# Optics Status Update

Chao Gu

# Calibration Status

- Compare the reconstruction matrix elements between different settings

  - If the elements agrees within errors, it gives a proof that we treat the target field correctly

- It turns out that we need to make some correction with beam position information to make the matrix elements comparable

  - Add a offset to the reference angle when calibrate the matrix and apply this correction back when reconstruction target variables
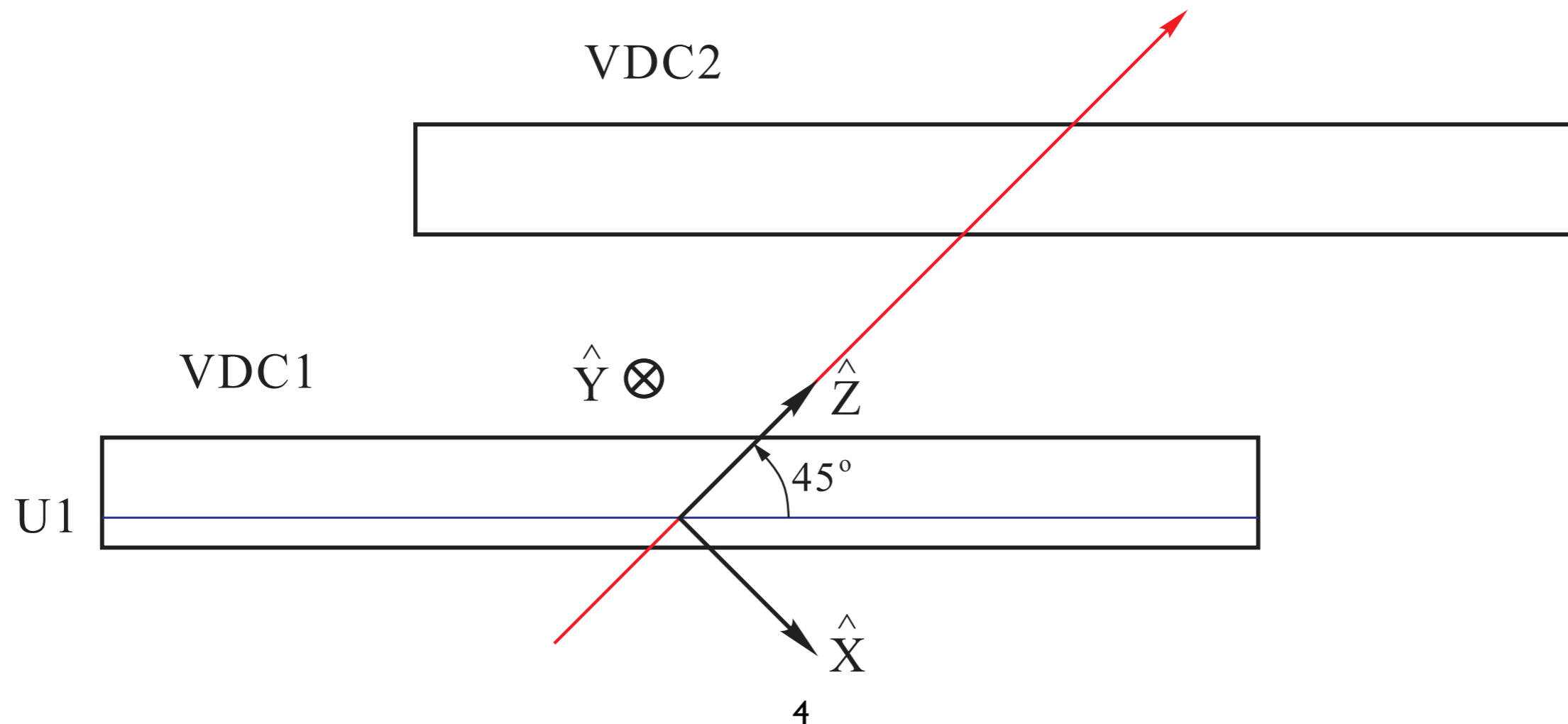
- Check focus plane offset

