# Lumical @ future ee collider first steps - beamstrahlung

Special thanks to Daniel Jeans and Andre Sailer

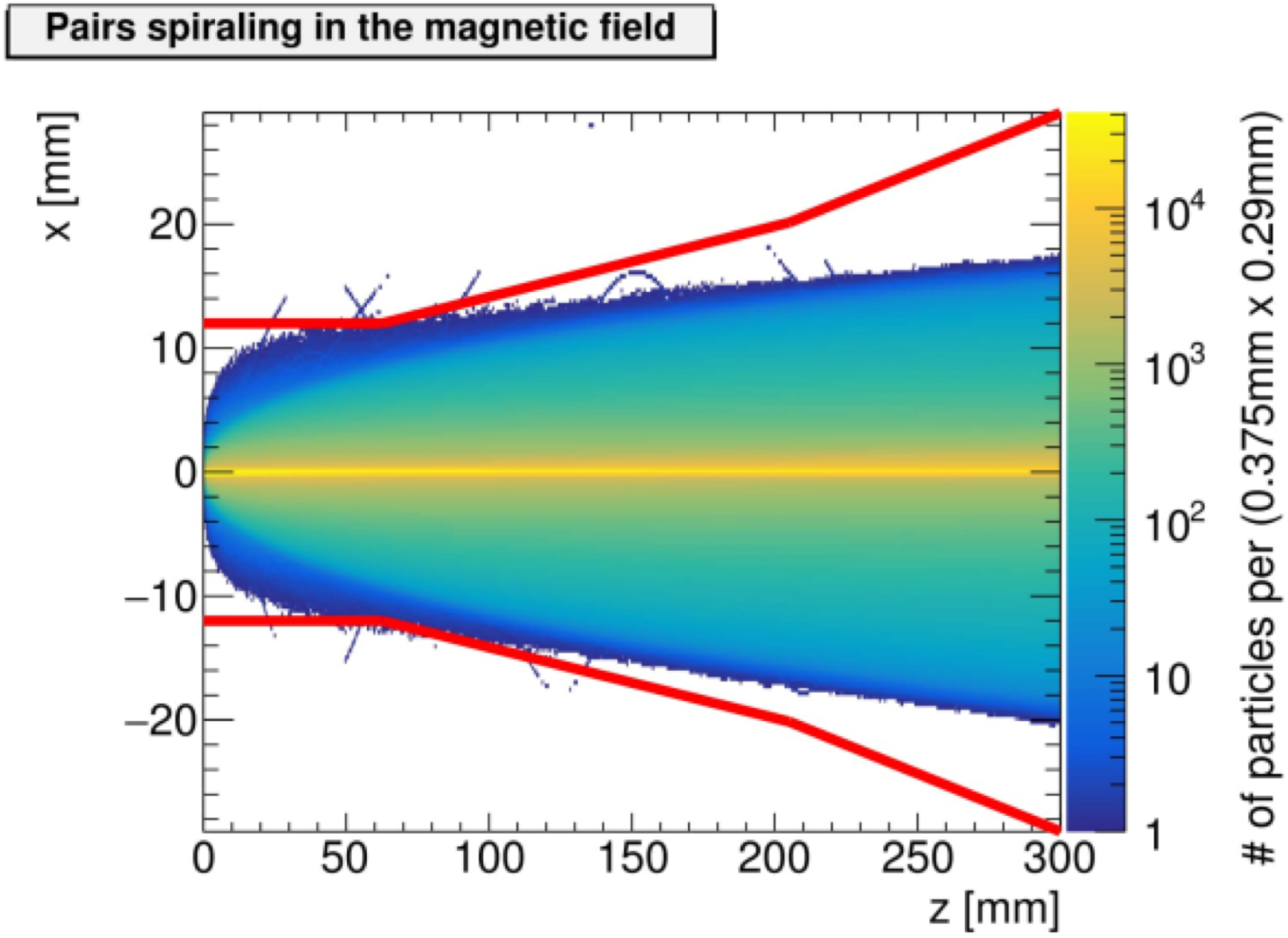
Yan Benhammou, Tel Aviv University

# motivation

- Study the luminosity calorimeter at ILD/FCC with complete simulation
  - Study of background
  - Study of signal (Bhabha, gamma gamma)

- During the LCWS at Tokyo, I asked Daniel to share with me his beamstrahlung files.

# Beamstrahlung : many low pT e+ e- pairs produced in each bunch crossing



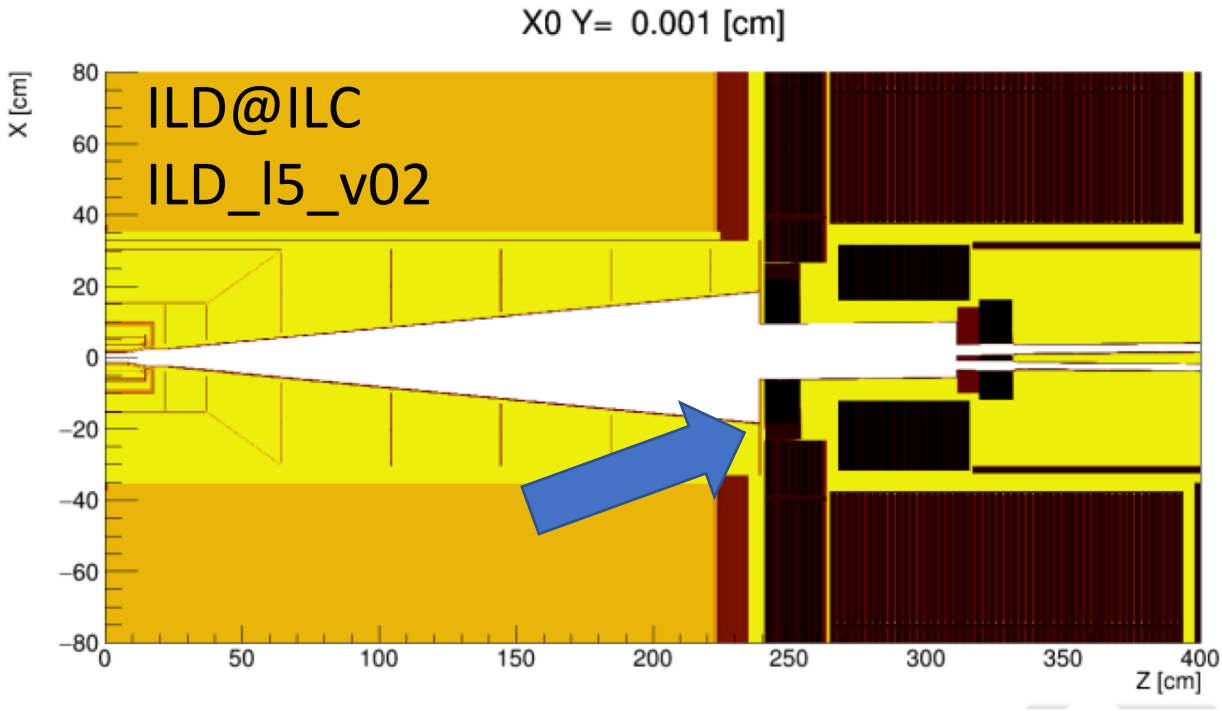

(b) *ILC250 set (A)*

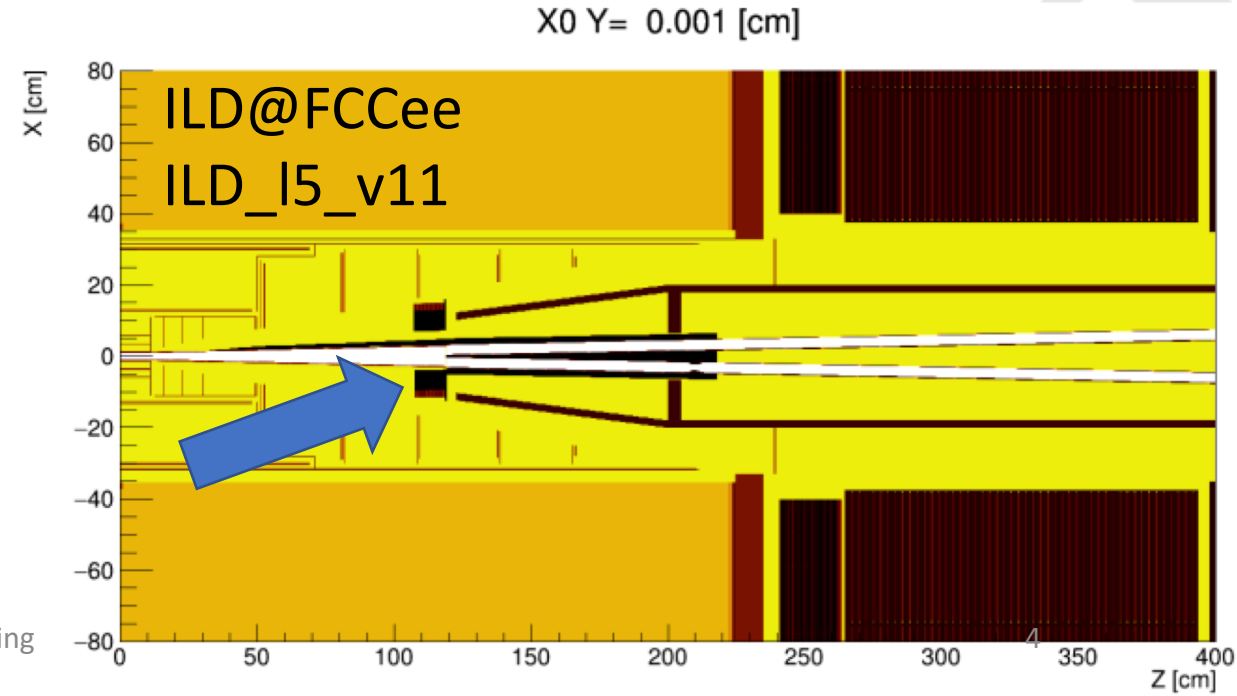
Pair background density for a full bunch train (1312 bunch crossings)

