QED PDFs in HERAFitter

work in progress

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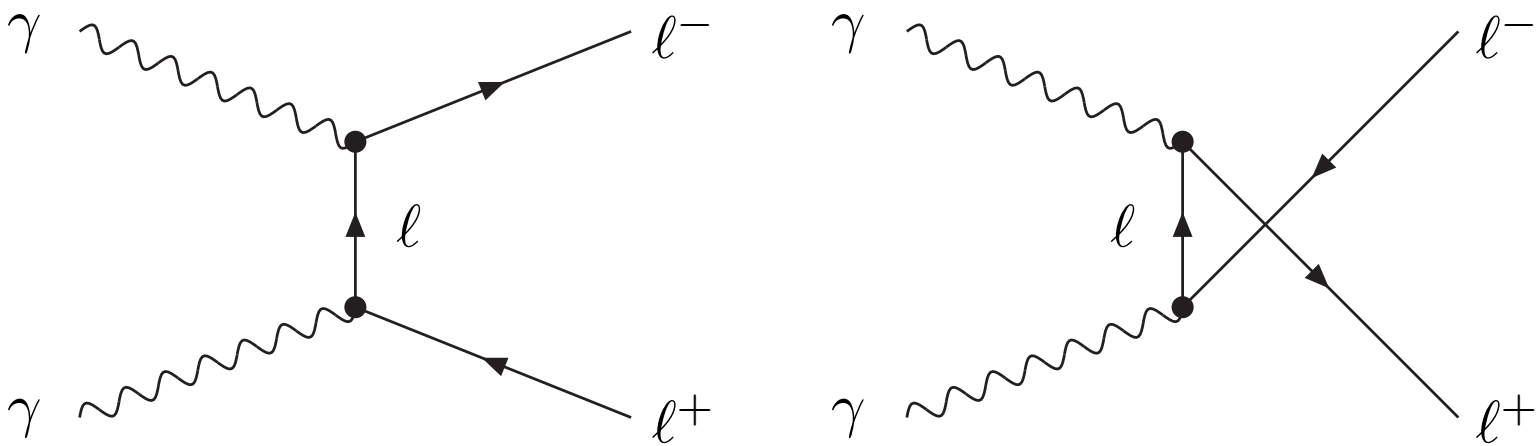
APPLGRID interface for $\gamma\gamma \to \ell^+\ell^-$ process. Motivation



Photon-induced $\gamma\gamma \to \ell^+\ell^-$ process is an irreducable background to neutral current Drell-Yan-like process $q\bar{q} \to \gamma/Z \to \ell^+\ell^-$ and should be considered as part of NLO EW contribution to the production of charged lepton pair.

Cross-section

3-differential cross-section of the process $p[\gamma]p[\gamma] \to \ell^+\ell^- + X$ at LO:

$$\frac{d\sigma_{\gamma\gamma}}{dx\,dy\,dz} =$$
$$= \frac{4\pi\alpha^2}{s_0} f_\gamma\left(\frac{M_{min}}{\sqrt{s_0}} e^{x+y}, \mu_F^2\right) f_\gamma\left(\frac{M_{min}}{\sqrt{s_0}} e^{x-y}, \mu_F^2\right)\left(1+\tanh^2 z\right),$$

where $x = \ln\frac{M_{\ell^+\ell^-}}{M_{min}}$, $y = Y_{\ell^+\ell^-}$, $z = -\ln\tan\frac{\hat{\theta}}{2}$.

f_γ — photon PDF (photon is considered as parton within proton).