# Calibration

- Coordinates at focus plane:
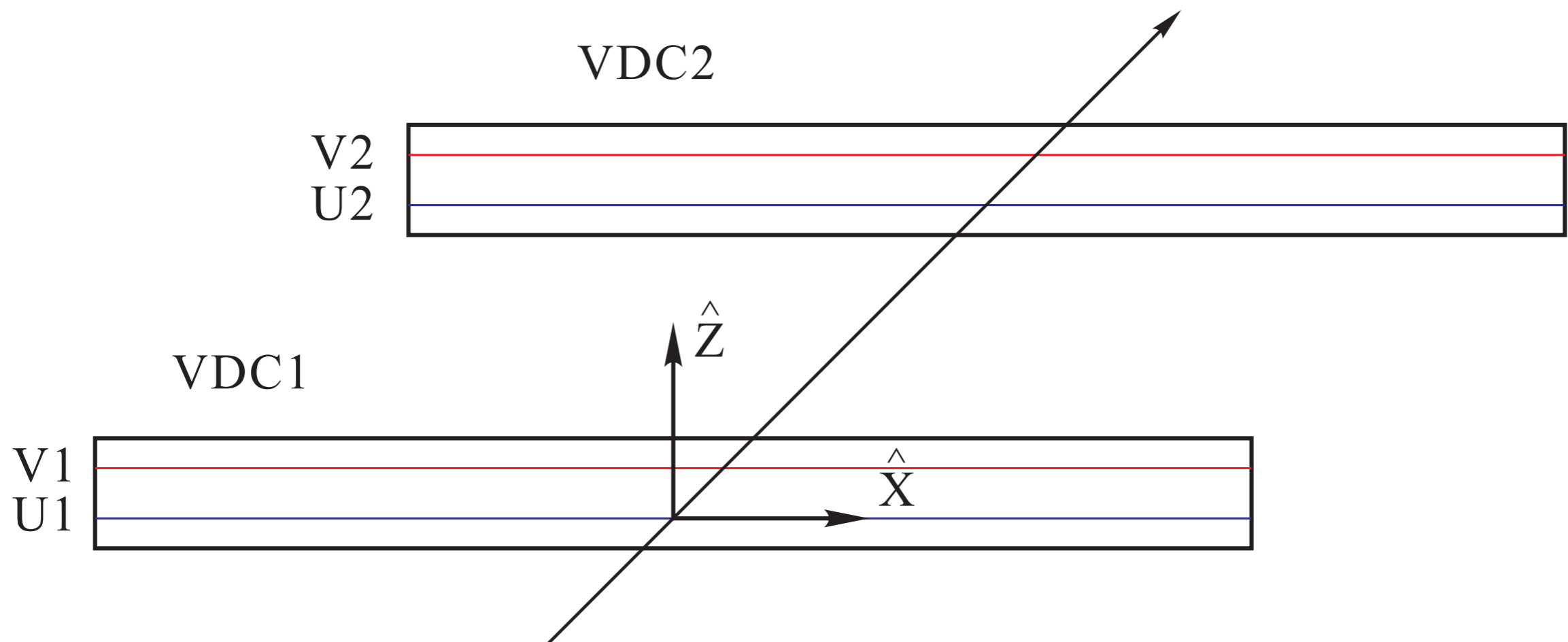
  - Detector Coordinate System (DCS)

  - Transport Coordinate System (TRCS)

  - Focal Plane Coordinate System (FCS)

# Calibration

- Coordinates at focus plane:

  - Detector Coordinate System (DCS)

  - Transport Coordinate System (TRCS)

  - Focal Plane Coordinate System (FCS)

VDC2

VDC1

$\hat{Y}$ ⊗

$\hat{Z}$

45°

U1

$\hat{X}$

# Calibration

- Coordinates at focus plane:

    - Detector Coordinate System (DCS)

    - Transport Coordinate System (TRCS)

