Pion-LT/Kaon-LT Collaboration Meeting

Muhammad Junaid
Ph.D. Student
Department of Physics
University of Regina, Canada

LTSep Analysis

- **Next steps are listed as follows:**
  - **Unseparated cross-section calculations**
  - **Model iterations**
  - **Rosenbluth equation fitting**
  - **L/T separated cross-section calculations**
  - **Pion Form Factor measurements**

DATA/SIMC Ratios

Physics Setting	Iteration 00	Iteration 01	Iteration 02
Q2=3.85 W=2.62 t=0.21 Loweps center	Data Yield = 4.846 SIMC Yield = 0.708 Data/SIMC Ratio = 6.847	Data Yield = 4.846 SIMC Yield = 0.122 Data/SIMC Ratio = 39.800	Data Yield = 4.846 SIMC Yield = 0.128 Data/SIMC Ratio = 37.777
Q2=3.85 W=2.62 t=0.21 Loweps left	Data Yield = 3.963 SIMC Yield = 0.619 Data/SIMC Ratio = 6.402	Data Yield = 3.963 SIMC Yield = 0.116 Data/SIMC Ratio = 34.088	Data Yield = 3.963 SIMC Yield = 0.125 Data/SIMC Ratio = 31.808
Q2=3.85 W=2.62 t=0.21 Higheps right	Data Yield = 24.395 SIMC Yield = 4.157 Data/SIMC Ratio = 5.869	Data Yield = 24.395 SIMC Yield = 0.653 Data/SIMC Ratio = 37.343	Data Yield = 24.395 SIMC Yield = 0.655 Data/SIMC Ratio = 37.224
Q2=3.85 W=2.62 t=0.21 Higheps center	Data Yield = 25.552 SIMC Yield = 4.840 Data/SIMC Ratio = 5.280	Data Yield = 25.552 SIMC Yield = 0.666 Data/SIMC Ratio = 38.360	Data Yield = 25.552 SIMC Yield = 0.661 Data/SIMC Ratio = 38.670
Q2=3.85 W=2.62 t=0.21 Higheps left	Data Yield = 18.233 SIMC Yield = 3.827 Data/SIMC Ratio = 4.764	Data Yield = 18.233 SIMC Yield = 0.576 Data/SIMC Ratio = 31.665	Data Yield = 18.233 SIMC Yield = 0.594 Data/SIMC Ratio = 30.676

Debugging

- In the 00th iteration, ratios were ~ 6, and in the 1st iteration, ratios were around 36.
- Data yields were consistent, but the SIMC yields dropped by a factor of 5.
- Rechecked all of my scripts.

- Checked all cuts in SIMC scripts – Found no Error

- Check SIMC yield calculations – Found no Error

- Checked average weight calculation scripts.
- Compared the average_kinematic.f script with my average kinematic Python script.
- Compared all calculations, especially thetacm and epsilon – Found no error

- Compared sigma functional forms in all of my scripts – Found Error
- In the fitting script, W_factor was missing from the functional forms.
- Added W_factor and re-ran iterations.
- Started getting ratios close to 1.

New Model Functions

LTSep Functions

- **Started with functional forms (with SIMC W_factor):**

$$\frac{d\sigma_T}{dt} = \frac{\mathrm{p1}}{Q^2} + \frac{\mathrm{p2}}{Q^4}$$

$$\frac{d\sigma_L}{dt} = (\mathrm{p5} + \mathrm{p6}/\mathrm{Q}^2) \cdot \frac{|t|}{(|t| + m_\pi^2)^2} \cdot Q^2 \mathrm{e}^{(\mathrm{p7}|t|)} F_\pi^2$$

Where, $F_\pi = \frac{1}{(1+\mathrm{p8}\cdot Q^2+\mathrm{p9}\cdot Q^4)^2}$

$$\frac{d\sigma_{LT}}{dt} = \left(\mathrm{e}^{\mathrm{p10}+\frac{\mathrm{p11}}{\sqrt{Q^2}}\cdot|t|} + \mathrm{p12} + \frac{\mathrm{p13}}{Q^4} \right) \cdot \sin(\theta^*)$$

$$\frac{d\sigma_{TT}}{dt} = \frac{\mathrm{p14}}{Q^4} \cdot \frac{|t|}{(|t| + m_\pi^2)^2} \cdot \sin(\theta^*)^2$$

Set σ_{LT} and σ_{TT} to zero.
In σ_L, fixed p7, p8 and p9

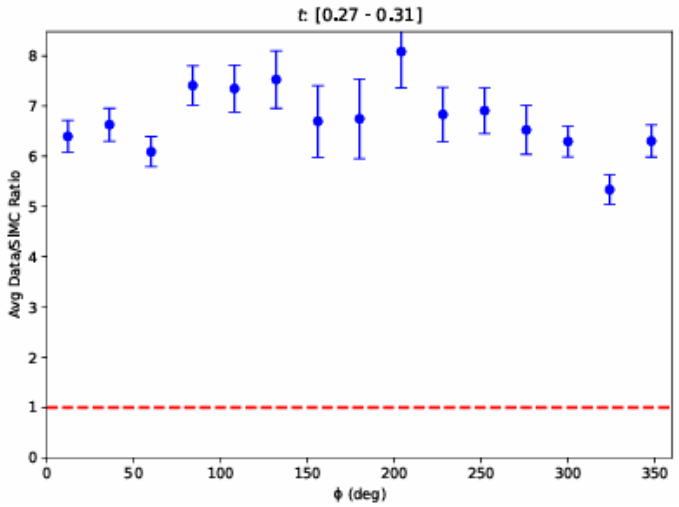
Parameter	Initial Values (Fpi2)
p1	3.9
p2	5.8
p5	37.08
p6	-6.35
p7	-4.11
P8	1.6
P9	-0.015
p10	-10000
p11	0.0
p12	0.0
p13	0.0
p14	0.0

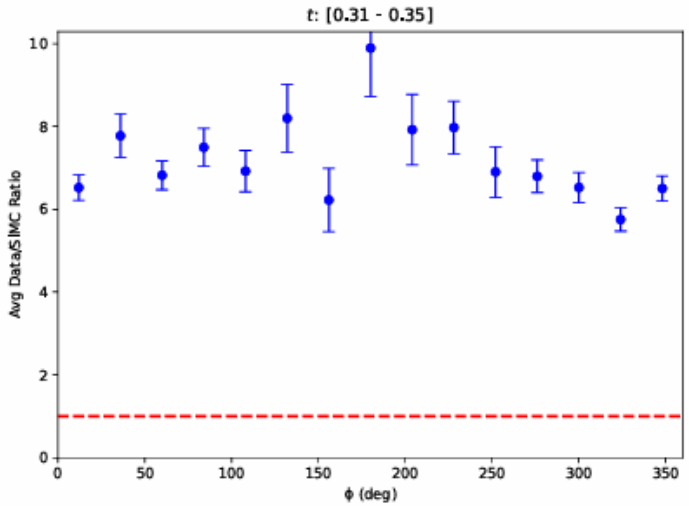
Iteration 00

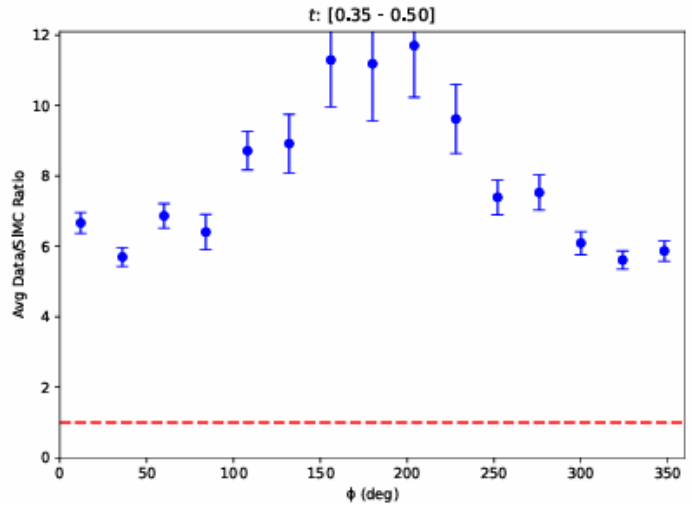
Physics Ratios

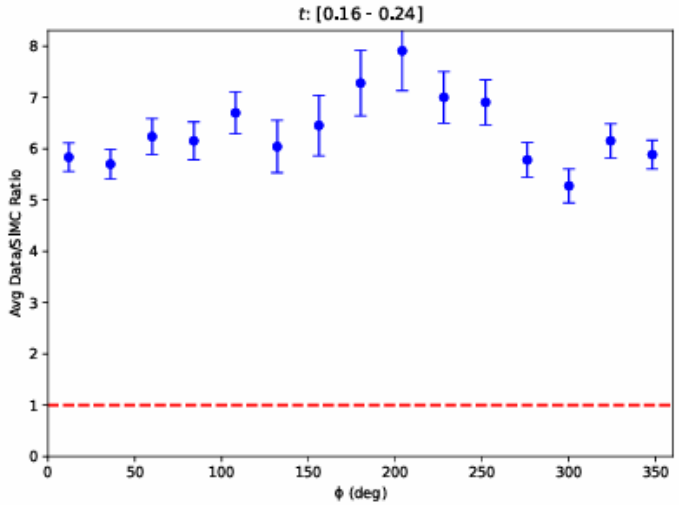
0th iterations

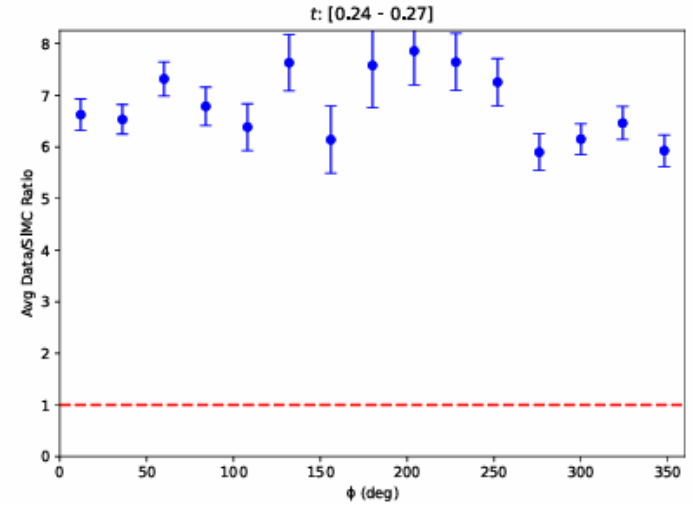
Physics Setting:
Q3p85_W2p62_t0p21_loweps







