

Bjorken Sum Rule

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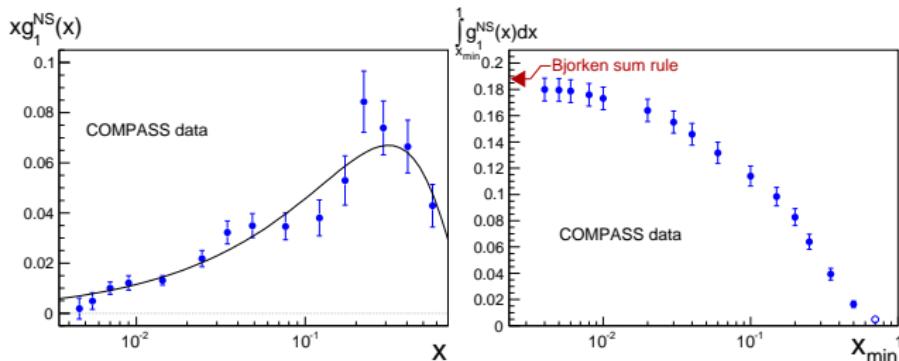
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Bjorken sum rule

$$\int_0^1 g_1^{NS}(x, Q^2) dx = \int_0^1 (g_1^p(x, Q^2) - g_1^n(x, Q^2)) dx = \frac{1}{6} | \frac{g_A}{g_V} | C_1^{NS}(Q^2)$$

- Non-singlet spin structure function $g_1^{NS} = g_1^p - g_1^n = 2 \left[g_1^p - \frac{g_A^d}{1 - 3/2\omega_D} \right]$,
 $\omega_D = 0.05$
- g_1^{NS} determined only from COMPASS data
- $| \frac{g_A}{g_V} | = 1.2694 \pm 0.0028$ obtained from neutron β -decay.



- COMPASS result: $| \frac{g_A}{g_V} | = 1.28 \pm 0.07 \pm 0.10$
- Verification of the Bjorken sum rule

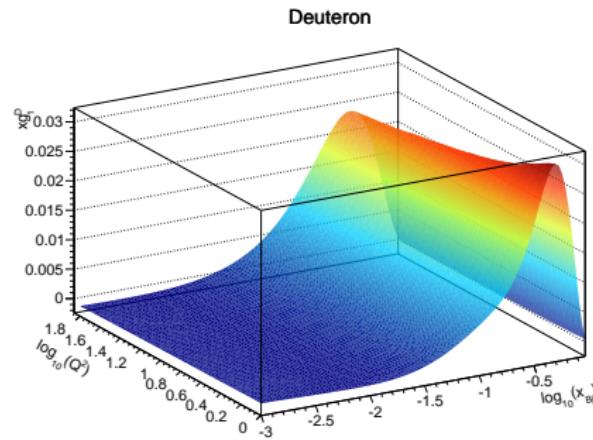
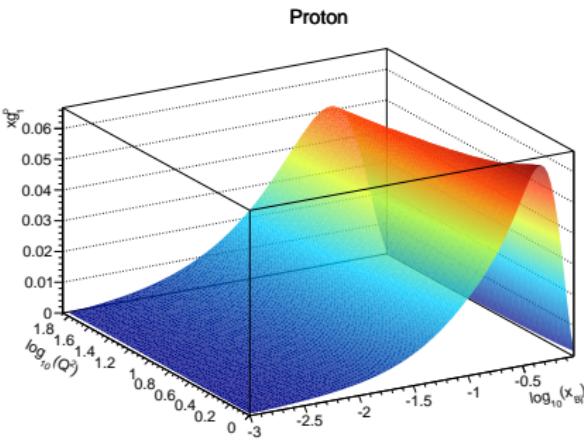
Input

- Data

- g_1^p 2007, 2011
- g_1^D 2002 - 2004
- 2006 Deuteron g_1^D should be included

- Using the results from Rolands QCD Program for g_1^D and g_1^p for Q^2 evolution

$$g_1(x, Q^2 = 3) = g_1^{data}(x, Q^2) + [g_1^{fit}(x, Q^2 = 3) - g_1^{fit}(x, Q^2)]$$