A. Schuetz arXiv:1801.04156

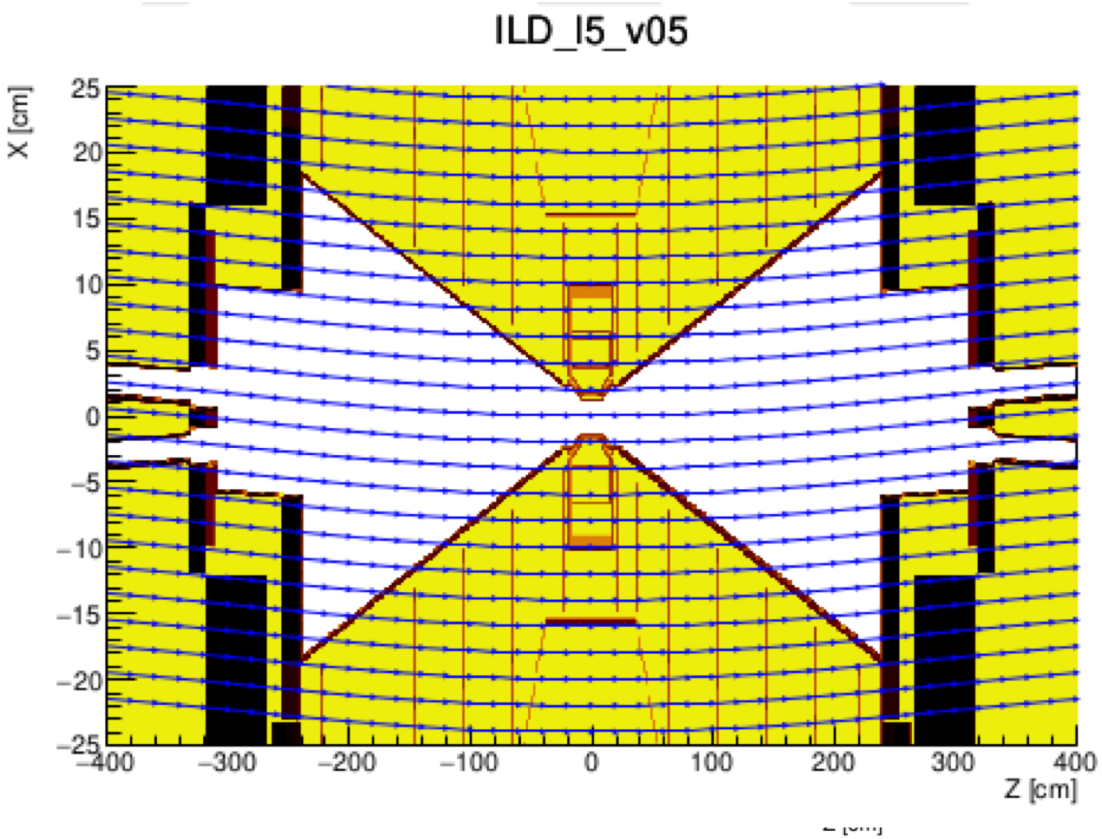
# Machine-detector interface

| | ILC | FCCee |
|---|---|---|
| Crossing angle | 14 mrad | 30 mrad |
| L* (distance from IP to last accel focusing quad. Magnet) | 4.1m | 2.0m |
| Detector solenoid | 3.5T | 2.0T |
| Additional B-fields | Anti-DID (?) | -compensating<br>-screening |

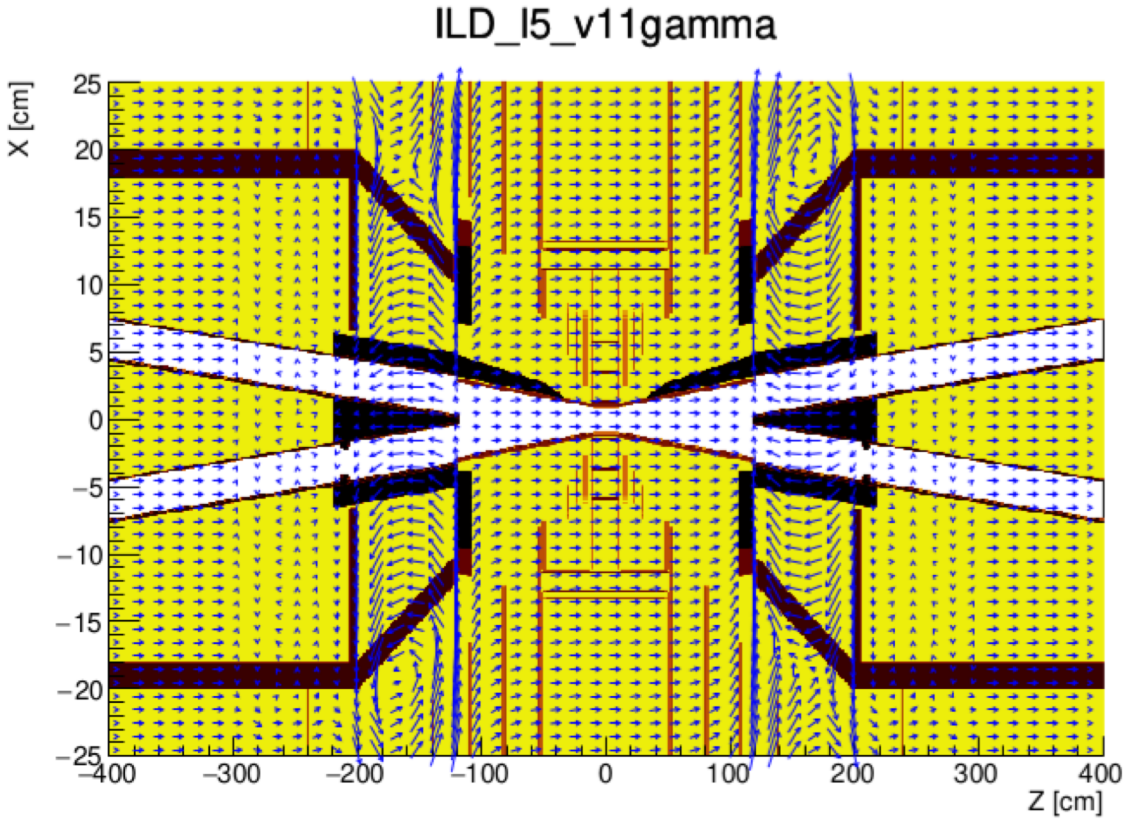


# Field map




ILC with anti DID




FCCee : screening and compensation coil

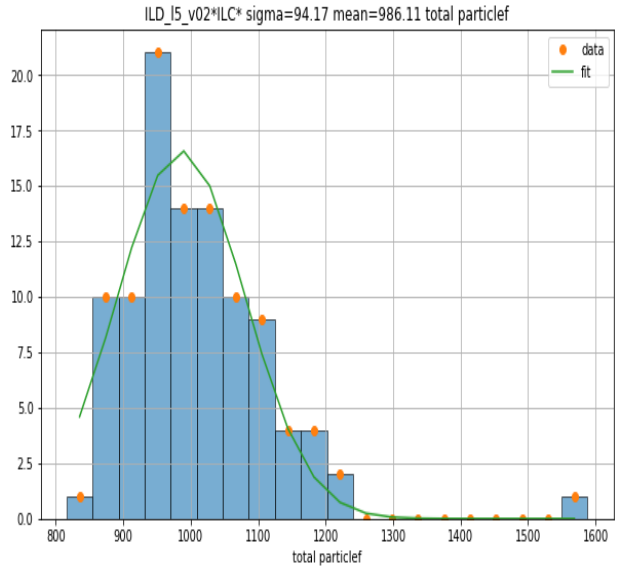
**beamstrahlung**: many very low $p_T$ e+e- created in bunch collisions
very different bunch structure, materials and fields in the forward region → major effect on beamstrahlung backgrounds ?

# simulation

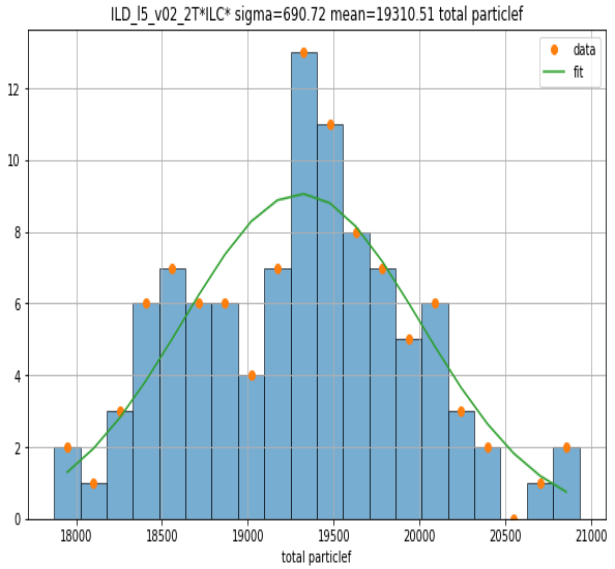
- GuineaPig : beamstrahlung generator (Berggren/Ciarma)
- Detector simulated :
  - ILC, 250 GeV
  - FCCee 91 GeV (Z) , FCCee 240 GeV (ZH)
- Using DD4HEP
- ILD@ILC:
  - Uniform 3.5 T (V02)
  - Uniform 2T (v02_2T)
  - Field map with and without anti DID (v03 and v05)
- ILD@FCCee:
  - Uniform 2T (v11beta)
  - Detailed magnetic field (v11gamma)

