



EUROPEAN
SPALLATION
SOURCE



SasView : A Small Angle Scattering Analysis Software Package

Andrew Jackson, European Spallation Source
on behalf of the SasView Collaboration



Science & Technology Facilities Council
ISIS

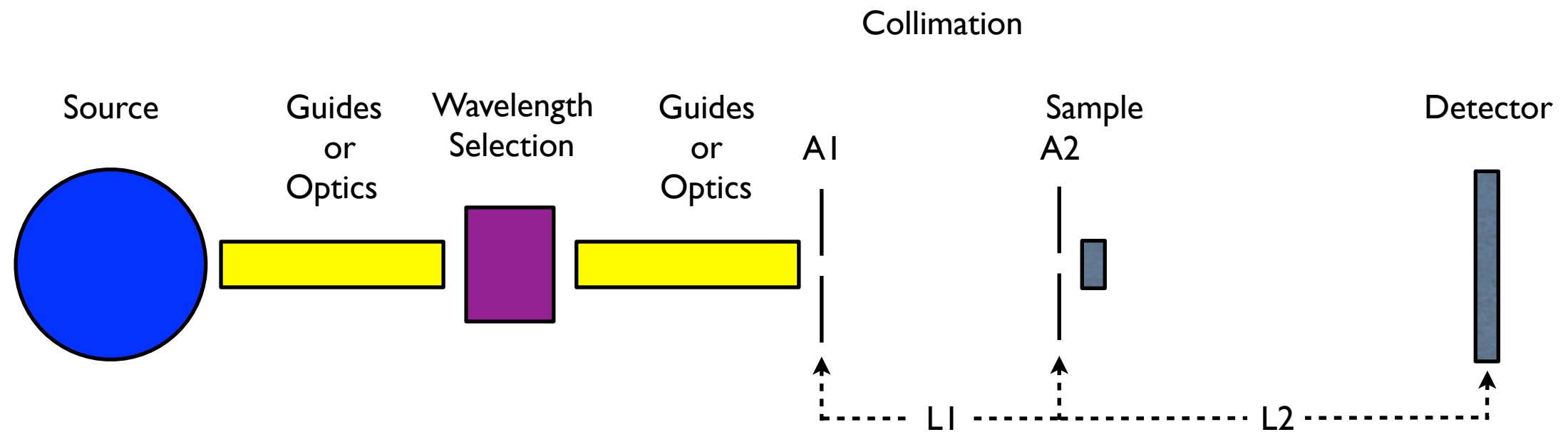


National Institute of Standards and Technology
Technology Administration, U.S. Department of Commerce

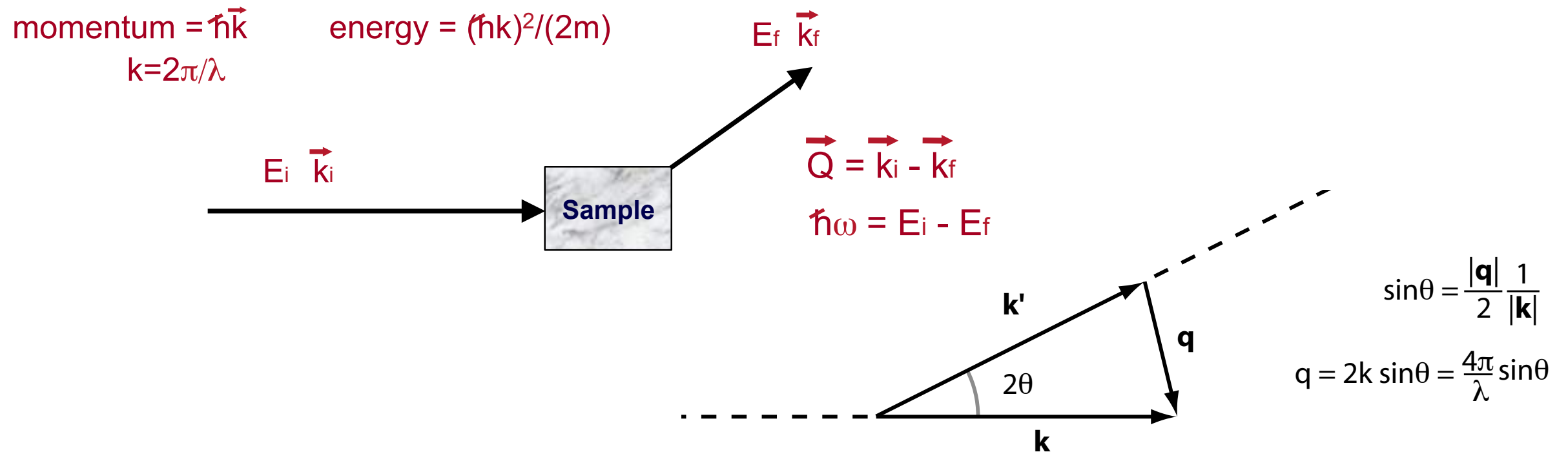


SANS Refresher

Anatomy of a SAS Instrument



What do we measure?



Measure number of neutrons scattered as function of Q and ω

Intensity of scattering as function of Q is related to the Fourier transform of the spatial arrangement of matter in the sample => Correlations in **Space**

Intensity of scattering as function of ω is related to the Fourier transform of the temporal arrangement of matter in the sample => Correlations in **Time**

Small Angle Scattering

Having determined that we can use scattering length density to describe our samples, we can replace the sum in

$$\frac{d\sigma}{d\Omega}(\mathbf{q}) = \frac{1}{N} \left| \sum_i^N b_i e^{i\mathbf{q} \cdot \mathbf{r}} \right|^2$$

with the integral of the SLD distribution across the whole sample and normalize by the sample volume thus:

$$\frac{d\Sigma}{d\Omega}(\mathbf{q}) = \frac{N}{V} \frac{d\sigma}{d\Omega}(\mathbf{q}) = \frac{1}{V} \left| \int_V \rho(\mathbf{r}) e^{i\mathbf{q} \cdot \mathbf{r}} d\mathbf{r} \right|^2$$

This is the “Rayleigh-Gans Equation” and shows us that small angle scattering arises as a result of **inhomogeneities in scattering length density**.

Form and Structure Factors

In small angle scattering we confuse terminology by often splitting the scattering structure factor into a **Form Factor**, $P(q)$ and a **Structure Factor**, $S(q)$ when considering particulate systems :

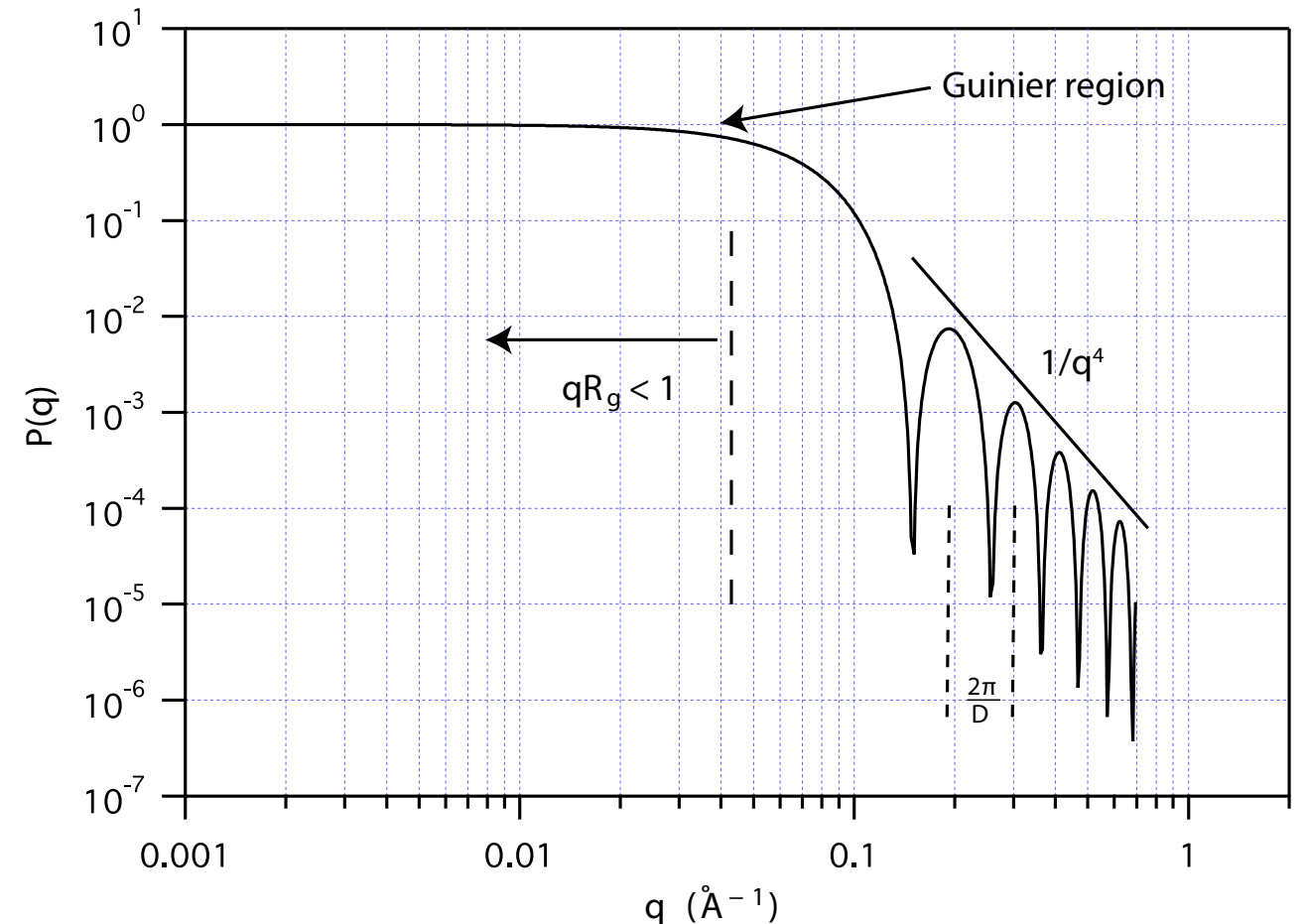
$$\frac{d\Sigma}{d\Omega}(q) = \frac{N}{V}(\rho_1 - \rho_2)^2 V_p^2 P(q) S(q)$$

$P(q)$ represents the interference of neutrons scattered from different parts of the same object, while $S(q)$ represents interference between neutrons scattered from different objects. If there is no interparticle correlation (e.g. it is a dilute solution) then $S(q) = 1$.

If we have an isotropic solution then

$$S(q) = 1 + 4\pi N_p \int_0^\infty [g(r) - 1] \frac{\sin(qr)}{qr} r^2 dr$$

where $g(r)$ is the particle pair correlation function and is related to the interaction potential between particles.



