# E01-020 Status Report (Studies of the Deuteron at High $Q^2$)

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(for the E01-020 Collaboration*)

Hall A Collaboration Meeting at JLab

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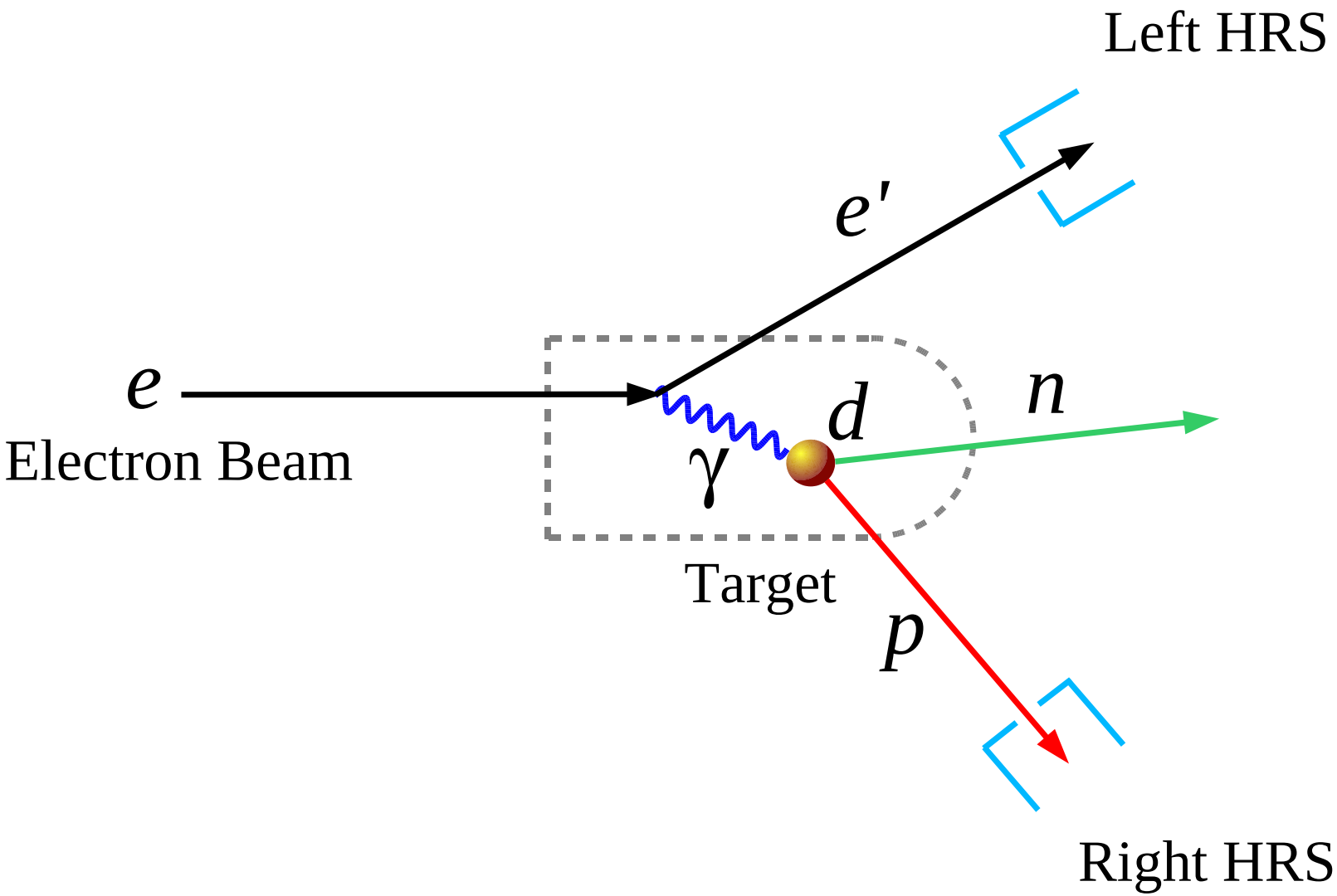
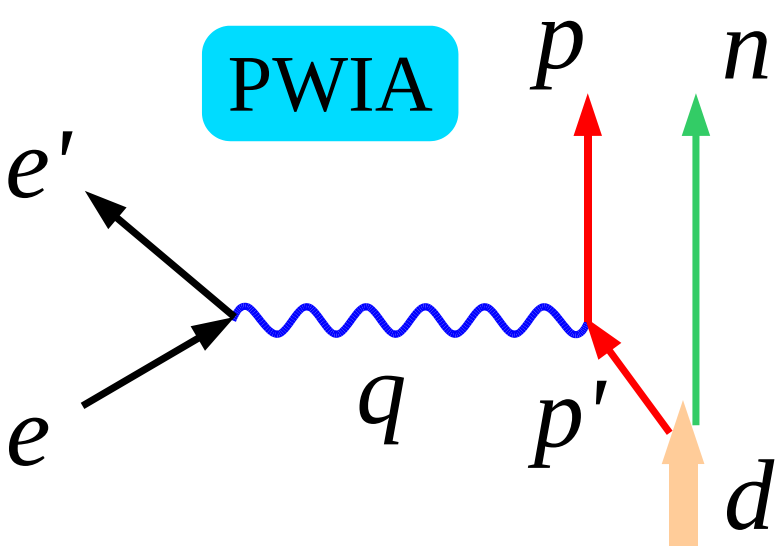
# Outline