# Number of hit pads in lumical

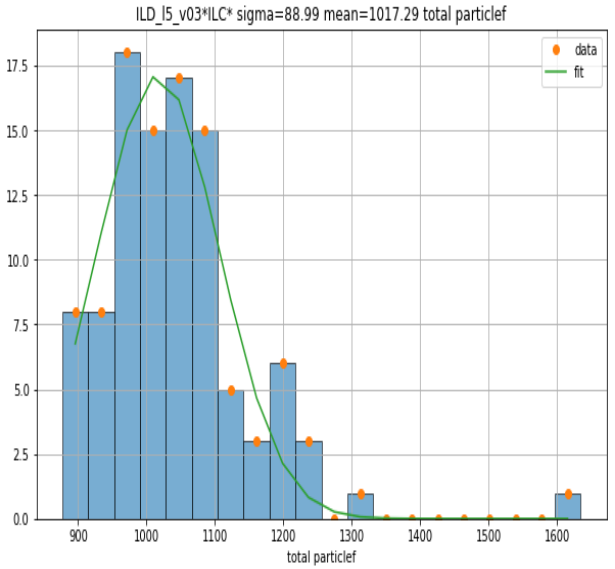
## v02



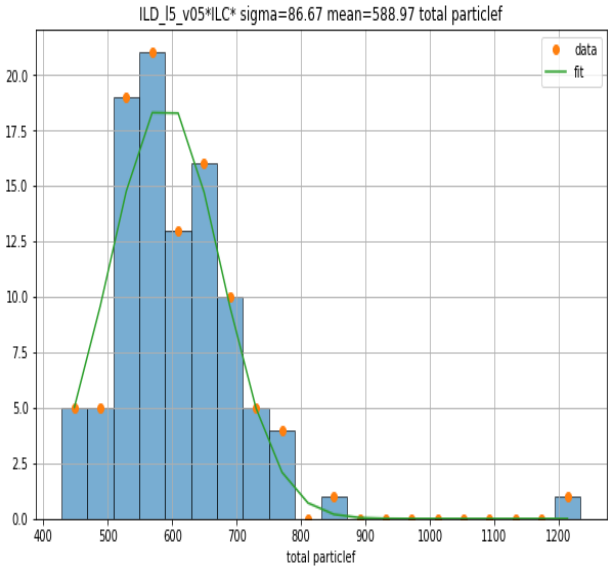

## V02_2T



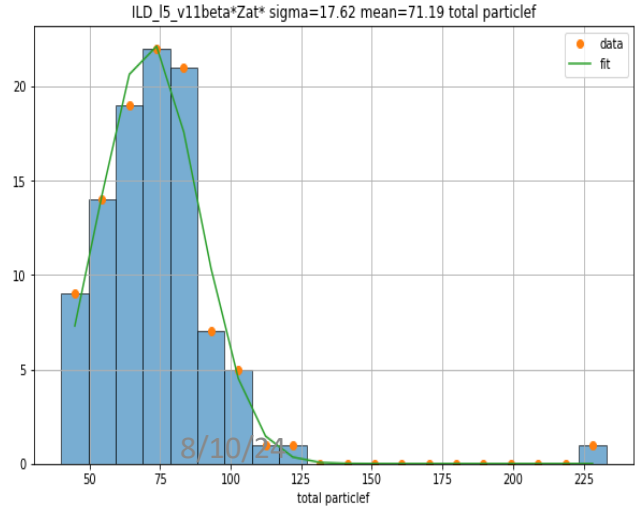

## V03



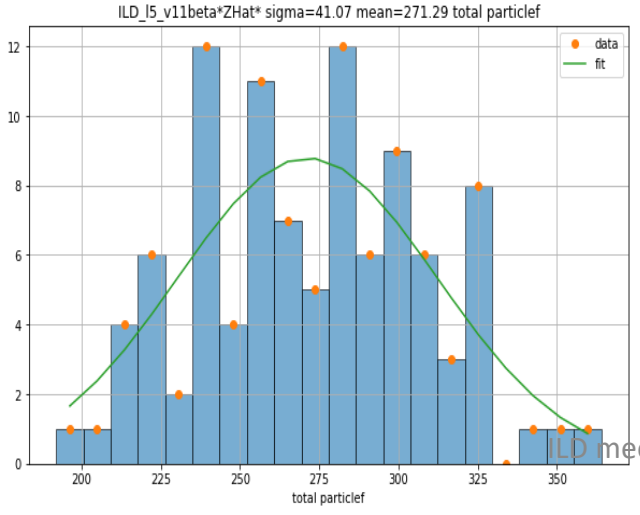

## V05



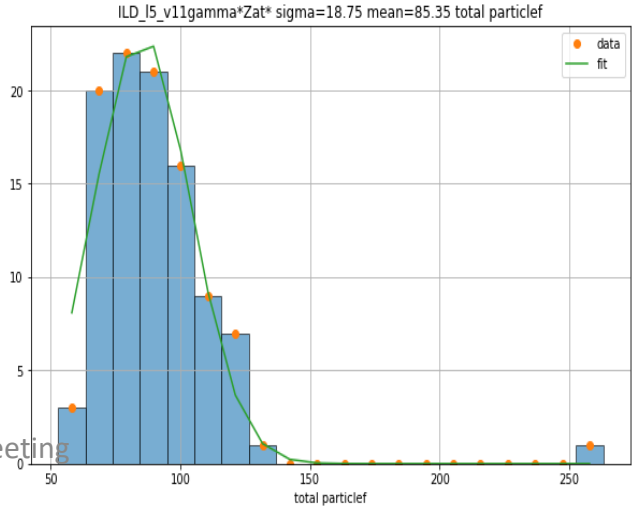

## V11 beta @Z



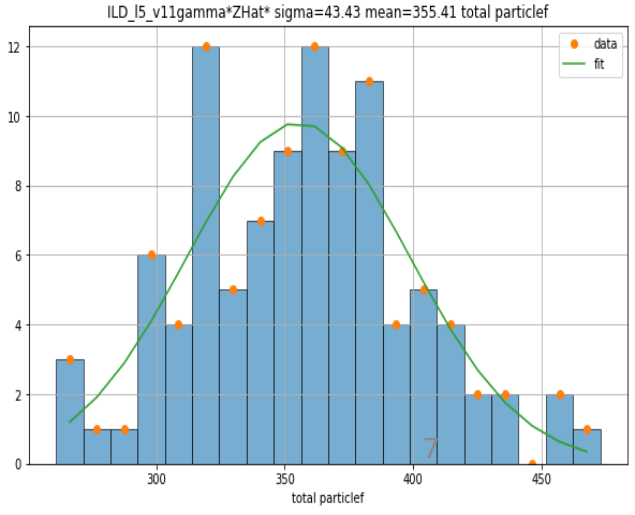

## V11 beta @ZH




## V11 gamma @Z

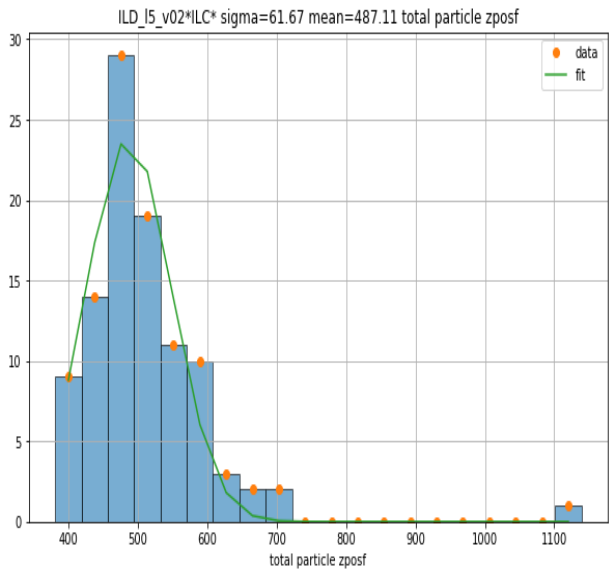



## V11 gamma@ZH

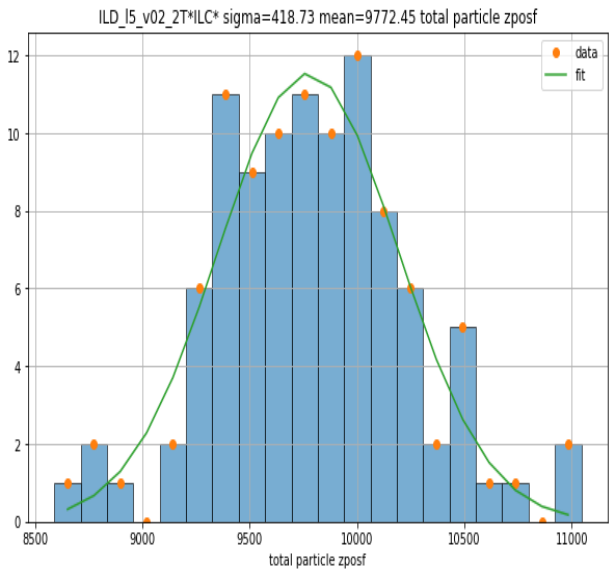


# Number of hit pads in lumical z>0

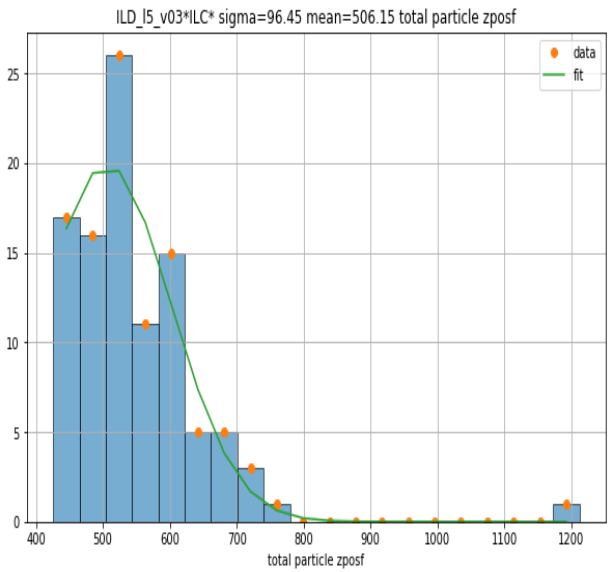
## v02



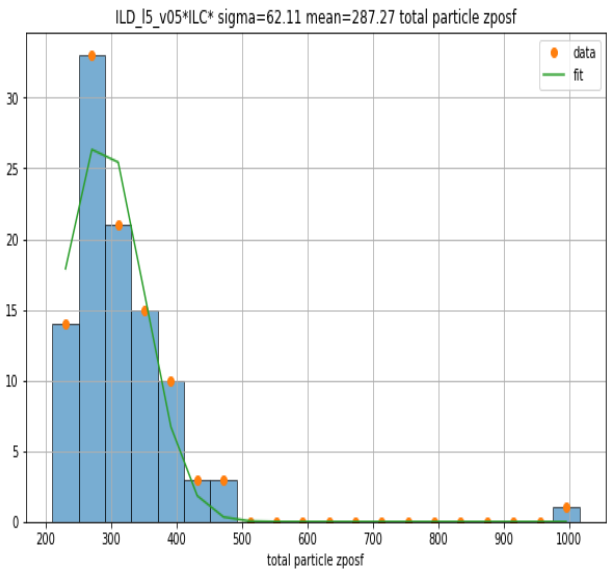

## V02_2T



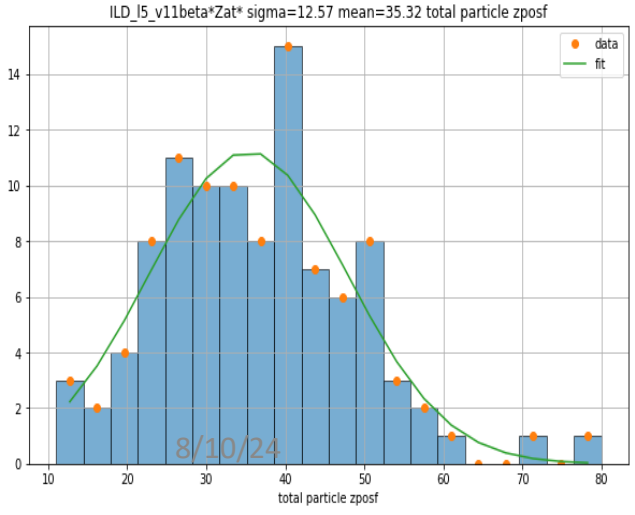

## V03



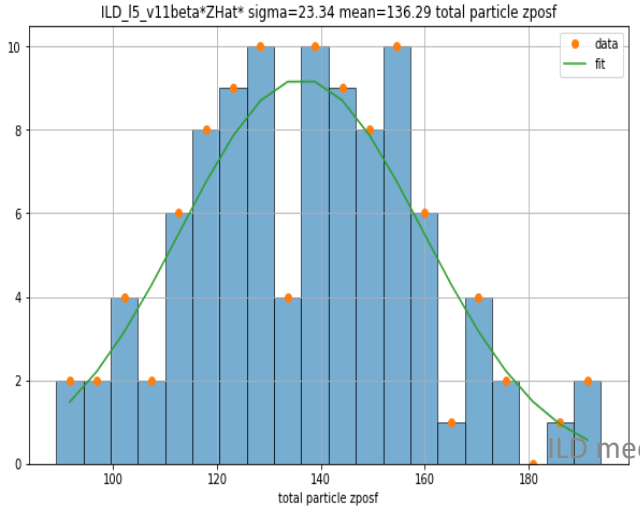

## V05



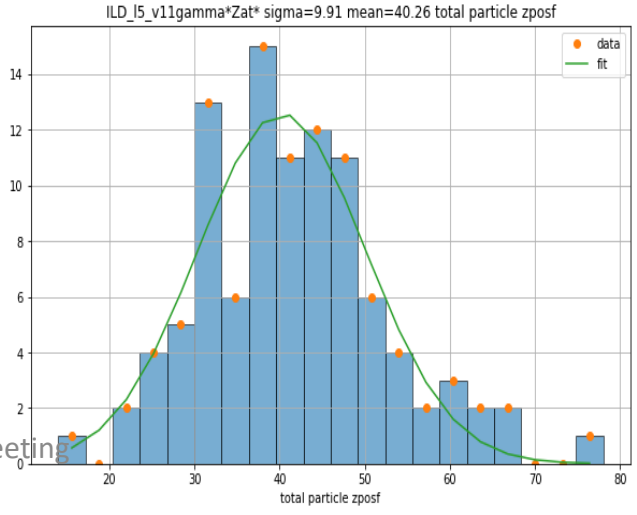

