

MPGD ECT Geometry and Rates

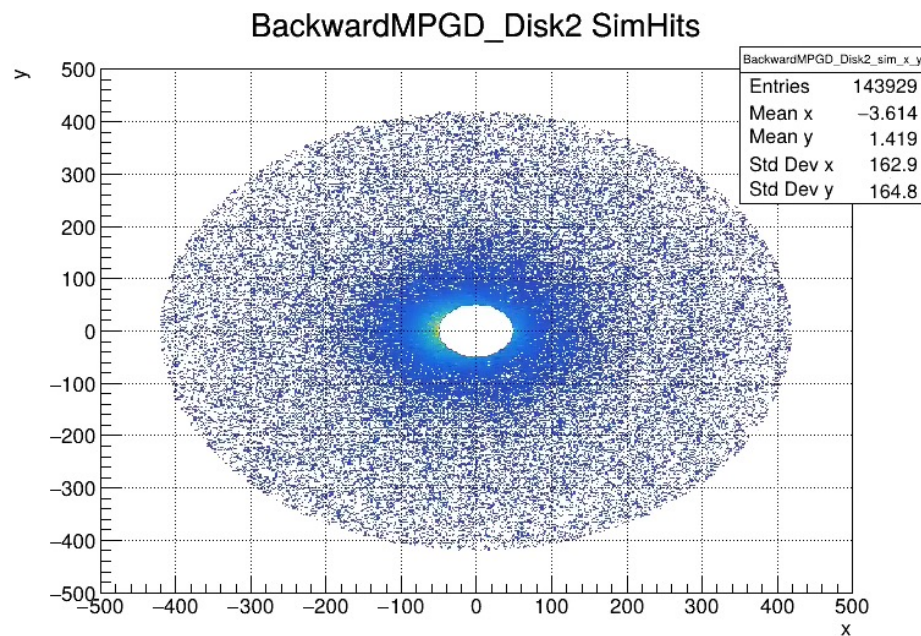
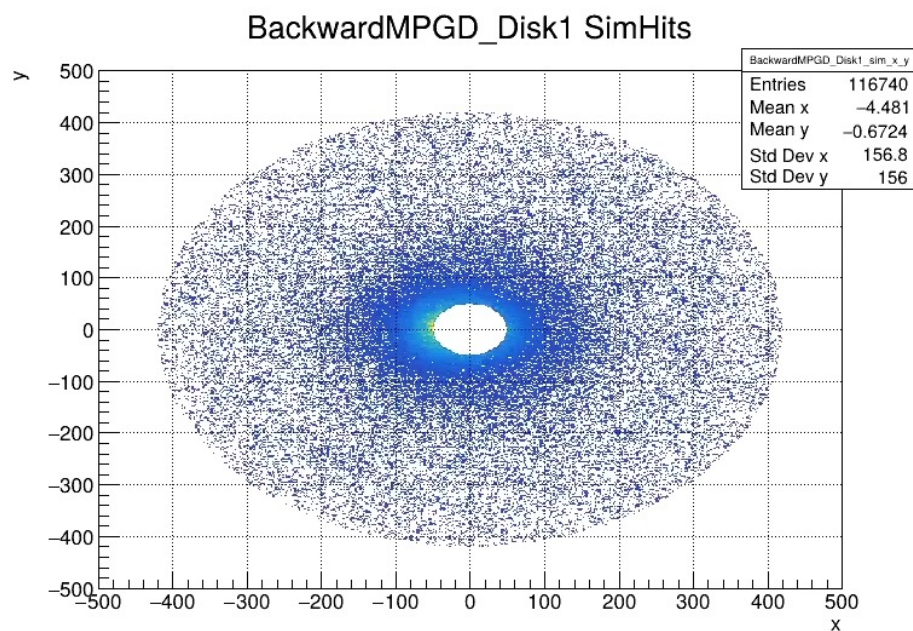
Matt Posik
Temple University

