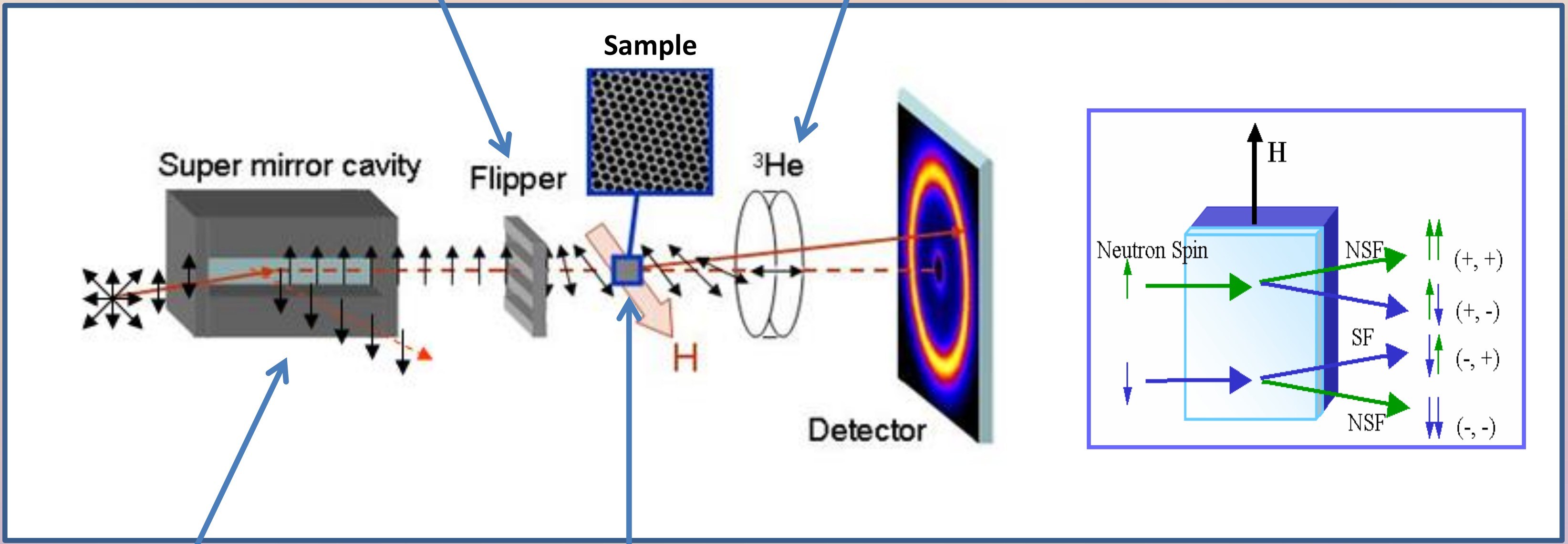
Polarization Analyzed SANS

Flip neutron spin at will with respect to the polarization axis using electromagnetic coil of RF flippers.

^{3}He cell can spin analyze a divergently scattering beam.

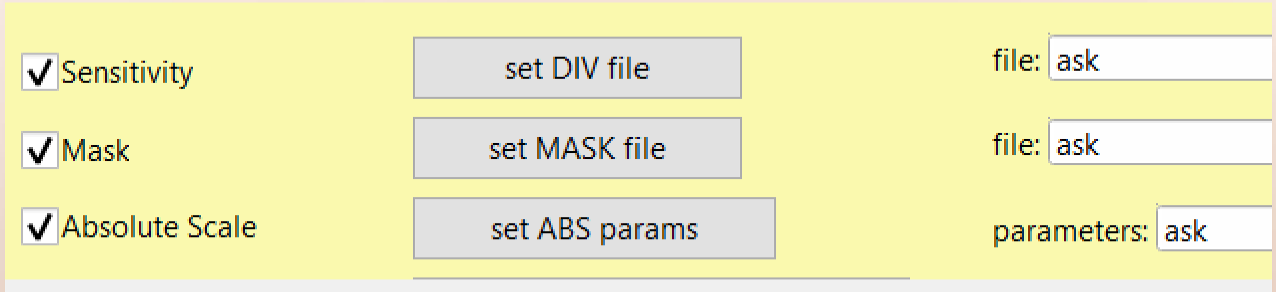


H defines polarization axis.
Select out one spin orientation.

Structural scattering does not flip neutron spins; magnetic scattering can (provides means to separate the two).

I. Spin leakage correction (Reduction, J. Appl. Cryst. 45, 546-553, 2012)
II. Magnetic interpretation of cross-sections (Analysis, J. Appl. Cryst. 45, 554-565, 2012).

Standard Instrumental Data Corrections



- 2D **Detector Sensitivity**: Corrects for bad pixels with DIV file
- **Absolute Scaling**: Normalize to Incident Beam Intensity
- **Mask** scattering from detector edges and “bad” spots

ALSO

Math for Sample-Specific Corrections

COR = (SAM - BGD) - [Tsam/Temp](EMP - BGD)

