

dQ/dx Studies

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ProtoDUNE Sim/Reco Meeting

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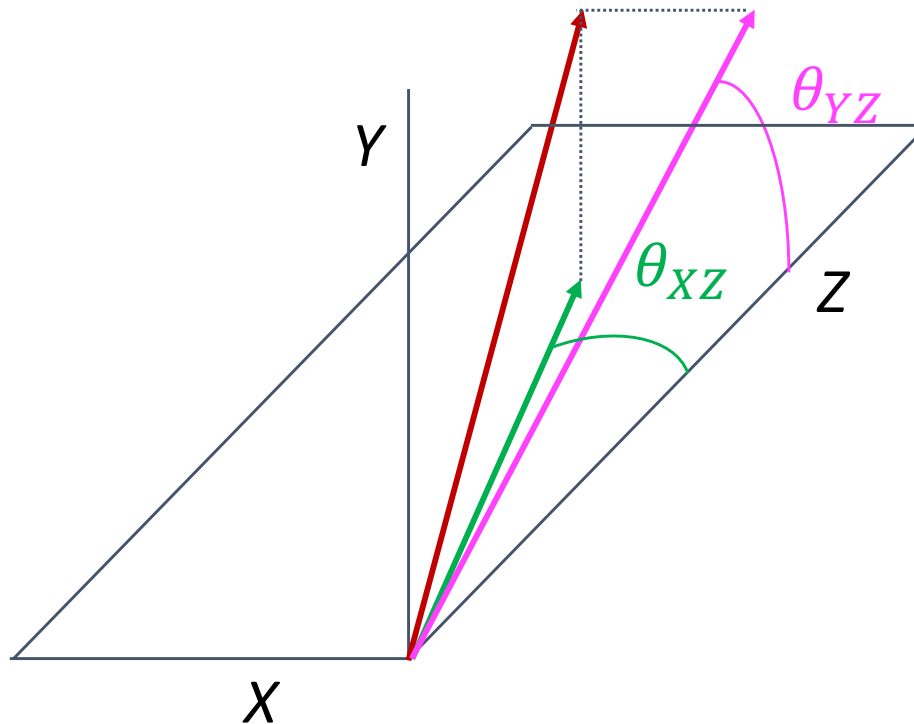
Introduction

- Major improvements to signal processing are available since the last production release.
- Undershoot correction (Tom Junk)
<https://indico.fnal.gov/event/19015/contribution/1/material/slides/0.pdf>
- 2D deconvolution (Wenqian Gu, wirecell team.)
<https://indico.fnal.gov/event/16764/session/17/contribution/61/material/slides/0.pdf>
- ADC gain calibration (David Adams)
<https://indico.fnal.gov/event/19739/contribution/2/material/slides/0.pdf>
- Coherent noise removal (Jingbo Wang)
<https://indico.fnal.gov/event/16764/session/17/contribution/59/material/slides/0.pdf>

- Take one 1 GeV electron file np04_raw_run005809_0004_dl6.root (135 events) and compare results using different reconstruction configurations
- 1D: official production file - np04_raw_run005809_0004_dl6_reco_12978544_0_20181107T191642.root
- 2D*: undershoot correction, 2D deconvolution
- 2D*+cali: with ADC gain calibration
- 2D*+cali+n.r.: with coherent noise removal
- Select tracks longer than 1m
- Look at dQ/dx distributions
 - Angular dependence
 - Resolution

