Bug with simulation in source foil bulk

(all souce foils bulk MC have the bug)

2026/07/02 Collaboration meeting, Bratislava

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Simulation set : phase 2

Source Foil Bulk (SFB)

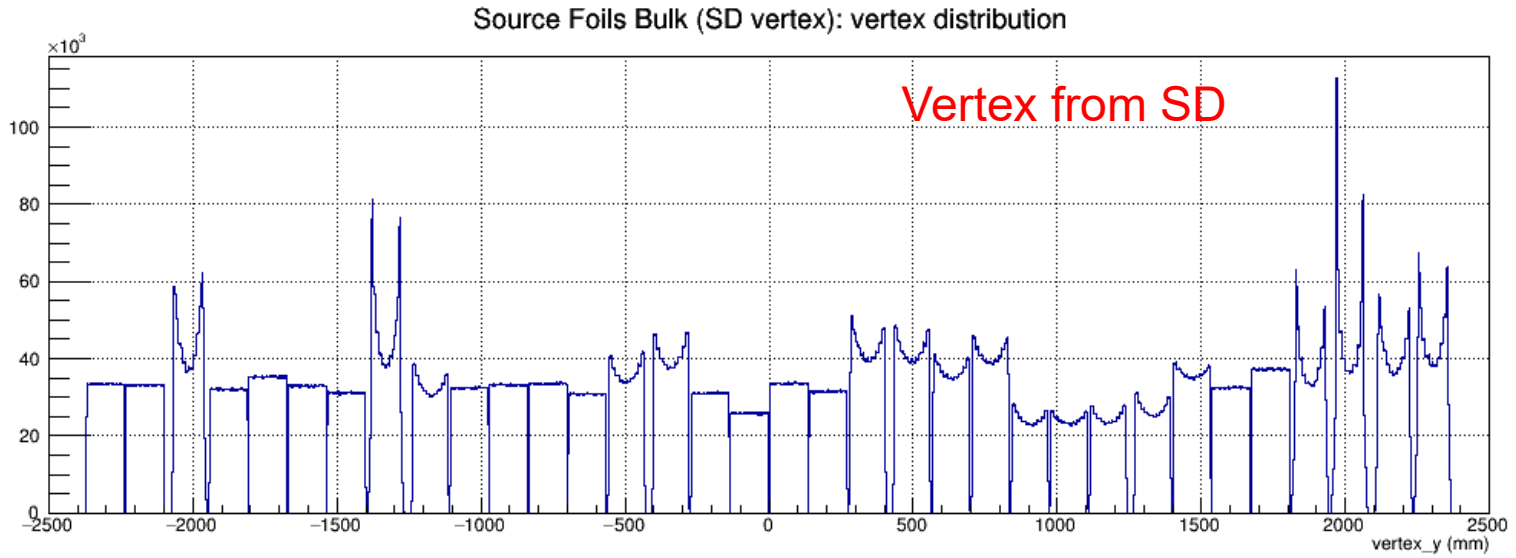
- 150×10^6 events simulated

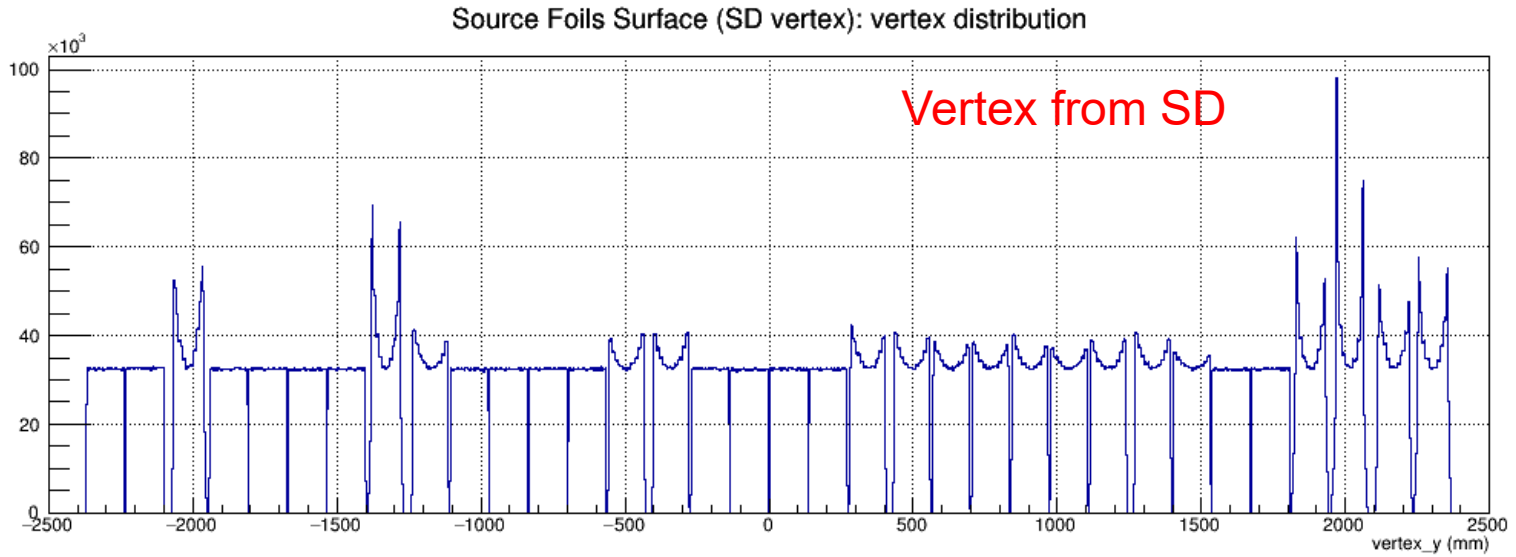
Source Foil Surfaces (SFS)

- 149×10^6 events simulated

- SFB : discrepancy between foils expected

  ➔ source foils mass not homogeneous
- SFS : vertex homogeneity in the y axis !





BiPo event reconstruction

Source Foil Bulk (SFB)