Blocked Beam (BGD) measure
of electronic and ambient bgr

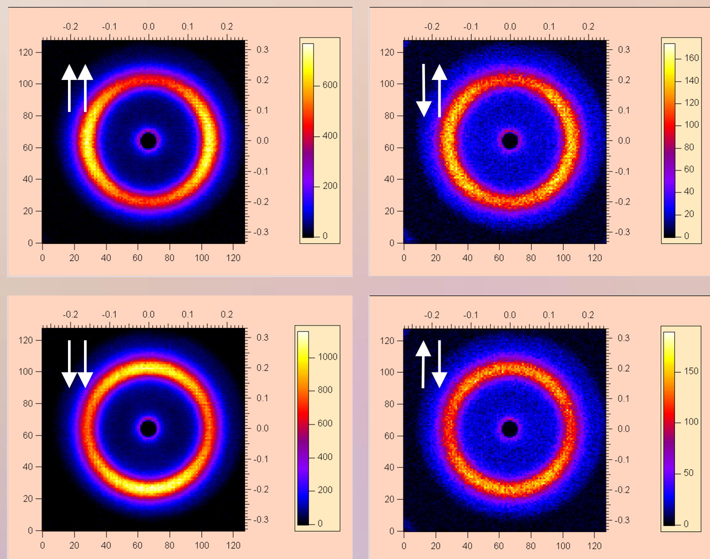
Sample Scattering files (SAM)

Empty Cell (EMP) measure of bgr
from sample holder and main beam

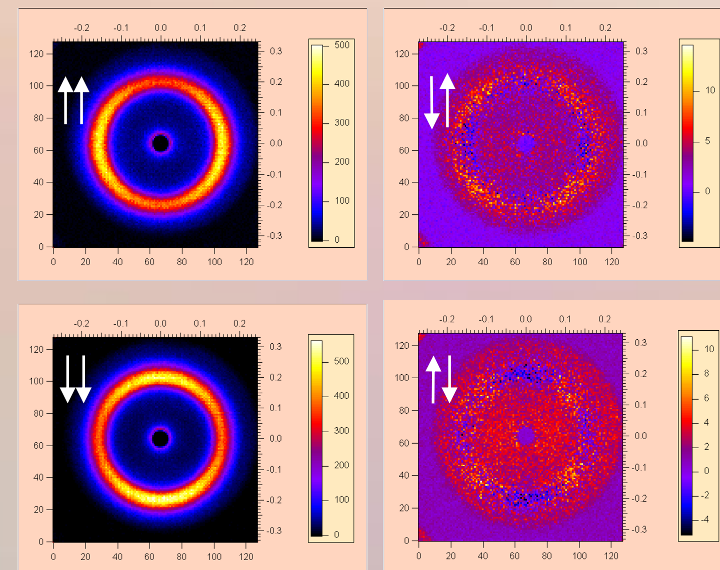
Sample and Empty Cell transmissions
relative to intensity of incident beam

Polarization Correction

Before correction structural Bragg peak dominates



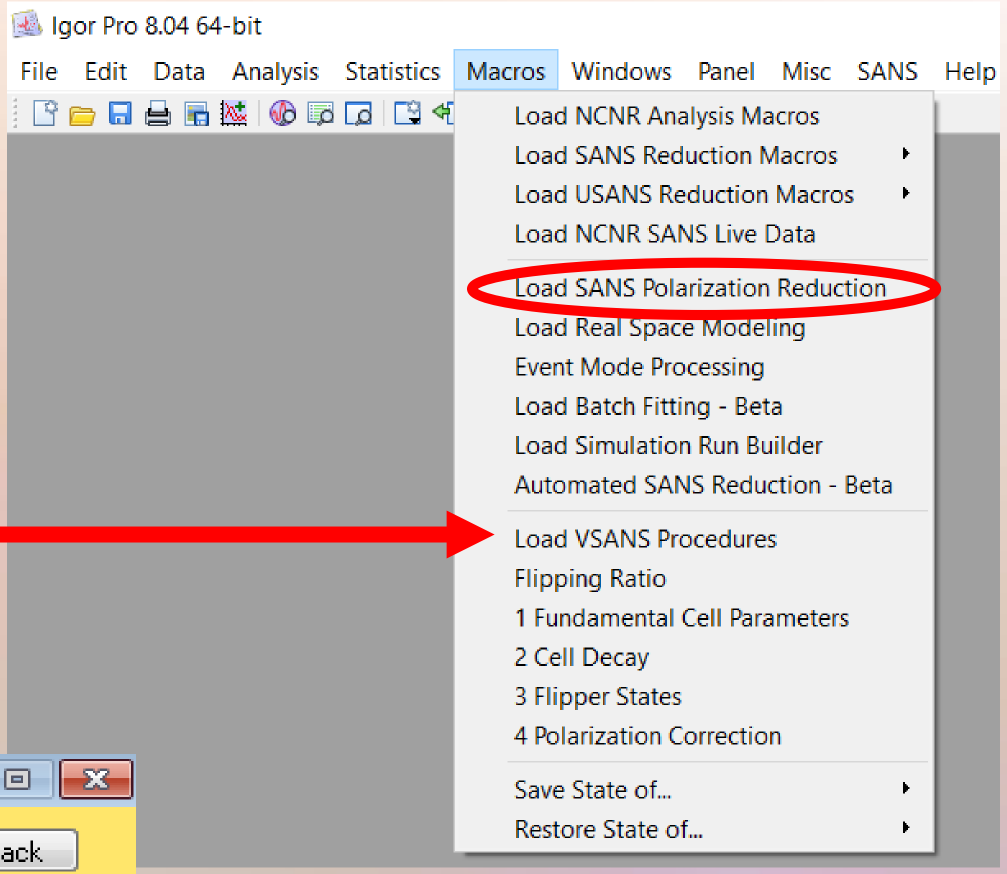
After correction four-fold magnetic symmetry becomes apparent

