Low-x and low-Q^2 $A_1^p(x)$ and $g_1^p(x)$: combination of 2007 and 2011 results

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Combination of 2007 and 2011 $A_1^p(x)$ and $g_1^p(x)$ results

- $\langle A \rangle = \frac{\sum_i A_i/\sigma_i^2}{\sum_i 1/\sigma_i^2}, \qquad 1/\sigma_A = \sqrt{\sum_i 1/\sigma_{A,i}^2}, \qquad i = 2007, 2011.$
- $\langle g \rangle = \frac{\sum_i g_i/\sigma_i^2}{\sum_i 1/\sigma_i^2}, \qquad 1/\sigma_g = \sqrt{\sum_i 1/\sigma_{g,i}^2}, \qquad i = 2007, 2011.$

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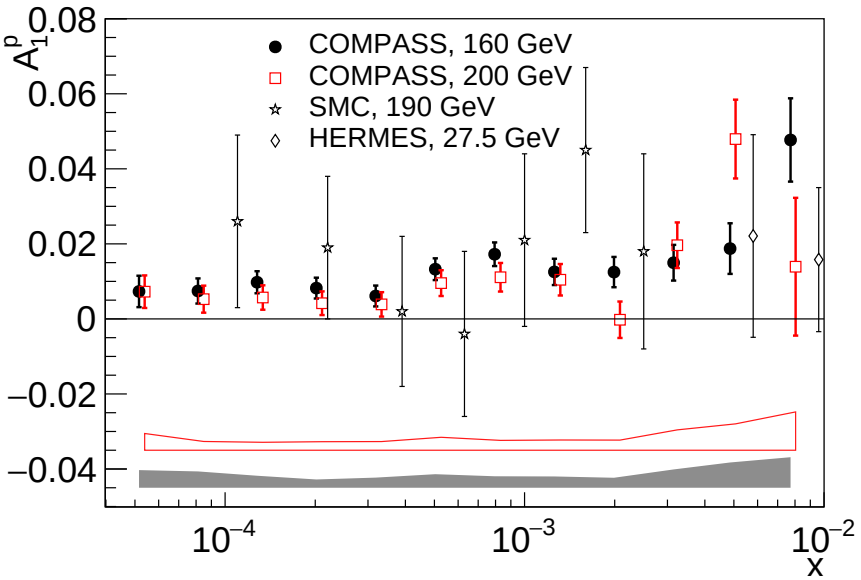

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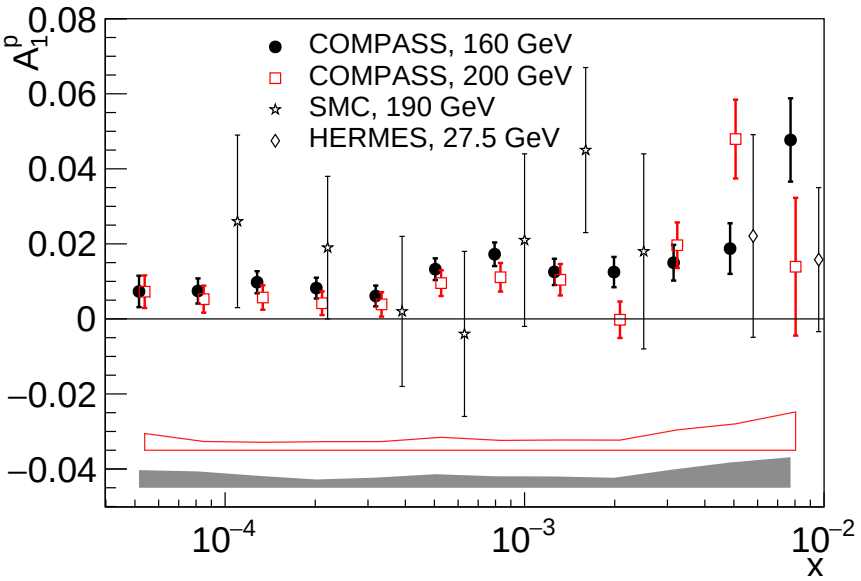