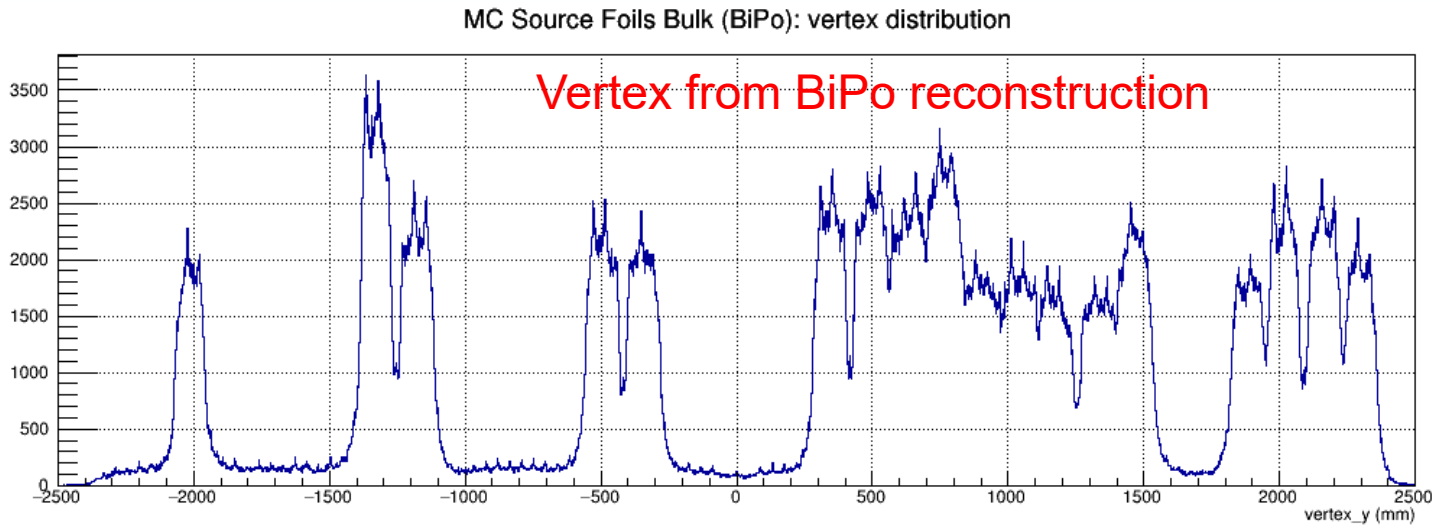
$\epsilon = 3.52\ \%$

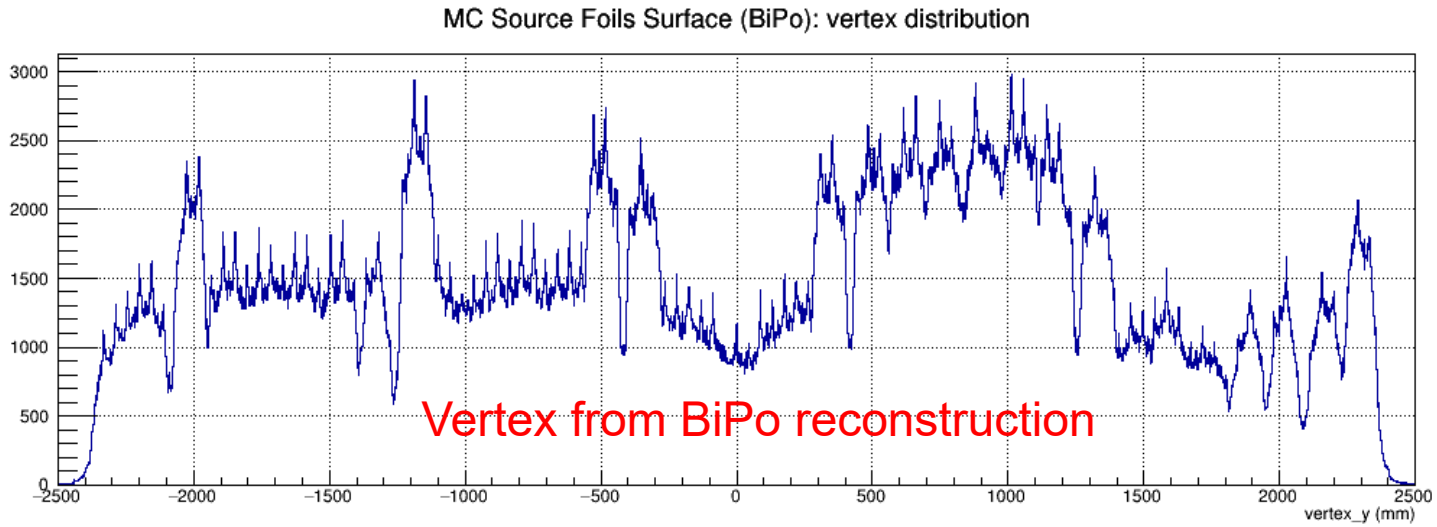
Source Foil Surfaces (SFS)

$\epsilon = 4.86\ \%$

- SFB BiPo efficiency ≃ SFS !
- More detection for ITEP foils (cureved)
- ≃ same event number for ITEP (SFB/SFS)

Curvature effect ??!



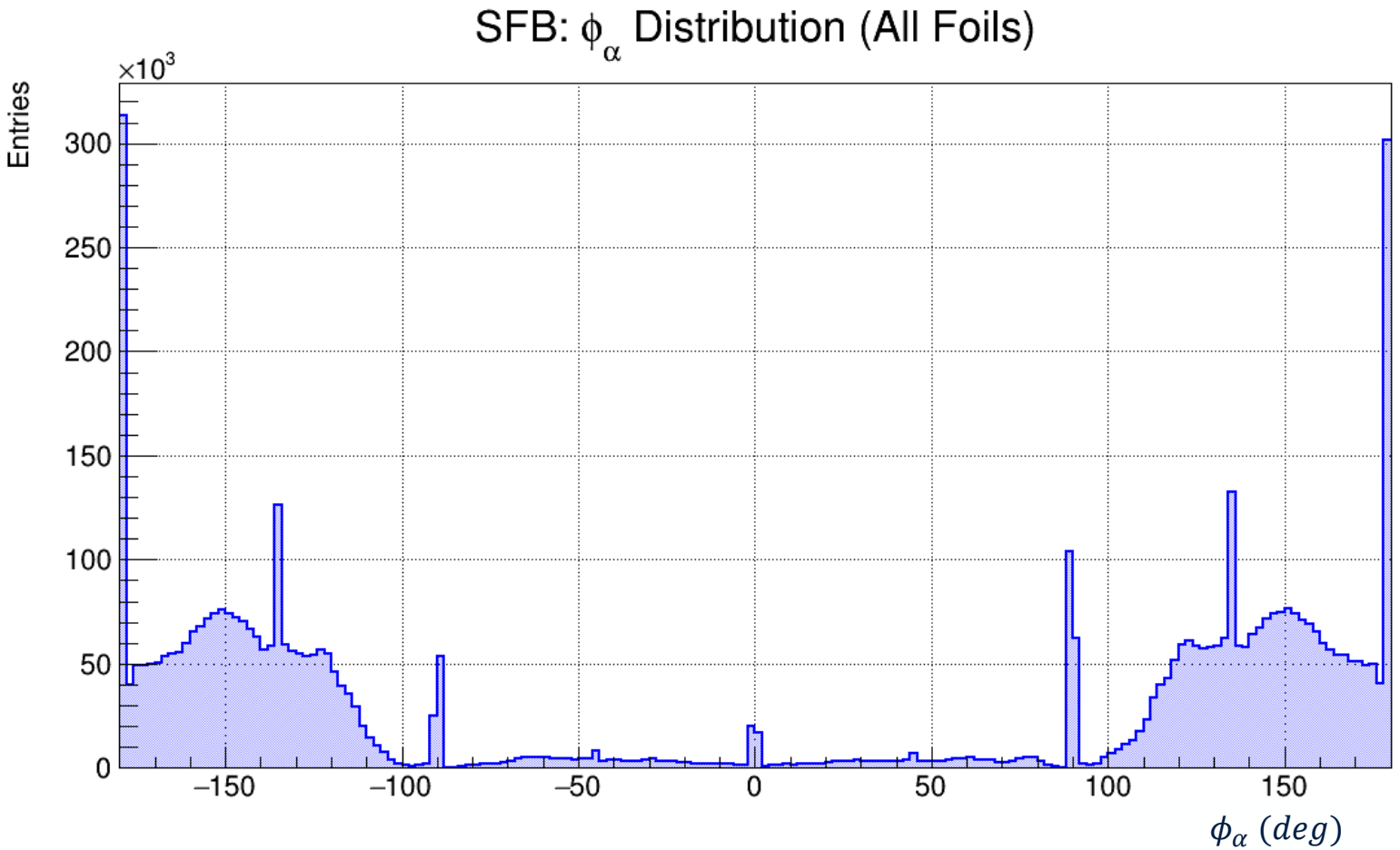


BiPo topology event : Φ_{alpha}

SFB MC

$\phi_\alpha \in$ [-180, 180] deg

- $\phi_\alpha \simeq 0°$ ➔ alpha in + x
- $\phi_\alpha \simeq \pm 90°$ ➔ Horizontal (+y & -y)
- $\phi_\alpha \simeq \pm 180°$ ➔ alpha in - x
- $|\phi_\alpha| < 90°$ ➔ alpha in + x
- $|\phi_\alpha| > 90°$ ➔ alpha in – x



Alpha go only on -x direction !

