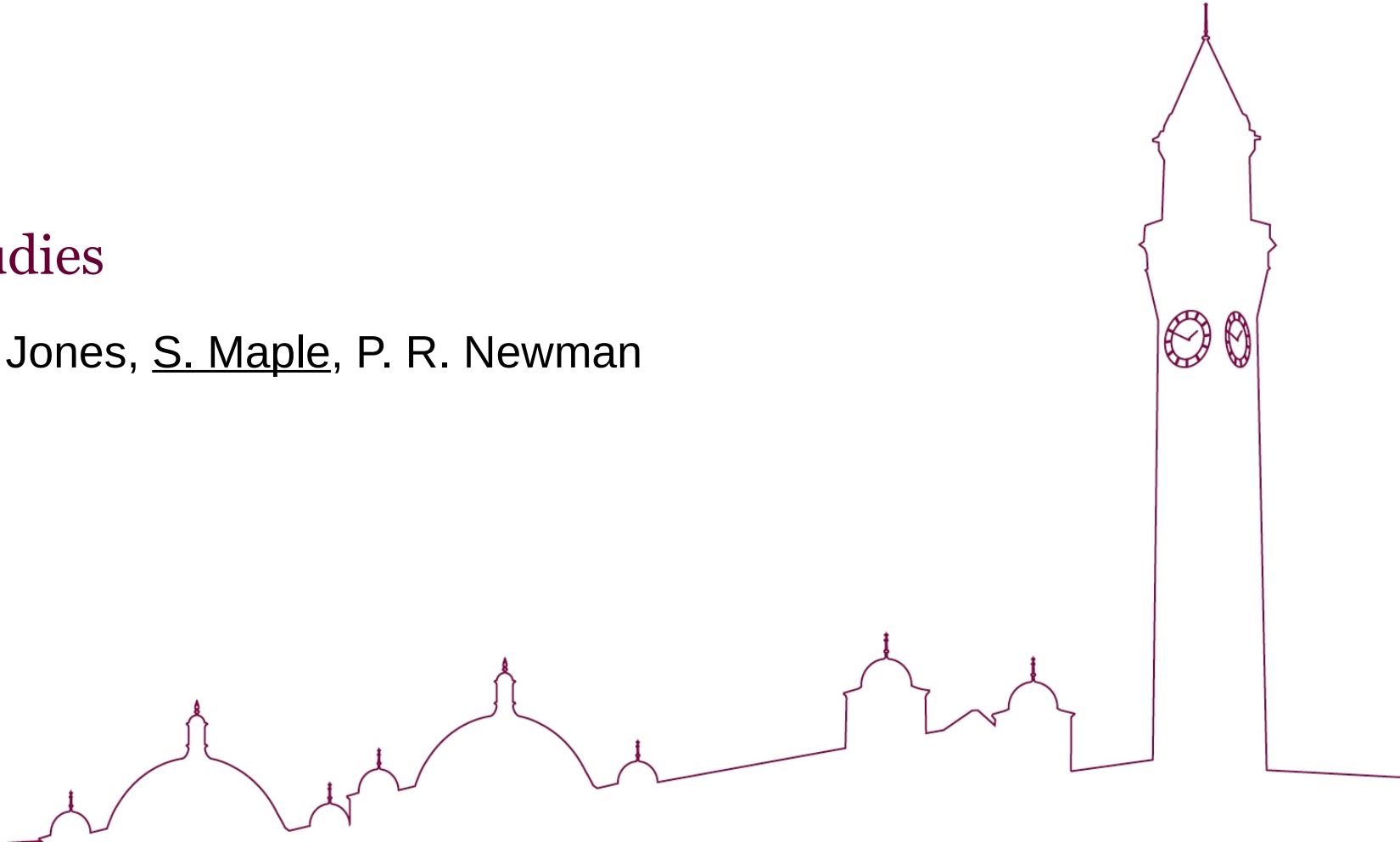UNIVERSITY OF BIRMINGHAM | SCHOOL OF PHYSICS AND ASTRONOMY

Dead layer studies

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Overview

- Simulations performed in Fun4All to study the role of the MPGD barrel layer

EPIC reference detector : Question 1

What is **the role of the single cyl. MPGD** in the current configuration of ePIC reference detector?