Calculating Rates



1. Z position used to select if what disk the hit belongs to

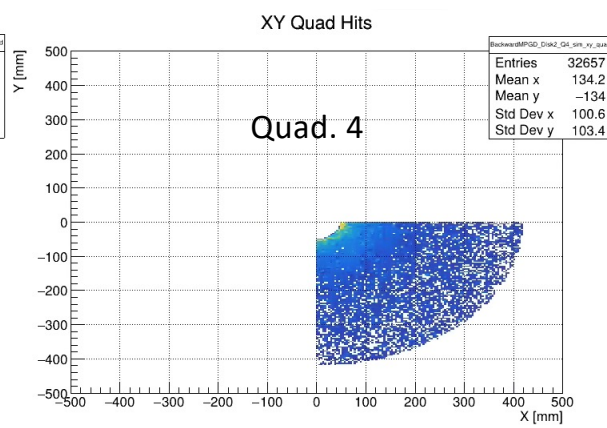
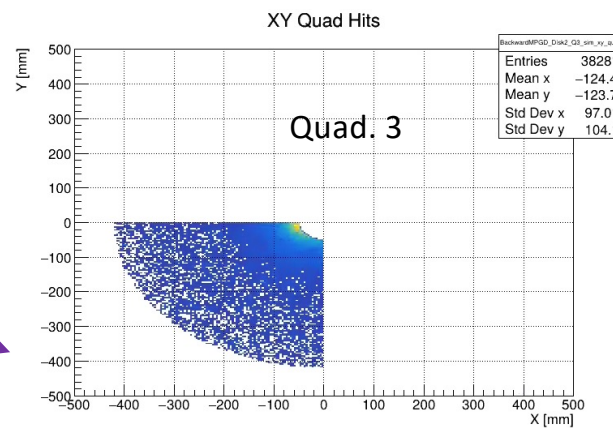
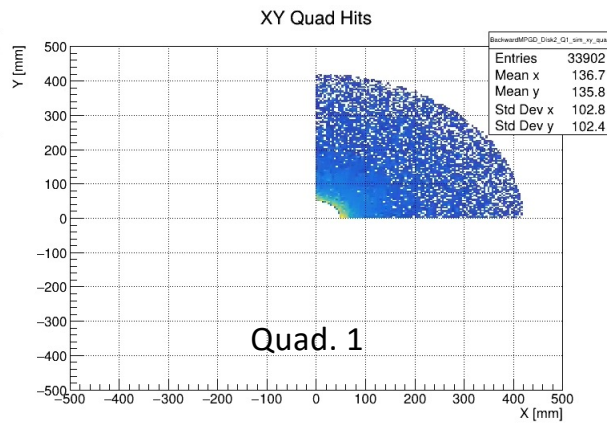
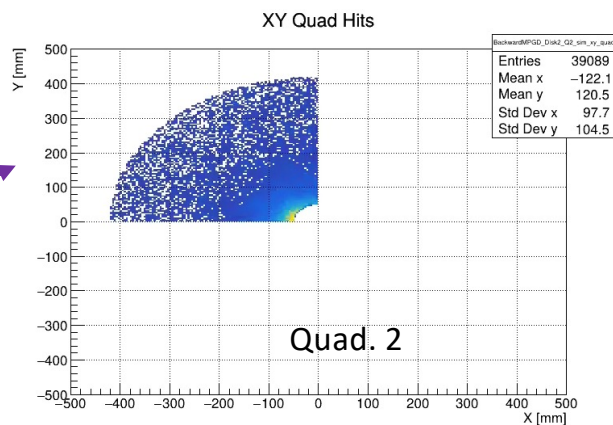
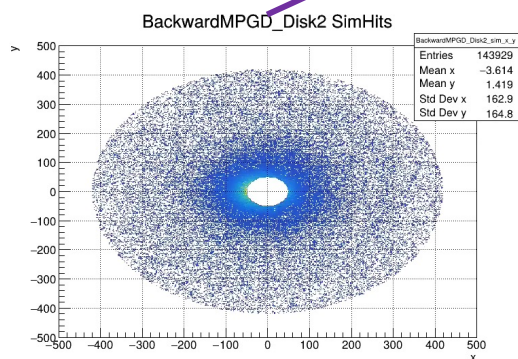
Example



