103. Baryon Magnetic Moments

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The figure below shows the measured magnetic moments of the stable baryons. It also shows the predictions of the simplest quark model, using the measured $p$, $n$, and $\Lambda$ moments as input. In this model, the moments are [1]

\[
\begin{align*}
\mu_p &= (4\mu_u - \mu_d)/3 \\
\mu_{\Sigma^+} &= (4\mu_u - \mu_s)/3 \\
\mu_{\Xi^0} &= (4\mu_u - \mu_s)/3 \\
\mu_\Lambda &= \mu_s \\
\mu_{\Sigma^0} &= (2\mu_u + 2\mu_d - \mu_s)/3 \\
\mu_{\Xi^-} &= (4\mu_s - \mu_d)/3 \\
\mu_{\Xi^0} &= (2\mu_u + 2\mu_d - \mu_s)/3 \\
\mu_{\Omega^-} &= 3\mu_s
\end{align*}
\]

and the $\Sigma^0 \rightarrow \Lambda$ transition moment is

\[
\mu_{\Sigma^0\Lambda} = (\mu_d - \mu_u)/\sqrt{3}.
\]

The quark moments that result from this model are $\mu_u = +1.852\mu_N$, $\mu_d = -0.972\mu_N$, and $\mu_s = -0.613\mu_N$. The corresponding effective quark masses, taking the quarks to be Dirac point particles, where $\mu = q\hbar/2m$, are 338, 322, and 510 MeV. As the figure shows, the model gives a good first approximation to the experimental moments. For efforts to make a better model, we refer to the literature [2].
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References:
2. See, for example, J. Franklin, Phys. Rev. D29, 2648 (1984);
   K. Suzuki, H. Kumagai, and Y. Tanaka, Europhys. Lett. 2, 109 (1986);
   M.I. Krivoruchenko, Sov. J. Nucl. Phys. 45, 109 (1987);
   L. Brekke and J.L. Rosner, Comm. Nucl. Part. Phys. 18, 83 (1988);
   K.-T. Chao, Phys. Rev. D41, 920 (1990) and references cited therein; Also, see references cited in discussions of results in the experimental papers.