SCE systematics for cross-section analysis

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Alternative SCE map:

Disclaimer: This is not the final or the best SCE map we can get.

The map uses crossing track method as described in microBooNE experiment MicroBooNE_SCE_paper but selecting ProtoDUNE-SP specific anode-cathode-anode tracks.

SCE causes **Spatial distortion** as well as distortion in **Efield.**

Spatial distortion (position offsets):

What we already have?

- Forward displacement map (which is used in simulation) and Backward displacement maps (which is used in calibration).

- Good coverage except for regions with Y<~100 and Y>~500, and Z<~40 and Z>~660, in reconstructed coordinates.

- beam particles are confined within ~200 cm<Y<500cm, and Z>30cm (for 1GeV beam they may not go further than 500cm).

Spatial distortion (position offsets): contd

What we lack or need?

Y<100 and Y>500 region not critical for systematics on cross-section analysis? We can just use the default SCE map values or simply use linear extrapolation of the offsets from alternative map.

Z<40cm very important. Few suggestions in order of preference:

(i)Use offset values from CRT measurement if available.

(ii)Linearly extrapolate the offset values measured in alternative map from closest bins to the boundary. This had been tried for track length estimation previously and the results are in close agreement with results from default SCE map.

(iii)Use default SCE map to fill the offset in missing bins.

Efield distortion:

Recombination factor depends on the Efield.

Efield has 3 components:
Ex, Ey, Ez (Ey and Ez are negligibly small compared to Ex --> more details in next slide).

What I have measured for the alternative map.
Average Ex in the central region of the TPC, which is a good approximation for central region. However, if we look further away from the central region, there will be bigger dependence of Ex on y and z coordinates.

Missing:

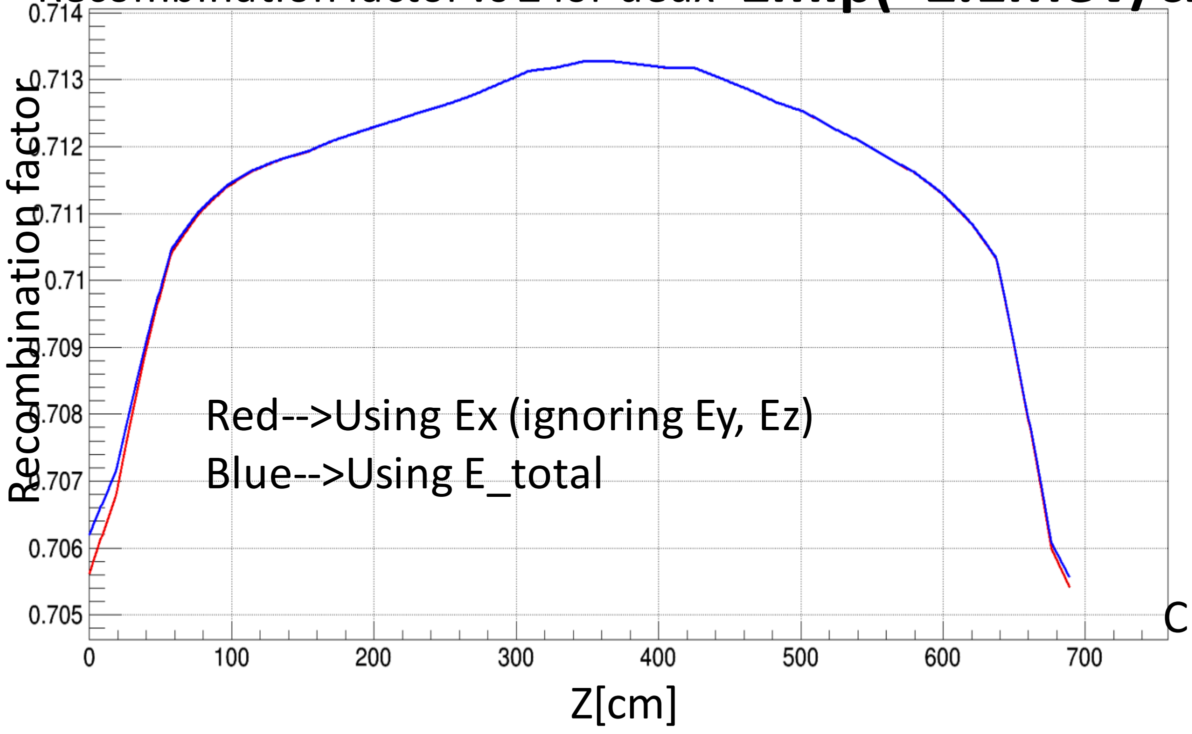
Local variation in drift field in Ex (x, y, z). I have 3 suggestions in order of preference):
(i)Use the technique used in microboone LASER analysis (for details microBooNE laser paper) to measure local Ex based on position offsets - which we already have.
(ii) Ignore the dependence of Ex on y and z coordinates.
(iii)I can use anode-cathode-anode method for EfieldX (x, y, z) but the statistics may or may not be enough for this (need to do more studies).

