NLO QCD analysis of polarized deep inelastic scattering data

Indirect determinations of $\Delta(g)$ come from fits of polarized parton distributions to all $g_1^{p(d,n)}$ data, using the Altarelli-Parisi evolution equations. There are 3 independent analyses in the range $1 < Q^2 < 10Gev^2$ done before the lattest publications of E143, E154 and SMC:

1- R.D. Ball, S. Forte and G. Ridolfi, Preprint CERN-TH-95-266, Phys. Lett. **B378,** 255, 1996.
Next-to-leading order determination of the singlet axial charge and the polarized gluon content of the nucleon.

2- M. Stratmann and W. Vogelsang, RAL-TR-96-097, Dec. 1996, HEP-PH/9612250.
Next-to-leading evolution of polarized and unpolarized fragmentation functions.

3- M. Gluck, E. Reya, and M. Stratmann, W. Vogelsang, Phys. Rev. **D53,** 4775, 1996.
Next-to-leading order radiative parton model analysis of polarized lepton-nucleon scattering.

4- T. Gehrmann and W.J. Sterling, Phys. Rev **D53,** 6100, 1996.
Polarized parton distributions in the nucleon.

These calculations require $\Delta g \sim 1 - 2$.

The polarized parton distribution at the low initial scale is defined as follows:

$$\Delta f(x, Q_0^2) = N_f \eta_f (x^{\alpha_f})(1-x)^{\beta f} f(x, Q_0^2)$$

where $\Delta f = \Delta u_v$, Δd_v, $\Delta\overline{Q}$, Δg are the polarized valence, sea, and gluon distributions. N_f is a normalization factor chosen such that the first moment of Δf is equal to η_f.

In fact :

Ref.	Q^2	η_g	η_g	η_g
[1] R.D. Ball	$1Gev^2$	$1.54 \pm .74$		
	$10GeV^2$	1.52 ± 0.74 (AB)	1.1 ± 0.52 (AR)	0.99 ± 0.23 (OS)
[3] M. Gluck	μ^2_{NLO}	$\Delta g = 0.507$standard	0.496 valence	
	$1GeV^2$	=0.961	0.982	
	$4GeV^2$	=1.443	1.494	
	$10GeV^2$	=1.737	1.807	
[4] T. Gehrmann	$4GeV^2$	1.71 setA	1.63 setB	1.02 setC

Sizeable gluon polarization clearly affects the Q^2 dependence of g_1. Since the calculation of $\Gamma_1(Q_0^2)$ requires the extrapolations of $g_1(x, Q^2 measured) \rightarrow g_1(x, Q_0^2)$, it might lead to different values of Γ_1.

Preliminary results from the NLO QCD fits made for the recent E143 and SMC data on g_1^p and g_1^d using the procedure of R.D. Ball, S. Forte and G.Ridolfi at $Q^2 = 10GeV^2$ were presented by Nassalski [5] and Ball et al. [6]

5- J.P. Nassalski, SINS-17-VI, HEP-PH/9612352, Dec. 1996.
Spin structure of the nucleon.

6- R.D. Ball, A. Deshpande, S. Forte, V.W. Hughes, J. Lichtenstadt, G. Ridolfi, Workshop on future physics at HERA, Hamburg, Germany, 25-26 Sept. 1995, HEP-PH/9609515. Sept 1996
Measurement of the polarized structure functions $g_1(p)$.

7- G. Altarelli, R.D. Ball, S. Forte and G.Ridolfi, Preprint CERN-TH/96-345, Jan. 1997, HEP-PH/9701289. Nucl. Phys. **B496,** 337, 1997, Acta Phys. Polon. **B29,** 1145, 1998, HEP-PH/9803237.

8-E154 Coll.K. Abe *et al.,* Phys. Lett.**B405,** 180, 1997.
Next-to-leading order analysis of the polarized deep inelastic scattering data.

[6] R. Ball et al. with the new experimental data of E143 find that the value of $\eta_g = 1.52 \pm 0.74$ becomes $1.30 \pm .56$ at $Q^2 = 1GeV^2$.

[7] G. Altarelli et al. with a more reliable determination of errors than [1] and using all recent data find : $\Delta g(1, 1GeV^2) = 1.6 \pm 0.4(exp) \pm 0.8(th) = 1.6 \pm 0.9$

[8] E154 experiment NLO analysis by Yury Kolomensky at $Q^2 = 5GeV^2$

gives $\Delta g = 1.6 \pm 0.7(stat)^{+0.3}_{-}0.6(syst)^{+0.1}_{-0.6}(th)$ in the $\overline{MS}$ scheme and $0.4^{+1.0}_{0.6}(stat)^{+0.9}_{-0.6}(syst)^{+1.1}_{-0.1}(th)$ in the A-B scheme.

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