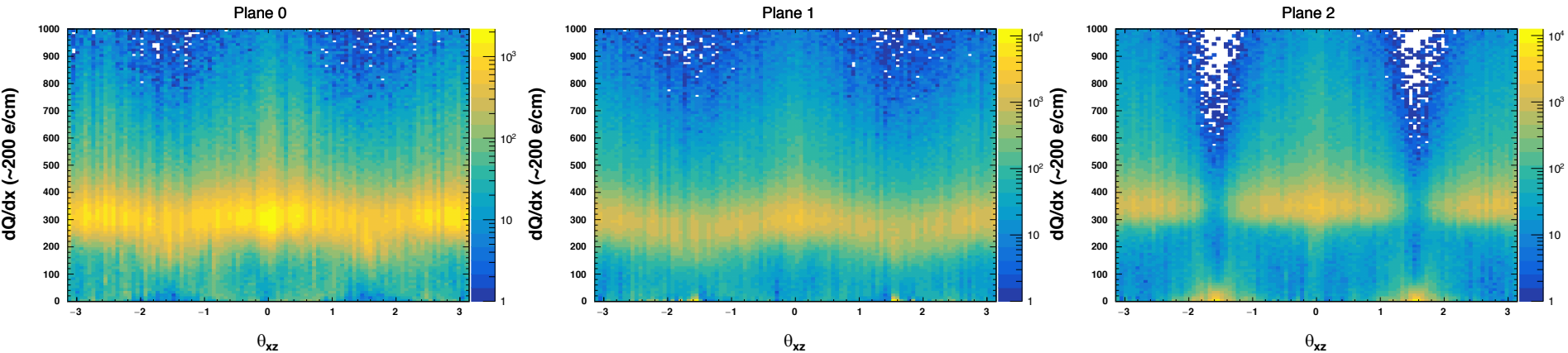
Angular dependence

- Plot dQ/dx vs θ_{xz} and θ_{yz}

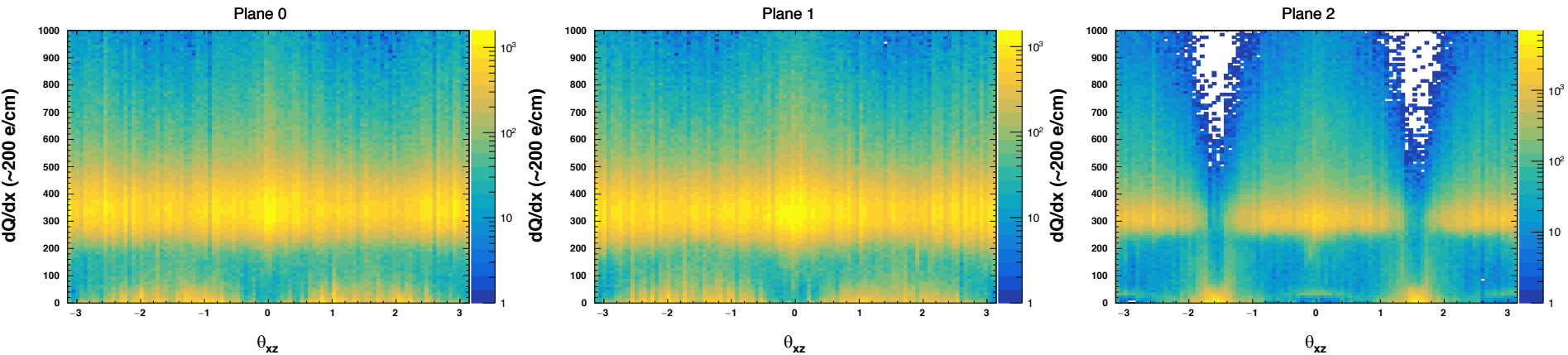




1D deconvolution



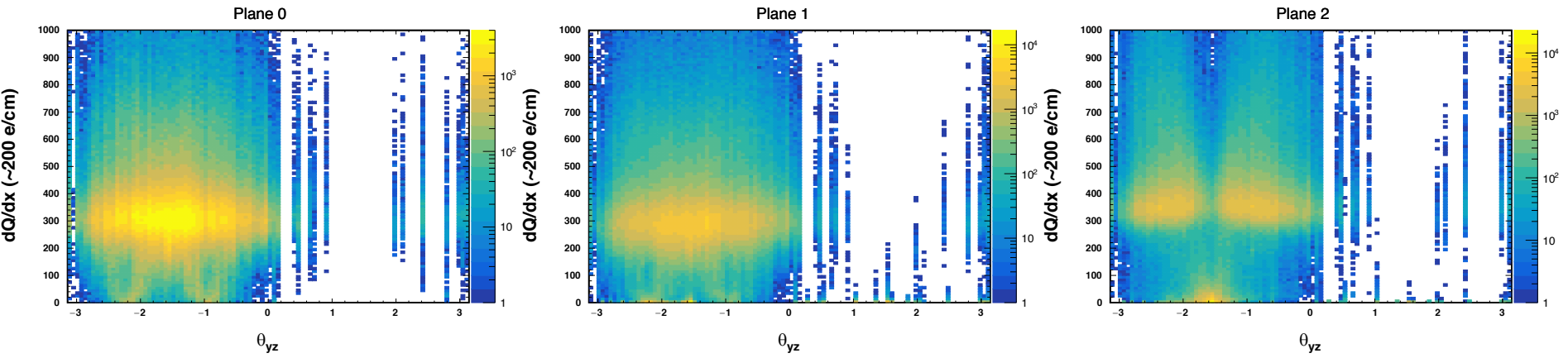
