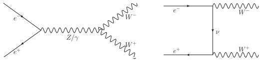
A refined TGC analysis using Optimal Observables

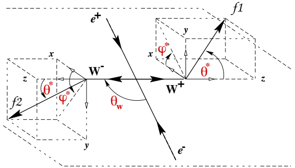
- TGCs are sensitive to the differential distributions!
  - Current method: fit to binned distributions of all angles.
  - Correlations among angles are ignored.

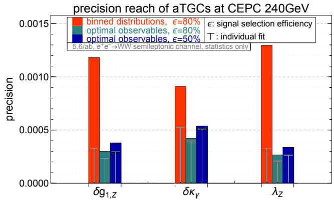
- What are optimal observables?
  (See *e.g.* Z.Phys. C62 (1994) 397-412 Diehl & Nachtmann)
  - For a given sample, there is an upper limit on the precision reach of the parameters.
  - In the limit of large statistics (everything is Gaussian) and small parameters (leading order dominates), this "upper limit" can be derived analytically!

$$\frac{d\sigma}{d\Omega} = S_0 + \sum_i S_{1,i}\, g_i\,,$$

- The optimal observables are given by $\mathcal{O}_i = \frac{S_{1,i}}{S_0}$, and are functions of the 5 angles.







How to do a practical OO analysis?

- Current estimations are based on ideal scenarios (statistical uncertainties only, no backgrounds...), in which case one can simply derive the bounds.

$$\frac{d\sigma}{d\Omega} = S_0 + \sum_i S_{1,i}\, g_i\,,$$

- Apply parton level OO to real events
  - the results can be biased, and the bias may take some effort to estimate
- Directly construct ”detector-level” OOs with numerical methods?
  - may require a lot of MC simulation...
- Beyond the 3-aTGCs: $\delta g_{1,Z},\ \delta\kappa_\gamma,\ \lambda_Z,\ \delta g^{ee}_{Z,L},\ \delta g^{ee}_{Z,R},\ \delta g^{e\nu}_{W},\ \delta_m$