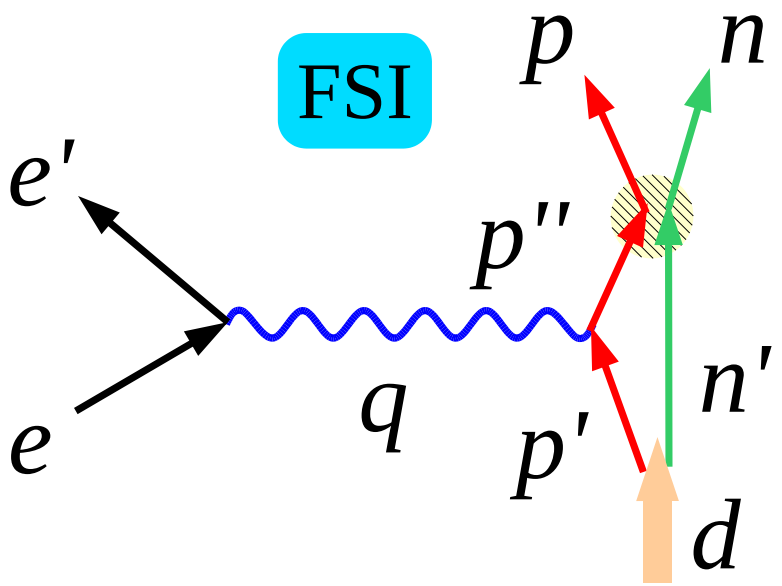
- Experiment E01-020
- Analysis Tasks
- Energy Loss Corrections
- Luminosity
- Target Boiling
- VDC Tracking Efficiency
- Summary