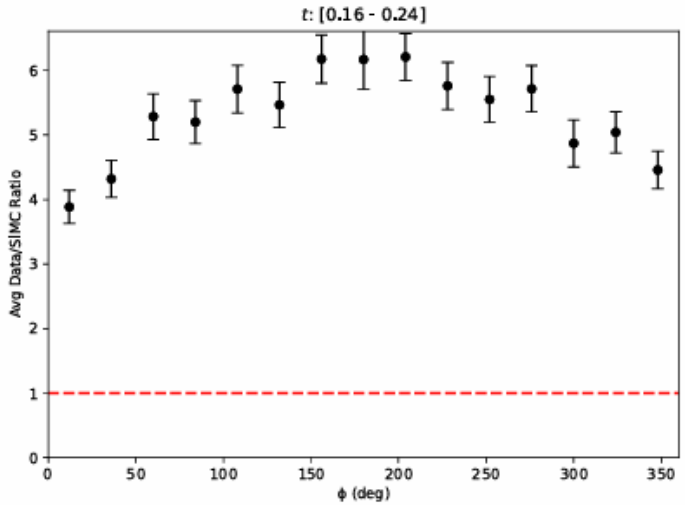


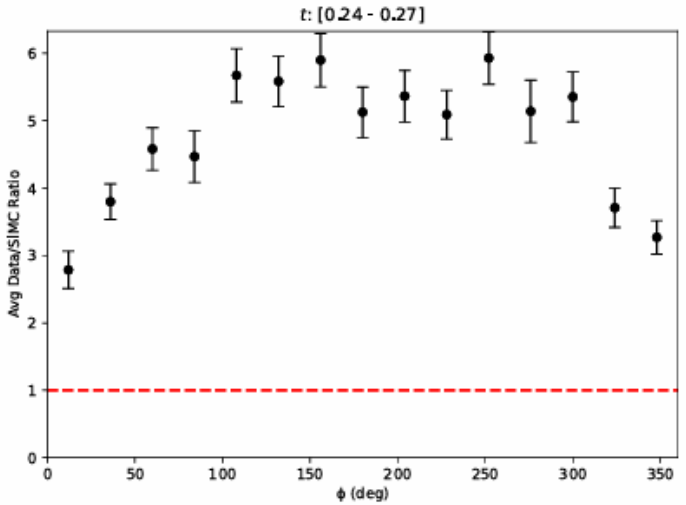


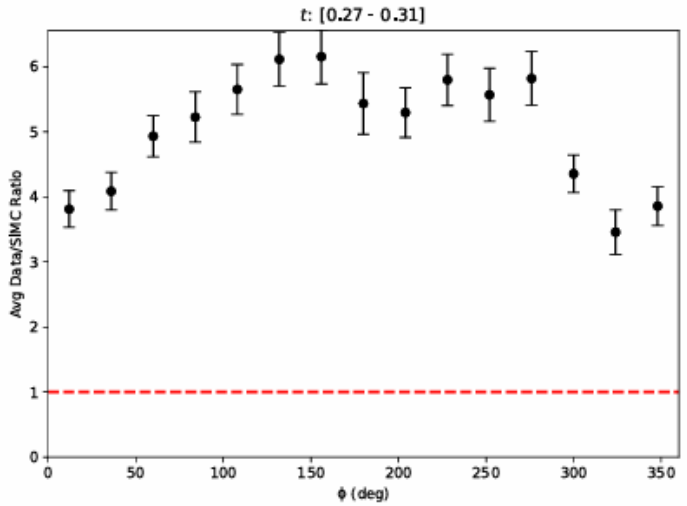
Physics Ratios

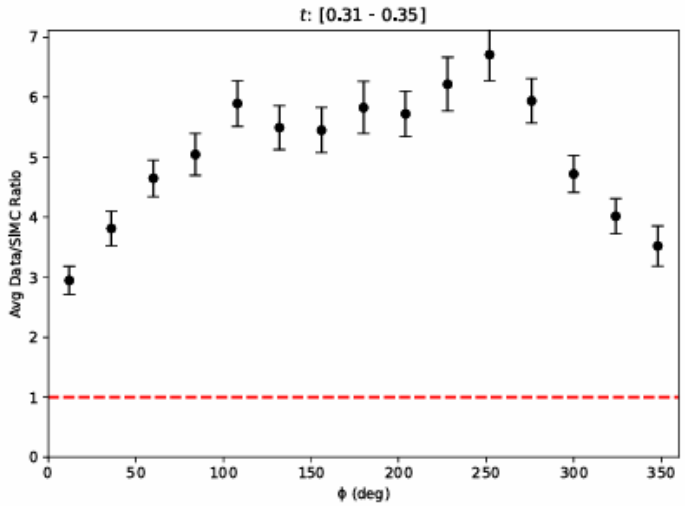
0th iterations

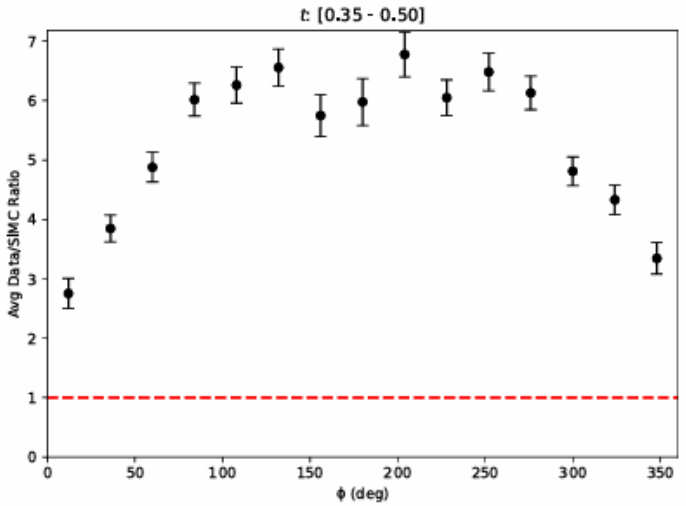
Physics Setting:
Q3p85_W2p62_t0p21_higheps







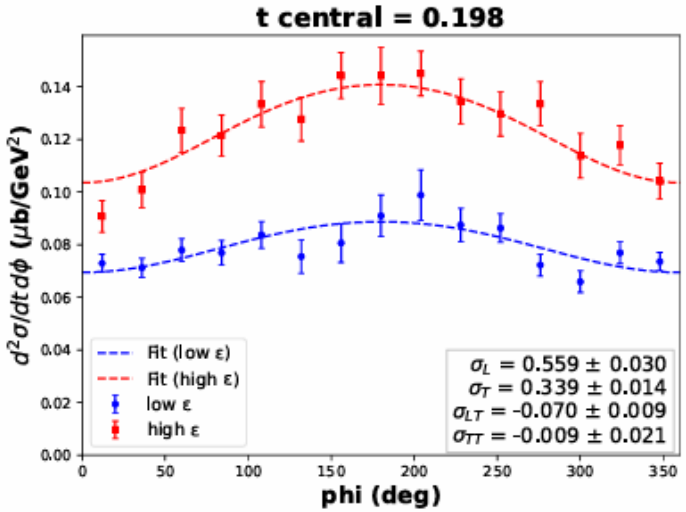


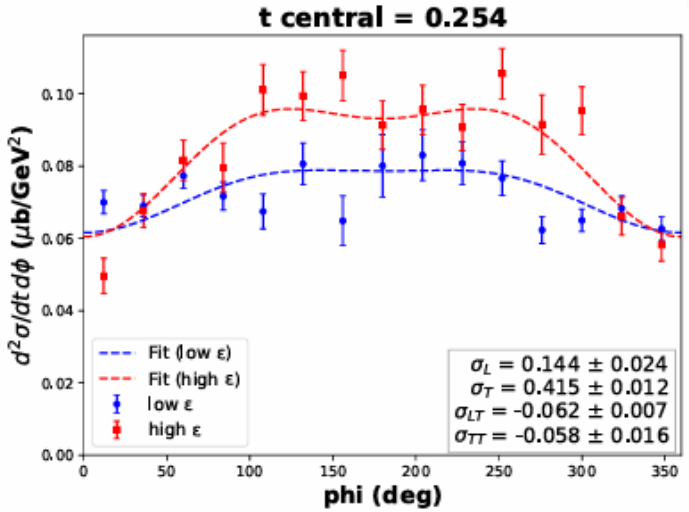


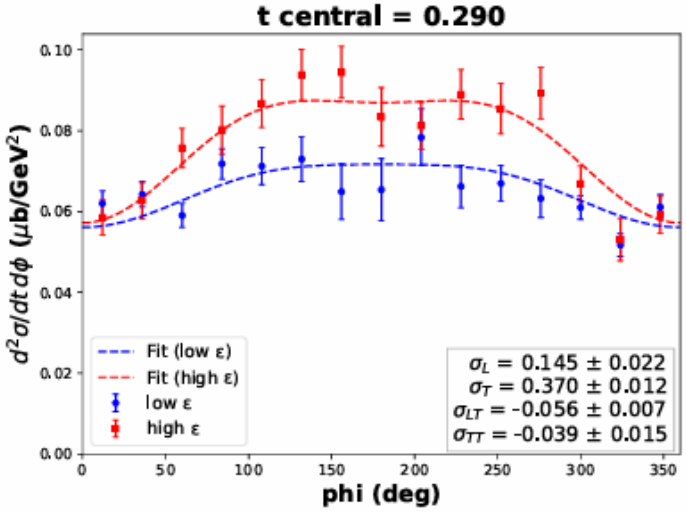
Un-separated Cross-sections

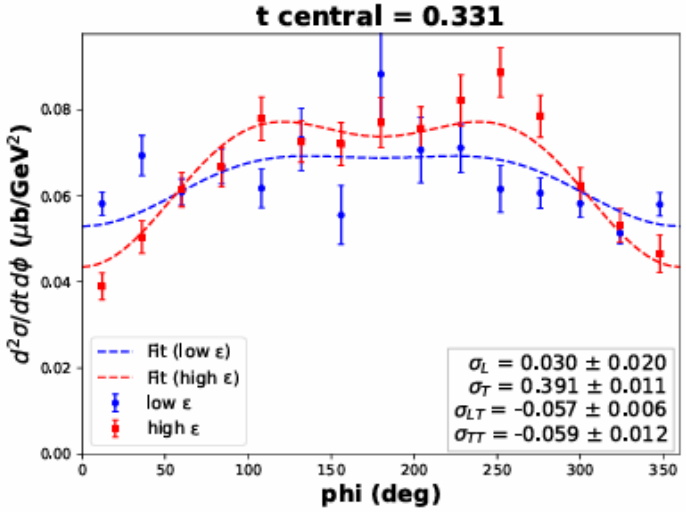
0th iterations

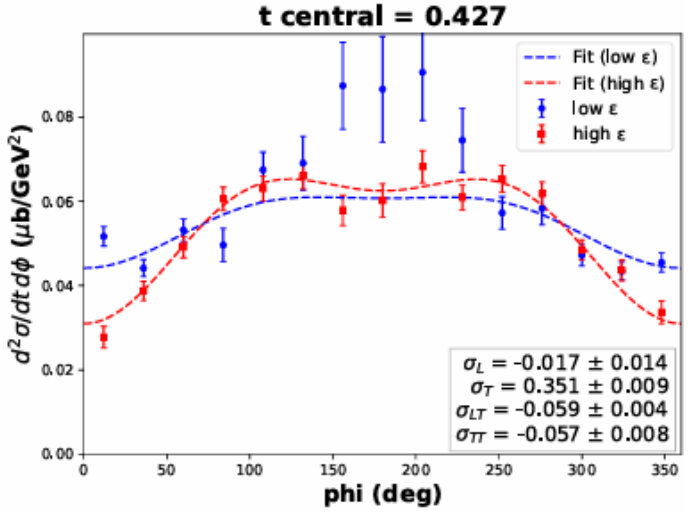
Physics Setting:
Q3p85_W2p62_t0p21
Iteration: 00





