Possible ΔR extraction from MARATHON+ data

Tyler Kutz

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Relevance of R

- R is the absorption cross section ratio for longitudinally to transversely polarized photons:
$$R = \sigma_L / \sigma_T$$
- Knowledge of R required to obtain F_2 from absolute cross section (typically obtained from SLAC parametrization, R1990)
- Cross section ratio only equal to F_2 ratio if R is independent of nucleus (often assumed based on SLAC and CERN measurements)

Sensitivity to ΔR

Difference in R between nucleus A and deuterium can be found from cross section ratios using a Rosenbluth separation style method:

$$\frac{\sigma_A}{\sigma_D} = \frac{\sigma_A^T}{\sigma_D^T}\left[1 + \frac{\epsilon}{1+\epsilon R_D}(R_A - R_D)\right]$$

where

$$\epsilon = \left[1 + 2\left(1 + \frac{\nu^2}{Q^2}\right)\tan^2\frac{\theta}{2}\right]$$

For MARATHON:

- EMC measurements in tritium, helium-3 care about $R_T - R_D$, $R_H - R_D$
- F_2^n/F_2^p measurement cares about $R_T - R_H$
  - Could be obtained directly if R data exists for helium-3

Overview of data

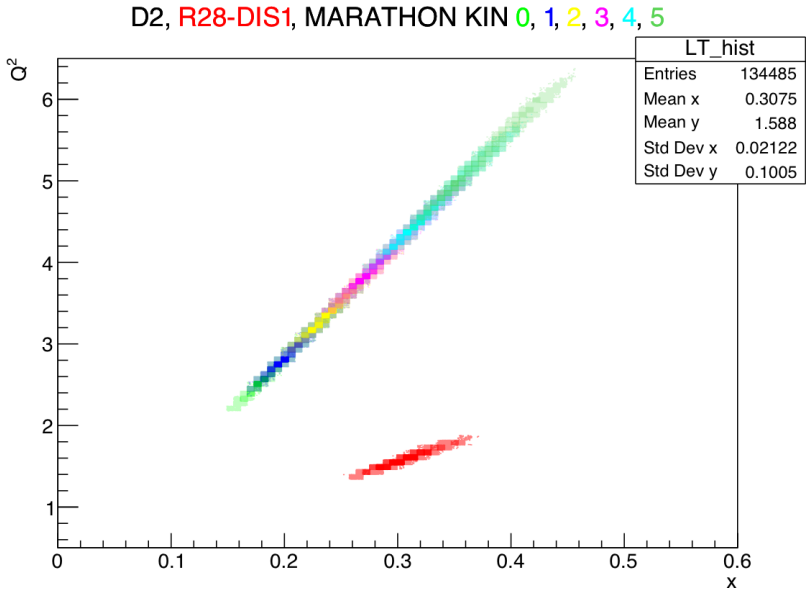
Spring 2018 data (MARATHON):

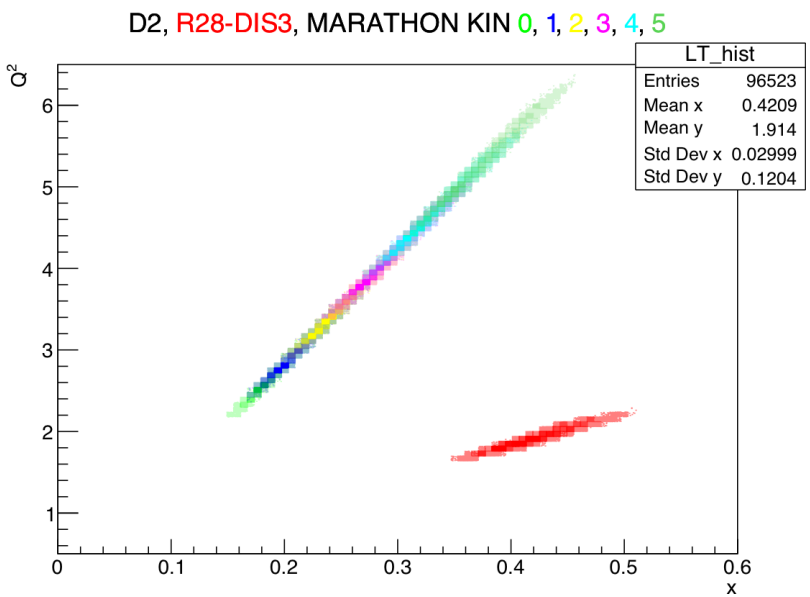
	E_0 (GeV)	E' (GeV)	θ (°)
KIN 0	10.6	3.1	16.807
KIN 1	10.6	3.1	17.755
KIN 2	10.6	3.1	19.115
KIN 3	10.6	3.1	20.578
KIN 4	10.6	3.1	21.930
KIN 5	10.6	3.1	23.213