Calculating Rates



2. Split each disk into quadrants



Example

Calculating Rates

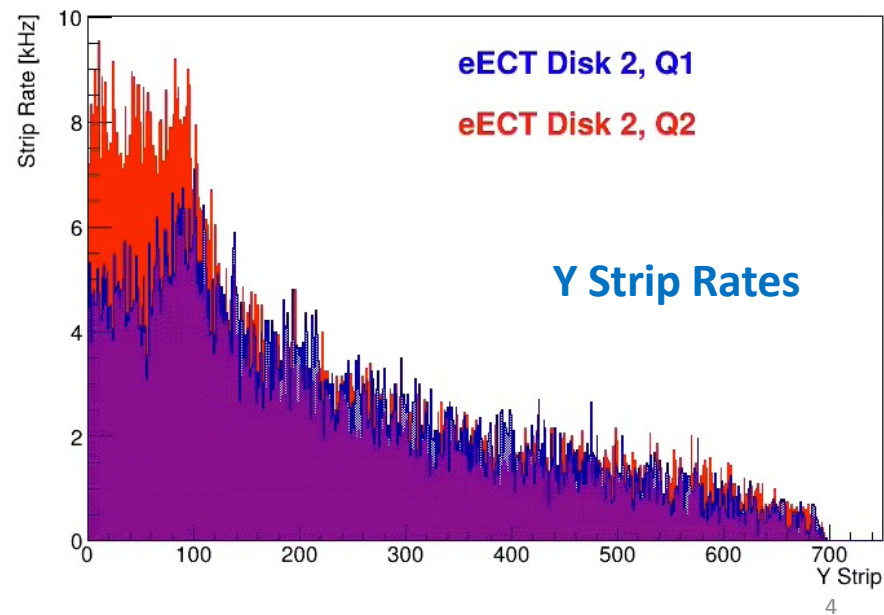
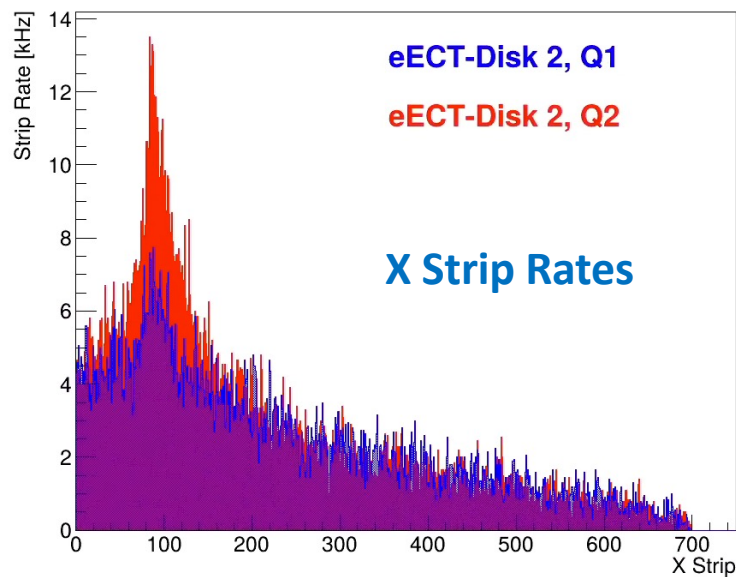


3. Create “strips” by binning x and y detector hits into bins based on readout strip pitch:

- Pitch = 600 μm , MPGD radius = 450 mm,
- #Strips = MPGD Radius / Pitch = 750 strips (bins),
- Bin width = 1 strip

