

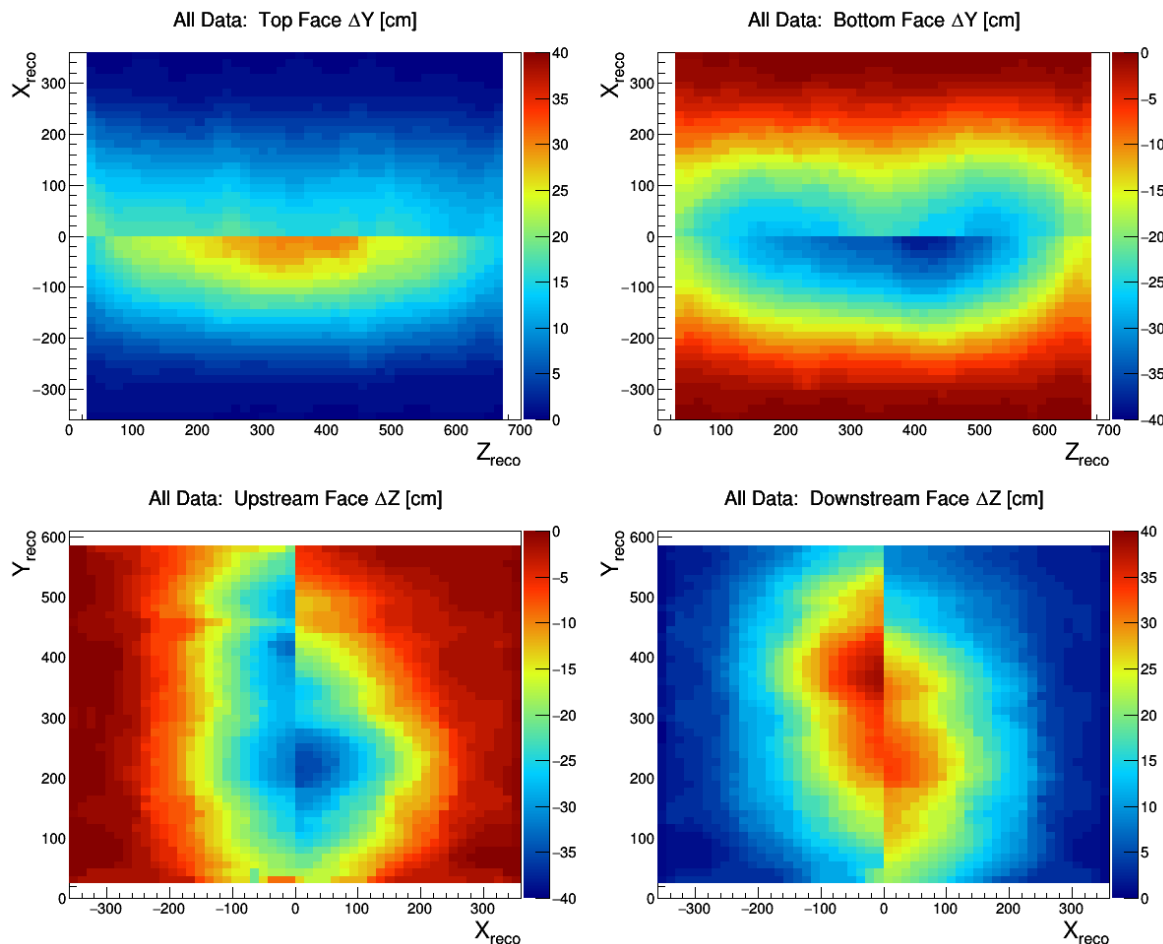
# SCE Map Update: Data-Driven Spatial and E Field Maps

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**Colorado State University**