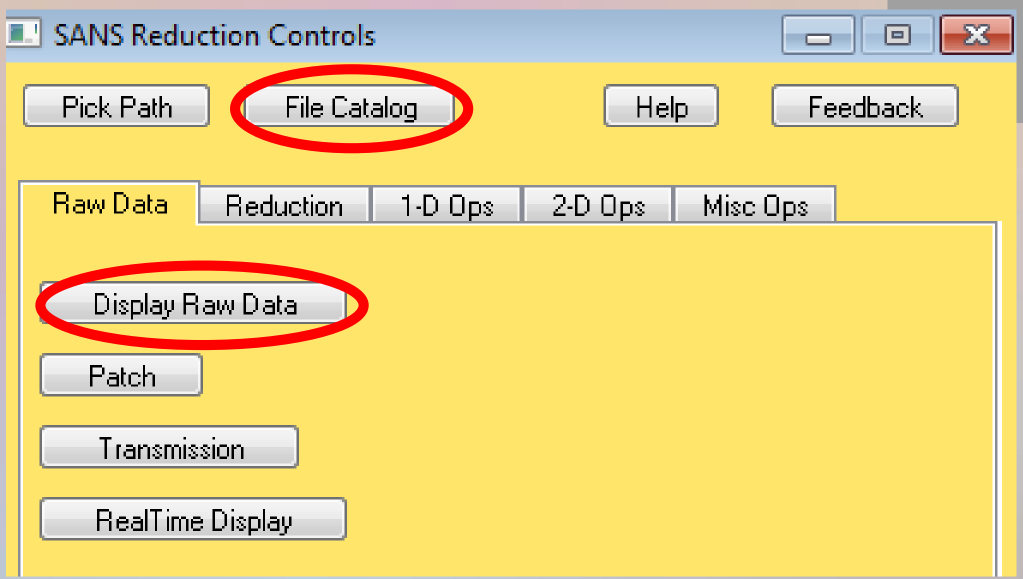


Non spin-flip contains structural scattering and usually is much more intense than magnetic-only spin-flip. Thus, spin-flip is more strongly affected by leakage.

Getting Started with IGOR for NG7 PASANS Reduction

Igor software and macros found at http://www.ncnr.nist.gov/programs/sans/data/red_anal.html





First Steps:

- Pick Path for *GlassyCoFe2O410KHFData NG7* files
- List files
- Plot 2D data

Checklist of files needed:

- Open Beam transmission (SM IN, 3HE OUT) for absolute scaling at every detector distance [often obtained during alignment]
- Sample transmission (SM IN, 3HE OUT) needed for absorption scaling
- Blocked beam transmission for each detector distance
- Blocked beam scattering for each detector distance

- A Trans. SM OUT, 3He OUT
- B Trans. SM OUT, 3He IN

Measures 3He decay (repeat every few hours)

- C Trans. (↑↑) SM IN, FLIP OFF, 3HE OFF
- D Trans. (↓ ↑) SM IN, FLIP ON, 3HE OFF
- E Trans. (↓ ↓) SM IN, FLIP ON, 3HE ON
- F Trans. (↑ ↓) SM IN, FLIP OFF, 3HE ON

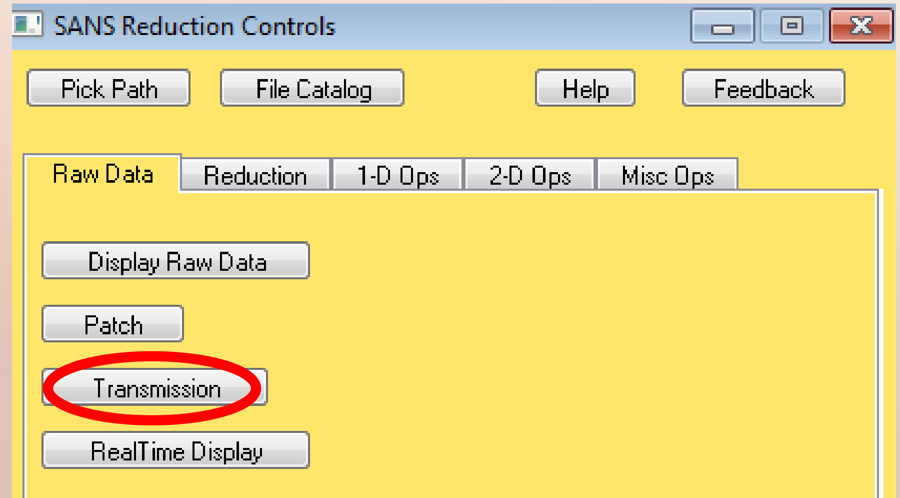
Measures supermirror efficiency, flipper efficiency, and any sample depolarization

- G Scatt. (↑↑) SM IN, FLIP OFF, 3HE OFF
- H Scatt. (↓ ↑) SM IN, FLIP ON, 3HE OFF
- J Scatt. (↓ ↓) SM IN, FLIP ON, 3HE ON
- K Scatt. ↑ ↓) SM IN, FLIP OFF, 3HE ON

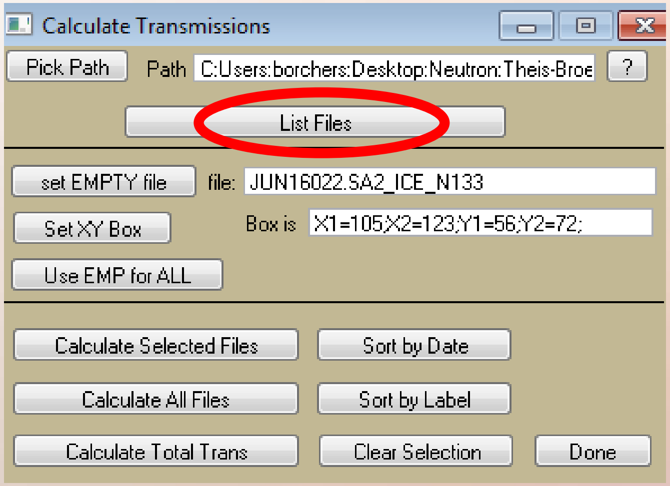
Measures desired four scattering cross-sections

