

Japan Charged-Particle Nuclear Reaction Data Group

Division of Physics, Graduate School of Science
Hokkaido University
060-0810 Sapporo, JAPAN

Telephone +81(JPN)-11-706-2684
Facsimile +81(JPN)-11-706-4850
E-mail nrdf@nucl.sci.hokudai.ac.jp

Memo CP-E/020

Date: April 19, 2003
To: Distribution
From: OTUKA Naohiko and KATŌ Kiyoshi
Subject: Total spin transfer

Recently we received experimental data of “total spin transfer” (A.Tamii et al., Phys. Lett. **B459** (1999) 61, T.Kawabata et al., Phys.Rev. **C65** (2002) 064316). This quantity is defined as follows:

$$\Sigma = \{3-(D_{SS}+D_{NN}+D_{LL})\}/4=(S_{SS}+S_{NN}+S_{LL})/2,$$

where D_{ii} ($ii=SS, NN, LL$) are “spin-rotation-depolarization parameters”, and $S_{ii} = (1-D_{ii})/2$ ($ii=SS, NN$ and LL) is spin-flip probability for the i -direction, respectively.

Total spin transfer Σ is used as an index to distinguish spin-flip ($\Delta S=1$) and non-spin-flip ($\Delta S=0$) excitation. $\Sigma \approx 1$ (0) for $\Delta S=1$ (0) is regarded as a good approximation at forward angles of outgoing particle. At 0 degree, especially, this relation is exactly correct due to the spatial symmetry. In this sense, total spin transfer Σ is similar to “spin-flip probability” S_{NN} , for which also $S_{NN} \approx 0$ for $\Delta S=0$. However, S_{NN} takes various values in $\Delta S=1$ excitations depending on the J^π . Therefore Σ is considered as a better index than S_{NN} .

A rule of “ $D_{SS}+D_{NN}+D_{LL}=3(-1)$ for $\Delta S=0(1)$ ” had been known in the measurements of (p,n) scattering. H.Sakai pointed out that this rule is effective to distinguish $\Delta S=1$ and 0 excitations and introduced Σ in 1999 (H.Sakai, Nucl. Phys. **A654** (1999) 731c). The validity of Σ as an index of $\Delta S=0(1)$ is theoretically confirmed (T.Suzuki, Prog. Theor. Phys. **103** (2000) 859). Due to the recent progress of experimental technique (high luminosity beam, reliable measurement of forward scattered particle), D_{SS} and D_{LL} are widely measured as well as D_{NN} , and consequently Σ is recognized as an experimental observable. We propose some codes for total spin transfer :

Dictionary 24 (Modifiers)

TST Total spin transfer

Dictionary 36 (Quantities)

, POL/DA/DE, , TST NO Total spin transfer with respect to angle and energy
PAR, DA, , TST DA Partial diff. cross section d/dA *total spin transfer

Related two proposals:

1. “NN,POL/DA,,SF” and “,POL/DA,,SF”

Now we have two codes “NN,POL/DA,,SF” and “,POL/DA,,SF” for “spin-flip probability S_{NN} ”. We propose that we keep “NN,POL/DA,,SF” while obsolete “,POL/DA,,SF” (we cannot find any entry which use the latter quantity code in EXFOR+CINDA Ver.1.10).

Dictionary 36 (Quantities)

,POL/DA,,SF	NO	Spin flip probability $S(nn)$ (obsolete, use “NN,POL/DA,,SF”)
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2. “,SIG,,SF”

Now “,SIG,,SF” is expanded as “spin-flip cross section” in our dictionary (we cannot find any entry which use this quantity code in EXFOR+CINDA Ver.1.10). But the definition of this quantity is ambiguous. If this quantity means “cross section multiplied by S_{NN} (spin-flip probability)”, it is better to use “NN,SIG,,SF” with a corrected expansion.

Dictionary 36 (Quantities)

,SIG,,SF	B	Spin flip cross section (obsolete, use “NN,SIG,,SF”)
NN,SIG,,SF	B	Cross section * Spin-flip probability $S(nn)$

We attach a coding sample for the proposed two new quantities “,POL/DA/E,,TST” and “PAR,DA,,TST”.

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Sample of coded entry (E1776.004, 027):

T. Kawabata et al., Phys. Rev. C **65** (2002) 064316 Fig.4 and Table II

SUBENT	E1776004	20030311	E177600400001
BIB	4	8	E177600400002
REACTION	(8-0-16(P, INL)8-0-16,, POL/DA/DE,, TST)		E177600400003
	DATA: total spin transfer		E177600400004
...			
ENDBIB	8	0	E177600400011
COMMON	1	3	E177600400012
ANG			E177600400013
ADEG			E177600400014
0.0			E177600400015
ENDCOMMON	3	0	E177600400016
DATA	3	96	E177600400017
E-EXC	DATA	DATA-ERR	E177600400018
MEV	NO-DIM	NO-DIM	E177600400019
5.61	-2.768	2.975	E177600400020
5.856	-1.308	1.971	E177600400021
...			
28.796	0.406	0.062	E177600400114
29.043	0.507	0.064	E177600400115
ENDDATA	98	0	E177600400116
ENDSUBENT	115	0	E177600499999
SUBENT	E1776027	20030311	E177602700001
BIB	5	8	E177602700002
REACTION	(8-0-16(P, INL)8-0-16, PAR, DA, TST)		E177602700003
	DATA: spin flip cross section(=angular distribution * total spin transfer)		E177602700004
...			
ENDBIB	8	0	E177602700011
COMMON	1	3	E177602700012
E-LVL			E177602700013
MEV			E177602700014
8.87			E177602700015
ENDCOMMON	3	0	E177602700016
DATA	3	1	E177602700017
ANG-CM	DATA	DATA-ERR	E177602700018
ADEG	MU-B/SR	MU-B/SR	E177602700019
4.4	19.0	2.0	E177602700020
ENDDATA	3	0	E177602700021
ENDSUBENT	20	0	E177602799999