2D deconvolution



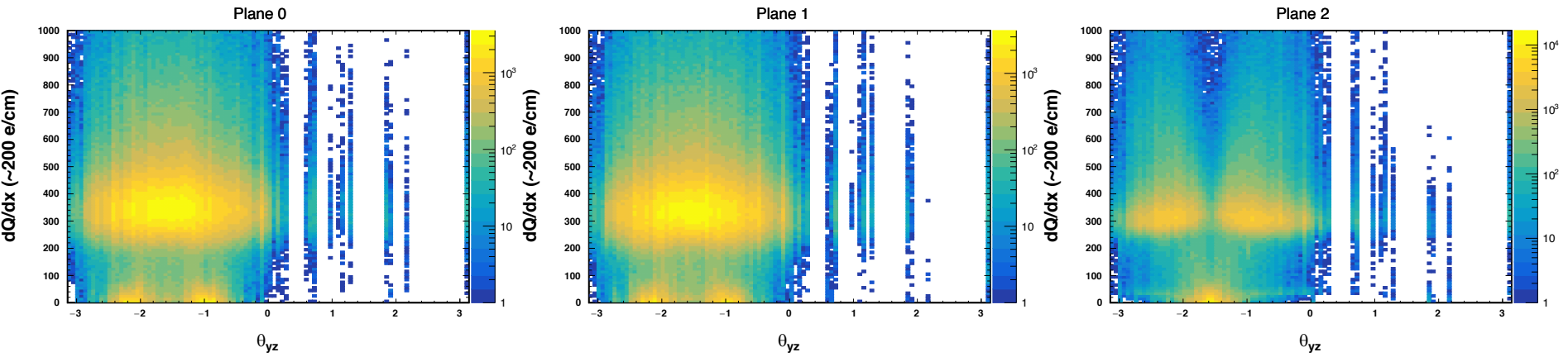
- 2D deconvolution makes the angular dependence flat for induction wires.
- 2D Deconvolution produces more low dQ/dx values on induction planes.