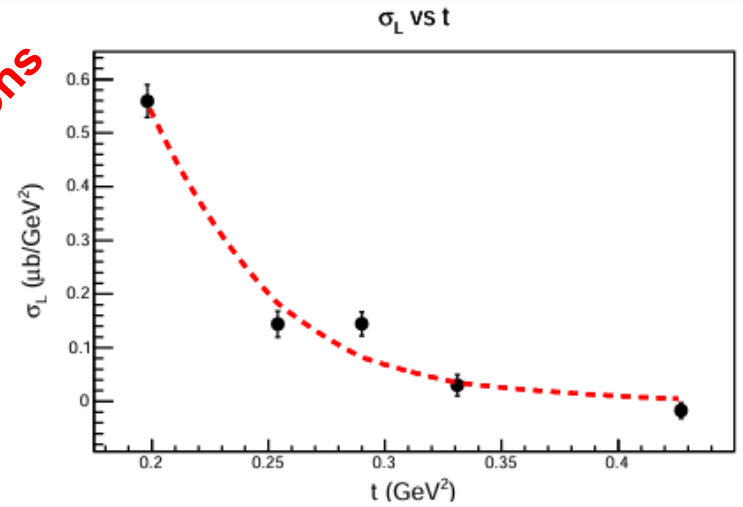


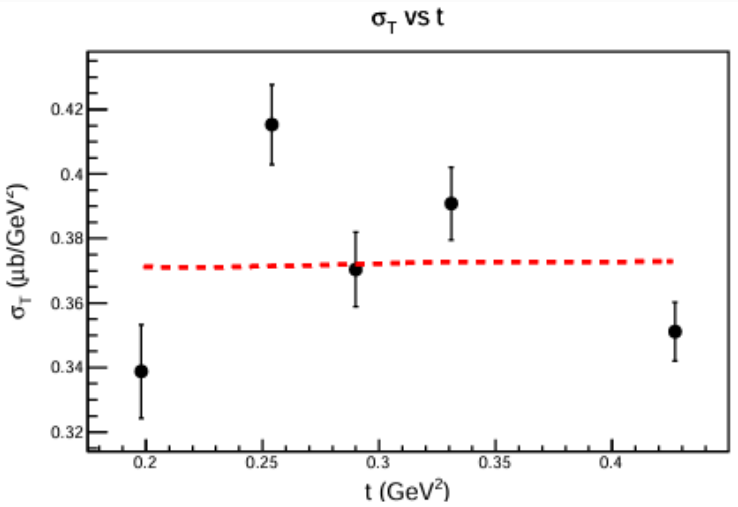


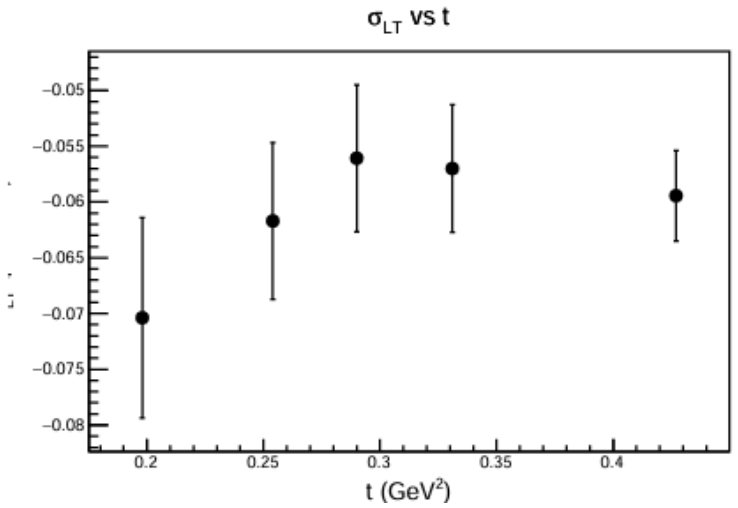


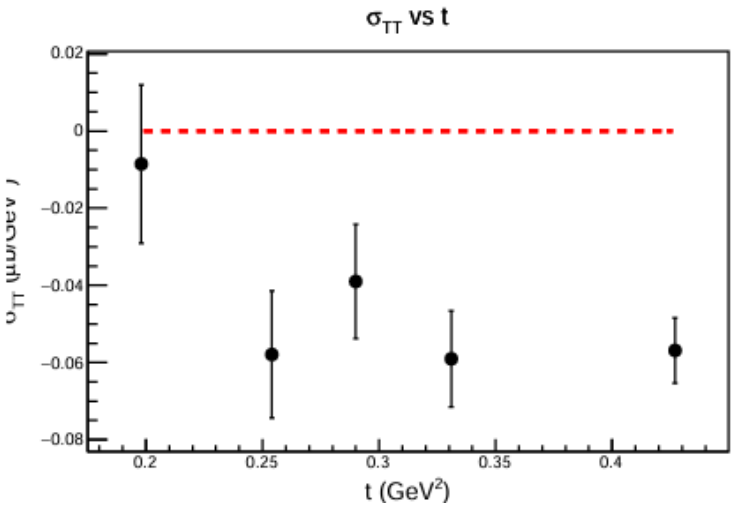
LT-separated Cross-sections

0th iterations





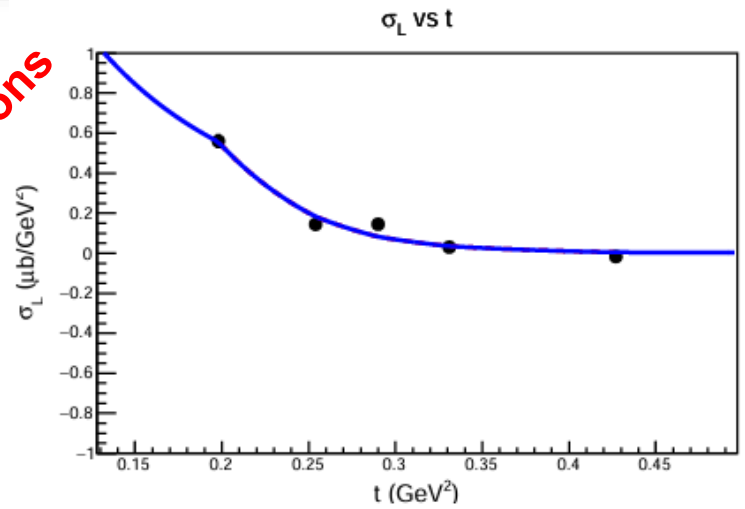


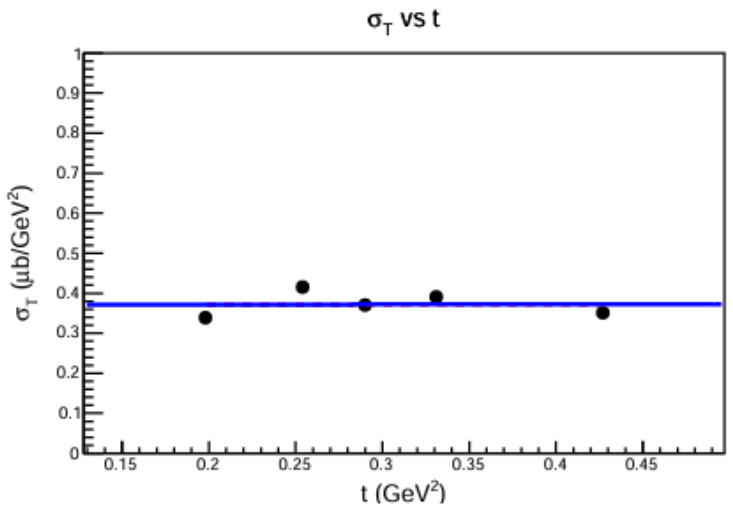


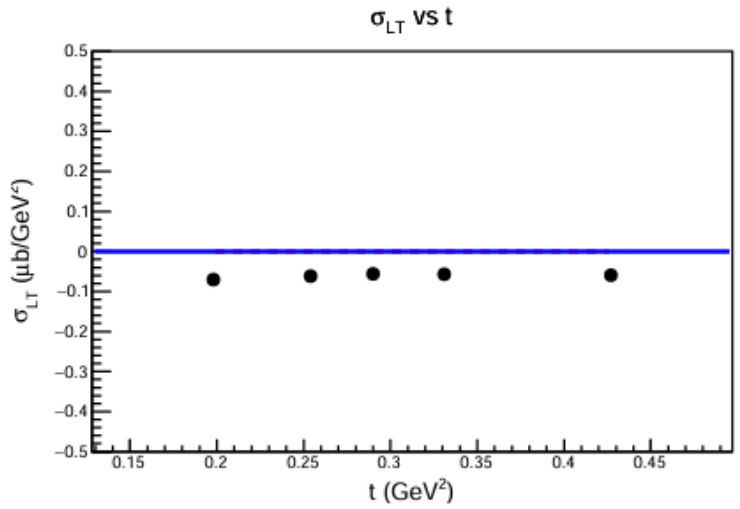
Parameter	Initial Values	New Values
p1	3.9	3.1
p2	5.8	-6.3
p5	37.08	-38.9
p6	-6.35	153.6
p7	-4.11	-4.11
P8	1.6	1.6
P9	-0.015	-0.015
p10	-10000	-10000
p11	0.0	0.0
p12	0.0	0.0
p13	0.0	0.0
p14	0.0	0.0

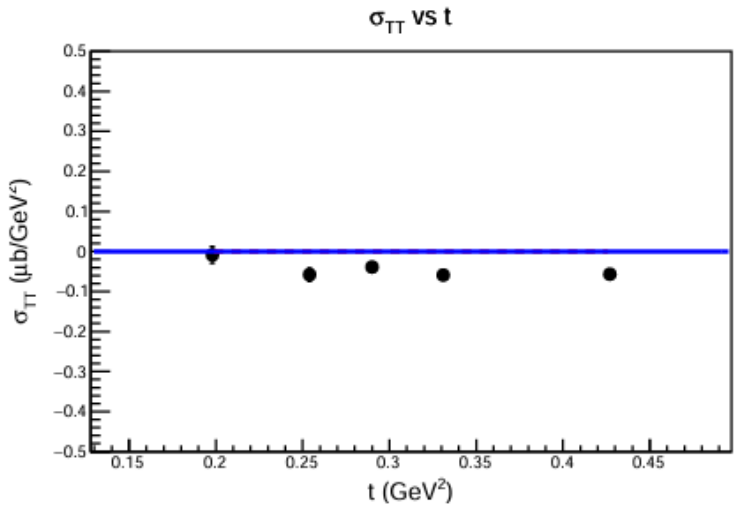
LT-separated Cross-sections

0th iterations









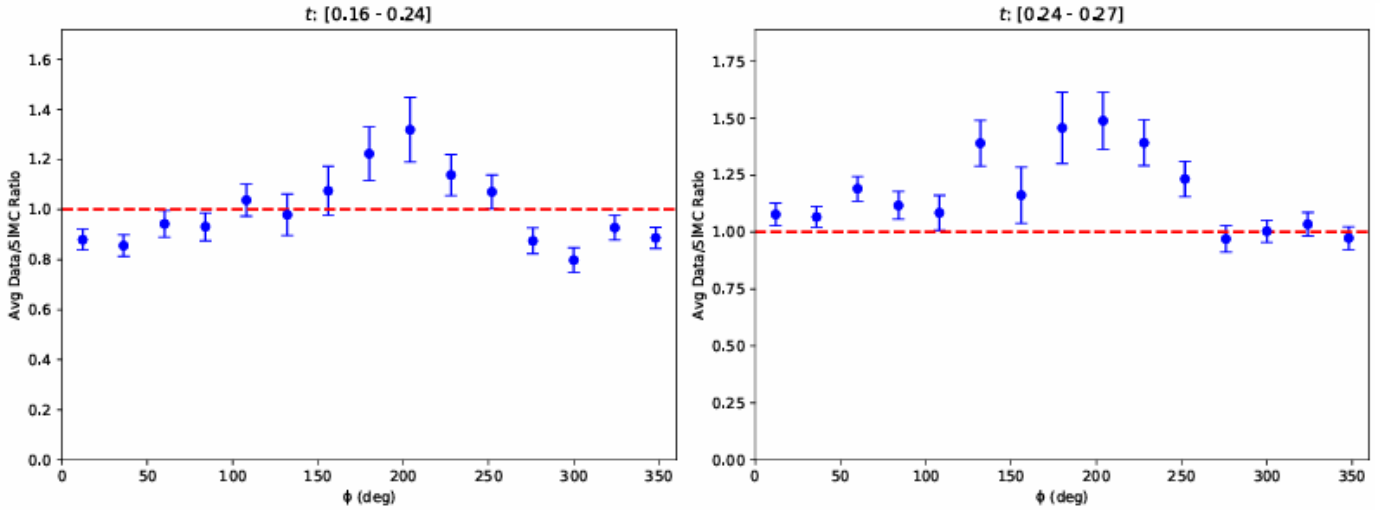
Parameter	Initial Values	New Values
p1	3.9	3.1
p2	5.8	-6.3
p5	37.08	-38.9
p6	-6.35	153.6
p7	-4.11	-4.11
P8	1.6	1.6
P9	-0.015	-0.015
p10	-10000	-10000
p11	0.0	0.0
p12	0.0	0.0
p13	0.0	0.0
p14	0.0	0.0

