Table 6 - cont'd

c) (continued)

$$Q = \frac{1}{4}\left[\sqrt{10}\;\overline{t^2_2} - \sqrt{14}\;\overline{t^3_2}\right] \qquad = \frac{1}{4}\left[\sqrt{10}\;\overline{{}^z t^2_2} - \sqrt{14}\;\overline{{}^z t^3_2}\right] \qquad = Q$$

$$Q' = \frac{1}{4}\left[\sqrt{10}\;\overline{t^2_2} + \sqrt{14}\;\overline{t^3_2}\right] \qquad = \frac{1}{4}\left[\sqrt{10}\;\overline{{}^z t^2_2} + \sqrt{14}\;\overline{{}^z t^3_2}\right] \qquad = Q'$$

$$R = \frac{i}{4}\left[-\sqrt{10}\;\overline{{}^y t^2_1} - \sqrt{\frac{18}{5}}\;\overline{{}^y t^1_1} - \sqrt{\frac{28}{5}}\;\overline{{}^y t^3_1}\right] = \frac{1}{4}\left[-\sqrt{10}\;\overline{{}^x t^2_1} - \sqrt{\frac{18}{5}}\;\overline{{}^x t^1_1} - \sqrt{\frac{28}{5}}\;\overline{{}^x t^3_1}\right] = R$$

$$R' = \frac{i}{4}\left[\sqrt{10}\;\overline{{}^y t^2_1} - \sqrt{\frac{18}{5}}\;\overline{{}^y t^1_1} - \sqrt{\frac{28}{5}}\;\overline{{}^y t^3_1}\right] = \frac{1}{4}\left[\sqrt{10}\;\overline{{}^x t^2_1} - \sqrt{\frac{18}{5}}\;\overline{{}^x t^1_1} - \sqrt{\frac{28}{5}}\;\overline{{}^x t^3_1}\right] = R'$$

$$R_1 = \frac{i}{4}\left[-\sqrt{\frac{24}{5}}\;\overline{{}^y t^1_1} - \sqrt{\frac{84}{5}}\;\overline{{}^y t^3_1}\right] = \frac{1}{4}\left[-\sqrt{\frac{24}{5}}\;\overline{{}^x t^1_1} - \sqrt{\frac{84}{5}}\;\overline{{}^x t^3_1}\right] = R_1$$

$$R_2 = \frac{-i}{4}\left[-\sqrt{28}\;\overline{{}^y t^3_3}\right] \qquad = \frac{1}{4}\left[-\sqrt{28}\;\overline{{}^x t^3_3}\right] \qquad = R_2$$

d) The 9 non linear constraints and the positivity conditions

$$|Q|^2 = P_1P_2, \quad |R_1|^2 = P_1P_1', \quad P_1R' = Q\bar{R}_1, \quad P_1 \geq 0, \quad P_2 \geq 0$$

$$|Q'|^2 = P_1'P_2', \quad RR' = \bar{R}_1R_2, \quad P_1'R = Q'\bar{R}_1, \quad P_1' \geq 0, \quad P_2' \geq 0$$

e) Transfer of polarization

$\sigma\,\rho_{11} = \sigma_o\, P_1\, (1 + z)$	$\sigma\,\rho_{-1-1} = \sigma_o\, P_1'\, (1 - z)$
$\sigma\,\rho_{-3-3} = \sigma_o\, P_2\, (1 + z)$	$\sigma\,\rho_{33} = \sigma_o\, P_2'\, (1 - z)$
$\sigma\,\rho_{1-3} = \sigma_o\, Q\, (1 + z)$	$\sigma\,\rho_{3-1} = \sigma_o\, Q'\, (1 - z)$
$\sigma\,\rho_{31} = \sigma_o\, R\, (x + iy)$	$\sigma\,\rho_{-1-3} = \sigma_o\, R'\, (x + iy)$
$\sigma\,\rho_{1-1} = \sigma\, R_1\, (x - iy)$	$\sigma\,\rho_{3-3} = \sigma_o\, R_2\, (x + iy)$

f) Expression of the observables in c) and e) as functions of the transversity amplitudes in Table 5 f).

$2\,\sigma_o\, P_1 = \vert a\vert^2$	$2\,\sigma_o\, P_1' = \vert a'\vert^2$
$2\,\sigma_o\, P_2 = \vert b\vert^2$	$2\,\sigma_o\, P_2' = \vert b'\vert^2$
$2\,\sigma_o\, Q = a\bar{b}$	$2\,\sigma_o\, Q' = b'\bar{a}'$
$2\,\sigma_o\, R = b'\bar{a}$	$2\,\sigma_o\, R' = a'\bar{b}$
$2\,\sigma_o\, R_1 = a\bar{a}'$	$2\,\sigma_o\, R_2 = b'\bar{b}$

Table 7. Amplitude reconstruction for reactions of type $\pi p \to \pi\Delta$ $\left(0^- \frac{1}{2}^+ \to 0^- \frac{3}{2}^{+e}\right)$ with polarized target.

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a) Combined production and decay angular distribution and measurement of the polarization transfer by the method of moments

$$I(\psi,\theta,\phi) = \frac{1}{2\pi} \sum_L C(L) \sum_M [\overline{t^L_M} + P_T\,(\cos\psi\ \overline{{}^z t^L_M} + \sin\psi\ \overline{{}^x t^L_M}) + P_L\ \overline{{}^y t^L_M}]\ Y^L_M(\theta,\phi)$$

$$C(L)\ (t^L_M + P_L\ {}^y t^L_M) = \langle Y^L_M(\theta\ \phi \rangle$$

$$C(L)\ P_T\ {}^z t^L_M = \langle 2\cos\psi\ Y^L_M(\theta,\phi)\rangle$$

$$C(L)\ P_T\ {}^x t^L_M = \langle 2\sin\psi\ Y^L_M(\theta,\phi)\rangle$$

with $C(0) = 1/\sqrt{4\pi}$, $C(2) = 1/\sqrt{4\pi}$ (all other C coefficients vanish)

---

b) The 12 real observables in transversity quantization

$$\sigma_o,\ t^2_o,\ \mathrm{Re}\ t^2_2,\ \mathrm{Im}\ t^2_2$$

$$P_R = {}^z t^o_o,\ \ {}^z t^2_o,\ \mathrm{Re}\ {}^z t^2_2,\ \mathrm{Im}\ {}^z t^2_2,\ \ \mathrm{Re}\ {}^x t^2_1,\ \ \mathrm{Im}\ {}^x t^2_1,\ \ \mathrm{Re}\ {}^y t^2_1,\ \ \mathrm{Im}\ {}^y t^2_1.$$

(M = even for t^L_M and ${}^z t^L_M$, M = odd for ${}^x t^L_M$ and ${}^y t^L_M$, by B-symmetry; $t^L_{-M} = (-1)^M\ \overline{t^L_M}$)

---

c) The 9 generalized spin rotation parameters and the 2 linear constraints

$$P_1 = \frac{1}{4}\ [1 + P_R - \sqrt{5}\ (t^2_o + {}^z t^2_o)\ ]$$

$$P'_1 = \frac{1}{4}\ [1 - P_R - \sqrt{5}\ (t^2_o - {}^z t^2_o)\ ]$$

$$P_2 = \frac{1}{4}\ [1 + P_R + \sqrt{5}\ (t^2_o + {}^z t^2_o)\ ]$$

$$P'_2 = \frac{1}{4}\ [1 - P_R + \sqrt{5}\ (t^2_o - {}^z t^2_o)\ ]$$

$$P_1 + P'_1 + P_2 + P'_2 = 1$$

$$P_1 - P'_1 + P_2 - P'_2 = P_R$$

$$Q = \frac{1}{4}\ \sqrt{10}\ (\overline{t^2_2} + \overline{{}^z t^2_2})\ ,\qquad Q' = \frac{1}{4}\ \sqrt{10}\ (\overline{t^2_2} - \overline{{}^z t^2_2})$$

$$R_- = -\frac{1}{2}\ \sqrt{10}\ \overline{{}^x t^2_1} = \frac{i}{2}\ \sqrt{10}\ \overline{{}^y t^2_1}$$

---

d) The 3 non linear constraints and the positivity conditions

$$|Q|^2 = P_1 P_2\ ,\quad |Q'|^2 = P'_1 P'_2\ ,\quad |R_-|^2 + |Q+Q'|^2 = (P_1 + P'_1)(P_2 + P'_2)$$

$$P_1 \gtrsim 0,\ \ P_2 \gtrsim 0,\ \ P'_1 \gtrsim 0,\ \ P'_2 \gtrsim 0.$$

Table 7 - cont'd

e) Transfer of polarization

$$\sigma \rho_{11}^{e} = \sigma_o [\frac{1}{2} (P_1 + P_1') + \frac{1}{2} (P_1 - P_1')z]$$

$$\sigma \rho_{33}^{e} = \sigma_o [\frac{1}{2} (P_2 + P_2') + \frac{1}{2} (P_2 - P_2')z]$$

$$\sigma \rho_{3-1}^{e} = \sigma_o [\frac{1}{2} (Q + Q') + \frac{1}{2} (Q - Q')z]$$

$$\sigma \rho_{31}^{e} = \sigma_o R_- (x + iy)$$

f) Transversity and helicity amplitudes

$$\begin{array}{c|cc|} \lambda_\Delta & \multicolumn{2}{c}{\lambda_p} \\ & \frac{1}{2} & -\frac{1}{2} \\ 3/2 & . & b' \\ 1/2 & a & . \\ -1/2 & . & a' \\ 3/2 & b & . \end{array} = T_{2\lambda_\Delta, 2\lambda_p} \qquad \begin{array}{|cc|} B' & -B \\ A & A' \\ A' & -A \\ B & B' \end{array} = H_{2\lambda_\Delta, 2\lambda_p}$$

$$A + i A' = -\frac{1}{2} (a + \sqrt{3}\, b) \qquad B + i B' = -\frac{1}{2} (\sqrt{3}\, a - b)$$

$$A - i A' = \frac{1}{2} (a' + \sqrt{3}\, b') \qquad B - i B' = \frac{1}{2} (\sqrt{3}\, a' - b')$$

g) Expression of the observables in c) - e) in terms of the transversity amplitudes in f)

$$2 \sigma_o P_1 = |a|^2 \qquad 2 \sigma_o P_1' = |a'|^2$$

$$2 \sigma_o P_2 = |b|^2 \qquad 2 \sigma_o P_2' = |b'|^2$$

$$2 \sigma_o Q = a\bar{b} \qquad 2 \sigma_o Q' = b'\bar{a}'$$

$$2 \sigma_o R_- = b'\bar{a} - a'\bar{b} \qquad \rightarrow [a\bar{a}' = 2 \sigma_o (P_1 Q' - P_1' Q)/R_-]$$

Table 8. Amplitude reconstruction for reactions of type $\pi p \rightarrow K^*\Lambda \; (0^- \tfrac{1}{2}^+ \rightarrow 1^{-e} \tfrac{1}{2}^+)$ with unpolarized target.

a) Joint angular distribution of K^* and Λ decays and measurement of the double multipole parameters by the method of moments

$$I(\theta,\phi,\theta',\phi') = \sum_{L,L'} C_{K*}(L)\; C_{\Lambda}(L') \sum_{M,M'} \overline{t^{LL'}_{MM'}}\; Y^{L}_{M}(\theta,\phi)\; Y^{L'}_{M'}(\theta,\phi)$$

$$C_{K*}(L)\; C_{\Lambda}(L')\; t^{LL'}_{MM'} = \langle Y^{L}_{M}(\theta,\phi) \quad Y^{L}_{M'}(\theta',\phi')\rangle$$

with

$$C_{K*}(o) = C_{\Lambda}(o) = 1/\sqrt{4\pi}, \quad C_{K*}(2) = -1/\sqrt{2\pi}, \quad C_{\Lambda}(1) = \alpha_{\Lambda}/\sqrt{4\pi}$$