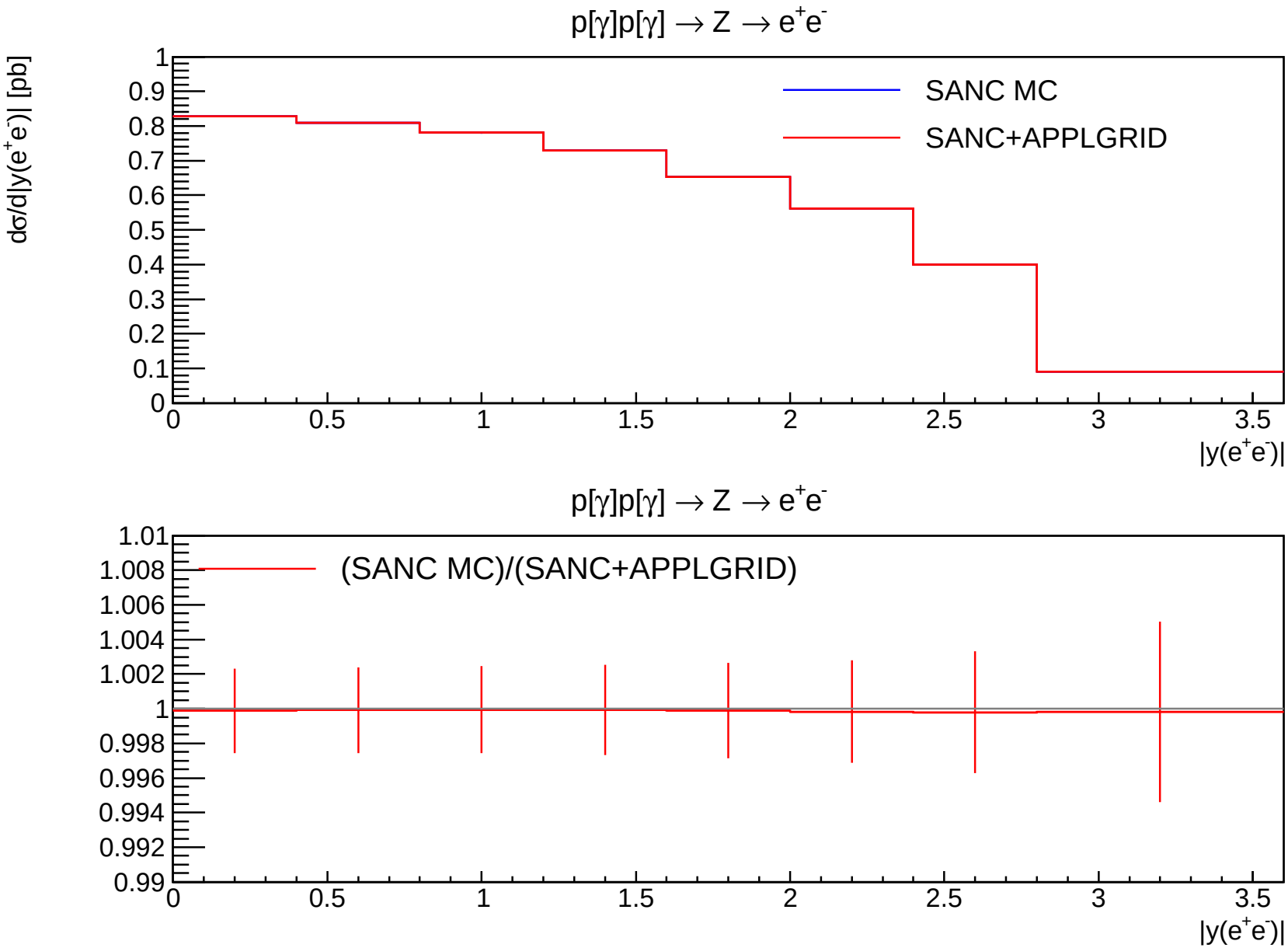
Some features of implementation

- SANC generator produces unweighted events which are saved to file. Each event i is assigned a weight

$$w_i = \frac{\sigma_{\gamma\gamma}}{N} \cdot \frac{1}{f_\gamma(x_{1_i}, Q_i^2) f_\gamma(x_{2_i}, Q_i^2)},$$

  where $\sigma_{\gamma\gamma} = \int d\sigma$, N - total number of events. At this stage MRST2004qed pdf set is used to evaluate photon pdf.
- These events are used to fill grids for different observables with help of APPLGRID interface (v. 1.4.56).
- The grids can be used for fast convolution with arbitrary photon PDF to get the cross-section.

Comparison between MC and APPLGRID



Using in HERAFitter

To use the grid with $\gamma\gamma \to e^+e-$ process in `HERAFitter` one need to modify the file `Z0_applgrid_nnlo.dat`:

```
...
TermName = 'A1', 'K'
TermType = 'applgrid','kfactor'
TermSource = 'theoryfiles/atlas/WZ2010/Z0-applgrid.root' ,.
             'theoryfiles/atlas/WZ2010/KF-Z0-nnlo2nlo-ew.txt'
TheorExpr= 'K*A1'
...
```

should be replaced by

```
...
TermName = 'A1', 'A2', 'K'
TermType = 'applgrid','applgrid','kfactor'
TermSource = 'theoryfiles/atlas/WZ2010/Z0-applgrid.root' ,
             'theoryfiles/atlas/WZ2010/Z0-photon-applgrid_yZ.root' ,
             'theoryfiles/atlas/WZ2010/KF-Z0-nnlo2nlo-ew.txt'
TheorExpr= 'K*A1+A2'
...
```

Plans

- Perform NLO QCD + LO QED fit using ATLAS data for high mass NC Drell-Yan process