FASER update

Paulina 12/03/26

Validation against YADISM (LO)

Fixed scales/1TeV/LO-nue-p

```
1. INTEGRATED CROSS-SECTIONS (full histogram range)

  | Obs     POWHEG σ     Analytical σ   A/P ratio    Paper σ

    El       4.0616        4.0354        0.9935       3.4216
    Eh       4.0616        4.0354        0.9935       3.6113
    Q2       4.0616        4.0354        0.9935       3.8107
    bjx      4.0616        4.0354        0.9935       3.8134
  theta      3.2252        3.6816        1.1415       2.8079
   inel      3.8196        4.0354        1.0565         –

Units: σ in pb
A/P = Analytical / POWHEG
```

Kinematic cuts

Q2≥10GeV2

W≥2GeV

Theta mismatch likely due to my pwhg bin range, Q2 diff because of how I integrate, fixing next

Running new sims now with more bins for theta

```
2. DISTRIBUTION-LEVEL COMPARISON (weighted Analytical/POWHEG, in fit window)

  | Obs       Fit window      Wgt mean    Wgt std    N bins      Verdict

    El       [150, 850]       0.99391     0.01369      21      EXCELLENT
    Eh       [150, 850]       0.99410     0.01311      21      EXCELLENT
    Q2       [100, 1000]      0.96100     0.02192      20       MODERATE
    bjx      [0.05, 0.8]      0.97565     0.05236      38           GOOD
  theta      [0.01, 0.08]     0.98810     0.00908      20           GOOD
   inel      [0.1, 0.9]       0.99350     0.00740      22      EXCELLENT
```

Fixed scales-no cuts/1TeV/LO-nue-p

```
1. INTEGRATED CROSS-SECTIONS (full histogram range)

   |  Obs        POWHEG σ      Analytical σ    A/P ratio

   |    El         4.5426          4.5560         1.0029
   |    Eh         4.5426          4.5560         1.0029
   |    Q2         4.5426          4.5560         1.0029
   |   bjx         4.5426          4.5560         1.0029
   | theta         4.5257          4.2017         0.9284
   |  inel         4.5202          4.5560         1.0079


Units: σ in pb
A/P = Analytical / POWHEG
```

NO Kinematic cuts

Q2≥4GeV2

W≥0

Theta mismatch likely due to my pwhg bin range, Q2 diff because of how I integrate, fixing next

Running new sims now with more bins for theta

```
2. DISTRIBUTION-LEVEL COMPARISON (weighted Analytical/POWHEG, in fit window)

   |  Obs        Fit window      Wgt mean    Wgt std    N bins      Verdict

   |    El       [150, 850]       0.99755    0.05099       21     EXCELLENT
   |    Eh       [150, 850]       0.99757    0.05100       21     EXCELLENT
   |    Q2       [100, 1000]      0.96205    0.02421       20      MODERATE
   |   bjx       [0.05, 0.8]      0.97991    0.12697       38          GOOD
   | theta       [0.01, 0.08]     0.91023    0.26600        9         CHECK
   |  inel       [0.1, 0.9]       1.00251    0.00465       22     EXCELLENT
```

Fixed scales/10TeV/LO-nue-p

```
1. INTEGRATED CROSS-SECTIONS (full histogram range)

  Obs       POWHEG σ     Analytical σ    A/P ratio

   El        36.1438        40.4665        1.1196
   Eh        36.1438        40.4665        1.1196
   Q2        36.1438        40.4665        1.1196
  bjx        36.1438        40.4665        1.1196
 theta       35.6729        40.4218        1.1331
  inel       33.3278        40.4665        1.2142

Units: σ in pb
A/P = Analytical / POWHEG
```

Kinematic cuts

Q2≥10GeV2

W≥2GeV

Not ideal… :(Unsure why, investigating now

```
2. DISTRIBUTION-LEVEL COMPARISON (weighted Analytical/POWHEG, in fit window)

  Obs          Fit window      Wgt mean    Wgt std    N bins     Verdict

   El         [1500, 8500]      1.12305    0.01300       21       CHECK
   Eh         [1500, 8500]      1.12322    0.01359       21       CHECK
   Q2          [100, 1000]      1.11837    0.02642       20       CHECK
  bjx          [0.05, 0.8]      1.07729    0.05781       38       CHECK
 theta    [0.004019, 0.03215]   1.08826    0.00873       26       CHECK
  inel         [0.1, 0.9]       1.12254    0.01465       22       CHECK
```

NEXT UP:
Validation against YADISM (NLO) for running scales
Reproducing BRG18

[BRG18] I know how to do vs I am unsure

- All 8 inclusive channels (CC & NC)

- Isoscalar averaging

- Lepton flavour blind

- 10^4 - 10^12 GeV

- Running scales

- NLO

- EW & CKM match

- No showers

- Qmin = 1.64 GeV

- NNLO effects

- Top mass effects

- PDF (lhapdf num?) NNPDF3.1sx+LHCb

- FONLL