    - Focal Plane Coordinate System (FCS)
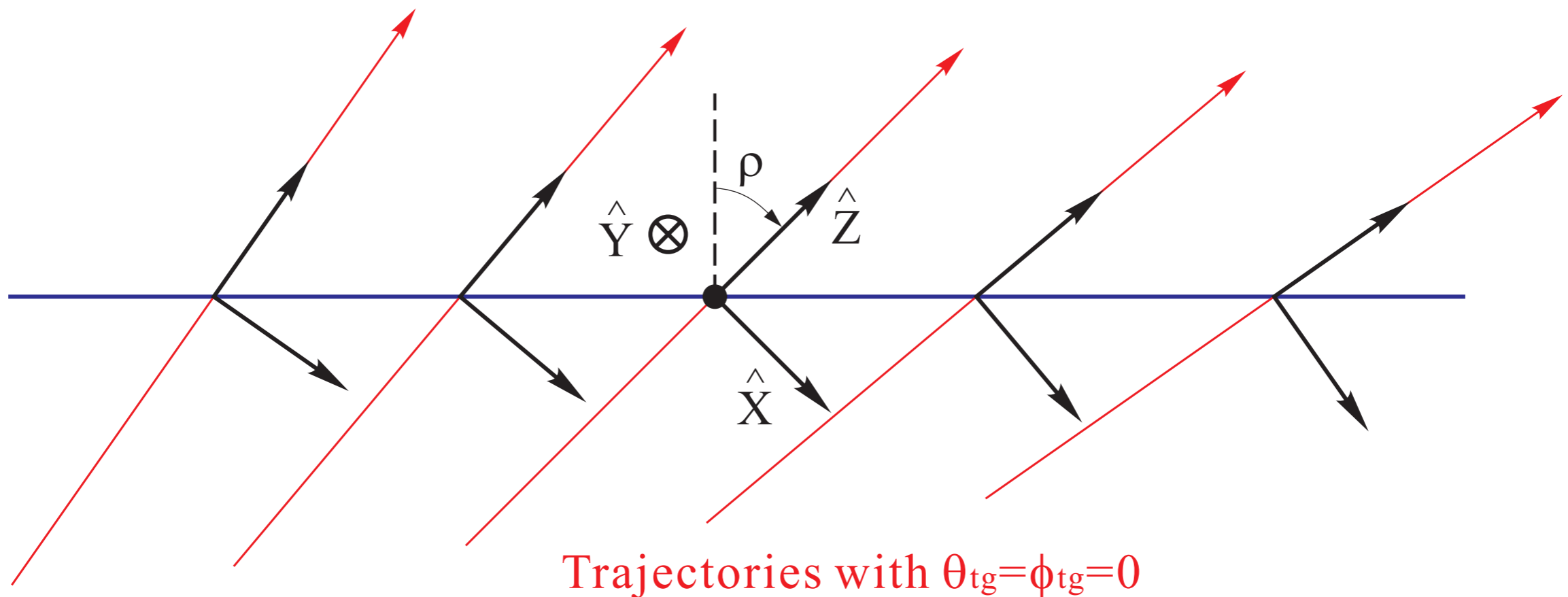


Trajectories with $\theta_{tg}=\phi_{tg}=0$

# Calibration

- Coordinates at focus plane:

  - Detector Coordinate System (DCS)

  - Transport Coordinate System (TRCS)

  - Focal Plane Coordinate System (FCS)

$$x_{\text{fp}} = x_{\text{tra}}$$

$$tan(\rho) = \sum t_{i000} x_{\text{fp}}^i$$

$$y_{\text{fp}} = y_{\text{tra}} - \sum y_{i000} x_{\text{fp}}^i$$

$$\theta_{\text{fp}} = \frac{\theta_{\text{det}} + tan(\rho)}{1 - \theta_{\text{det}} tan(\rho)}$$

$$\phi_{\text{fp}} = \frac{\phi_{\text{det}} - \sum p_{i000} x_{\text{fp}}^i}{cos(\rho_0) - \theta_{\text{det}} sin(\rho_0)}.$$