Measurement conditions: 1) Sample at 10K and 1.2T with 3.5m and 14m detector settings
2) Empty at RmT and 0.07T with 3.5m and 14m detector settings

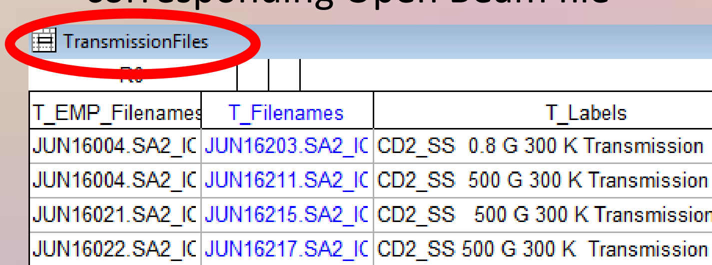
Calculate Sample and Empty Transmissions



1) List files to make two tables

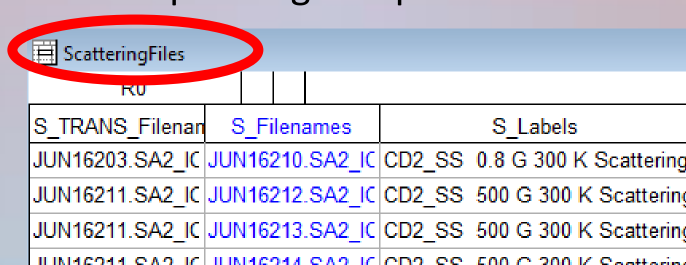


2) Associate Sample Trans files with corresponding Open Beam file


TransmissionFiles

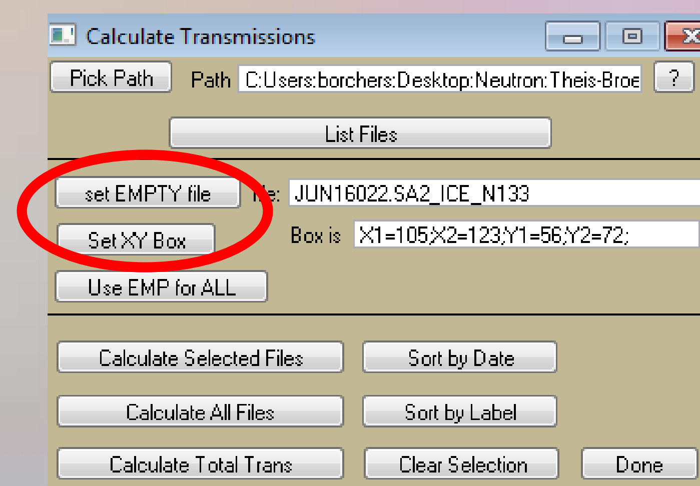
T_EMP_Filenames	T_Filenames	T_Labels
JUN16004.SA2_IC	JUN16203.SA2_IC	CD2_SS 0.8 G 300 K Transmission
JUN16004.SA2_IC	JUN16211.SA2_IC	CD2_SS 500 G 300 K Transmission
JUN16021.SA2_IC	JUN16215.SA2_IC	CD2_SS 500 G 300 K Transmission
JUN16022.SA2_IC	JUN16217.SA2_IC	CD2_SS 500 G 300 K Transmission

3) Associate Sample Scatt files with corresponding Sample Trans file


ScatteringFiles

S_TRANS_Filenan	S_Filenames	S_Labels
JUN16203.SA2_IC	JUN16210.SA2_IC	CD2_SS 0.8 G 300 K Scattering
JUN16211.SA2_IC	JUN16212.SA2_IC	CD2_SS 500 G 300 K Scatterin
JUN16211.SA2_IC	JUN16213.SA2_IC	CD2_SS 500 G 300 K Scatterin
JUN16211.SA2_IC	JUN16214.SA2_IC	CD2_SS 500 G 300 K Scatterin

4) Set region of Open Beam to use for normalization. Calculate Transmission.