1. What is the contribution to tracking in term momentum and transverse point resolution?
   - **Ongoing simulation effort should evaluate so that we reach a consensus on this question**

2. Are the Cyl MPGD layer (and TOF layers) mainly for pattern recognition in support of the main Si trackers?
   - Minimum number of tracking layers required for pattern recognition
   - **Need simulation with background to make this determination**

3. Is the MPGD layer together with the TOF layers for redundancy
   - to recover for missing hit from the Si trackers (dead pixels …)
   - **Ongoing simulation effort should evaluate the impact on overall tracking performance**

4. Why do the MPGD and TOF cover an |eta | up to 1.5 and not limited to 1.1
   - Impact on the Si support structure and services
   - Impact on tracking performance in the forward nd backward endcap

Kondo slides at https://indico.bnl.gov/event/17750/

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- We check contribution of MPGD layer to momentum/pointing resolution (1.) and redundancy (3.)
  - If no contribution to resolution or redundancy then it is mainly for pattern recognition (2.)

Fun4All barrel simulations

- Single pions generated in pseudorapidity range -0.5<η<0.5
- Marco 1.7T Field map used
- I show only results for 0<η<0.5, but the setup is symmetric so they should match
- In the simulations, layers are made inefficient but are still present → Events are chosen by requiring hits in all layers except the "dead" ones

Layer	Radius / cm	x/X0	Resolution / μm
Beampipe	3.18	0.36%	N/A
Layer 1	3.6	0.05%	10/√12
Layer 2	4.8	0.05%	10/√12
Layer 3	12	0.05%	10/√12
Support	13.5	0.04%	N/A
Layer 4	27	0.25%	10/√12
Layer 5	42	0.55%	10/√12
MPGD	55	0.50%	150x150
ToF	64	1.00%	30x3000
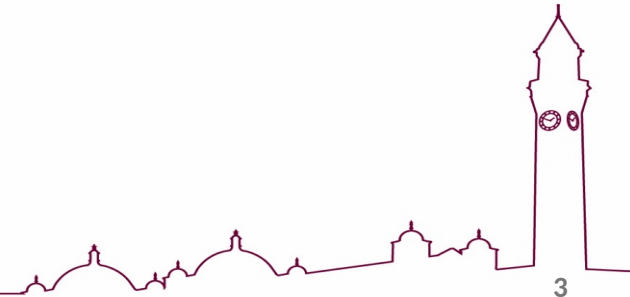
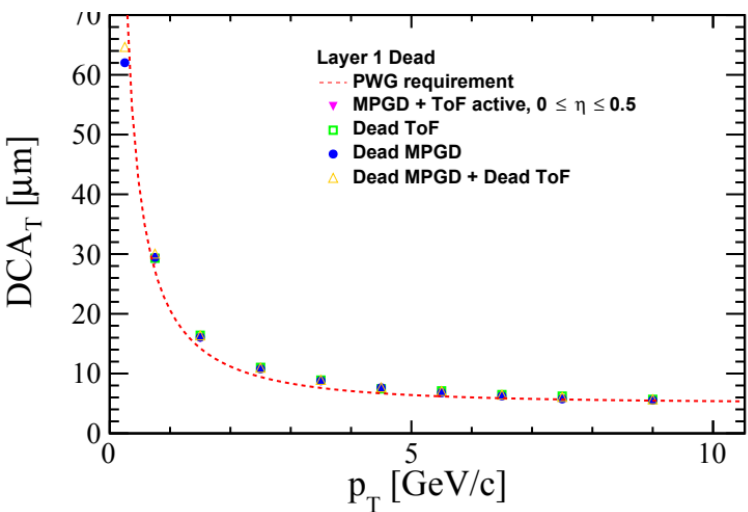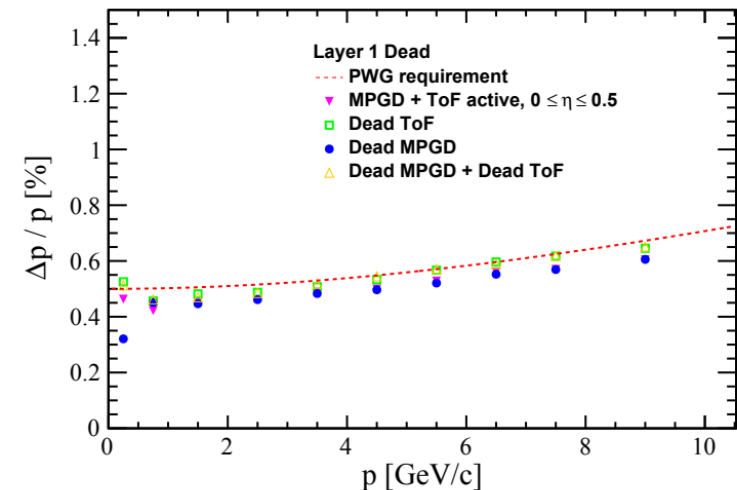# Dead Layer comparisons – All Si Barrel layers Alive
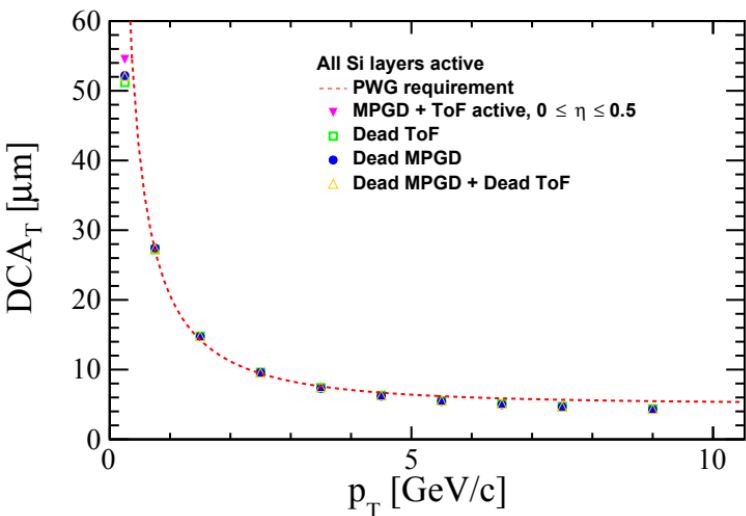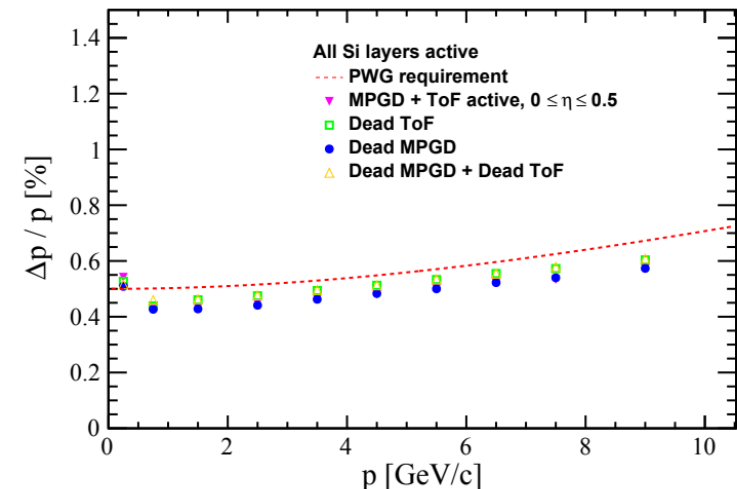
MPGD + ToF alive

