# Estimation of the bias due to semi-inclusive trigger for $A_1^p$(2011) and POLDIS

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## Contents



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# 1 Introduction

In this note a short overview on POLDIS is given including the changes made during the conversion from FORTRAN to C++. The new version of POLDIS is used to evaluate the influence of semi-inclusive triggers on the inclusive asymmetry $A_1^p$ in 2011.

## 1.1 Old version

Poldis has been developed by A. Bravar, K. Kurek and R. Windmolders [1]. It has been used to evaluate the influence of semi-inclusive triggers on the asymmetry $A_1$ by SMC. The influence has been found to be negligible [2]. This version uses its own Lepto Monte Carlo generator to generate events. For each event a weight is calculated based on polarised and unpolarised parton distributions. The Fortran code of this version has been converted to C++ and the build in lepto generator has been removed. Therefore the MC data has to be generated before using Poldis. In the case of the 2011 data a full simulation of the setup is performed using a proton target.

# 2 Method

Poldis uses the informations from the Lepto generator like which kind of reaction took place and which quark was hit. The calculation of the asymmetry is done in the following way:

1. Get information on the process, the target and the quark (LST 22,24,25)
2. Get the polarised and unpolarised PDFs for the $x$ and $Q^2$ of the process
3. Select the PDFs for the quark flavour in this reaction
4. Calculate $R$ and the depolarisation factor $D$
5. Calculate $A_{ll}$ for this process
6. Calculate $A_1^i = A_{ll} \cdot q(x, Q^2)/\Delta q(x, Q^2)/D$
7. Calculate the sum of $A_1^i$ for all events
8. $A_1 = A_1^i/N$

The calculation of $A_{ll}$ is based on which kind of interaction took place. In Poldis the folowing processes are implemented for $A_{ll}$:

- $\gamma q \longrightarrow q$
- $\gamma q \longrightarrow qg$
- $\gamma q \longrightarrow q\bar{q}$
- $\gamma q \longrightarrow q\bar{q}$ (Heavy quarks)

During the conversion from FORTRAN code into C++ code also the possibility to use different polarised and unpolarised PDFs is implemented. Now the following PDFs can be used:

- Unpolarised PDF

  - MSTW [3] (LO and NLO)
  - NNPDF 3.0 [4] (LO and NLO)

- Polarised PDF
  - AAC [5] (LO and NLO)
  - BB [6] (LO and NLO)
  - BB 2010 [7] (NLO)
  - DNS 2005 [8] (LO and NLO)
  - GRSV [9] (LO and NLO)
  - LSS 2001 [10] (LO and NLO)
  - LSS 2005 [11] (LO and NLO)
  - LSS 2006 [12] (NLO)
  - LSS 2010 [13] (NLO)
  - NNPDF(pol) 1.1 [14] (NLO)
  - COMPASS (NLO)

In case of the COMPASS, BB and BB2010 parametrisations no separate distributions for the different sea quarks ($u, \bar{u}, d, \bar{d}$ and $s, \bar{s}$) are available, therefore they are all treated equally. In case of the BB parametrisations only the valence distributions of $u$ and $d$ and a sea quark distributions is available. For COMPASS it is assumed that $\Delta s = \Delta\bar{s}$ and that all sea quark distributions are equal. For the cross section ratio also different parametrisations can be used:

- $R = 0$
- $R$ NMC [**?** ]
- $R$ 1990 [**?** ]
- $R$ 1998 [**?** ]

# 3 Results for the 2011 setup

The influence of semi-inclusive triggers on the asymmetry $A_1^p$ has been tested using a Monte Carlo simulation of the 2011 setup with a proton target. This simulation was performed by Artem Ivanov. From these data the generator informations stored in the NLUdata and LUJET of the McGen informations in the mDSTs are used. All events are split up into two groups (inclusive and semi-inclusive triggers). The selection is made in the same way as in the real data analysis. If a inclusive trigger bit is set the event is added to the inclusive group. If there was no inclusive trigger bit set but an semi-inclusive one or only the calorimeter trigger bit it is added to the semi-inclusive trigger group. Both samples where processed in POLDIS and the asymmetry is calculated using different PDFs. An example for the resulting $A_1^p$ using MSTW and GRSV2000 in NLO and LO is shown in figure 1.
Performing this procedure for all different PDFs the difference between both samples is calculated and shown in figure 2. Here, the difference is compared to the statistical uncertainty of the 2011 data. As our Monte Carlo simulation is done in LO the plot showing the difference