The form factor for a sphere (shown above) is given by:

$$P(q) = \left[\frac{3(\sin(qr) - qr \cos(qr))}{(qr)^3} \right]^2$$

Form and Structure Factors

The form factor for a cylinder is given by:

$$P(q) = \int_0^{\pi/2} f^2(q, \alpha) \sin \alpha d\alpha$$

$$f(q, \alpha) = j_0(qH \cos \alpha) \frac{J_1(qr \sin \alpha)}{(qr \sin \alpha)}$$

$$j_0(x) = \sin(x)/x$$

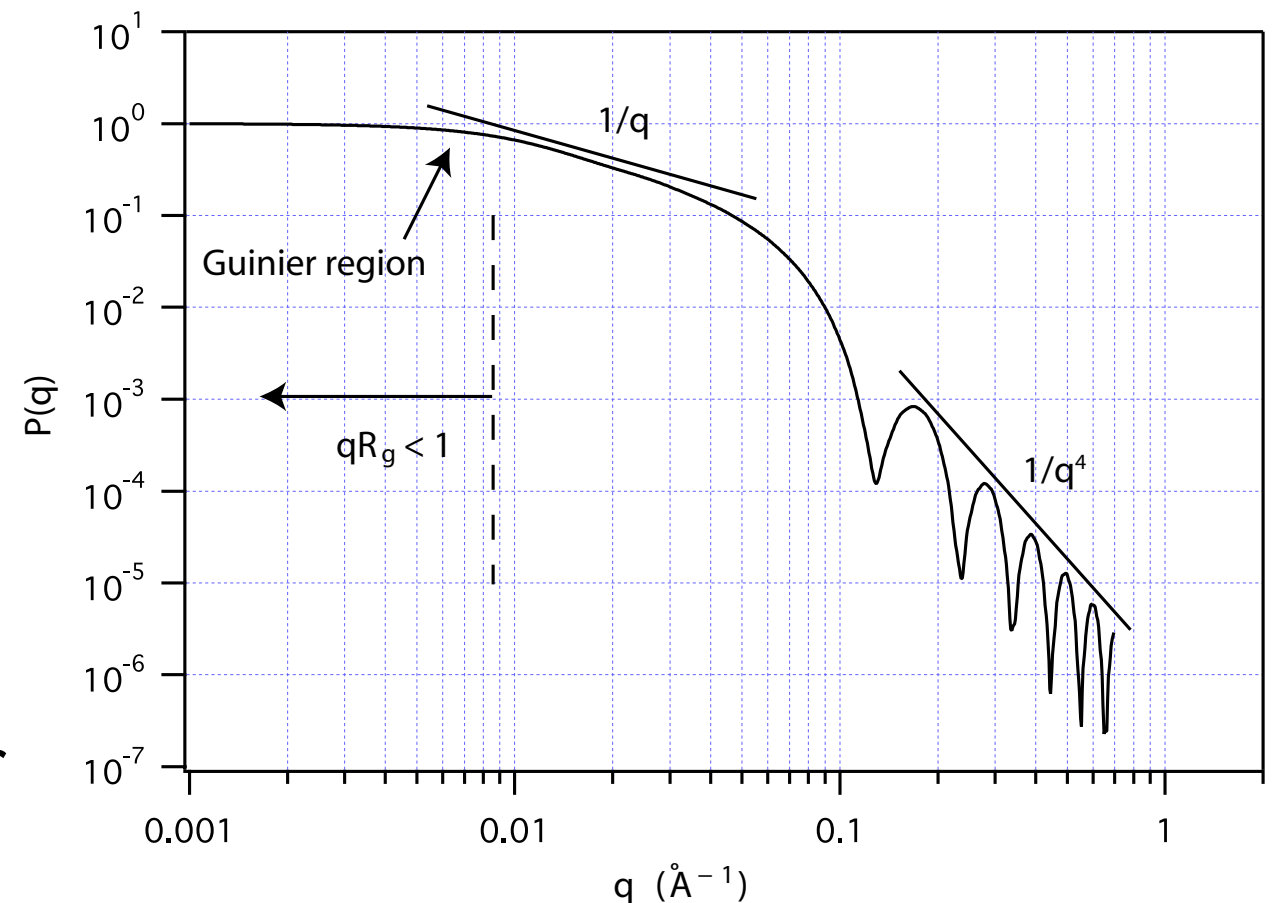
$$V_{cyl} = \pi r^2 L$$

where J_1 is the first order Bessel function and α is defined as the angle between the cylinder axis and the scattering vector q .

The radius of gyration of a cylinder is given by

$$R_g^2 = \frac{R^2}{2} + \frac{L^2}{12}$$

where R is the radius and L the length of the cylinder.



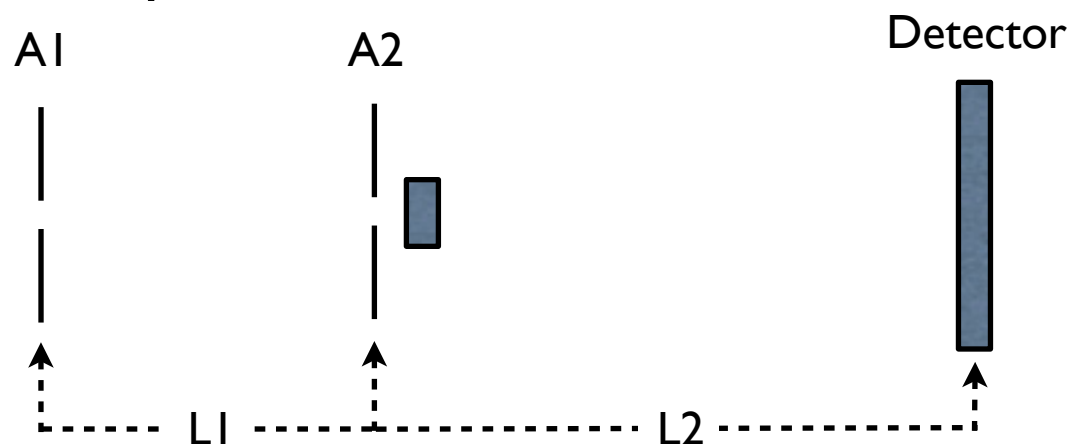
SANS Resolution

The intensity measured at each nominal Q value is, in fact, a sum of intensities from nearby Q vectors.

This is a result of the beam and the detector pixels having finite sizes, and the wavelength having a spread of values.

The effect is that the scattering that one would calculate is “smeared” by a **resolution function**.

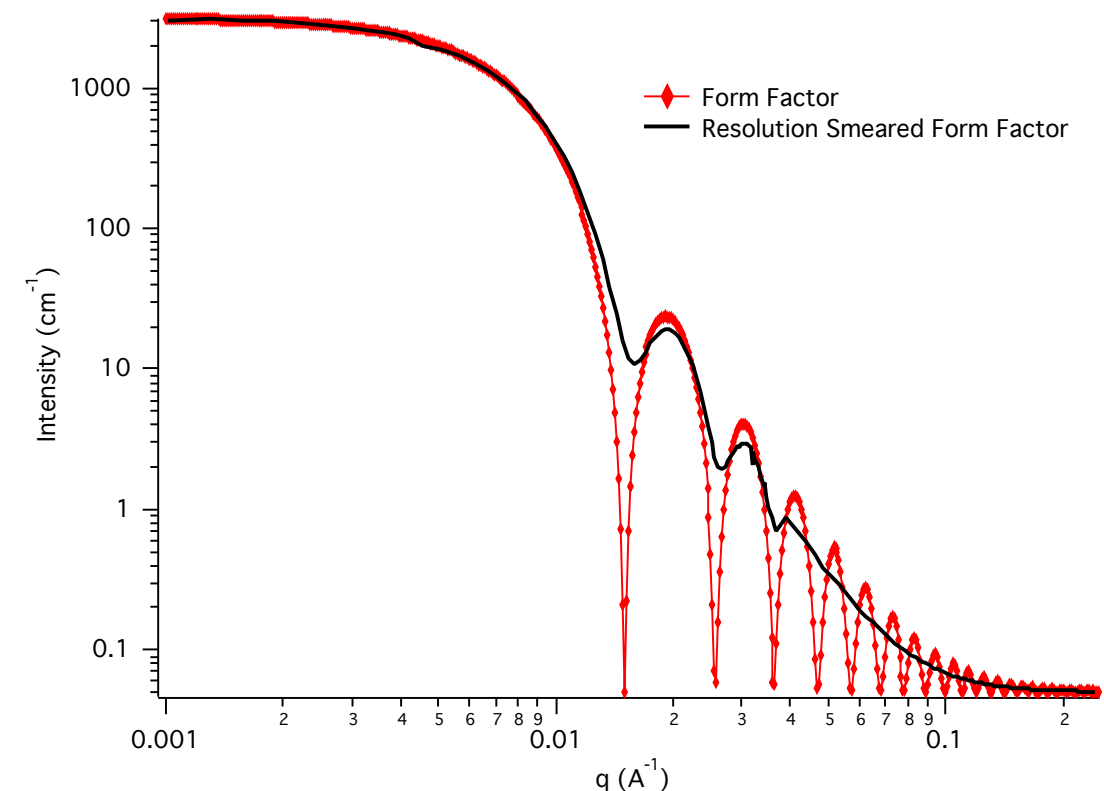
Difficult to “desmear” reliably, therefore smear model functions in analysis.



$$(\sigma_Q)^2 = \frac{1}{12} \left(\frac{2\pi}{\lambda} \right)^2 \left[3 \frac{R_1^2}{L_1^2} + 3 \frac{R_2^2}{L_2^2} + \frac{(\Delta R)^2}{L_2^2} + \frac{R^2}{L_2^2} \left(\frac{\Delta \lambda}{\lambda} \right)^2 \right]$$

$$Q = \frac{2\pi\theta}{\lambda} = \frac{2\pi R}{\lambda L_2} \quad L' = \frac{1}{L_1} + \frac{1}{L_2}$$

$$\left(\frac{\sigma_Q}{Q} \right)^2 = \left(\frac{R_1 L_2}{2 R L_1} \right)^2 + \left(\frac{R_2 (L_1 + L_2)}{2 R L_1} \right)^2 + \frac{1}{12} \left(\frac{\Delta R}{R} \right)^2 + \frac{1}{12} \left(\frac{\Delta \lambda}{\lambda} \right)^2$$



See Mildner & Carpenter, J. Appl. Cryst. 17, 1984 for the gory details.

SAS Data Analysis

Model Independent

We can use an approximation from Guinier

$$I(Q) = I(0)e^{-\frac{(QR_g)^2}{3}}$$

$$\ln(I(Q)) = \ln(I(0)) - \frac{R_g^2}{3}Q^2$$

to obtain the radius of gyration of the scattering objects assuming particulate scatterers and $S(q) = 1$.

Similar approximations can be made to get the cross section of cylinders or the thickness of disks. Various other model independent approaches exist to extract information from the data without a scattering model.

Indirect Fourier Transform

Since we are missing the phase information as a result of the differential cross section being related to the square of the amplitude of the fourier transform, we cannot simply take the fourier transform of our data to get back to $\rho(r)$. Thus we must use an indirect method.

A popular implementation of this method is found in the *ATSAS suite* of software from Prof. Svergun's group. *SasView* also has an implementation of this method.

Model Dependent

We calculate the form and structure factors for a given scattering system and compare that with the measured scattering data. The model is fitted to the data to obtain the parameters that describe the scattering. We can simultaneously fit multiple contrasts to be able to study complex structures.

The software we will be using for this workshop is called *SasView* (<http://www.sasview.org>) and is being jointly developed by NIST, ILL, ISIS, SNS, ANSTO and ESS.

Other software packages for this kind of analysis include the *NIST Igor Macros* developed at the NCNR and *SasFit* developed at the Paul Scherrer Institute.

