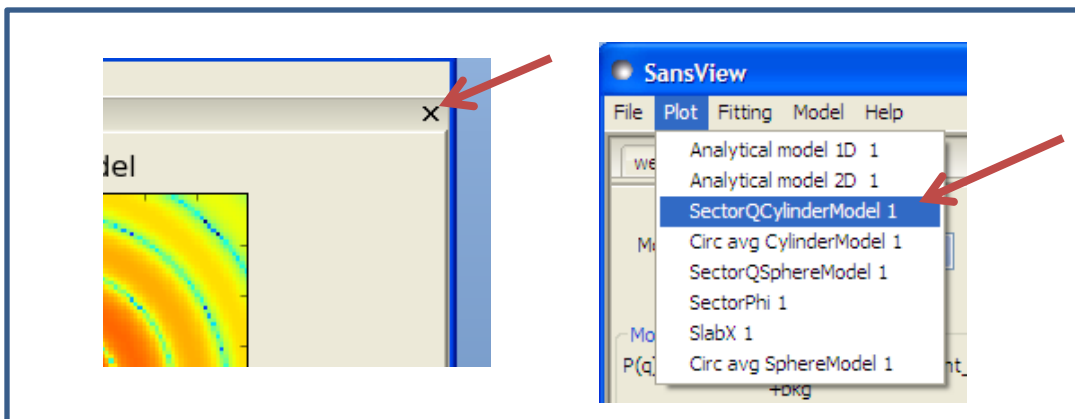


Fig. XII-2



## XII. Miscellaneous (Continued)

XII-3. Your workspace can be **re-arranged** by clicking and dragging the title bar outside or back to inside of the SansView interface (Fig. XII-3).