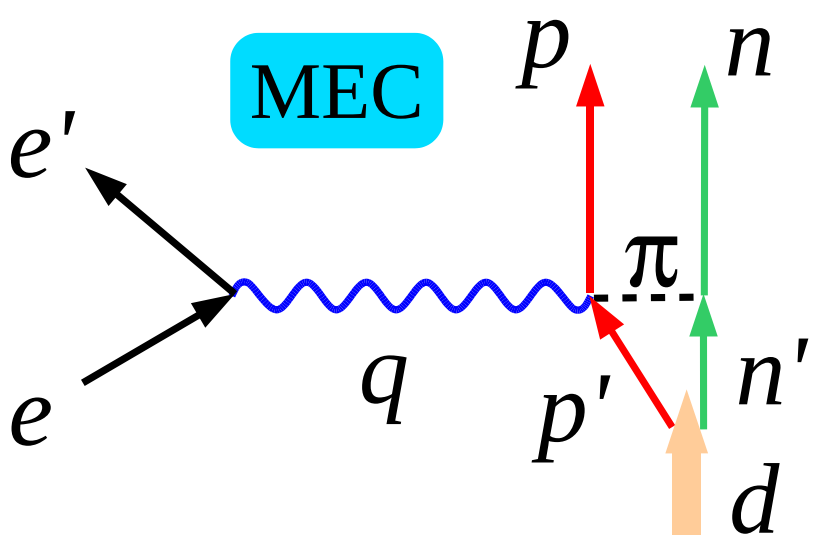
# One Photon Exchange Approximation

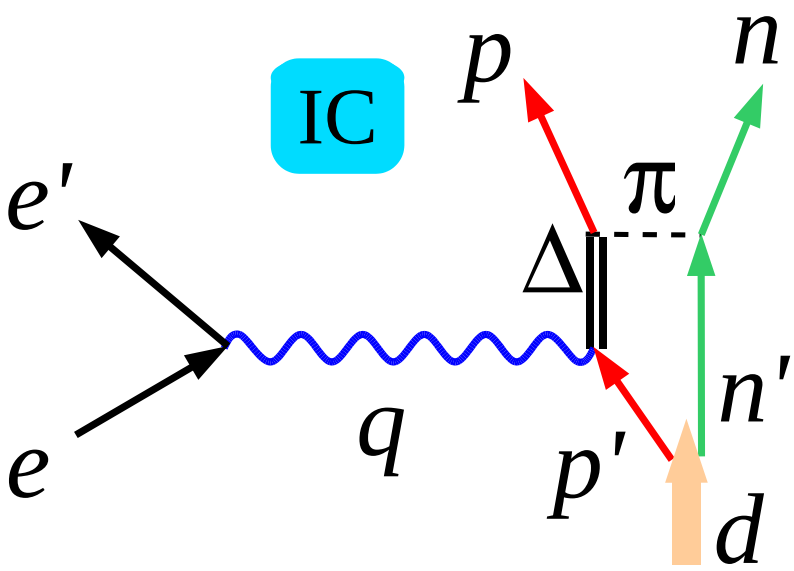


# Plane Wave Impulse Approximation and Beyond



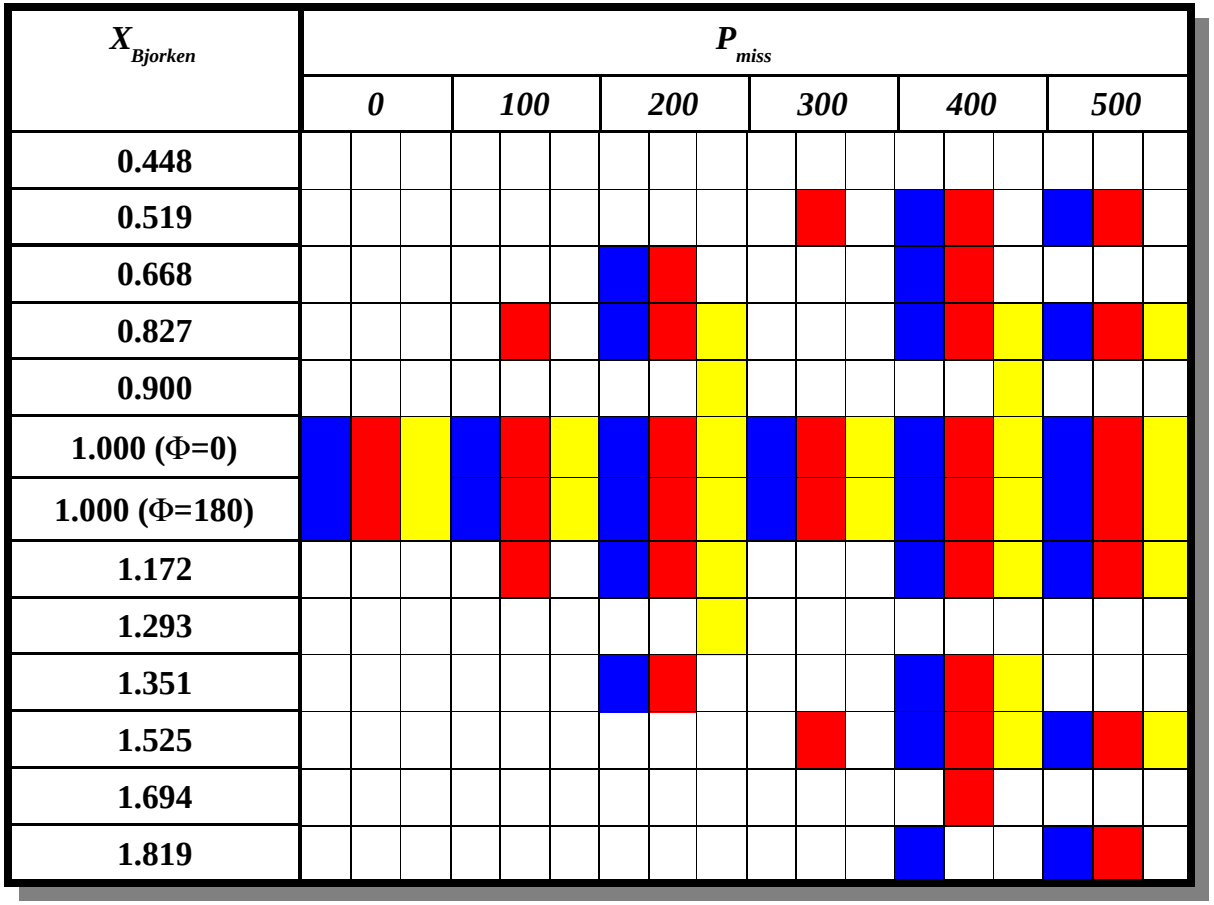



# Physics Motivations

| Kinematics | $Q^2$ $(\text{GeV}/c)^2$ | $p_m$ | $x_B$ | FSI | MEC/IC | Motivation |
|---|---|---|---|---|---|---|
| **Parallel** | 2.1 | $\parallel q$ | < 1 | Minimum | Maximum | Emphasize MEC/IC |
| **Anti-parallel** | 2.1 | $\parallel -q$ | > 1 | Minimum | Minimum | Study Deuteron Short-Range Structure |
| **Perpendicular** | 0.8<br>2.1<br>3.5 | $\perp q$ | 1 | Maximum | Minimum | Test Relativistic Models ($R_{LT}$) |
| **Neutron Angular Distribution** | 0.8<br>2.1<br>3.5 | vary | vary | variable | variable | Study FSI, MEC/IC and Nucleonic Dynamics |

# Run Summary




**Blue :** $Q^2 = 0.8$ $(\mathrm{GeV}/c)^2$

**Red :** $Q^2 = 2.1$ $(\mathrm{GeV}/c)^2$

**Yellow :** $Q^2 = 3.5$ $(\mathrm{GeV}/c)^2$

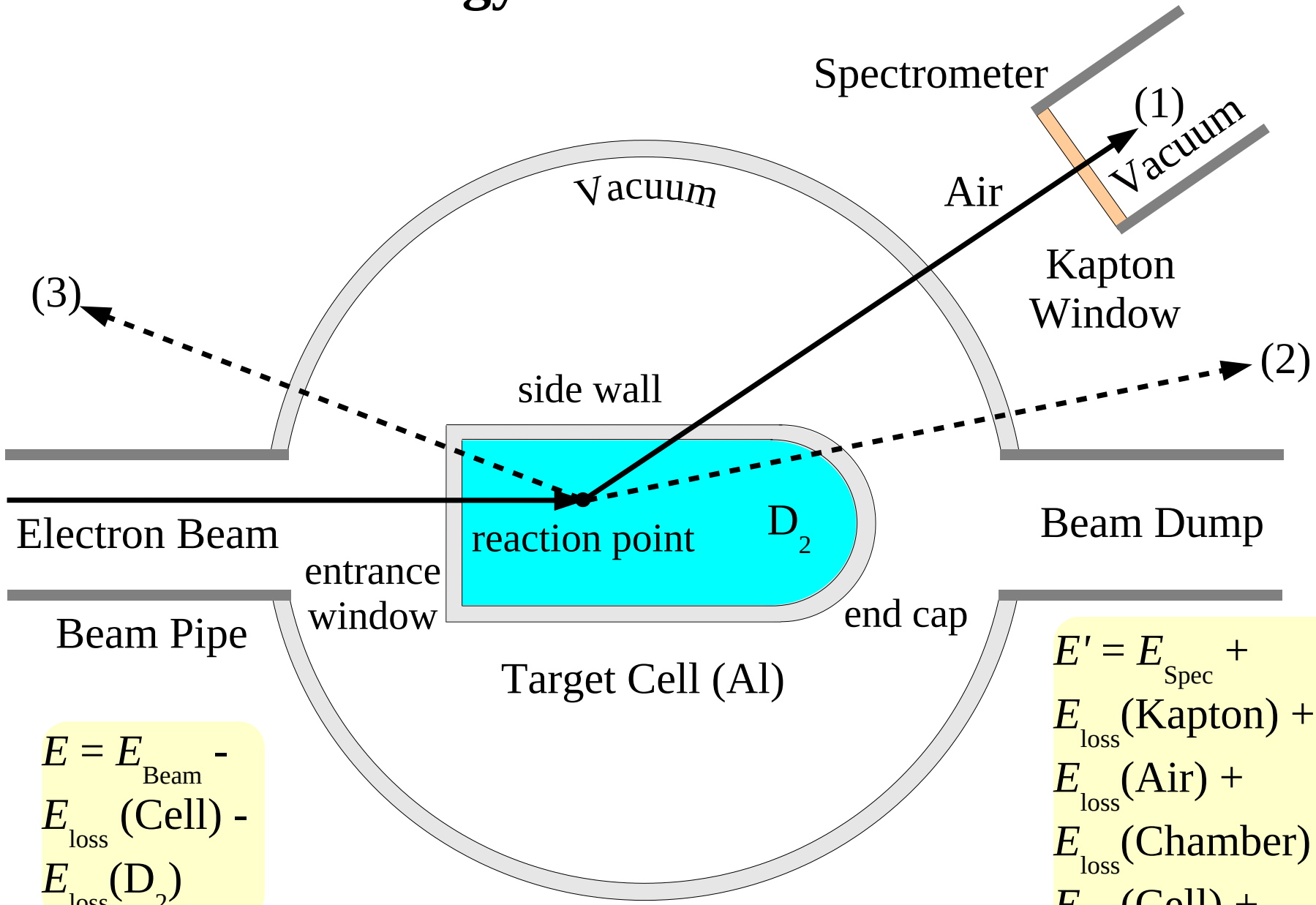
The experiment was completed in November 2002

