Reflection Symmetry and Spin and Parity of Θ+

Comments on experiments

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Bohr theorem and spin parity

- Reflexion symmetry in p-conserving collosion NP 10 (1959) 486
- Eigen value of R is conserved .
- n is the normal to the reaction plane
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- $R_i = R_f$, $R = P \exp(i \pi S_n)$,
- ΔS_n = even/odd as $P_i = +/- P_f$

- P is the parity of particles and S_n the sum of the spin components.
- R of γ = +/- for linear polarization with E along n,
- n is the normal to the reaction plane
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Neutron spin is set up. n : normal to K-Θ+ reaction plane

γ	n	=	K-	Θ	=	K+	n
E -	1/2 + up		0-	1/2+ up, 5/2+up	co-planar		1/2+down
				1/2- down, 5/2-down	co-planar		1/2+down
M+	1/2 + up		0-	1/2- up, 5/2- up	co-planar		1/2 +up
				1/2+ down, 5/2+down	co-planar		1/2+up

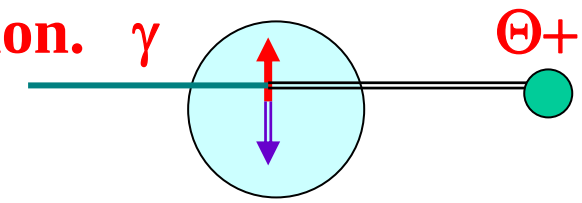
- 1. In case of E vector // n, then E excitation, and vice versa.
- 2. Linear polarization of γ and n spins can not give both spin parity of Θ.
- 3. So one need additional observables such as angular distributions.
- 4. Model of spin-flip/non-flip in production/decay should be such as

	E and K+ coplanar,		M and K+ coplanar,	
	Production	Decay	Production	Decay
Θ 1/2+	Spin-nonflip	Spin-flip	Spin-flip	Spin-flip
1/2-	Spin-flip	Spin-nonflip	Spin-nonflip	Spin-nonflip

Polarized nucleons for photonuclear reactions.

- HD polarized n in polarized D, & polarized nuclear targets.

- Polarized nucleon in unpolarized target
- tagged by residual nuclear polarization.



- $A(J=0) = n(j_m) + B(-j_m)$,
- where $B(-j_m)$ is measured by β asymmetry in coincidence
- with K- K+ and n at the same vertex point.

- Conditions
- B polarization is not disturbed by nuclear and atomic
- processes for the time t ~ halflife.
- t is short enough to avoid accidental coincident loss.

$^{28}Si(n+^{27}Si)$

- $^{28}Si(J=0) = n(d5/2) + {}^{27}Si(d5/2)$
- Select n 1/2 spin up
- in the outermost d5/2 shell with mass ~ 923 MeV and low p.
- $^{27}Si(d5/2)$ gs probability ~ 40 % out of 14 neutrons.
- (A hole in an inner shell is highly excited and not feed ^{27}Si gs)
- $^{27}Si(d5/2)$ gs life t(1/2) = 4.13 sec. 99.8 % Q(EC)=4.81 MeV.
- Ratio of the true to accidental coincidence rate
- $R = 10^6(\gamma/sec)\ 4.10^{20}$ (target at the vertex) 10(sec) 0.1 mb ~ 0.5
- where 0.1 mb is for the total cross section of 4~10 sec β rays.
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$^{12}C\ (n + {}^{11}C)$

- p3/2 neutron spin is tagged by measuring the beta decay of ^{11}C
- $\beta+$ decays with T = 20 ms and Q(EC) = 1.9 MeV.

Spin observables and Reaction models provide Θ Spin Parity on the basis of Reflection Symmetry

- 1. **Exp. of E-γ n spin up and coplanar K-,K+ leads to**
- **Θ 1/2 (5/2) + if spin-nonflip production and spin flip decay**
- **Θ 1/2 (5/2) - if spin-flip production and spin nonflip decay**

- **M-γ gives Θ - and + for spin nonflip and spin fip production**

- **In other wards, spin flip or spin nonflip processes in production and decay , together with E and M γ lead to the Θ parity.**

- **2. Final state n spin is given by the reflection symmetry as down or up for E or M γ, irrespective of the Θ parity.**

- **3. In case of Θ 1/2 (5/2)+ by E-γ involves the p-wave (parity -) in the decay, which is reflected on the angular distribution of K+**

- **4. Polarized n target can be obtained by tagging the residual nuclear spin through the beta decay asymmetry.**