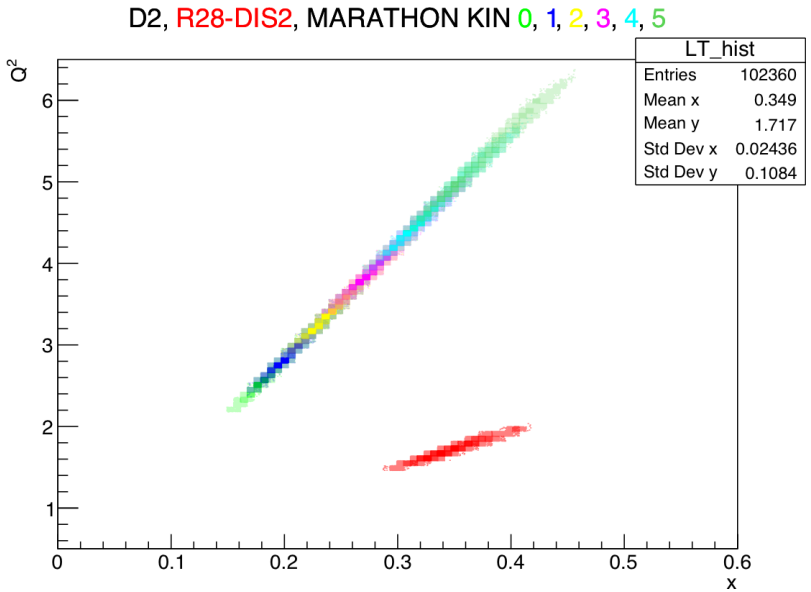
Fall 2018 data:

	E_0 (GeV)	E' (GeV)	θ (°)
R28-DIS1	4.3	1.58	28.004
R28-DIS2	4.3	1.71	28.004
R28-DIS3	4.3	1.91	28.004

x vs. Q^2 coverage (deuterium)