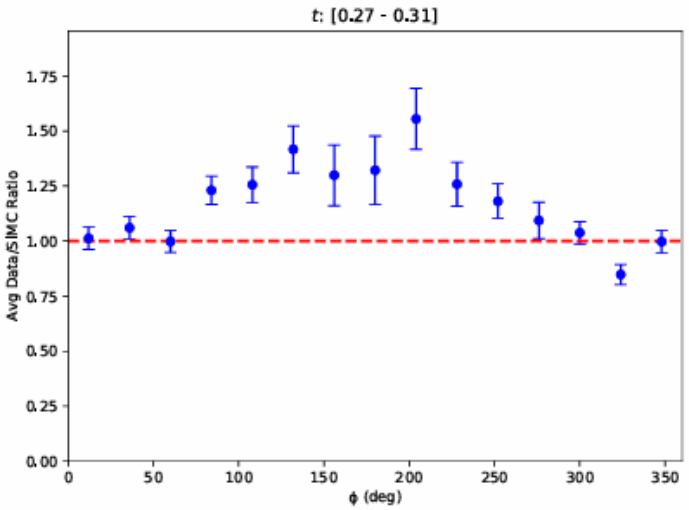
Iteration 01

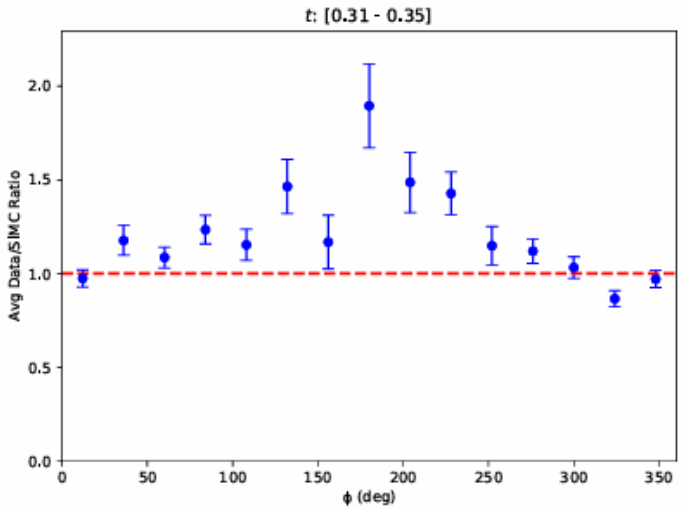
Physics Ratios

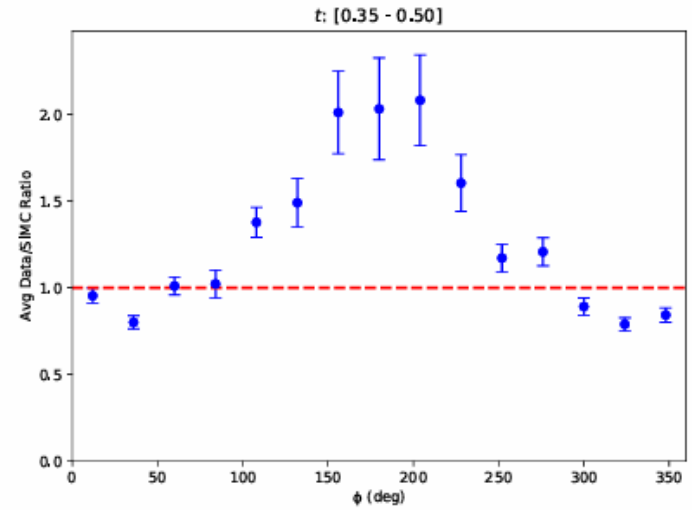
1st iterations

Physics Setting:
Q3p85_W2p62_t0p21_loweps





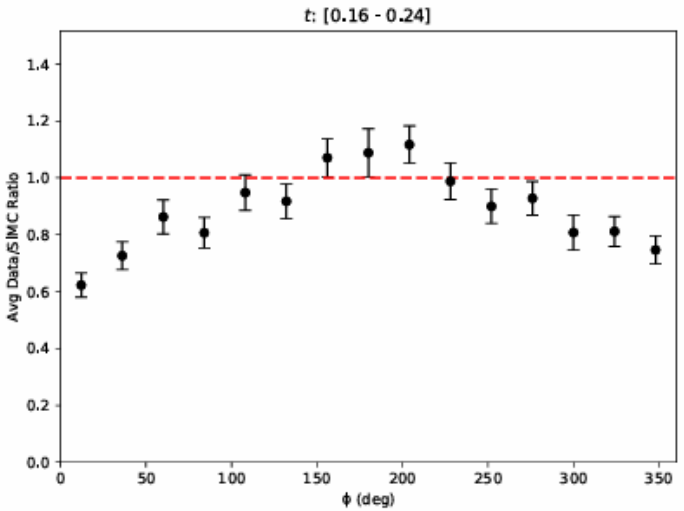


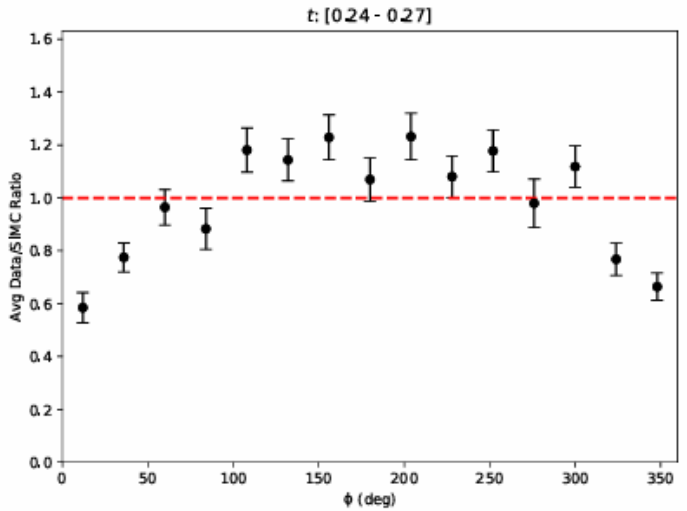


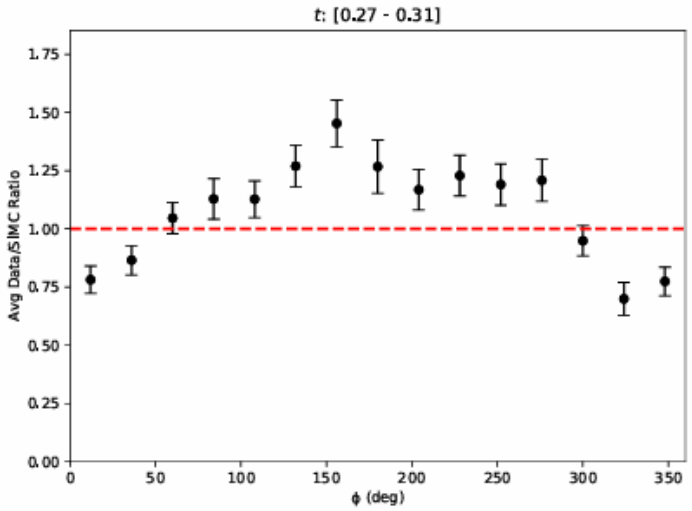
Un-separated Cross-sections

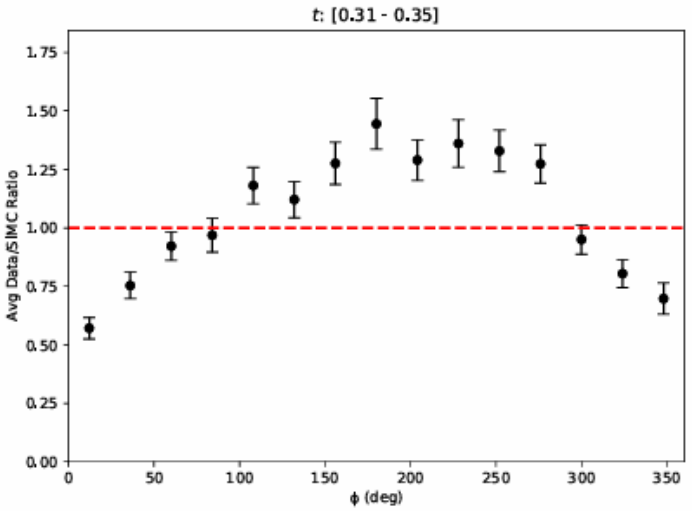
1st iterations

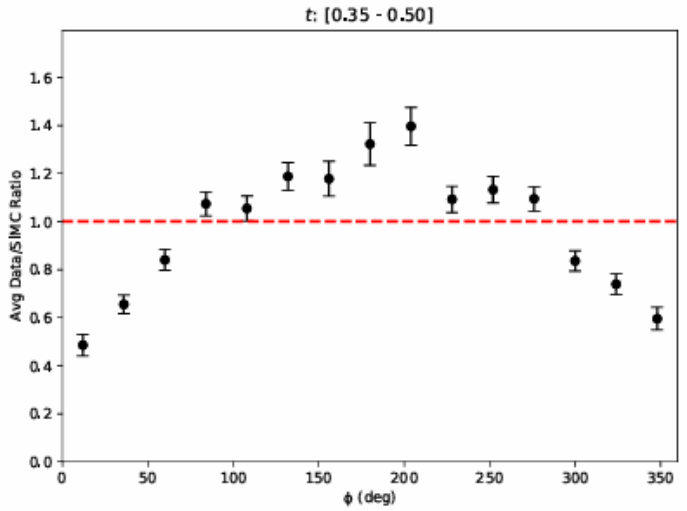
Physics Setting:
Q3p85_W2p62_t0p21_higheps