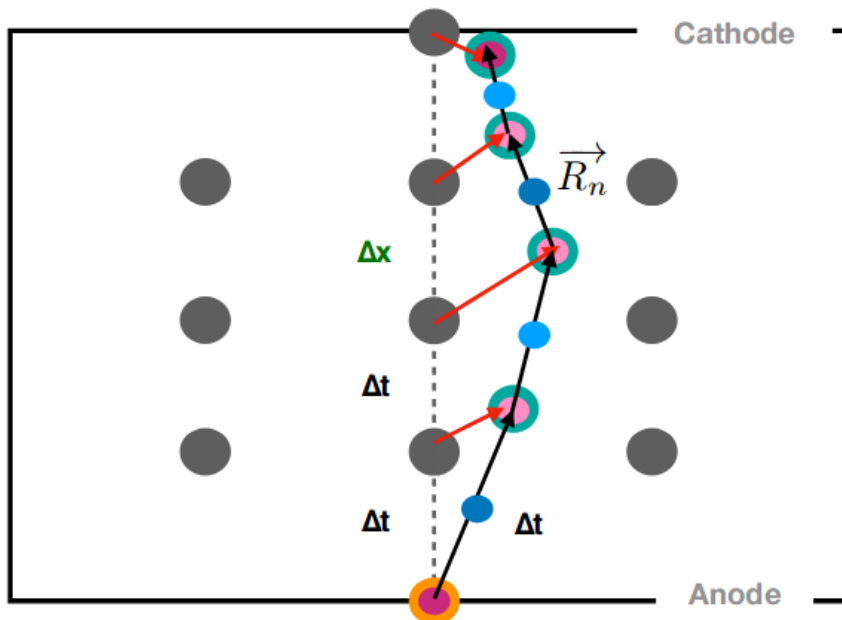
ProtoDUNE Sim/Reco Meeting

*April 10<sup>th</sup>, 2019*

- ◆ Brief presentation on data-driven SCE maps, which we finally have in hand (and validated with “by eye” inspection)
  - Includes both spatial distortion maps and E field maps
- ◆ Methodology:
  - Use spatial offset maps at boundaries, calculated for both data and MC, and form “scale factor map” for each face
  - Interpolate scale factors across entire detector to get data/MC scale factor for each 3D voxel; apply scale factor to MC map (no flow for now, but can do both with and without flow and compare)
  - Obtain forward displacement map everywhere this way; use tetrahedral interpolation to obtain backward map on grid
  - Use backward displacement map to obtain E field everywhere (see slide 4)



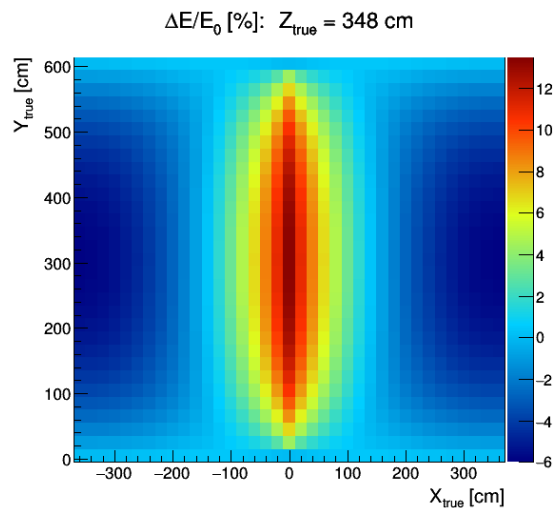
- ◆ Reminder: we have long had our spatial displacement maps at TPC faces (in direction orthogonal to face)



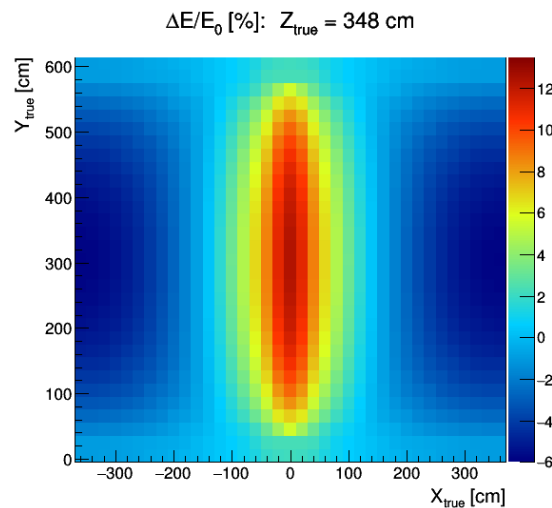
$$|\vec{v}_n| = \frac{|\vec{R}_n|}{\Delta X} |\vec{v}_0|$$

- ◆ E field calculation methodology developed by University of Bern – Mike M. made own implementation
- ◆ Above figure from forthcoming public note on laser-based SCE analysis at MicroBooNE
- ◆ Calculate drift velocity → use  $v(E)$  curve to get local E field