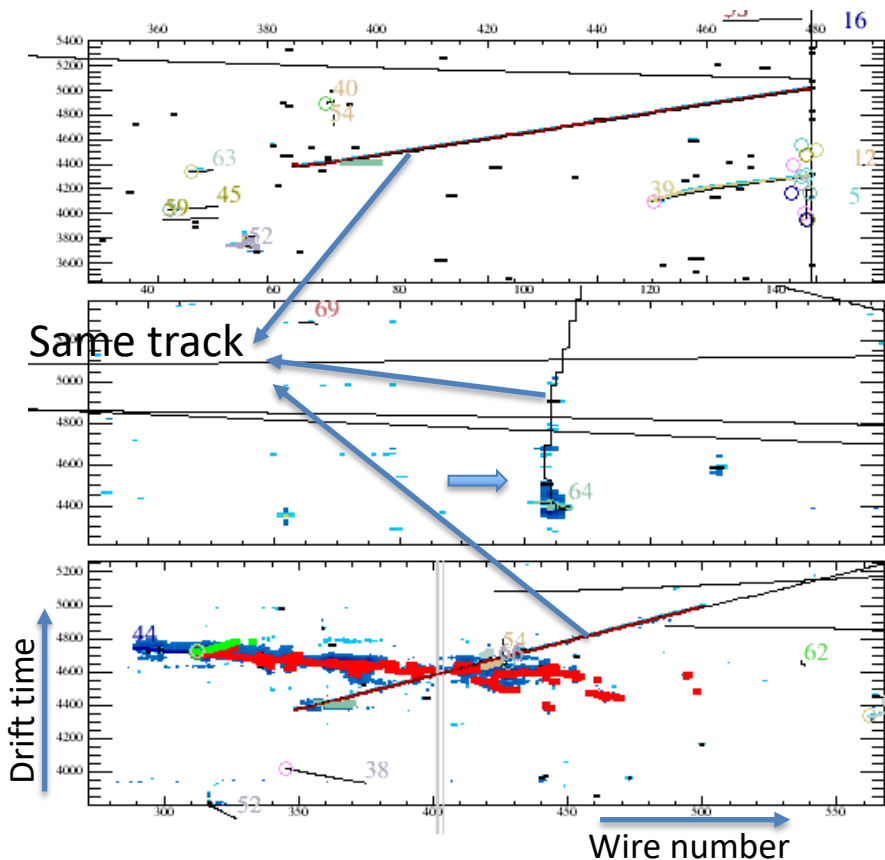
θ_{yz}

1D deconvolution



2D deconvolution

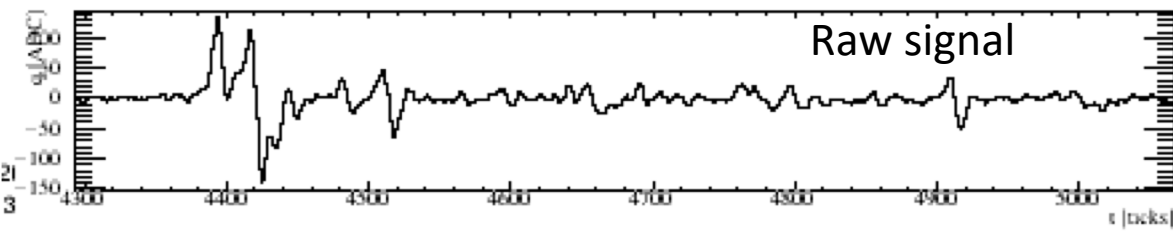
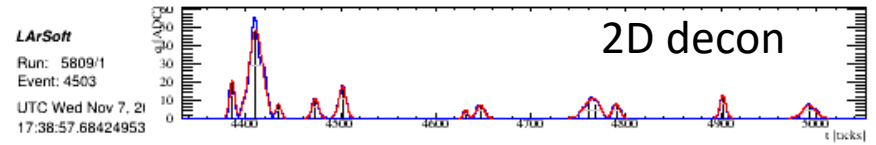
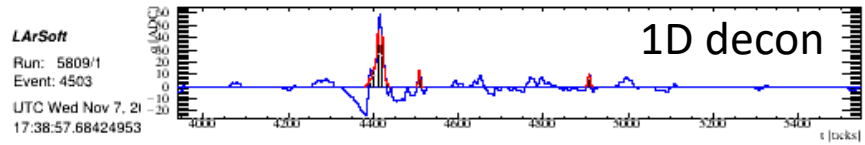
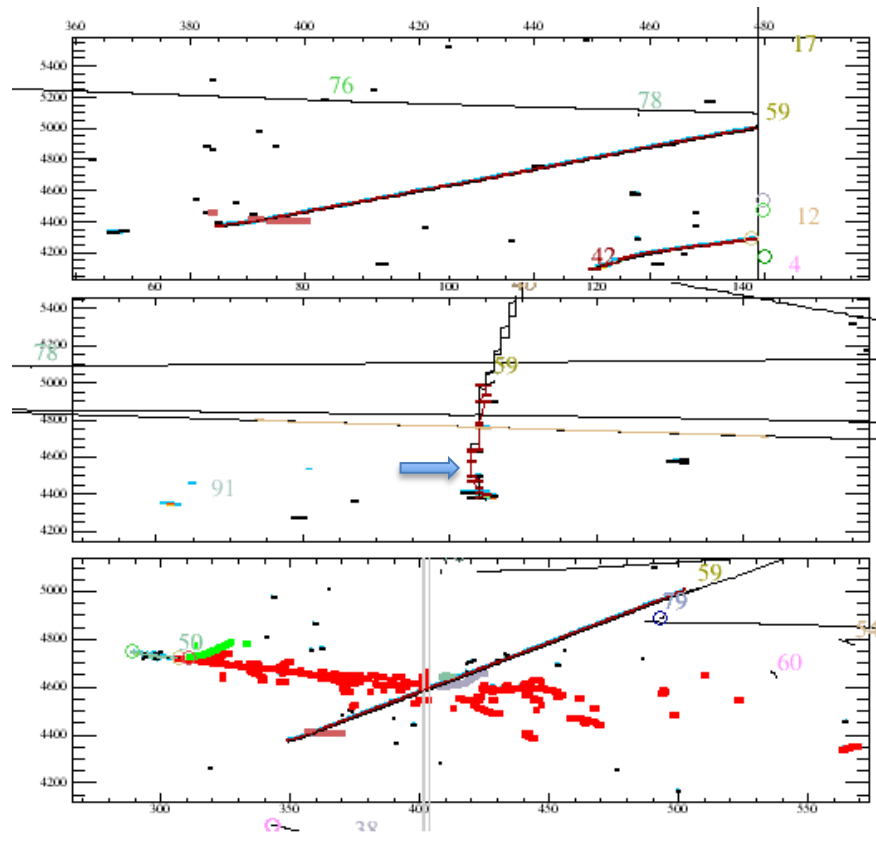




