

International Atomic Energy Agency

**Tensor Polarization
and**

Initial State Spin Correlation

WP 2008-23 (Action 25 – NRDC 2007)

http://www-nds.iaea.org/nrdc/nrdc_2008/working/wp2008-23.pdf

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Action 25 – NRDC 2007

A25 Otsuka (not JCPRG...)

*Submit summary on **tensor polarization** data as a memo to remove inconsistencies in dictionary expansions*

Spin Observables

- Search of **spin-orbit** optical potential parameter
 - A_y : Vector analyzing power
- **Few body system** study (with Fadeev calculation etc.) in $d + p$ elastic scattering
 - A_y , A_{yy} etc.

etc.

Back Ground of This Action

- **Various notations for a given quantity**
Troubles in compilation + dictionary

Example: 7 Conventions for a Spin Obs.

Table in N. Hoshizaki, J. Phys. Soc. Jpn. Suppl. 54 (1985) 549

Type	HOS-68	ASH-77	BYS-78	YOK-80	HOL-84	OHL-72 & others	YOK-80# ASH-77*
	Fig.1a	Fig.2	Fig.1b OSRBT	Fig.1c	Fig.1c		(B, T; S, R)

Initial state correlation of polarizations

$\overset{\uparrow}{A}+\overset{\uparrow}{B}+\overset{\uparrow}{C}+\overset{\uparrow}{D}$	A_{yy}	A_{NN}	A_{00nn}	C_{NN}	A_{NN}	A_{nn}	$C_{y,y}$	$(N, N; 0, 0)$
	A_{zz}	$-A_{LL}$	A_{00kk}	C_{LL}	A_{LL}	A_{ll}	$C_{z,z}$	$(L, L; 0, 0)^\#$ $-(L, L; 0, 0)^*$
	A_{xx}	$-A_{SS}$	A_{00ss}	C_{SS}			$C_{x,x}$	$(S, S; 0, 0)^\#$ $-(S, S; 0, 0)^*$
	A_{xz}	$-A_{SL}$	A_{00sk}	C_{SL}	A_{SL}	A_{sl}	$C_{x,z}$	$(S, L; 0, 0)^\#$ $-(S, L; 0, 0)^*$
	A_{zx}	$-A_{LS}$	A_{00ks}	C_{LS}			$C_{z,x}$	$(L, S; 0, 0)^\#$ $-(L, S; 0, 0)^*$

Note: $A_{zx} = A_{xz}$

$$A_{yy} = A_{NN} = A_{00nn} = C_{NN} = A_{NN} = A_{nn} = C_{y,y} \quad !?$$

History – Clarification of Spin Obs.

2001 (Vienna)

A34: McLane To clarify the questions raised in WP2001-6 on proposed Polarization quantities and update the proposed LEXFOR entry on Polarization.

2002 (Paris)

A42: McLane Try to resolve the problems in order to define the various polarization quantities for LEXFOR and dictionary 36 consistently.

2003 (Vienna)

A43 McLane (Continuing) Try to resolve the problems in order to define the various polarization quantities for LEXFOR and dictionary 36 consistently.

2005 (Vienna) – reported in WP2006-14

A26 Otsuka Submit summary on **tensor polarization data** as a memo to remove inconsistencies in dictionary expansions

2006 (Vienna) – no progress

A26 Otsuka (Continuing) Submit summary on tensor polarization data as a memo to remove inconsistencies in dictionary expansions.

2007 (Vienna) – reported in WP2008-23

A25 Otsuka (continuing) Submit summary on tensor polarization data as a memo to remove inconsistencies in dictionary expansions.

Problem in $ij, POL/DA, , ANA$

Two quantities,

- (1) **Tensor analyzing power** (in Cartesian coord.);
- (2) **Initial spin correlation parameter**

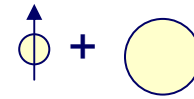
had been coded by the same quantity code

$ij, POL/DA, , ANA$ ($i, j = S, N$ or L)

before the 2006 NRDC meeting.

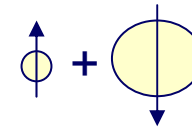
Two Quantities Coded by ij , POL/DA, , ANA

Tensor analyzing power: A_{ij}



$$\sigma = \sigma_0 \left(1 + \frac{3}{2} p_y A_y + \frac{2}{3} p_{xz} A_{xz} + \frac{1}{3} p_{xx} A_{xx} + \frac{1}{3} p_{yy} A_{yy} + \frac{1}{3} p_{zz} A_{zz} \right)$$

Initial spin correlation parameter: $C_{i,j}$



$$\sigma = \sigma_0 \left(1 + p_y^b A_y^b + p_y^T A_y^T + p_x^b p_x^T C_{x,x} + p_z^b p_x^T C_{z,x} + p_y^b p_y^T C_{y,y} + p_z^b p_z^T C_{z,z} + p_x^b p_z^T C_{x,z} \right)$$

σ_0 = cross section for unpolarized beam and target

See more detail in a famous review article:

G. G. Ohlsen, Rep. Prog. Phys. **35**(1972)717

Conclusion 27 – NRDC 2006 meeting

Quantity	Old rule	New rule
Tensor analyzing power	$ij, POL/DA, , ANA$	(unchanged)
Initial spin correlation parameter	(72 entries, 241 data sets)	$ij, POL/DA, , C$ <i>(Affected entries should be corrected.)</i>

241 data sets were analyzed to find entries to be corrected according to this conclusion.

Tips

- **Tensor analyzing power is never coded when in EXFOR when projectile is a spin $\frac{1}{2}$ particle (neutron, proton etc.).**
- **Initial spin correlation parameter is never coded when beam and/or target is/are unpolarized.**

Proposal (1)

(1) Correct area 1, 2, C, E, O and T entries according to the list in WP2008-23.

(Hard copy of this working paper is available for relevant compilers.)

(2) Update LEXFOR entries.

Proposal (2)

Corrections of dictionary expansions

LL , POL/DA , , C	Initial spin correlation parameter, C(LL)
LS , POL/DA , , C	Initial spin correlation parameter, C(LS)
NN , POL/DA , , C	Initial spin correlation parameter, C(NN)
SL , POL/DA , , C	Initial spin correlation parameter, C(SL)
SS , POL/DA , , C	Initial spin correlation parameter, C(SS)
LL , POL/DA , , ANA	Tensor analyzing power, A(zz)
LL/PAR , POL/DA , , ANA	Partial tensor analyzing power, A(zz)
LS , POL/DA , , ANA	Tensor analyzing power, A(zx)
NL , POL/DA , , ANA	Tensor analyzing power, A(yz)
NN , POL/DA , , ANA	Tensor analyzing power, A(yy)
NN/PAR , POL/DA , , ANA	Partial tensor analyzing power, A(yy)
SL , POL/DA , , ANA	Tensor analyzing power, A(xz)
SL/PAR , POL/DA , , ANA	Partial tensor analyzing power, A(xz)
SS , POL/DA , , ANA	Tensor analyzing power, A(xx)



Remaining Work

LEXFOR update

END