# Analysis Tasks

| Beam/Luminosity | Kinematics | Normalization | Physics |
|---|---|---|---|
| Beam Charge Calibration | Energy Loss Corrections | VDC Tracking | Cut Definitions (ESPACE Level) |
| Beam Position Calibration | Optics Optimization | Electronic Deadtimes | First Pass Through Data |
| Target Density (Boiling) | Beta Optimization | Detector Efficiencies | Efficiency/Deadtime Corrections |
| Liminosity Monitoring | Scintilators Gain Match | Absolute Normalizations | Radiative Corrections |
| | VDC T0 Calibration | | Phase Space Determination |
| | Relative Offsets (Pointing) | | Cross Sections |
| | Absolute Angular Offsets | | Phase Space Matching |
| | Kinematics Calibration: H($e$,$e'p$) | | FSI, MEC/IC, NN Dynamics and $R_{LT}$ |

| Finished Tasks | Current Tasks | Future Tasks | Goals |
|---|---|---|---|

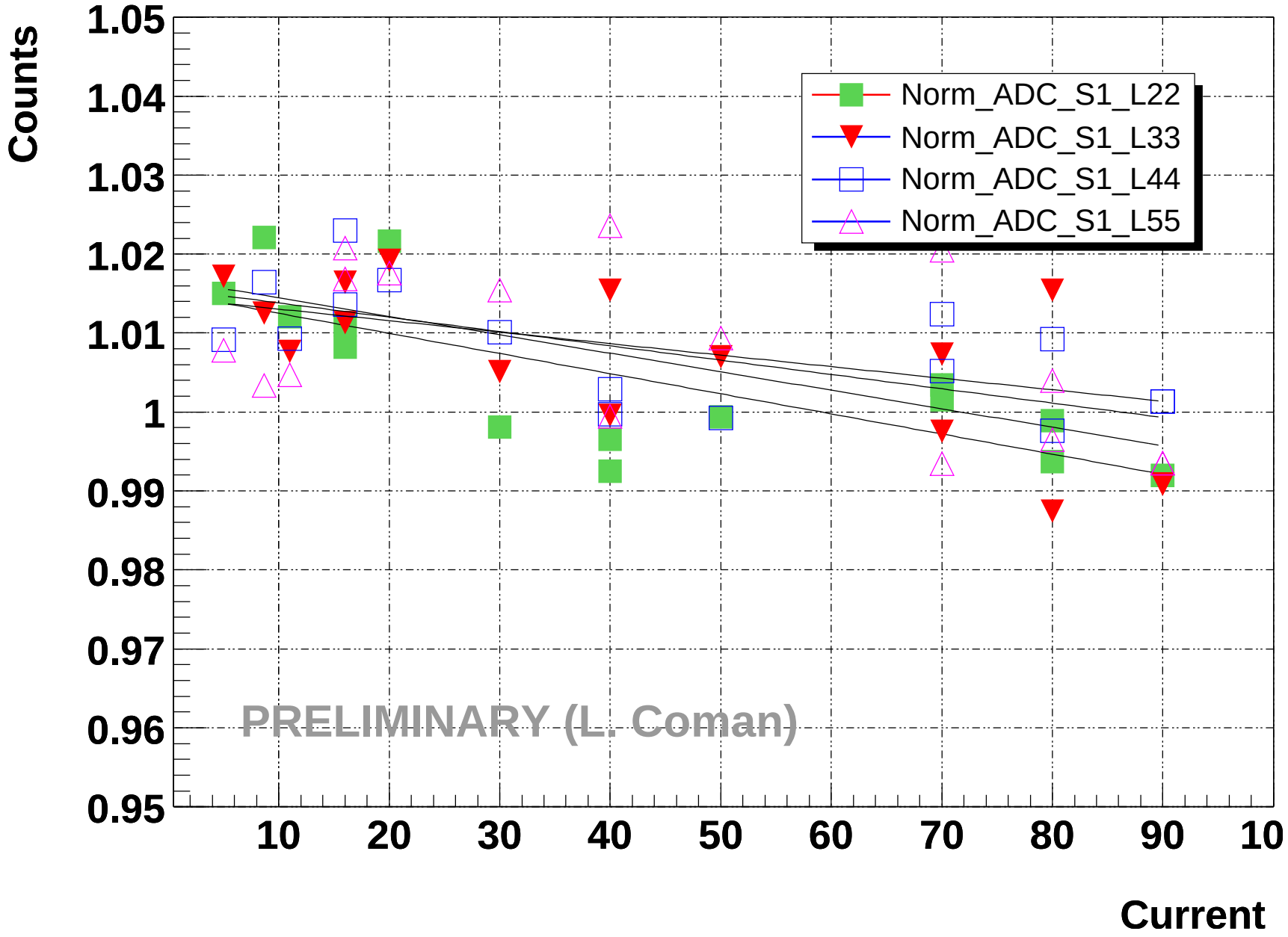
# Energy Loss Corrections



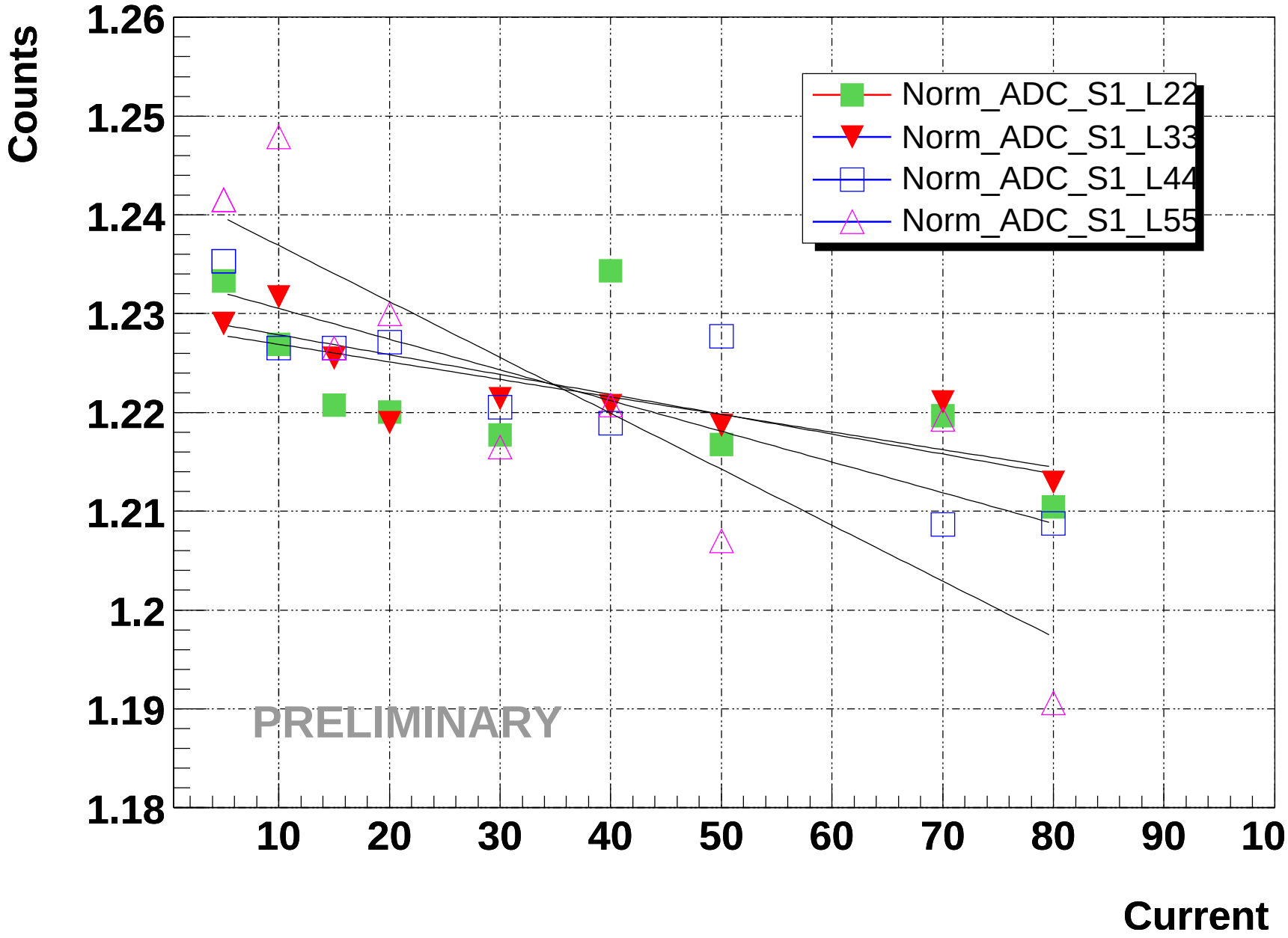

$E = E_{Beam} - E_{loss}(Cell) - E_{loss}(D_2)$

$E' = E_{Spec} + E_{loss}(Kapton) + E_{loss}(Air) + E_{loss}(Chamber) + E_{loss}(Cell) + E_{loss}(D_2)$

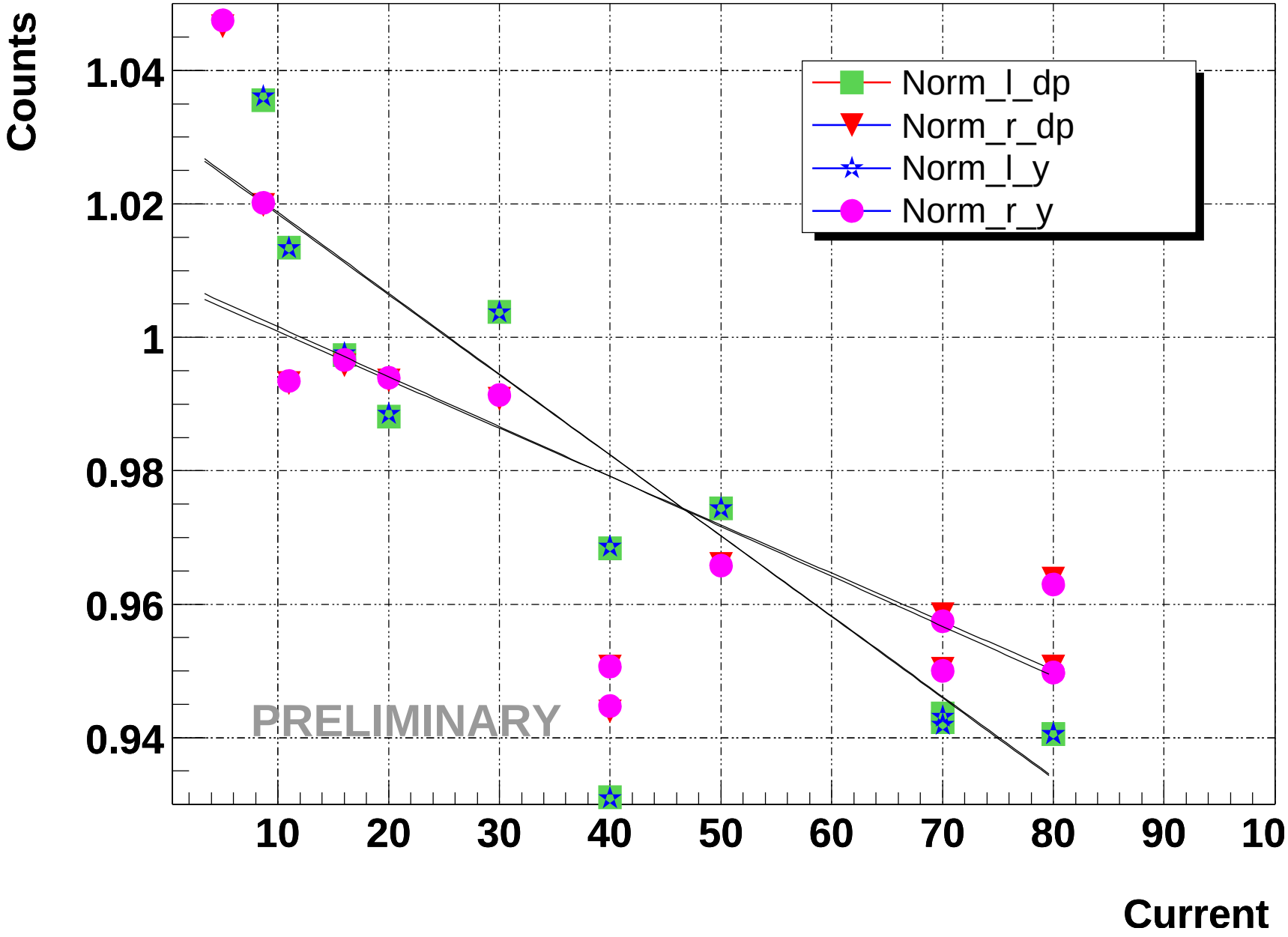
# Luminosity : ADC ($LD_2$)



