CURRENT OPERATOR

(γ, p)

$$\hat{j}^{\mu}_{cc1} = G_M(Q^2)\gamma^{\mu} - \frac{\kappa}{2M} F_2(Q^2)\bar{p}^{\mu} \xrightarrow{cc1} \gamma^{\mu} + \kappa_p\left(\gamma^{\mu} - \frac{\bar{p}^{\mu}}{2M}\right)$$

$$\hat{j}^{\mu}_{cc2} = F_1(Q^2)\gamma^{\mu} + \frac{i\kappa}{2M} F_2(Q^2)\sigma^{\mu\nu}q_{\nu} \xrightarrow{cc2} \gamma^{\mu} + \frac{i\kappa_p}{2M}\sigma^{\mu\nu}q_{\nu}$$

$$\hat{j}^{\mu}_{cc3} = F_1(Q^2)\frac{\bar{p}^{\mu}}{2M} + \frac{i}{2M} G_M(Q^2)\sigma^{\mu\nu}q_{\nu} \xrightarrow{cc3} \frac{\bar{p}^{\mu}}{2M} + \frac{i}{2M}(1+\kappa_p)\sigma^{\mu\nu}q_{\nu}$$

$$\sigma^{\mu\nu} = \frac{i}{2}\left[\gamma^{\mu}, \gamma^{\nu}\right] \qquad \bar{p}^{\mu} = (E+E', \vec{p}_m + \vec{p}_1{}')$$

$G_M = F_1 + \kappa F_2$ $\quad$ F_1, F_2 Dirac and Pauli form factors

CC1 CC2 CC3 equivalent on shell, but can give different results when the nucleon is off-shell