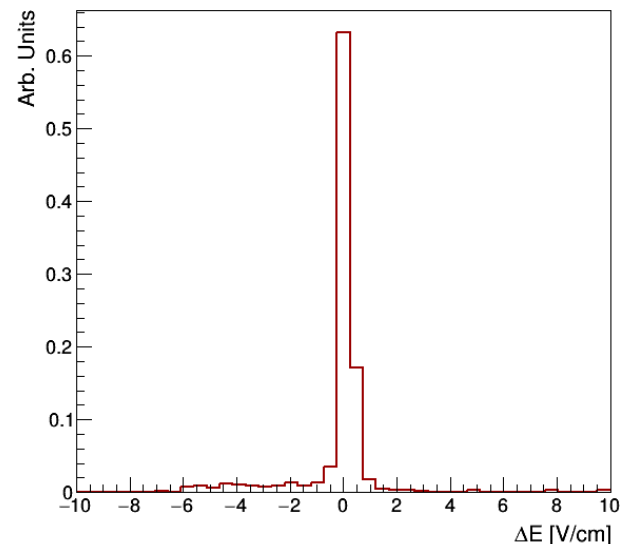
## True E Field



## Calc. E Field

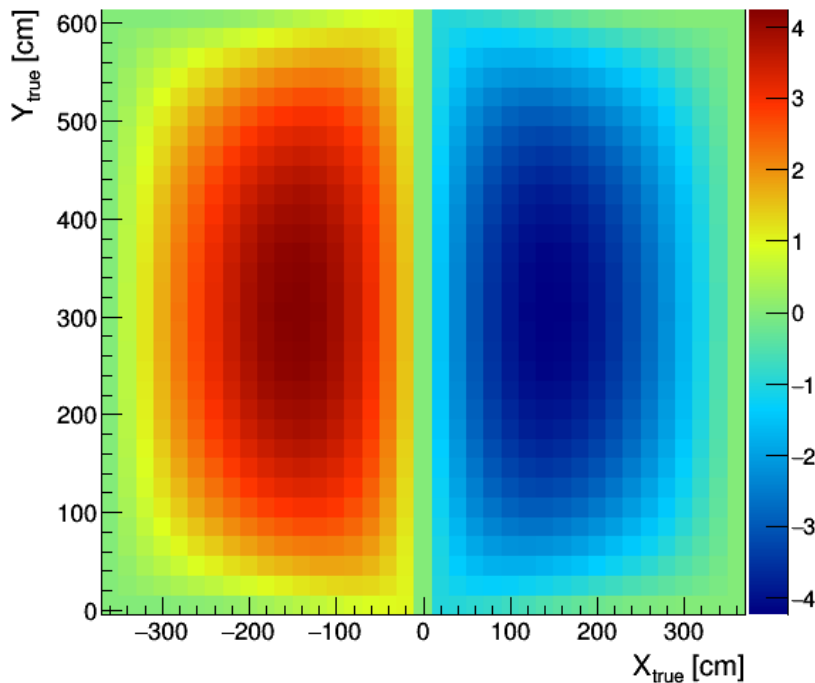


## Calculated E Field Resolution



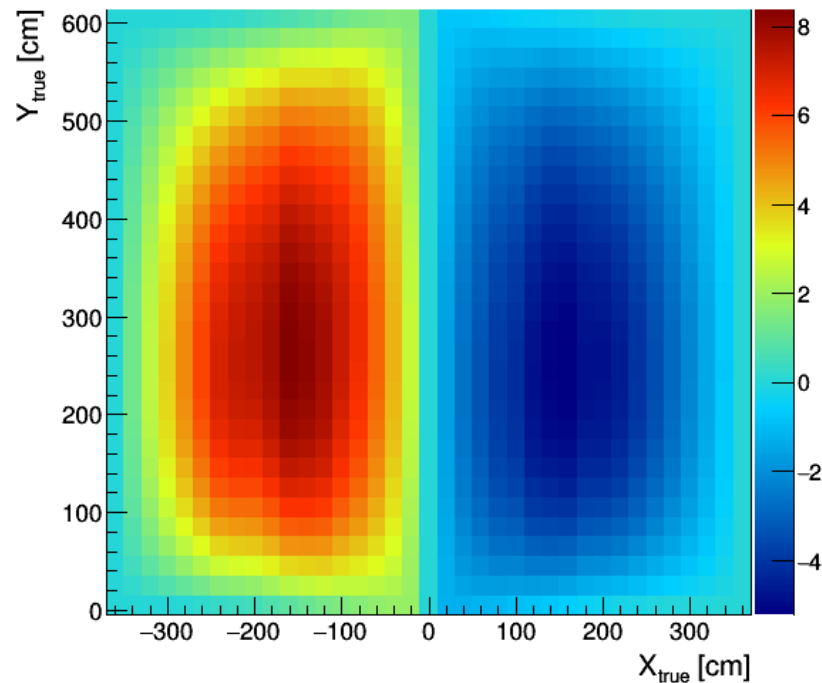
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$\Delta X$  [cm]:  $Z_{\text{true}} = 348$  cm