(all other C coefficients vanish)

b) The 12 real observables in transversity quantization

$$\sigma_o,\, t^{20}_{00},\; t^{01}_{00},\; t^{21}_{00},\; \left.\begin{matrix}\mathrm{Re}\\ \mathrm{Im}\end{matrix}\right\}\; t^{20}_{20},\; t^{21}_{20},\; t^{21}_{11},\; t^{21}_{1-1}$$

(M+M' = even, by B-symmetry; $t^{LL'}_{-M-M'} = (-1)^{M+M'}\; \overline{t^{LL'}_{MM'}}$)

c) Observable density matrix elements in transversity quantization

$$\left.\begin{matrix} P_o = \rho^{00}_{++} \\ P'_o = \rho^{00}_{--} \end{matrix}\right\} = \frac{1}{6}\,[1 - \sqrt{10}\; t^{20}_{00} \pm (\sqrt{3}\; t^{01}_{00} - \sqrt{30}\; t^{21}_{00})]$$

$$\left.\begin{matrix} P = \rho^{11e}_{--} \\ P' = \rho^{11e}_{++} \end{matrix}\right\} = \frac{1}{6}\,[1 + \sqrt{\frac{5}{2}}\; t^{20}_{00} \mp (\sqrt{3}\; t^{01}_{00} + \sqrt{\frac{15}{2}}\; t^{21}_{00})]$$

$$\left.\begin{matrix} Q = \rho^{1-1}_{--} \\ Q' = \rho^{1-1}_{++} \end{matrix}\right\} = \frac{1}{6}\,[\sqrt{15}\; \overline{t^{20}_{20}} \quad \mp \sqrt{45}\; \overline{t^{21}_{20}}]$$

$$S_1 = \rho^{10e}_{-+} = \frac{-1}{6}\,\sqrt{45}\; \overline{t^{21}_{1-1}}$$

$$S_2 = \rho^{10e}_{+-} = \frac{1}{6}\,\sqrt{45}\; \overline{t^{21}_{11}}$$

Table 8 - (cont'd)

d) Positivity and diacritical constraints

$$P_o \geq 0, \qquad P \geq |Q|, \qquad P_o' \geq 0, \qquad P' \geq |Q'|$$

$$32 P_o P = |\Gamma - \sqrt{\Delta}|^2 / |S_2|^2 + |\Gamma + \sqrt{\Delta}|^2 / |S_1|^2$$

$$32 P_o' P' = |\Gamma' + \sqrt{\Delta}|^2 / |S_2|^2 + |\Gamma' - \sqrt{\Delta}|^2 / |S_1|^2$$

with

$$\Gamma = 4 S_1 S_2 - P_o Q + P_o' Q' \qquad \Gamma' = 4 S_1 S_2 + P_o Q - P_o' Q'$$

$$\Delta = \Delta(4 S_1 S_2, -P_o Q, -P_o' Q') \qquad \Delta(x,y,z) = x^2 + y^2 + z^2 - 2(xy + yz + zx)$$

$\sqrt{\Delta}$ = one of the two complex roots, to be fixed by the diacritical constraints.

e) Transversity and helicity amplitudes

λ_Λ	λ_{K^*}	λ_p = +½	λ_p = -½
+½	1	·	c'
	0	a	·
	-1	·	b'
-½	1	b	·
	0	·	a'
	-1	c	·

$= T^{\lambda_{K^*}}_{2\lambda_\Lambda, 2\lambda_p}$;

λ_Λ	λ_{K^*}	λ_p = +½	λ_p = -½
+½	1	C'	-C
	0	A	A'
	-1	B'	-B
-½	1	B	B'
	0	A'	-A
	-1	C	C'

$= H^{\lambda_{K^*}}_{2\lambda_\Lambda, 2\lambda_p}$

$$2(A + iA') = -\sqrt{2}(b+c), \qquad 2(A - iA') = \sqrt{2}(b'+c')$$

$$2(B + iB') = -\sqrt{2}a + (b-c), \qquad 2(B - iB') = \sqrt{2}a' - (b'-c'),$$

$$2(C + iC') = -\sqrt{2}a - (b-c), \qquad 2(C - iC') = \sqrt{2}a' + (b'-c').$$

The Byers - Yang [5] amplitudes are given by

$$a_+ = -a', \quad b_+ = -(b'+c')/\sqrt{2}, \qquad c_+ = -i(-b'+c')/\sqrt{2}$$

$$a_- = -a, \quad b_- = (b+c)/\sqrt{2}, \qquad c_- = i(-b+c)/\sqrt{2}$$

if one uses standard s, t, and u transversity frames for the quantization of p, K*, and Λ respectively.

Table 8 - cont'd

f) Expression of the observables in c) and d) as functions of the transversity amplitudes

$$2\sigma P_o = |a|^2 \qquad 2\sigma P'_o = |a'|^2$$

$$2\sigma P = \tfrac{1}{2}(|b|^2+|c|^2) \qquad 2\sigma P' = \tfrac{1}{2}(|b'|^2+|c'|^2)$$

$$2\sigma Q = b\bar{c} \qquad 2\sigma Q' = c'\bar{b}'$$

$$2\sigma S_1 = \tfrac{1}{2}(b\bar{a}-a'\bar{b}') \qquad 2\sigma S_2 = \tfrac{1}{2}(c'\bar{a}'-a\bar{c})$$

g) Algebraic reconstruction of the amplitudes

$$|a|^2 = 2\sigma P_o \qquad |a'|^2 = 2\,\sigma P_o$$

$$|b|^2 = 2\sigma\,(P+\varepsilon\sqrt{P^2-|Q|^2}) \qquad |c'|^2 = 2\sigma\,(P'+\varepsilon\sqrt{P'^2-|Q'|^2})$$

$$|c|^2 = 2\sigma\,(P-\varepsilon\sqrt{P^2-|Q|^2}) \qquad |c'|^2 = 2\sigma\,(P'-\varepsilon\sqrt{P'^2-|Q'|^2})$$

$$\phi_b-\phi_c = \mathrm{Arg}\,Q \qquad \phi_{c'}-\phi_{b'} = \mathrm{Arg}\,Q'$$

$$\begin{cases}\phi_b-\phi_a = \mathrm{Arg}\,(\Gamma-\sqrt{\Delta})/S_2 \\ \phi_a-\phi_c = \mathrm{Arg}\,(-\Gamma-\sqrt{\Delta})/S_1\end{cases} \qquad \begin{cases}\phi_{a'}-\phi_{b'} = \mathrm{Arg}\,(-\Gamma'-\sqrt{\Delta})/S_2 \\ \phi_{c'}-\phi_{b'} = \mathrm{Arg}\,(\Gamma'-\sqrt{\Delta})/S_1\end{cases}$$

with the expression for $\Gamma, \Gamma', \sqrt{\Delta}$ given in d), and the signs ε, ε' fixed by :

$$\varepsilon[\,|S_1|^2|\Gamma-\sqrt{\Delta}|^2 - |S_2|^2|\Gamma+\sqrt{\Delta}|^2] \geq 0, \quad \varepsilon'[\,|S_1|^2|\Gamma'+\sqrt{\Delta}|^2-|S_2|^2|\Gamma'-\sqrt{\Delta}|^2] \geq 0$$

Table 9 - Amplitude reconstruction for reactions of type $\pi p \to K^* \Lambda$ $(0^- \frac{1}{2}^+ \to 1^{-e} \frac{1}{2}$ with polarized target.

a) Combined production and joint decay angular distribution, and measurement of the polarization transfer by the method of moments

$$I(\psi,\Theta\phi,\Theta'\phi') = \frac{1}{2\pi} \sum_{L,L'} C_{K^*}(L)\, C_\Lambda(L')$$

$$\times \sum_{M,M'} [\overline{t^{LL'}_{MM'}} + P_T \cos\psi\, \overline{{}^z t^{LL'}_{MM'}} + P_T \sin\psi\, \overline{{}^x t^{LL'}_{MM'}} + P_L\, \overline{{}^y t^{LL'}_{MM'}}] Y^L_M(\Theta,\phi) Y^{L'}_{M'}(\Theta',\phi')$$

$$C_{K^*}(L)\, C_\Lambda(L')\, (t^{LL'}_{MM'} + P_L\, {}^y t^{LL'}_{MM'}) = \langle Y^L_M(\Theta,\phi)\, Y^{L'}_{M'}(\Theta',\phi')\rangle$$

$$C_{K^*}(L)\, C_\Lambda(L')\, P_T\, {}^z t^{(L)}_M = \langle 2\cos\psi\, Y^L_M(\Theta,\phi)\, Y^{L'}_{M'}(\Theta'\phi')\rangle$$

$$C_{K^*}(L)\, C_\Lambda(L')\, P_T\, {}^x t^{(L)}_M = \langle 2\sin\psi\, Y^L_M(\Theta,\phi)\, Y^{L'}_{M'}(\Theta'\phi')\rangle$$

with

$$C_{K^*}(o) = C_\Lambda(o) = 1/\sqrt{4\pi}\,, \quad C_{K^*}(2) = -1/\sqrt{2\pi}, \quad C_\Lambda(1) = \alpha_1/\sqrt{4\pi}$$

(all other C coefficients vanish)

b) The 48 real observables in transversity quantization

$$\sigma_o,\ t^{20}_{oo},\ t^{01}_{oo},\ t^{21}_{oo},\ \left.\begin{matrix}Re\\Im\end{matrix}\right\} t^{20}_{20},\ t^{21}_{20},\ t^{21}_{11},\ t^{21}_{1-1}$$

$$P_R = {}^z t^{oo}_{oo},\ {}^z t^{20}_{oo},\ {}^z t^{01}_{oo},\ {}^z t^{21}_{oo},\ \left.\begin{matrix}Re\\Im\end{matrix}\right\} {}^z t^{20}_{20},\ {}^z t^{21}_{20},\ {}^z t^{21}_{11},\ {}^z t^{21}_{1-1}$$

$$\left.\begin{matrix}Re\\Im\end{matrix}\right\} {}^x t^{20}_{10},\ {}^x t^{01}_{01},\ {}^x t^{21}_{10},\ {}^x t^{21}_{01},\ {}^x t^{21}_{21},\ {}^x t^{21}_{2-1}$$

$$\left.\begin{matrix}Re\\Im\end{matrix}\right\} {}^y t^{20}_{10},\ {}^y t^{01}_{01},\ {}^y t^{21}_{10},\ {}^y t^{21}_{01},\ {}^y t^{21}_{21},\ {}^y t^{21}_{2-1}$$

($M + M'$ = even for $t^{LL'}_{MM'}$, ${}^z t^{LL'}_{MM'}$ and odd for ${}^x t^{LL'}_{MM'}$, ${}^y t^{LL'}_{MM'}$, by B-symmetry; $t^{LL'}_{-M-M'} = (-)^{M+M'}\, \overline{t^{LL'}_{MM'}}$)