Ab-initio Structure Generation

An approach that is popular for bio-macromolecules in solution is to generate a structure from many sub-resolution spheres and calculate what the scattering would be. That is then compared with the data and the spheres redistributed. This is repeated until agreement is found.

The *ATSAS suite* is the primary example of software using this method

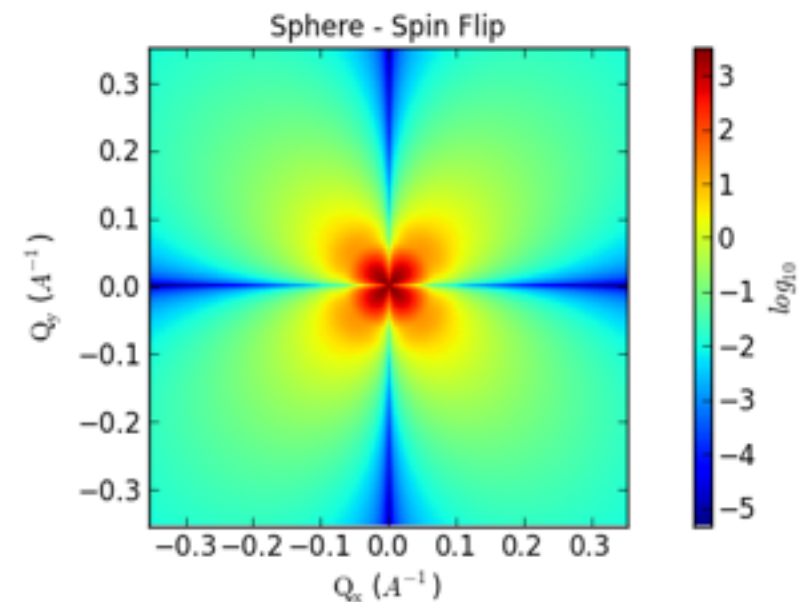
What is SasView?

SasView

User friendly, open source analytical modeling of SAS data.

Current Release (3.1.2) Includes:

- Large number of 1D scattering models
- 2D analysis for oriented objects
- Batch mode
- Magnetic contrast with polarisation analysis
- Lots of extra tools



www.sasview.org



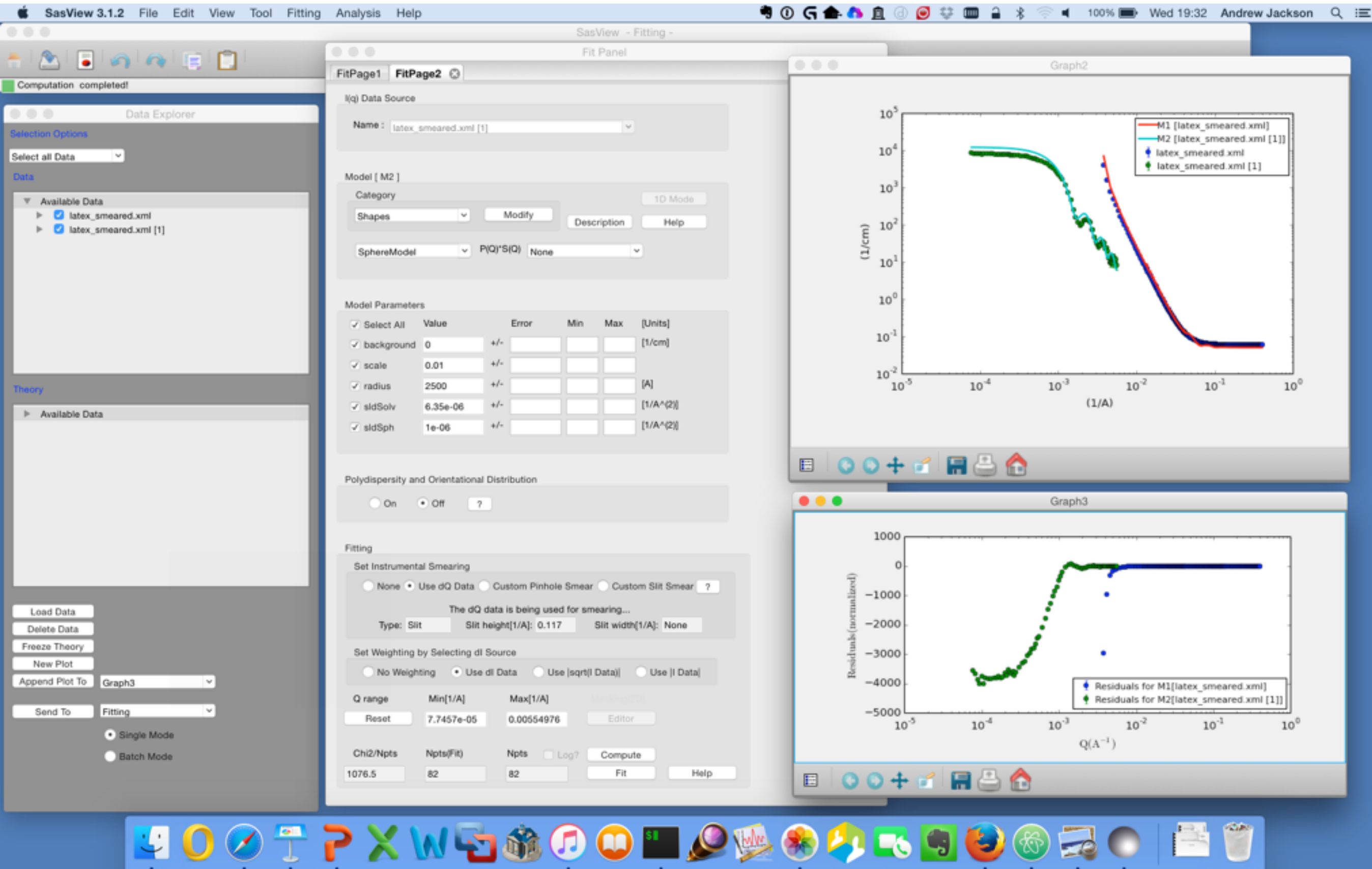
SasView is a Small Angle Scattering Analysis Software Package, originally developed as part of the NSF DANSE project under the name SansView, now managed by an international collaboration of facilities. Feedback and contributions are welcome and encouraged.

Download The Latest Version of [SasView](#)

User Mailing List

[Subscribe to the user mailing list](mailto:sasview-users@lists.sourceforge.net) (sasview-users@lists.sourceforge.net).

1D Analysis



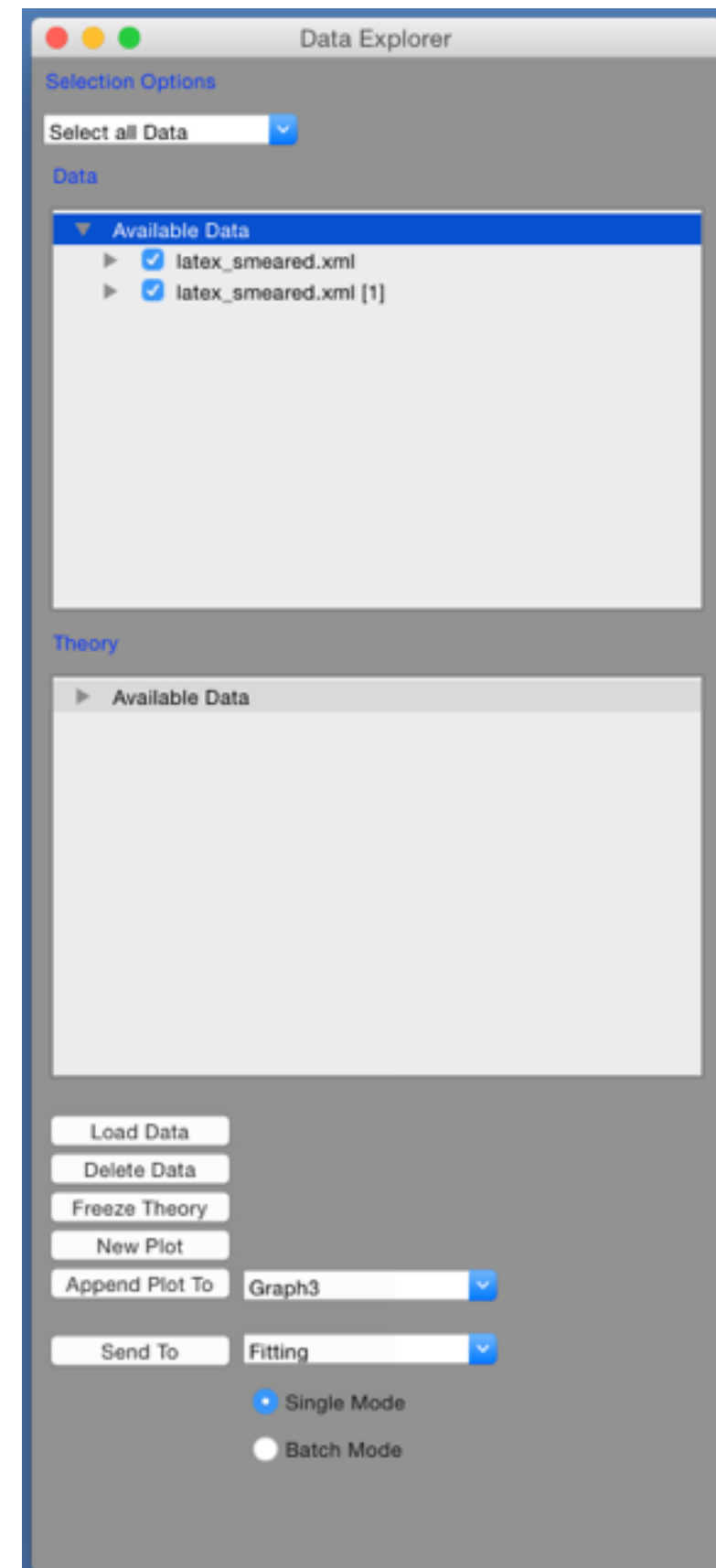
1D Analysis

Load Data ...

Select Data Sets ...

Here we have SANS & USANS from latex spheres

Send to Fitting ...



1D Analysis

Send to fitting ...

Select a model ...



Fit Panel

FitPage1 FitPage2

I(q) Data Source

Name : latex_smeared.xml [1]

Model [M2]

Category Shapes 1D Mode Description Help

SphereModel

Model Parameters

<input checked="" type="checkbox"/> Select All	Value	Error	Min	Max	[Units]
<input checked="" type="checkbox"/> background	0	+/-			[1/cm]
<input checked="" type="checkbox"/> scale	0.01	+/-			
<input checked="" type="checkbox"/> radius	2500	+/-			[Å]
<input checked="" type="checkbox"/> sldSolv	6.35e-06	+/-			[1/Å ²]
<input checked="" type="checkbox"/> sldSph	1e-06	+/-			[1/Å ²]

Polydispersity and Orientational Distribution

☐ On ☒ Off ?

Fitting

Set Instrumental Smearing

☐ None ☒ Use dQ Data ☐ Custom Pinhole Smear ☐ Custom Slit Smear ?

The dQ data is being used for smearing...