I will prefer to use (i). To save work/time (ii) can be also be used.

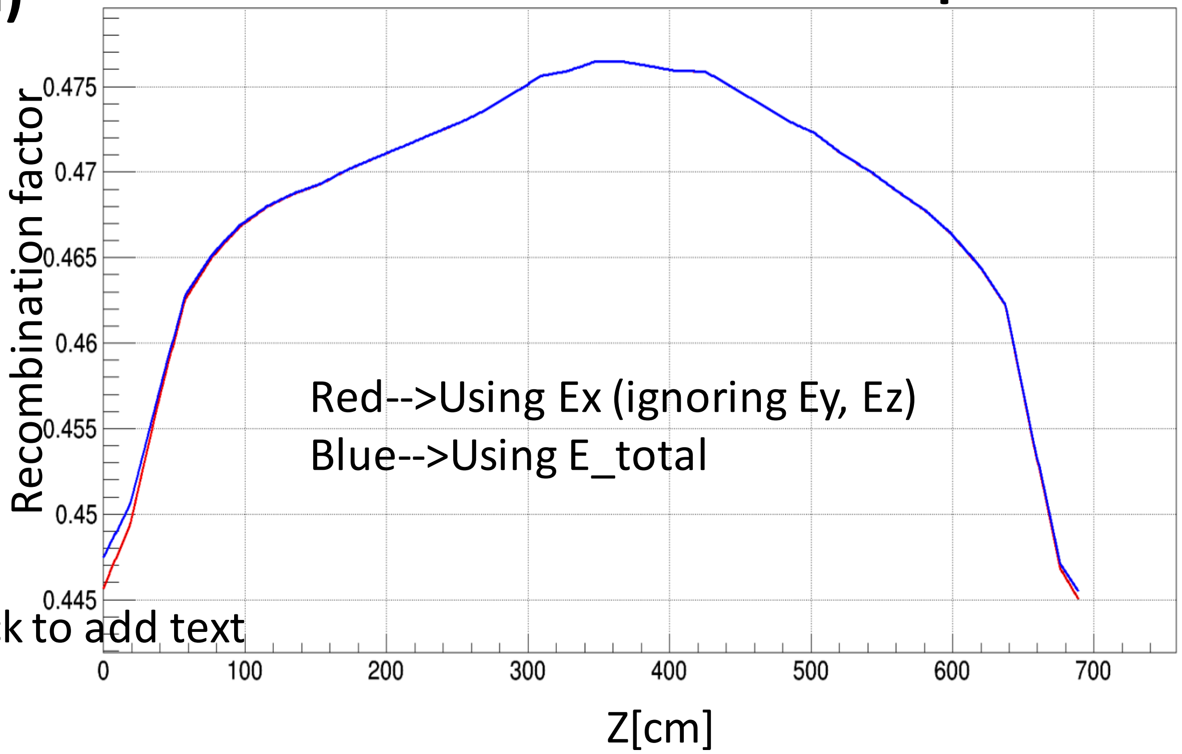
What about Ey and Ez?

Ey and Ez appear only in the recombination factor, where we use E_total=sqrt(Ex^2+Ey^2+Ez^2)

Recombination factor vs Z for dedx=**1mip(~2.1MeV/cm)**



Recombination factor vs Z for dedx=**5mip**



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Plots showing recombination factor as a function of Z for fixed X=-20cm and Y=420cm

From the above two plots, effect of Ey and Ez on recombination is very small, less than 0.1% at mip, and <0.5% at 5mips
The above study is performed using default SCE map.
Suggestions:(i) We may use the Ey, Ez values from default map, (ii)ignore Ey, Ez (iii)use Z and Y offsets from alternative map to measure Ey, Ez as described in microBooNE LASER paper which however does not looks as trivial as calculating Ex

Conclusions, Questions?