Table 9 - cont'd

c) The 31 generalized spin rotation parameters and the 16 linear constraints

$$P_o = \frac{1}{6}[1 - \sqrt{10}\, t^{20}_{00} + \sqrt{3}\, t^{01}_{00} - \sqrt{30}\, t^{21}_{00}] = \frac{1}{6}[P_R - \sqrt{10}\, {}^{z}t^{20}_{00} + \sqrt{3}\, {}^{z}t^{01}_{00} - \sqrt{30}\, {}^{z}t^{21}_{00}] = P_o$$

$$P'_o = \frac{1}{6}[1 - \sqrt{10}\, t^{20}_{00} - \sqrt{3}\, t^{01}_{00} + \sqrt{30}\, t^{21}_{00}] = \frac{-1}{6}[P_R - \sqrt{10}\, {}^{z}t^{20}_{00} - \sqrt{3}\, {}^{z}t^{01}_{00} + \sqrt{30}\, {}^{z}t^{21}_{00}] = P'_o$$

$$P = \frac{1}{6}\,[1 + \sqrt{\tfrac{5}{2}}\, t^{20}_{00} - \sqrt{3}\, t^{01}_{00} - \sqrt{\tfrac{15}{2}}\, t^{21}_{00}] = \frac{1}{6}[P_R + \sqrt{\tfrac{5}{2}}\, {}^{z}t^{20}_{00} - \sqrt{3}\, {}^{z}t^{01}_{00} - \sqrt{\tfrac{5}{2}}\, {}^{z}t^{21}_{00}] = P$$

$$P' = \frac{1}{6}\,[1 + \sqrt{\tfrac{5}{2}}\, t^{20}_{00} + \sqrt{3}\, t^{01}_{00} + \sqrt{\tfrac{15}{2}}\, t^{21}_{00}] = \frac{-1}{6}[P_R + \sqrt{\tfrac{5}{2}}\, {}^{z}t^{20}_{00} + \sqrt{3}\, {}^{z}t^{01}_{00} + \sqrt{\tfrac{5}{2}}\, {}^{z}t^{21}_{00}] = P'$$

$$P_o + P'_o + 2(P+P') = 1 \qquad\qquad P_R = P_o - P'_o + 2(P-P')$$

$$Q = \frac{1}{6}\,[\sqrt{15}\, \overline{t^{20}_{20}} - \sqrt{45}\, \overline{t^{21}_{20}}] = \frac{1}{6}[\sqrt{15}\, \overline{{}^{z}t^{20}_{20}} - \sqrt{45}\, \overline{{}^{z}t^{21}_{20}}] = Q$$

$$Q' = \frac{1}{6}\,[\sqrt{15}\, \overline{t^{20}_{20}} + \sqrt{45}\, \overline{t^{21}_{20}}] = \frac{-1}{6}[\sqrt{15}\, \overline{{}^{z}t^{20}_{20}} + \sqrt{45}\, \overline{{}^{z}t^{21}_{20}}] = Q'$$

$$S_1 = \frac{1}{6}\,[-\sqrt{45}\, \overline{t^{21}_{1-1}}]; \qquad \frac{1}{6}[-\sqrt{45}\, \overline{{}^{z}t^{21}_{1-1}}] = T_1$$

$$S_2 = \frac{1}{6}\,[\sqrt{45}\, \overline{t^{21}_{11}}]; \qquad \frac{-1}{6}[\sqrt{45}\, \overline{{}^{z}t^{21}_{11}}] = T_2$$

$$R_o = \frac{i}{6}\,[-\sqrt{6}\, \overline{{}^{y}t^{01}_{01}} + \sqrt{60}\, \overline{{}^{y}t^{21}_{01}}] = \frac{1}{6}[-\sqrt{6}\, \overline{{}^{x}t^{01}_{01}} + \sqrt{60}\, \overline{{}^{x}t^{21}_{01}}] = R_o$$

$$R_1 = \frac{i}{6}\,[\sqrt{90}\, \overline{{}^{y}t^{21}_{2-1}}] = \frac{1}{6}[\sqrt{90}\, \overline{{}^{x}t^{21}_{21}}] = R_1$$

$$R_2 = \frac{-i}{6}\,[-\sqrt{90}\, \overline{{}^{y}t^{21}_{21}}] = \frac{1}{6}[-\sqrt{90}\, \overline{{}^{x}t^{21}_{21}}] = R_2$$

$$R_3 = \frac{-i}{6}\,[-\sqrt{6}\, \overline{{}^{y}t^{01}_{01}} - \sqrt{15}\, \overline{{}^{y}t^{21}_{01}}] = \frac{1}{6}[-\sqrt{6}\, \overline{{}^{x}t^{01}_{01}} - \sqrt{15}\, \overline{{}^{x}t^{21}_{01}}] = R_3$$

$$A_1 = \frac{i}{6}\,[-\sqrt{\tfrac{15}{2}}\, \overline{{}^{y}t^{20}_{10}} + \sqrt{\tfrac{45}{2}}\, \overline{{}^{y}t^{21}_{10}}]; \qquad \frac{1}{6}[-\sqrt{\tfrac{15}{2}}\, \overline{{}^{x}t^{20}_{10}} + \sqrt{\tfrac{45}{2}}\, \overline{{}^{x}t^{21}_{10}}] = U_1$$

$$A_2 = \frac{-i}{6}\,[-\sqrt{\tfrac{15}{2}}\, \overline{{}^{y}t^{20}_{10}} - \sqrt{\tfrac{45}{2}}\, \overline{{}^{y}t^{21}_{10}}]; \qquad \frac{1}{6}[-\sqrt{\tfrac{15}{2}}\, \overline{{}^{x}t^{20}_{10}} - \sqrt{\tfrac{45}{2}}\, \overline{{}^{x}t^{21}_{10}}] = U_2$$

d) Polarization transfer

$$\sigma\,\rho^{00}_{++} = \sigma_o\, P_o\,(1+z) \qquad\qquad \sigma\,\rho^{00}_{--} = \sigma_o\, P'_o\,(1-z)$$

$$\sigma\,\rho^{00e}_{--} = \sigma_o\, P\,(1+z) \qquad\qquad \sigma\,\rho^{11e}_{++} = \sigma_o\, P'\,(1-z)$$

$$\sigma\,\rho^{1-1}_{--} = \sigma_o\, Q\,(1+z) \qquad\qquad \sigma\,\rho^{1-1}_{++} = \sigma_o\, Q'\,(1-z)$$

$$\sigma\,\rho^{10e}_{-+} = \sigma_o\,(S_1 + T_1\, z) \qquad\qquad \sigma\,\rho^{10e}_{+-} = \sigma_o\,(S_2 - T_2\, z)$$

$$\sigma\,\rho^{00}_{+-} = \sigma_o\, R_o(x - iy) \qquad\qquad \sigma\,\rho^{11e}_{+-} = \sigma_o\, R_3(x + iy)$$

$$\sigma\,\rho^{1-1}_{-+} = \sigma_o\, R_1(x - iy) \qquad\qquad \sigma\,\rho^{1-1}_{+-} = \sigma_o\, R_2\,(x + iy)$$

$$\sigma\,\rho^{10e}_{--} = \sigma_o\,(U_1\, x - iA_1\, y) \qquad\qquad \sigma\,\rho^{10e}_{++} = \sigma_o\,(U_2\, x + i\, A_2 y)$$

Table 9 - cont'd

e) Expression of the observables in c) and d) as functions of the transversity amplitudes in Table 8e).

$2\sigma_o P_o = \|a\|^2$	$2\sigma_o P'_o = \|a'\|^2$
$2\sigma_o P = \frac{1}{2}(\|b\|^2 + \|c\|^2)$	$2\sigma_o P' = \frac{1}{2}(\|b'\|^2 + \|c'\|^2$
$2\sigma_o Q = b\bar{c}$	$2\sigma_o Q' = c'\bar{b}'$
$2\sigma_o S_1 = \frac{1}{2}(b\bar{a} - a'\bar{b}')$	$2\sigma_o S_2 = \frac{1}{2}(c'\bar{a}' - a\bar{c})$
$2\sigma_o T_1 = \frac{1}{2}(b\bar{a} + a'\bar{b}')$	$2\sigma_o T_2 = \frac{1}{2}(c'\bar{a}' + a\bar{c})$
$2\sigma_o R_o = a\bar{a}'$	$2\sigma_o R_3 = \frac{1}{2}(c'\bar{b} + b'\bar{c})$
$2\sigma_o R_1 = b\bar{b}'$	$2\sigma_o R_2 = c'\bar{c}$
$2\sigma_o U_1 = \frac{1}{2}(b\bar{a}' - a'\bar{c})$	$2\sigma_o U_2 = \frac{1}{2}(c'\bar{a} - a\bar{b}')$
$2\sigma_o A_1 = \frac{1}{2}(b\bar{a}' + a'\bar{c})$	$2\sigma_o A_2 = \frac{1}{2}(c'\bar{a} + a\bar{b}')$

f) Complement to the algebraic reconstruction of amplitudes in Table 8g), for transversally polarized target.

$\|b\|^2 = 2\sigma_o \|S_1 + T_1\|^2/P_o$	$\|b'\|^2 = 2\sigma_o \|S_1 - T_1\|^2/P'_o$
$\|c\|^2 = 2\sigma_o \|S_2 - T_2\|^2/P_o$	$\|c'\|^2 = 2\sigma_o \|S_2 + T_2\|^2/P'_o$
$\phi_b - \phi_a = \mathrm{Arg}\,(S_1 + T_1)$	$\phi_{c'} - \phi_{a'} = \mathrm{Arg}\,(S_2 + T_2)$

Table 10 - Amplitude reconstruction for reactions of type $\pi p \rightarrow \rho N$ $(0^{-}\ \frac{1}{2}^{+} \rightarrow 1^{-e}\ \frac{1}{2}^{+e})$ with polarized target.

a) Combined production and decay angular distribution and measurement of the polarization transfer by the method of moments.

$$I(\psi,\Theta,\phi) = \frac{1}{2\pi} \sum_{L} C(L) \sum_{M} [\overline{t^{L}_{M}} + P_{T} \cos\psi\, \overline{{}^{2}t^{L}_{M}} + P_{T} \sin\psi\, \overline{{}^{x}t^{L}_{M}} + P_{L}\, \overline{{}^{y}t^{L}_{M}}] Y^{L}_{M}(\Theta,\phi)$$

$$C(L)\ (t^{L}_{M} + P_{L}\ {}^{y}t^{L}_{M}) = \langle Y^{L}_{M}\ (\Theta,\phi)\rangle$$

$$C(L)\ P_{T}\ {}^{z}t^{L}_{M} = \langle 2\ \cos\psi\ Y^{L}_{M}\ (\Theta,\phi)\rangle$$

$$C(L)\ P_{T}\ {}^{x}t^{L}_{M} = \langle 2\ \sin\psi\ Y^{L}_{M}\ (\Theta,\phi)\rangle$$

with

$C(o) = 1/\sqrt{4\pi}$, $C(2) = -\ 1/\sqrt{2\pi}$ (all other C coefficients vanish)

b) The 12 real observables in transversity quantization

$$\sigma_{o},\ t^{2}_{o},\ \mathrm{Re}\ t^{2}_{2},\ \mathrm{Im}\ t^{2}_{2}$$

$$P_{R} = {}^{z}t^{o}_{o},\ {}^{z}t^{2}_{o},\ \mathrm{Re}\ {}^{z}t^{2}_{2},\ \mathrm{Im}\ {}^{z}t^{2}_{2},\quad \mathrm{Re}\ {}^{x}t^{2}_{1},\ \mathrm{Im}\ {}^{x}t^{2}_{1}$$

$$\mathrm{Re}\ {}^{y}t^{2}_{1},\ \mathrm{Im}\ {}^{y}t^{2}_{1}$$

(M = even for t^{L}_{M} and ${}^{z}t^{L}_{M}$, M = odd for ${}^{x}t^{L}_{M}$ and ${}^{y}t^{L}_{M}$, by B-symmetry; $t^{L}_{-M} = (-)^{M}\ t^{L}_{M}$).