## V11 beta @Z



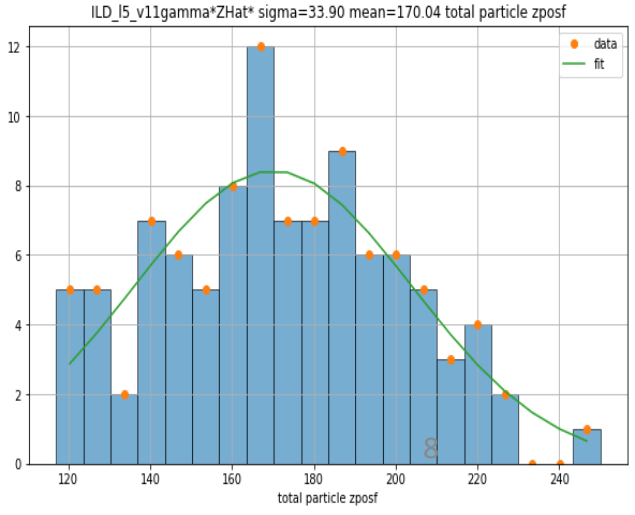

## V11 beta @ZH




## V11 gamma @Z

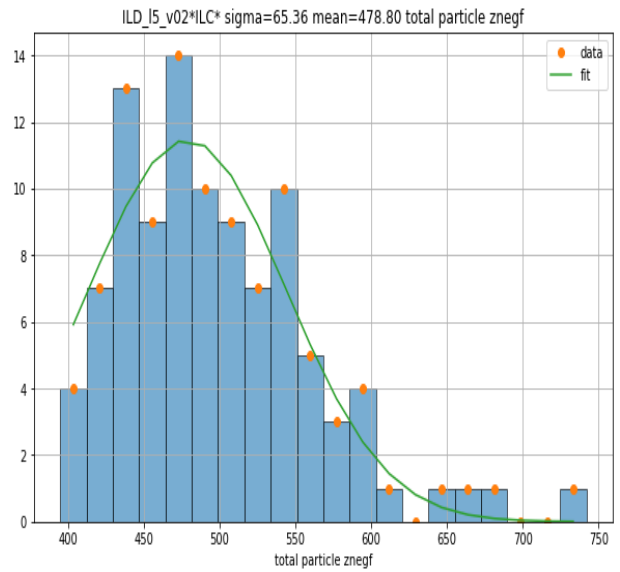



## V11 gamma@ZH

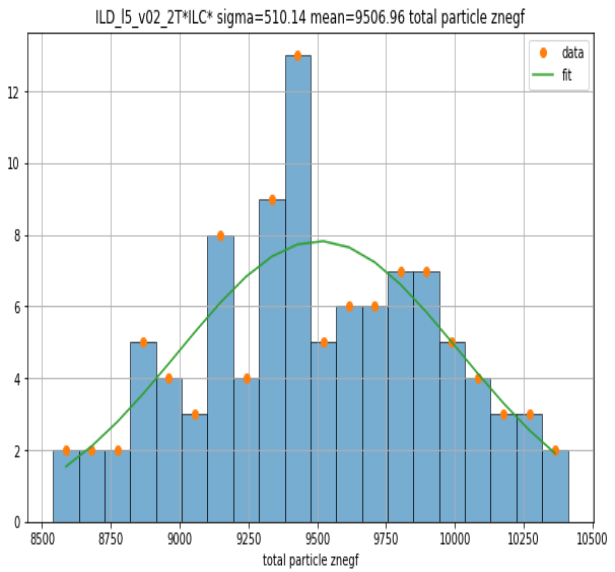


# Number of hit pads in lumical z<0

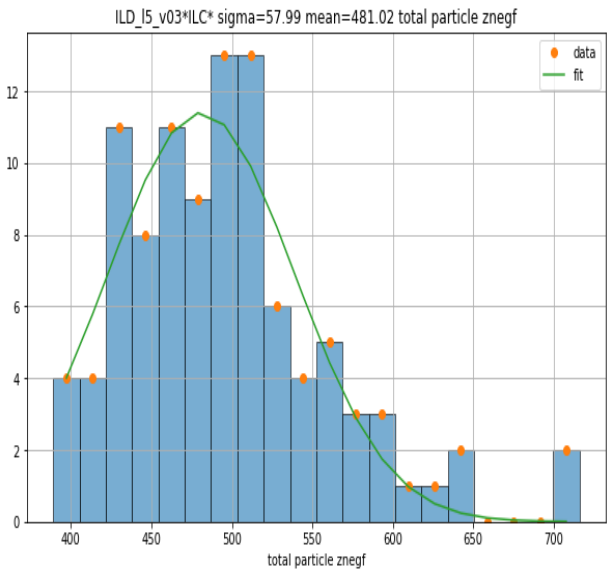
## v02



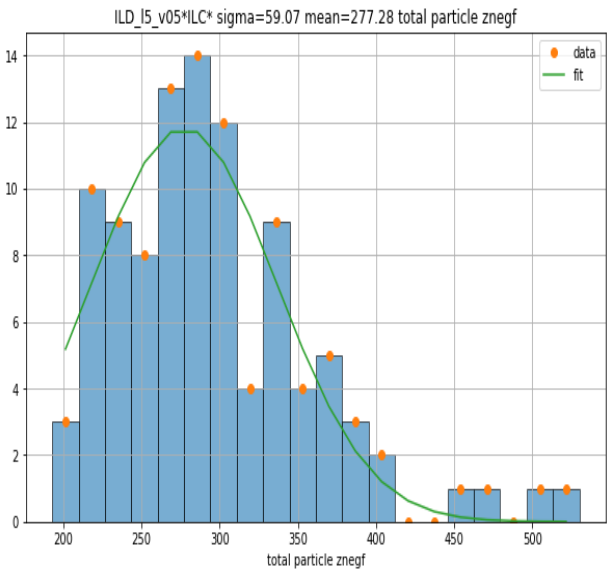

## V02_2T



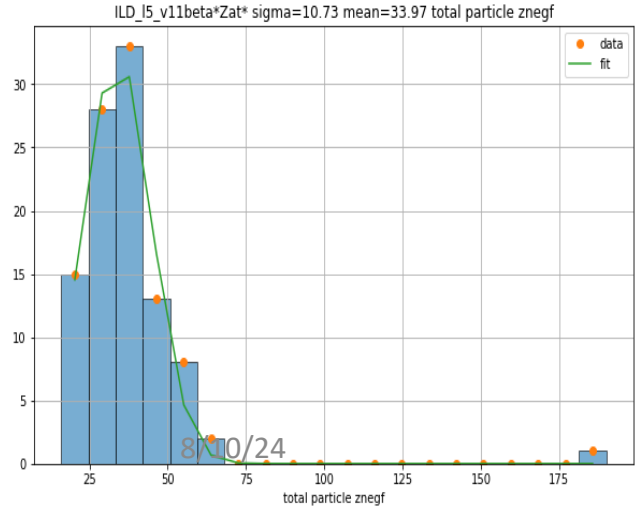

## V03



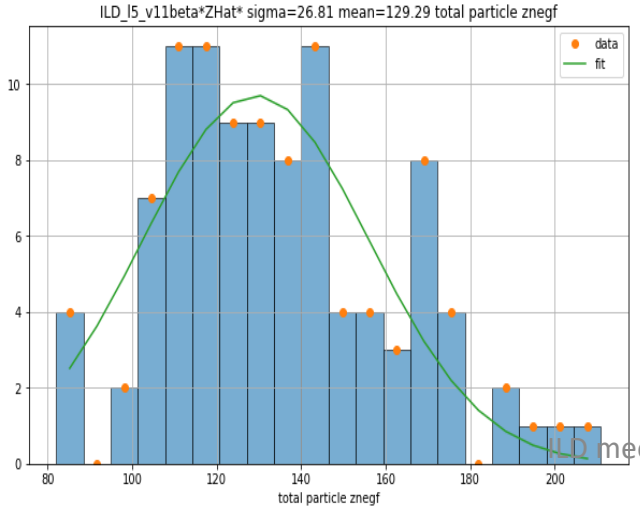

## V05



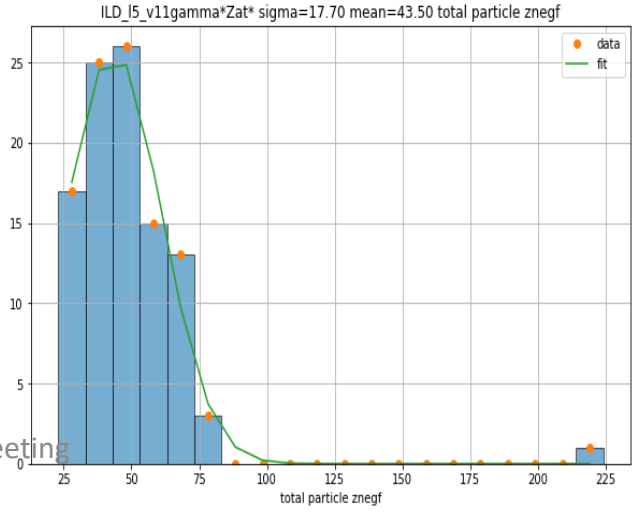

## V11 beta @Z



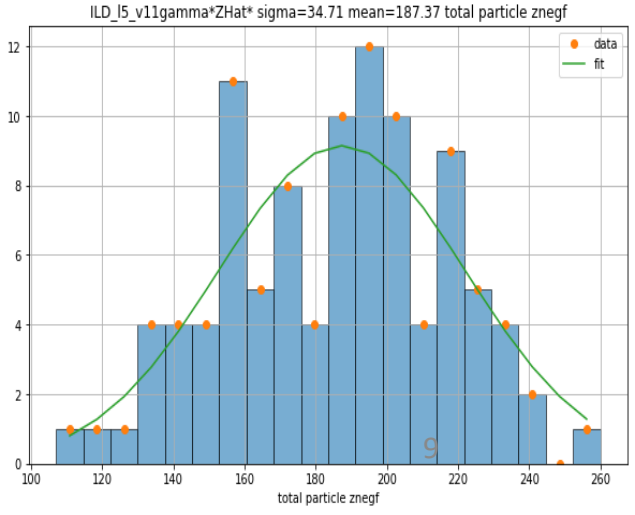

## V11 beta @ZH




## V11 gamma @Z




## V11 gamma@ZH



# Number of hit pads in lumical

| | ILC | | | | FCC | | | |
|---|---|---|---|---|---|---|---|---|
| | v02 | V02_2T | V03 | V05 | V11 beta @Z | V11 beta @ZH | V11 gamma @Z | V11 gamma@ZH |
