What Values to Use for the Constants and Couplings?

- Deuterium target:

$$A_{PV}=\frac{\sigma_R-\sigma_L}{\sigma_R+\sigma_L}=\left(\frac{G_F Q^2}{2\sqrt{2}\pi\alpha}\right)\left[g_A^e Y_1 \frac{F_1^{\gamma Z}}{F_1^{\gamma}}+\frac{g_V^e}{2} Y_3 \frac{F_3^{\gamma Z}}{F_1^{\gamma}}\right]=\left(\frac{G_F Q^2}{4\sqrt{2}\pi\alpha}\right)\left[a_1 Y_1+a_3 Y_3\right]$$

Define: $\kappa=\left(\frac{3G_F}{2\sqrt{2}\pi\alpha}\right)$

$$\boxed{\frac{G_F}{(\hbar c)^3}=\frac{\sqrt{2}}{8}\left(\frac{g_W}{M_W}\right)^2 \qquad g_W=\frac{g_e}{\sin\,\theta_W} \qquad g_e=\sqrt{4\pi\alpha}}$$

- Rule of Thumb: α, $\sin^2\theta_W$ run, G_F does not.

Q^2	$1/\alpha_{eff}$	$\sin^2 W$ (eff)	$\hat{s}_Z^{\,2}(\overline{MS})$	G_F	κ (ppm/GeV^2)
8315.178 (Z-pole)	128.948	**0.23147**	0.23115(12) (JE)	**1.166370E-5**	507.825
1.925	134.196	0.23609	0.23647 (at 1.9?) (JE)	1.1663787(6)E-5 (PDG2012)	528.452
1.125					
0	**137.036**	0.23804			539.636
Proposal	137.036	0.235		**1.166370E-5**	539.63

All **red numbers** from PDG2011, but use JE's if available

Differ by 2%!

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with QPM and other assumptions

$$A_d=\left(\frac{3 G_F Q^2}{2\sqrt{2}\,\pi\alpha}\right)\frac{2 C_{1u}\left[1+R_C(x)\right]-C_{1d}\left[1+R_S(x)\right]+Y\left(2C_{2u}-C_{2d}\right)R_V(x)}{5+R_S(x)+4R_C(x)}$$

$$C_{1u}=-\frac{1}{2}+\frac{4}{3}\sin^2\theta_w=-0.1852,$$
$$C_{2d}=\frac{1}{2}-\frac{2}{3}\sin^2\theta_w=0.3426,$$
$$C_{2u}=-\frac{1}{2}+2\sin^2\theta_w=-0.02782,$$
$$C_{2d}=\frac{1}{2}-2\sin^2\theta_w=0.02782.$$

OR

$$C_{1u}=\rho'_e\left(-\frac{1}{2}+\frac{4}{3}\kappa'_e\sin^2\theta_w\right)+\lambda'=-0.1822$$
$$C_{2d}=\rho'_e\left(\frac{1}{2}-\frac{2}{3}\kappa'_e\sin^2\theta_w\right)-2\lambda'=0.3380$$
$$C_{2u}=\rho_e\left(-\frac{1}{2}+2\kappa_e\sin^2\theta_w\right)+\lambda_u=-0.02551,$$
$$C_{2d}=\rho_e*\left(\frac{1}{2}-2\kappa_e\sin^2\theta_w\right)+\lambda_d=0.01661,$$

$$2C_{1u}-C_{1d}=-0.71304,\ 2C_{2u}-C_{2d}=-0.08347.$$

$$2C_{1u}-C_{1d}=-0.70232,\ 2C_{2u}-C_{2d}=-0.06764$$