Focal Plane Offset:
t000, y000, p000

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# Calibration

$$x_{\text{fp}} = x_{\text{tra}}$$

$$tan(\rho) = \sum t_{i000} x_{\text{fp}}^i$$

$$y_{\text{fp}} = y_{\text{tra}} - \sum y_{i000} x_{\text{fp}}^i$$

$$\theta_{\text{fp}} = \frac{\theta_{\text{det}} + tan(\rho)}{1 - \theta_{\text{det}} tan(\rho)}$$

$$\phi_{\text{fp}} = \frac{\phi_{\text{det}} - \sum p_{i000} x_{\text{fp}}^i}{cos(\rho_0) - \theta_{\text{det}} sin(\rho_0)}.$$

Focal Plane Offset:
t000, y000, p000

| i | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| t000 | -1.001E+00 | -3.313E-01 | -4.291E-02 | 4.429E-03 |
| y000 | -8.068E-03 | 1.071E-03 | 8.690E-04 | -9.990E-05 |
| p000 | -2.865E-03 | -2.292E-03 | 8.465E-03 | 3.471E-03 |

# Calibration

## First Order Matrix

| E/GeV | Field | T0000 | T1000 | T0100 | T0010 | T0001 |
|-------|-------|-------|-------|-------|-------|-------|
| 2.254 | L | 1.157E-02 | 1.993E-02 | -2.805E+00 | -7.459E-03 | 3.764E-01 |
| 1.706 | 2.5T | 1.091E-02 | 2.093E-02 | -2.858E+00 | -8.634E-03 | 2.917E-01 |
| | | P0000 | P1000 | P0100 | P0010 | P0001 |
| 2.254 | L | -2.437E-03 | 3.260E-03 | 1.983E-01 | -7.104E-01 | 3.731E-01 |
| 1.706 | 2.5T | -2.426E-03 | 4.650E-03 | 2.460E-01 | -7.128E-01 | 3.708E-01 |
| | | D0000 | D1000 | D0100 | D0010 | D0001 |
| 2.254 | L | 1.340E-03 | 7.447E-02 | -2.443E-02 | -1.283E-02 | 6.918E-02 |
| 1.706 | 2.5T | 9.524E-04 | 7.498E-02 | -2.446E-02 | 6.858E-03 | 4.086E-02 |