| total | 986+/-8 | 19310+/-74 | 1017+/-8 | 589+/-7 | 71+/- 1 | 271+/- 7 | 85+/-1 | 355+/- 5 |
| Z>0 | 487+/-5 | 9772+/-33 | 506+/-13 | 287+/-6 | 35+/- 1 | 136+/- 3 | 40+/-1 | 170+/- 3 |
| Z<0 | 479+/-6 | 9507+/-60 | 481+/-5 | 277+/-6 | 33+/- 1 | 129+/- 4 | 43+/- 1 | 187+/-4 |

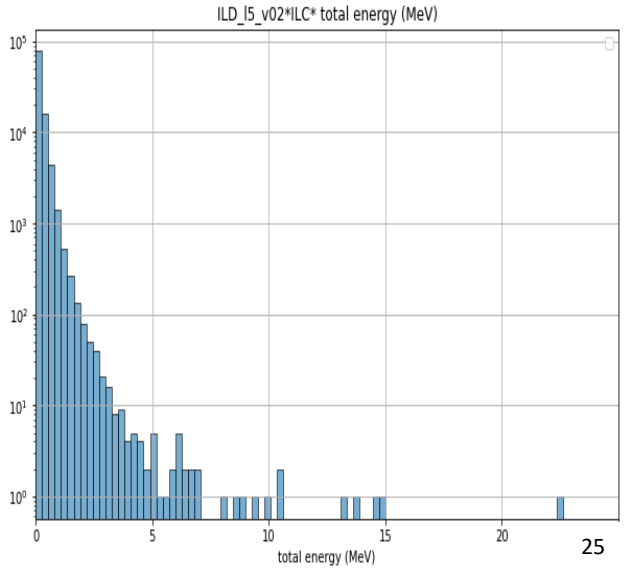
Important effect of magnetic field reduction



Important effect of anti DID

# Energy deposited per pad (MeV)

## v02

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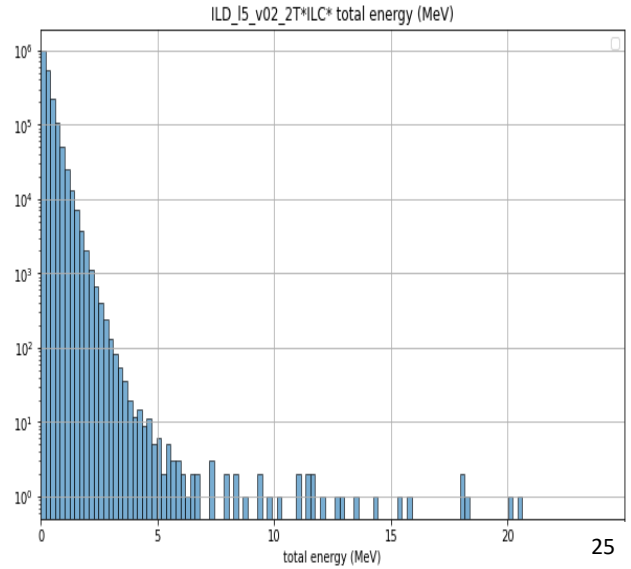
## V02_2T

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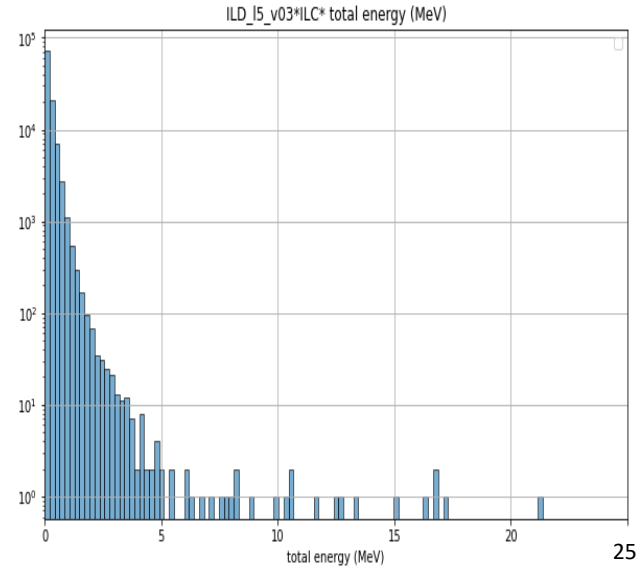
## V03

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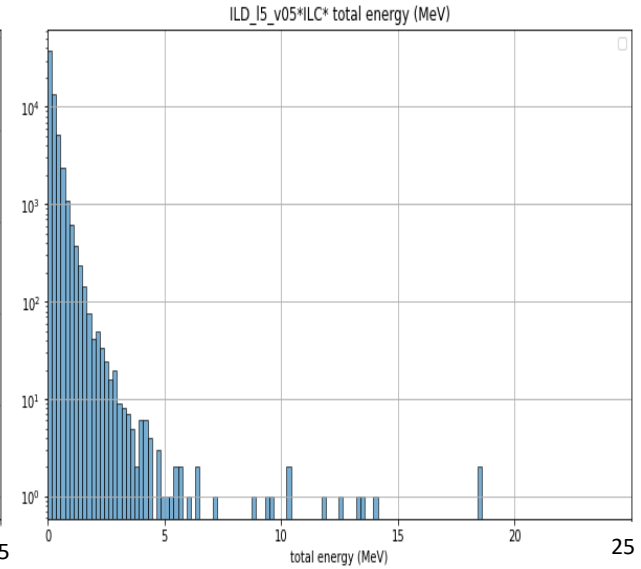
## V05

