ACOT STATUS & ISSUES

1) Use QCDNUM NLO ZMSTF calc for NC K-factor denominator

This will particularly help FL

~~*This is done; need to implement faster method*~~ **DONE!!!**

2) Extend above to Charged Current (CC)

“Wiring” is in place, should be short time scale

…brief comments on:

3) K-Factor technique

K-factor issues

4) Renormalization scales μ_F, μ_R

Variations of the scales

THANKS TO: Olek, Ingo, Tzvetalina,

Fred Olness

27 February 2013

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OLD METHOD: ACOT K-FACTOR

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   ===========  Calls to fcn= IfcnCount          906
uv:     4.0681    0.6870    4.7833    0.0000    9.2448    0.0000    0.0000    0.0000    0.0000    0.0000
dv:     2.4305    0.6870    4.6045    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
Ub:     0.0954   -0.1902    2.0363    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
Db:     0.1383   -0.1902    2.0891    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
GL:     8.7193    0.2662    9.8465    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
ST:     0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
cpu_time     193.00     193.02       0.02
                        906       560.00    582         0.96

After minimisation       560.00    582      0.962

Dataset     1     107.43    145   NC cross section HERA-I H1-ZEUS combined e-p.
Dataset     2     402.11    379   NC cross section HERA-I H1-ZEUS combined e+p.
Dataset     3      20.16     34   CC cross section HERA-I H1-ZEUS combined e-p.
Dataset     4      30.30     34   CC cross section HERA-I H1-ZEUS combined e+p.
  Correlated Chi2    0.0000000000000000
  --------- in store-pdfs -------
cpu_time     193.00     193.64       0.64
```

Both ACOT and QCDNUM K-Factors work well, yield similar results on first iteration

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NEW METHOD: QCDNUM K-FACTOR

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  ===========  Calls to fcn= IfcnCount          699
uv:     3.7318    0.6608    4.9035    0.0000   11.1241    0.0000    0.0000    0.0000    0.0000    0.0000
dv:     2.1951    0.6608    4.4262    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
Ub:     0.0961   -0.1883    1.8060    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
Db:     0.1392   -0.1883    2.5388    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
GL:     7.0498    0.2250    8.7102    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
ST:     0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
cpu_time     192.27     192.28       0.01
                       699       564.87    582         0.97

After minimisation       564.87    582      0.971

Dataset     1     107.65    145   NC cross section HERA-I H1-ZEUS combined e-p.
Dataset     2     405.75    379   NC cross section HERA-I H1-ZEUS combined e+p.
Dataset     3      20.80     34   CC cross section HERA-I H1-ZEUS combined e-p.
Dataset     4      30.68     34   CC cross section HERA-I H1-ZEUS combined e+p.
 Correlated Chi2    0.0000000000000000
 --------- in store-pdfs -------
cpu_time     192.27     193.01       0.74
```

F_L is Special

$$F_L \sim \frac{m^2}{Q^2} q(x) + \alpha_s \{c_g \otimes g(x) + c_q \otimes q(x)\}$$

At LO, if we neglect masses, FL=0.

For this reason, we define K-Factor as:

$$k = \frac{\sigma[Your\ Choice]}{\sigma[Massive\ LO\ Calculation]}$$

This is fine, so long as you use the correct pieces to reconstruct the result.

