Polarization Analyzed SANS



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).

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- 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



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 Pro 8.04 64-bit File Edit Data Analysis Statistics Macros Windows Panel Misc SANS Help Pro R R R R R R R R R R R R R R R R R R R
Igor software and macros found at http://www.ncnr.nist.gov/programs/sans/data/red_anal.html	Load NCNR SANS Live Data Load SANS Polarization Reduction Load Real Space Modeling Event Mode Processing Load Batch Fitting - Beta Load Simulation Run Builder Automated SANS Reduction - Beta
	Load VSANS Procedures Flipping Ratio 1 Fundamental Cell Parameters 2 Cell Decay 3 Flipper States 4 Polarization Correction
Pick Path File Catalog Help Feedb	Save State of Restore State of
Raw Data Reduction 1-D Ops 2-D Ops Misc Ops Display Raw Data Patch Transmission RealTime Display RealTime Display	 First Steps: Pick Path for <i>GlassyCoFe2O410KHFData NG7</i> 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



Measurement conditions:1) Sample at 10K and 1.2T with 3.5m and 14m detector settings2) Empty at RmT and 0.07T with 3.5m and 14m detector settings

1) List files to make two tables

Calculate Transmissions						
Pick Path Path C:Users:borchers:Desktop:Neutron:Theis-Broe						
List	Files					
set EMPTY file file: JUN16	022.SA2 ICE N133					
Set XY Box Box is	×1=105;×2=123;×1=56;×2=72;					
Use EMP for ALL						
Calculate Selected Files	Sort by Date					
Calculate All Files	Sort by Label					
Calculate Total Trans	Clear Selection Done					

2) Associate Sample Trans files with corresponding Open Beam file

🗐 TransmissionFile	s	>						
R								
T_EMP_Filenames	1	_Fi	lena	ames				T_Labels
JUN16004.SA2_IC	JUI	116	203	.SA2_	IC	CD2	SS	0.8 G 300 K Transmission
JUN16004.SA2_IC	JUI	116	211	.SA2_	IC	CD2_	SS	500 G 300 K Transmission
JUN16021.SA2_IC	JUL	116	215	.SA2_	IC	CD2_	SS	500 G 300 K Transmissior
JUN16022.SA2_IC	JUI	116	217	.SA2_	IC	CD2_	SS	500 G 300 K Transmission

3) Associate Sample Scatt files with corresponding Sample Trans file

E ScatteringFiles										
RU										
S_TRANS_Filenan	5	S_F	ilen	ames				S_La	abels	
JUN16203.SA2_IC	JUI	116	210	.SA2	IC	CD2	SS	0.8 G	300 K	Scattering
JUN16211.SA2_IC	JUI	116	212	.SA2	IC	CD2	SS	500 G	300 K	Scattering
JUN16211.SA2_IC	JUI	116	213	.SA2	IC	CD2	SS	500 G	300 K	Scattering
JUN16211.SA2 IC	JUI	116	214	SA2	IC	CD2	SS	500 G	300 K	Scattering

Calc	ulate	Sampl	e and	Empty	y Tra	nsmiss	ions
II S/	ANS Reduct	ion Controls	;				×
F	ick Path	File Cat	alog	He		Feedback)
B	aw Data	Reduction	1-D Ops	2-D Ops	Misc O	ps	
	Display Ra	w Data					
	Patch	on					
	RealTime [Display					

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



Reducing Polarized Data in Four Easy Steps



1) Define ³He Cells

2) Measure ³He Time-dependence

3) Measure supermirror and flipper efficiencies

4) Polarization correct scattering files on absolute scale

Step 1: Define Your ³He Cells

	💵 Fundamental C	ell Parameters				E	- 0	×
	Add Cell	Save Pa	arameters	Revert Para	meters	?		
	R0		Maverick					
	CellName	lambda	Te	err_Te	mu	err_mu		\square
	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		
S	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		
ле	OlafE	7.5	0.87	0.005	3.2	0.005		
								-
	•	1	1				Þ	

T_E (transmission of glass) is known *a priori*

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

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

Step 2: ³He Decay Curve



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

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*.

			Us	er ente	red					
	Flipper and Superm	nirror								×
	Field Condition Cor	nd_HighField 🔻	Ď	Add	d Condition			?		
	R0		Burgundy1	V					■ ○	
C	ondCell_HighF Cor C	Cond_HighField	Cond_HighField	Cond_HighField	Cond_HighField	Cond_HighField	Cond_HighField	Cond_HighField	Cond_HighField	
	X Rumundul	UU_Trans	DU_Trans	DD_Trans	UD_Trans	Blocked	Pol_SM_FL	Pol_SM	Include	· •
-	Burgundy1	24	25	27	28	63	0.86771	0.0000002	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	
										-
-									F	
	Do Average	-	Show Calc		Cle	ar Table	Clear Ro	W		
					_					
	Sam depol≭P	om*Df 0.9665	07 + /- 0 0100	711		M	anual Entry			
	Jaii_deport	SIII 1 1 0.000.	07 +7- 0.01007							
	Sam_depol*P	sm 0.886647	+/- 0.0193037			Sn	apshot			
	1								- I	

Use Files C, D, E and F: Measure $\uparrow \uparrow, \downarrow \uparrow, \downarrow \downarrow$, and $\uparrow \downarrow$ transmissions to obtain polarization of super mirror, polarization of flipper, and sample depolarization.