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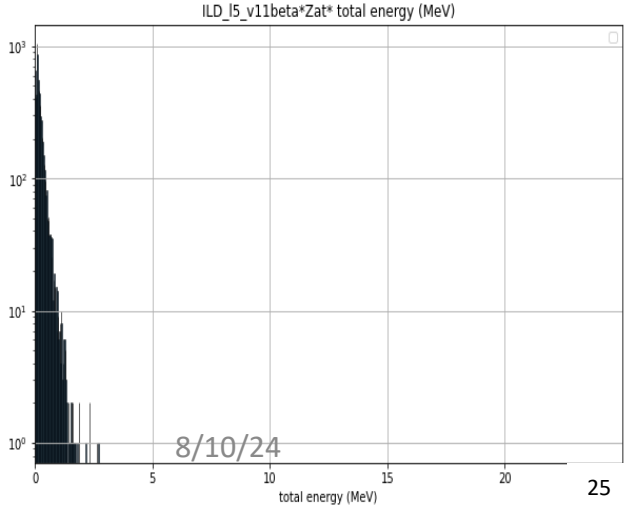
## V11 beta @Z

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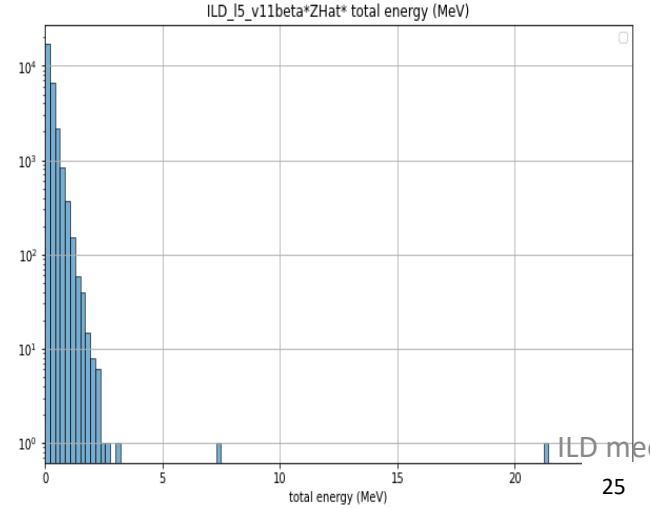
## V11 beta @ZH

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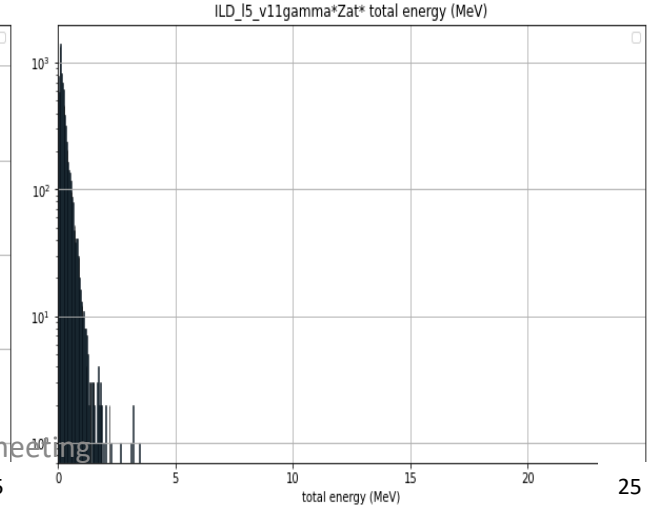
## V11 gamma @Z

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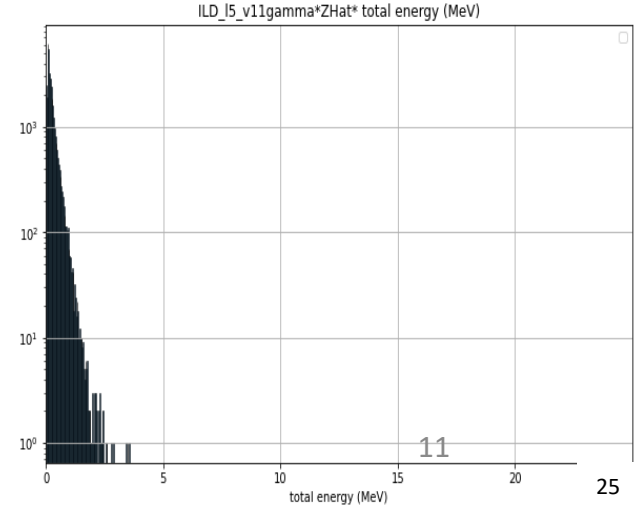
## V11 gamma@ZH

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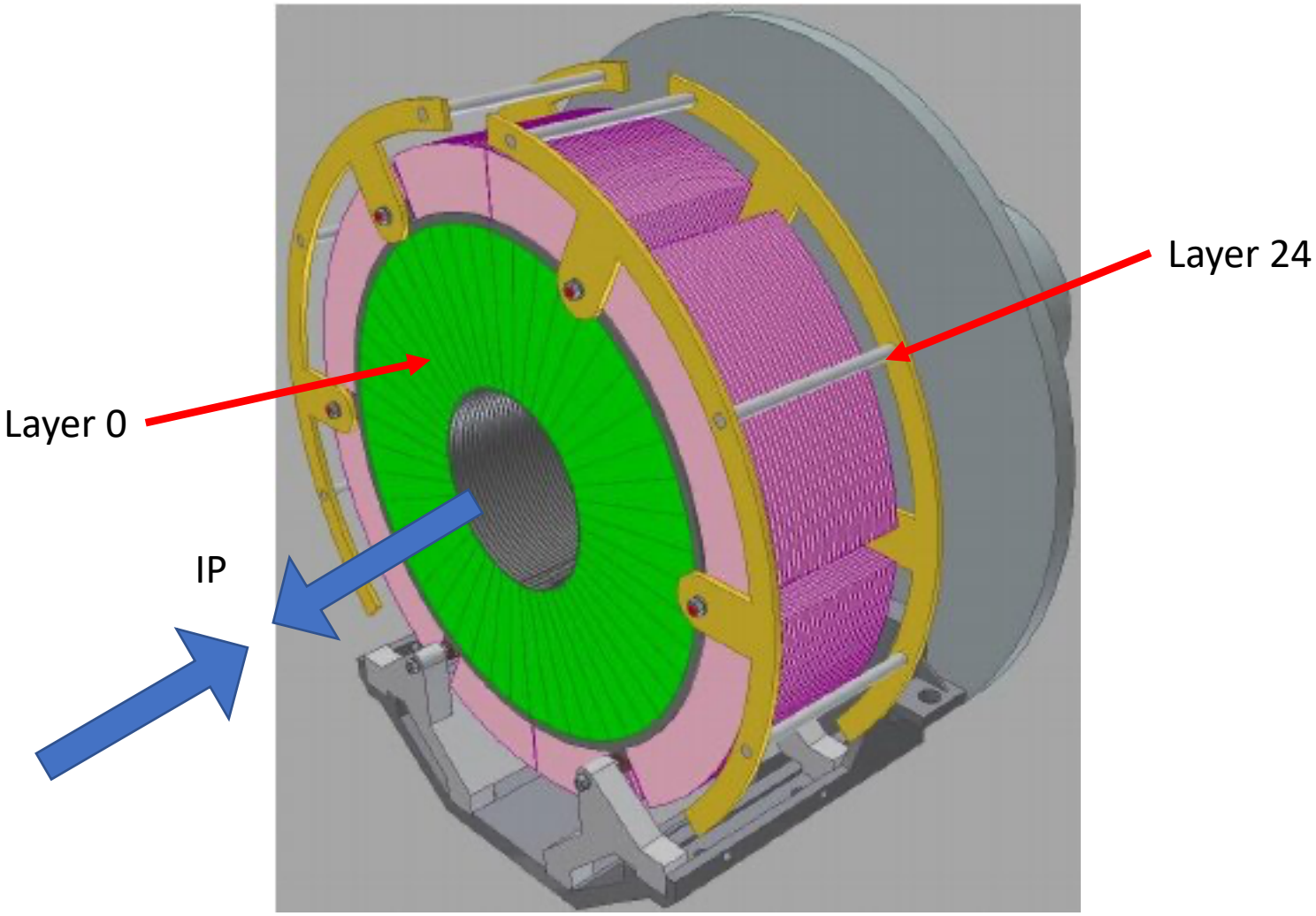
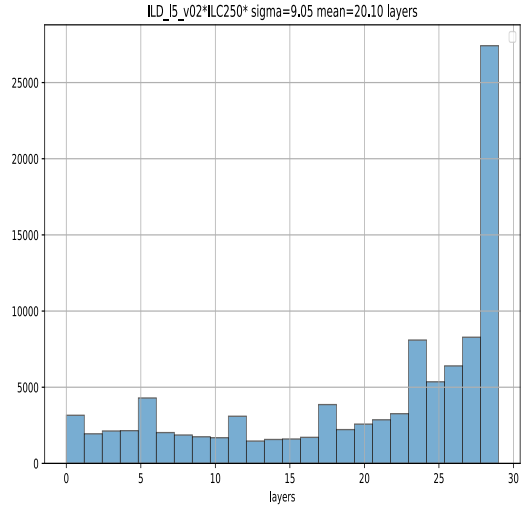
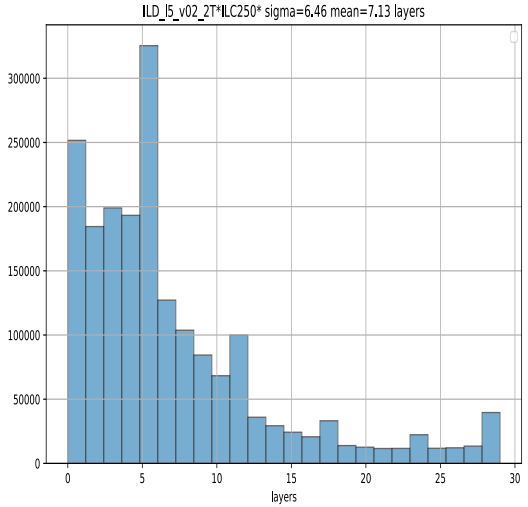
# Layer hit