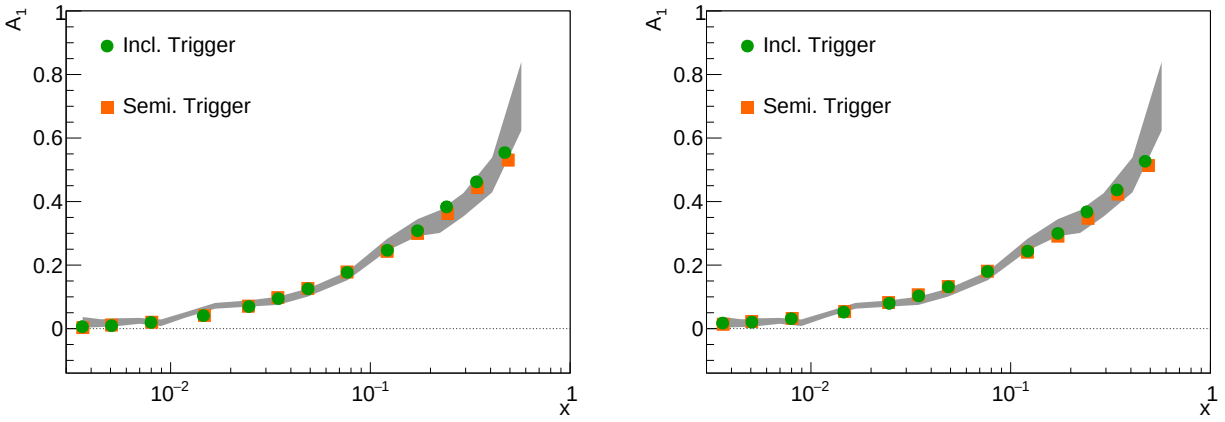


**Figure 1:** *Comparison between $A_1^p$ obtained from POLDIS using MSTW and GRSV as PDFs for inclusive and semi-inclusive trigger. The left plot shows the results in using the NLO PDFS and the left one the results using LO. The grey band indicates the results for $A_1$ from the 2011 data with its statistical uncertainty.*

between both samples in LO has to be used for the estimate of the bias. From this plot it can be seen that there is an small offset introduced by using semi-inclusive triggers on the asymmetry $A_1^p$ which is in the order of $\sim 0.1\Delta A^p_{1,\mathrm{stat}}$. This contributions is neglected in the systematic uncertainty of $A_1$

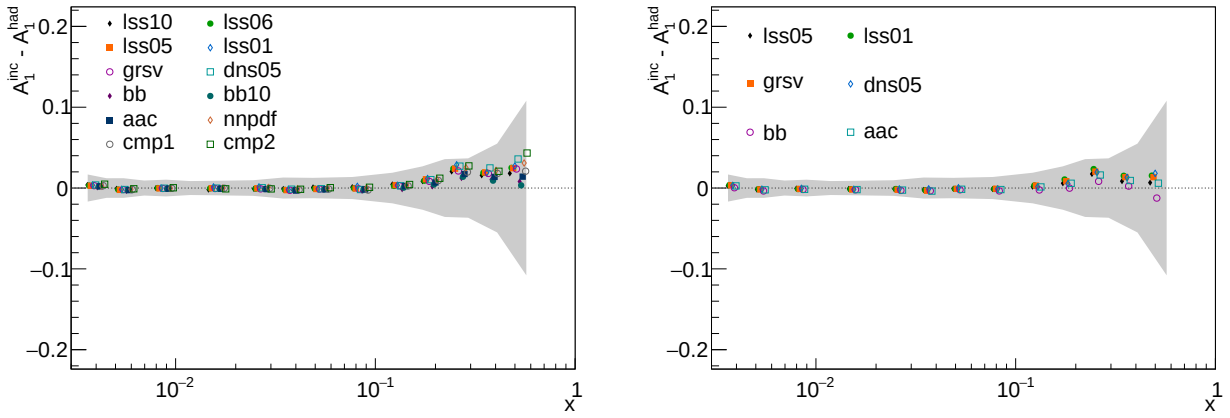


**Figure 2:** *Comparison between the statistical uncertainties of the 2011 data (grey band) and the difference between inclusive and semi-inclusive triggers using different PDFs for inclusive and semi-inclusive trigger. The left plot shows the results in using the NLO PDFS and the left one the results using LO.*

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