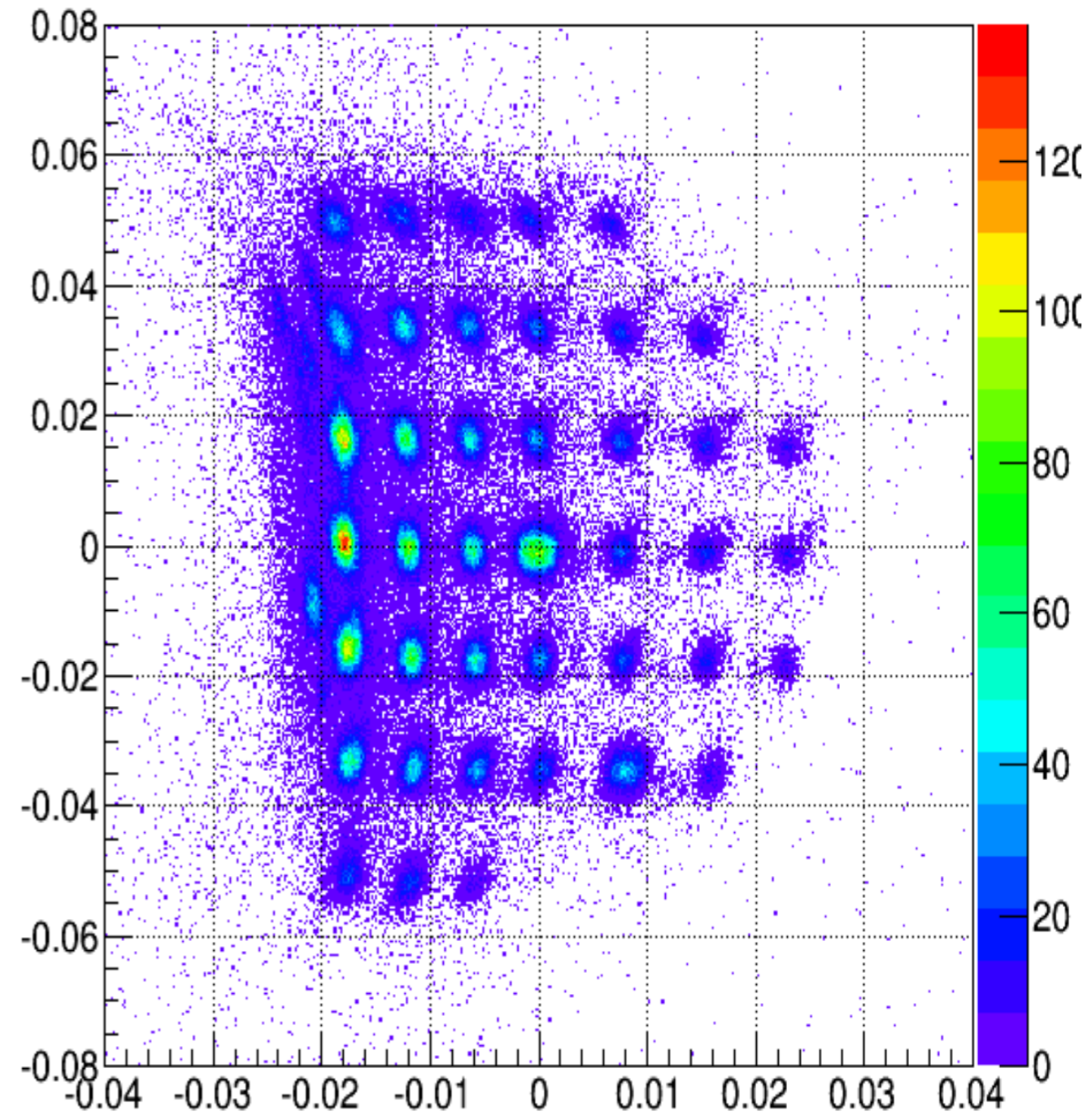After Correction, the 2 matrix can be used