Y

V

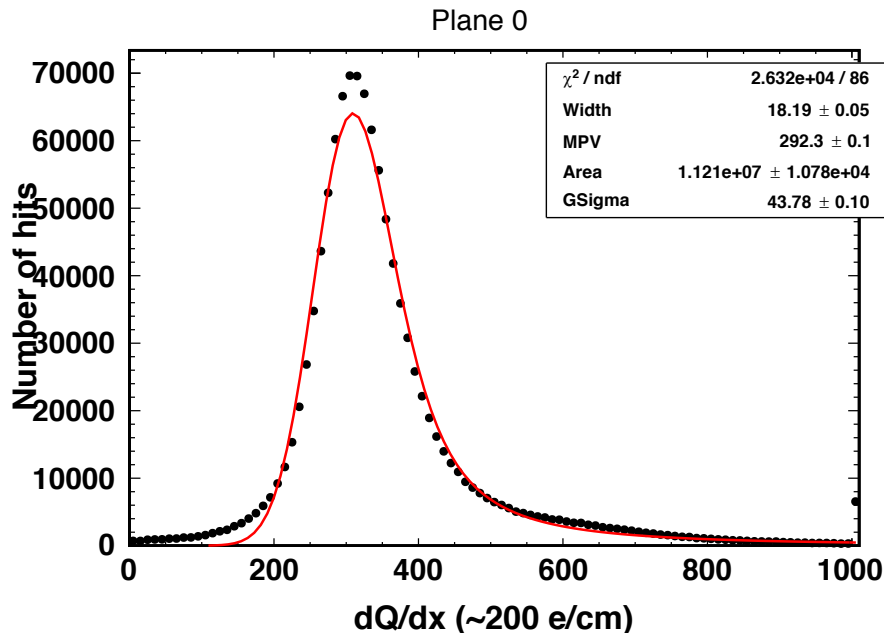
U



- 2D deconvolution recovers prolonged induction signal.

Track dQ/dx Resolution

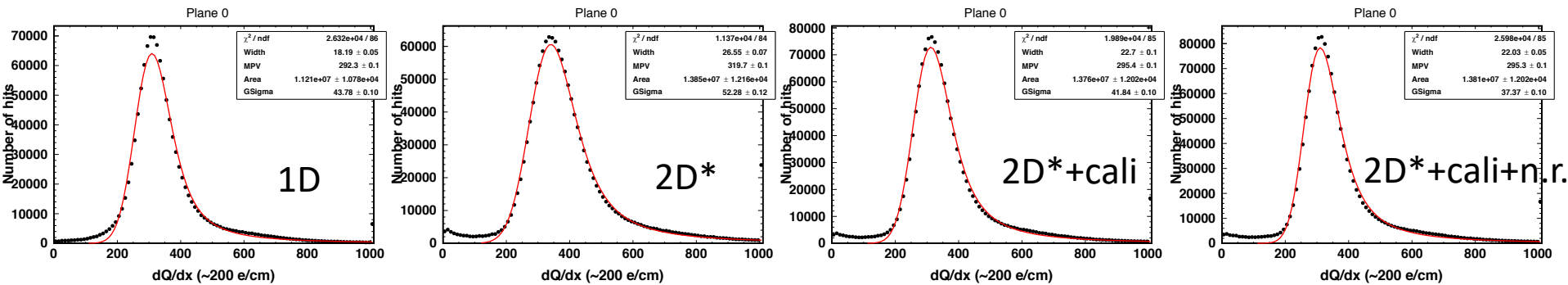
- Apply angular cuts from Ajib to remove low dQ/dx values.
<https://indico.fnal.gov/event/19376/contribution/3/material/slides/0.pdf>
- Fit dQ/dx distribution with Landau convoluted with Gaussian
<https://root.cern.ch/root/html/tutorials/fit/langaus.C.html>



4 parameters:

- Width - Landau width
- MPV - most probable value (peak)
- Area - normalization
- GSigma - Gaussian width

