Nuclear corrections to the deuteron asymmetry

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Number of counts from all target components for helicity L:

$$L = \Phi(N_6\sigma_6^L + N_7\sigma_7^L + N_D^/\sigma_D^L + N_p\sigma_p^L + N_{He}\sigma_{He} + N_{Al}\sigma_{Al})$$
$$= \Phi(N_6(\sigma_{He}^L + \sigma_D^L) + N_7(\sigma_{He}^L + \sigma_T^L) + N_D^/\sigma_D^L + N_p^L\sigma_p^L + N_{He}\sigma_{He} + N_{Al}\sigma_{Al})$$
$$\sigma_{He}^L = \sigma_{He}^R = \sigma_{He}$$
$$\sigma_A^{L(R)} = \sigma_A(1 \pm A_A^{A/}P_{A/}P_b)$$

(symbols: 6,7 = ^{6,7}Li, D=^{2}H; T=^{3}H; p=^{1}H; L(R) = +(-))

Using the cluster model for Li (^{6}Li = ^{4}He+^{2}H; ^{7}Li = ^{4}He+^{3}H):

$$L(R) = \Phi(N_6(\sigma_{He} + \sigma_D^6(1 \pm A_D^6 P_6 P_b)) + N_7(\sigma_{He} + \sigma_T^7(1 \pm A_T^7 P_7 P_b))$$
$$+ N_D^/\sigma_D(1 \pm A_D P_D P_b) + N_p\sigma_p(1 \pm A_p P_p P_b) + N_{He}\sigma_{He} + N_{Al}\sigma_{Al})$$
$$N_6 + N_7 = N_{Li} \qquad N_D^/ + N_p = N_D \qquad N_{Li} = N_D$$
$$\eta_7 = \frac{N_7}{N_{Li}} \qquad \eta_p = \frac{N_p}{N_D}$$

$$L(R) = \Phi((1-\eta_7)N_D(\sigma_{He} + \sigma_D^6(1 \pm A_D^6 P_6 P_b)) + N_D\eta_7(\sigma_{He} + \sigma_T^7(1 \pm A_T^7 P_7 P_b))$$
$$+ (1-\eta_p)N_D\sigma_D(1 \pm A_D P_D P_b) + N_D\eta_p\sigma_p(1 \pm A_p P_p P_b) + N_{He}\sigma_{He} + N_{Al}\sigma_{Al})$$

The L-R counts simplify to:

$$L-R = 2\Phi P_b N_D((1-\eta_7)\sigma_D^6 A_D^6 P_6 + \eta_7 \sigma_T^7 A_T^7 P_7 + (1-\eta_p)\sigma_D A_D P_D + \eta_p \sigma_p A_p P_p)$$

$$\sigma_D^6 A_D^6 = g_{EMC}^6 \sigma_D A_D^6 \quad A_D = \gamma A_n$$

$$\sigma_T^7 A_T^7 = g_{EMC}^7 \sigma_p (\tfrac{2}{3} A_p) \quad A_D^6 = \gamma^6 A_n = \frac{\gamma^6}{\gamma} A_D$$

$$L-R = 2\Phi P_b N_D(\,(1-\eta_7)\, g_{EMC}^6 \sigma_D A_D \frac{\gamma^6}{\gamma} P_6 + \eta_7 g_{EMC}^7 \sigma_p \frac{2}{3} A_p P_7 + (1-\eta_p)\sigma_D A_D P_D$$
$$+ \eta_p \sigma_p A_p P_p)$$

After factoring σ_D and rearranging:

$$L-R = 2\Phi P_b N_D \sigma_D [((1-\eta_7)\, g_{EMC}^6 \frac{\gamma^6}{\gamma} P_6 + (1-\eta_p) P_D) A_D$$
$$+ (\tfrac{2}{3}\eta_7 g_{EMC}^7 \frac{\sigma_p}{\sigma_D} P_7 + \eta_p \frac{\sigma_p}{\sigma_D} P_p) A_p]$$

During a given run, the polarization changes were small, so:

$$P_6 = \alpha P_D \quad P_7 = \beta P_D \quad P_p = \delta P_D$$

$$L-R = 2\Phi P_b P_D N_D \sigma_D [((1-\eta_7)\, g_{EMC}^6 \frac{\gamma^6}{\gamma} \alpha + (1-\eta_p)) A_D$$
$$+ (\tfrac{2}{3}\eta_7 \beta g_{EMC}^7 + \eta_p \delta) \frac{\sigma_p}{\sigma_D} A_p]$$

The sum of counts is:

$$L + R = 2\Phi(N_6\sigma_6 + N_7\sigma_7 + N_D^{/}\sigma_D + N_p\sigma_p + N_{He}\sigma_{He} + N_{Al}\sigma_{Al})$$

$$\sigma_A = g_{EMC}^{A}\sigma_D$$

$$L + R = 2\Phi\sigma_D N_D[(1-\eta_7)\frac{\sigma_6}{\sigma_D} + \eta_7\frac{\sigma_7}{\sigma_D} + (1-\eta_p) + \eta_p\frac{\sigma_p}{\sigma_D} + \sum\frac{N_A}{N_D}\frac{\sigma_A}{\sigma_D}]$$

The raw asymmetry and the dilution factor then are:

$$\epsilon = \frac{L-R}{L+R} = fP_bP_D[((1-\eta_7)\,g_{EMC}^{6}\frac{\gamma^6}{\gamma}\alpha + (1-\eta_p))A_D + (\tfrac{2}{3}\eta_7\beta g_{EMC}^{7} + \eta_p\delta)\frac{\sigma_p}{\sigma_D}A_p]$$

$$f = \left[3(1-\eta_7)g_{EMC}^{6} + \eta_7 g_{EMC}^{7}(3 + \frac{\sigma_p}{\sigma_D}) + (1-\eta_p) + \eta_p\frac{\sigma_p}{\sigma_D} + \sum\frac{N_A}{N_D}\frac{\sigma_A}{\sigma_D}\right]^{-1}$$

and the corrected deuteron asymmetry in LiD is:

$$A_D = \frac{1}{((1-\eta_7)\,g_{EMC}^{6}\frac{\gamma^6}{\gamma}\alpha + (1-\eta_p))}\left[\frac{\epsilon}{fP_bP_D} - (\tfrac{2}{3}\eta_7\beta g_{EMC}^{7} + \eta_p\delta)\frac{\sigma_p}{\sigma_D}A_p\right]$$