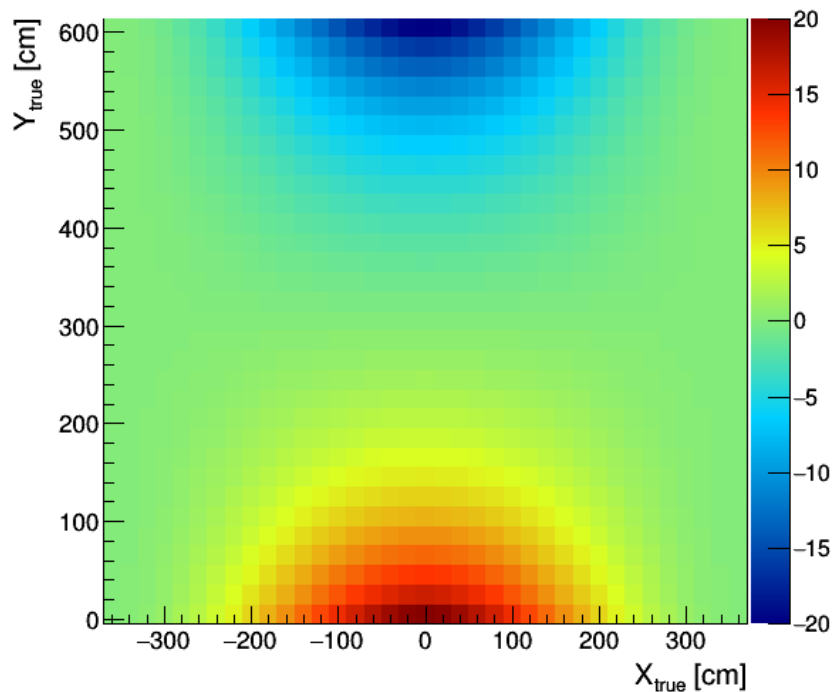
**MC (No Flow)**

$\Delta X$  [cm]:  $Z_{\text{true}} = 348$  cm



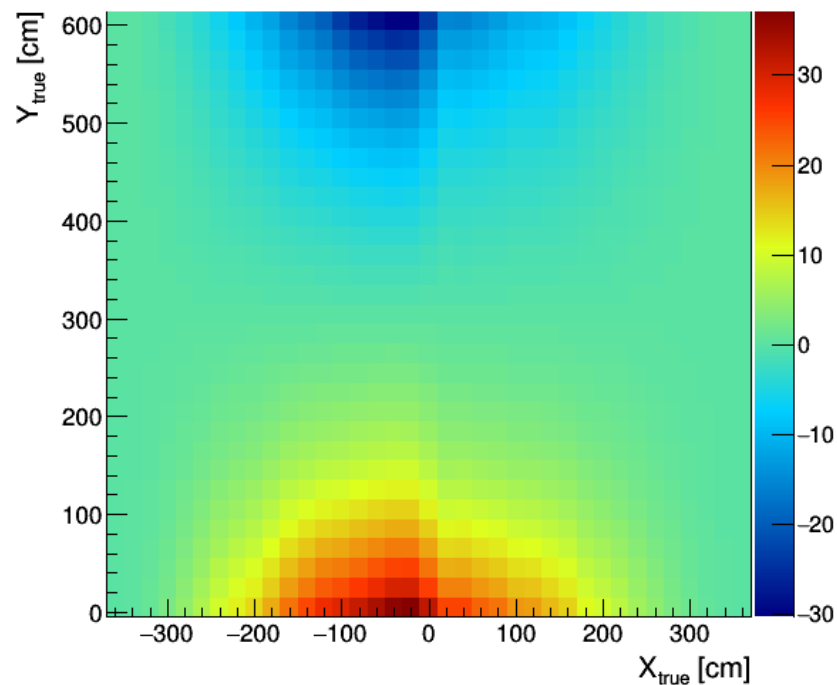
**Data**

$\Delta Y$  [cm]:  $Z_{\text{true}} = 348$  cm



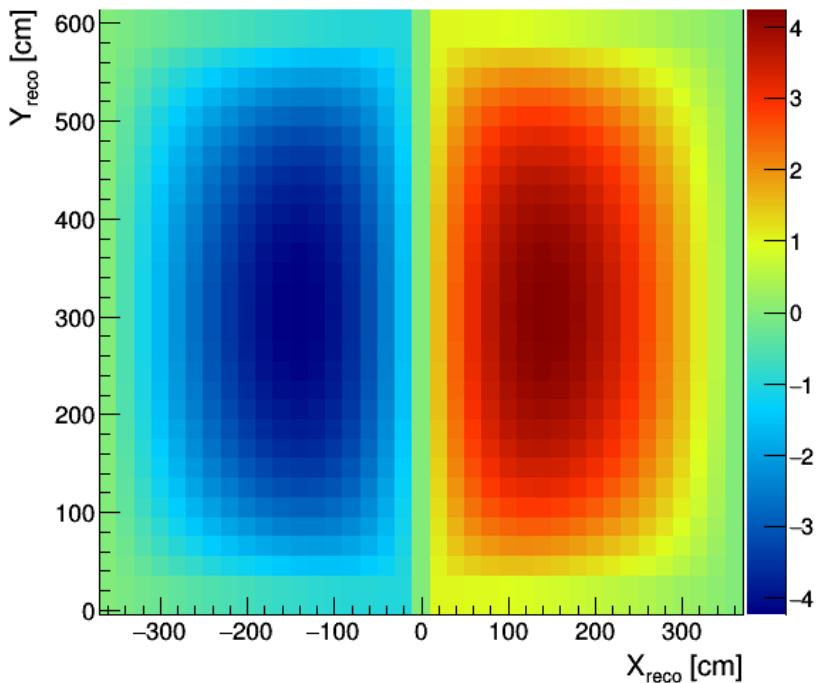