BiPo topology event : Φ_{alpha}

SFS MC

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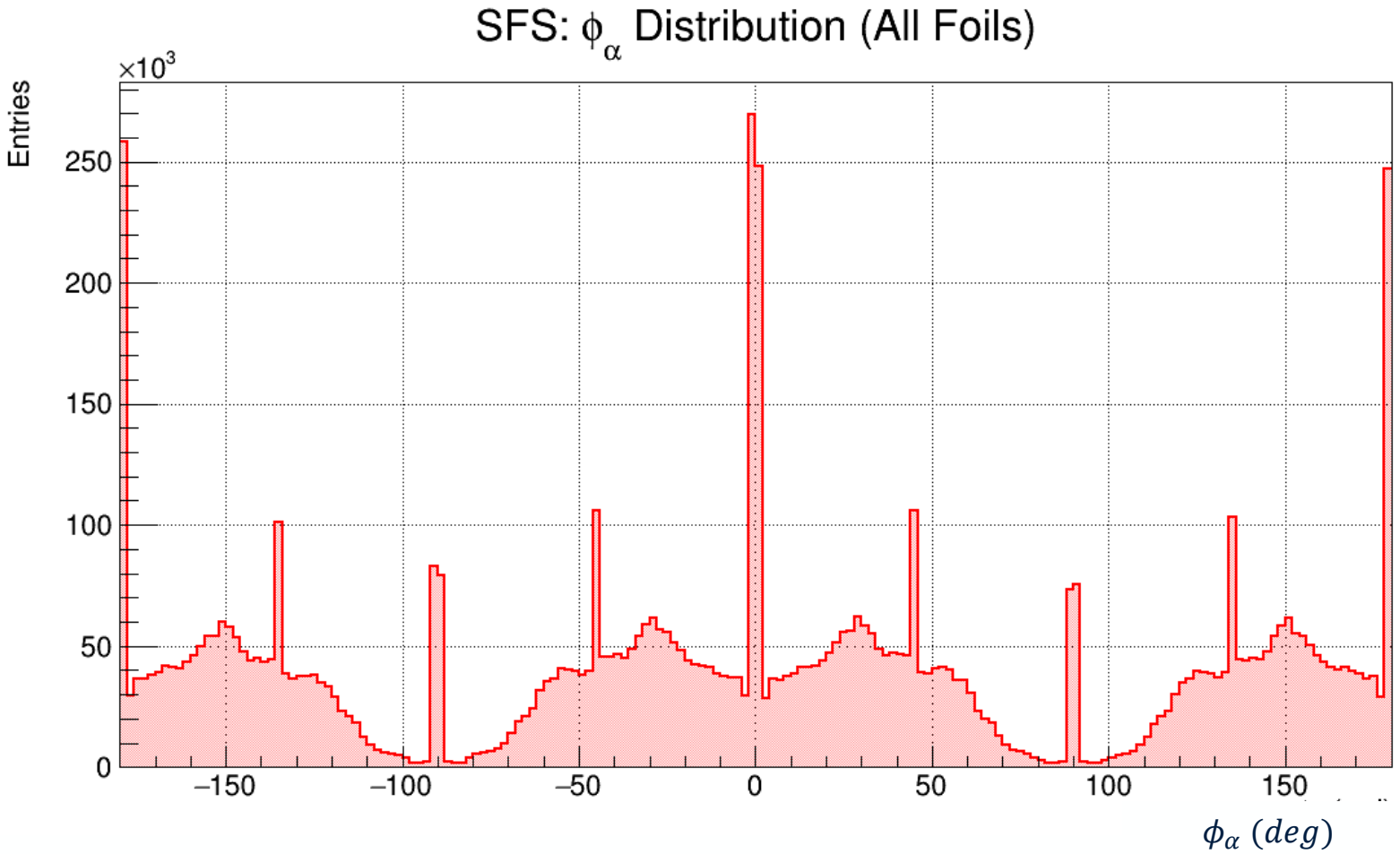

➔ homogeneous !

BiPo topology event : Φ_{alpha} ITEP (SFS & SFB) + data !

$\phi_\alpha \in$ [-180, 180] deg

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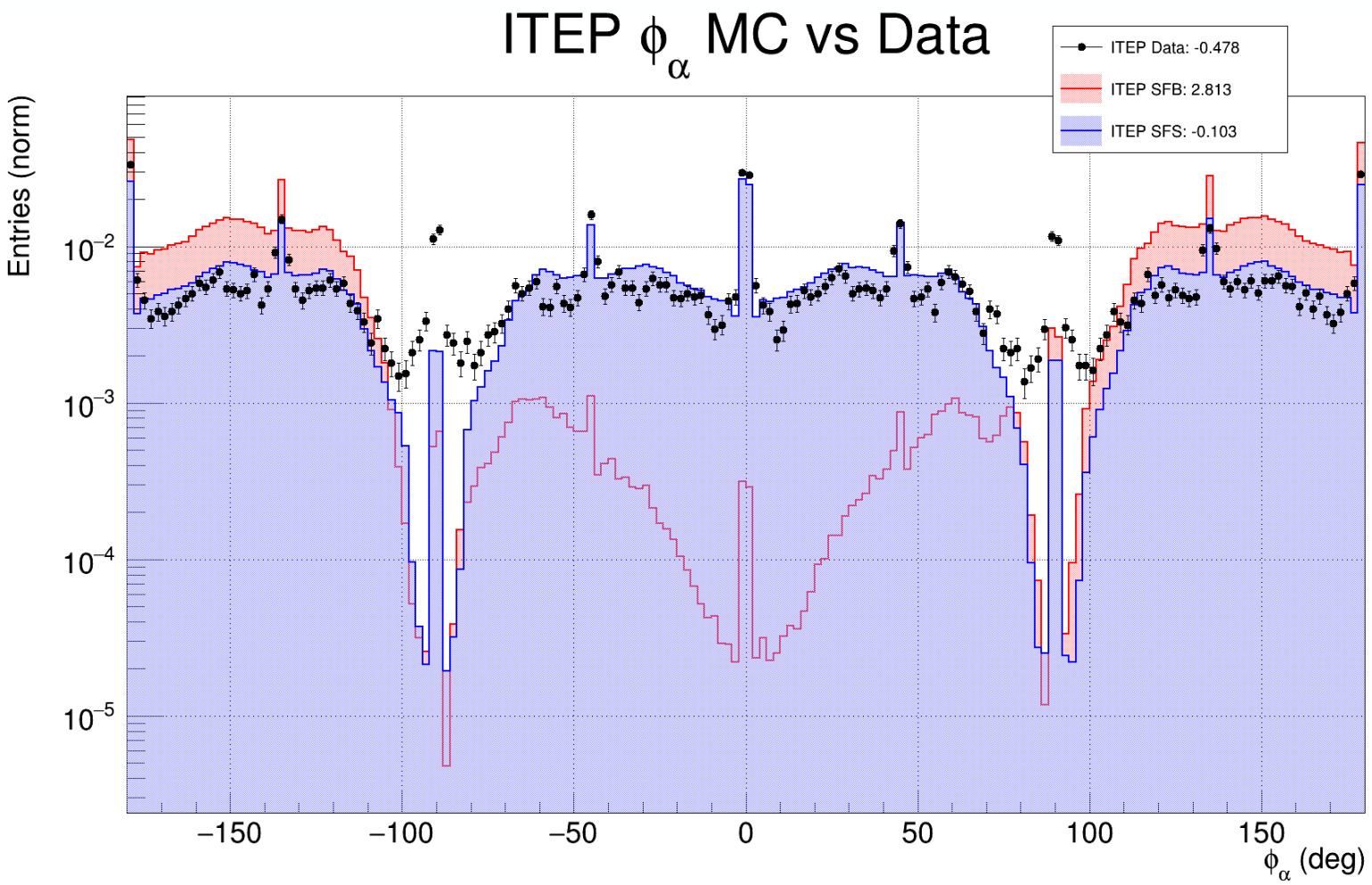
- $|\phi_\alpha| > 90°$ ➔ alpha in – x