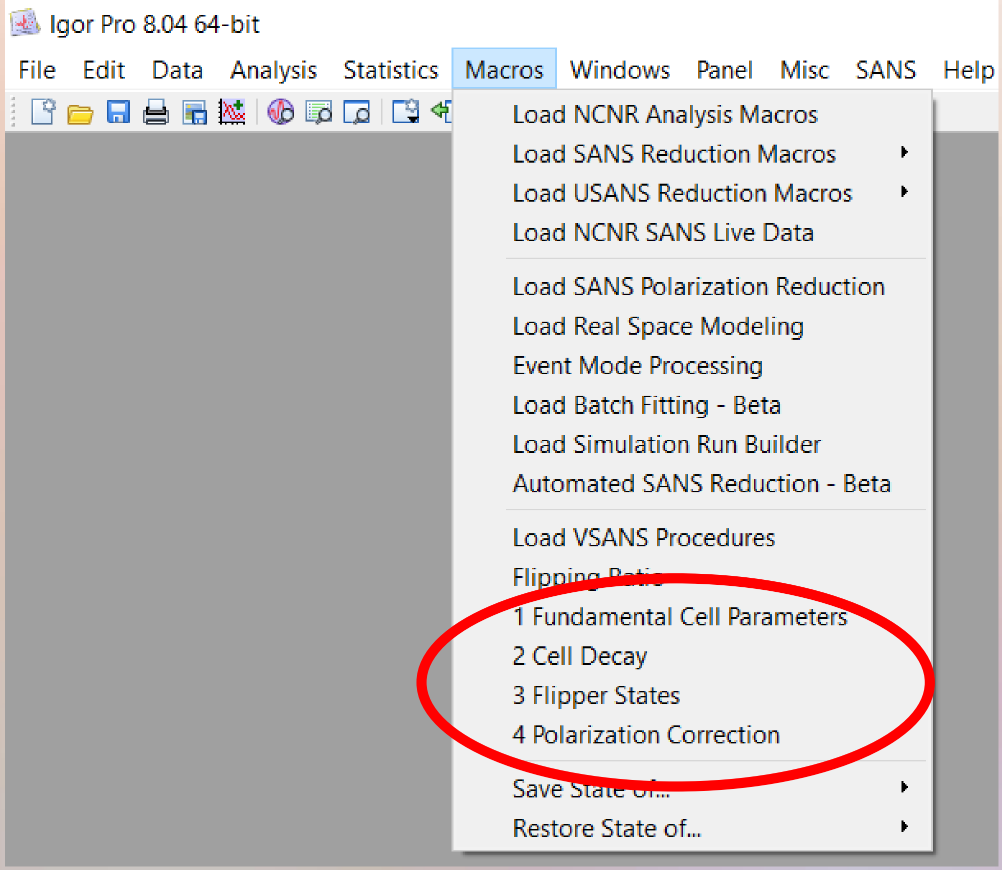
Reducing Polarized Data in Four Easy Steps

1) Define ^{3}He Cells

2) Measure ^{3}He Time-dependence

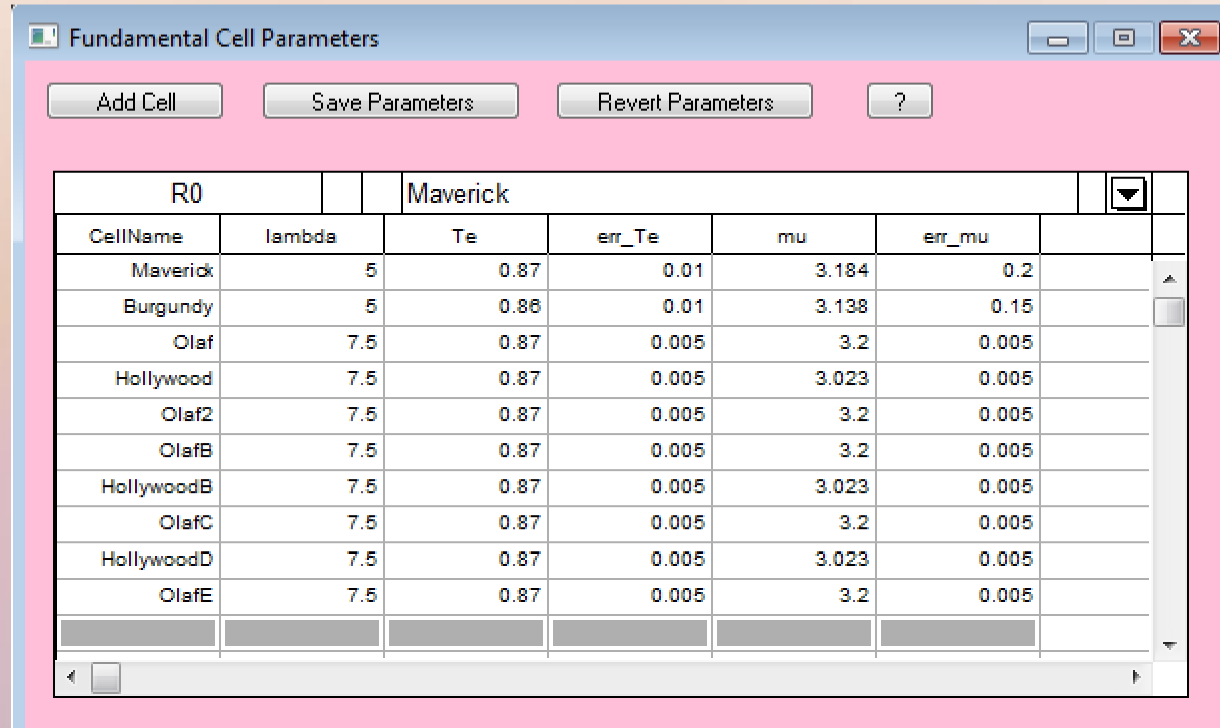
3) Measure supermirror and flipper efficiencies

4) Polarization correct scattering files on absolute scale



Step 1: Define Your ^{3}He Cells

- T_E (transmission of glass) is known *a priori*
- μ (effective cell path length) is known *a priori*
- Nominal values will be available within the IGOR framework.