Type: Slit Slit height[1/Å]: 0.117 Slit width[1/Å]: None

Set Weighting by Selecting dI Source

☐ No Weighting ☒ Use dI Data ☐ Use |sqrt(I Data)| ☐ Use |I Data|

Q range Min[1/Å] Max[1/Å] Masking(Q)

Reset 7.7457e-05 0.00554976 Editor

Chi2/Npts Npts(Fit) Npts ☐ Log? Compute

1076.5 82 82 Fit Help

1D Analysis

Send to fitting ...

Select a model ...

Set parameters ...



Fit Panel

FitPage1 FitPage2

I(q) Data Source

Name: latex_smeared.xml [1]

Model [M2]

Category: Shapes [v] Modify Description Help

SphereModel [v] P(Q)*S(Q) None [v]

1D Mode

Model Parameters

<input checked="" type="checkbox"/> Select All	Value	Error	Min	Max	[Units]
<input checked="" type="checkbox"/> background	0	+/-			[1/cm]
<input checked="" type="checkbox"/> scale	0.01	+/-			
<input checked="" type="checkbox"/> radius	2500	+/-			[Å]
<input checked="" type="checkbox"/> sldSolv	6.35e-06	+/-			[1/Å ²]
<input checked="" type="checkbox"/> sldSph	1e-06	+/-			[1/Å ²]

Polydispersity and Orientational Distribution

☐ On ☒ Off ?

Fitting

Set Instrumental Smearing

☐ None ☒ Use dQ Data ☐ Custom Pinhole Smear ☐ Custom Slit Smear ?

The dQ data is being used for smearing...

Type: Slit Slit height[1/Å]: 0.117 Slit width[1/Å]: None

Set Weighting by Selecting dI Source

☐ No Weighting ☒ Use dI Data ☐ Use |sqrt(I Data)| ☐ Use |I Data|

Q range Min[1/Å] Max[1/Å] Masking(Q)

Reset 7.7457e-05 0.00554976 Editor

Chi2/Npts Npts(Fit) Npts Log? Compute

1076.5 82 82 Fit Help

1D Analysis

Send to fitting ...

Select a model ...

Set parameters ...

Use resolution ...

The screenshot shows the 'Fit Panel' window with two tabs: 'FitPage1' and 'FitPage2'. The 'FitPage2' tab is active. The interface is organized into several sections:

- I(q) Data Source:** A dropdown menu showing 'latex_smeared.xml [1]'.
- Model [M2]:** Includes a 'Category' dropdown set to 'Shapes', a 'Modify' button, and buttons for 'Description' and 'Help'. Below this, a dropdown shows 'SphereModel', followed by 'P(Q)*S(Q)' and another dropdown set to 'None'. A '1D Mode' button is also present.
- Model Parameters:** A table with columns for 'Select All', 'Value', 'Error', 'Min', 'Max', and '[Units]'. All 'Select All' checkboxes are checked.

Select All	Value	Error	Min	Max	[Units]
<input checked="" type="checkbox"/>	background	0	+/-		[1/cm]
<input checked="" type="checkbox"/>	scale	0.01	+/-		
<input checked="" type="checkbox"/>	radius	2500	+/-		[Å]
<input checked="" type="checkbox"/>	sldSolv	6.35e-06	+/-		[1/Å ²]
<input checked="" type="checkbox"/>	sldSph	1e-06	+/-		[1/Å ²]
- Polydispersity and Orientational Distribution:** Radio buttons for 'On', 'Off' (selected), and '?'.
- Fitting:** A section with a 'Set Instrumental Smearing' subsection. It has radio buttons for 'None', 'Use dQ Data' (selected), 'Custom Pinhole Smear', and 'Custom Slit Smear'. Below this, it says 'The dQ data is being used for smearing...' and includes fields for 'Type: Slit', 'Slit height[1/Å]: 0.117', and 'Slit width[1/Å]: None'. There is also a 'Set Weighting by Selecting dI Source' subsection with radio buttons for 'No Weighting', 'Use dI Data' (selected), 'Use |sqrt(I Data)|', and 'Use |I Data|'. At the bottom, there are fields for 'Q range' (with a 'Reset' button), 'Min[1/Å]: 7.7457e-05', 'Max[1/Å]: 0.00554976', and a 'Masking(Q)' button. Finally, there are fields for 'Chi2/Npts: 1076.5', 'Npts(Fit): 82', 'Npts: 82', a 'Log?' checkbox, and buttons for 'Compute', 'Fit', and 'Help'.

1D Analysis

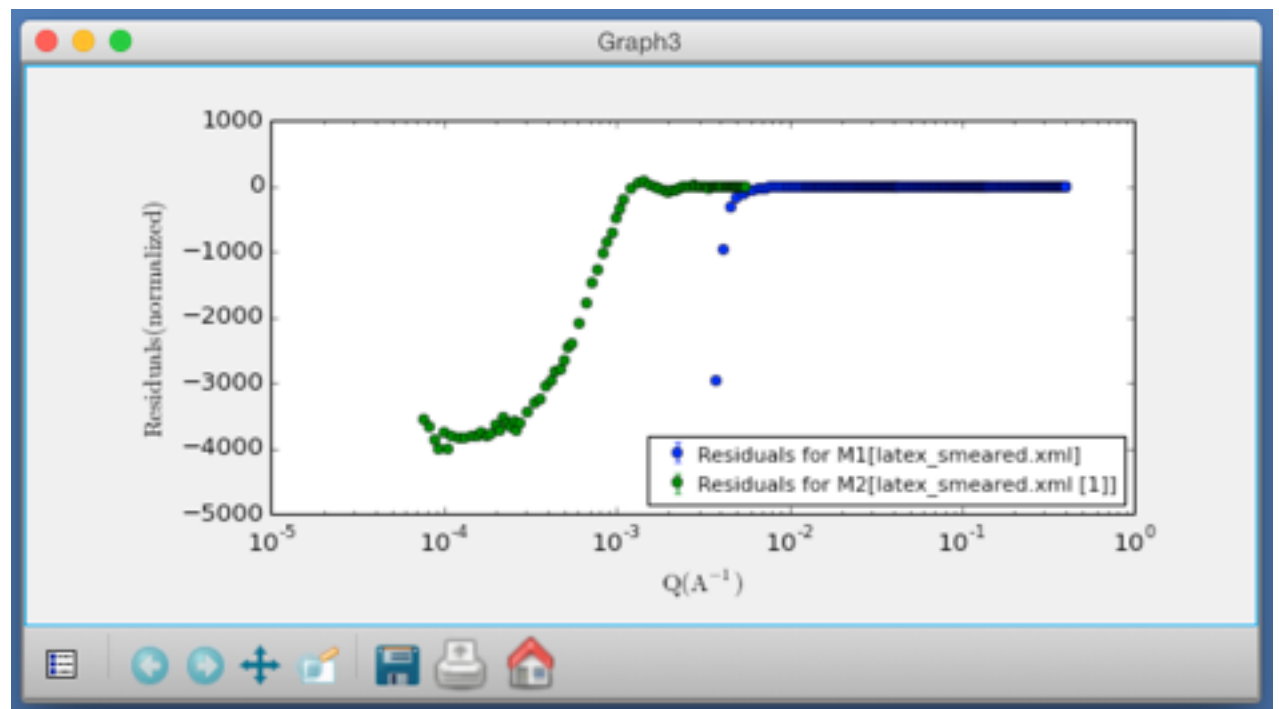
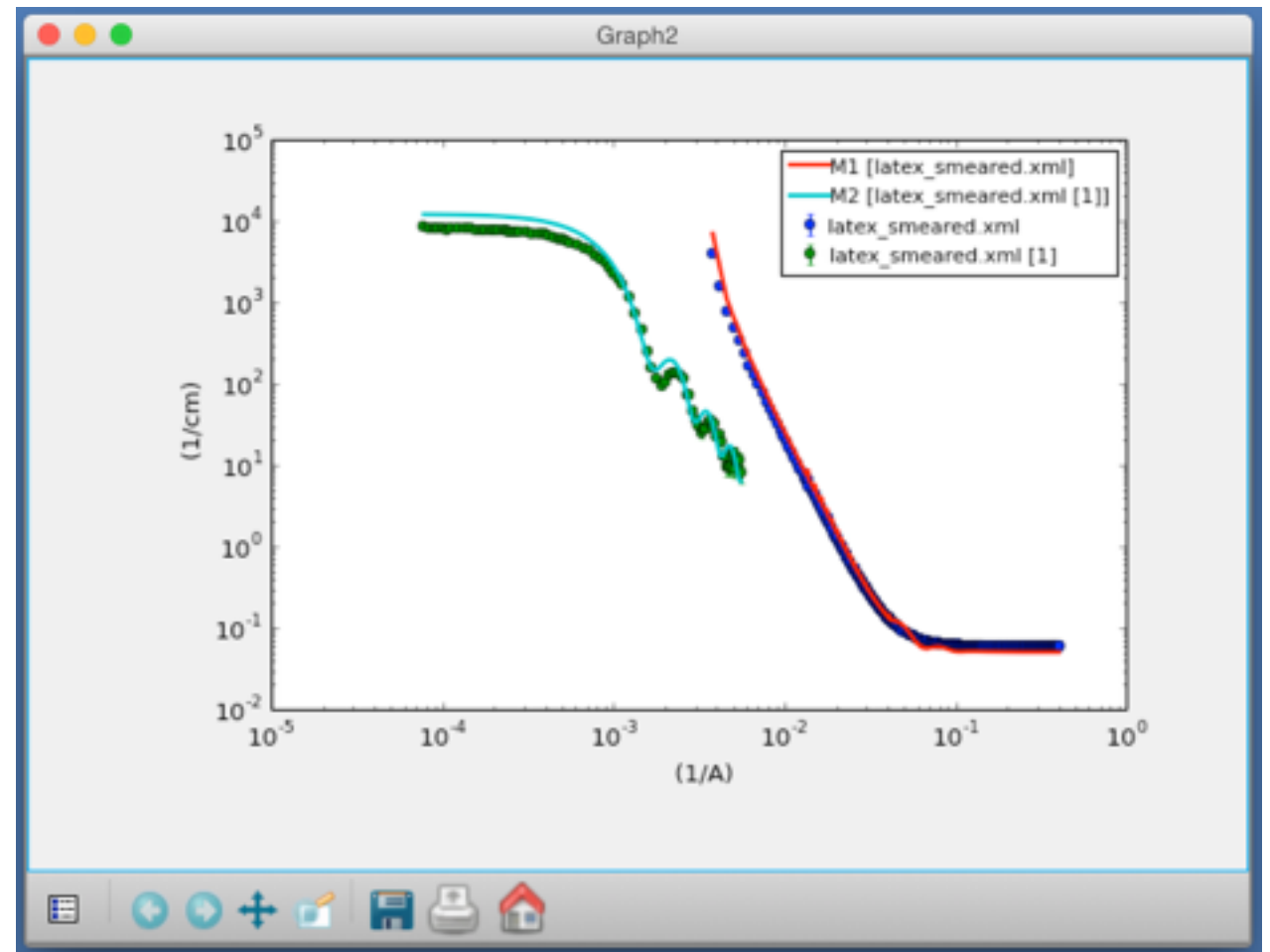
Send to fitting ...

Select a model ...

Set parameters ...