Just distribution normalization !

Alpha go preferentially on **–x** axis



BiPo topology event : Φ_{alpha} LAPP (SFS & SFB) + data !

$\phi_\alpha \in$ [-180, 180] deg

- $\phi_\alpha \simeq 0°$ ➔ alpha in + x
- $\phi_\alpha \simeq \pm 90°$ ➔ Horizontal (+y & -y)
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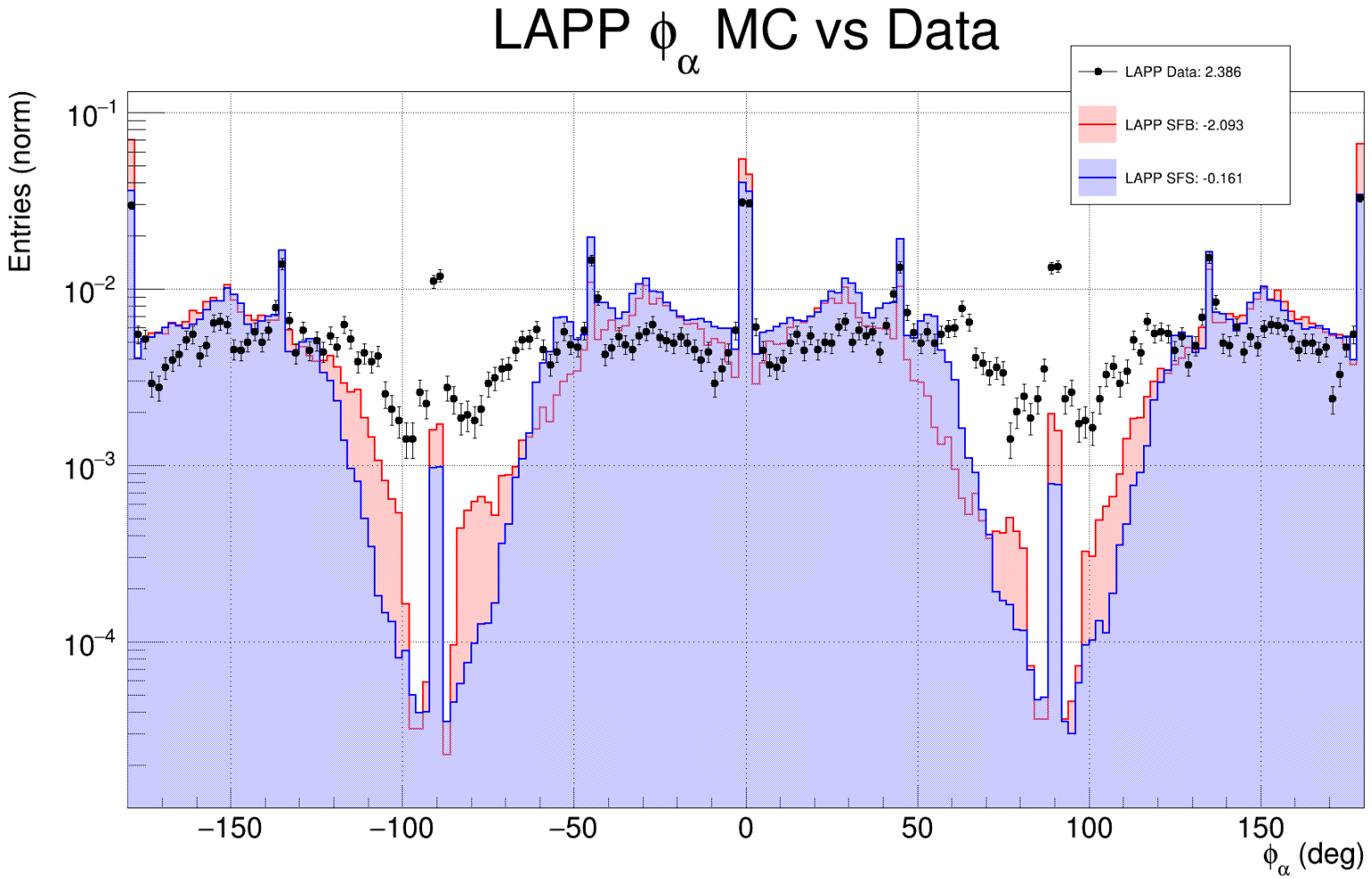
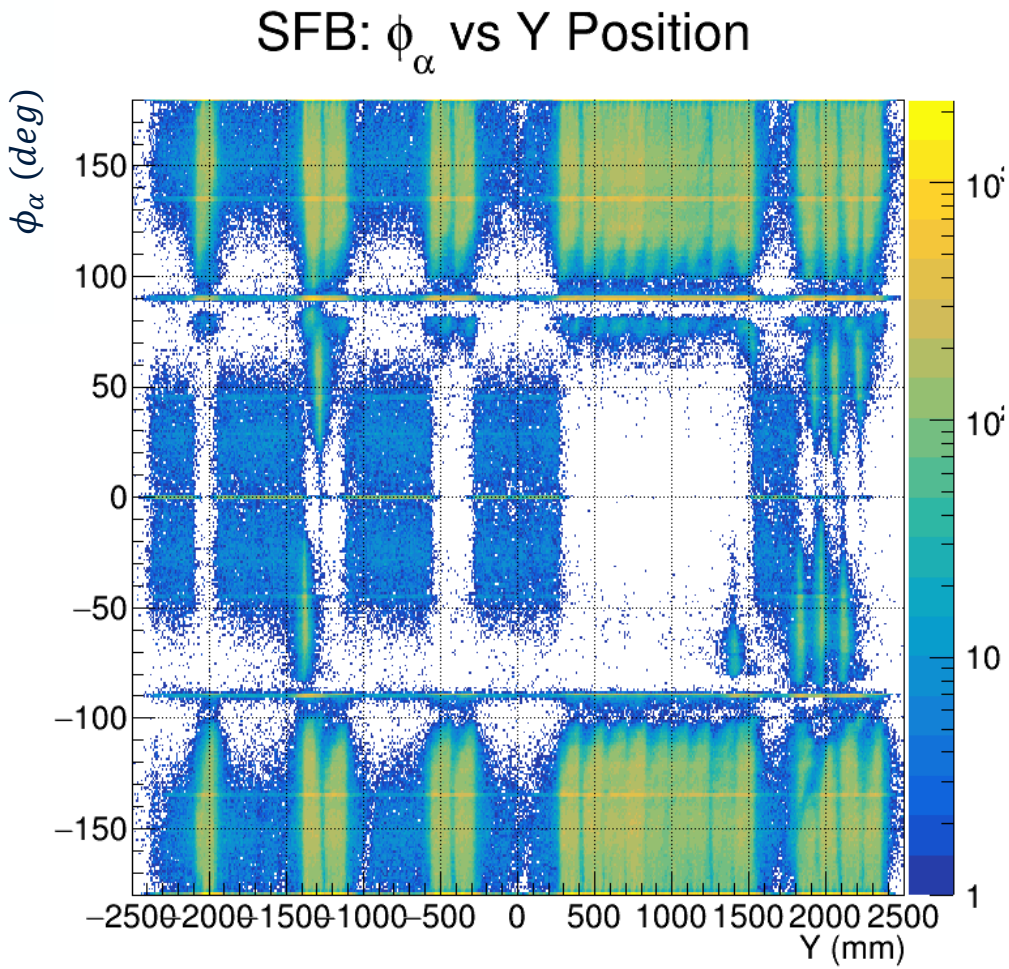
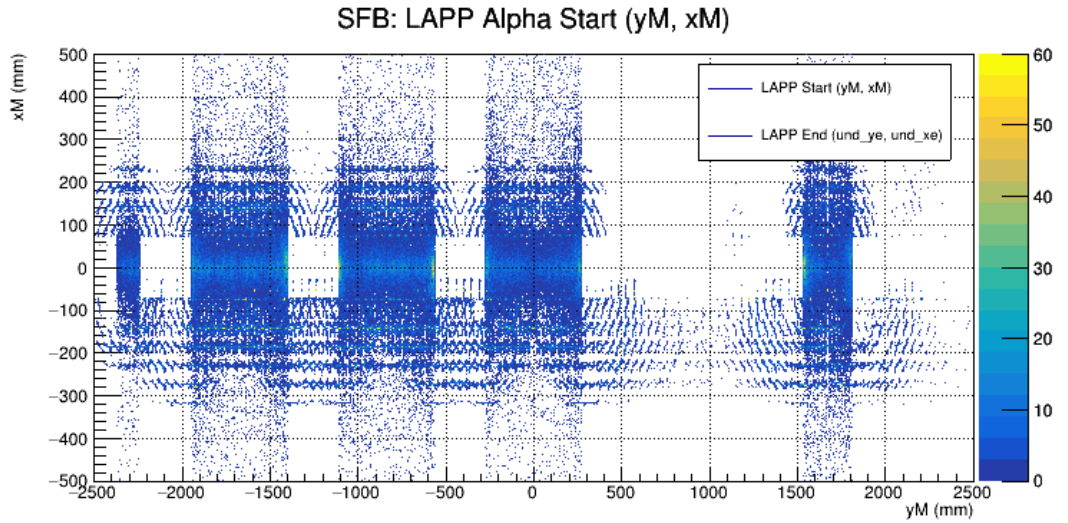
Just distribution normalization !