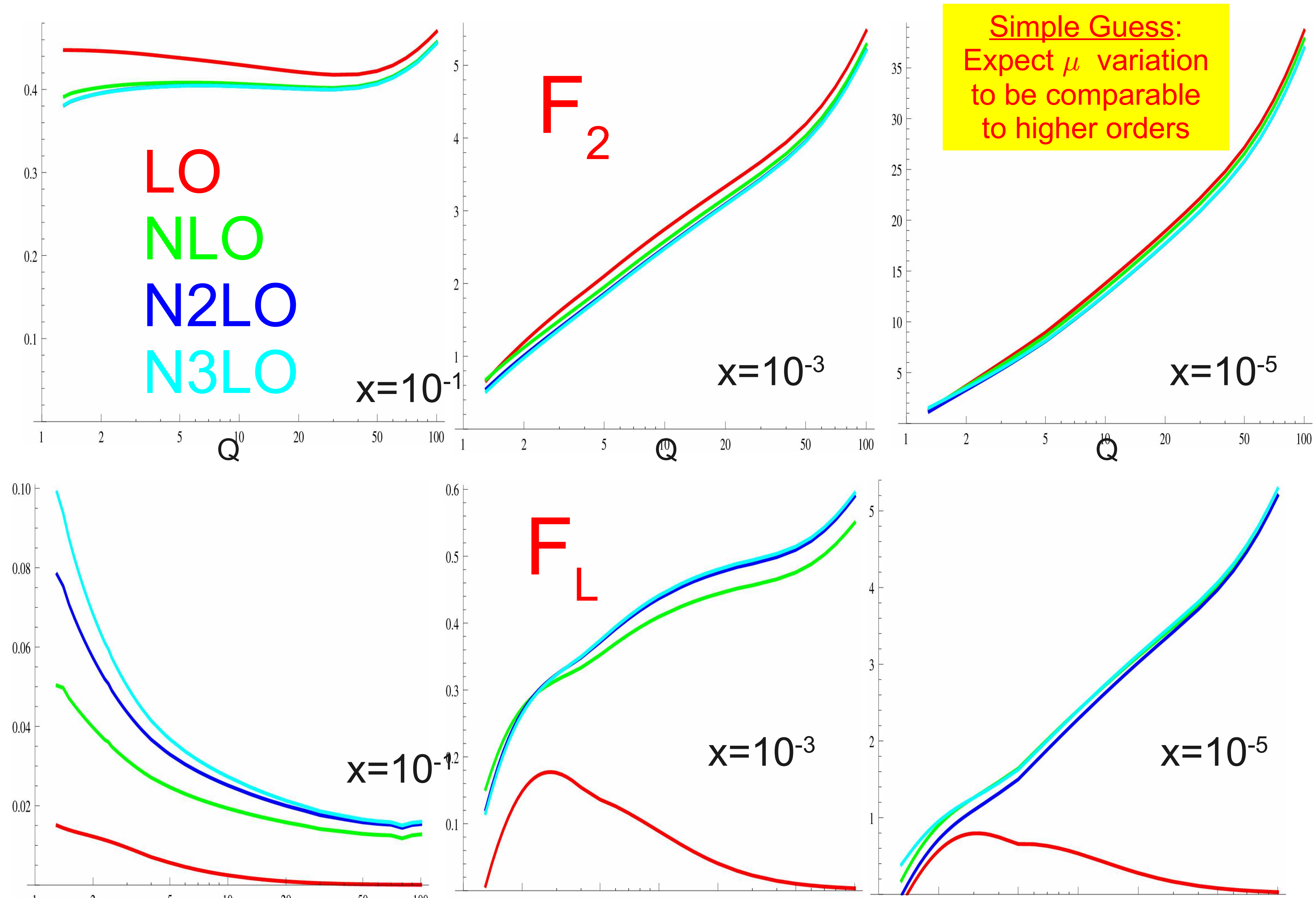
$$\sigma[Your\ Choice] = k\ \sigma[Massive\ LO\ Calculation]$$

If we neglect masses in FL, this trick won't work *(at least at LO)*

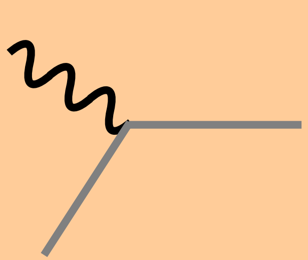
For NLO QCDNUM calculation, this is not a problem as it is fast and non-zero.

To extend to F2c, F2b, need to pass in values; this can done through current vars.