**MC (No Flow)**

$\Delta Y$  [cm]:  $Z_{\text{true}} = 348$  cm



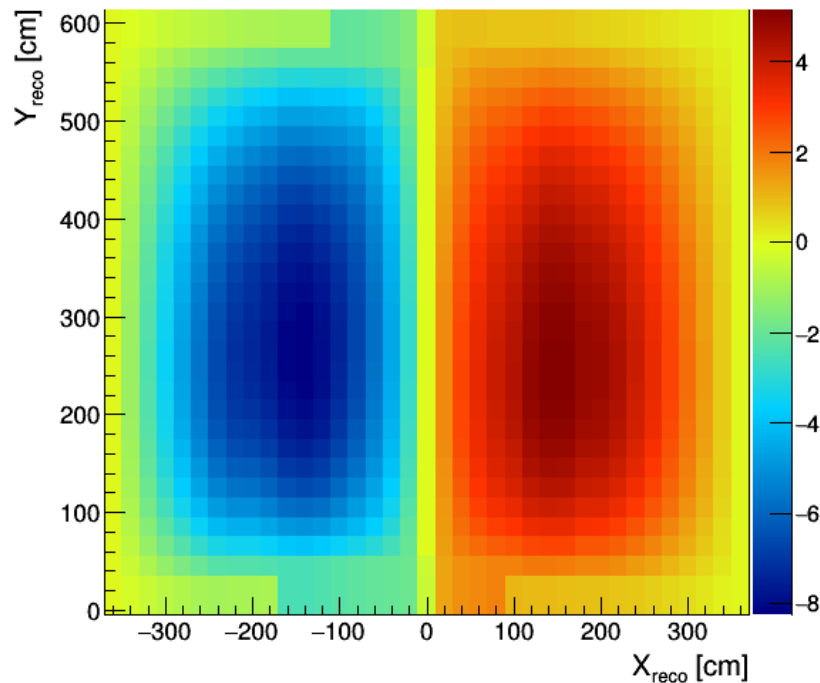
**Data**

$\Delta X$  [cm]:  $Z_{\text{reco}} = 348$  cm



**MC (No Flow)**

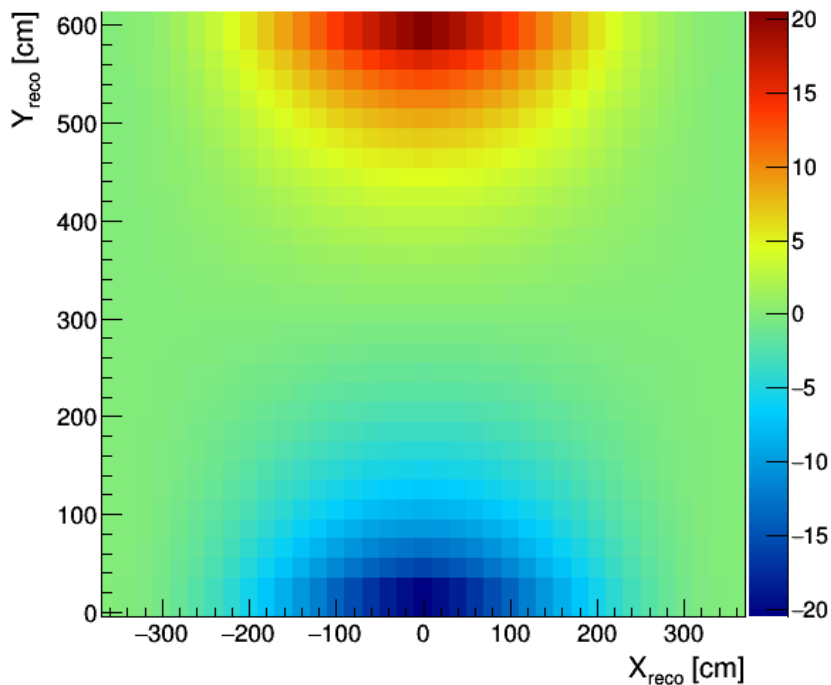
$\Delta X$  [cm]:  $Z_{\text{reco}} = 348$  cm