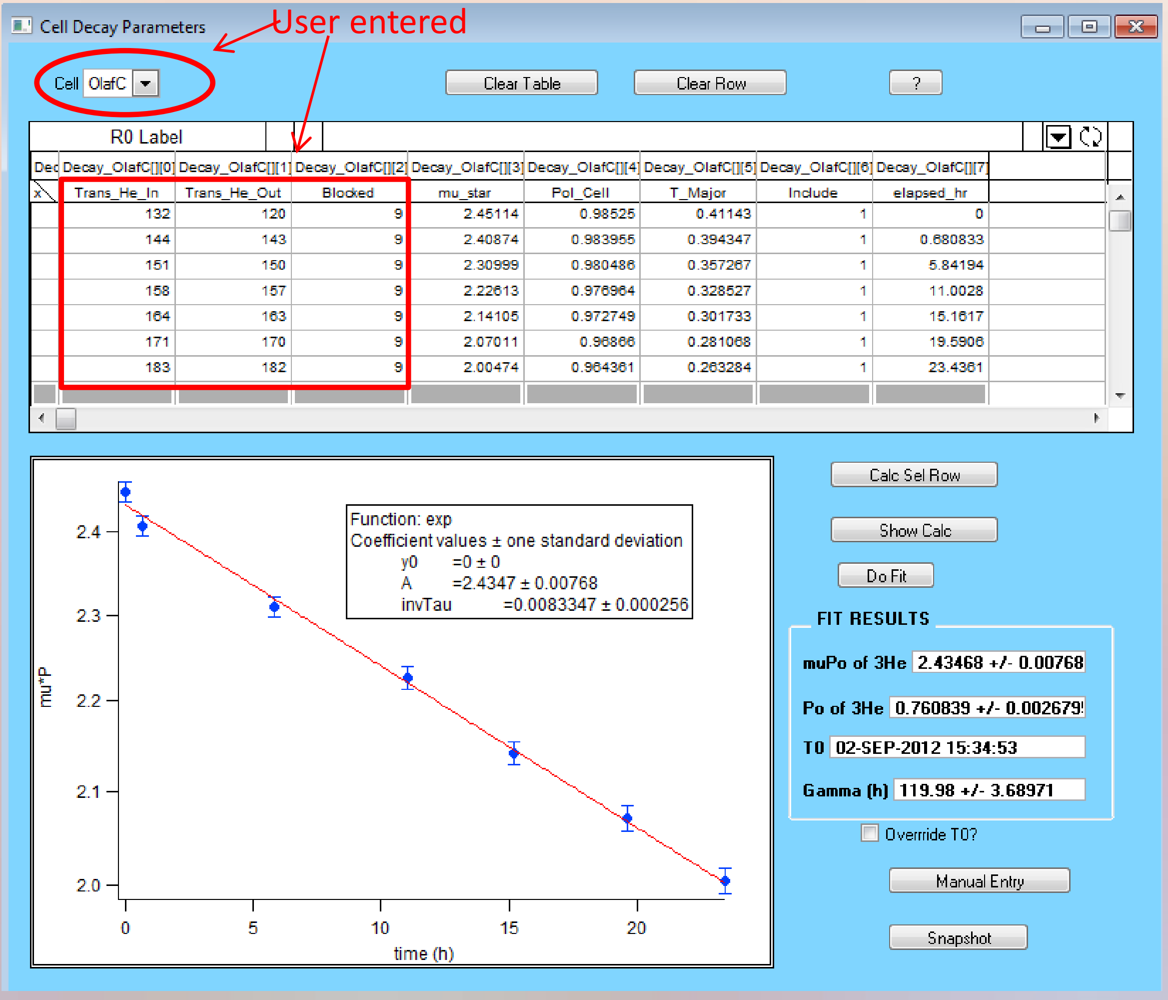


CellName	lambda	Te	err_Te	mu	err_mu
Maverick	5	0.87	0.01	3.184	0.2
Burgundy	5	0.86	0.01	3.138	0.15
Olaf	7.5	0.87	0.005	3.2	0.005
Hollywood	7.5	0.87	0.005	3.023	0.005
Olaf2	7.5	0.87	0.005	3.2	0.005
OlafB	7.5	0.87	0.005	3.2	0.005
HollywoodB	7.5	0.87	0.005	3.023	0.005
OlafC	7.5	0.87	0.005	3.2	0.005
HollywoodD	7.5	0.87	0.005	3.023	0.005
OlafE	7.5	0.87	0.005	3.2	0.005

What you need to know: Every ^{3}He analyzer cell has its own decay curve.

Step 2: ^{3}He Decay Curve

- T_{Major} is the transmission of majority spin state
- Γ is decay constant in hours
- P_o is initial atomic polarization; P_{cell} is effective polarization
- May override values, if desired