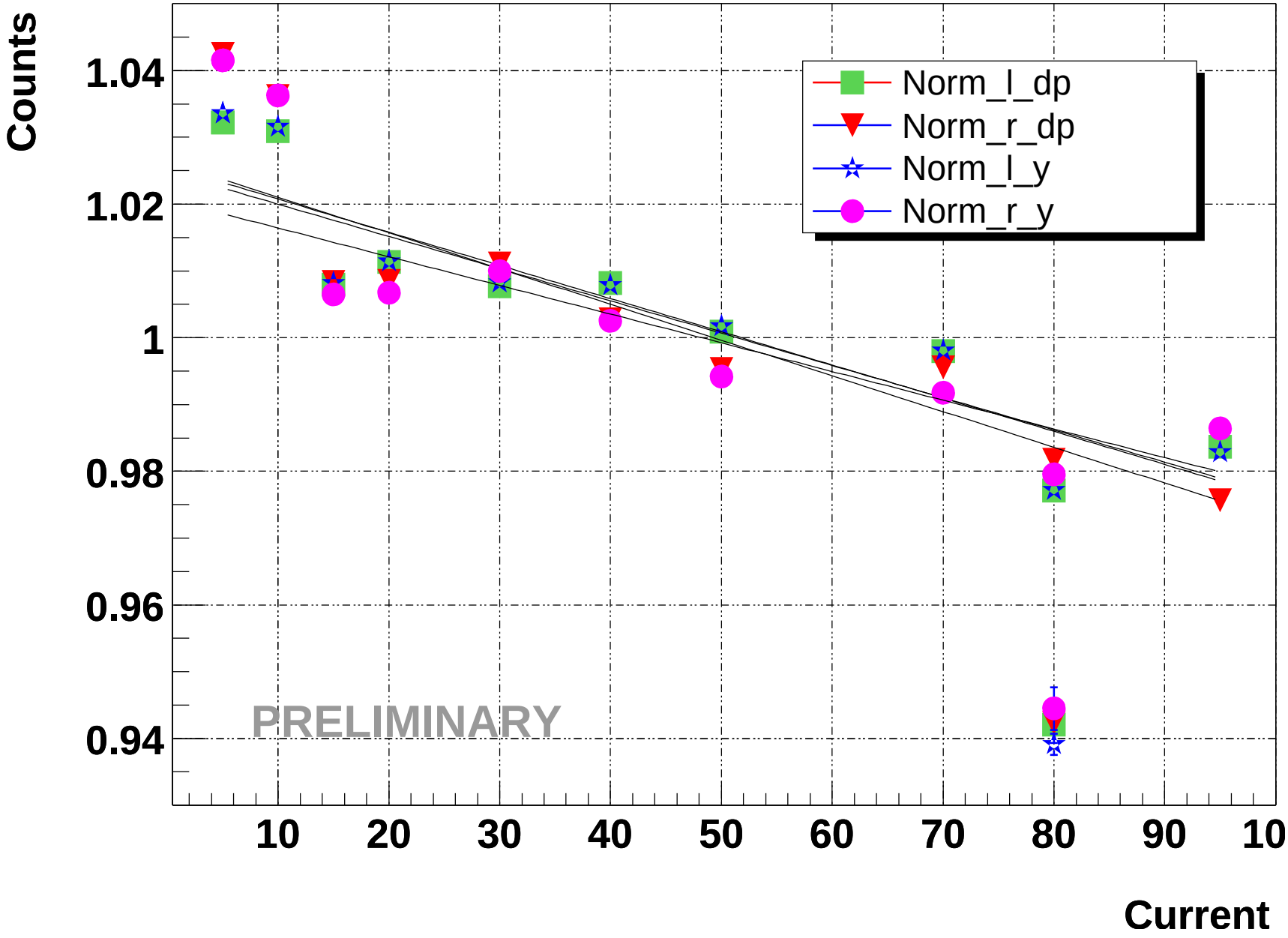
# Luminosity : ADC ($^{12}C$)