MPGD alive ToF dead

ToF Alive MPGD dead

MPGD dead ToF dead
(Si only)

- Momentum and DCA resolutions dominated by Si layers (small improvement to momentum resolution by ToF)
- No contribution by MPGD to either p or DCA_T measurement

Dead Layer comparisons – Layer 1 Dead

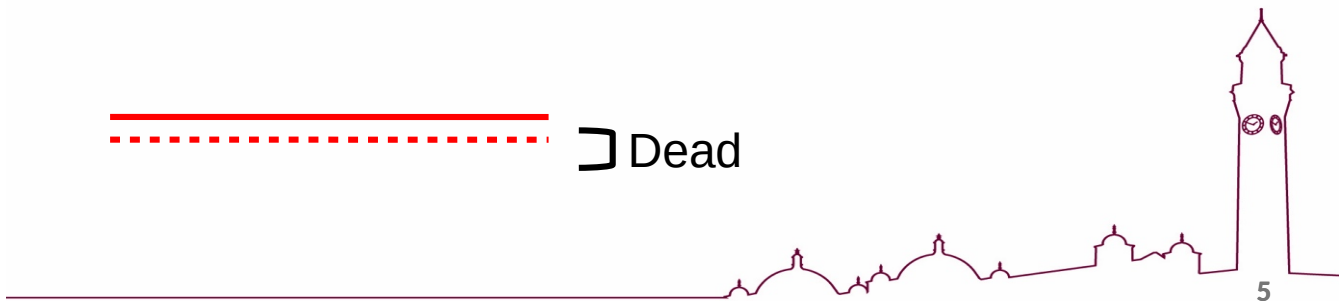
MPGD + ToF alive

MPGD alive ToF dead
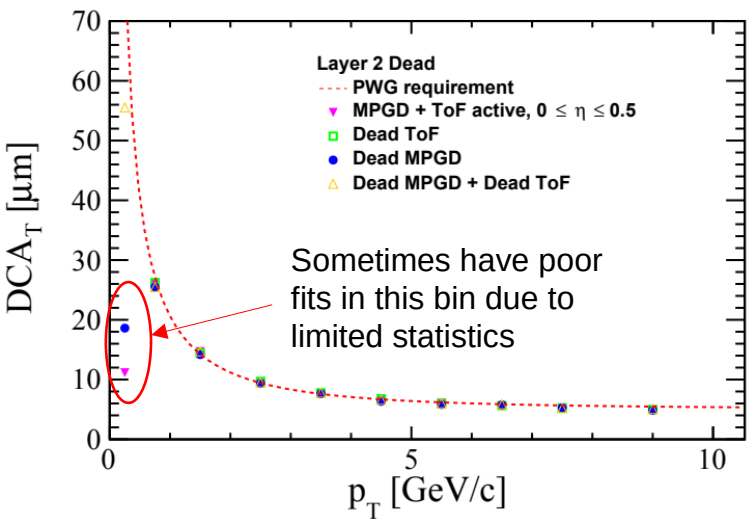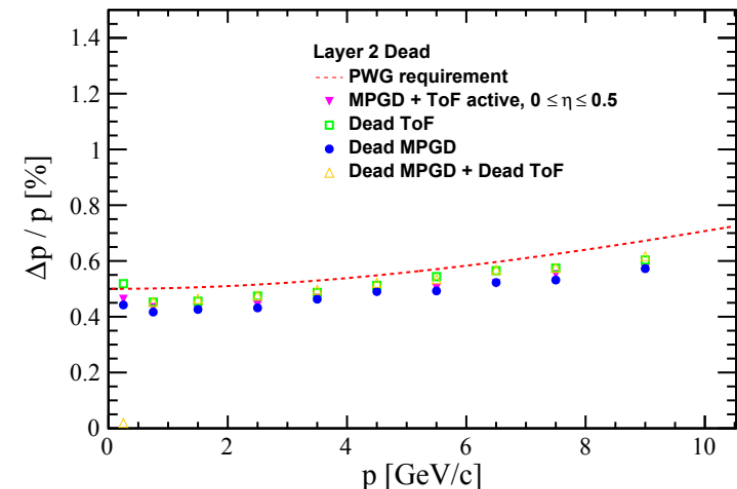
ToF Alive MPGD dead

MPGD dead ToF dead (Si only)

- Much the same as before: though there's a small degradation in p and DCA_T resolution due to slightly reduced lever arm

⊐ Dead

Dead Layer comparisons – Layer 2 Dead

MPGD + ToF alive
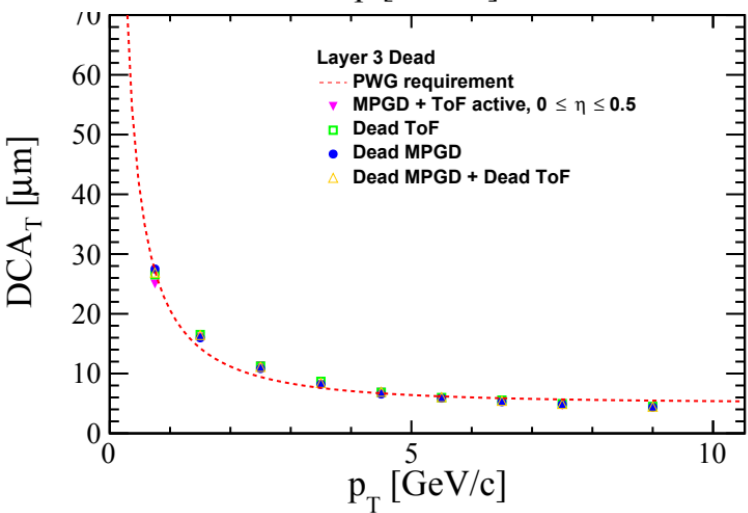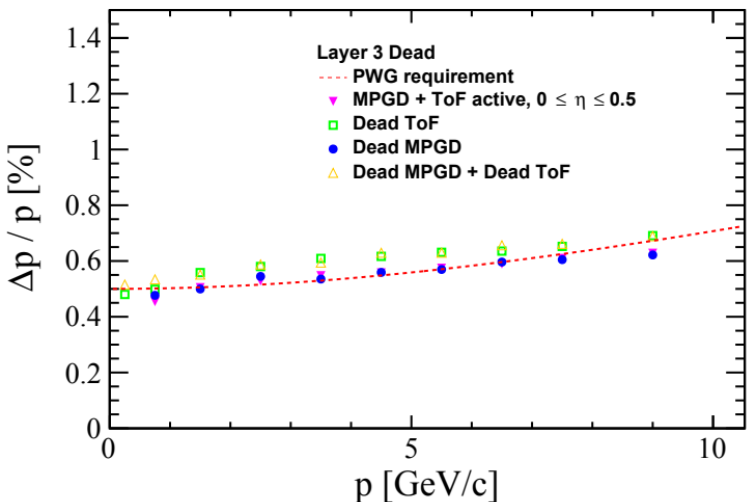
MPGD alive ToF dead