to replay the same run
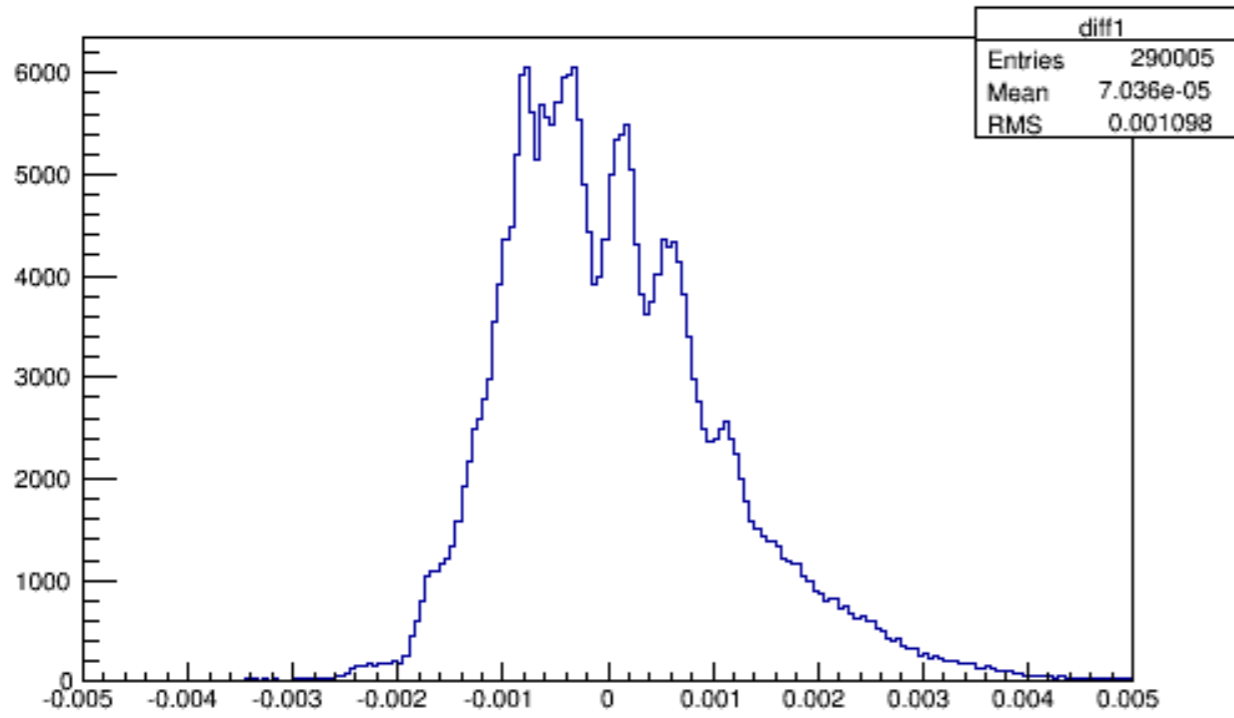
# Calibration