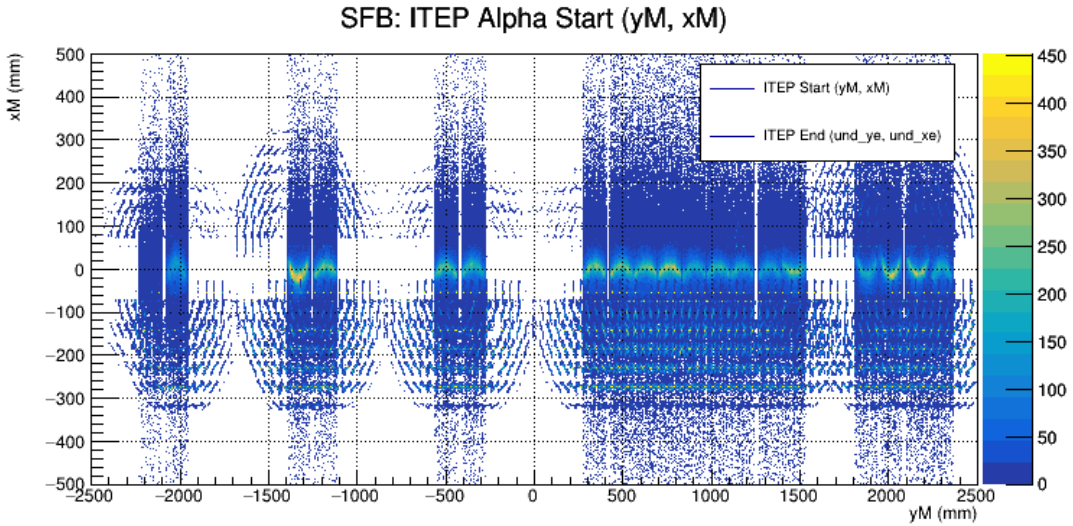
SFS & SFB has same behavior !