**Data**

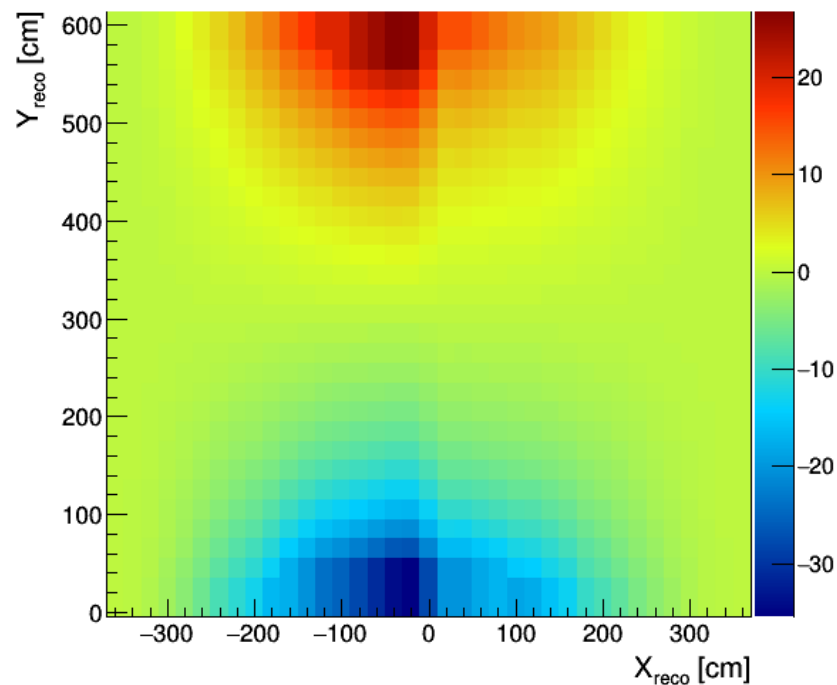


$\Delta Y$  [cm]:  $Z_{\text{reco}} = 348$  cm



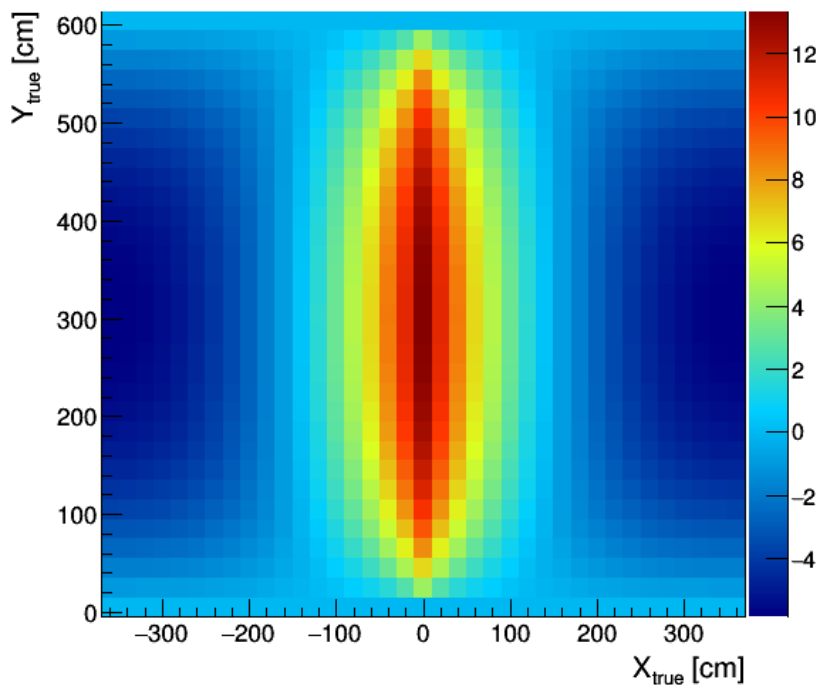
**MC (No Flow)**

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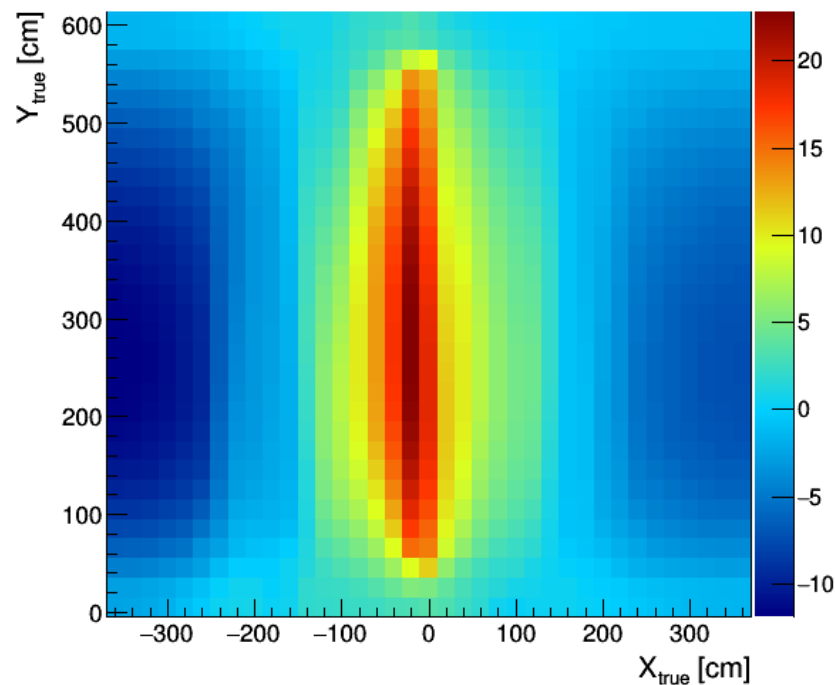
**Data**