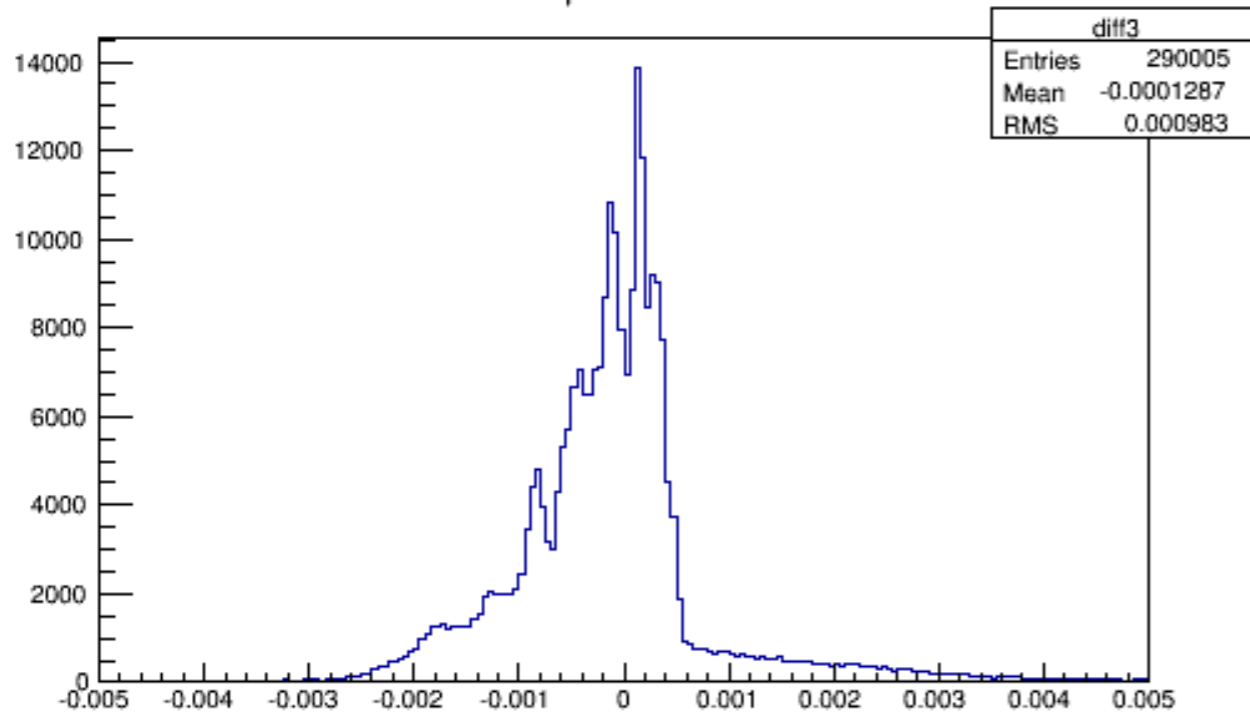Run 5585 (use longitudinal matrix)
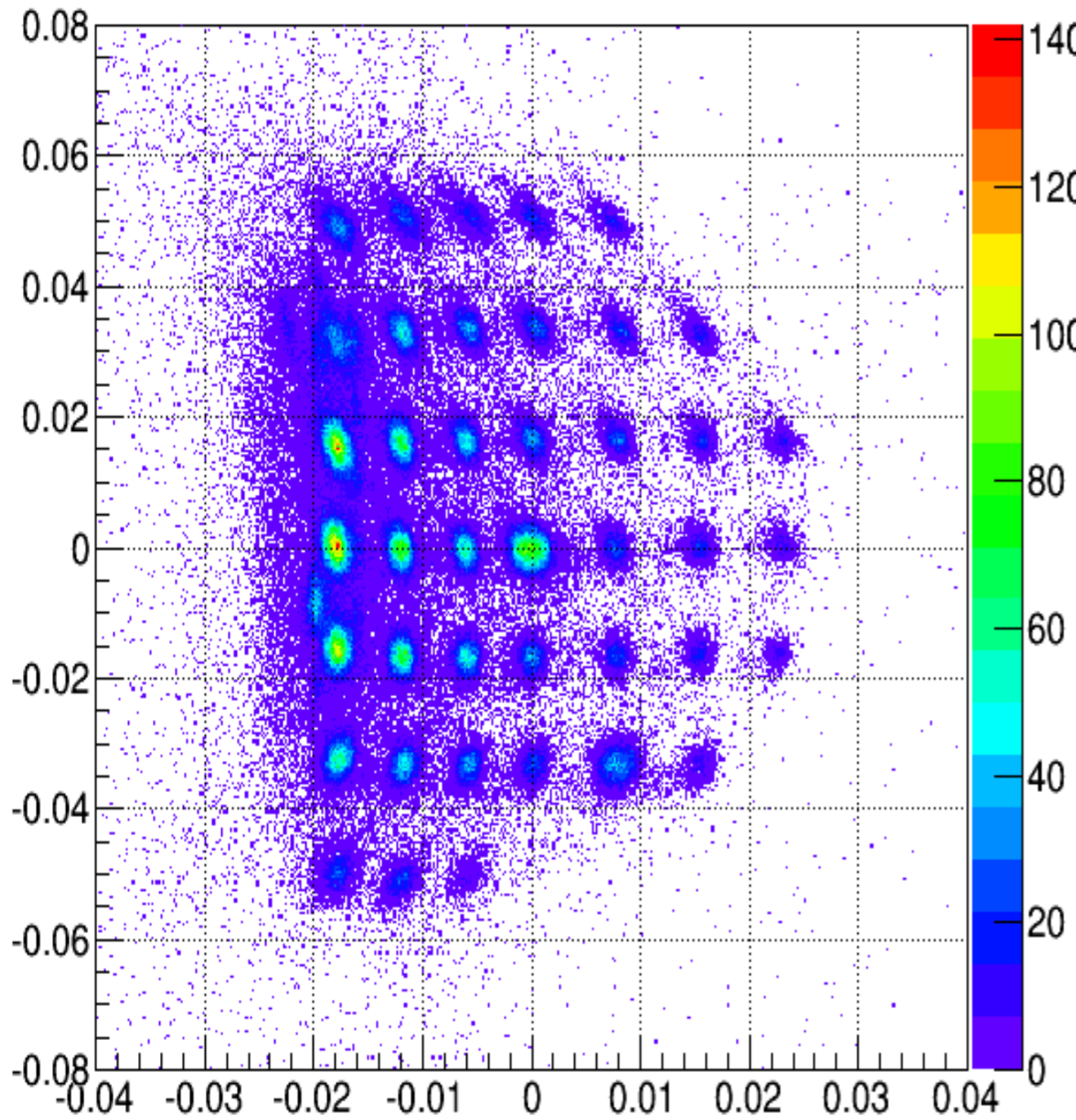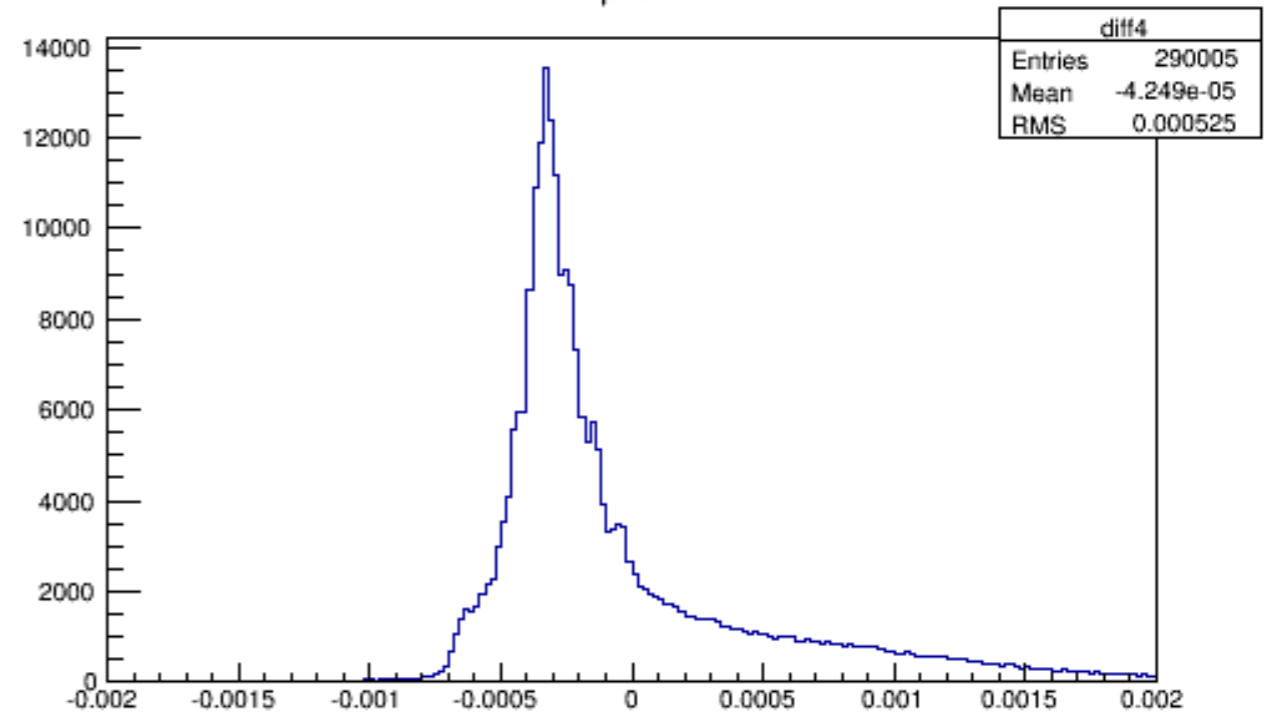
Run 5585 (use 2.5T-field matrix)

# Calibration

### theta diff



| diff1 | |
|---|---|
| Entries | 290005 |
| Mean | 7.036e-05 |
| RMS | 0.001098 |

### phi diff



| diff3 | |
|---|---|
| Entries | 290005 |
| Mean | -0.0001287 |
| RMS | 0.000983 |

### dp diff



| diff4 | |
|---|---|
| Entries | 290005 |
| Mean | -4.249e-05 |
| RMS | 0.000525 |

# Status

- Still checking the momentum calibration because the spectrum against nu shows some strange behavior which only relate to dp calibration

- Working on RHRS calibration