Table 10 - cont'd

c) Generalized spin rotation parameters

$$P_o = \frac{1}{6} \left[1 + P_R - \sqrt{10}\,(t_o^2 + {}^{z}t_o^2)\right]$$

$$P'_o = \frac{1}{6} \left[1 - P_R - \sqrt{10}\,(t_o^2 - {}^{z}t_o^2)\right]$$

$$P = \frac{1}{6} \left[1 + P_R + \sqrt{\frac{5}{2}}\,(t_o^2 + {}^{z}t_o^2)\right]$$

$$P' = \frac{1}{6} \left[1 - P_R + \sqrt{\frac{5}{2}}\,(t_o^2 - {}^{z}t_o^2)\right]$$

$$Q = \frac{1}{6} \sqrt{15}\,(\overline{t_2^2} + \overline{{}^{z}t_2^2})$$

$$Q' = \frac{1}{6} \sqrt{15}\,(\overline{t_2^2} - \overline{{}^{z}t_2^2})$$

$$U = \frac{-1}{6} \sqrt{30}\,\overline{{}^{x}t_1^2}$$

$$A = \frac{-i}{6} \sqrt{30}\,\overline{{}^{y}t_1^2}$$

d) Transfer of polarization

$$\sigma\,\rho_{oo} = \sigma_o\,[(P_o + P'_o) + (P_o - P'_o)z]$$

$$\sigma\,\rho^{e}_{11} = \sigma_o\,[(P + P') + (P - P')z]$$

$$\sigma\,\rho_{1-1} = \sigma_o\,[(Q + Q') + (Q - Q')z]$$

$$\sigma\,\rho^{e}_{10} = \sigma_o\,[U\,x - i\,A\,y]$$

e) Transversity and helicity amplitudes, as in Table 8e)

f) Expression of the observables in c) and d) as functions of the transversity amplitudes.

$$2\sigma_o\,P_o = |a|^2 \qquad\qquad 2\sigma_o\,P'_o = |a'|^2$$

$$2\sigma_o\,P = \frac{1}{2}(|b|^2 + |c|^2) \qquad\qquad 2\sigma_o\,P' = \frac{1}{2}(|b'|^2 + |c'|^2)$$

$$2\sigma_o\,Q = b\bar{c} \qquad\qquad 2\sigma_o\,Q' = c'\bar{b}'$$

$$2\,\sigma_o\,U = \frac{1}{2}(b\bar{a}' - a\bar{b}' + c'\bar{a} - a'\bar{c})$$

$$2\,\sigma_o\,A = \frac{1}{2}(b\bar{a}' - a\bar{b}' - c'\bar{a} + a'\bar{c})$$

Table 11. Amplitude reconstruction for reactions of type $\pi p \to K^{**}\Lambda$ $(0^- \frac{1}{2}^+ \to 2^{+e} \frac{1}{2}^+)$ with unpolarized target.

a) Joint angular distribution of the K^{**} and Λ decays, and measurement of the double multipole parameters by the method of moments.

$$I(\Theta,\phi;\Theta',\phi') = \sum_{L,L'} C_{K^{**}}(L) C_{\Lambda}(L') \sum_{M_1 M'} \overline{t^{LL'}_{MM'}}\, Y^{L}_{M}(\Theta,\phi)\, Y^{L'}_{M'}(\Theta',\phi')$$

$$C_{K^{**}}(L)\, C_{\Lambda}(L')\, t^{LL'}_{MM'} = \langle Y^{L}_{M}(\Theta,\phi)\; Y^{L'}_{M'}(\Theta',\phi')\rangle$$

with: $C_{K^{**}}(0) = C_{\Lambda}(0) = 1/\sqrt{4\pi}$, $\quad C_{\Lambda}(1) = \alpha_{\Lambda}/\sqrt{4\pi}$

$C_{K^{**}}(2) = -\sqrt{5/14\pi}$, $\quad C_{K^{**}}(4) = \sqrt{9/14\pi}$, for $2 \to 00$ decay

$C_{K^{**}}(2) = -\sqrt{5/56\pi}$, $\quad C_{K^{**}}(4) = -\sqrt{2/7\pi}$, for $2^+ \to 1^- 0^-$ decay

(all other C coefficients vanish)

b) The 30 real observables in transversity quantization

$$\sigma_0,\ t^{20}_{00},\ t^{40}_{00},\ t^{01}_{00},\ t^{21}_{00},\ t^{41}_{00},$$

$$\left.\begin{matrix}\mathrm{Re}\\ \mathrm{Im}\end{matrix}\right\}\ \left\{\begin{matrix} t^{20}_{20},\ t^{40}_{20},\ t^{40}_{40},\ t^{21}_{20},\ t^{41}_{20},\ t^{41}_{40},\\ t^{21}_{11},\ t^{21}_{1-1},\ t^{41}_{11},\ t^{41}_{1-1},\ t^{41}_{31},\ t^{41}_{3-1}\end{matrix}\right.$$

(L = even, M + M' = even by B-symmetry, $t^{LL'}_{-M-M'} = (-1)^{M+M'}\,\overline{t^{LL'}_{MM'}}$)

Table 11 - cont'd

c) Observable elements of this joint density matrix in transversity quantization.

$$\left.\begin{array}{l} P_o = \rho^{00}_{++} \\ P'_o = \rho^{00}_{--} \end{array}\right\} = \frac{1}{10}\left[1-\sqrt{\frac{50}{7}}\,t^{20}_{00} + \sqrt{\frac{162}{7}}\,t^{40}_{00} \pm \left(\sqrt{3}\,t^{01}_{00} - \sqrt{\frac{150}{7}}\,t^{21}_{00} + \sqrt{\frac{486}{7}}\,t^{41}_{00}\right)\right]$$

$$\left.\begin{array}{l} P_1 = \rho^{11e}_{--} \\ P'_1 = \rho^{11e}_{++} \end{array}\right\} = \frac{1}{10}\left[1-\sqrt{\frac{25}{14}}\,t^{20}_{00} - \sqrt{\frac{72}{7}}\,t^{40}_{00} \mp \left(\sqrt{3}\,t^{01}_{00} - \sqrt{\frac{75}{14}}\,t^{21}_{00} - \sqrt{\frac{216}{7}}\,t^{41}_{00}\right)\right]$$

$$\left.\begin{array}{l} P_2 = \rho^{22e}_{++} \\ P'_2 = \rho^{22e}_{--} \end{array}\right\} = \frac{1}{10}\left[1+\sqrt{\frac{50}{7}}\,t^{20}_{00} + \sqrt{\frac{9}{14}}\,t^{40}_{00} \pm \left(\sqrt{3}\,t^{01}_{00} + \sqrt{\frac{150}{7}}\,t^{21}_{00} + \sqrt{\frac{27}{14}}\,t^{41}_{00}\right)\right]$$

$$P_o + P'_o + 2(P_1 + P'_1 + P_2 + P'_2) = 1$$

$$\left.\begin{array}{l} Q_1 = \rho^{1-1}_{--} \\ Q'_1 = \rho^{1-1}_{++} \end{array}\right\} = \frac{1}{10}\left[\sqrt{\frac{75}{7}}\,\overline{t}^{20}_{20} - \sqrt{\frac{180}{7}}\,\overline{t}^{40}_{20} \mp \left(\sqrt{\frac{225}{7}}\,\overline{t}^{21}_{20} - \sqrt{\frac{540}{7}}\,\overline{t}^{41}_{20}\right)\right]$$

$$\left.\begin{array}{l} Q_3 = \rho^{20e}_{++} \\ Q'_3 = \rho^{20e}_{--} \end{array}\right\} = \frac{1}{10}\left[\sqrt{\frac{50}{7}}\,\overline{t}^{20}_{20} + \sqrt{\frac{135}{14}}\,\overline{t}^{40}_{20} \mp \left(\sqrt{\frac{150}{7}}\,\overline{t}^{21}_{20} + \sqrt{\frac{405}{14}}\,\overline{t}^{41}_{20}\right)\right]$$

$$\left.\begin{array}{l} Q_2 = \rho^{2-2}_{++} \\ Q'_2 = \rho^{2-2}_{--} \end{array}\right\} = \frac{1}{10}\left[\sqrt{45}\,\overline{t}^{40}_{40} \pm \sqrt{135}\,\overline{t}^{41}_{40}\right]$$

$$S_1 = \rho^{10e}_{-+} = \frac{1}{10}\left[-\sqrt{75/7}\,\overline{t}^{21}_{1-1} + \sqrt{810/7}\,\overline{t}^{41}_{1-1}\right]$$

$$S_2 = \rho^{21e}_{-+} = \frac{1}{10}\left[-\sqrt{450/7}\,\overline{t}^{21}_{1-1} - \sqrt{135/7}\,\overline{t}^{41}_{1-1}\right]$$

$$S_3 = \rho^{10e}_{+-} = \frac{1}{10}\left[\sqrt{75/7}\,\overline{t}^{21}_{11} - \sqrt{810/7}\,\overline{t}^{41}_{11}\right]$$

$$S_4 = \rho^{21e}_{+-} = \frac{1}{10}\left[\sqrt{450/7}\,\overline{t}^{21}_{11} + \sqrt{135/7}\,\overline{t}^{41}_{11}\right]$$

$$S_5 = \rho^{2-1e}_{+-} = \frac{1}{10}\left[\sqrt{135}\,\overline{t}^{41}_{31}\right]$$

$$S_6 = \rho^{2-1e}_{-+} = \frac{1}{10}\left[-\sqrt{135}\,\overline{t}^{41}_{3-1}\right]$$

Table 11 - cont'd

d) Transversity and helicity amplitudes, and their relations

λ_Λ	$\lambda_{K^{**}}$	$\lambda_p = +\frac{1}{2}$	$\lambda_p = -\frac{1}{2}$
	2	d	
	1		c'
$+\frac{1}{2}$	0	a	
	-1		b'
	-2	e	
	2		e'
	1	b	
$-\frac{1}{2}$	0		a'
	-1	c	
	-2		d'

$= T^{\lambda_{K^{**}}}_{2\lambda_\Lambda, 2\lambda_p}$

λ_Λ	$\lambda_{K^{**}}$	$\lambda_p = +\frac{1}{2}$	$\lambda_p = -\frac{1}{2}$
	2	D	-D'
	1	C'	C
$+\frac{1}{2}$	0	A	-A'
	-1	B'	B
	-2	E	-E'
	2	E'	E
	1	B	-B'
$-\frac{1}{2}$	0	A'	A
	-1	C	-C'
	-2	D'	D

$= H^{\lambda_{K^{**}}}_{2\lambda_\Lambda, 2\lambda_p}$

$4(A-iA') = -2a - \sqrt{6}\,(d+e)$, $\quad 4(A+iA') = -2a' - \sqrt{6}\,(d'+e')$

$4(B-iB') = -2(b+c) - 2(d-e)$, $\quad 4(B+iB') = -2(b'+c') - 2(d'-e')$

$4(C-iC') = -2(b+c) + 2(d-e)$, $\quad 4(C+iC') = -2(b'+c') + 2(d'-e')$

$4(D-iD') = -\sqrt{6}\,a - 2(b-c) + (d+e)$, $\quad 4(D+iD') = -\sqrt{6}\,a' - 2(b'-c') + (d'+e')$

$4(E-iE') = -\sqrt{6}\,a + 2(b-c) + (d+e)$, $\quad 4(E+iE') = -\sqrt{6}\,a' + 2(b'-c') + (d'+e')$

e) Expression of the observables in c) and d) as functions of the transversity amplitudes.