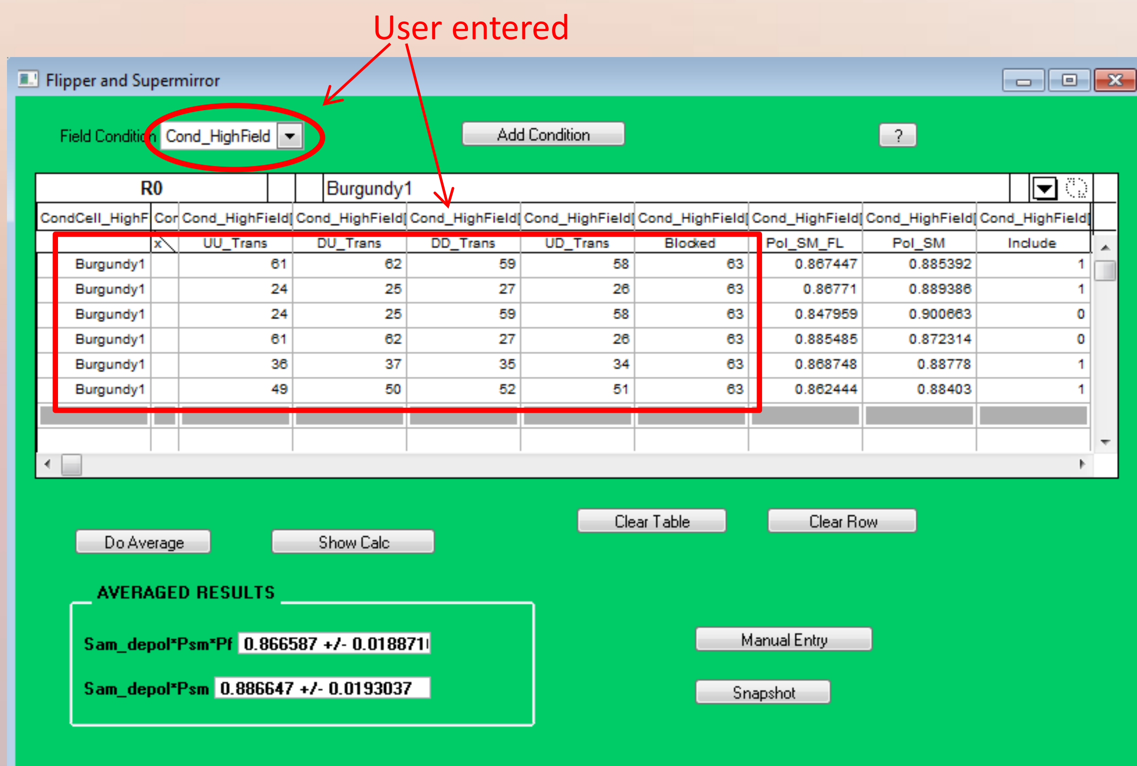


Trans_He_In	Trans_He_Out	Blocked	mu_star	Pol_Cell	T_Major	Include	elapsed_hr
132	120	9	2.45114	0.98525	0.41143	1	0
144	143	9	2.40874	0.983955	0.394347	1	0.680833
151	150	9	2.30999	0.980486	0.357267	1	5.84194
158	157	9	2.22613	0.976964	0.328527	1	11.0028
164	163	9	2.14105	0.972749	0.301733	1	15.1617
171	170	9	2.07011	0.96866	0.281068	1	19.5906
183	182	9	2.00474	0.964361	0.263284	1	23.4361

Use Files A and B: Unpolarized transmissions define time-dependent decay curve.

Step 3: Polarization Efficiencies

- P_{Cell} is automatically calculated for times at which polarized transmissions are taken.
- Sample depolarization of the neutron beam is *condition dependent*.