ToF Alive MPGD dead

MPGD dead ToF dead
(Si only)

- Similar story here: momentum resolution matches all layers alive

⊐ Dead

Dead Layer comparisons – Layer 3 Dead

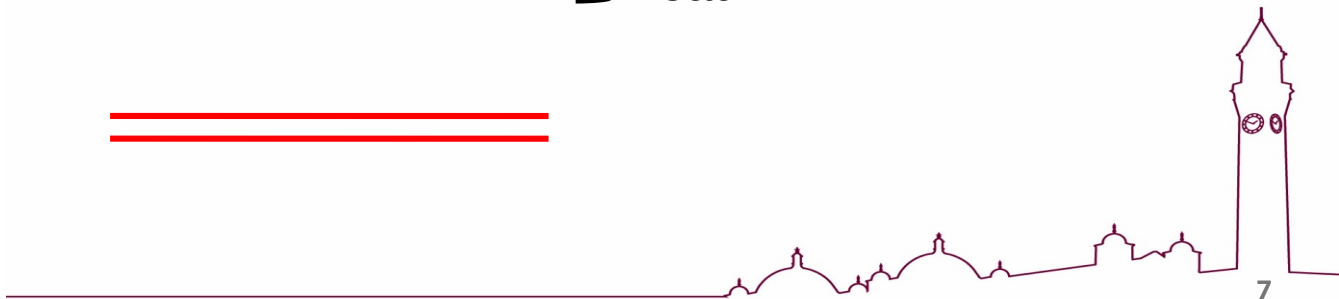MPGD + ToF alive

MPGD alive ToF dead
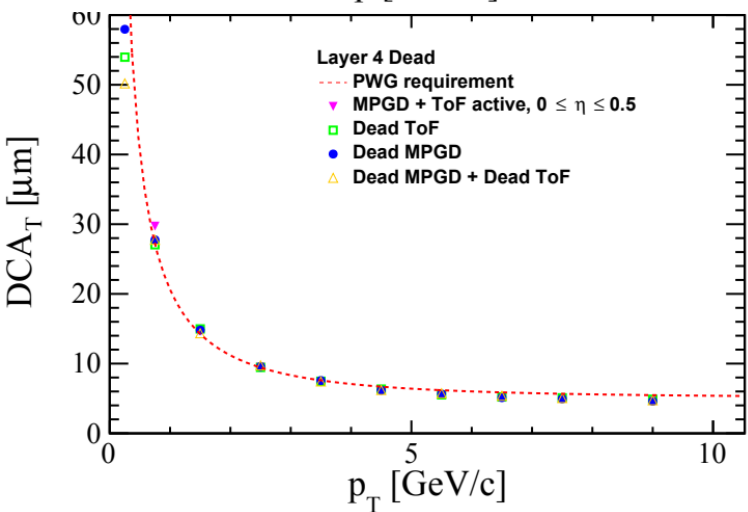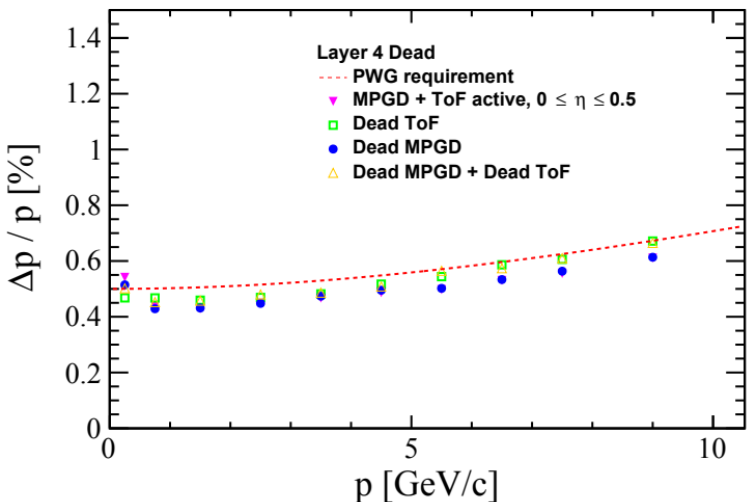
ToF Alive MPGD dead