$2\sigma P_0 = |a|^2$ $\qquad 2\sigma P'_0 = |a'|^2$

$2\sigma P_1 = \frac{1}{2}(|b|^2+|c|^2)$ $\qquad 2\sigma P'_1 = \frac{1}{2}(|b'|^2+|c'|^2)$

$2\sigma P_2 = \frac{1}{2}(|d|^2+|e|^2)$ $\qquad 2\sigma P'_2 = \frac{1}{2}(|d'|^2+|e'|^2)$

$2\sigma Q_1 = b\bar{c}$ $\qquad 2\sigma Q'_1 = c'\bar{b}'$

$2\sigma Q_2 = d\bar{e}$ $\qquad 2\sigma Q'_2 = e'\bar{d}'$

$2\sigma Q_3 = \frac{1}{2}(d\bar{a}+a\bar{e})$ $\qquad 2\sigma Q'_3 = \frac{1}{2}(e'\bar{a}'+a'\bar{d}')$

$2\sigma S_1 = \frac{1}{2}(b\bar{a}-a'\bar{b}')$ $\qquad 2\sigma S_2 = \frac{1}{2}(c'\bar{a}'-a\bar{c})$

$2\sigma S_3 = \frac{1}{2}(e'\bar{b}'-b\bar{e})$ $\qquad 2\sigma S_4 = \frac{1}{2}(d\bar{c}-c'\bar{d}')$

$2\sigma S_5 = \frac{1}{2}(d\bar{b}-b'\bar{d}')$ $\qquad 2\sigma S_6 = \frac{1}{2}(e'\bar{c}'-c\bar{e})$

Table 12. Amplitude reconstruction for reactions of type $\pi p \rightarrow A_2 N$ $(0^- \frac{1}{2}^+ \rightarrow 2^{+e} \frac{1}{2}^{+e})$ with polarized target.

a) Combined production and decay angular distribution and measurement of the polarization transfer by the method of moments.

$$I(\psi,\Theta,\phi) = \frac{1}{2\pi} \sum_L C(L) \sum_M [\overline{t^L_M} + P_T(\cos\psi\, \overline{{}^z t^L_M} + \sin\psi\, \overline{{}^x t^L_M}) + P_L\, \overline{{}^y t^L_M}]\, Y^L_M(\Theta,\phi)$$

$$C(L)\,(t^L_M + P_L\, {}^y t^L_M) = \langle Y^L_M(\Theta,\phi)\rangle$$

$$C(L)\, P_T\, {}^z t^L_M = \langle 2\cos\psi\, Y^L_M(\Theta,\phi)\rangle$$

$$C(L)\, P_T\, {}^x t^L_M = \langle 2\sin\psi\, Y^L_M(\Theta,\phi)\rangle$$

with

$C(2) = -\sqrt{5/14\pi}$, $C(4) = \sqrt{9/14\pi}$ for $2 \rightarrow 0\ 0$ decay

$C(2) = -\sqrt{5/56\pi}$, $C(4) = -\sqrt{2/7\pi}$ for $2^+ \rightarrow 1^- 0^-$ decay

$C(0) = 1/\sqrt{4\pi}$ (all other C coefficients vanish)

b) The 30 real observables in transversity quantization

$$\sigma_0,\ t^2_0,\ t^4_0,\quad \left.\begin{matrix}\mathrm{Re}\\ \mathrm{Im}\end{matrix}\right\}\ t^2_2,\ t^4_2,\ t^4_4$$

$$P_R = {}^z t^0_0,\ {}^z t^2_0,\ {}^2 t^4_0,\quad \left.\begin{matrix}\mathrm{Re}\\ \mathrm{Im}\end{matrix}\right\}\ {}^z t^2_2\ {}^z t^4_2,\ {}^z t^4_4,\ {}^x t^2_1,\ {}^x t^4_1,\ {}^x t^4_3$$

$$\left.\begin{matrix}\mathrm{Re}\\ \mathrm{Im}\end{matrix}\right\}\ {}^y t^2_1,\ {}^y t^4_1,\ {}^y t^4_3$$

(M = even for t^L_M and ${}^z t^L_M$, M = odd for ${}^x t^L_M$ and ${}^y t^L_M$, by B-symmetry; $t^L_M = (-1)^M\, \overline{t^L_M}$)

Table 12 - cont'd

c) The 29 generalized spin rotation parameters

$$\left.\begin{matrix} P_o \\ P'_o \end{matrix}\right\} = \frac{1}{10}\left[(1 \pm P_R) - \sqrt{\frac{50}{7}}\,(t^2_o \pm {}^z t^2_o) + \sqrt{\frac{162}{7}}(t^4_o \pm {}^z t^4_o)\right]$$

$$\left.\begin{matrix} P_1 \\ P'_1 \end{matrix}\right\} = \frac{1}{10}\left[(1 \pm P_R) - \sqrt{\frac{25}{14}}\,(t^2_o \pm {}^z t^2_o) - \sqrt{\frac{72}{7}}(t^4_o \pm {}^z t^4_o)\right]$$

$$\left.\begin{matrix} P_2 \\ P'_2 \end{matrix}\right\} = \frac{1}{10}\left[(1 \pm P_R) + \sqrt{\frac{50}{7}}\,(t^2_o \pm {}^z t^2_o) + \sqrt{\frac{9}{14}}\,(t^4_o \pm {}^z t^4_o)\right]$$

$$P_o + P'_o + 2(P_1 + P'_1 + P_2 + P'_2) = 1$$

$$P_o - P'_o + 2(P_1 - P'_1 + P_2 - P'_2) = P_R$$

$$\left.\begin{matrix} Q_1 \\ Q'_1 \end{matrix}\right\} = \frac{1}{10}\left[\sqrt{\frac{75}{7}}\,(\overline{t^2_2} \pm \overline{{}^z t^2_2}) - \sqrt{\frac{180}{7}}\,(\overline{t^4_2} \pm \overline{{}^z t^4_2})\right]$$

$$\left.\begin{matrix} Q_3 \\ Q_3 \end{matrix}\right\} = \frac{1}{10}\left[\sqrt{\frac{50}{7}}\,(\overline{t^2_2} \pm \overline{{}^z t^2_2}) + \sqrt{\frac{135}{14}}\,(\overline{t^4_2} \pm \overline{{}^z t^4_2})\right]$$

$$\left.\begin{matrix} Q_2 \\ Q'_2 \end{matrix}\right\} = \frac{1}{10}\sqrt{45}\,(\overline{t^4_4} \pm \overline{{}^z t^4_4})$$

$$U_1 = \frac{1}{10}\left[-\sqrt{\frac{50}{7}}\,\overline{{}^x t^2_1} + \sqrt{\frac{540}{7}}\,\overline{{}^x t^4_1}\right]$$

$$U_2 = \frac{1}{10}\left[-\sqrt{\frac{300}{7}}\,\overline{{}^x t^2_1} - \sqrt{\frac{90}{7}}\,\overline{{}^x t^4_1}\right]$$

$$U_3 = \frac{1}{10}\left[-\sqrt{90}\,\overline{{}^x t^4_3}\right]$$

$$A_1 = \frac{i}{10}\left[-\sqrt{\frac{50}{7}}\,\overline{{}^y t^2_1} + \sqrt{\frac{540}{7}}\,\overline{{}^y t^4_1}\right]$$

$$A_2 = \frac{i}{10}\left[-\sqrt{\frac{300}{7}}\,\overline{{}^y t^2_1} - \sqrt{\frac{90}{7}}\,\overline{{}^y t^4_1}\right]$$

$$A_3 = \frac{i}{10}\left[-\sqrt{90}\,\overline{{}^y t^4_3}\right]$$

Table 12 - cont'd

d) Transfer of polarization

$$\sigma\,\rho_{00} = \sigma_o\,[(P_o+P'_o) + (P_o-P'_o)z]$$

$$\sigma\,\rho^e_{11} = \sigma_o\,[(P_1+P'_1) + (P_1-P'_1)z]$$

$$\sigma\,\rho^e_{22} = \sigma_o\,[(P_2+P'_2) + (P_2-P'_2)z]$$

$$\sigma\,\rho_{1-1} = \sigma_o\,[(Q_1+Q'_1) + (Q_1-Q'_1)z]$$

$$\sigma\,\rho_{2-2} = \sigma_o\,[(Q_2+Q'_2) + (Q_2-Q'_2)z]$$

$$\sigma\,\rho_{20} = \sigma_o\,[(Q_3+Q'_3) + (Q_3-Q'_3)z]$$

$$\sigma\,\rho_{10} = \sigma_o\,[U_1\,x - i\,A_1\,y]$$

$$\sigma\,\rho_{21} = \sigma_o\,[U_2\,x - i\,A_2\,y]$$

$$\sigma\,\rho_{2-1} = \sigma_o\,[U_3\,x - i\,A_3\,y]$$

e) Transversity and helicity amplitudes as in Table 11d)

f) Expression of the observables in c) and d) as functions of the transversity amplitudes.

$$2\sigma_o\,P_o = |a|^2 \qquad 2\sigma_o\,P'_o = |a'|^2$$

$$2\sigma_o\,P_1 = \frac{1}{2}(|b|^2+|c|^2) \qquad 2\sigma_o\,P'_1 = \frac{1}{2}(|b'|^2+|c'|^2)$$

$$2\sigma_o\,P_2 = \frac{1}{2}(|d|^2+|e|^2) \qquad 2\sigma_o\,P'_2 = \frac{1}{2}(|d'|^2+|e'|^2)$$

$$2\sigma_o\,Q_1 = b\bar{c} \qquad 2\sigma_o\,Q'_1 = c'\overline{b'}$$

$$2\sigma_o\,Q_2 = d\bar{e} \qquad 2\sigma_o\,Q'_2 = e'\bar{d}'$$

$$2\sigma_o\,Q_3 = \frac{1}{2}(d\bar{a} + a\bar{e}) \qquad 2\sigma_o\,Q'_3 = \frac{1}{2}(a'\overline{d'}+e'\bar{a}')$$

$$2\sigma_o\,U_1 = \frac{1}{2}(b\bar{a}'-a\bar{b}'+c'\bar{a}-a'\bar{c}) \qquad 2\sigma_o\,A_1 = \frac{1}{2}(b\bar{a}'-a\bar{b}'-c'\bar{a}+a'\bar{c})$$

$$2\sigma_o\,U_2 = \frac{1}{2}(d\bar{c}'-c\bar{d}'+e'\bar{b}-b'\bar{e}) \qquad 2\sigma_o\,A_2 = \frac{1}{2}(d\bar{c}'-c\bar{d}'-e'\bar{b}+b'\bar{e})$$

$$2\sigma_o\,U_3 = \frac{1}{2}(d\bar{b}'-b\bar{d}'+e'\bar{c}-c'\bar{e}) \qquad 2\sigma_o\,A_3 = \frac{1}{2}(d\bar{b}'-b\bar{d}'-e'\bar{c}+e'\bar{e})$$

Table 13. Amplitude reconstruction for reactions of type $\pi p \rightarrow K^* \Sigma^*$ $(0^- \frac{1}{2}^+ \rightarrow 1^{-e} \frac{3}{2}^+$ with unpolarized target.

a) Joint angular distribution of the $K^* \Sigma^*$ decays, and measurement of the L and L' even multipole parameters by the method of moments

$$I(\theta,\phi;\ \theta',\phi') = \sum_{LL'} C_{K^*}(L)\ C_{\Sigma^*}(L') \sum_{M,M'} \overline{t^{LL'}_{MM'}}\ Y^L_M\ (\theta,\phi)\ Y^{L'}_{M'}\ (\theta',\phi')$$

$$C_{K^*}(L)\ C_{\Sigma^*}(L')\ t^{LL'}_{MM'} = \langle Y^L_M\ (\theta,\phi)\ Y^{L'}_{M'}\ (\theta',\phi')\rangle$$

with $C_{K^*}(0) = C_{\Sigma^*}(0) = 1/\sqrt{4\pi}$, $C_{K^*}(2) = -1/\sqrt{2\pi}$, $C_{\Sigma^*}(2) = -1/\sqrt{4\pi}$

(all other C coefficients vanish)

b) Joint angular distribution of the K^* decay and Σ^* cascade decay and measurement of the L even double multiple parameters by the method of moments

$$I(\theta,\phi;\ \theta',\phi';\ \theta_1,\phi_1) = \sum_{L,L',J,L_1} C_{K^*}(L)\ \ C(L'\ J\ L_1)$$

$$\times \sum_{M,M',N,M_1} \langle\ JL_1NM_1 | L'M'\rangle\ \ \overline{t^{LL'}_{MM'}}\ Y^L_M\ (\theta,\phi)\ Y^J_N\ (\theta',\phi')\ Y^{L_1}_{M_1}\ (\theta_1,\phi_1)\ ,$$

$$C_{K^*}(L)\ C(L'\ J\ L_1)\ t^{LL'}_{MM'}$$

$$= \sum_{MM'M_1} \langle JL_1NM_1\ L'M'\rangle\ \langle Y^L_M\ (\theta,\phi)\ Y^J_N\ (\theta',\phi')\ Y^{L_1}_{M_1}\ (\theta_1,\phi_1)\rangle\ ,$$

with C_{K^*} as in a) $\qquad C(101) = -\sqrt{\frac{5}{9}}\ \alpha_\Lambda/4\pi$

$C(000) = 1/4\pi \qquad C(121) = -\sqrt{\frac{2}{45}}\ \alpha_\Lambda/4\pi$

$C(220) = -1/4\pi \qquad C(321) = \sqrt{\frac{7}{5}}\ \alpha_\Lambda/4\pi$

(all other C coefficients vanish)