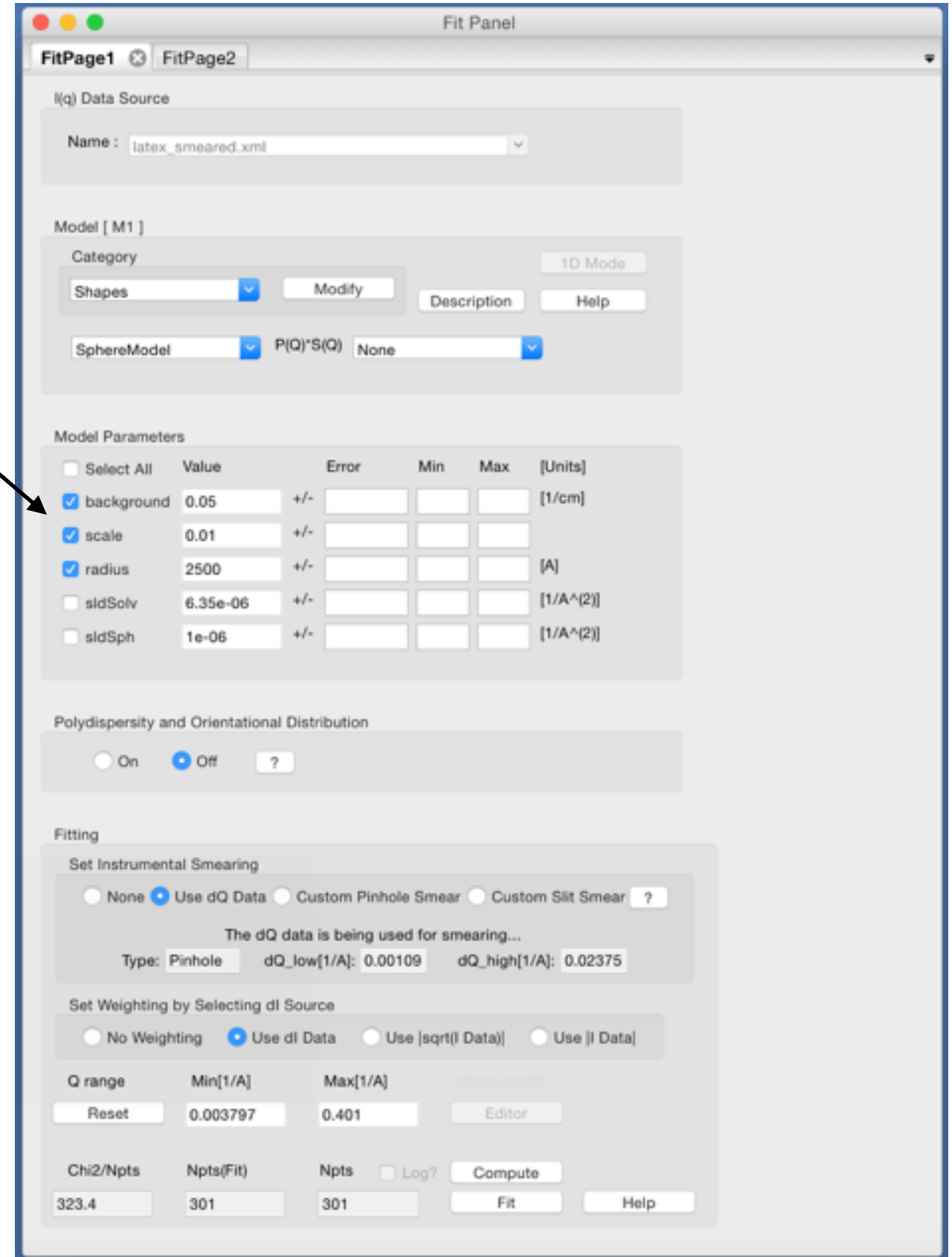
Use resolution ...

How does it look?



1D Analysis

Choose which parameters to fit ...



The screenshot shows the 'Fit Panel' window with the following sections:

- l(q) Data Source:** Name: latex_smeared.xml
- Model [M1]:**
 - Category: Shapes
 - Model: SphereModel
 - P(Q)*S(Q): None
- Model Parameters:** A table with columns: Select All, Value, Error, Min, Max, [Units].

Select All	Value	Error	Min	Max	[Units]
<input checked="" type="checkbox"/>	background	0.05	+/-		[1/cm]
<input checked="" type="checkbox"/>	scale	0.01	+/-		
<input checked="" type="checkbox"/>	radius	2500	+/-		[Å]
<input type="checkbox"/>	sldSolv	6.35e-06	+/-		[1/Å ²]
<input type="checkbox"/>	sldSph	1e-06	+/-		[1/Å ²]
- Polydispersity and Orientational Distribution:** On ☐ Off ☒ ?
- Fitting:**
 - Set Instrumental Smearing: None ☐ Use dQ Data ☒ Custom Pinhole Smear ☐ Custom Slit Smear ☐ ?
 - The dQ data is being used for smearing...
 - Type: Pinhole dQ_low[1/Å]: 0.00109 dQ_high[1/Å]: 0.02375
 - Set Weighting by Selecting dI Source: No Weighting ☐ Use dI Data ☒ Use |sqrt(I) Data| ☐ Use |I Data| ☐
 - Q range: Min[1/Å]: 0.003797 Max[1/Å]: 0.401
 - Chi2/Npts: 323.4 Npts(Fit): 301 Npts: 301

1D Analysis

Choose which parameters to fit ...

... and press the Fit button!

The screenshot shows the 'Fit Panel' window with two tabs: 'FitPage1' and 'FitPage2'. The 'FitPage1' tab is active. The interface includes the following sections:

- I(q) Data Source:** A dropdown menu showing 'latex_smeared.xml'.
- Model [M1]:**
 - Category:** A dropdown menu showing 'Shapes'.
 - Modify:** A button.
 - Description:** A button.
 - Help:** A button.
 - SphereModel:** A dropdown menu.
 - P(Q)*S(Q):** A dropdown menu showing 'None'.
- Model Parameters:** A table with columns: Select All, Value, Error, Min, Max, [Units].

Select All	Value	Error	Min	Max	[Units]
<input checked="" type="checkbox"/>	background	0.05	+/-		[1/cm]
<input checked="" type="checkbox"/>	scale	0.01	+/-		
<input checked="" type="checkbox"/>	radius	2500	+/-		[Å]
<input type="checkbox"/>	sldSolv	6.35e-06	+/-		[1/Å ²]
<input type="checkbox"/>	sldSph	1e-06	+/-		[1/Å ²]
- Polydispersity and Orientational Distribution:** Radio buttons for 'On', 'Off' (selected), and '?'.
- Fitting:**
 - Set Instrumental Smearing:** Radio buttons for 'None', 'Use dQ Data' (selected), 'Custom Pinhole Smear', and 'Custom Slit Smear'. Below, it says 'The dQ data is being used for smearing...' and shows 'Type: Pinhole', 'dQ_low[1/Å]: 0.00109', and 'dQ_high[1/Å]: 0.02375'.
 - Set Weighting by Selecting dI Source:** Radio buttons for 'No Weighting', 'Use dI Data' (selected), 'Use [sqrt(I) Data]', and 'Use |I Data|'.
 - Q range:** 'Reset' button, 'Min[1/Å]: 0.003797', 'Max[1/Å]: 0.401', and an 'Editor' button.
 - Chi2/Npts:** '323.4'.
 - Npts(Fit):** '301'.
 - Npts:** '301'.
 - Buttons:** 'Compute' (highlighted with a red box), 'Fit' (highlighted with a red box), and 'Help'.

Two arrows from the text on the left point to the 'background' parameter in the 'Model Parameters' table and the 'Fit' button.

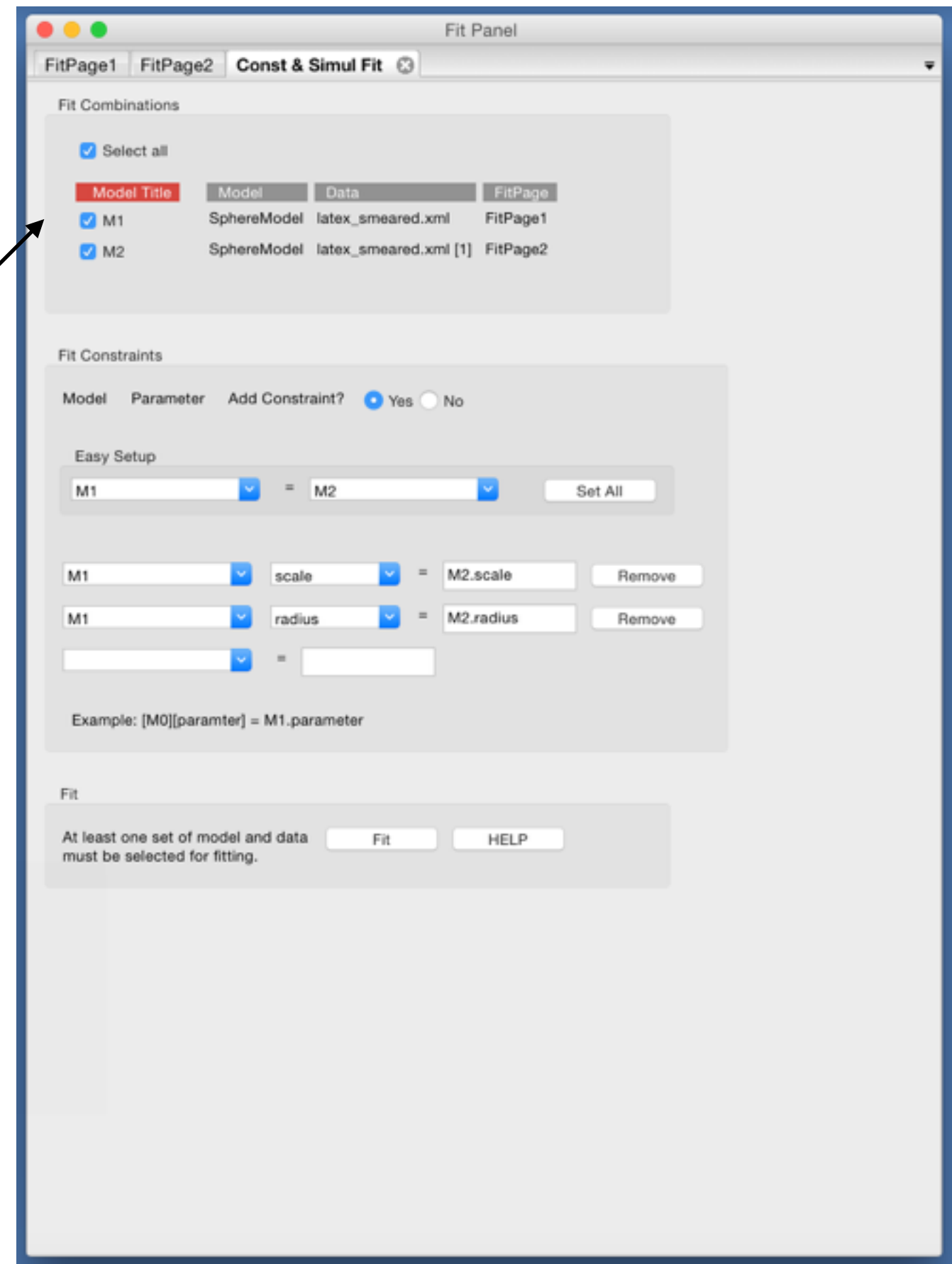
Constraints / Simultaneous Fit

But wait! We have two data
sets of the same sample :
SANS + USANS ...