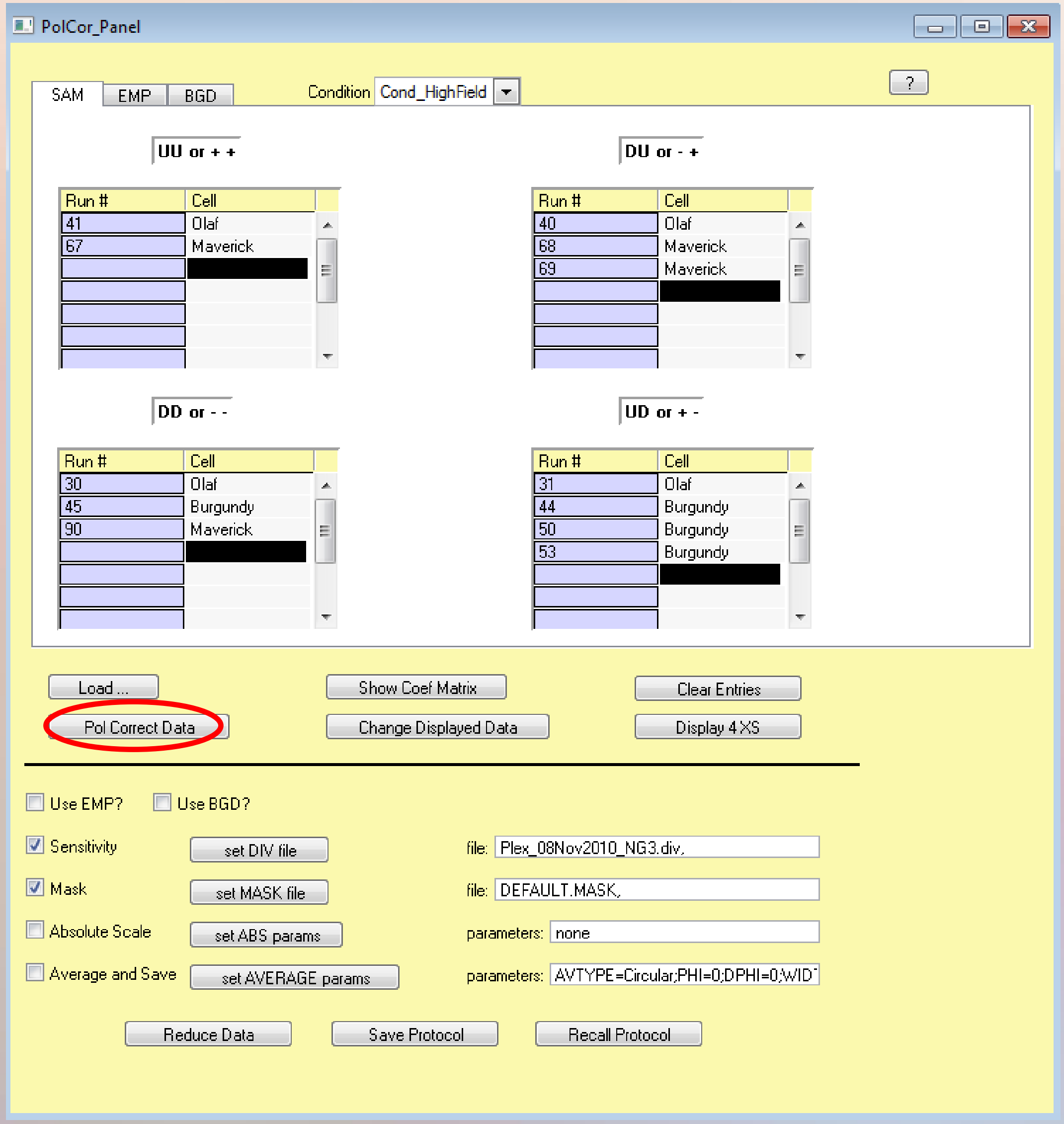


CondCell_HighF	Cor	Cond_HighField	Cond_HighField	Cond_HighField	Cond_HighField	Cond_HighField	Cond_HighField	Cond_HighField	Cond_HighField
	x	UU_Trans	DU_Trans	DD_Trans	UD_Trans	Blocked	Pol_SM_FL	Pol_SM	Include
Burgundy1		61	62	59	58	63	0.867447	0.885392	1
Burgundy1		24	25	27	26	63	0.86771	0.889386	1
Burgundy1		24	25	59	58	63	0.847959	0.900663	0
Burgundy1		61	62	27	26	63	0.885485	0.872314	0
Burgundy1		36	37	35	34	63	0.868748	0.88778	1
Burgundy1		49	50	52	51	63	0.862444	0.88403	1

Use Files C, D, E and F: Measure ↑↑,↓↑, ↓↓, and ↑↓ transmissions to obtain polarization of super mirror, polarization of flipper, and sample depolarization.

Step 4: Polarization Correct Sample and Empty Data

- Associate ^{3}He cell used with file
- Can add up to 10 files together
- **Data and empty** scattering files are pol corrected **separately**
- **Fully reduce each detector setting separately**



Use Files G, H, J, and K: Need *at least one* of each ↑↑,↓↑, ↓↓, and ↑↓ scattering files.

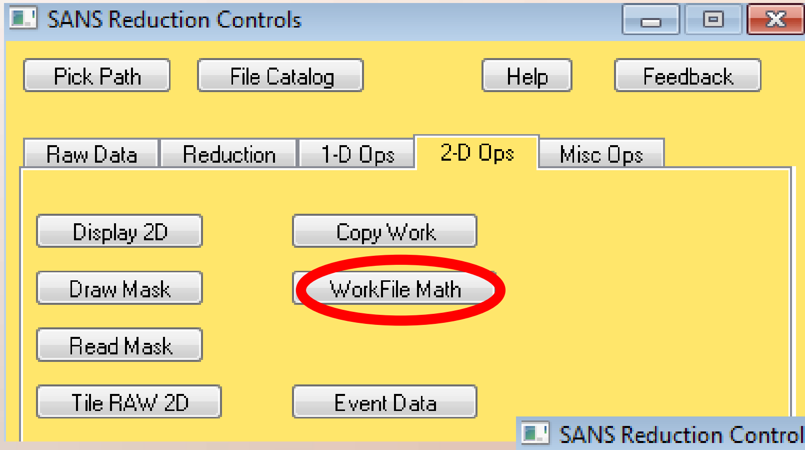
J. Appl. Cryst. (2012). **45**, 546–553

Followed by **Standard Instrumental Data Corrections**

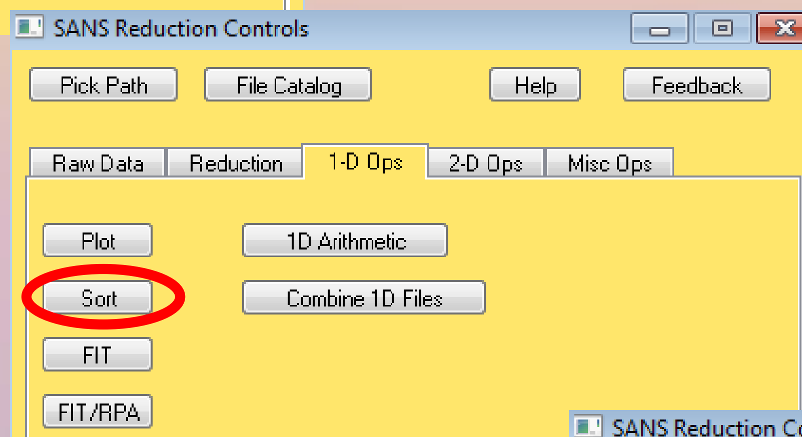
Average and Save:
Choose 2D_Ascii for format of corrected data

- Subtraction of Empty Cell
- Detector Sensitivity
- Detector Mask
- Absolute Intensity Scaling

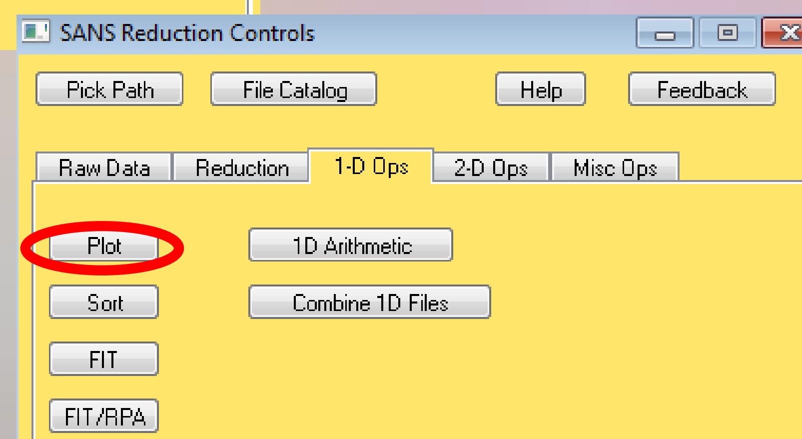
Final Steps to Generate 1D Data Slices



Generate 1-D Sector Cuts
(Intensity vs Q)



Splice together data from different detector settings



Plot and then **fit with Sasview**!