$\Delta E_x/|E_0|$  [%]:  $Z_{\text{true}} = 348$  cm



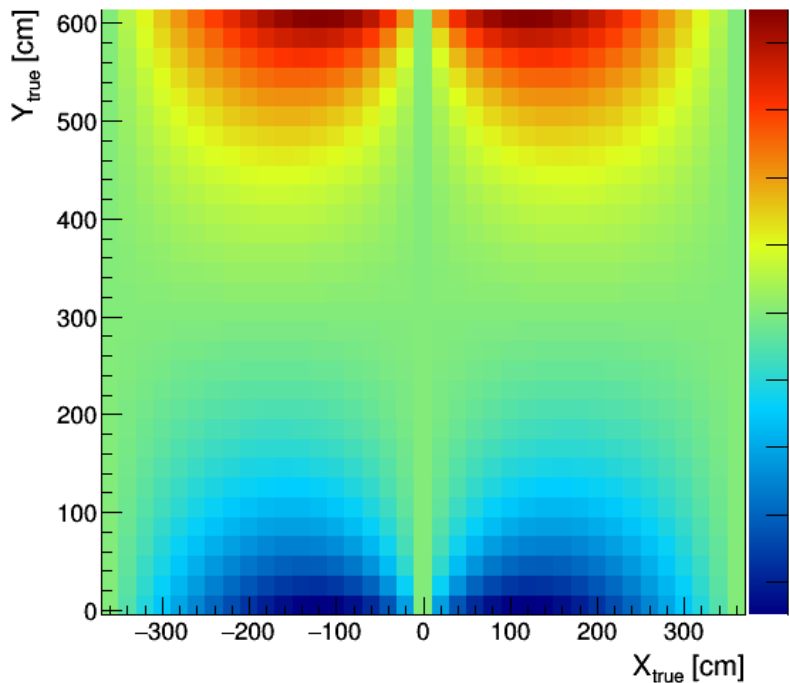
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$\Delta E_x/|E_0|$  [%]:  $Z_{\text{true}} = 348$  cm