Constraints / Simultaneous Fit

But wait! We have two data sets of the same sample : SANS + USANS ...

Set up a simultaneous fit ...

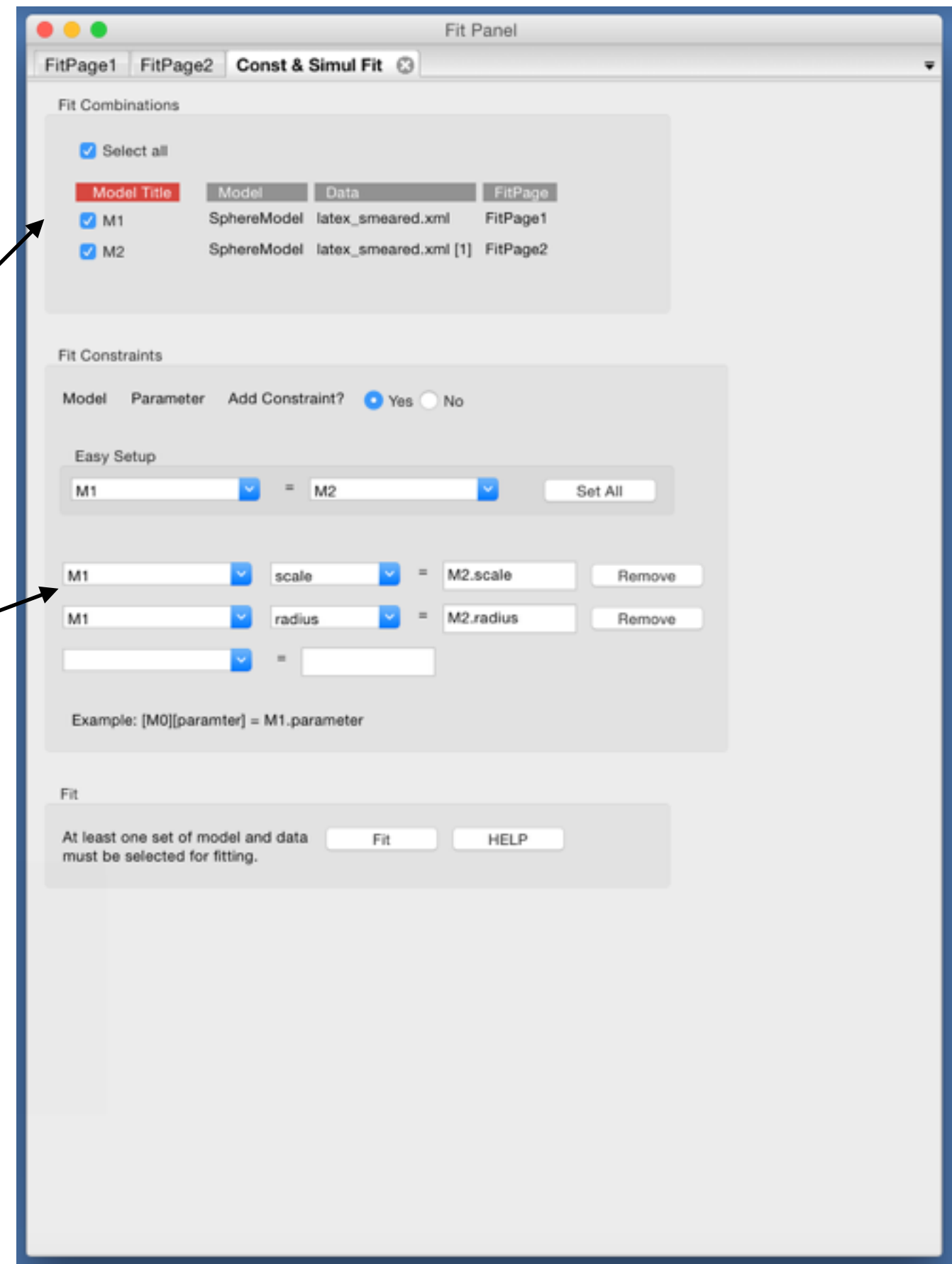


Constraints / Simultaneous Fit

But wait! We have two data sets of the same sample : SANS + USANS ...

Set up a simultaneous fit ...

... with constraints



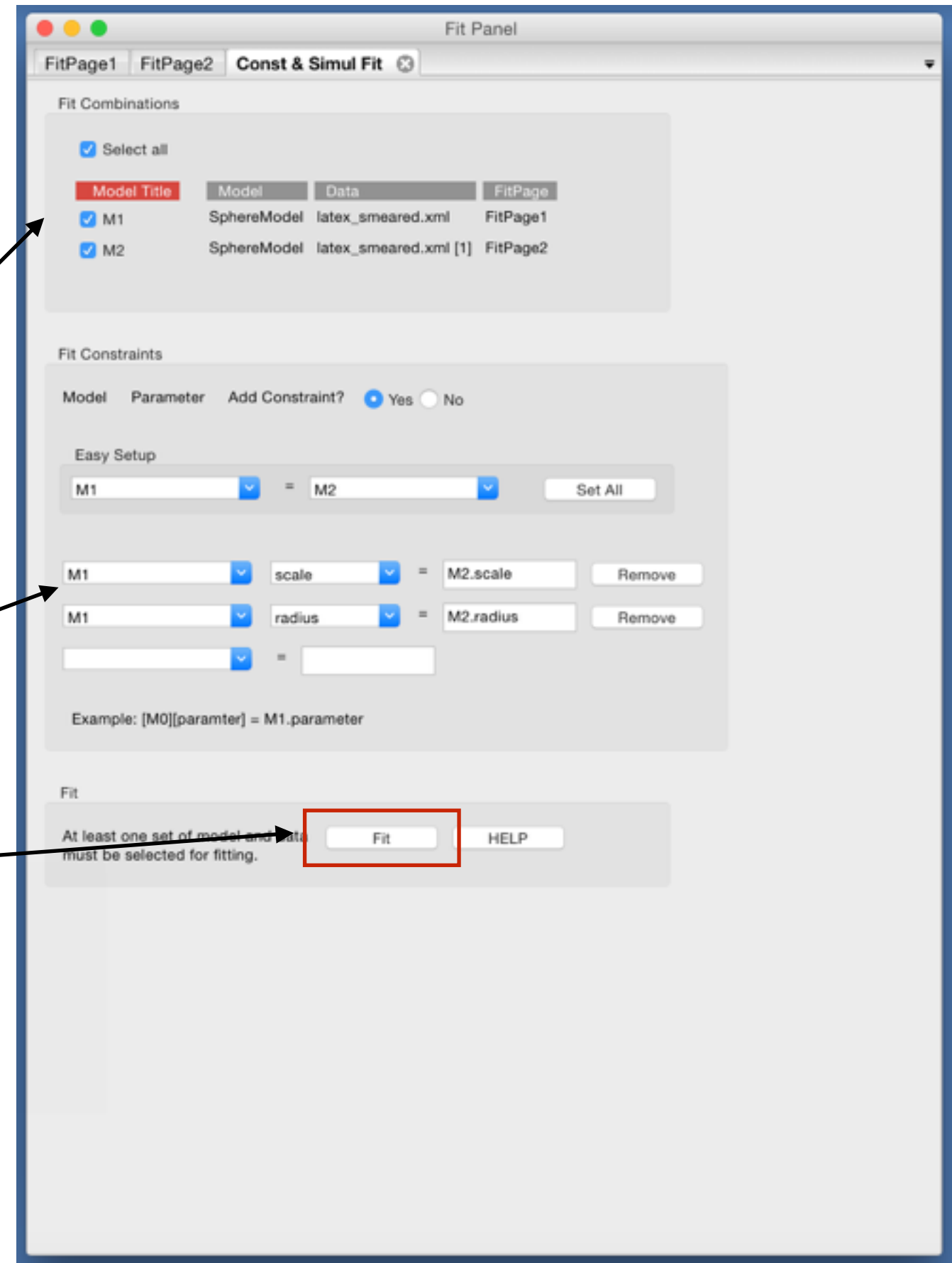
Constraints / Simultaneous Fit

But wait! We have two data sets of the same sample : SANS + USANS ...

Set up a simultaneous fit ...

... with constraints

Now press the Fit button!



Constraints / Simultaneous Fit

Fit Panel

FitPage1 FitPage2 Const & Simul Fit

l(q) Data Source

Name: latex_smeared.xml [1]

Model [M2]

Category Shapes 1D Mode

SphereModel None

Model Parameters

<input type="checkbox"/> Select All	Value	Error	Min	Max	[Units]
<input checked="" type="checkbox"/> background	2.6088	+/- 0.48857			[1/cm]
<input checked="" type="checkbox"/> scale	0.0075699	+/- 6.9289e-06			
<input checked="" type="checkbox"/> radius	2324	+/- 0.32602			[Å]
<input type="checkbox"/> sldSolv	6.35e-06	+/-			[1/Å ²]
<input type="checkbox"/> sldSph	1e-06	+/-			[1/Å ²]

Polydispersity and Orientational Distribution

☐ On ☒ Off ?

Fitting

Set Instrumental Smearing

☐ None ☒ Use dQ Data ☐ Custom Pinhole Smear ☐ Custom Slit Smear ?

The dQ data is being used for smearing...