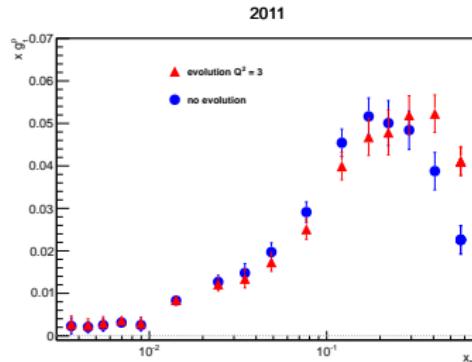
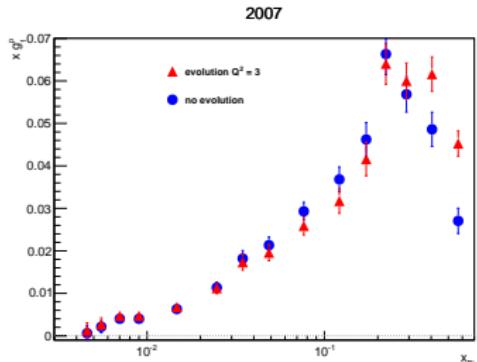


Difference in the calculation

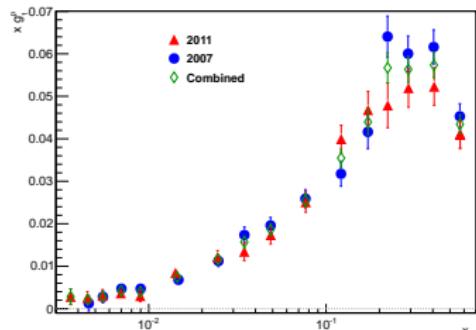
- Paper:
 - Combine g_1^P and g_1^D first and do the evolution afterwards
 - Calculate the integral for the unmeasured region from a NLO fit on g_1^{NS}
- My approach:
 - Combine g_1^P and g_1^D after the evolution (different Q^2 in 2011 and 2007)
 - Calculate the integral for the unmeasured region numerical from Rolands QCD program

Calculation: Combine 2007 and 2011 after Q^2 evolution

Q^2 evolution of the data

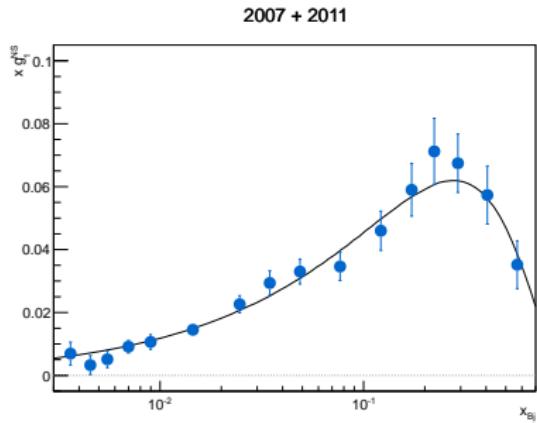
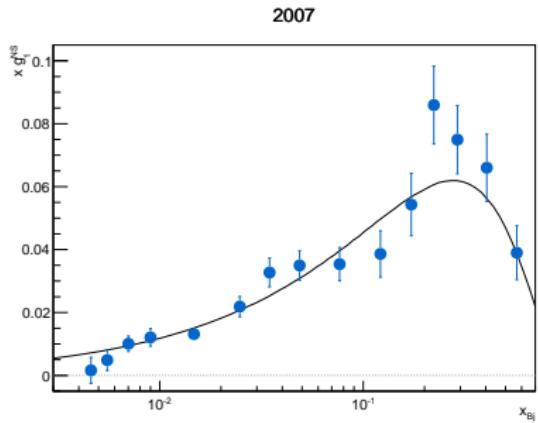


