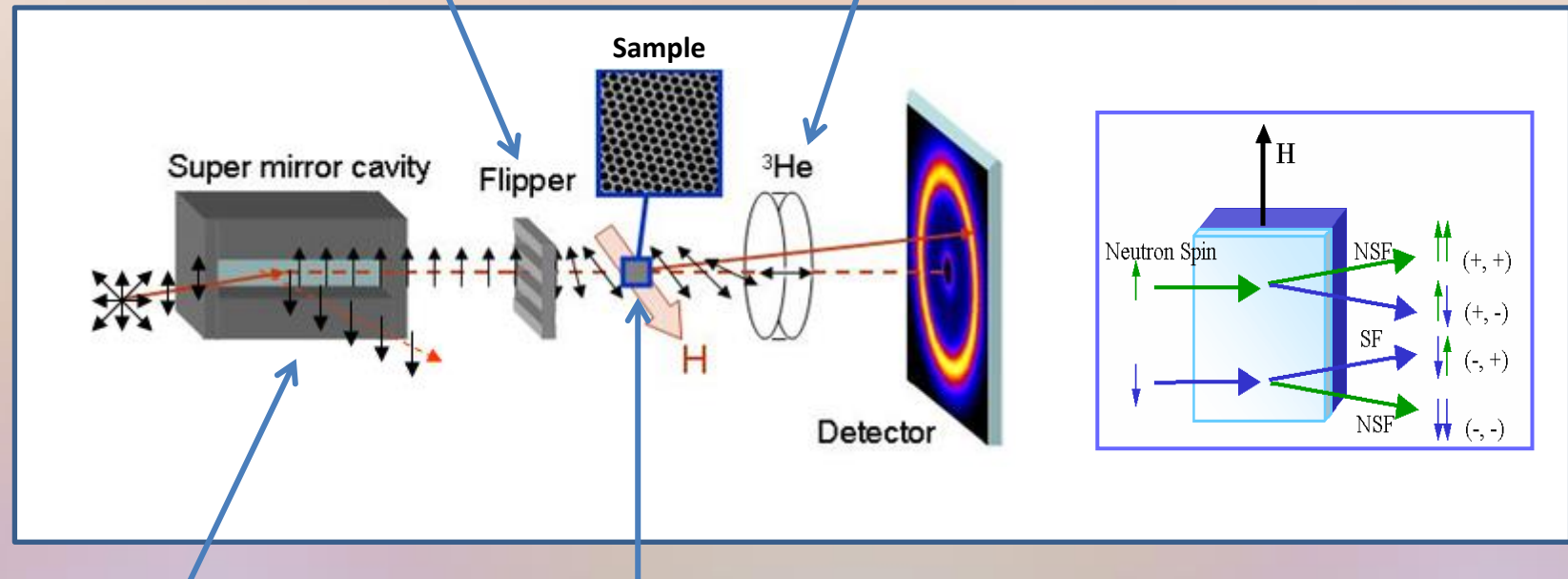# Polarization Analyzed SANS

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

✓ Sensitivity	set DIV file	file: ask
✓ Mask	set MASK file	file: ask
✓ Absolute Scale	set ABS params	parameters: ask

- 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

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

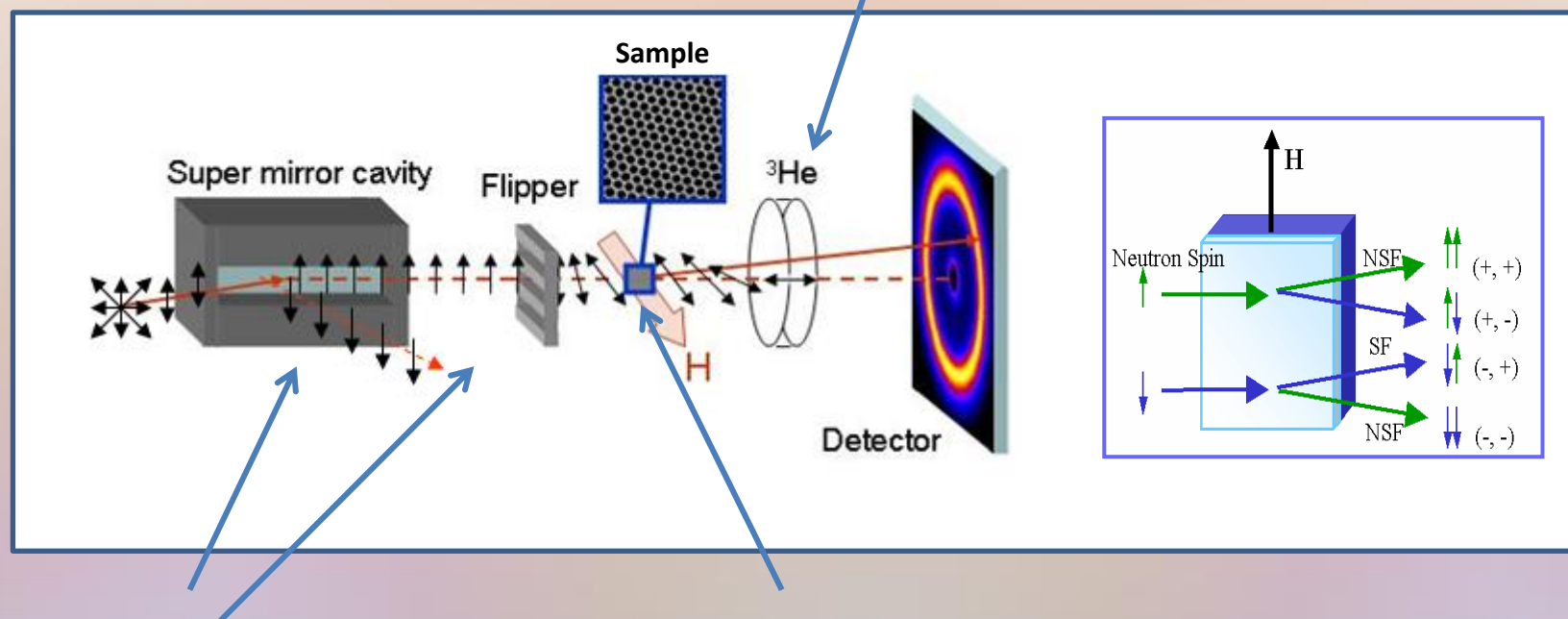Blocked Beam (BGD) measure
of electronic and ambient bgr