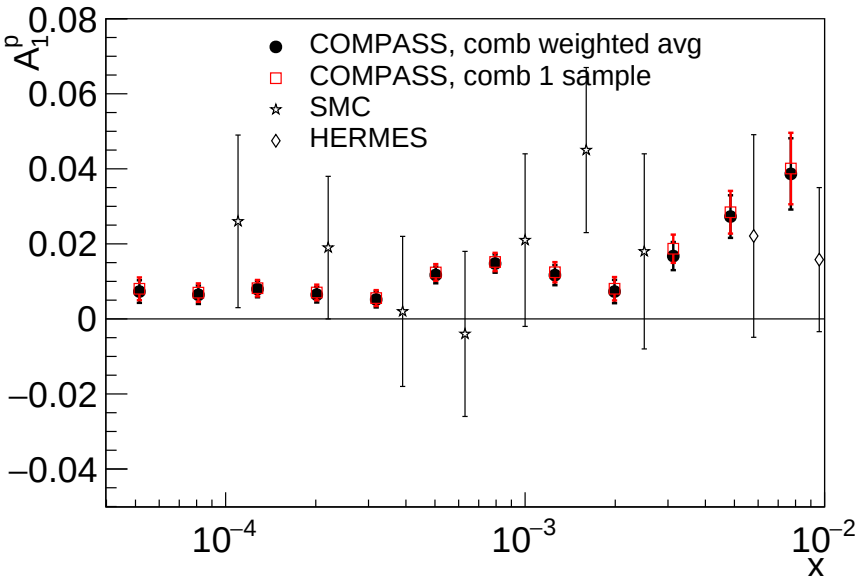

Systematic error of A_1^p

One-photon-exchange asymmetry: $A_1^{1\gamma} = \frac{1}{fDP_bP_t} A^{raw} - \left(\frac{\eta A_2}{\rho} + A_1^{RC} + A^{false} \right)$

Multiplicative systematic error: $\Delta A_1^{mult} = |A_1| \sqrt{\left(\frac{dP_b}{P_b} \right)^2 + \left(\frac{dP_t}{P_t} \right)^2 + \left(\frac{df}{f} \right)^2 + \left(\frac{dD(R)}{D(R)} \right)^2}$

Additive systematic error: $\Delta A_1^{add} = \sqrt{\left(\frac{\eta}{\rho} A_2 \right)^2 + \left(\Delta A_1^{RC} \right)^2 + \left(\Delta A^{false} \right)^2}$

Total systematic error: $\Delta A_1^{syst} = \sqrt{\left(\Delta A_1^{mult} \right)^2 + \left(\Delta A_1^{add} \right)^2}$

Estimation of false asymmetries A^{false}

- Pulls: $\Delta r = \dfrac{A_{1,i} - \bar{A}_1}{\sqrt{\sigma^2_{A_1,i} - \sigma^2_{\bar{A}_1}}}$ 2007: 23 configurations; 2011: 39 configurations
- Upper limit of the systematic error: $\dfrac{\sigma^{syst}_{\Delta r}}{\sigma^{stat}} = \sqrt{(max\{1, \sigma_{\Delta r}\} + \delta_{\sigma_{\Delta r}})^2 - 1}$