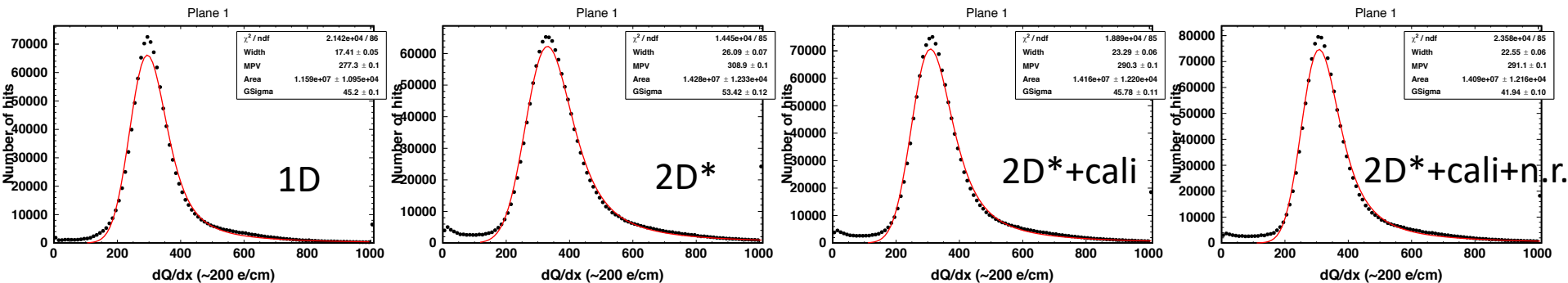
Plane 0



	Width	MPV	Gsigma	Gsigma/MPV
1D	18.19	292.3	43.78	15.0%
2D*	26.55	319.7	52.28	16.3%
2D*+cali	22.7	295.4	41.84	14.2%
2D*+cali+n.r.	22.03	295.3	37.37	12.7%

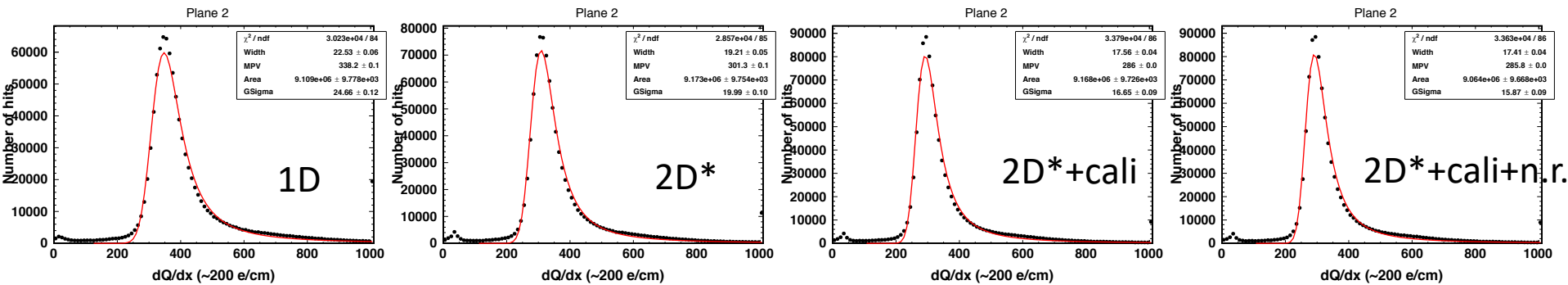
- 2D deconvolution gives consistent result as 1D deconvolution for tracks at good angles.
- ADC gain calibration and coherent noise removal improve dQ/dx resolution.

Plane 1



	Width	MPV	Gsigma	Gsigma/MPV
1D	17.41	277.3	45.2	16.3%
2D*	26.09	308.9	53.42	17.3%
2D*+cali	23.29	290.3	45.78	15.7%
2D*+cali+n.r.	22.55	291.1	41.94	14.4%

Plane 2



	Width	MPV	Gsigma	Gsigma/MPV
1D	22.53	338.2	24.66	7.3%
2D*	19.21	301.3	19.99	6.6%
2D*+cali	17.56	286	16.65	5.8%
2D*+cali+n.r.	17.41	285.8	15.87	5.6%

- Collection plane dQ/dx resolution is much better than induction planes.
- Difference between 1D and 2D* could be due to undershoot corrections.

Conclusions

- 2D deconvolution improves the reconstruction of prolonged signals on the induction wires.
- Gain calibration and coherent noise removal improve the dQ/dx resolution.