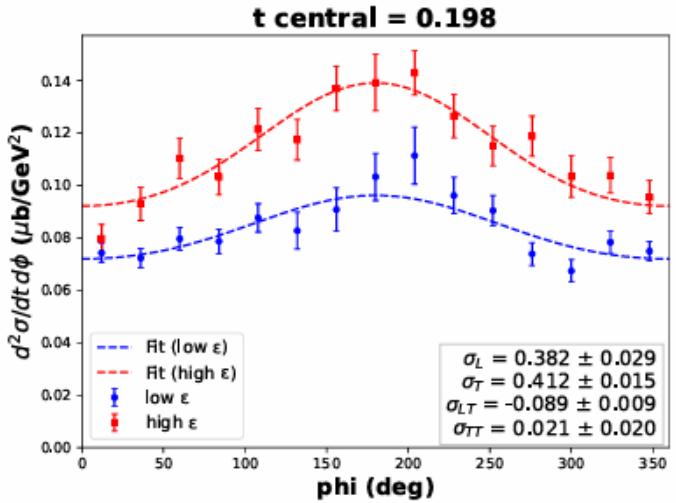


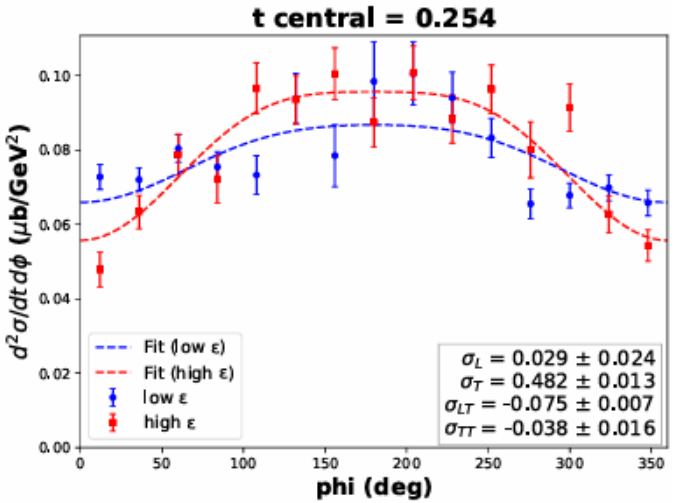


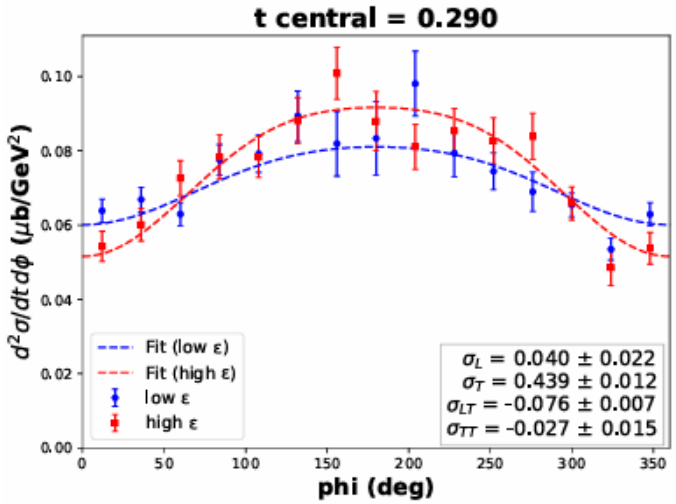
Un-separated Cross-sections

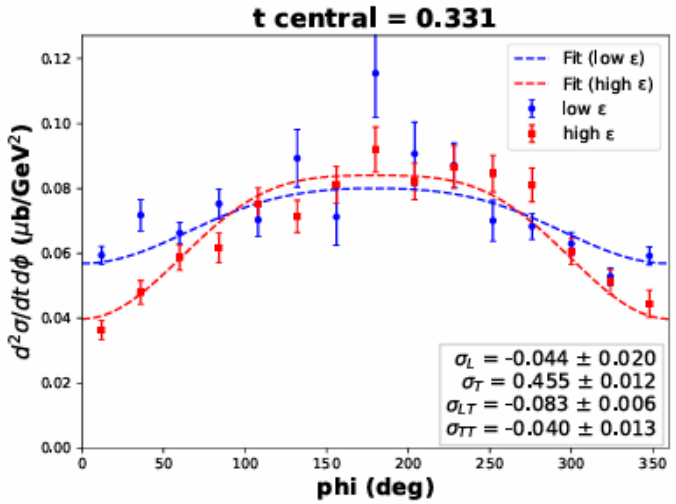
1st iterations

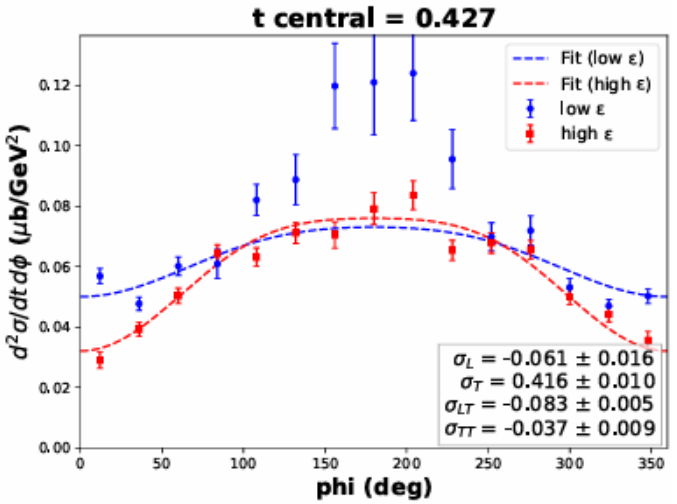
Physics Setting:
Q3p85_W2p62_t0p21
Iteration: 01