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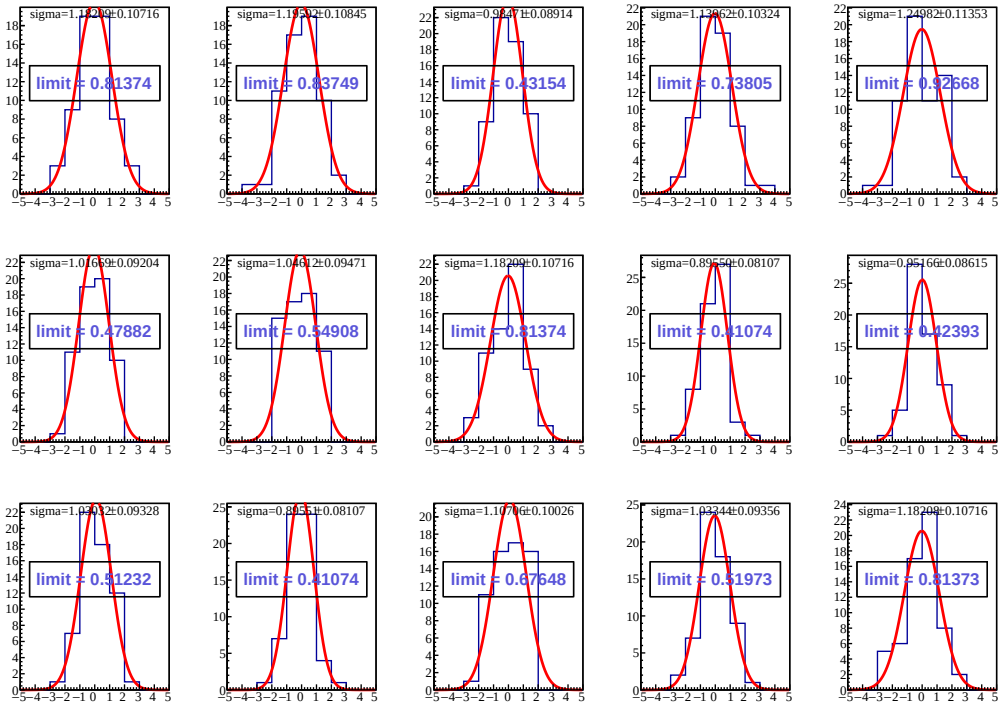
2007+2011 sample (limit $\in [0.41, 0.93]$)



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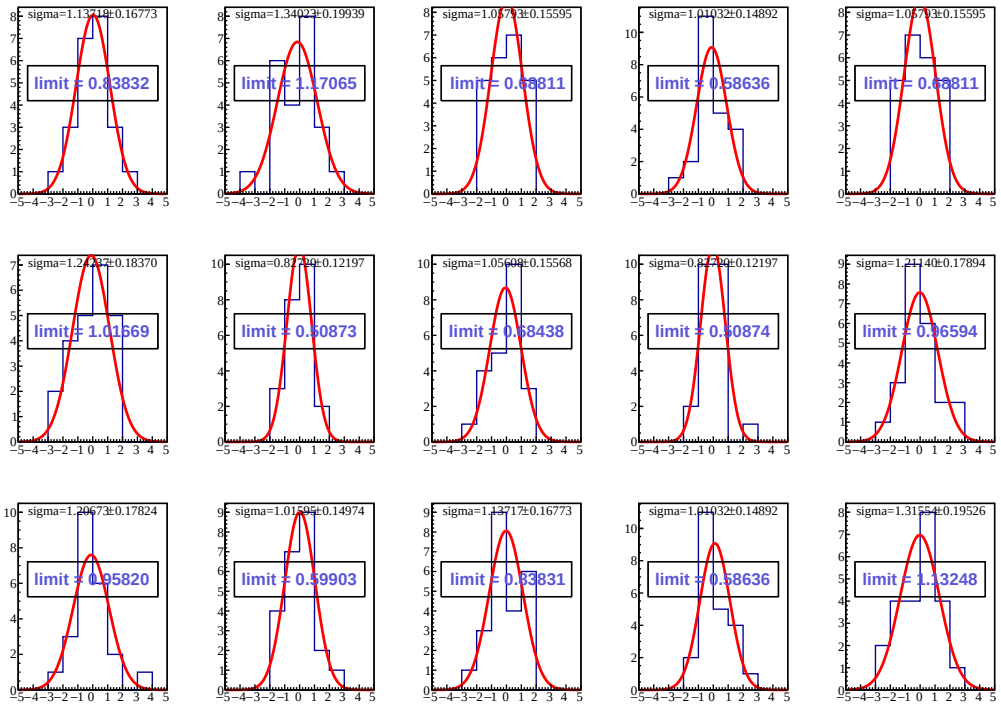
2007 sample (limit $\in [0.51, 1.17]$)