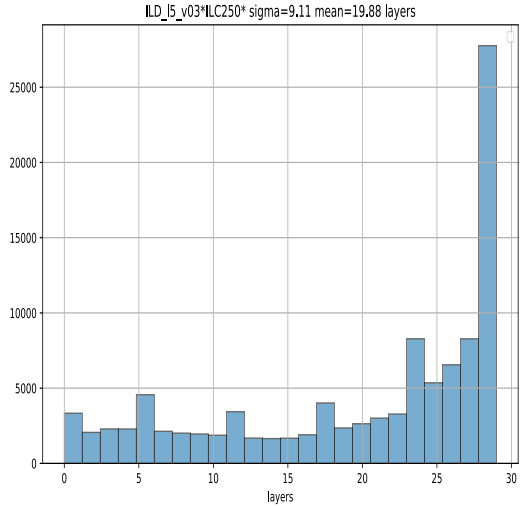


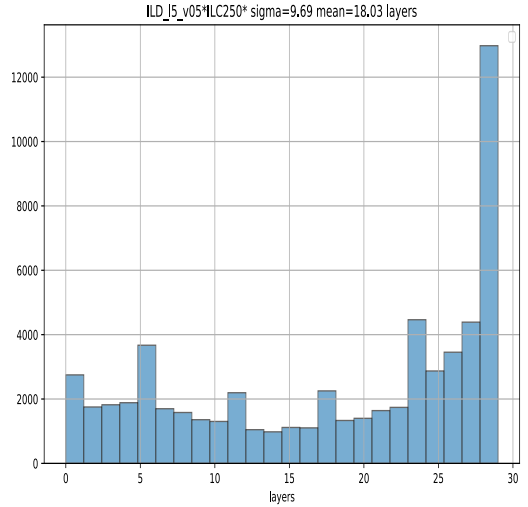
# Layer hit

| v02 | V02_2T | V03 | V05 |
|---|---|---|---|

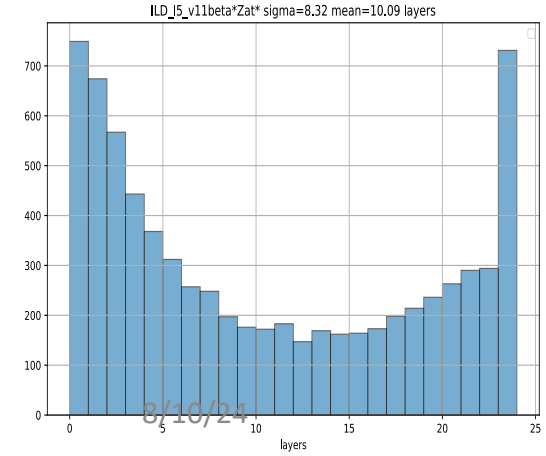


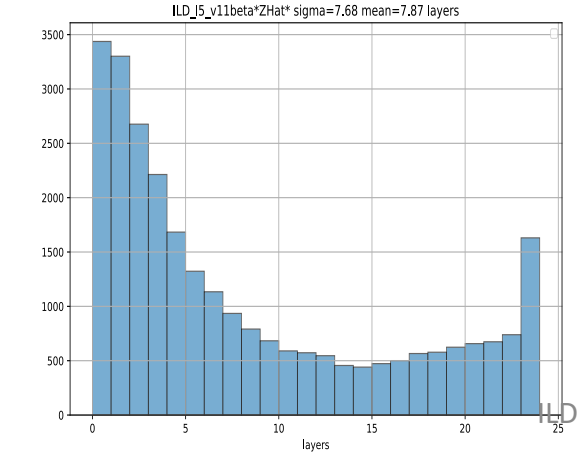



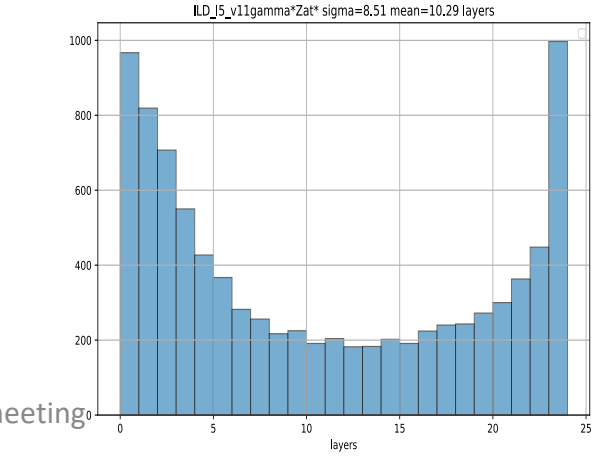



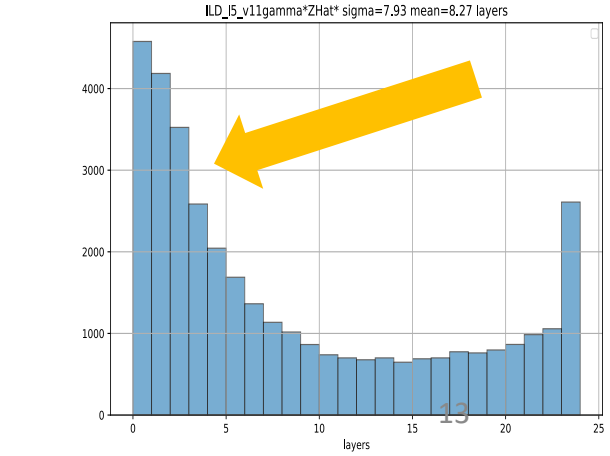




| V11 beta @Z | V11 beta @ZH | V11 gamma @Z | V11 gamma@ZH |
|---|---|---|---|



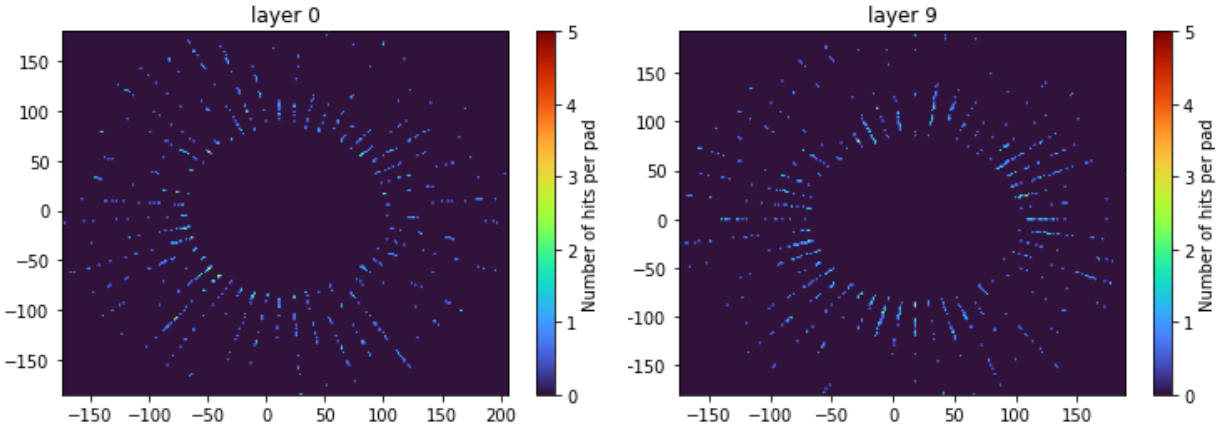



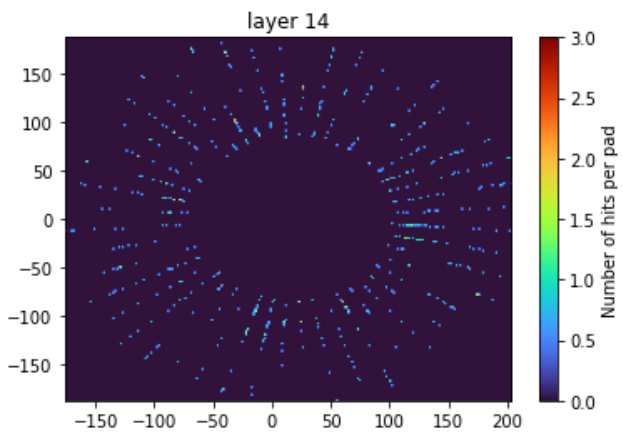
# ILD_l5_v05 (ILC with anti DID)