Step 4: Polarization Correct Sample and Empty Data

- Associate ³He 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

PolCor_Panel							
SAM EMP BGD Condition Cond_HighField	?						
UU or + +	DU or - +						
Run # Cell 41 Olaf 67 Maverick	Run # Cell 40 Olaf 68 Maverick 63 Maverick						
DD or	UD or + -						
Run # Cell 30 Olaf 45 Burgundy 90 Maverick	Run # Cell 31 Olaf 44 Burgundy 50 Burgundy 53 Burgundy						
Load Show Coef Matrix Pol Correct Data Change Displayed Data	Clear Entries Display 4 XS						
🔲 Use EMP? 👘 Use BGD?							
Sensitivity set DIV file file: Plex	_08Nov2010_NG3.div,						
V Mask set MASK file file: DEF	AULT.MASK,						
Absolute Scale <u>set ABS params</u> paramete	ris: none						
Average and Save set AVERAGE parameters: AVTYPE=Circular;PHI=0;DPHI=0;WID							
Reduce Data Save Protocol	Recall Protocol						

Use Files G, H, J, and K: Need at least one of each $\uparrow \uparrow, \downarrow \uparrow$, $\downarrow \downarrow$, and $\uparrow \downarrow$ scattering files.

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Followed by Standard Instrumental Data Corrections

SAM EMP BGD Condition Cond_HighField	PolCor_Panel			
JU or ++ JU or + Image: Cell Image: Cell <tr< th=""><th>SAM EMP BGD</th><th>Condition Cond_HighField -</th><th></th><th>?</th></tr<>	SAM EMP BGD	Condition Cond_HighField -		?
Run # Cell 41 Olaf 67 Maverick 68 Maverick 69 Maverick 69 Maverick 69 Maverick 69 Maverick 60 Maverick 60 Maverick 61 Maverick 62 Maverick 83 Mayerick 90 Maverick 84 Burgundy 90 Maverick 83 Burgundy 90 Maverick 90	UU or + +		DU or - +	
DD or Burgundy 30 Olaf 45 Burgundy 30 Maverick # 50 Burgundy 53 Burgundy 54 Bomozation Change Displayed Data Display 4 XS Yes Sensitivity set MASK file file: DEFAULT.MASK, X Absolute Scale set ABS params parameters: Average and Save set AVERAGE params parameters: AVTYPE=Circular.PHI=0.0PHI=0.WID <td>Run # Cell 41 Olaf 67 Maverick </td> <td></td> <td>Run # Cell 40 Olaf 68 Maverick 69 Maverick</td> <td></td>	Run # Cell 41 Olaf 67 Maverick		Run # Cell 40 Olaf 68 Maverick 69 Maverick	
Run # Cell 30 Olaf 45 Burgundy 90 Maverick 53 Burgundy 54 Show Coef Matrix Clear Entries Display 4 XS X Use EMP? Use BGD? Vise EMP? Sensitivity set DIV file file: Plex_08Nov2010_NG3.div, V Mask set MASK file file: DEFAULT.MASK, X Absolute Scale set AVERAGE params set AVERAGE params parameters: AVTYPE=Circular,PHI=0,DPHI=0,WID'	DD or	,	UD or + -	
Load Show Coef Matrix Clear Entries Pol Correct Data Change Displayed Data Display 4 XS X Use EMP? Use BGD? Sensitivity set DIV file file: Plex_08Nov2010_NG3.div, Mask set MASK file file: DEFAULT.MASK, X Absolute Scale set ABS params parameters: none X Average and Save set AVERAGE params parameters: AVTYPE=Circular;PHI=0;DPHI=0;WID*	Run # Cell 30 Olaf 45 Burgundy 90 Maverick		Run # Cell 31 Olaf 44 Burgundy 50 Burgundy 53 Burgundy	
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Sensitivity set DIV file file: Plex_08Nov2010_NG3.div, Mask set MASK file file: DEFAULT.MASK, Absolute Scale set ABS params parameters: none Average and Save set AVERAGE params parameters: AVTYPE=Circular;PHI=0;DPHI=0;WID*	🗶 Use EMP? 🔲 Use BGD?			
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Image: Absolute Scale set ABS params parameters: none Image: Average and Save set AVERAGE params parameters: AVTYPE=Circular;PHI=0;DPHI=0;WID*	Mask set MASK	file file: DEFA	ULT.MASK,	
X Average and Save set AVERAGE params parameters: AVTYPE=Circular;PHI=0;DPHI=0;WID*	X Absolute Scale set ABS pa	rams parameters	none	
	X Average and Save set AVER.	AGE parameters	AVTYPE=Circular;PHI=0;DPHI=0;WI	D'
Reduce Data Save Protocol Recall Protocol	Reduce Data	Save Protocol	Recall Protocol	

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
SANS Reduction Controls	
Pick Path File Catalog Help Feedback	
Raw Data Reduction 1-D Ops 2-D Ops Misc Ops	Generate 1-D Sector Cuts
Diselar 2D Com/Mate	(Intensity vs Q)
Tile RAW 2D Event Data SANS Reduction Controls	s E
Pick Path File Cat	talog Help Feedback
Raw Data Reduction	Splice together data from
Plot 10	D Arithmetic different detector settings
Sort C	iombine 1D Files
FIT	
FIT/BPA	SANS Reduction Controls
	Pick Path File Catalog Help Feedback
	Raw Data Reduction 1-D Ops 2-D Ops Misc Ops
	Plot 1D Arithmetic
Plot and then fit with S	Sort Combine 1D Files
	FIT
	FIT/RPA