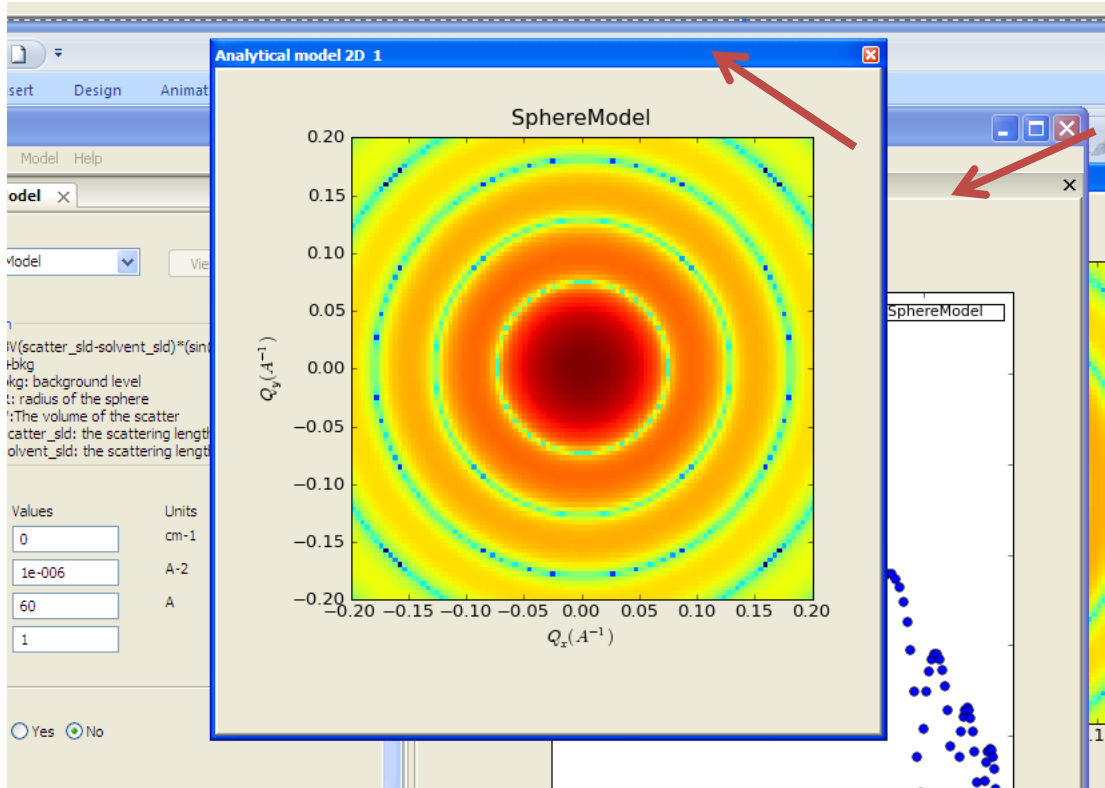


Fig.XII-3

XII-4. **Changing color map** of a 2D image (Fig. XII-4);

Open the context menu by right-clicking the image plot. Select "2D Color Map". Type integer numbers (non zero) in the box. If no numbers (no space) are entered, the image will be displayed in the default color depth. A different color map can be selected by choosing one from the combobox named Cmap. This feature is a one time feature, which means it will not be updated when updating or changing the image plot. Note: This feature is still under construction, so use it with care. (Fig. XII-4).

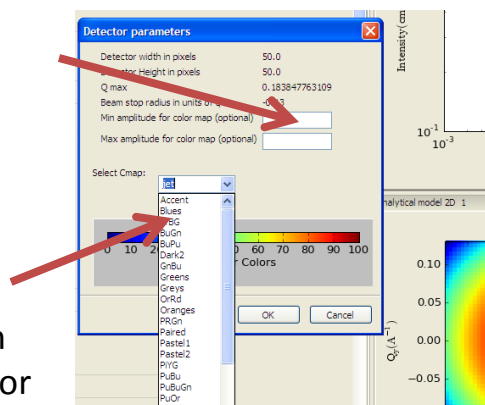


Fig.XII-4

## XII. Miscellaneous (Continued)

XII-5. **Zooming:** 1D data plot can be zoomed out and in:

A) for both x- and y-axis; one-click in the plot panel, locate your pointer inside the axes then rotate the roller at the center of your mouse to zoom in and out (Fig. XII-5).