Combination of 2011 and 2007 data @ $Q^2 = 3$



Calculation: Calculate g_1^{NS}

$$g_1^{NS} = 2 \left[g_1^p - \frac{g_1^d}{1 - 3/2\omega_D} \right]$$



2011: Use the fitted value for g_1^D for the lowest x -bin

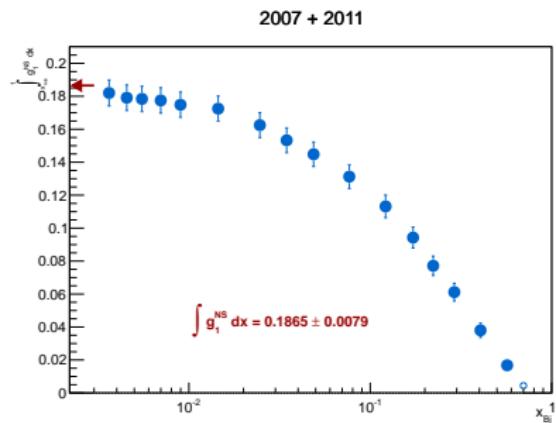
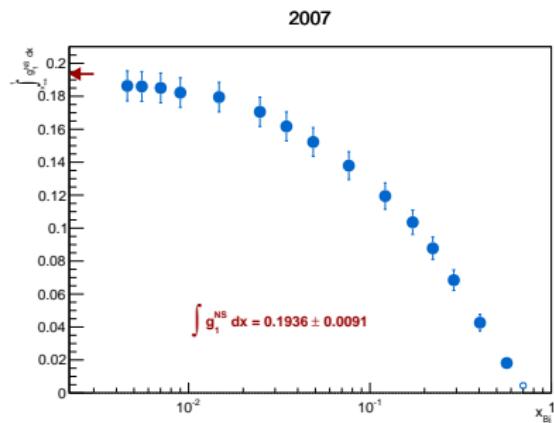
Calculation: The integral

- Measured region

$$\sum_i g_1^{NS}(x_i) \cdot (x_{i+1} - x_i)$$

- Unmeasured region from Roland's Fit:

$$\sum_i [g_1^{NS}(x_{i+1}) + g_1^{NS}(x_i)] \cdot (x_{i+1} - x_i)/2$$



Results II

Using $C_1^{NS}(Q^2)$ from PLB 404 (2007) 153 to get g_A/g_V

$$C_1^{NS} = 1 - \left(\frac{\alpha_s}{\pi}\right) - 3.25 \left(\frac{\alpha_s}{\pi}\right)^2 - 13.85026 \left(\frac{\alpha_s}{\pi}\right)^3$$

$$\alpha_s(Q^2 = 3 \text{ GeV}^2) = 0.330143 \quad \Rightarrow \quad C_1^{NS} = 0.842948$$

	Published	2007	2007 + 2011
$0 < x < 0.0025$	-	-	0.0045
$0 < x < 0.004$	0.0098	0.0071	-
$0.0025 < x < 0.7$	-	-	0.1776 ± 0.0079
$0.004 < x < 0.7$	$0.175 \pm 0.009 \pm 0.015$	0.1818 ± 0.0091	-
$0.7 < x < 1$	0.0048	0.0045	0.0044
Γ_1^{NS}	$0.190 \pm 0.009 \pm 0.015$	0.1934 ± 0.0091	0.1865 ± 0.0079
g_A/g_V	$1.28 \pm 0.07 \pm 0.10$	1.377 ± 0.065	1.328 ± 0.056

Summary

- First results for the test of the Bjorken Sum Rule including the 2011 data
- Possible improvement:
 - Fit on g_1^{NS} to calculate the integral
 - Using a formula for calculating $g_1^{p,d,NS}$ instead of the an interpolation from the $x - Q^2$ grid
- Some further work needed
- 2006 deuteron data on g_1 should be included (full x-range)