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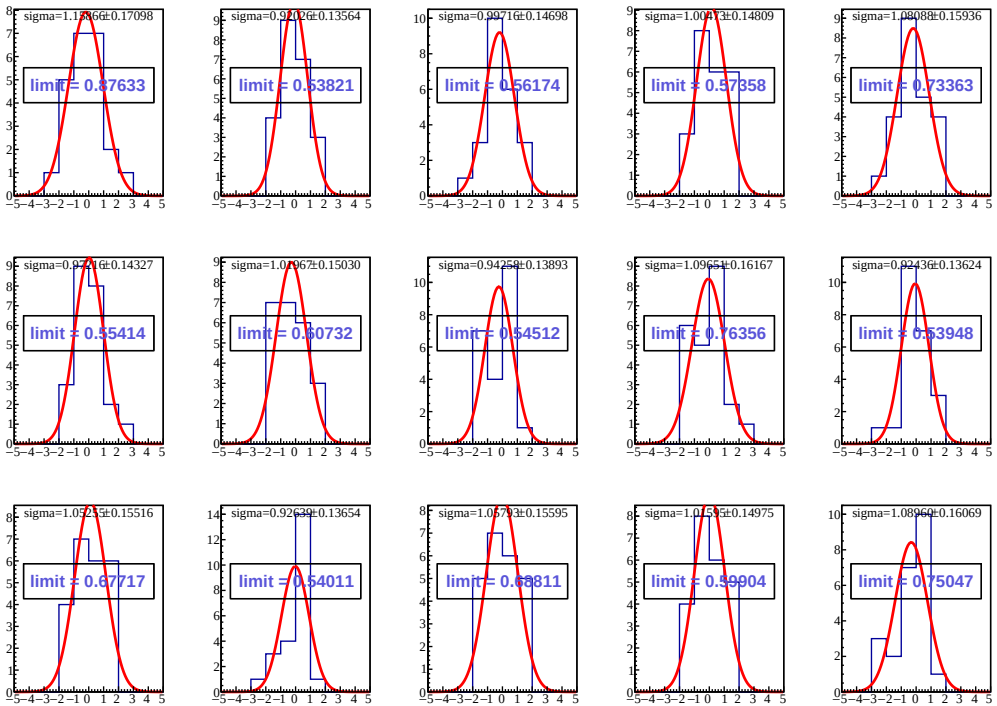
2011 sample (limit $\in [0.54, 0.88]$)



Systematic error of g_1^p

- $A_1^p \sim \dfrac{A^{raw}}{f D P_b P_t} \qquad g_1^p = \dfrac{F_2^p}{2x(1+R)} A_1^p = \dfrac{F_2^p A^{LL}}{2xD(1+R)}, \qquad A_1^p = \dfrac{A^{LL}}{D}$
- $\dfrac{\sigma^2_{syst}(g_1^p)}{(g_1^p)^2} = \dfrac{\sigma^2_{syst}(A^{LL})}{(A^{LL})^2} + \dfrac{\sigma^2_{syst}(F_2^p)}{(F_2^p)^2} + \dfrac{\sigma^2_{syst}[D \cdot (1+R)]}{[D \cdot (1+R)]^2}$
- $\sigma_{syst}(A^{LL}) = \sqrt{\sigma^2_{syst}(A_1^p) \cdot D^2 + (A_1^p)^2 \cdot \sigma^2_{syst}(D)}$
- but with $\sigma^2_{syst}(A_1^p)$ obtained removing the term related to the depolarisation factor D:

$$\Delta A_1^{mult} = |A_1| \sqrt{\left(\frac{dP_b}{P_b}\right)^2 + \left(\frac{dP_t}{P_t}\right)^2 + \left(\frac{df}{f}\right)^2 + \cancel{\left(\frac{dD(R)}{D(R)}\right)^2}}$$