Type: Slit Slit height[1/Å]: 0.117 Slit width[1/Å]: None

Set Weighting by Selecting dI Source

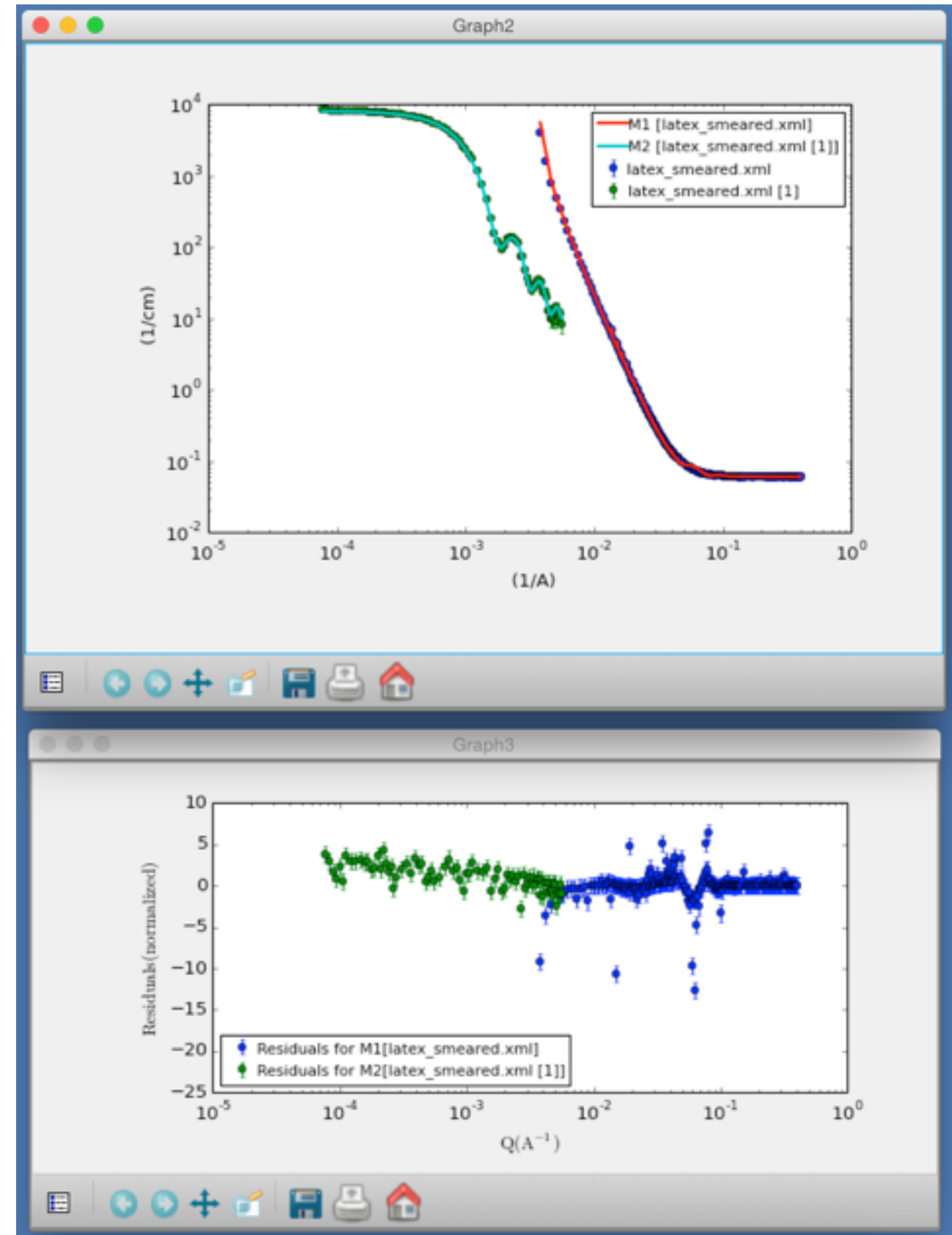
☐ No Weighting ☒ Use dI Data ☐ Use |sqrt(I Data)| ☐ Use |I Data|

Q range Min[1/Å] Max[1/Å] Marking[?] Editor

Reset 7.7457e-05 0.00554976

Chi2/Npts Npts(Fit) Npts Log? Compute

3.5962 82 82 Fit Help



2D Modelling

Cite this: *Soft Matter*, 2011, **7**, 9992

www.rsc.org/softmatter

PAPER

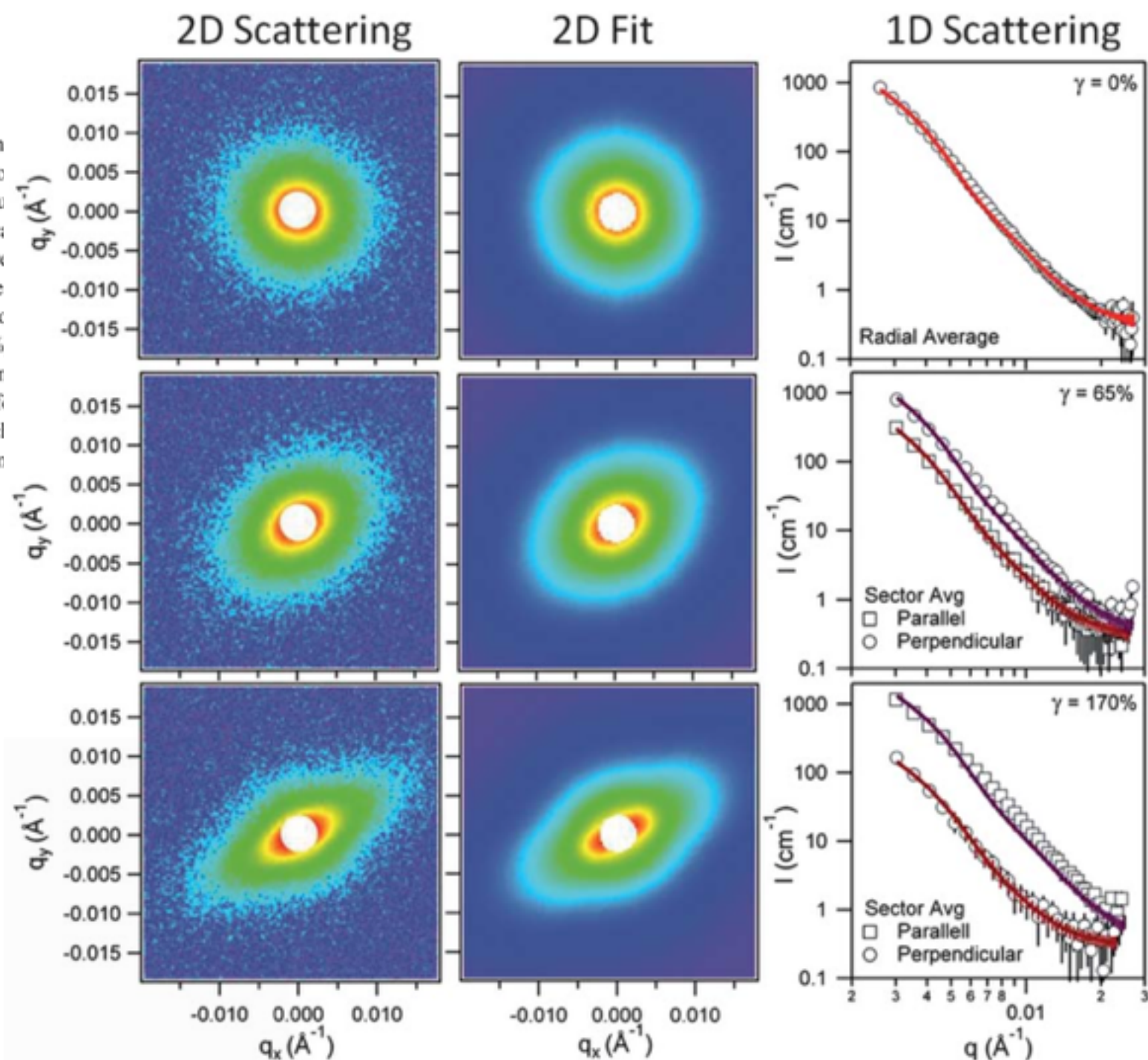
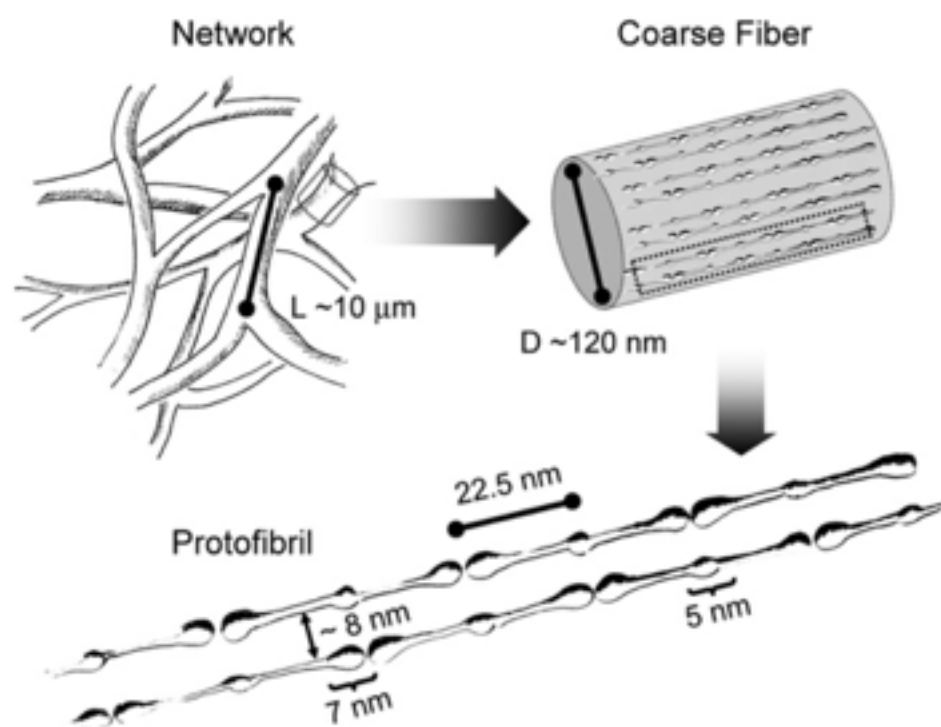
In situ neutron scattering study of structural transitions in fibrin networks under shear deformation

Katie M. Weigandt,^a Lionel Porcar^{bc} and Danilo C. Pozzo^{*a}

Received 23rd June 2011, Accepted 5th August 2011

DOI: 10.1039/c1sm06176c

Small angle neutron scattering (SANS) is used to decipher the origin of the strain hardening response of coarse fibrin networks by directly measuring the structural response of a fibrin gel to deformation. A special Couette shear cell is used to systematically probe the structure of a fibrin clot over strain values in the range of $\gamma = 1$ –170%. The SANS results indicate that the hardening response of coarse fibrin gels occurs in two distinct regions having different mechanical signatures that are separated by an intermediate strain softening regime ($\gamma < 10\%$) where there is a measurable increase in the shear modulus upon the application of strain. At higher strain values ($\gamma > 30\%$) the hardening regime is directly correlated to significant fiber alignment. The mean diameter determined directly from two-dimensional fits to the anisotropic scattering data is found to increase monotonically in the high-strain regime. The results suggest that the non-linear mechanical response of fibrin clots is the result of a reduction of lateral entropic fluctuations at low strain and of fiber alignment at higher strain values.



Other Features

Batch fitting ...

Fit Panel

FitPage1 BatchPage1

I(q) Data Source

- Choose a file to set initial fit parameters -
- This panel is not designed to view individual fits. -

Name : P123_D2O_30_percent.xml

- P123_D2O_30_percent.xml
- P123_D2O_10_percent.xml
- P123_D2O_40_percent.xml

Model

Category

Shape-Independent

Modify

Description

Help

1D Mode

Polydispersity and Orientational Distribution

☐ On ☒ Off ?

Fitting

Set Instrumental Smearing

☒ None ☐ Use dQ Data ☐ Custom Pinhole Smear ☐ Custom Slit Smear ?

No smearing is selected...