Example

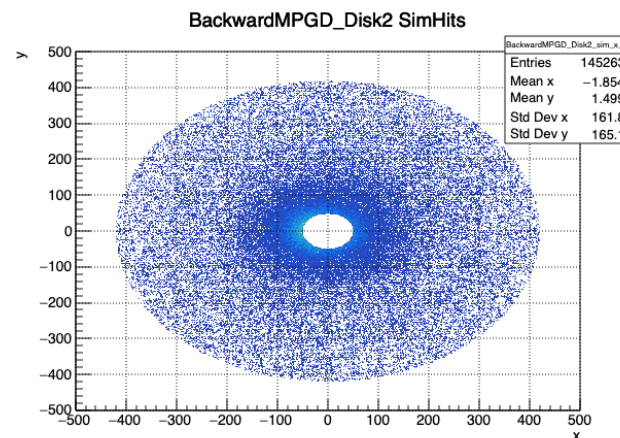
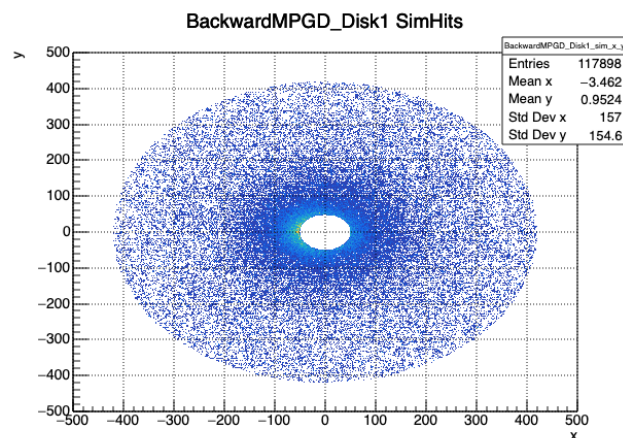
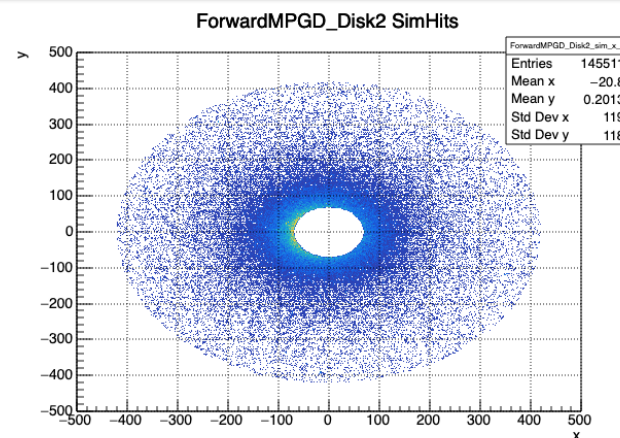
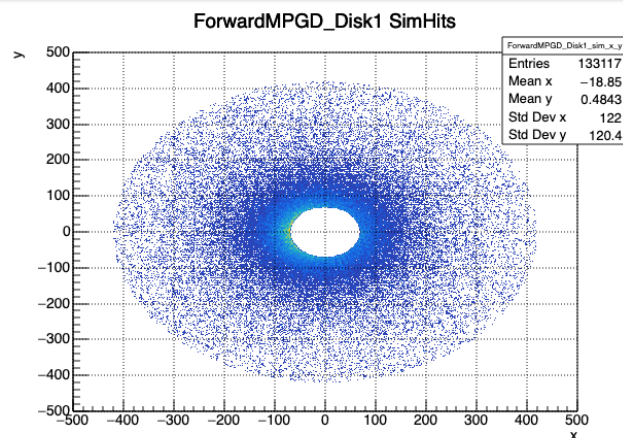
4. Strip Rate [kHz] = Strip Hits / #Events / $2\mu\text{s}$ / $1\text{e}3$