BiPo topology event : Φ_{alpha} vs Y axis







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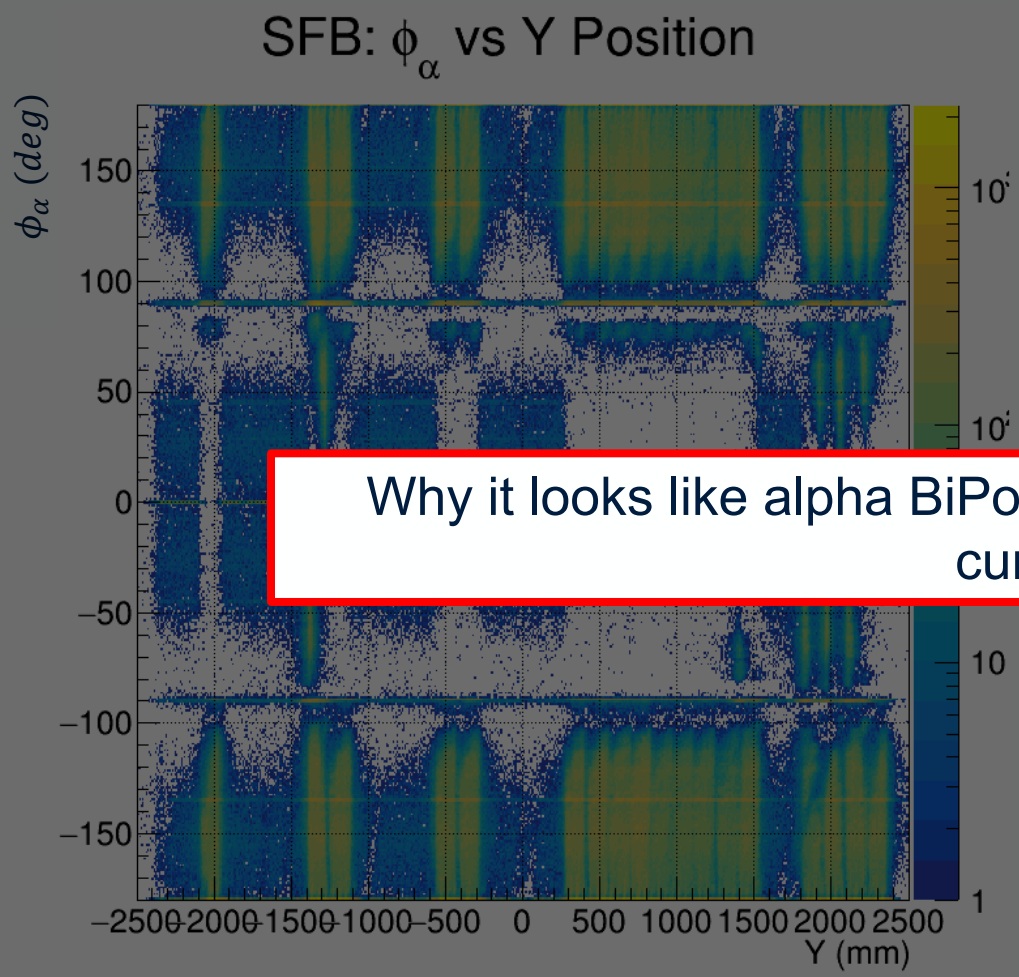
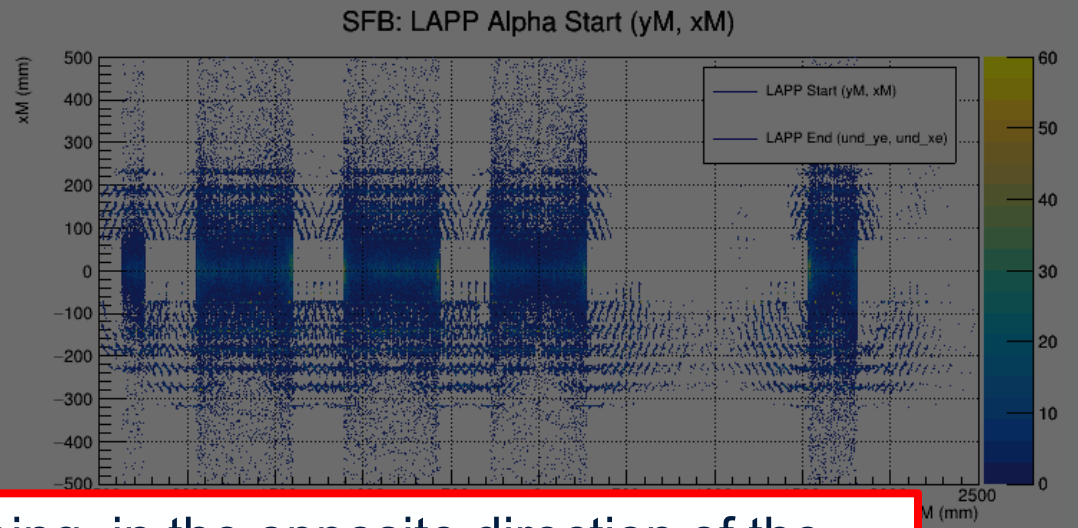
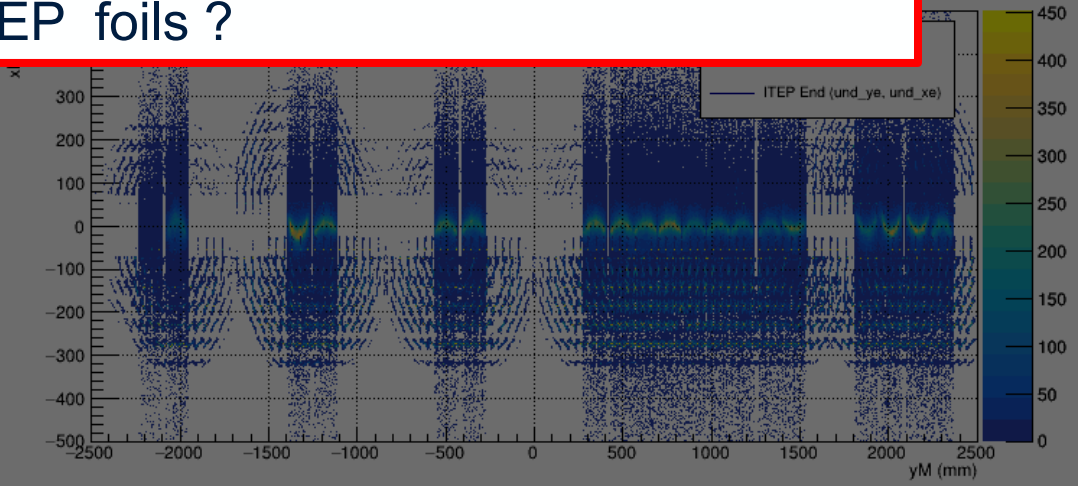
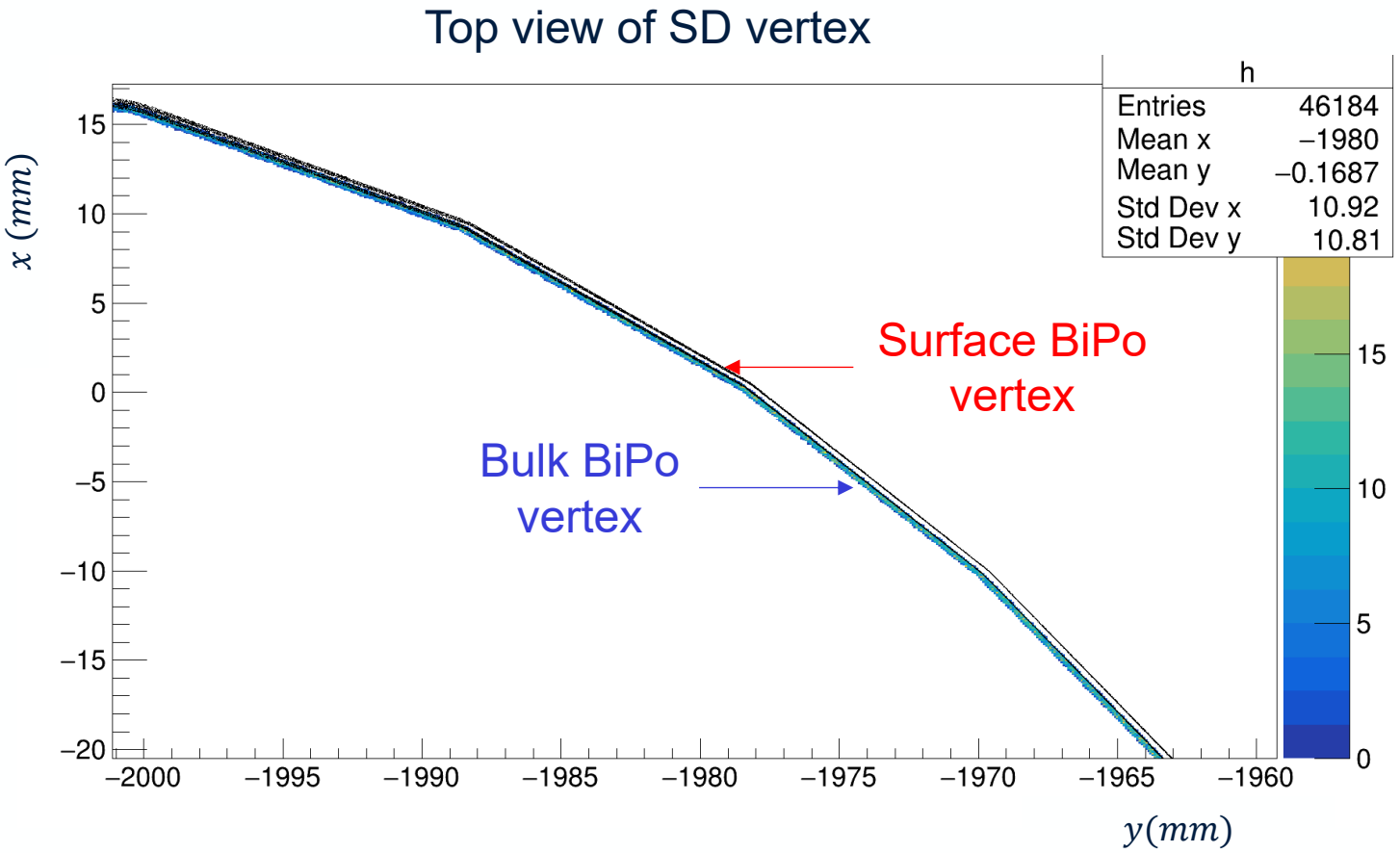




Why it looks like alpha BiPo event are going in the opposite direction of the curvature for ITEP foils ?

