Report on status on the DBD bench-mark “Polarisation measurement using WW events”

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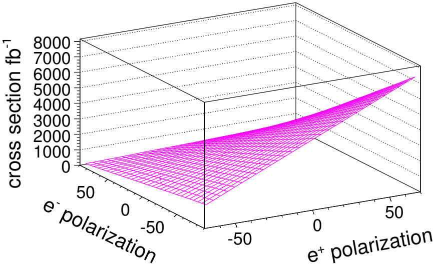
WW and Polarisation

(Ref: Ivan Marchesini's PhD thesis.)

WW production : a high cross-section, polarisation dependent process



Ideally suited to make polarisation measurements.

Polarisation from the Blondel-scheme

Polarisation measurement from data with the (modified) Blondel scheme:

$$\sigma = \sigma_u \left[1 - P_{e^+} P_{e^-} + A_{LR}(P_{e^+} - P_{e^-})\right], \quad (1)$$

hence

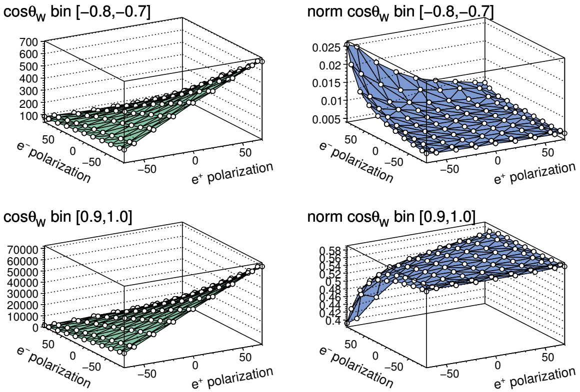
$$P_{e^\pm} = \sqrt{\frac{(\sigma_{+-} + \sigma_{-+} - \sigma_{++} - \sigma_{--})(\mp\sigma_{-+} \pm \sigma_{+-} - \sigma_{++} + \sigma_{--})}{(\sigma_{-+} + \sigma_{+-} + \sigma_{++} + \sigma_{--})(\mp\sigma_{-+} \pm \sigma_{+-} + \sigma_{++} - \sigma_{--})}}$$

$\sigma_{\pm\pm}$ = cross-section for $\mathrm{e}^+\mathrm{e}^- \rightarrow WW$ for the particular beam-polarisation.
++ and - - data needed !

However: 100:s of fb^{-1} needed to get to 0.2 %.

Polarisation from Θ_W

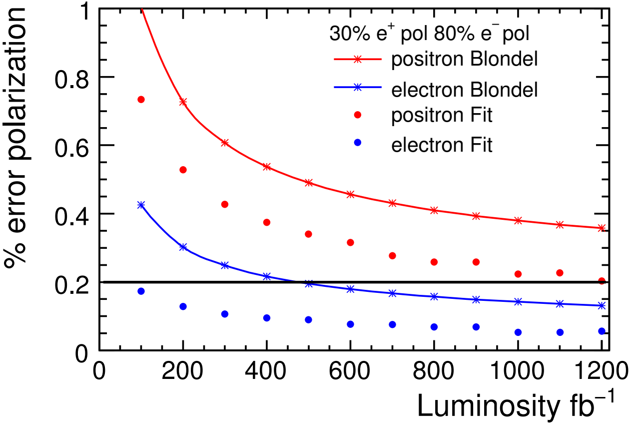
Look at polarisation dependence in bins of Θ_W:



Fit number of data events in Θ_W-bins for $\mathcal{P}_{e^+}$ for $\mathcal{P}_{e^-}$ obtained from templates of $d\sigma(\Theta_W, \mathcal{P}_{e^+}, \mathcal{P}_{e^-})$

Θ_W and Blondel

Result of fit and Blondel-scheme:



Θ_W and Blondel

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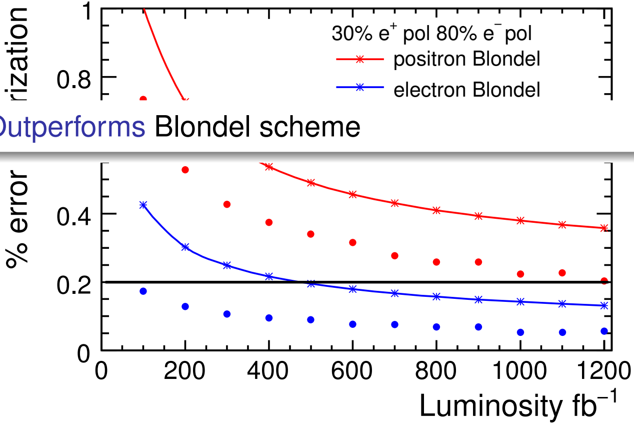

- Θ_W Outperforms Blondel scheme

TGC:s in *WW*

There is a catch, however:

Triple Gauge Couplings

TGC:s :

- 14 complex parameters, 8 CP conserving.
- In the SM: only 4 real parameters non-zero, all equal to unity
- Deviations from SM loop-corrections and beyond SM physics

Deviations from the SM still allowed (by LEP), modifies angular diff. cross-sections $\rightarrow$ % level corrections to polarisation measurement $\rightarrow$ fit simultaneously. Complicated, however: almost no change in error on $\mathcal{P}$ (Ivan's thesis)

Status

- The signal and relevant backgrounds are generated.
- NB. For this bench-mark, the signal (*WW*), has a higher cross-section than it's relevant backgrounds (all other 4-fermion channels) !
- The frame-work from Ivan has been taken over and adapted by Aura Rosca.
- She has done 'dry-runs' on generator-level information.

What lumi is useful ?

- We are asked to simulate 1 ab^{-1}.
- For *WW* this means 20 Mevents = LOI mass-production.
- However, the polarisation measurement is probably systematics-limited before this.
- From Ivan's thesis: At 500 GeV, $|\mathcal{P}| = (80\%, 30\%)$, $\mathcal{P}_{e^-}$ is limited by systematics - from ϵ, luminosity, and polarimeters, but not beam-spectrum - at $\approx$ 300 fb^{-1} (both for Blondel and Θ_W).
- How will this scale to 1 TeV ? One one hand, there are less signal events and lower positron polarisation $\rightarrow$ higher statistical error/(year). On the other hand, the machine is less clean, and events are more forward $\rightarrow$ expect higher systematics..
- Note: LOI analysis was done on a 80 fb^{-1} samples only and extrapolated to 500 fb^{-1}.
- Strictly speaking, the signal is only $WW \rightarrow q\bar{q}l\nu$, which is 22 % of the total (= 4.3 Mevent).

Conclusions

For the *WW* bench-mark,

- All is ready to go.
  - Signal and background generated.
  - Analysis chain is in place.
- Note that for *WW*, all polarisation combinations need to be simulated.
- Unclear exactly which and how many events need to be fully simulated.

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