

Polarization

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Polarization

If the spins of a collection of particles, either stationary or in a beam are oriented in all directions with equal probability, the assembly is said to be unpolarized.

If the spins are predominantly oriented in one direction, the assembly is said to be polarized.

Polarization

Important conventions

- **Basel Convention for spin- $1/2$ particles**
- **Madison Convention for spin-1 particles;**
quantities given in Cartesian coordinates

Polarization

Quantities in Cartesian coordinates

Polarization: refers to the degree of polarization of a single particle or ensemble.

where

$P_s(\theta)$ is the polarization of the outgoing particle beam as a function of angle.

REACTION Coding: , POL/DA

Polarization

Asymmetry: the relative difference between:

a.) number of particles scattered to the right and to the left in the reaction plane.

REACTION coding: POL/DA, ,ASY

b.) angular distribution for incident projectiles with polarization vectors perpendicular and parallel to the reaction plane.

REACTION coding: ,POL/DA, ,ASY/PP

c.) angular distribution for forward and backward scattered particles.

REACTION Coding: ,POL/DA, ,ASY/FB

Angles are given as ANG1 and ANG2.

Polarization

Analyzing Power: relative difference in cross sections for corresponding spin up vs. spin down.

Vector analyzing power (A_i or $A_{i,0;0,0}$ and A_j or $A_{0;j,0,0}$):

Coding: Modifier ANA in SF8.

Example: ,POL/DA, ,ANA Analyzing power, A_n ,

- incident projectile spin normal to scattering plane.

Tensor analyzing power (A_{ij} or $A_{i,j,0,0}$): initial spin state correlation parameters.

Coding: Modifier ANA in SF8, and a branch code in SF5 giving components of beam and target spin

Example: NN, POL/DA, ,ANA Tensor analyzing power, A_{NN} ,

incident projectile and target spins normal to scattering plane.

Polarization

- **Spin-Correlation Parameter** (C_{kp} or $C_{0,0,k,p}$): final spin state correlation parameters.

REACTION Coding: Modifier C in SF8, and branch code in SF5 giving components of beam and target spin.

Example: LL, POL/DA, , C C_{LL} , spin correlation function,
outgoing particle and recoil nucleus spins parallel to beam
direction in scattering plane

If time reversal holds: $C_{NN} = A_{NN}$.

Polarization

Spin-Rotation-Depolarization Parameters (D_{ik} or $D_{i,0,k,0}$ for incident beam and D_{jp} or $D_{0,j,0,p}$ for target)

- measure of the rotation of the spin of the scattered beam.
- **REACTION Coding:** Modifier D in SF8, and a branch code in SF5 giving components of beam and target spin.
- **Example:** **LL, POL/DA, , D** Spin-Rotation Parameter D_{LL} ,
 - beam and scattered particle spins parallel to beam direction in scattering plane.
- D_{NN} is also known as the **Spin-Depolarization Parameter**.

Polarization

Spin-flip Parameter (S_{kp} or $S_{0,0,k,p}$): spin flip parameters.

- **REACTION Coding:** Modifier S in SF8, and a branch code in SF5 giving components of beam and target spin.

Example: **NN, POL/DA, , SF** Spin-flip probability (S_{nn})

Spin-Rotation Function (**SRF** or **Q**): gives the coupling between the longitudinal component of the beam polarization and the component of the outgoing particle spin perpendicular to the beam direction.

REACTION coding: **POL/DA, , SRF**

Polarization

Quantities given in Spherical Coordinates

Analyzing Power (T_{kq})

Vector analyzing power (iT_{11})

REACTION Coding: quantity code VAP in SF6

Example: (....., , POL/DA , , VAP)

Tensor analyzing power (T_{20} , T_{21} , T_{22})

REACTION Coding: quantity code TAP in SF6; k and q are specified under the branch field using the codes 20, 21, and 22.

Example: (....., 20 , POL/DA , , TAP)

Polarization

Polarized beam specification

- For a polarized incident neutron beam, enter POLNS under INC-SOURCE;
- for a polarized ion beam, enter POLIS.
- If the incident source is known, it should follow in the same set of parenthesis.

Example: INC-SOURCE (POLNS ,D-T)

- Atomic beam and Lamb-shift sources are entered using the codes ATOMI and LAMB, respectively.

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Polarized target specification

- For a polarized target, enter the code POLTR under the keyword INC-SOURCE.

Polarization

- Incident beam and target polarization should be given in the data table, if known, using the data headings POL-BM and POL-TR, respectively.
- The numerical uncertainties are entered using the headings POL-BM-ERR and POL-TR-ERR; an explanation may be given in free text under ERR-ANALYS .

Horse by Skyler