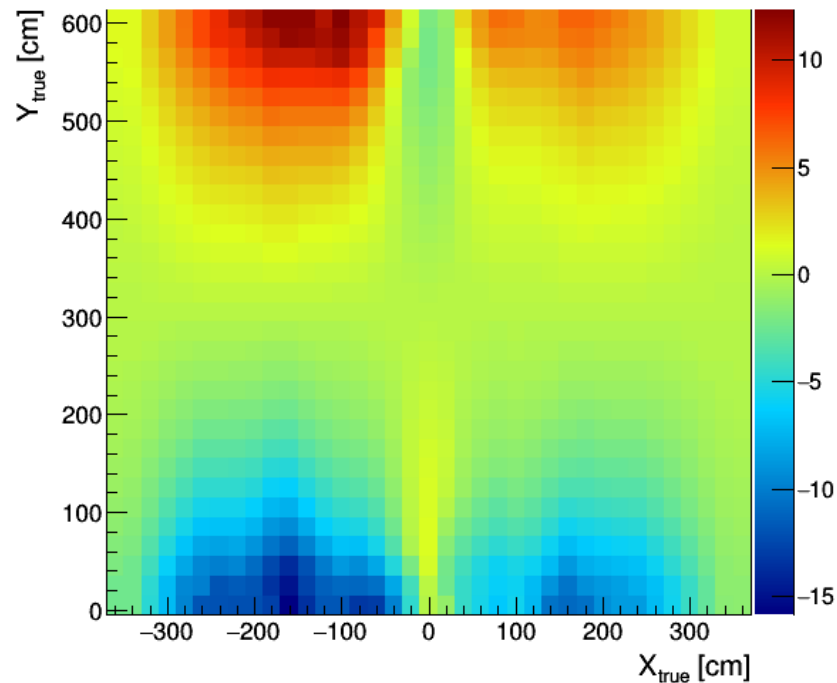
**Data**

$\Delta E_Y/|E_0|$  [%]:  $Z_{\text{true}} = 348$  cm



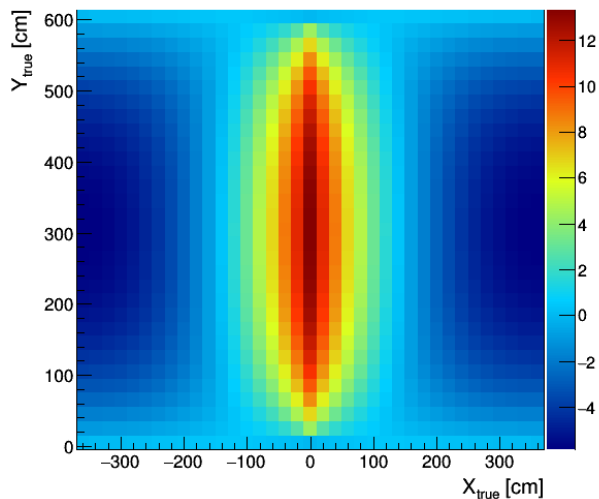
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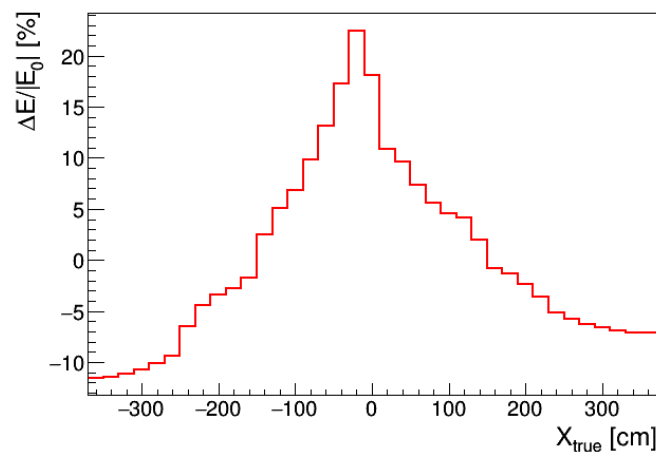
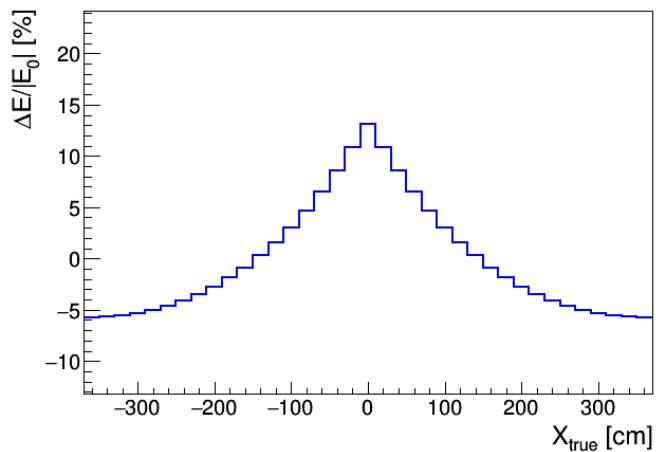
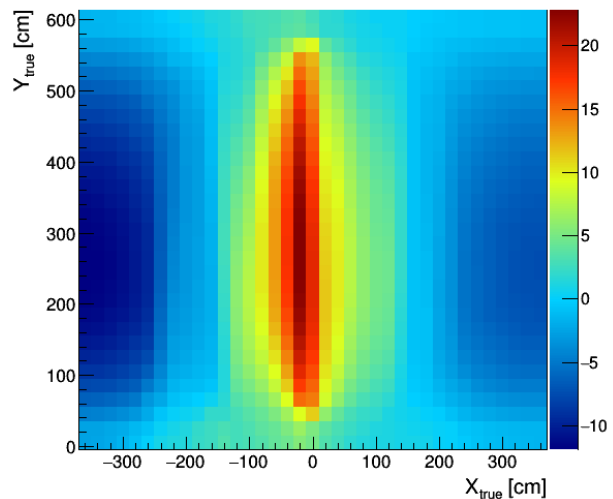


**Data**

$\Delta E/E_0$  [%]:  $Z_{\text{true}} = 348$  cm



$\Delta E/E_0$  [%]:  $Z_{\text{true}} = 348$  cm



**MC (No Flow)**

**Data**

- ◆ First full data-driven SCE maps available, which includes:
  - Forward displacement maps (simulation)
  - Backward displacement maps (reconstruction)
  - Electric field maps (simulation/reconstruction)
- ◆ This was done by interpolating results at TPC boundaries
  - Will spend more time investigating method of using pairs of crossing tracks to do true 3D correction in bulk – does it help?
  - Data can tell us which is performing best (dE/dx resolution, data/MC comparison of track angles/lengths)
- ◆ Would be nice to produce new MC with new SCE simulation
  - Also include Hannah's SCE calibration in reconstruction chain, which targets dE/dx of  $t_0$ -tagged tracks (beam and cosmics)

# BACKUP SLIDES