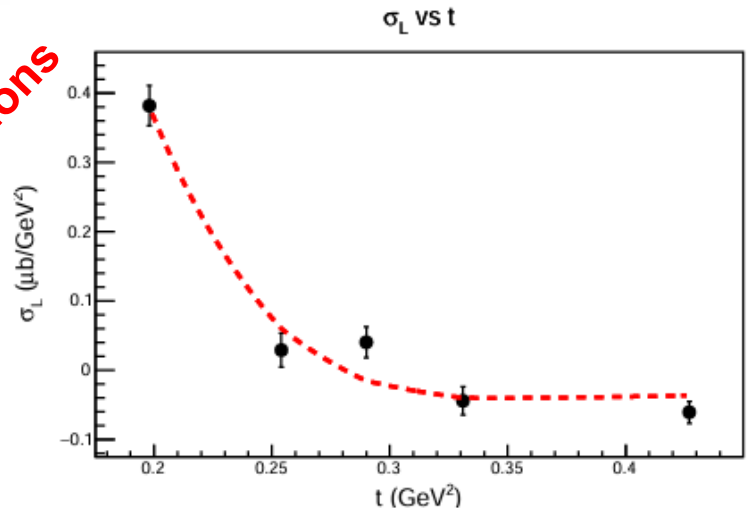


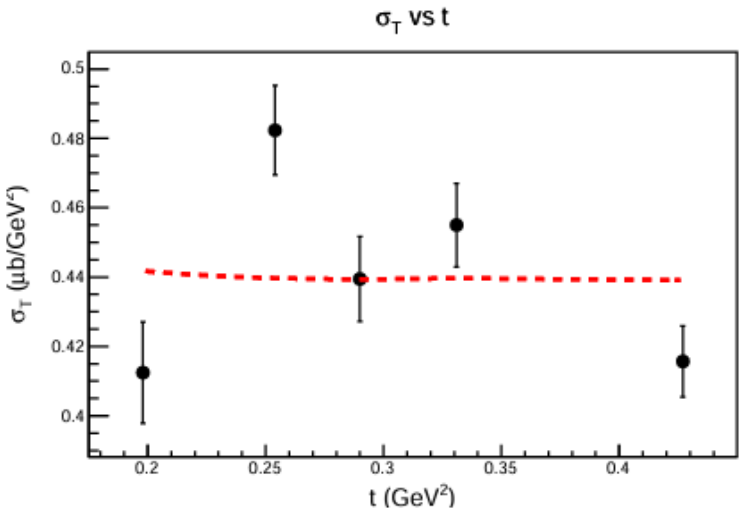


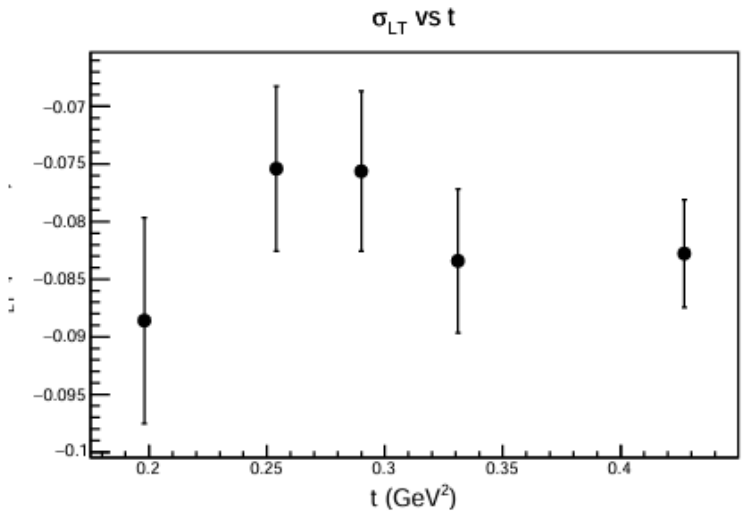


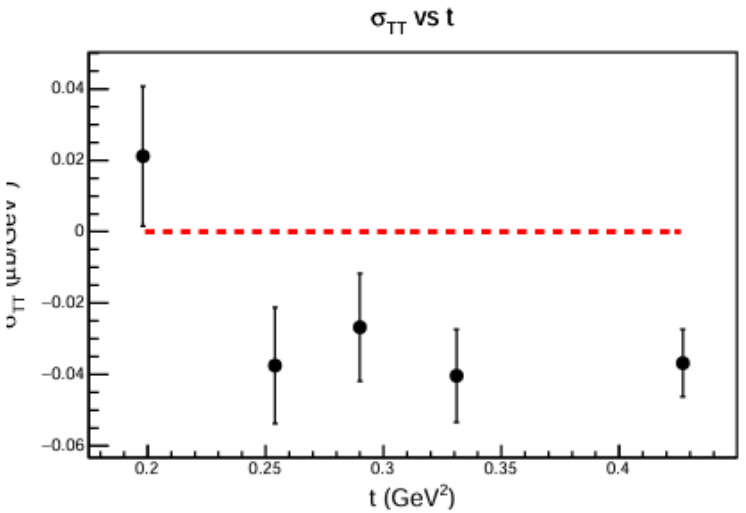
LT-separated Cross-sections

1st iterations





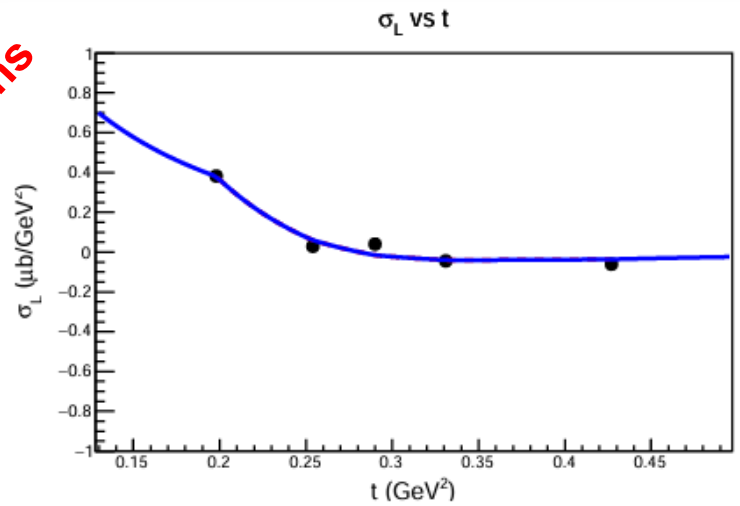


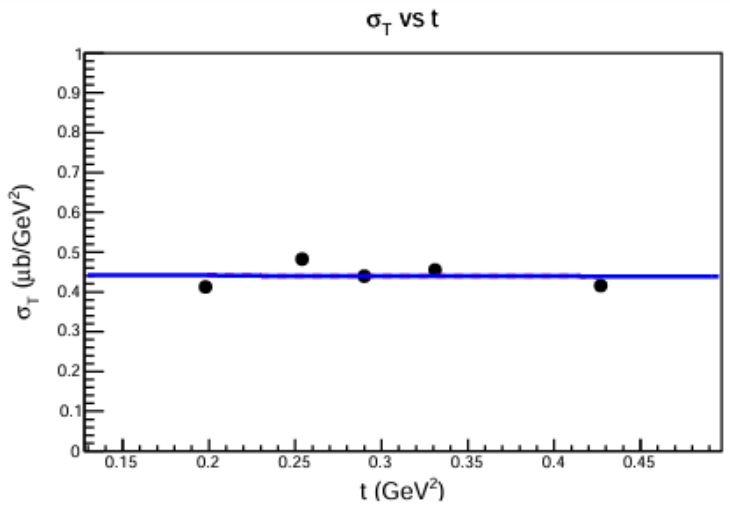


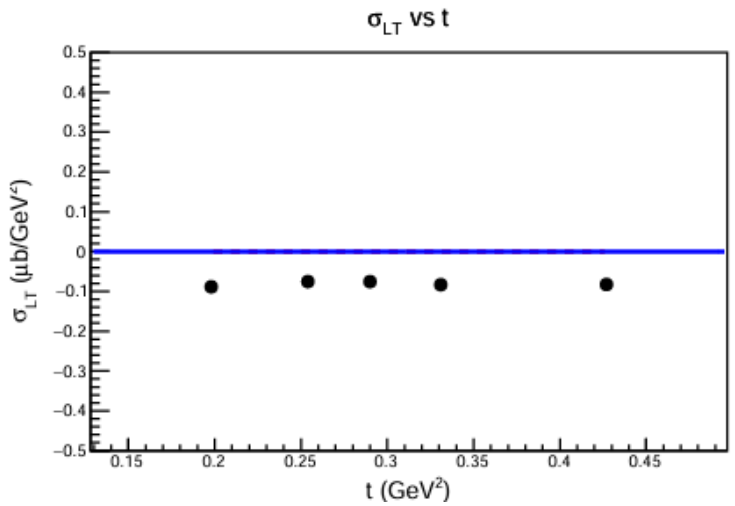
Parameter	Initial Values	New Values
p1	3.1	2.9
p2	-6.3	-5.0
p5	-33.9	-33.7
p6	134.6	131.6
p7	-4.11	-4.11
P8	1.6	1.6
P9	-0.015	-0.015
p10	-10000	-10000
p11	0.0	0.0
p12	0.0	0.0
p13	0.0	0.0
p14	0.0	0.0

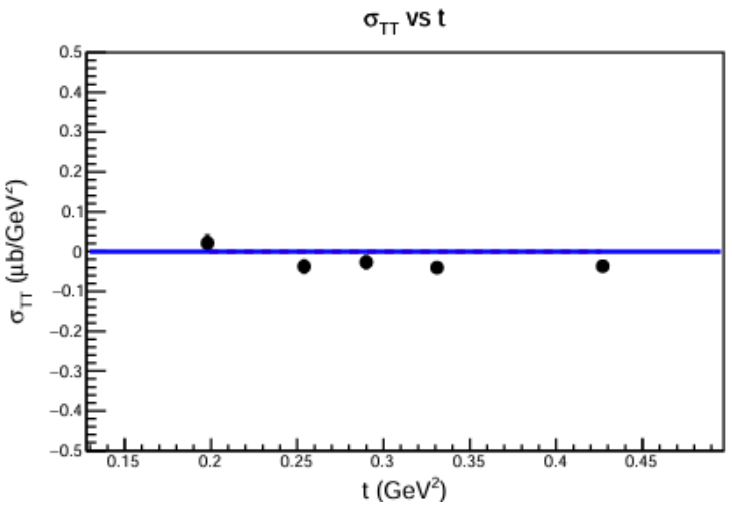
LT-separated Cross-sections

1st iterations









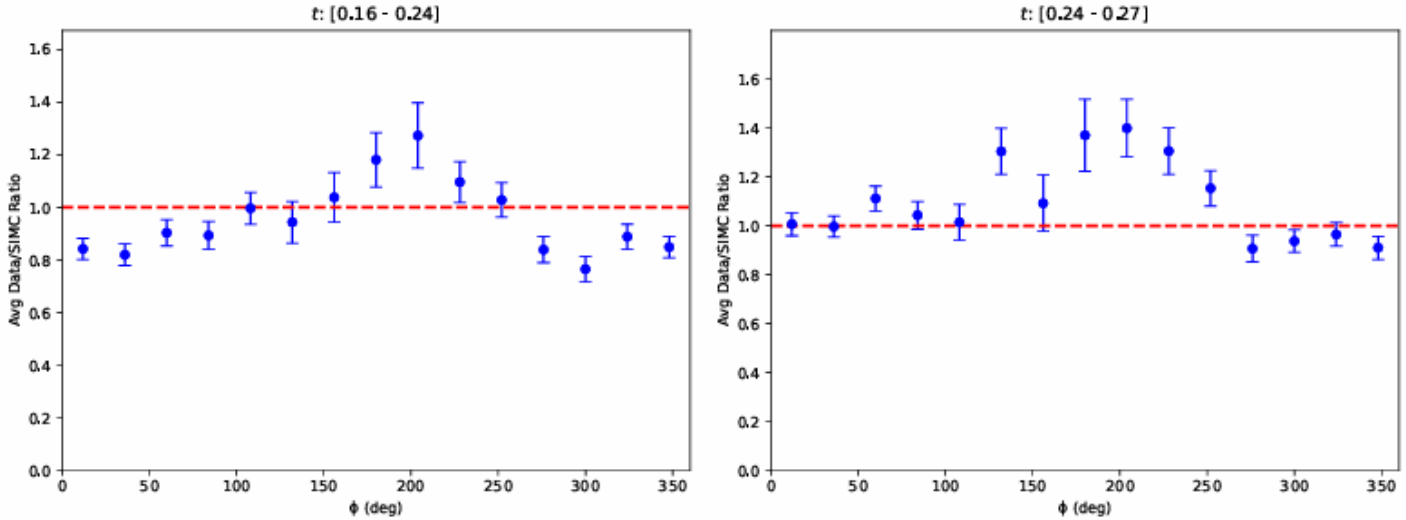
Parameter	Initial Values	New Values
p1	3.1	2.9
p2	-6.3	-5.0
p5	-33.9	-33.7
p6	134.6	131.6
p7	-4.11	-4.11
P8	1.6	1.6
P9	-0.015	-0.015
p10	-10000	-10000
p11	0.0	0.0
p12	0.0	0.0
p13	0.0	0.0
p14	0.0	0.0

