

# Kinematic coverage of data for $R = \sigma_L/\sigma_T$ extraction

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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 $\Delta R$

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):

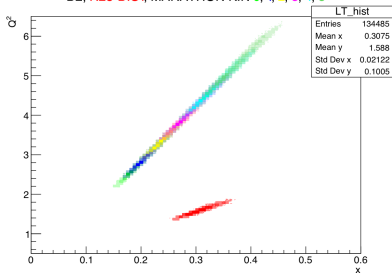
	$E_0$ (GeV)	$E'$ (GeV)	$\theta$ ( $^\circ$ )
KIN 0	10.6	3.1	16.807
KIN 1	10.6	3.1	17.755
KIN 2	10.6	3.1	19.115
KIN 3	10.6	3.1	20.578
KIN 4	10.6	3.1	21.930
KIN 5	10.6	3.1	23.213

Fall 2018 data:

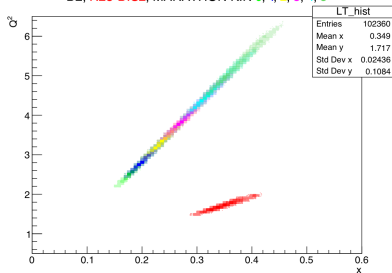
	$E_0$ (GeV)	$E'$ (GeV)	$\theta$ ( $^\circ$ )
R28-DIS1	4.3	1.58	28.004
R28-DIS2	4.3	1.71	28.004
R28-DIS3	4.3	1.91	28.004

# $x$ vs. $Q^2$ coverage (deuterium)

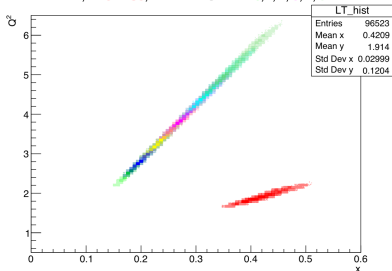
D2, R28-DIS1, MARATHON KIN 0, 1, 2, 3, 4, 5



D2, R28-DIS2, MARATHON KIN 0, 1, 2, 3, 4, 5



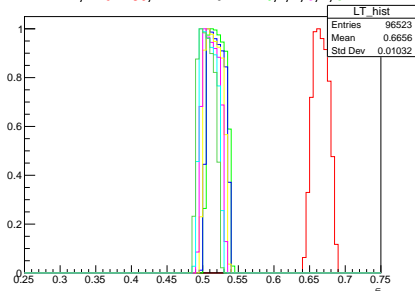
D2, R28-DIS3, MARATHON KIN 0, 1, 2, 3, 4, 5



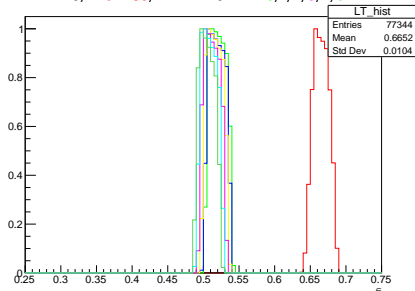
- Good overlap in  $x_{Bj}$
- No overlap in  $Q^2$ ...evolve result with DGLAP equations
- DGLAP up or DGLAP down?

# $\epsilon$ separation (R28-DIS3, all targets)

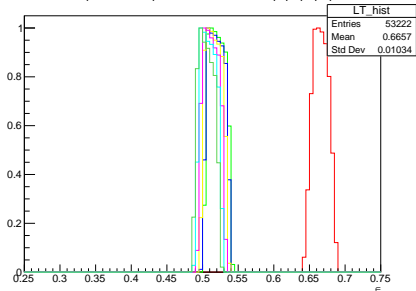
D2, R28-DIS3, MARATHON KIN 0, 1, 2, 3, 4, 5



H3, R28-DIS3, MARATHON KIN 0, 1, 2, 3, 4, 5



He3, R28-DIS3, MARATHON KIN 0, 1, 2, 3, 4, 5



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