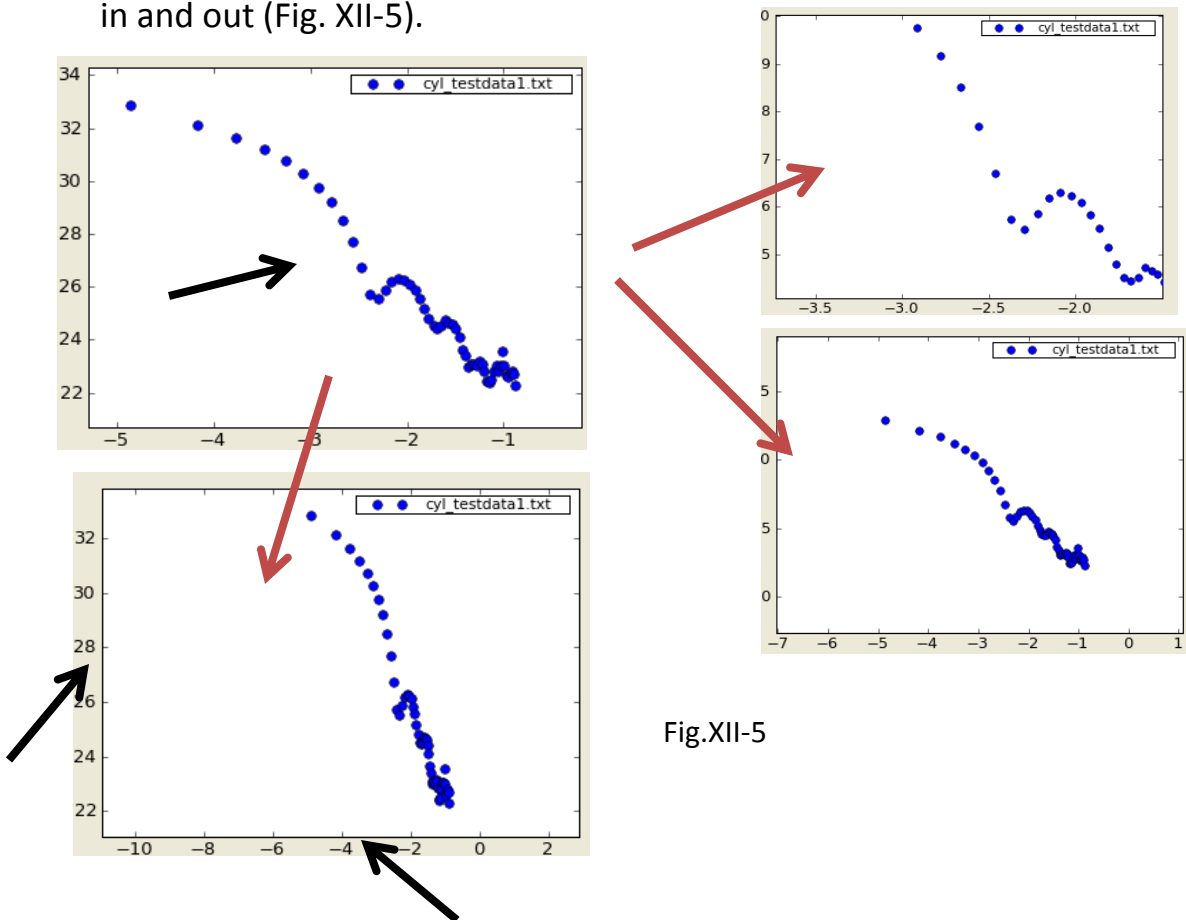


Fig.XII-5

B) The x- or y- axis separately; click once in the plot panel, locate your pointer (black arrows in Fig. XII-5) somewhere between the axis line and label, and use the mouse roller to zoom in and out the axis as desired.

XII-6. The data points or curve can also be dragged around by selecting the arrow icon in the toolbar then by clicking-holding-dragging the plot.

## XII. Miscellaneous (Continued)

XII-7. Some **Helps** and tips are available within the SansView application. Select “Fitting help” or others in the “Help” menu. This will provide you an instant help (Fig. XII-6).