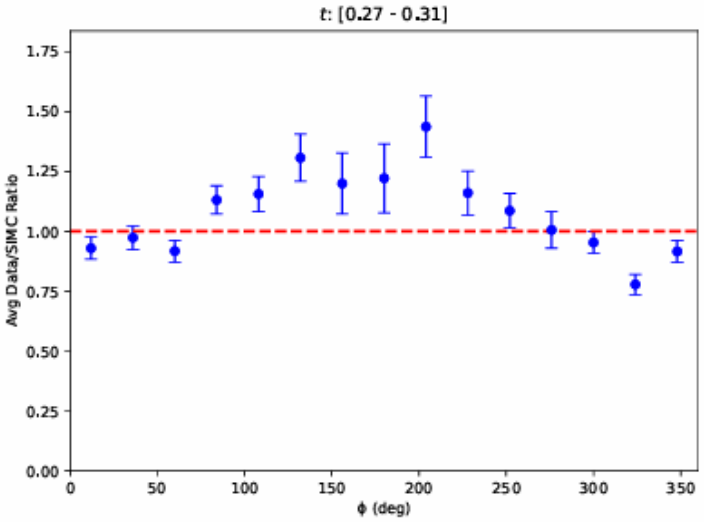
Iteration 02

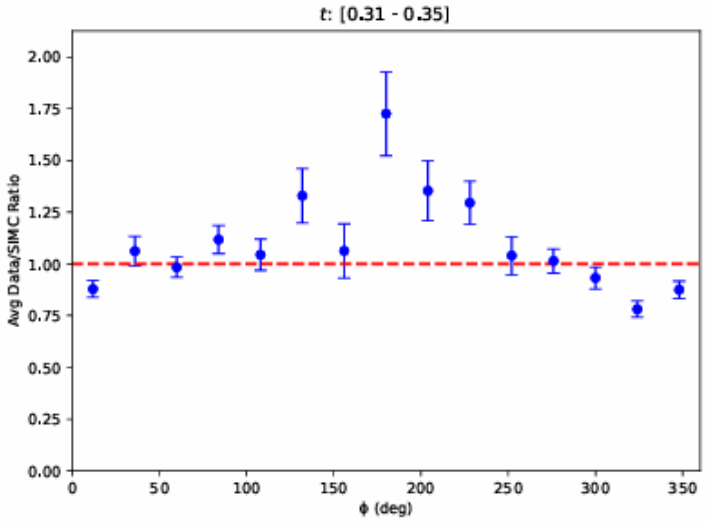
Physics Ratios

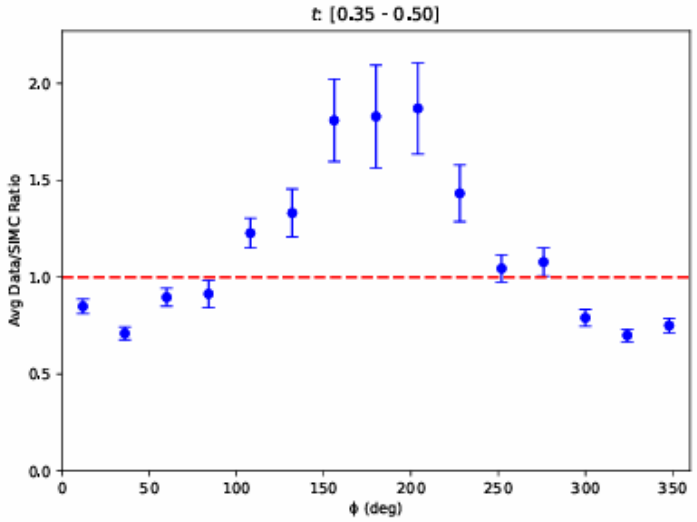
2nd iterations

Physics Setting:
Q3p85_W2p62_t0p21_loweps





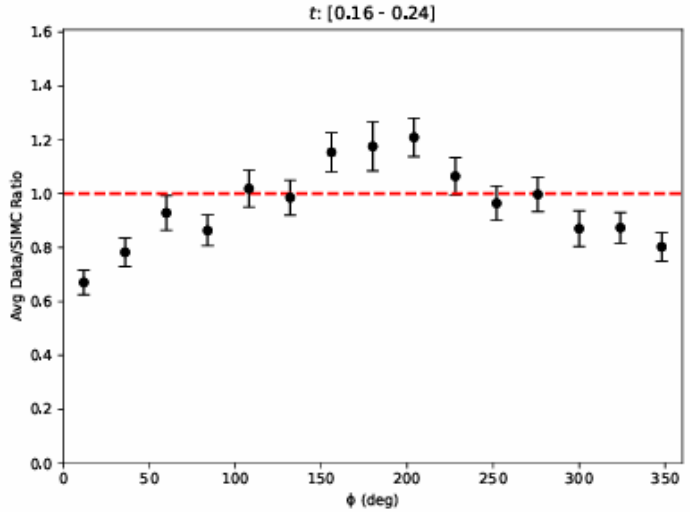


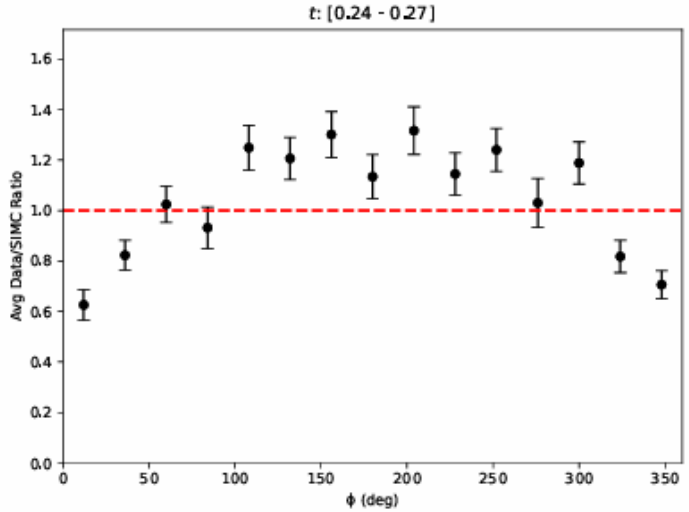


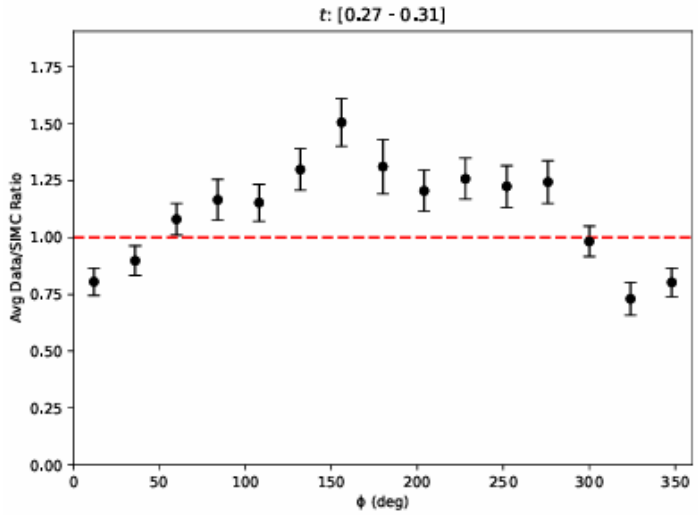
Physics Ratios

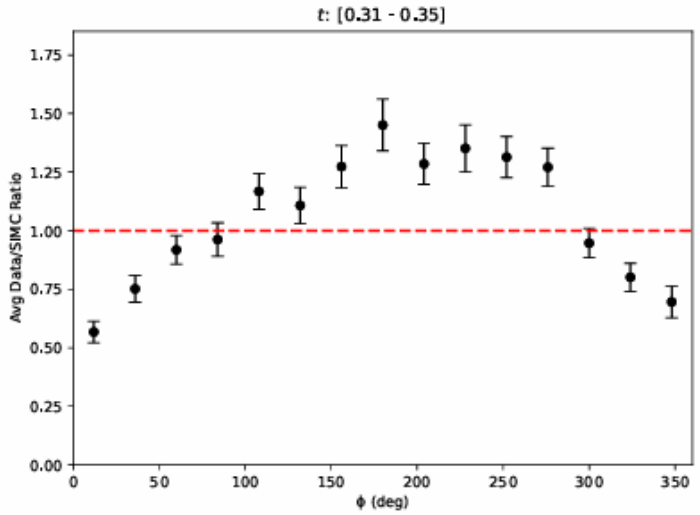
2nd iterations

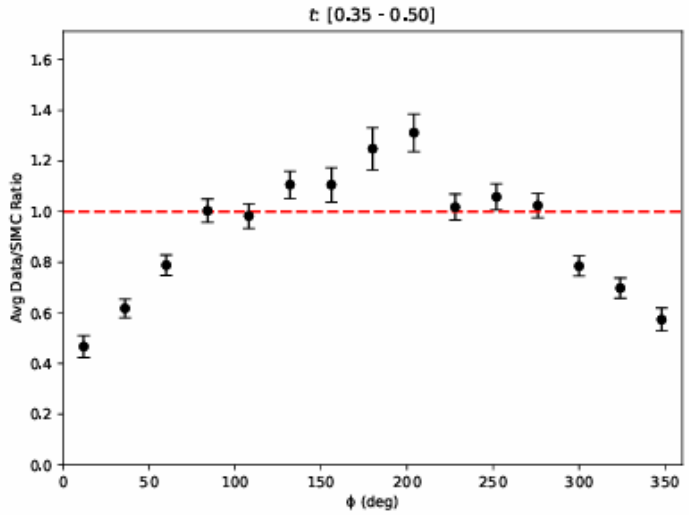
Physics Setting:
Q3p85_W2p62_t0p21_higheps







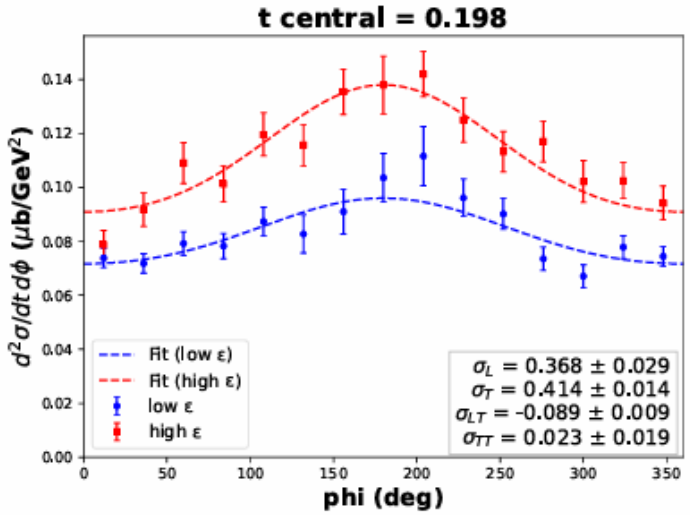


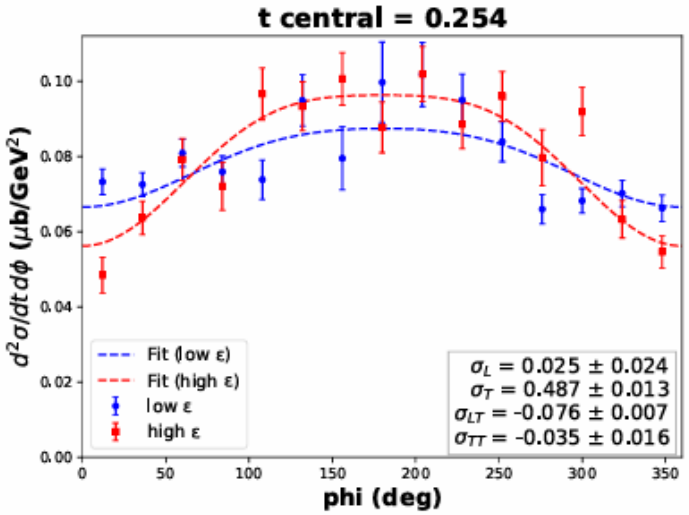


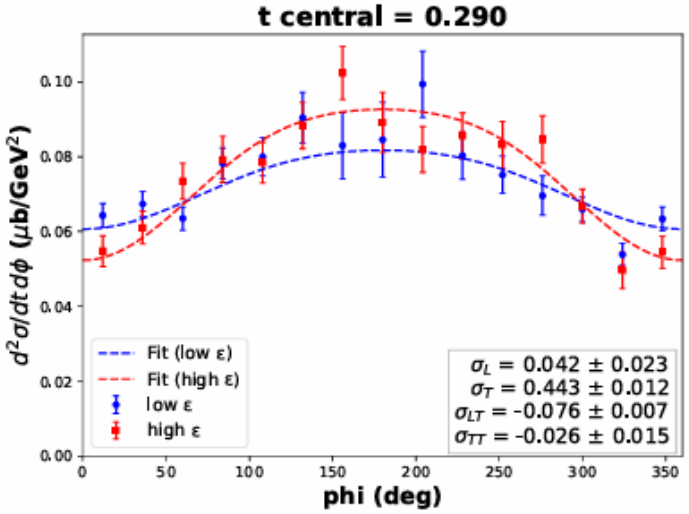
Un-separated Cross-sections

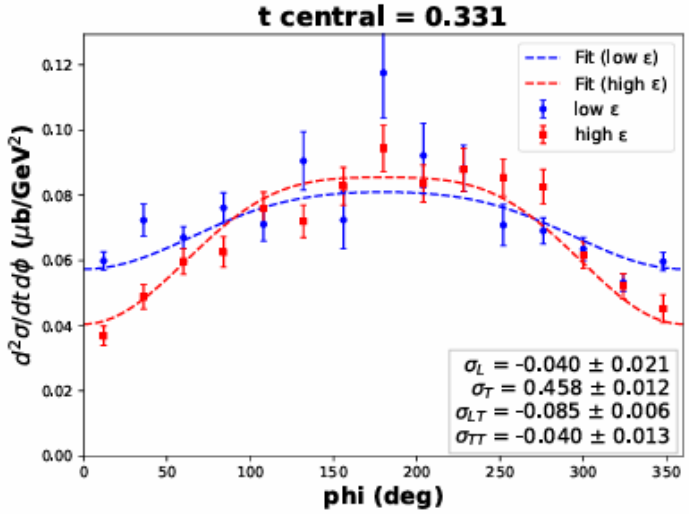
2nd iterations

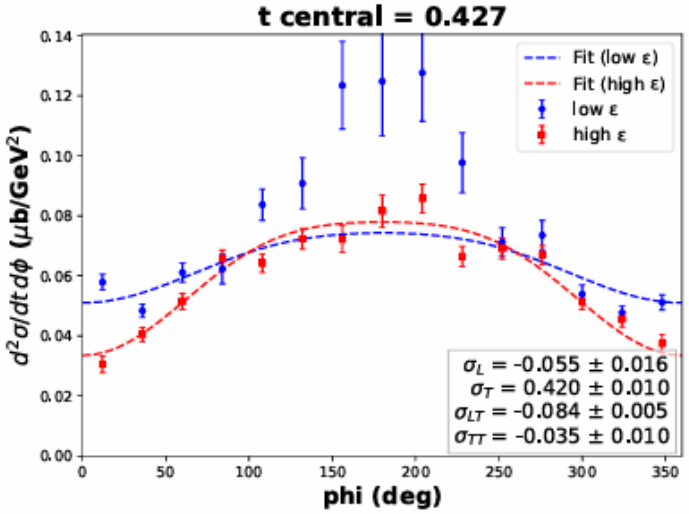
Physics Setting:
Q3p85_W2p62_t0p21
Iteration: 02