MPGD dead ToF dead
(Si only)

- Degradation in p resolution due to worse sagitta measurement

⊐Dead

Dead Layer comparisons – Layer 4 Dead

MPGD + ToF alive

MPGD alive ToF dead

ToF Alive MPGD dead

MPGD dead ToF dead
(Si only)

⅂ Dead

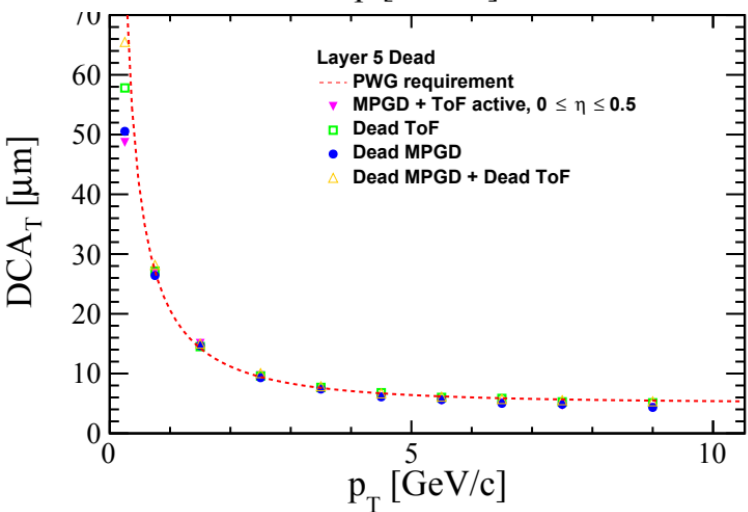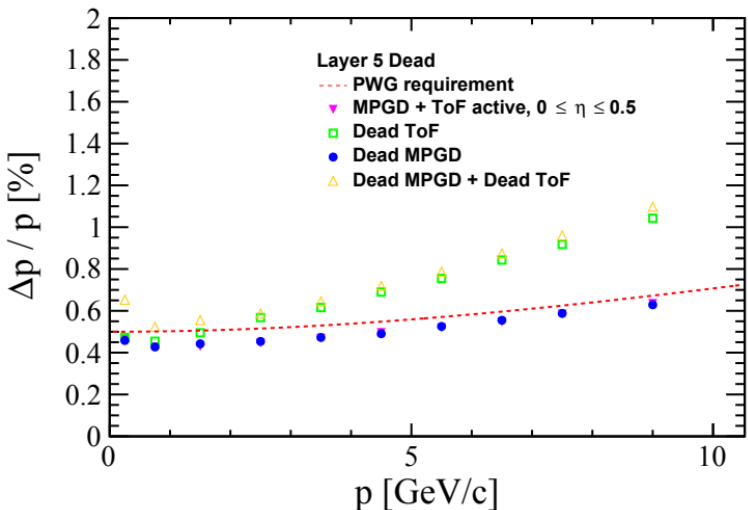- Also see degradation in p resolution due to worse sagitta measurement

Dead Layer comparisons – Layer 5 Dead

MPGD + ToF alive

MPGD alive ToF dead

ToF Alive MPGD dead

MPGD dead ToF dead (Si only)

⅃ Dead

- We see strong separation between between the configurations with and without the ToF layer
  - MPGD+ToF and ToF only match up
  - MPGD only is very slightly better than just silicon
    - → MPGD does not offer performance if ToF is active

Summary

- Simulations were performed to determine the role of the barrel MPGD layer
  - In these studies, the MPGD layer does not contribute to the momentum or transverse pointing resolution with all layers active
  - We also do not recover any performance with an active MPGD assuming a single Si layer fail → not providing redundancy
  - → Main purpose of MPGD layer is for pattern recognition