

**NATIONAL NUCLEAR DATA CENTER
Bldg. 197D
Brookhaven National Laboratory
P. O. Box 5000
Upton, NY 11973-5000, U.S.A.**

(Internet) nndc@bnl.gov

Telephone: (631)344-2902

FAX: (631)344-2806

Memo CP-C/273

DATE: 8 September 2000
TO: Distribution
FROM: V. McLane
SUBJECT: Neutron-transmission spin-spin measurements

As a corollary to the LEXFOR entry on polarization, I have drafted a memo on neutron transmission spin-spin measurements. These quantities are currently given under the entry of CROSS SECTIONS.

In checking through the quantities given in the library as POL,,ASY, I have found that all are the spin-spin asymmetry. This has been added to the entry, and revised quantities are proposed.

I have checked the quantities already on the library, and have prepared updates for those which will need to be updated.

Modified Quantities.

Delete:

,POL,,ASY
LON,POL,,ASY
TRS,POL,,ASY

Add:

,POL,,DSP/ASY
LON,POL,,DSP/ASY
TRS,POL,,DSP/ASY

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Neutron transmission spin-spin measurements.

Spin-spin asymmetry

Definition: The spin-spin asymmetry, ε , is defined as

$$\varepsilon_{L,T} = \frac{N_{\uparrow\downarrow} - N_{\uparrow\uparrow}}{N_{\uparrow\downarrow} + N_{\uparrow\uparrow}}$$

where: $N_{\uparrow\downarrow}$ is number of events incident-projectile and target spins anti-parallel,
 $N_{\uparrow\uparrow}$ is number of events incident-projectile and target spins parallel.

REACTION Coding: POL in reaction SF6, DSP/ASY in SF8.¹

Example: (... (N,TOT) , , POL , , DSP / ASY)

Spin-spin difference cross section

Definition: The spin-spin difference cross, $\Delta\sigma$, is defined as:

$$\Delta\sigma = \sigma_{\uparrow\downarrow} - \sigma_{\uparrow\uparrow}$$

where $\sigma_{\uparrow\downarrow}$ = cross section for incident-projectile and target spins anti-parallel,
 $\sigma_{\uparrow\uparrow}$ = cross section for incident-projectile and target spins parallel.

The total cross section for a polarized spin-1/2 beam and polarized target may be expressed as

$$\sigma_{tot} = \sigma_0 + \frac{1}{2} \Delta\sigma_L P_b^z P_t^z + \frac{1}{2} (P_b^x P_t^x + P_b^y P_t^y)$$

where: σ_0 = unpolarized neutron total cross section,
 $\Delta\sigma_L$ = cross section difference for beam and target polarized along axis longitudinal to beam direction (*i.e.*, along z axis),
 $\Delta\sigma_T$ = cross section difference for beam and target polarized along axis transverse to beam direction (*i.e.*, along y axis).

REACTION Coding: modifier DSP in SF8

Example: (... (N,TOT) , LON , SIG , , DSP) Total spin-spin difference cross section for longitudinal spin states

Spin-spin cross sections

Definitions: $\sigma_{SS} = (\sigma_{\uparrow\downarrow} - \sigma_{\uparrow\uparrow})/2 = \Delta\sigma/2$.

REACTION Coding: modifier SS in SF8

Example: (... (N,TOT) , , SIG , , SS)

¹ If the data is measured as parallel – anti-parallel, reverse the sign on the data.