Table 13 - cont'd

c) The 48 observables in transversity quantization

$\sigma,\ t^{20}_{00},\ t^{01}_{00},\ t^{02}_{00},\ t^{03}_{00},\ t^{21}_{00},\ t^{22}_{00},\ t^{23}_{00}$

$$\left.\begin{matrix}\text{Re}\\ \text{Im}\end{matrix}\right\} \begin{matrix} t^{20}_{20},\ t^{02}_{02},\ t^{03}_{02},\ t^{21}_{20},\ t^{22}_{20},\ t^{23}_{20},\ t^{23}_{02},\ t^{22}_{22},\ t^{23}_{22}, \\ t^{22}_{2-2},\ t^{23}_{2-2},\ t^{21}_{11},\ t^{22}_{11},\ t^{23}_{11},\ t^{21}_{1-1},\ t^{22}_{1-1},\ t^{23}_{13},\ t^{23}_{1-3} \end{matrix}$$

(L = even, M+M' = even by B-symmetry, $t^{LL'}_{-M-M'} = (-1)^{M+M'}\ t^{LL'}_{MM'}$)

d) Observable elements of the joint density matrix in transversity quantization

$$\left.\begin{matrix} P_0 = \rho^{00}_{11} \\ P'_0 = \rho^{00}_{-1-1} \end{matrix}\right\} = \frac{1}{12}\left[1 - \sqrt{10}\ t^{20}_{00} - \sqrt{5} t^{02}_{00} + \sqrt{50}\ t^{22}_{00} \pm \left(\sqrt{\frac{3}{5}}\ t^{01}_{00} - \sqrt{\frac{63}{5}}\ t^{03}_{00} - \sqrt{6}\ t^{21}_{00} + \sqrt{126}\ t^{23}_{00}\right)\right]$$

$$\left.\begin{matrix} P_1 = \rho^{11e}_{-1-1} \\ P'_1 = \rho^{11e}_{11} \end{matrix}\right\} = \frac{1}{12}\left[1 + \sqrt{\frac{5}{2}}\ t^{20}_{00} - \sqrt{5}\ t^{02}_{00} - \sqrt{\frac{25}{2}}\ t^{22}_{00} \mp \left(\sqrt{\frac{3}{5}}\ t^{01}_{00} - \sqrt{\frac{63}{5}}\ t^{03}_{00} + \sqrt{\frac{3}{2}}\ t^{21}_{00} - \sqrt{\frac{63}{2}}\ t^{23}_{00}\right)\right]$$

$$\left.\begin{matrix} P_2 = \rho^{11e}_{33} \\ P'_2 = \rho^{11e}_{-3-3} \end{matrix}\right\} = \frac{1}{12}\left[1 + \sqrt{\frac{5}{2}}\ t^{20}_{00} + \sqrt{5}\ t^{02}_{00} + \sqrt{\frac{25}{2}}\ t^{22}_{00} \pm \left(\sqrt{\frac{27}{5}}\ t^{01}_{00} + \sqrt{\frac{7}{5}}\ t^{03}_{00} + \sqrt{\frac{27}{2}}\ t^{21}_{00} + \sqrt{\frac{7}{2}}\ t^{23}_{00}\right)\right]$$

$$\left.\begin{matrix} P_3 = \rho^{00}_{-3-3} \\ P'_3 = \rho^{00}_{33} \end{matrix}\right\} = \frac{1}{12}\left[1 - \sqrt{10}\ t^{20}_{00} + \sqrt{5}\ t^{02}_{00} - \sqrt{50}\ t^{22}_{00} \mp \left(\sqrt{\frac{27}{5}}\ t^{01}_{00} + \sqrt{\frac{7}{5}}\ t^{03}_{00} - \sqrt{54}\ t^{21}_{00} - \sqrt{14}\ t^{23}_{00}\right)\right]$$

$$P_0 + P'_0 + 2(P_1 + P'_1 + P_2 + P'_2) + P_3 + P'_3 = 1$$

$$\left.\begin{matrix} Q_1 = \rho^{1-1}_{-1-1} \\ Q'_1 = \rho^{1-1}_{11} \end{matrix}\right\} = \frac{1}{12}\left[\sqrt{15}\ \overline{t^{20}_{20}} - \sqrt{75}\ \overline{t^{22}_{20}} \mp \left(3\ \overline{t^{21}_{20}} - \sqrt{189}\ \overline{t^{23}_{20}}\right)\right]$$

$$\left.\begin{matrix} Q_2 = \rho^{1-1}_{33} \\ Q'_2 = \rho^{1-1}_{-3-3} \end{matrix}\right\} = \frac{1}{12}\left[\sqrt{15}\ \overline{t^{20}_{20}} + \sqrt{75}\ \overline{t^{22}_{20}} \pm \left(9\ \overline{t^{21}_{20}} + \sqrt{21}\ \overline{t^{23}_{20}}\right)\right]$$

Table 13 - cont'd

$$\left.\begin{aligned} Q_3 &= \rho^{00}_{1-3} \\ Q'_3 &= \rho^{00}_{3-1} \end{aligned}\right\} = \frac{1}{12}\left[\sqrt{10}\,\overline{t^{02}_{02}} - 10\,\overline{t^{22}_{02}} \mp \left(\sqrt{14}\,\overline{t^{03}_{02}} - \sqrt{140}\,\overline{t^{23}_{02}}\right)\right]$$

$$\left.\begin{aligned} Q_4 &= \rho^{11e}_{3-1} \\ Q'_4 &= \rho^{11e}_{1-3} \end{aligned}\right\} = \frac{1}{12}\left[\sqrt{10}\,\overline{t^{02}_{02}} + 5\,\overline{t^{22}_{02}} \pm \left(\sqrt{14}\,\overline{t^{03}_{02}} + \sqrt{35}\,\overline{t^{23}_{02}}\right)\right]$$

$$\left.\begin{aligned} Q_5 &= \rho^{1-1}_{-13} \\ Q'_5 &= \rho^{1-1}_{-31} \end{aligned}\right\} = \frac{1}{12}\left[\sqrt{150}\,\overline{t^{22}_{2-2}} \pm \sqrt{210}\,\overline{t^{23}_{2-2}}\right]$$

$$\left.\begin{aligned} Q_6 &= \rho^{1-1}_{3-1} \\ Q'_6 &= \rho^{1-1}_{1-3} \end{aligned}\right\} = \frac{1}{12}\left[\sqrt{150}\,\overline{t^{22}_{22}} \pm \sqrt{210}\,\overline{t^{23}_{22}}\right]$$

$$S_1 = \rho^{10e}_{-11} = \frac{-1}{12}\left[6\,\overline{t^{21}_{1-1}} - \sqrt{126}\,\overline{t^{23}_{1-1}}\right]$$

$$\left.\begin{aligned} S_3 &= \rho^{10e}_{13} \\ S_5 &= \rho^{10e}_{-3-1} \end{aligned}\right\} = \frac{-1}{12}\left[\sqrt{27}\,\overline{t^{21}_{1-1}} + \sqrt{42}\,\overline{t^{23}_{1-1}} \pm \sqrt{75}\,\overline{t^{22}_{1-1}}\right]$$

$$S_2 = \rho^{10e}_{1-1} = \frac{1}{12}\left[6\,\overline{t^{21}_{11}} - \sqrt{126}\,\overline{t^{23}_{11}}\right]$$

$$\left.\begin{aligned} S_4 &= \rho^{10e}_{31} \\ S_6 &= \rho^{10e}_{-1-3} \end{aligned}\right\} = \frac{1}{12}\left[\sqrt{27}\,\overline{t^{21}_{11}} + \sqrt{42}\,\overline{t^{23}_{11}} \pm \sqrt{75}\,\overline{t^{22}_{11}}\right]$$

$$S_7 = \rho^{10e}_{-33} = \frac{-1}{12}\left[\sqrt{210}\,\overline{t^{23}_{1-3}}\right]$$

$$S_8 = \rho^{10e}_{3-3} = \frac{1}{12}\left[\sqrt{210}\,\overline{t^{23}_{13}}\right]$$

Table 13 - cont'd

e) Transversity and helicity amplitudes

λ_{Σ^*}	λ_{K^*}	$\lambda_p = +\frac{1}{2}$	$\lambda_p = -\frac{1}{2}$	$\lambda_p = +\frac{1}{2}$	$\lambda_p = -\frac{1}{2}$
$+\frac{3}{2}$	1	e		E	-E'
	0		d'	D'	D
	-1	f		F	-F'
$+\frac{1}{2}$	1		c'	C'	C
	0	a		A	-A'
	-1		b'	B'	B
$-\frac{1}{2}$	1	b		B	-B'
	0		a'	A'	A
	-1	c		C	-C'
$-\frac{3}{2}$	1		f'	F'	F
	0	d		D	-D'
	-1		e'	E'	E
		$= T^{\lambda_{K^*}}_{2\lambda_{\Sigma^*},2\lambda_p}$		$= H^{\lambda_{K^*}}_{2\lambda_{\Sigma^*},2\lambda_p}$	

$$4(A-iA') = -\sqrt{2}(b+c) - \sqrt{6}(e+f), \qquad 4(A+iA') = -\sqrt{2}(b'+c') - \sqrt{6}(e'+f'),$$

$$4(B-iB') = -\sqrt{2}a - (b-c) - \sqrt{6}d - \sqrt{3}(e-f) \qquad 4(B+iB') = -\sqrt{2}a' - (b'-c') - \sqrt{6}d' - \sqrt{3}(e'-f')$$

$$4(C-iC') = -\sqrt{2}a + (b-c) - \sqrt{6}d + \sqrt{3}(e-f) \qquad 4(C+iC') = -\sqrt{2}a' + (b'-c') - \sqrt{6}d + \sqrt{3}(e'-f')$$

$$4(D-iD') = -\sqrt{6}(b+c) + \sqrt{2}(e+f) \qquad 4(D+iD') = -\sqrt{6}(b'+c') + \sqrt{2}(e'+f')$$

$$4(E-iE') = -\sqrt{6}a - \sqrt{3}(b-c) + \sqrt{2}d + (e-f) \qquad 4(E+iE') = -\sqrt{6}a' - \sqrt{3}(b'-c') + \sqrt{2}d' + (e'-f')$$

$$4(F-iF') = -\sqrt{6}a + \sqrt{3}(b-c) + \sqrt{2}d - (e-f) \qquad 4(F+iF') = -\sqrt{6}a' + \sqrt{3}(b'-c') + \sqrt{2}d' - (e'-f')$$

Table 13 - cont'd

f) Expression of the observables in d) as functions of the transversity amplitudes

$2\sigma P_o = \|a\|^2$	$2\sigma P'_o = \|a'\|^2$
$2\sigma P_1 = \frac{1}{2}(\|b\|^2+\|c\|^2)$	$2\sigma P'_1 = \frac{1}{2}(\|b'\|^2+\|c'\|^2)$
$2\sigma P_2 = \frac{1}{2}(\|e\|^2+\|f\|^2)$	$2\sigma P'_2 = \frac{1}{2}(\|e'\|^2+\|f'\|^2)$
$2\sigma P_3 = \|d\|^2$	$2\sigma P'_3 = \|d'\|^2$
$2\sigma Q_1 = b\bar{c}$	$2\sigma Q'_1 = c'\bar{b}'$
$2\sigma Q_2 = e\bar{f}$	$2\sigma Q'_2 = f'\bar{e}'$
$2\sigma Q_3 = a\bar{d}$	$2\sigma Q'_3 = d'\bar{a}'$
$2\sigma Q_4 = \frac{1}{2}(e\bar{b} + f\bar{c})$	$2\sigma Q'_4 = \frac{1}{2}(b'\bar{c}' + e'\bar{f}')$
$2\sigma Q_5 = b\bar{f}$	$2\sigma Q'_5 = f'\bar{b}'$
$2\sigma Q_6 = e\bar{c}$	$2\sigma Q'_6 = c'\bar{e}'$
$2\sigma S_1 = \frac{1}{2}(b\bar{a} - a'\bar{b}')$	$2\sigma S_2 = \frac{1}{2}(c'\bar{a}' - a\bar{c})$
$2\sigma S_3 = \frac{1}{2}(c'\bar{d}' - a\bar{f})$	$2\sigma S_5 = \frac{1}{2}(f'\bar{a}' - d\bar{c})$
$2\sigma S_4 = \frac{1}{2}(e\bar{a} - d'\bar{b}')$	$2\sigma S_6 = \frac{1}{2}(b\bar{d} - a'\bar{e}')$
$2\sigma S_7 = \frac{1}{2}(f'\bar{d}' - d\bar{f})$	$2\sigma S_8 = \frac{1}{2}(e\bar{d} - d'\bar{e}')$