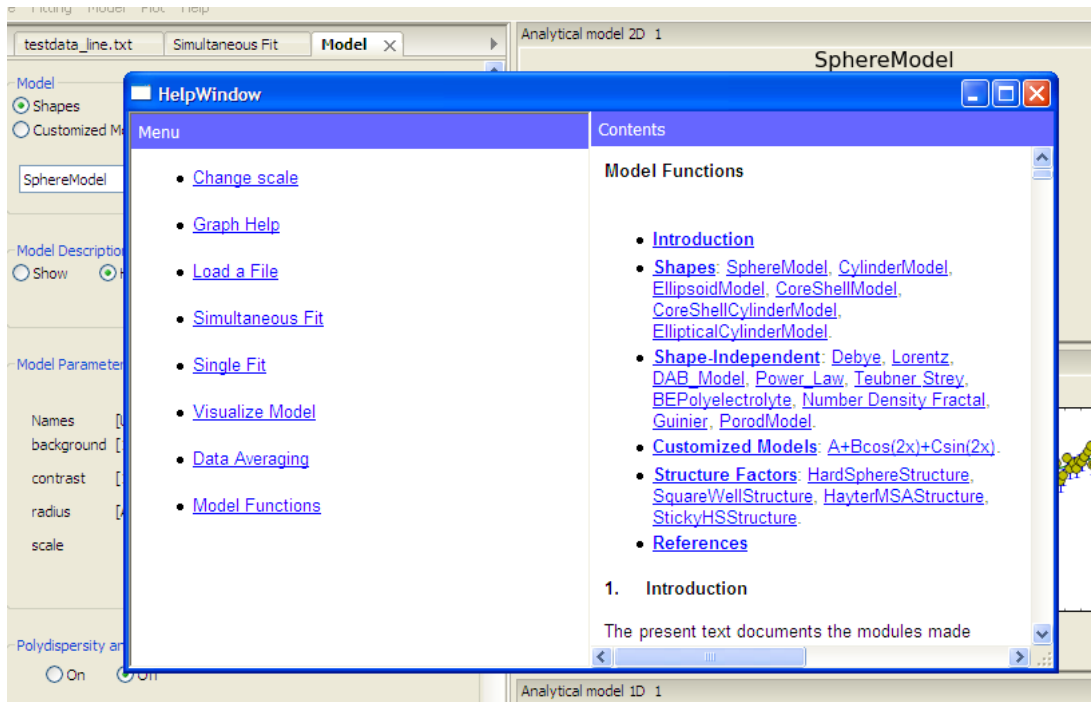


Fig.XII-6

XII-8. Simple tips will be displayed at the bottom line of the application whenever necessary (Fig. XII-7).

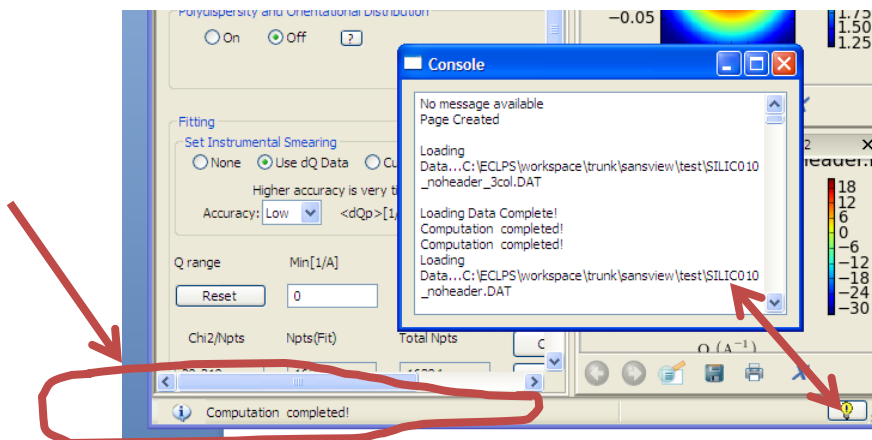


Fig.XII-7



## XII. Miscellaneous (Continued)

### XII-9. **Loadable data formats** (Also, see I-4 ):

#### A) 1D data:

- a) File extensions that can be loaded: .txt, .dat, .abs, .xml, or w/o extension (ASC format).
- b) 2 to 4 columns of data are required in order of Q, I, (dI, dQ ).
- c) The meta data (header) will be ignored unless in a standard xml format.

#### B) 2D data:

- a) File extensions that can be loaded: .ASC, .DAT, .sans
- b) 2D ASCII file should be from NIST IgorPro SANS reduction package and saved to the detector coordinates (\*.ASC).
- c) 2D NIST reduced q map file (\*.DAT).
- d) Examples of data files are available in “test” folder inside the SansView folder (See page 4 and Appendix: User model documentation).

### XII-10. **Supporting model functions**: The descriptions are available in the help menu.

**A)** Shape models (form factors): sphere, cylinder, coreshell cylinder, coreshell sphere, ellipsoid, elliptical cylinder, and many more.

**B)** Shape independent models: DAB, BEPolyelectrolyte, Guinier, Debye, Porod, line, number density fractal, Lorentz, power law, etc.

**C)** Structure factors: SquareWell, HardSphere, StickyHS, HayterMSA.

**D)** Customized models: Refelectivity, ReflectivityII, and example models. Users can define their own model functions by modifying an example python file in the “plugins” folder inside of the SansView folder. See Appendix or the example files in the plugins folder.