$F_{2,L}$ @ N3LO


Simple Guess:
Expect μ variation
to be comparable
to higher orders
LO
NLO
N2LO
N3LO
F_2
F_L
x=10^-1
x=10^-3
x=10^-5
Q
Q
Q
x=10^-1
x=10^-3
x=10^-5

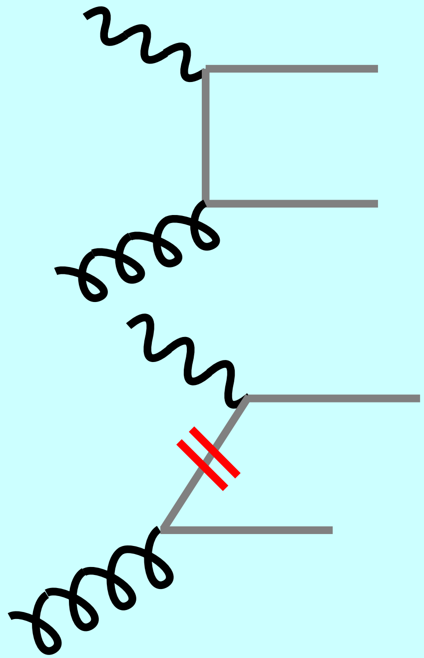
Renormalization Scales: *Oversimplified*



$f_q(x, \mu_F)$

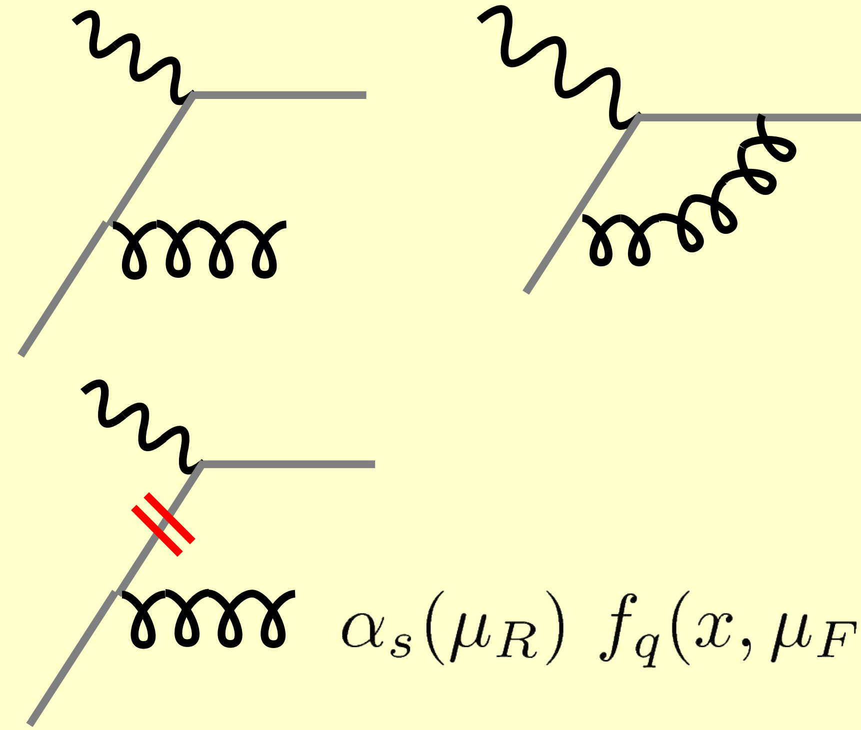
μ_F Is used to regulat the IR collinear singularity

μ_R Is used to regularize the UV divergence: $\alpha_s(\mu_R)$



$\alpha_s(\mu_R)\ f_g(x, \mu_F)$

$$\ln\left(\frac{\mu_F}{m_q}\right)$$



$\alpha_s(\mu_R)\ f_q(x, \mu_F)$

$$\ln\left(\frac{\mu_F}{m_q}\right)\ \ln\left(\frac{\mu_R}{\mu_F}\right)$$

Setting $\mu_F = \mu_R$ avoids extra logs

Full ACOT: Complete for $\mu_R = \mu_F$; can be generalized
ACOT-ZM: Based on Furmanski & Petronzio; can be generalized
ACOT-χ : Complete up to NLO-Quark term; can be generalized

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