Table 14. Amplitude reconstruction for reactions of type $\pi p \to \rho\Delta$ with polarized target.

a) Combined production and joint decay angular distribution and measurement of the polarization transfer by the method of moments.

$$I(\psi;\Theta,\phi,\Theta',\phi') = \frac{1}{2\pi} \sum_{L,L} C_\rho(L) \; C_\Delta(L')$$

$$\times \sum_{M,M'} [\overline{t^{LL'}_{MM'}} + P_T(\cos\psi \; \overline{{}^{z}t^{LL'}_{MM'}} + \sin\psi \; \overline{{}^{x}t^{LL'}_{MM'}}) + P_2 \; \overline{{}^{Y}t^{LL'}_{MM'}}] Y^L_M(\Theta,\phi) Y^{L'}_{M'}(\Theta',\phi')$$

$$C_\rho(L) \; C_\Delta(L') \; (t^{LL'}_{MM'} + P_L \; {}^{Y}t^{LL'}_{MM'}) = \langle Y^L_M(\Theta,\phi) \; Y^{L'}_{M'}(\Theta',\phi')\rangle$$

$$C_\rho(L) \; C_\Delta(L') \; P_T \; {}^{z}t^{LL'}_{MM'} = \langle 2\cos\psi \; Y^L_M(\Theta,\phi) \; Y^{L'}_{M'}(\Theta',\phi')\rangle$$

$$C_\rho(L) \; C_\Delta(L') \; P_T \; {}^{x}t^{LL'}_{MM'} = \langle 2\sin\psi \; Y^L_M(\Theta,\phi) \; Y^{L'}_{M'} \; (\Theta',\phi')\rangle$$

with

$$C_\rho(0) = C_\Delta(0) = 1/\sqrt{4\pi}, \quad C_\rho(2) = -1/\sqrt{2\pi}, \quad C_\Delta(2) = -1/\sqrt{4\pi}$$

(all other C coefficients vanish).

b) The 72 real observables in transversity quantization

$$\sigma_0, \; t^{20}_{00}, \; t^{02}_{00}, \; t^{22}_{00}, \quad \left.\begin{matrix}\mathrm{Re}\\ \mathrm{Im}\end{matrix}\right\} \; t^{20}_{20}, \; t^{02}_{02}, \; t^{22}_{20}, \; t^{22}_{02}, \; t^{22}_{22}, \; t^{22}_{2-2}, \; t^{22}_{11}, \; t^{22}_{1-1}$$

$$P_R, \; {}^{z}t^{20}_{00}, \; {}^{z}t^{02}_{00}, \; {}^{z}t^{22}_{00}, \quad \left.\begin{matrix}\mathrm{Re}\\ \mathrm{Im}\end{matrix}\right\} \; {}^{z}t^{20}_{20}, \; {}^{z}t^{02}_{02}, \; {}^{z}t^{22}_{20}, \; {}^{z}t^{22}_{02}, \; {}^{z}t^{22}_{22}, \; {}^{z}t^{22}_{2-2}, \; {}^{z}t^{22}_{11}, \; {}^{z}t^{22}_{1-1}$$

$$\left.\begin{matrix}\mathrm{Re}\\ \mathrm{Im}\end{matrix}\right\} \; {}^{x}t^{20}_{10}, \; {}^{x}t^{02}_{01}, \; {}^{x}t^{22}_{10}, \; {}^{x}t^{22}_{01}, \; {}^{x}t^{22}_{21}, \; {}^{x}t^{22}_{12}, \; {}^{x}t^{22}_{2-1}, \; {}^{x}t^{22}_{1-2}$$

$$\left.\begin{matrix}\mathrm{Re}\\ \mathrm{Im}\end{matrix}\right\} \; {}^{Y}t^{20}_{10}, \; {}^{Y}t^{02}_{01}, \; {}^{Y}t^{22}_{10}, \; {}^{Y}t^{22}_{01}, \; {}^{Y}t^{22}_{21}, \; {}^{Y}t^{22}_{12}, \; {}^{Y}t^{22}_{2-1}, \; {}^{Y}t^{22}_{1-2}$$

Table 14 - cont'd

c) The 63 generalized spin rotation parameters and the 8 linear constraints

$$\left.\begin{matrix} P_o \\ P'_o \end{matrix}\right\} = \frac{1}{12}\left[(1 \pm P_R) - \sqrt{10}\,(t^{20}_{00} \pm {}^z t^{20}_{00}) - \sqrt{5}\,(t^{02}_{00} \pm {}^z t^{02}_{00}) + \sqrt{50}\,(t^{22}_{00} + {}^z t^{22}_{00})\right]$$

$$\left.\begin{matrix} P_1 \\ P'_1 \end{matrix}\right\} = \frac{1}{12}\left[(1 \pm P_R) + \sqrt{\frac{5}{2}}\,(t^{20}_{00} \pm {}^z t^{20}_{00}) - \sqrt{5}\,(t^{02}_{00} \pm {}^z t^{02}_{00}) - \sqrt{\frac{25}{2}}\,(t^{22}_{00} \pm {}^z t^{22}_{00})\right]$$

$$\left.\begin{matrix} P_2 \\ P'_2 \end{matrix}\right\} = \frac{1}{12}\left[(1 \pm P_R) + \sqrt{\frac{5}{2}}\,(t^{20}_{00} \pm {}^z t^{20}_{00}) + \sqrt{5}\,(t^{02}_{00} \pm {}^z t^{02}_{00}) + \sqrt{\frac{25}{2}}\,(t^{22}_{00} \pm {}^z t^{22}_{00})\right]$$

$$\left.\begin{matrix} P_3 \\ P'_3 \end{matrix}\right\} = \frac{1}{12}\left[(1 \pm P_R) - \sqrt{10}\,(t^{20}_{00} \pm {}^z t^{20}_{00}) + \sqrt{5}\,(t^{02}_{00} \pm {}^z t^{02}_{00}) - \sqrt{50}\,(t^{22}_{00} \pm {}^z t^{22}_{00})\right]$$

$$P_o + P'_o + 2(P_1 + P'_1 + P_2 + P'_2) + P_3 + P'_3 = 1$$

$$P_o - P'_o + 2(P_1 - P'_1 + P_2 - P'_2) + P_3 - P'_3 = P_R$$

$$\left.\begin{matrix} Q_1 \\ Q'_1 \end{matrix}\right\} = \frac{1}{12}\left[\sqrt{15}\,(\overline{t^{20}_{20}} \pm \overline{{}^z t^{20}_{20}}) - \sqrt{75}\,(\overline{t^{22}_{20}} \pm \overline{{}^z t^{22}_{20}})\right]$$

$$\left.\begin{matrix} Q_2 \\ Q'_2 \end{matrix}\right\} = \frac{1}{12}\left[\sqrt{15}\,(\overline{t^{20}_{20}} \pm \overline{{}^z t^{20}_{20}}) + \sqrt{75}\,(\overline{t^{22}_{20}} \pm \overline{{}^z t^{22}_{20}})\right]$$

$$\left.\begin{matrix} Q_3 \\ Q'_3 \end{matrix}\right\} = \frac{1}{12}\left[\sqrt{10}\,(\overline{t^{02}_{02}} \pm \overline{{}^z t^{02}_{02}}) - 10\,(\overline{t^{22}_{02}} \pm \overline{{}^z t^{22}_{02}})\right]$$

$$\left.\begin{matrix} Q_4 \\ Q'_4 \end{matrix}\right\} = \frac{1}{12}\left[\sqrt{10}\,(\overline{t^{02}_{02}} \pm \overline{{}^z t^{02}_{02}}) + 5\,(\overline{t^{22}_{02}} \pm \overline{{}^z t^{22}_{02}})\right]$$

$$\left.\begin{matrix} Q_5 \\ Q'_5 \end{matrix}\right\} = \frac{1}{12}\,\sqrt{150}\,(\overline{t^{22}_{2-2}} \pm \overline{{}^z t^{22}_{2-2}})$$

$$\left.\begin{matrix} Q_6 \\ Q'_6 \end{matrix}\right\} = \frac{1}{12}\,\sqrt{150}\,(\overline{t^{22}_{22}} \pm \overline{{}^z t^{22}_{2-2}})$$

$$\left.\begin{matrix} T_1 \\ T'_1 \end{matrix}\right\} = \frac{-1}{12}\,\sqrt{75}\,(\overline{t^{22}_{1-1}} \pm \overline{{}^z t^{22}_{1-1}})$$

$$\left.\begin{matrix} T_2 \\ T'_2 \end{matrix}\right\} = \frac{1}{12}\,\sqrt{75}\,(\overline{t^{22}_{11}} \pm \overline{{}^z t^{22}_{11}})$$

Table 14 - cont'd

c) Continued

$$R_1 = \frac{1}{12}\left[-\sqrt{10}\ \overline{x_{t_{01}}^{02}} + 10\ \overline{x_{t_{01}}^{22}}\right] = \frac{-i}{12}\left[-\sqrt{10}\ \overline{y_{t_{01}}^{02}} + 10\ \overline{y_{t_{01}}^{22}}\right] = R_1$$

$$R_2 = \frac{1}{12}\left[-\sqrt{10}\ \overline{x_{t_{01}}^{02}} - 5\ \overline{x_{t_{01}}^{22}}\right] = \frac{i}{12}\left[-\sqrt{10}\ \overline{y_{t_{01}}^{02}} - 5\ \overline{y_{t_{01}}^{22}}\right] = R_2$$

$$R_3 = \frac{1}{12}\left[\ \sqrt{150}\ \overline{x_{t_{2-1}}^{22}}\right] = \frac{i}{12}\left[\ \sqrt{150}\ \overline{y_{t_{2-1}}^{22}}\right] = R_3$$

$$R_4 = \frac{1}{12}\left[-\sqrt{150}\ \overline{x_{t_{21}}^{22}}\right] = \frac{i}{12}\left[-\sqrt{150}\ \overline{y_{t_{21}}^{22}}\right] = R_4$$

$$U_1 = \frac{1}{12}\left[-\sqrt{\frac{15}{2}}\ \overline{x_{t_{10}}^{20}} + \sqrt{\frac{75}{2}}\ \overline{x_{t_{10}}^{22}}\right];\ \frac{i}{12}\left[-\sqrt{\frac{15}{2}}\ \overline{y_{t_{10}}^{20}} + \sqrt{\frac{75}{2}}\ \overline{y_{t_{10}}^{22}}\right] = A_1$$

$$U_2 = \frac{1}{12}\left[-\sqrt{\frac{15}{2}}\ \overline{x_{t_{10}}^{20}} - \sqrt{\frac{75}{2}}\ \overline{x_{t_{10}}^{22}}\right];\ \frac{i}{12}\left[-\sqrt{\frac{15}{2}}\ \overline{y_{t_{10}}^{20}} - \sqrt{\frac{75}{2}}\ \overline{y_{t_{10}}^{22}}\right] = A_2$$

$$U_3 = \frac{1}{12}\left[-\sqrt{75}\ \overline{x_{t_{1-2}}^{22}}\right];\quad \frac{i}{12}\left[-\sqrt{75}\ \overline{y_{t_{1-2}}^{22}}\right] = A_3$$

$$U_4 = \frac{1}{12}\left[-\sqrt{75}\ \overline{x_{t_{12}}^{22}}\right];\quad \frac{i}{12}\left[-\sqrt{75}\ \overline{y_{t_{12}}^{22}}\right] = A_4$$