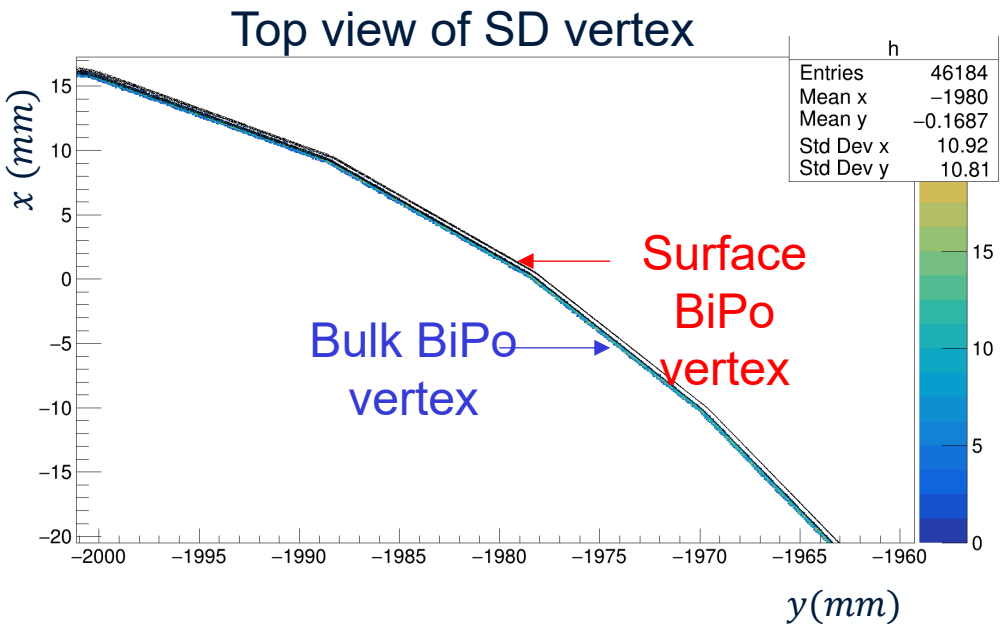


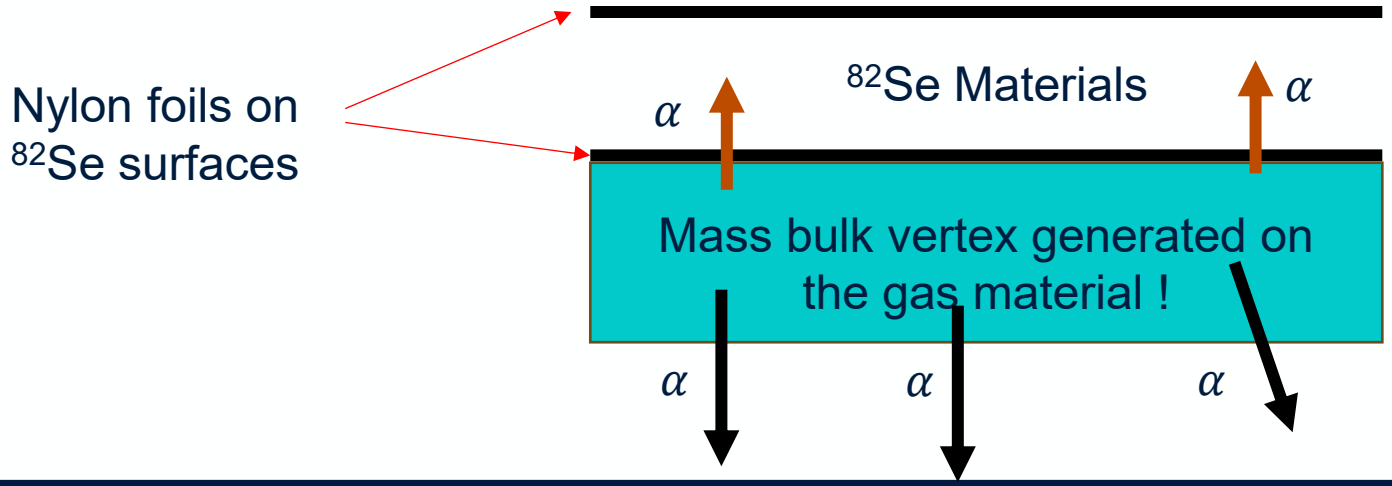
BiPo Bulk/Surface event vertex for ITEP foil



- We see 2 Nylon Surfaces, between them, ^{82}Se material
- We can see BiPo vertex from source foil bulk generator are generated in the He gas, not between 2 Nylon surfaces !
- Hudge impact on BiPo efficiency, all **BiPo going in +x can't cross source foils.**
- Issue on all ITEP foils, LAPP foils are fine.
- Issue for all isotopes simulated in source foil mass bulk ➔ **Energy resolution impact.**

BiPo Bulk/Surface event vertex for ITEP foil





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Bug fixed by François, huge thanks to him !