MPGD ECT Disks



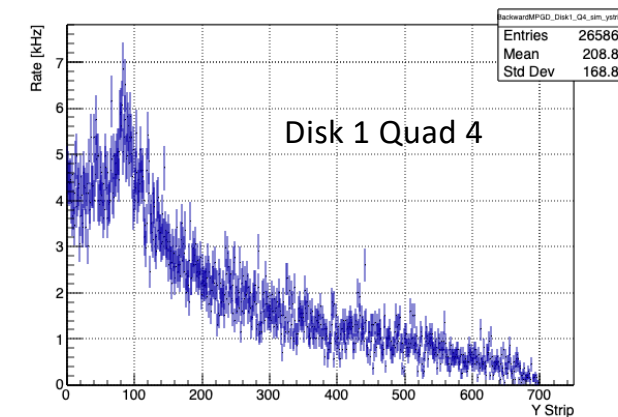
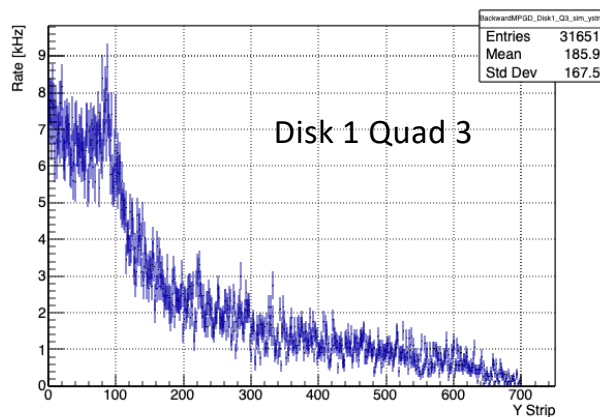
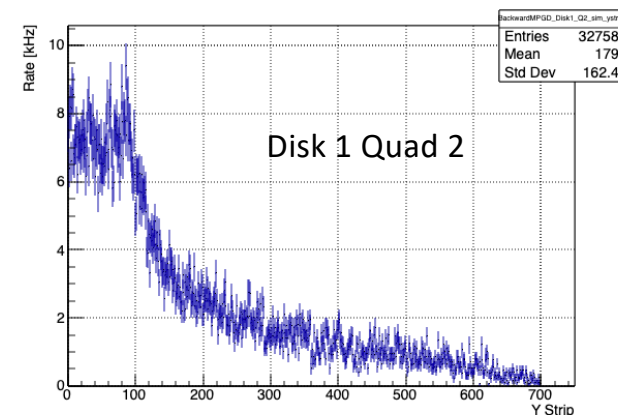
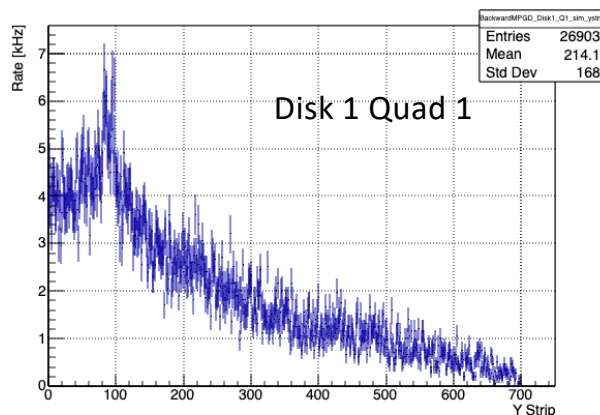
- E: 10x275
- $Q^2 = 1 \text{ GeV}^2$
- Geo: 26.07.1
- EICrecon: 1.39.2
- Events: 10k
- Sources: DIS, SR, Touch,
Brem, Coul,Pgas
- Beampipe: 10um Au coat