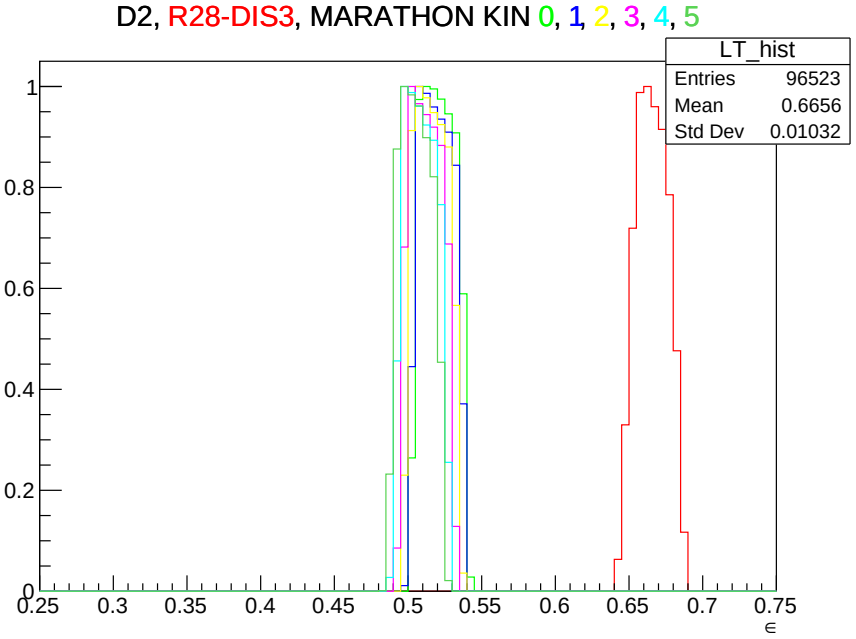


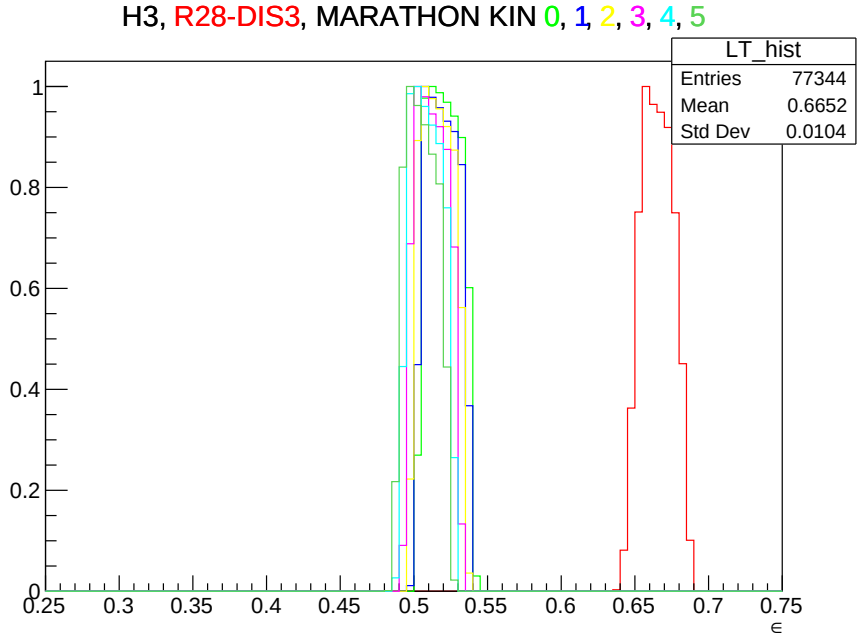


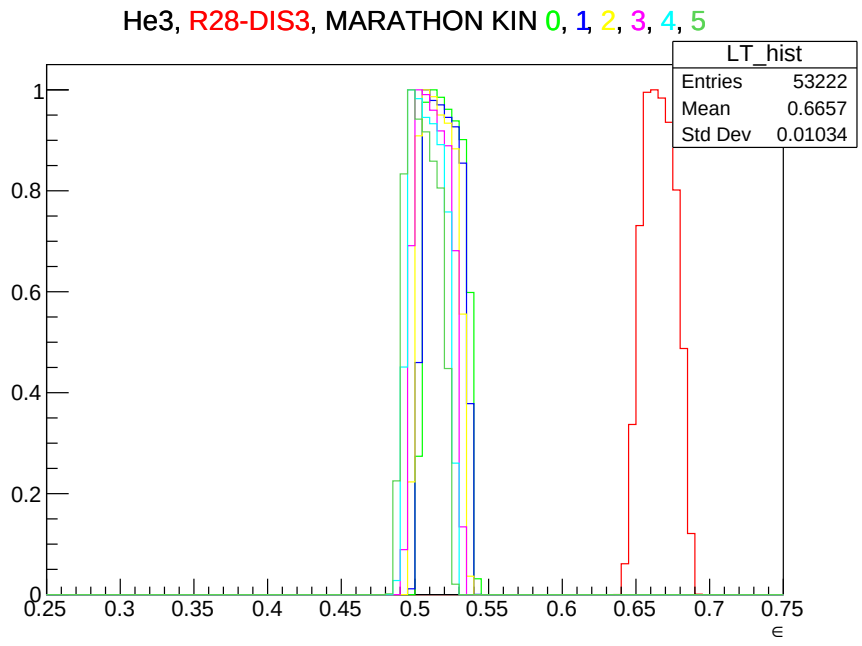


- Good overlap in x_{Bj}
- No overlap in Q^2...evolve result with DGLAP equation
- DGLAP up or DGLAP down?

ϵ separation (R28-DIS3, all targets)







Issues

- $\Delta\epsilon \approx 0.15$ smaller than desired, but could still be useful
- Extract ratio in similar manner to MARATHON analysis, but bin in ϵ instead of x_{Bj}
- Concern: result could be very sensitive to small analysis changes due to short lever arm