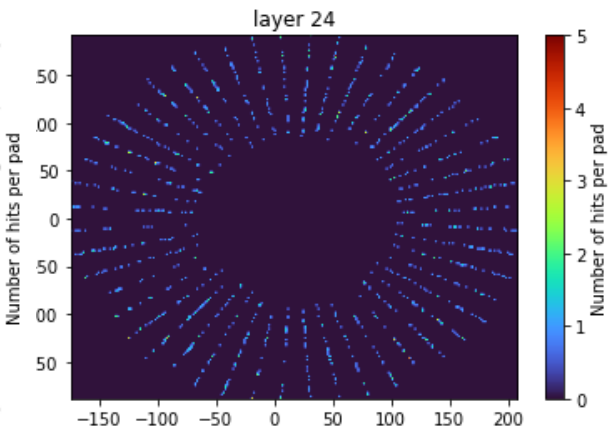
z>0



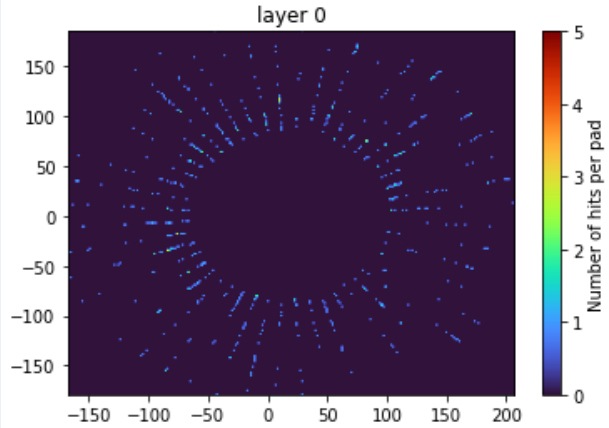


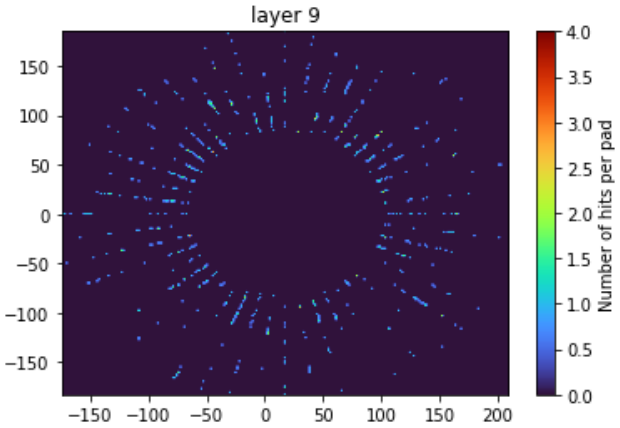


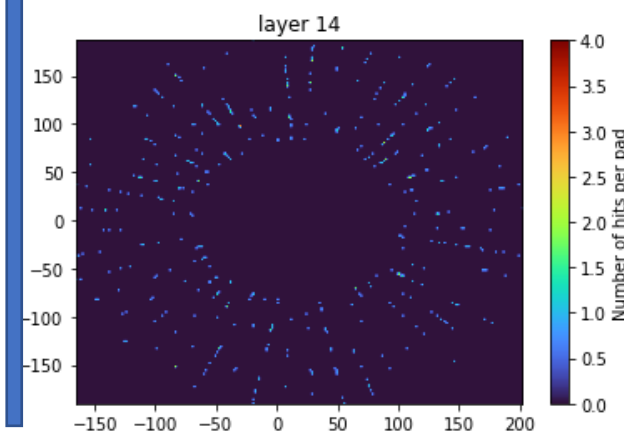


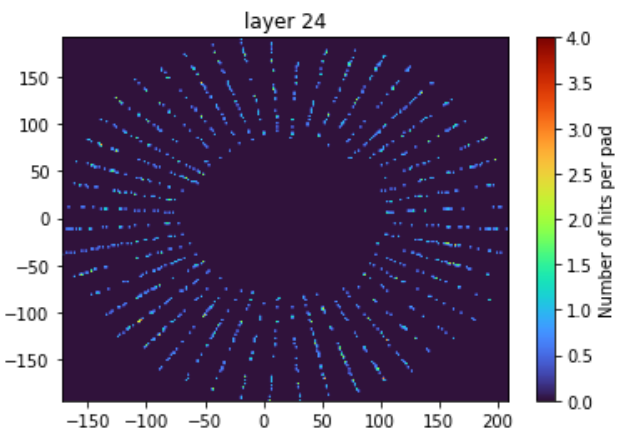




Z<0



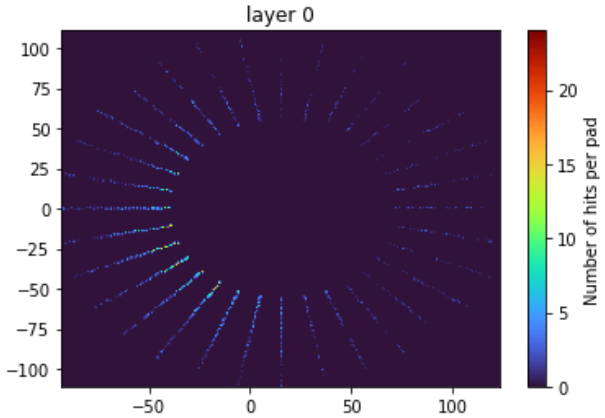



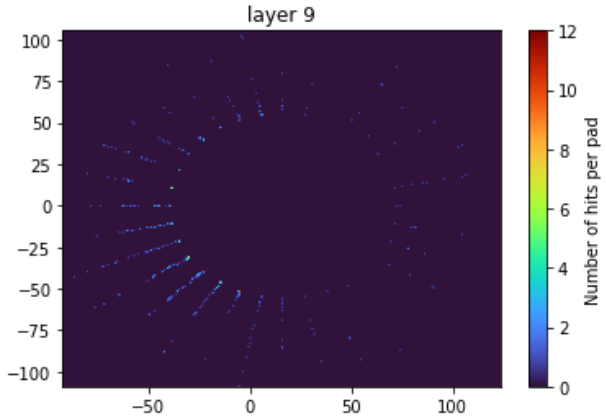



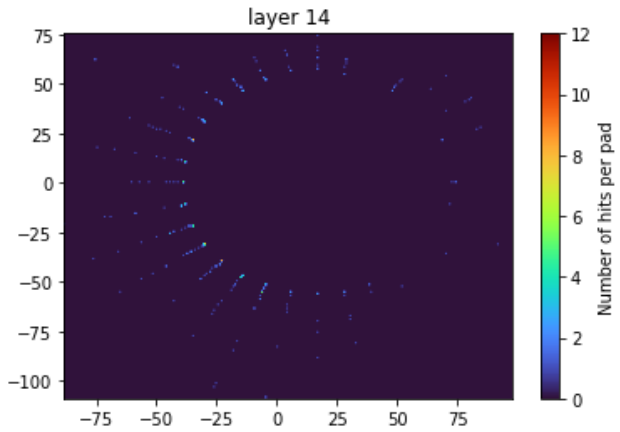



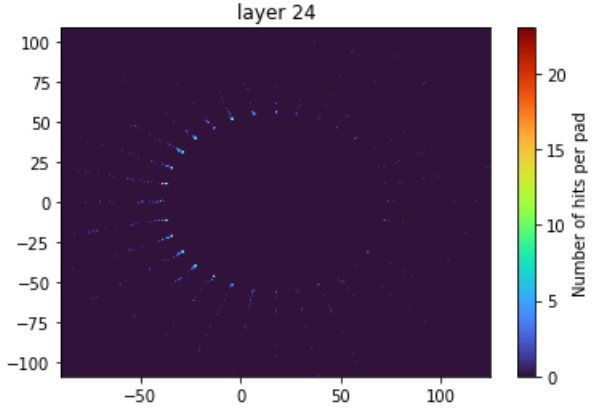
# ILD_l5_v11gamma (FCC @ ZH peak)

z>0

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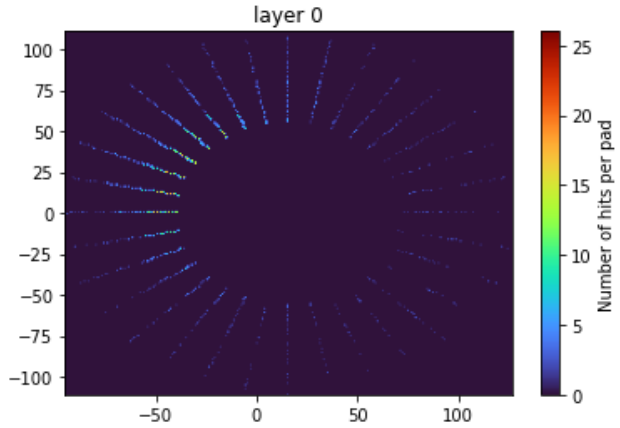


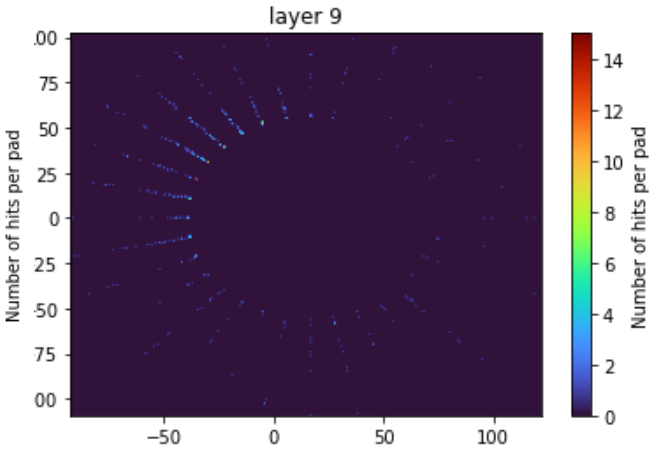


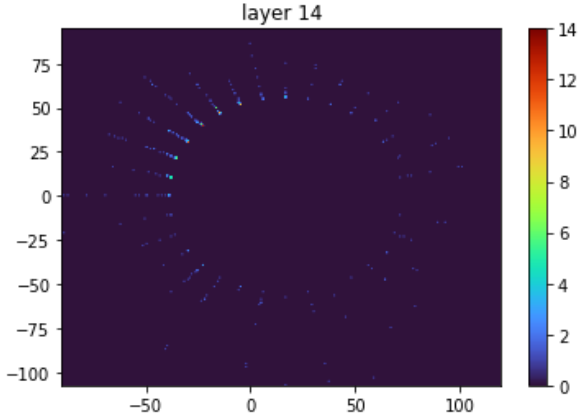


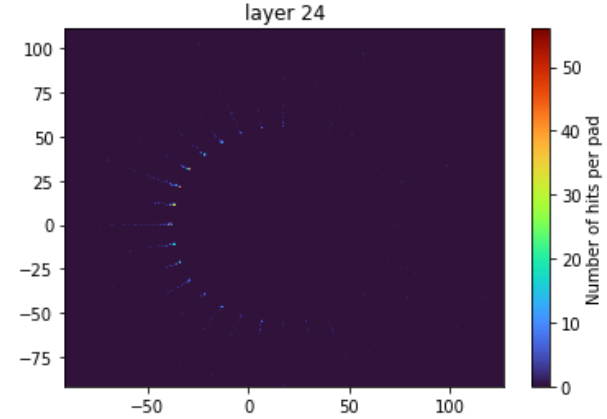

# conclusion

- Study of beamstrahlung signal in LumiCal for FCCee started with full simulation (and comparison with ILC). Preliminary analysis shows:
  - Less hits in the LumiCal @ FCC than at ILC
  - Same energy deposited shape
  - Position of hits in LumiCal is different at FCC and ILC (front-end/right-left)
- Near future:
  - Maybe need more statistics (more BX to generate and simulate)
  - Continue the background study
- Less near future:
  - Bhabha generation and simulation with all the configurations