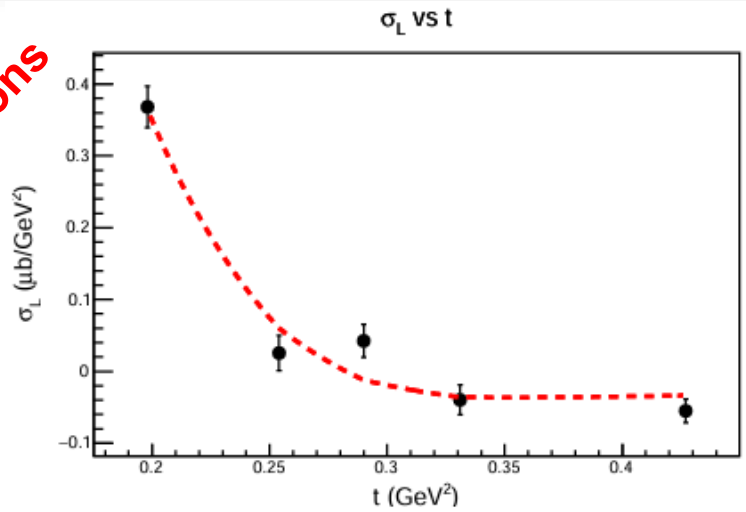


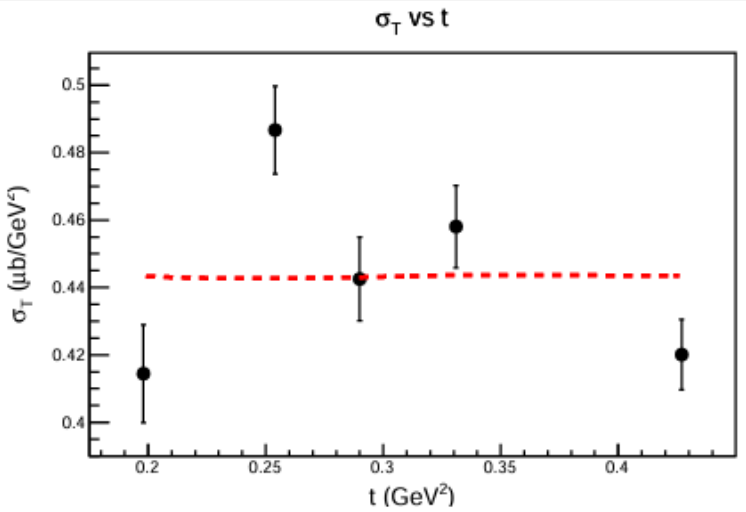


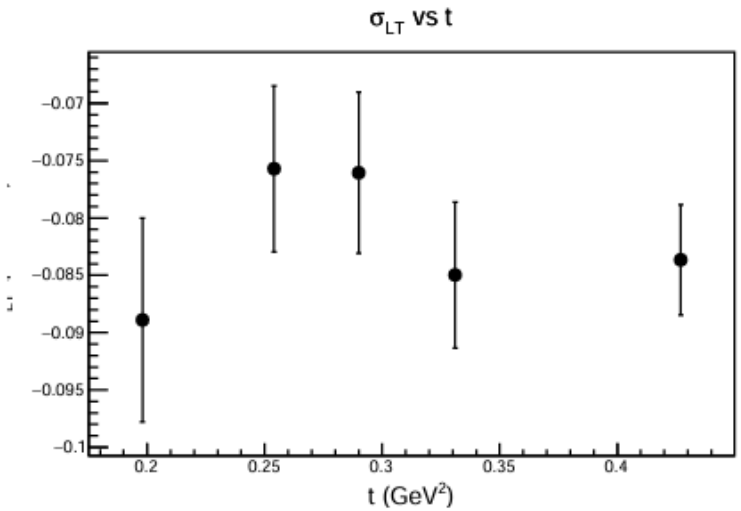


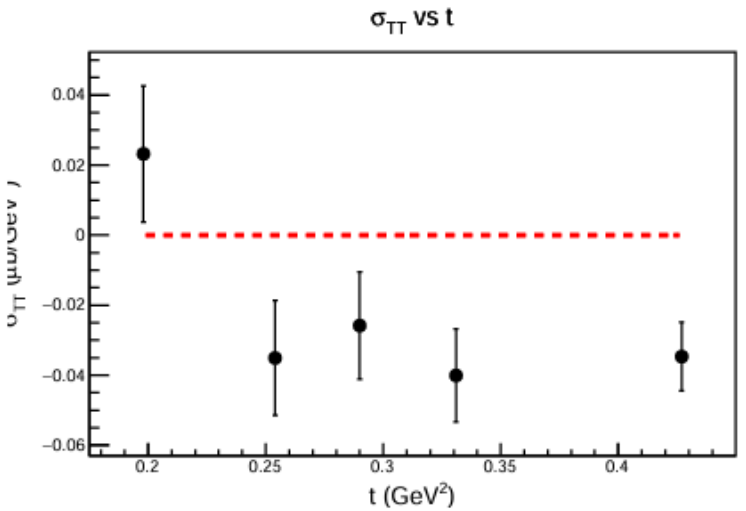
LT-separated Cross-sections

2nd iterations





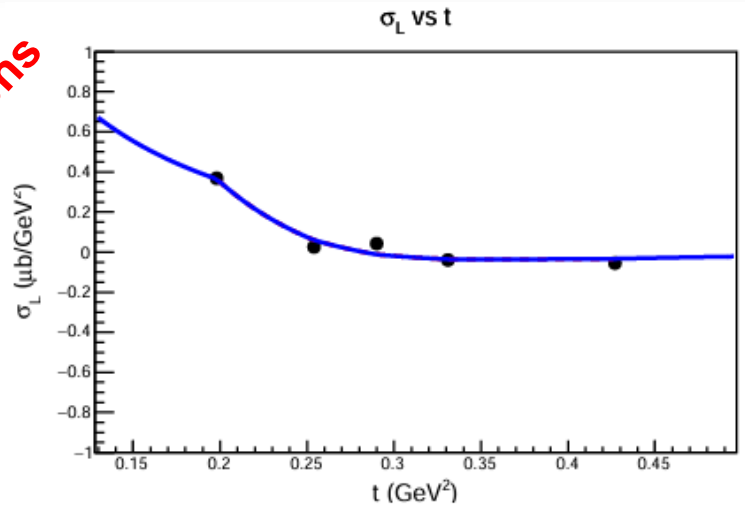


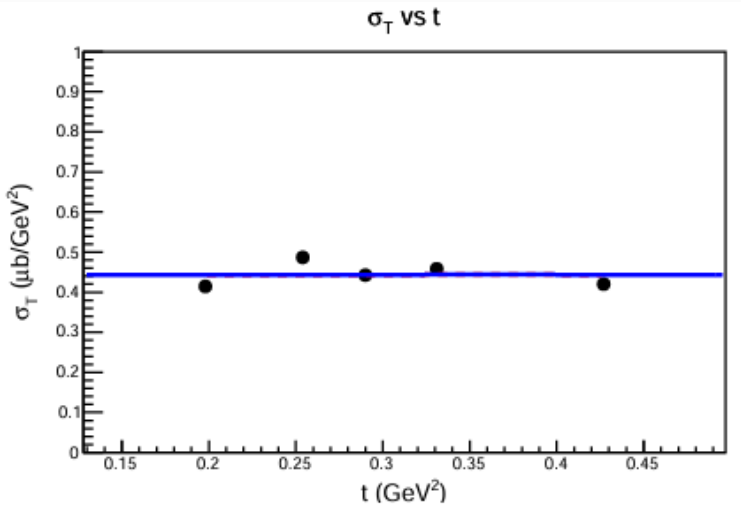


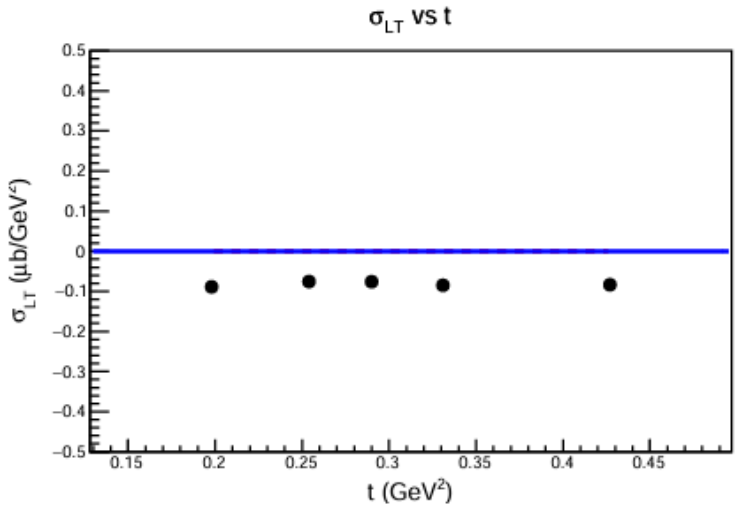
Parameter	Initial Values	New Values
p1	2.9	3.2
p2	-5.0	-6.4
p5	-33.7	-32.0
p6	131.6	125.9
p7	-4.11	-4.11
P8	1.6	1.6
P9	-0.015	-0.015
p10	-10000	-10000
p11	0.0	0.0
p12	0.0	0.0
p13	0.0	0.0
p14	0.0	0.0

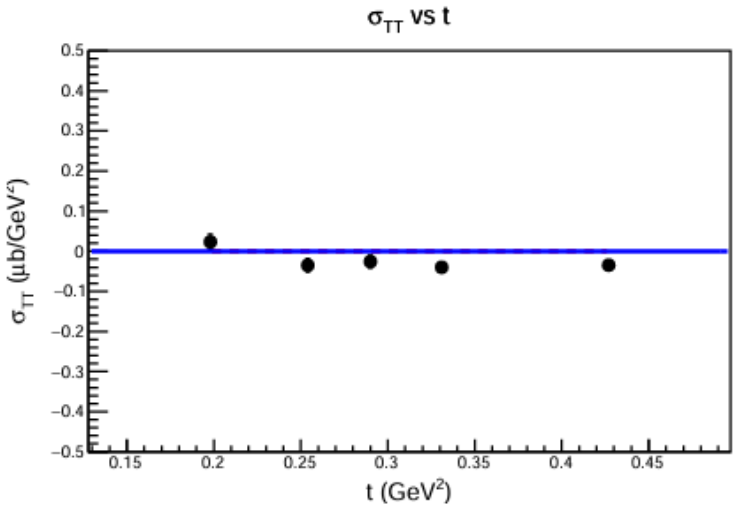
LT-separated Cross-sections

2nd iterations









Parameter	Initial Values	New Values
p1	2.9	3.2
p2	-5.0	-6.4
p5	-33.7	-32.0
p6	131.6	125.9
p7	-4.11	-4.11
P8	1.6	1.6
P9	-0.015	-0.015
p10	-10000	-10000
p11	0.0	0.0
p12	0.0	0.0
p13	0.0	0.0
p14	0.0	0.0

LTSep Analysis

- **Working on physics setting: "Q2 = 3.85, W = 2.62, t = 0.21 (2 epsilons)"**

- **The following studies have been finalized for Pion Form Factor measurement:**
  - **Unseparated cross-section calculations**
  - **Model iterations**
  - **Rosenbluth equation fitting**
  - **L/T separated cross-section calculations**

- **In progress:**
  - Working on model iterations.
  - Next plan is to include sigma LT and sigma TT terms in iterations.