# Luminosity : δp and $y_{tg}$ ($LD_2$)



# Luminosity : δp and $y_{tg}$ ($^{12}C$)



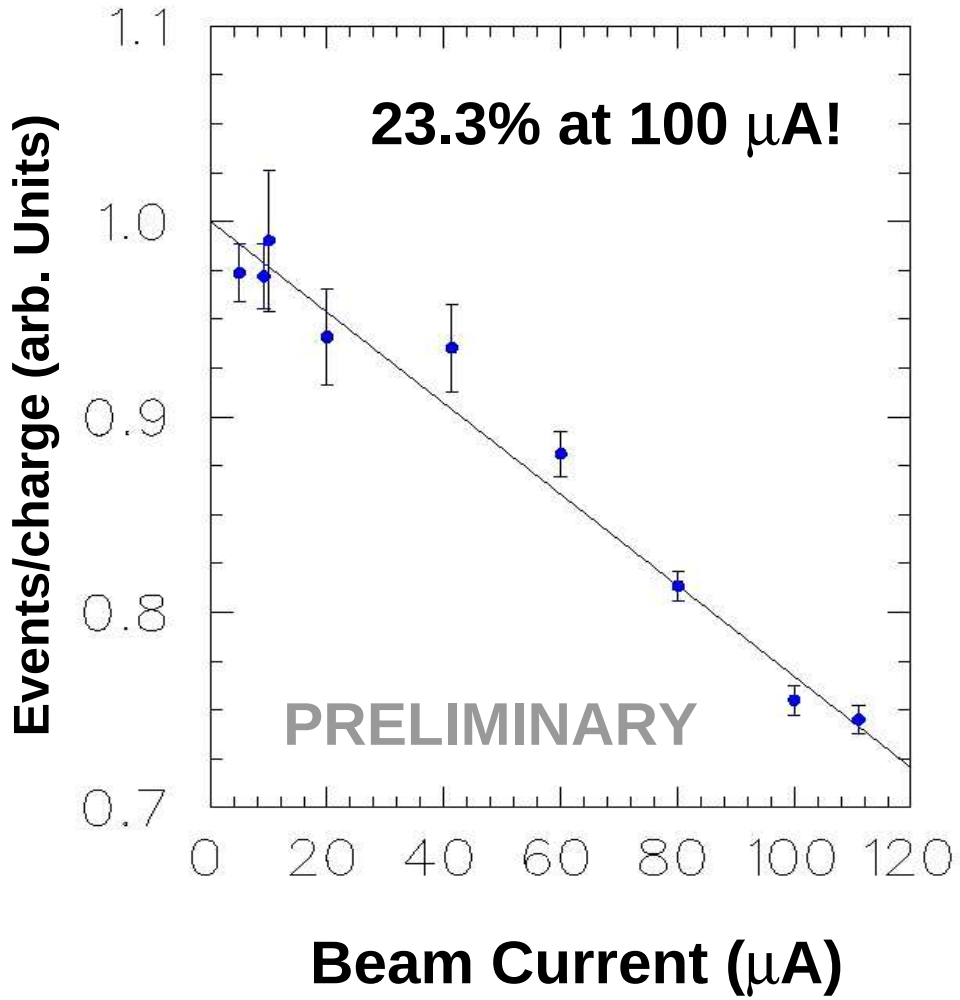
# Luminosity : Results (L. Coman)

| Target | ADC | S1_L11 | S1_L22 | S1_L33 | Norm_l_dp | % | Norm_r_dp | % | Norm_l_y | % | Norm_r_y | % | VDC Cuts | Deadtime |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Deuteron | **Left Arm** | -4.16E-4 | -4.93E-5 | -3.54E-4 | -4.82E-3 | **48** | -1.61E-3 | **16** | -4.81E-3 | **48** | -1.61E-3 | **16** | Standard | Comp |
| Deuteron | **%** | **4.2** | **0.5** | **3.5** | -9.86E-4 | **10** | -5.08E-4 | **5** | -9.85E-4 | **10** | -5.08E-4 | **5** | Loose | Comp |
| Deuteron | | | | | -5.04E-3 | **50** | -1.85E-3 | **19** | -5.04E-3 | **50** | -1.85E-3 | **19** | Standard | Comp + Elec |
| Deuteron | | | | | -1.20E-3 | **12** | -7.25E-4 | **7** | -1.21E-3 | **12** | -7.48E-4 | **7** | Loose | Comp + Elec |
| Carbon | **Left Arm adc** | -2.01E-4 | -1.78E-4 | -3.11E-4 | -1.20E-3 | **12** | -8.83E-4 | **9** | -1.20E-3 | **12** | -8.90E-4 | **9** | Standard | Comp |
| Carbon | **%** | **2.0** | **1.8** | **3.1** | -3.05E-4 | **3** | -3.68E-4 | **4** | -3.19E-4 | **3** | -2.64E-4 | **3** | Loose | Comp |
| Carbon | **Right Arm adc** | -1.97E-4 | -4.14E-4 | -2.50E-4 | -1.45E-3 | **14** | -1.11E-3 | **11** | -1.45E-3 | **14** | -1.12E-3 | **11** | Standard | Comp + Elec |
| Carbon | **%** | **2.0** | **4.1** | **2.5** | -4.83E-4 | **5** | -5.35E-4 | **5** | -4.97E-4 | **5** | -4.30E-4 | **4** | Loose | Comp + Elec |