But sndpu don’t use Falaise 5.1.13b

Reconstructed vertex of BiPo events

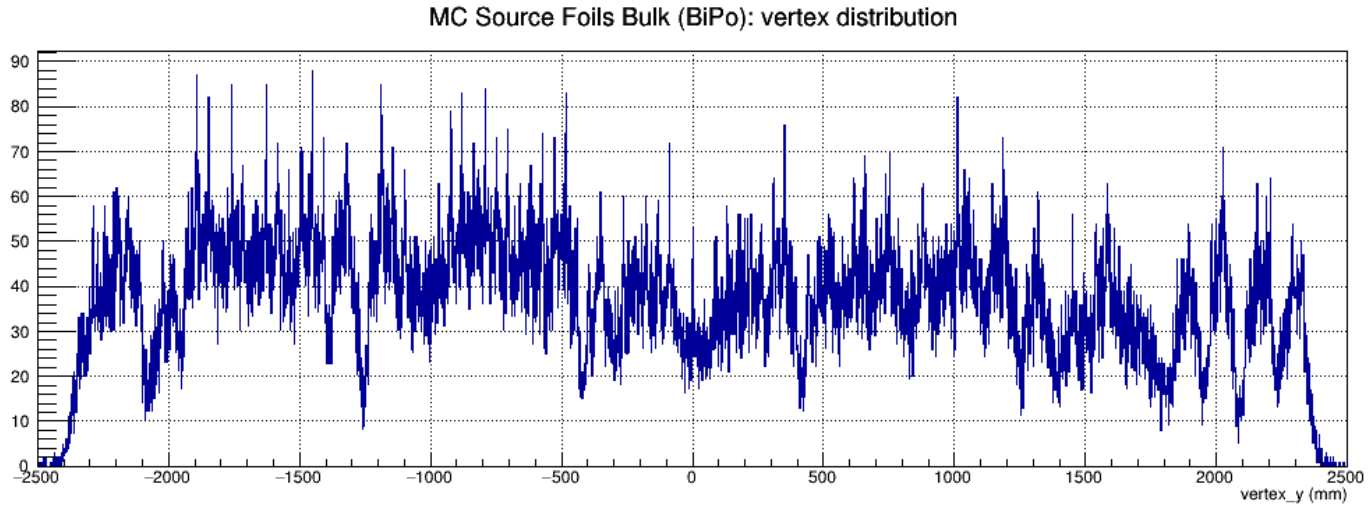
BiPo event reconstructed uniform

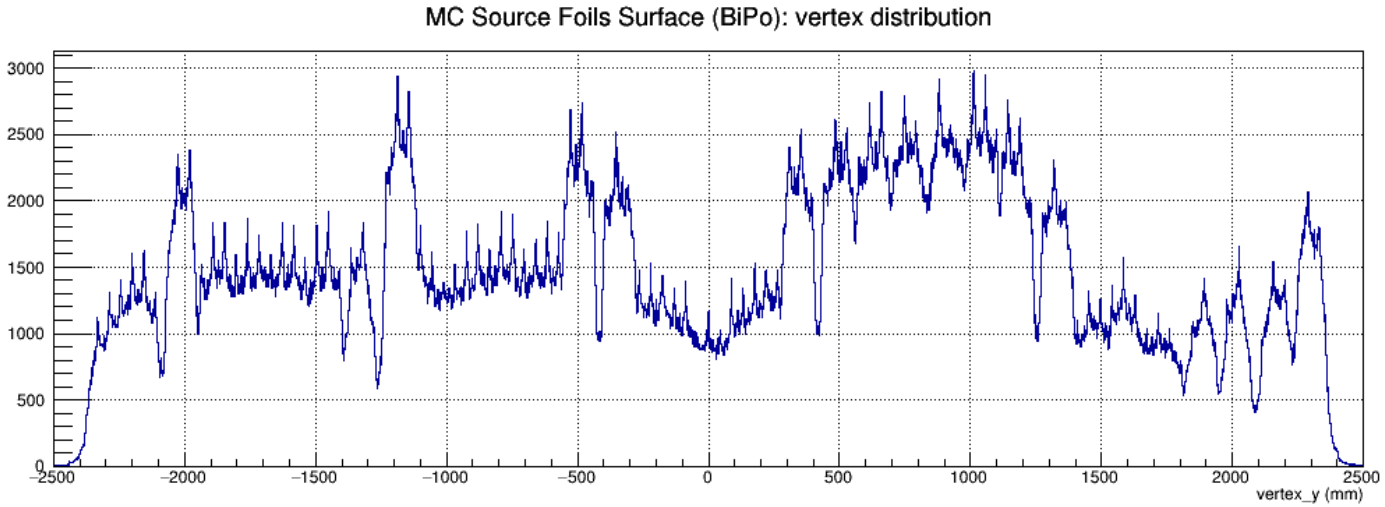
BiPo efficiency with Source Foils Bulk MC:

$\epsilon = 0.37$ % (50×10^6 event generated)

➔ More coherent than $\epsilon = 3.52$ %

(my own simulation)





Check of source foil mass bulk vertex generator

$\phi_\alpha \in$ [-180, 180] deg

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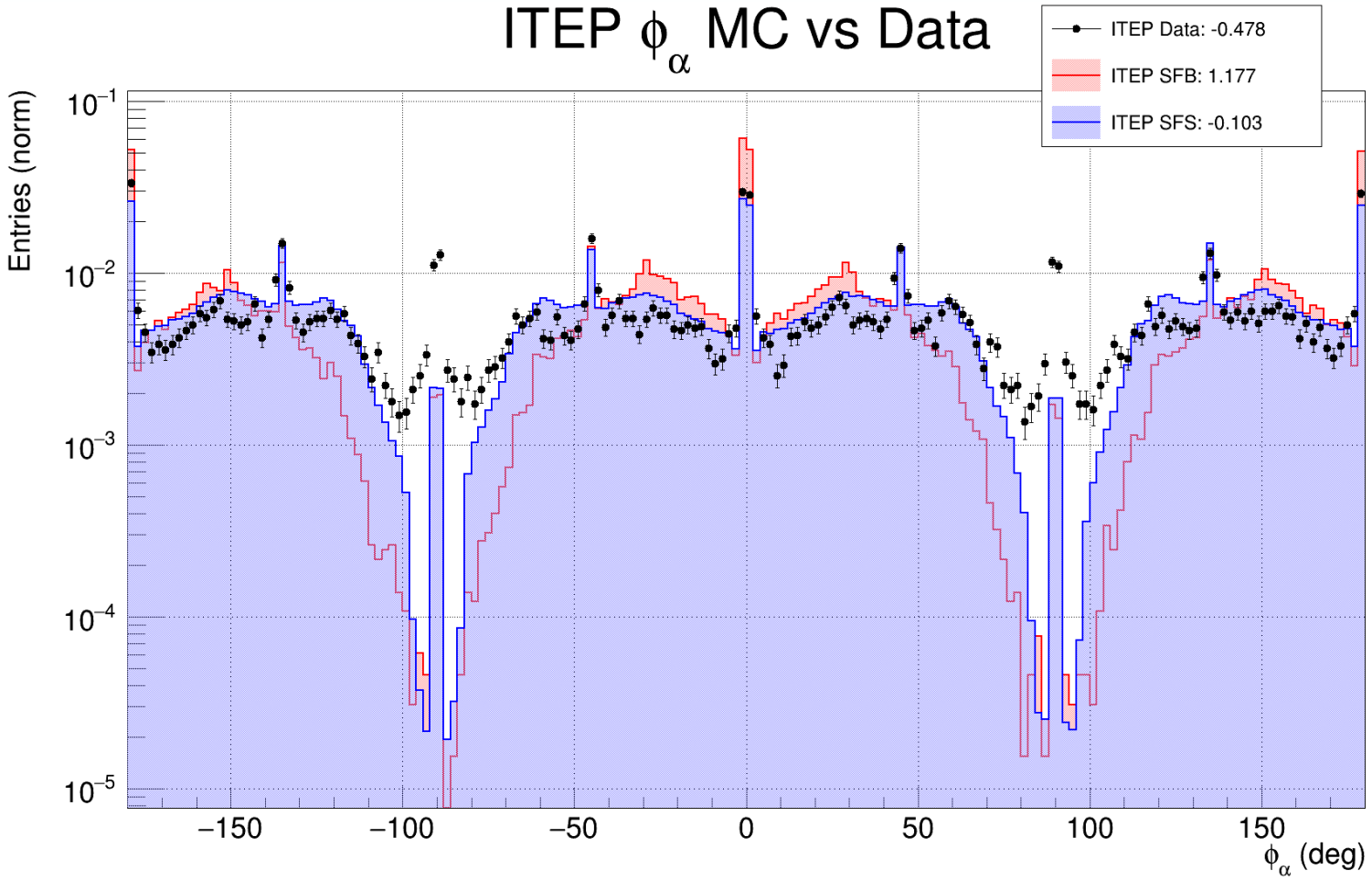
Just distribution normalization !

- Alpha track in all directions now !



Conclusion

- Bug on the source foil bulk vertex generator
- Event were simulated out of the ^{82}Se, after the Nylon foil
- Impact on energy loss of electrons/alpha with this vertex !
- Bug fix work well now !
- Waiting for the new blessed simulation with this correction (after sndpu fix)
- Another proof that alpha study is relevant for SuperNEMO understanding

Thank you ! ☺