**E)**  $P(Q)*S(Q)$ : Form factor times structure factor supports for some shape based models (with 4 structure factors above). For cylinder and ellipsoid based models, the 2<sup>nd</sup> virial coefficient will be calculated automatically and applied to the structure factors.

### XII-11. **Instrumental smearing** is supported in fitting when your data includes dQ in its fourth column.



## XII. Miscellaneous (Continued)

XII-12. **Polydispersity (1D and 2D) and orientational distribution (2D only)** can be taken account for modeling and fitting.

**A)** The SansView provides *Gaussian, flat, Lognormal, or Schulz* distribution function (where  $PD = \text{Sigma (STD)}/\text{mean}$ ,  $\text{Sig} = \text{Sigma}$  (for angles),  $N_{\text{pts}}$  = number of points to average over the distribution,  $N_{\text{sigma}}$  = number (of which times sigma is the distance from the center over the distribution function). Proper values for  $N_{\text{pts}}$  and  $N_{\text{sigmas}}$  may be 10 to 30 and 2.5 to 5, respectively depending on the distribution function chosen. The  $PD/\text{Sig}$  is fittable but frequently it becomes saturated

**B)** Using a customized function:

Users can make two columns of a distribution function, and open the file from 'array' function option. The file should include two columns of data where the first column is the values of the parameter and the 2<sup>nd</sup> column is the weighting factors. (Note that this values will override the corresponding mean value (eg., radius) so that the parameter will become no longer active.) An example of the distribution functions is;

degree	weight
0.707	0.4
1.14	1
1.414	0.4

XII-13. **Customized models:** Users can define their own SANS model function in the plugin folder of the SansView folder. Modify the sample files in the folder, or create a new one. If it compiled OK, the model function will be show up under "Customized model" menu in the menu bar. See Appendix or the example files in the plugins folder of SansView folder for more details.

XII-14. **Startup Setting:** A 'StartupSetting' is found under the 'View' in the menu. With the current option selected, the default View will be changed after restarting the SansView; for example, if you don't want the DataExplorer panel shown, select the current option after the DataExplorer closed, etc.

The SansView will try to remember as much as close to the View you current have.



## XIII. Appendix

### User Model Documentation

SansView has a plug-in mechanism that allows users to write their own models in python. Each user model is placed in the *plugins* folder of the SansView installation. For instance, on the default Windows installation, the user model files will be placed in

`C:\Program Files\SansView-[version]\plugins`

Note that the user may thus define any number of such special models. The content of each model plugin is the following:

```
"""
    Test plug-in model
    """
from sans.models.pluginmodel import Model1DPlugin

import math

# ALL Your models MUST HAVE the class name Model as listed below (i.e.
# DO NOT MODIFY this next line).
# The unique name that appears in the menu for each of your models comes
# next (Name of the model)
class Model(Model1DPlugin):
    """ Class that evaluates a user model.
    """
```



### XIII. Appendix (Continued)

```
## Name of the model -- this is where you put the unique name
##for the model that will appear in the menu
name = "A+Bcos(2x)+Csin(2x)"

def __init__(self):
    """ Initialization """
    Model1DPlugin.__init__(self, name= self.name)

    ## Parameters definition and defaults
    self.params = {}
    self.params['A'] = 1.0
    self.params['B'] = 1.0
    self.params['C'] = 10.0

    ## Parameter details [units, minimum value, maximum value]
    self.details = {}
    self.details['A'] = ["", -1e16, 1e16]
    self.details['B'] = ["", -1e16, 1e16]
    self.details['C'] = ["", -1e16, 1e16]
    self.description = "F(x)=A+Bcos(2x)+Csin(2x) "

def function(self, x = 0.0):
    """ Evaluate the model
        @param x: input x
        @return: function value
    """
    # For convenience, use local variables for the parameters
    A = self.params['A']
    B = self.params['B']
    C = self.params['C']

    return A+B*math.cos(2.0*x)+C*math.sin(2.0*x)
```