PRELIMINARY

# Boiling Analysis: 15 cm LH2 cell (P. Ulmer)

Raster: 2mm x 2mm nominal, Fan: 60Hz




**Cuts:**

$-4<\varepsilon_m<10$ MeV

$3\leq mult\leq 7$

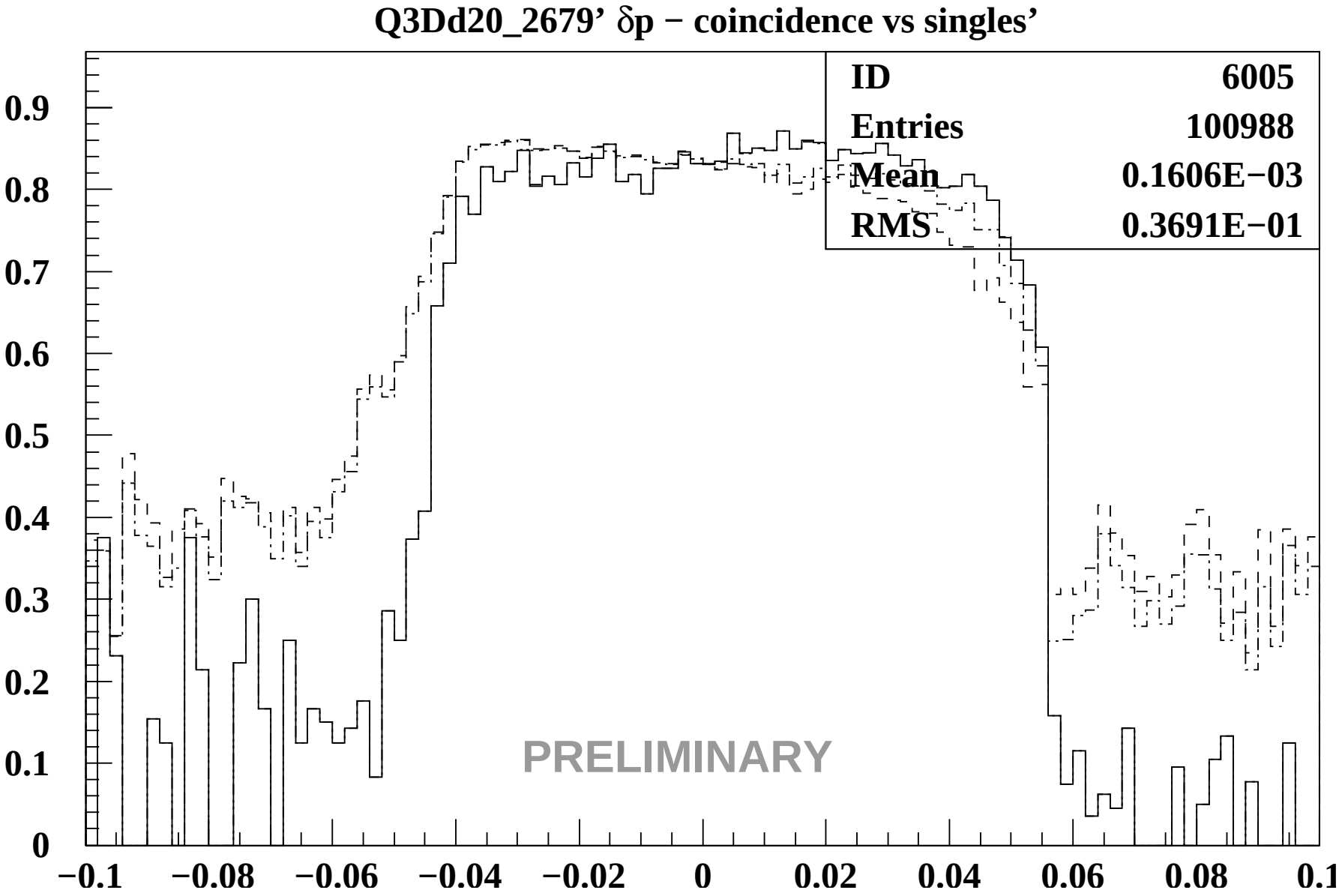
clusters=1

**Corrections:**

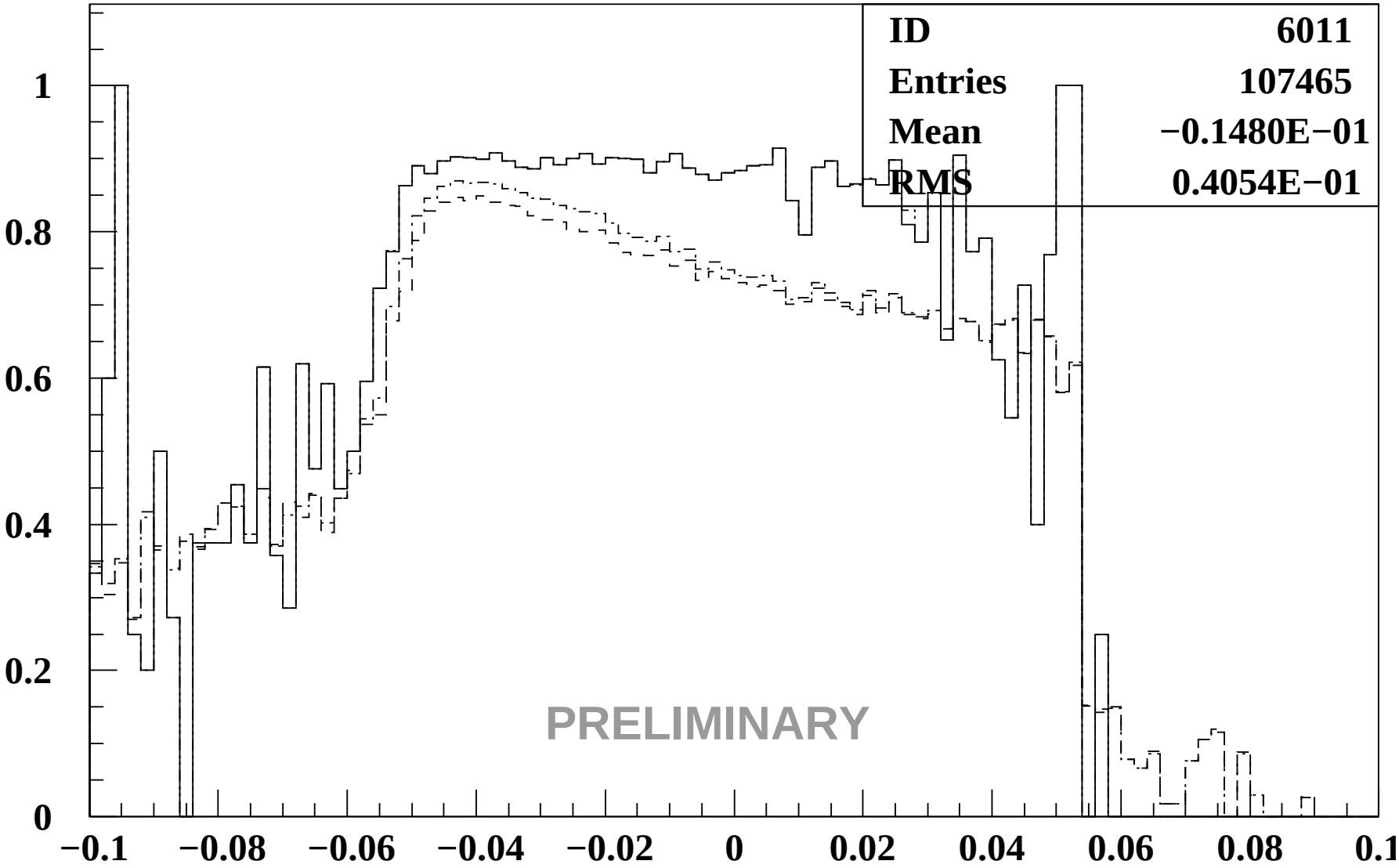
T5/E5

no VDC corr.

# Left VDC Efficiency (R. Roché)



# Right VDC Efficiency



# Summary

- Optics optimization is completed.
- A new target model is added to ESPACE in addition to the integration of the energy loss calculations.
- Many Current Tasks:
  - Beam/Target: Charge Calibration, Target Boiling, Luminosity
  - Kinematics: Beta Optimization, Angular Offsets
  - Normalization: VDC Tracking