Summary

- Take into account dependency with beam energy of:
  - $\frac{dP_t}{P_t}$
  - ΔA_1^{RC}
  - $\frac{dD(R)}{D(R)}$
  - $\frac{d[D \cdot (1+R)]}{D \cdot (1+R)}$
- $1/\delta_A = \sqrt{\sum_i 1/\delta^2_{A,i}}, \qquad i = 2007, 2011$
- Work ongoing

BACKUP

A_1^p total systematic error

One-photon-exchange asymmetry: $A_1^{1\gamma} = \frac{1}{fDP_bP_t} A^{raw} - \left(\frac{\eta A_2}{\rho} + A_1^{RC} + A^{false} \right)$

Multiplicative systematic error: $\Delta A_1^{mult} = |A_1| \sqrt{\left(\frac{dP_b}{P_b}\right)^2 + \left(\frac{dP_t}{P_t}\right)^2 + \left(\frac{df}{f}\right)^2 + \left(\frac{dD(R)}{D(R)}\right)^2}$

Additive systematic error: $\Delta A_1^{add} = \sqrt{\left(\frac{\eta}{\rho} A_2\right)^2 + \left(\Delta A_1^{RC}\right)^2 + \left(\Delta A^{false}\right)^2}$

Total systematic error: $\Delta A_1^{syst} = \sqrt{\left(\Delta A_1^{mult}\right)^2 + \left(\Delta A_1^{add}\right)^2}$

ΔA_1^{mult}	Beam polarization	dP_b/P_b	5%
	Target polarization	dP_t/P_t	2% (2007) / 3.5% (2011)
	Dilution factor	df/f	5%
	Depolarization factor	$dD(R)/D(R)$	1%-**39%**
	Total		$\Delta A_1^{mult} \simeq (0.07 - 0.40) \cdot A_1$
ΔA_1^{add}	Transverse asymmetry	$\eta/\rho \cdot \Delta A_2$	$3 \cdot 10^{-6} - 9 \cdot 10^{-4}$
	Rad. corrections	ΔA_1^{RC}	$0.1 \cdot A_1^{RC} = 3 \cdot 10^{-5} - 3 \cdot 10^{-4}$
	False asymmetry	ΔA^{false}	$< (0.34 - \mathbf{1.5}) \cdot \Delta A_1^{stat}$

$\Rightarrow$ The false asymmetries and the error of the depolarization factor are larger than for DIS.

Systematics table in the paper draft (latest version)

Table 1: Decomposition of systematic uncertainties of A_1^p and g_1^p into multiplicative/additive contributions.

			ΔA_1^p	Δg_1^p
Multiplicative contribution	Beam polarisation	$\Delta P_b/P_b$	5%	5%
	Target polarisation	$\Delta P_t/P_t$	2% (2007) 3.5% (2011)	2% (2007) 3.5% (2011)
	Depolarisation factor	$\Delta D/D$	1 – 39 %	–
	Dilution factor	$\Delta f/f$	5%	5%
	$D(1+R)$	$\Delta(D(1+R))/D(1+R)$	–	0.02% – 6%
	F_2	$\Delta F_2/F_2$	–	3% – 7%
Additive contribution	Transverse asymmetry	$\eta/\rho \cdot \Delta A_2$	$< 0.03\,\Delta A_1^{stat}$	$< 0.03\,\Delta g_1^{stat}$
	Radiative corrections	ΔA_1^{RC}	$< 0.04\,\Delta A_1^{stat}$	$< 0.04\,\Delta g_1^{stat}$
	False asymmetries	A_{false}	$< 1.5\,\Delta A_1^{stat}$	$< 1.5\,\Delta g_1^{stat}$