Set Weighting by Selecting dI Source

☐ No Weighting ☒ Use dI Data ☐ Use |sqrt(I Data)| ☐ Use |I Data|

Q range Min[1/A] Max[1/A] Masking(2D)

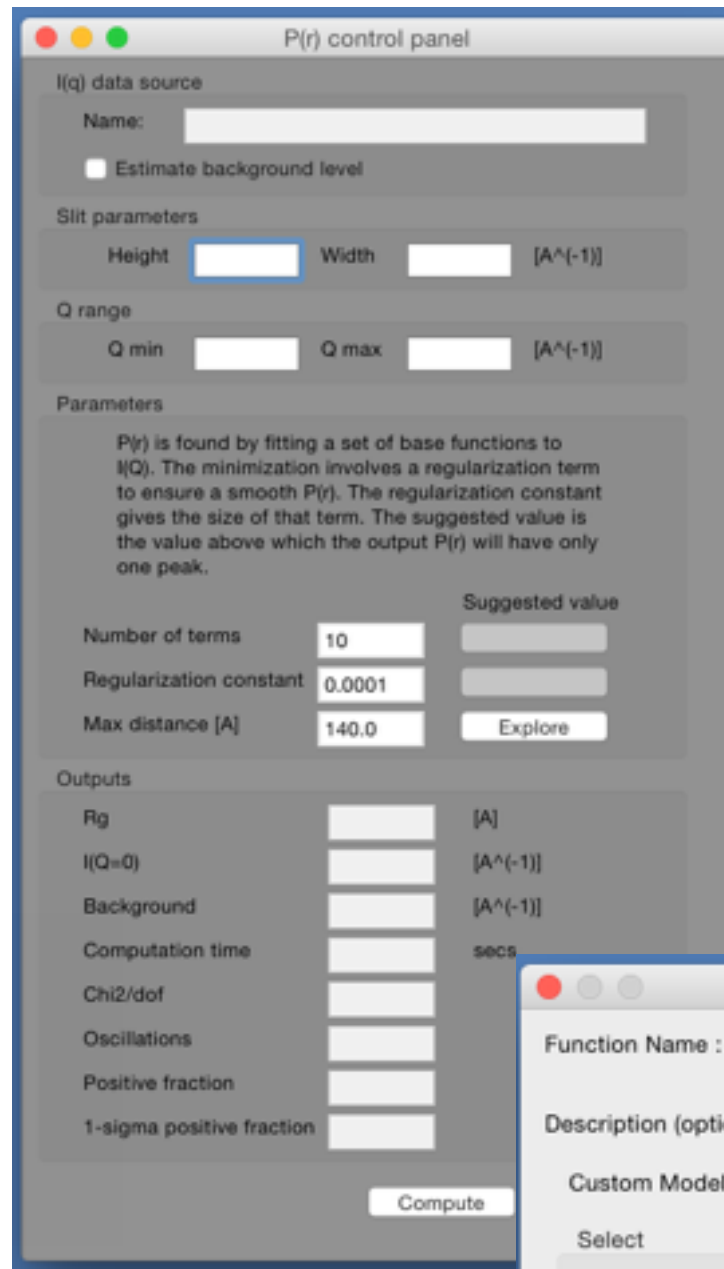
Reset 0.009 0.2545 Editor

Chi2/Npts Npts(Fit) Npts Log? Compute

- 124 124 Fit Help

Other Features

P(r) Inversion ...



P(r) control panel

I(q) data source
Name:
☐ Estimate background level

Slit parameters
Height Width [\AA^{-1}]

Q range
Q min Q max [\AA^{-1}]

Parameters
P(r) is found by fitting a set of base functions to I(Q). The minimization involves a regularization term to ensure a smooth P(r). The regularization constant gives the size of that term. The suggested value is the value above which the output P(r) will have only one peak.

Number of terms Suggested value

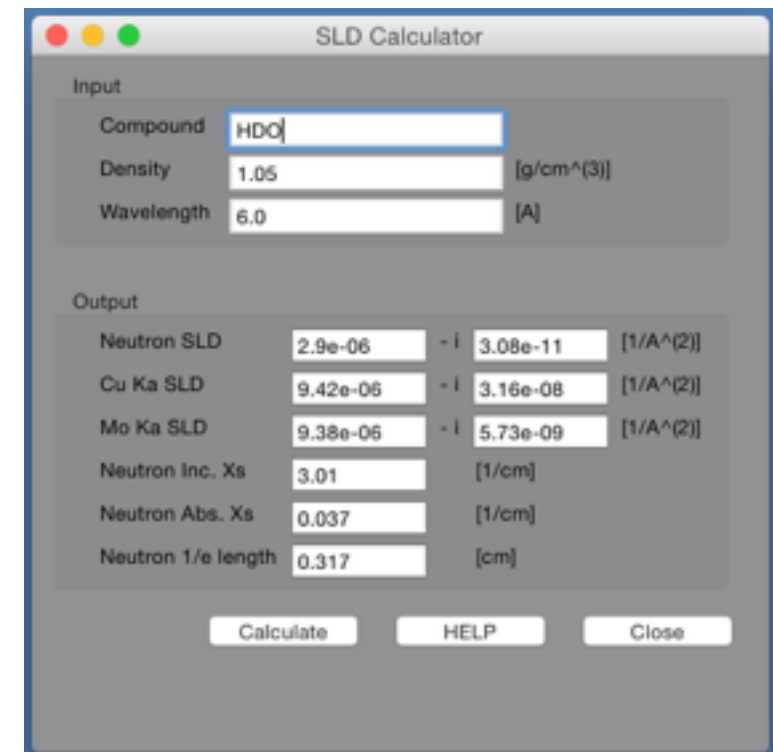
Regularization constant

Max distance [\AA]

Outputs

Rg	<input type="text"/>	[\AA]
I(Q=0)	<input type="text"/>	[\AA^{-1}]
Background	<input type="text"/>	[\AA^{-1}]
Computation time	<input type="text"/>	secs
Chi2/dof	<input type="text"/>	
Oscillations	<input type="text"/>	
Positive fraction	<input type="text"/>	
1-sigma positive fraction	<input type="text"/>	

SLD Calculator ...



SLD Calculator

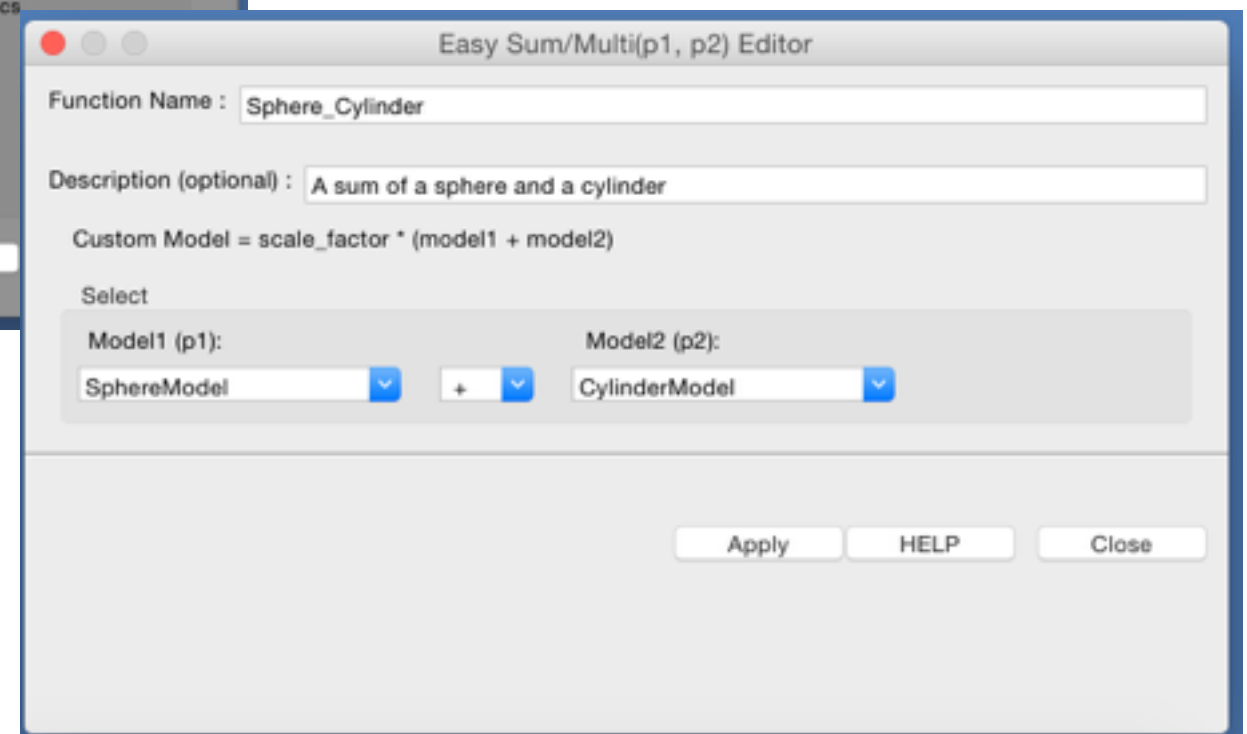
Input

Compound
Density [g/cm^3]
Wavelength [\AA]

Output

Neutron SLD	<input type="text" value="2.9e-06"/>	- i	<input type="text" value="3.08e-11"/>	[$1/\text{\AA}^2$]
Cu Ka SLD	<input type="text" value="9.42e-06"/>	- i	<input type="text" value="3.16e-08"/>	[$1/\text{\AA}^2$]
Mo Ka SLD	<input type="text" value="9.38e-06"/>	- i	<input type="text" value="5.73e-09"/>	[$1/\text{\AA}^2$]
Neutron Inc. Xs	<input type="text" value="3.01"/>			[1/cm]
Neutron Abs. Xs	<input type="text" value="0.037"/>			[1/cm]
Neutron 1/e length	<input type="text" value="0.317"/>			[cm]

Sum & Multiplication of Models ...



Easy Sum/Multi(p1, p2) Editor

Function Name :

Description (optional) :

Custom Model = scale_factor * (model1 + model2)

Select

Model1 (p1):

SasView Development

A little history ...

Where did SasView come from?



DANSE project output
~ 8.5% of funds were for
SANS

Kickoff meeting August
2006

Heritage: NIST IGOR
macros



Continuity ...

NIST Supported initial transition from NSF funding

Expansion ...

NIST Supported initial transition from NSF funding

Now 7 active facilities

ORNL, ISIS, NIST, ESS, ILL, TUD/RID, ANSTO

SINE2020 Funding at ESS

First major investment since DANSE

<http://sine2020.eu>

Development Model

Open, Collaborative, Community Development

Code is open source and publicly hosted at Github

Bi-weekly developer calls

Code Camps

1st at NIST April 2013

2nd at ISIS April 2014

3rd at ESS Feb 2015

4th in Delft hosted by TU Delft / RID March 2016

5 Year Roadmap

<http://www.sasview.org>

<http://github.com/SasView>

The Future ... is Now!

SESANS

- Automatic transform of SANS model to $P(z)$
- Example scripts for fitting SESANS data
- Simultaneous fitting of SANS & SESANS
- Integration of SESANS fitting into GUI

Models

- New models
- New model package (sasmodels)
 - separation of models from GUI
 - simpler addition of models by users
 - speed! GPU and parallel processing

Documentation

- Enhanced, updated documentation for models

Current Development Team

- Paul Butler (NIST)
- Mathieu Doucet (ORNL)
- Steve King (ISIS)
- Andrew Jackson (ESS)



- Jurrian Bakker (TUD)
 - Wim Bouwman (TUD)
 - Miguel Gonzales (ILL)
 - Richard Heenan (ISIS)
 - Paul Kienzle (NIST)
 - Jeff Kryzwon (NIST)
 - Ricardo Leal (ORNL)
 - David Manicke (ANSTO)
 - Torben Nielsen (ESS)
 - Steve Parnell (TUD)
 - Wojciech Potrzebowski (ESS)
 - Piotr Rozyczko (ESS)
 - Adam Washington (Sheffield)
-
- and thanks to the many previous contributors, particularly Jae Hie Cho and Alina Gervaise

Questions?