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

Spin leakage

The absorption of the 3He cell is not perfect so it will allow some of the unwanted spins to go through. The absorption also degrades as function of time.
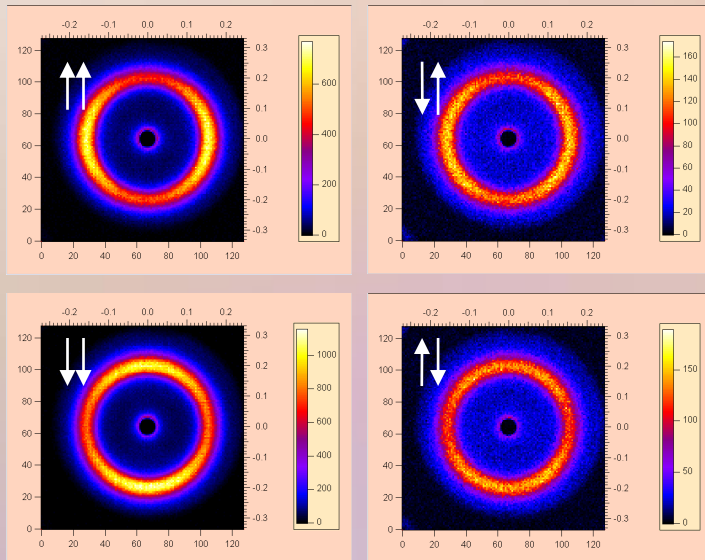

Although are close from having a perfect flipping ratio, the supermirror and flipper still allos a small % of spins pointing along an undesired direction.

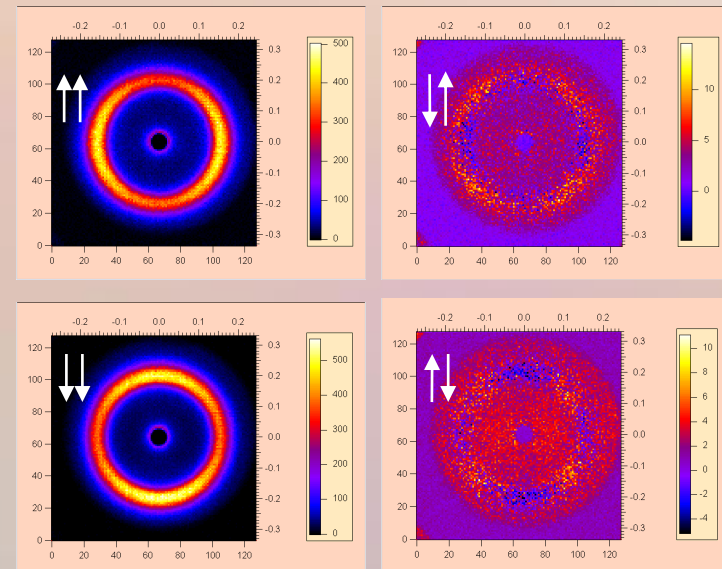Macroscopic field of ferromagnetic domains or domain walls within the sample can depolarize the beam.

I. Spin leakage correction (Reduction, J. Appl. Cryst. 45, 546-553, 2012)

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.

Checklist of files needed:

- Open Beam transmission (SM OUT, 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

Fortunately, software are available to do the reduction and polarization reduction. Here's an example:

[Polarized Beam Data Reduction on the Web (nist.gov)](nist.gov)