Table 14 - cont'd

d) Transfer of polarization

$\sigma\,\rho^{oo}_{11e} = \sigma_o \tfrac{1}{2}[(P_o+P'_o) + (P_o-P'_o)z]$, $\sigma\,\rho^{oo}_{31e} = \sigma_o\, R_1(x+iy)$,

$\sigma\,\rho^{11e}_{11e} = \sigma_o \tfrac{1}{2}[(P_1+P'_1) + (P_1-P'_1)z]$, $\sigma\,\rho^{11e}_{31e} = \sigma_o\, R_2(x-iy)$,

$\sigma\,\rho^{11e}_{33e} = \sigma_o \tfrac{1}{2}[(P_2+P'_2) + (P_2-P'_2)z]$, $\sigma\,\rho^{1-1}_{13e} = \sigma_o\, R_3(x+iy)$,

$\sigma\,\rho^{oo}_{33e} = \sigma_o \tfrac{1}{2}[(P_3+P'_3) + (P_3-P'_3)z]$, $\sigma\,\rho^{1-1}_{31e} = \sigma_o\, R_4(x-iy)$,

$\sigma\,\rho^{1-1}_{11e} = \sigma_o \tfrac{1}{2}[(Q_1+Q'_1) + (Q_1-Q'_1)z]$, $\sigma\,\rho^{10e}_{11e} = \sigma_o\,(U_1\, x - i\, A_1 y)$,

$\sigma\,\rho^{1-1}_{33e} = \sigma_o \tfrac{1}{2}[(Q_2+Q'_2) + (Q_2-Q'_2)z]$, $\sigma\,\rho^{10e}_{33e} = \sigma_o\,(U_2\, x - i\, A_2 y)$

$\sigma\,\rho^{oo}_{3-1e} = \sigma_o \tfrac{1}{2}[(Q_3+Q'_3) + (Q_3-Q'_3)z]$, $\sigma\,\rho^{10e}_{-13e} = \sigma_o\,(U_3\, x - i\, A_3\, y)$

$\sigma\,\rho^{11e}_{3-1e} = \sigma_o \tfrac{1}{2}[(Q_4+Q'_4) + (Q_4-Q'_4)z]$, $\sigma\,\rho^{10e}_{3-1e} = \sigma_o\,(U_4\, x - i\, A_4\, y)$

$\sigma\,\rho^{1-1}_{-13e} = \sigma_o \tfrac{1}{2}[(Q_5+Q'_5) + (Q_5-Q'_5)z]$,

$\sigma\,\rho^{1-1}_{3-1e} = \sigma_o \tfrac{1}{2}[(Q_6+Q'_6) + (Q_6-Q'_6)z]$,

$\sigma\,\rho^{10e}_{13e} = \sigma_o \tfrac{1}{2}[(T_1+T'_1) + (T_1-T'_1)z]$,

$\sigma\,\rho^{10e}_{31e} = \sigma_o \tfrac{1}{2}[(T_2+T'_2) + (T_2-T'_2)z]$,

Table 14 - cont'd

e) Transversity and helicity amplitudes as in Table 13 e)

f) Expression of the observables in c) and d) as functions of the transversity amplitudes.

$2\sigma_o\, P_o = \|a\|^2$	$2\sigma_o\, P'_o = \|a'\|^2$
$2\sigma_o\, P_1 = \frac{1}{2}(\|b\|^2+\|c\|^2)$	$2\sigma_o\, P'_1 = \frac{1}{2}(\|b'\|^2+\|c'\|^2)$
$2\sigma_o\, P_2 = \frac{1}{2}(\|e\|^2+\|f\|^2)$	$2\sigma_o\, P'_2 = \frac{1}{2}(\|e'\|^2+\|f'\|^2)$
$2\sigma_o\, P_3 = \|d\|^2$	$2\sigma_o\, P'_3 = \|d'\|^2$
$2\sigma_o\, Q_1 = b\bar{c}$	$2\sigma_o\, Q'_1 = c'\bar{b}'$
$2\sigma_o\, Q_2 = e\bar{f}$	$2\sigma_o\, Q'_2 = f\bar{e}'$
$2\sigma_o\, Q_3 = a\bar{d}$	$2\sigma_o\, Q'_3 = d'\bar{a}'$
$2\sigma_o\, Q_4 = \frac{1}{2}(e\bar{b} + f\bar{e})$	$2\sigma_o\, Q'_4 = \frac{1}{2}(b'\bar{e}' + c'\bar{f}')$
$2\sigma_o\, Q_5 = b\bar{f}$	$2\sigma_o\, Q'_5 = f'\bar{b}'$
$2\sigma_o\, Q_6 = e\bar{c}$	$2\sigma_o\, Q'_6 = c'\bar{e}'$
$2\sigma_o\, S_1 = \frac{1}{2}(d\bar{c} + a\bar{f})$	$2\sigma_o\, S'_1 = \frac{1}{2}(f'\bar{a}' + c'\bar{d}')$
$2\sigma_o\, S_2 = \frac{1}{2}(e\bar{a} - b\bar{d})$	$2\sigma_o\, S'_2 = \frac{1}{2}(a'\bar{e}' + d'\bar{b}')$
$2\sigma_o\, R_1 = \frac{1}{2}(d'\bar{a} - a'\bar{d}')$	$2\sigma_o\, R_3 = \frac{1}{2}(c'\bar{f} - f'\bar{c})$
$2\sigma_o\, R_2 = \frac{1}{4}(e\bar{c}'-c\bar{e}'+b\bar{f}'-f\bar{b}')$	$2\sigma_o\, R_4 = \frac{1}{2}(e\bar{b}' - b\bar{e}')$
$2\sigma_o\, U_1 = \frac{1}{4}(c'\bar{a}-a'\bar{c}+b\bar{a}'-a\bar{b}')$	$2\sigma_o\, U_3 = \frac{1}{4}(f'\bar{a}-a'\bar{f}+b\bar{d}'-d\bar{b}')$
$2\sigma_o\, U_2 = \frac{1}{4}(f'\bar{d}-d'\bar{f}+e\bar{d}'-d\bar{e}')$	$2\sigma_o\, U_4 = \frac{1}{4}(c'\bar{d}-d'\bar{c}+e\bar{a}'-a\bar{e}')$
$2\sigma_o\, A_1 = \frac{i}{4}(e\bar{c}'-c\bar{e}'-b\bar{f}'+f\bar{b}')$	$2\sigma_o\, A_3 = \frac{i}{4}(f'\bar{a}-a'\bar{f}-b\bar{d}'+d\bar{b}')$
$2\sigma_o\, A_2 = \frac{i}{4}(f'\bar{d}-d'\bar{f}-e\bar{d}'+d\bar{e}')$	$2\sigma_o\, A_4 = \frac{i}{4}(c'\bar{d}-d'\bar{c}-e\bar{a}'+a\bar{e}')$

Table A1. Number of ghost amplitudes in reactions with an unpolarized spin j particle and an (unpolarized or polarized) spin ½ particle as initial state.

j	0	1/2	1	3/2	2	integer	half odd integer
N_U	1	7	17	31	49	$8j(j+1)+1$	$8(j+\frac{1}{2})^2-1$
N_P	0	1	4	7	12	$2j(j+1)$	$2(j+\frac{1}{2})^2-1$
N_R	1	6	13	24	37	$6j(j+1)+1$	$6(j+\frac{1}{2})^2$

The tabulated numbers of real amplitudes are :

N_U = ghost amplitudes for unpolarized initial state

N_P = ghost amplitudesfor polarized spin ½ initial particle

$N_R = N_U - N_P$ = amplitudes reached by initial polarization.

Note that identity of particles, internal symmetry (isospin charge conjugation) and, for elastic reactions, time reversal may decrease N_U.

Table A2. Number of amplitudes, independent observables, and observable constraints in reactions of type $0\ \frac{1}{2} \rightarrow \ell j$ (ℓ = integer, j = half odd integer) for different initial polarizations and complete measurement of the final polarization.

$(2\ell+1)(j+1/2)$	A	U_I	U_N	T_I	T_N	T_L	L_I	L_N
1	3	2	0	1	1	2	1	1
2	7	6	2	1	7	8	1	7
3	11	10	8	1	17	18	1	17
4	15	14	18	1	31	32	1	31
5	19	18	32	1	49	50	1	49
n	4n-1	4n-2	$2(n-1)^2$	1	$2n^2-1$	$2n^2$	1	$2n^2-1$

Terminology :

A = number of real amplitudes (up to the overall phase)

U = number of observables for unpolarized target (or beam)

T = number of new observables reached with transversally polarized target (or beam)

L = idem with longitudinally polarized target (or beam)

The subindices classify these observables into

I = independent observables

N = non linear observable constraints

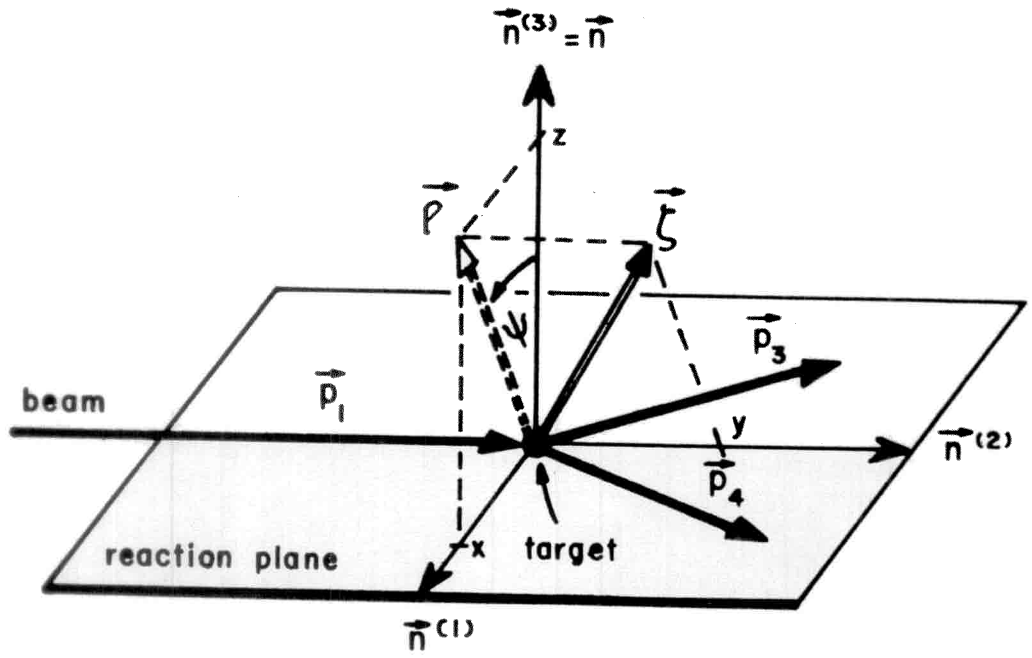
L = linear observable constraints

(Linear constraints coming from B-symmetry have not been counted, otherwise the total number of observables is multiplied by 2).

FIGURE CAPTION

Figure 1. The s-transversity frame for the target quantization

The reaction plane is defined in the laboratory system by the momenta $\vec{p}_1$, $\vec{p}_3$, $\vec{p}_4$. The Basel normal $\vec{n}$ is defined by the direction of $\vec{p}_1 \times \vec{p}_3$. The frame axes are: $\vec{n}^{(3)} = \vec{n}$, $\vec{n}^{(2)}$ along $\vec{p}_1$, and $\vec{n}^{(1)} = \vec{n}^{(2)} \times \vec{n}^{(3)}$. The projection of the polarization vector $\vec{\zeta}$ on the plane $\left(\vec{n}^{(1)}, \vec{n}\right)$ defines the direction $\vec{\ell}$, and ψ is the angle between $\vec{n}$ and $\vec{\ell}$ with the sign of $\vec{n} \times \ell . \vec{p}_1$.



$\vec{n}^{(3)} = \vec{n}$
z
$\vec{\rho}$
$\vec{\zeta}$
ψ
$\vec{p}_3$
beam
$\vec{p}_1$
y
$\vec{n}^{(2)}$
$\vec{p}_4$
reaction plane
x
target
$\vec{n}^{(1)}$

FIG. 1