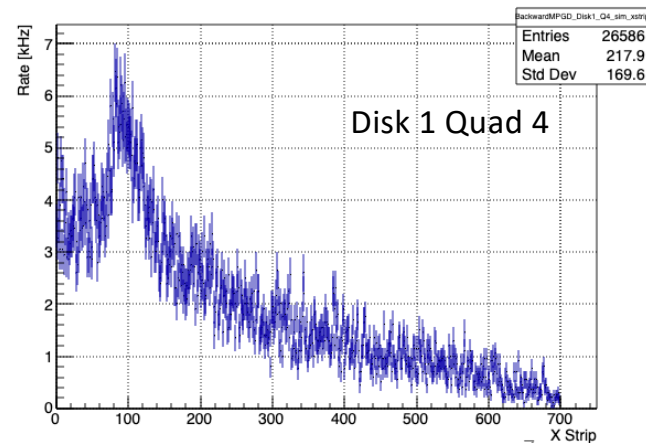
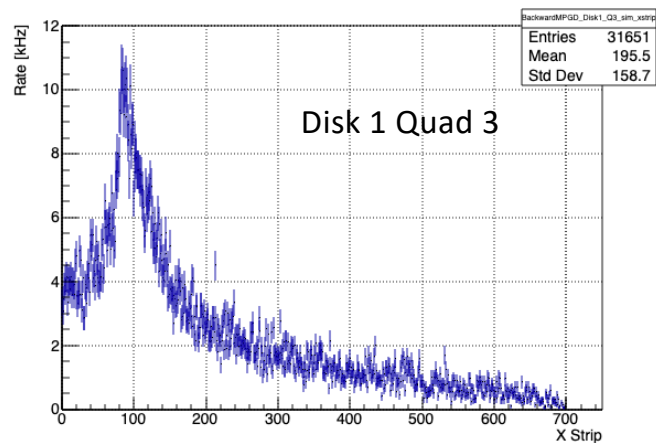
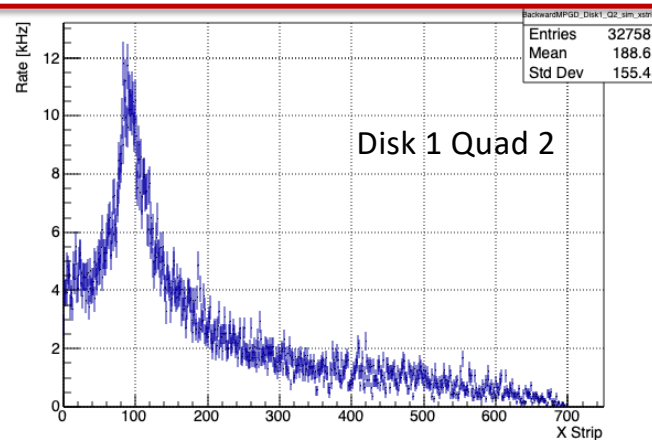
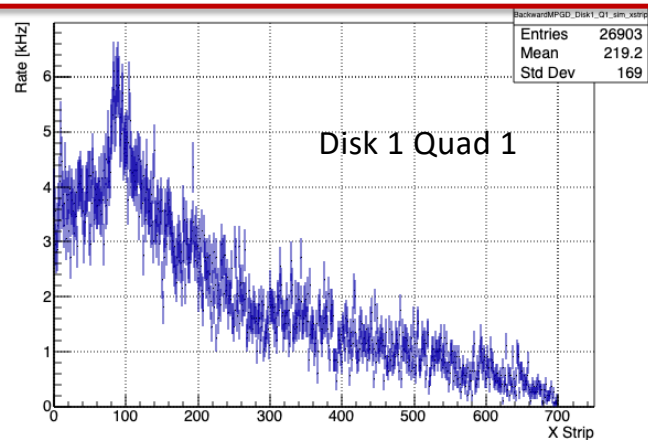
Backward ECT: Disk 1 Y-Strip Rate



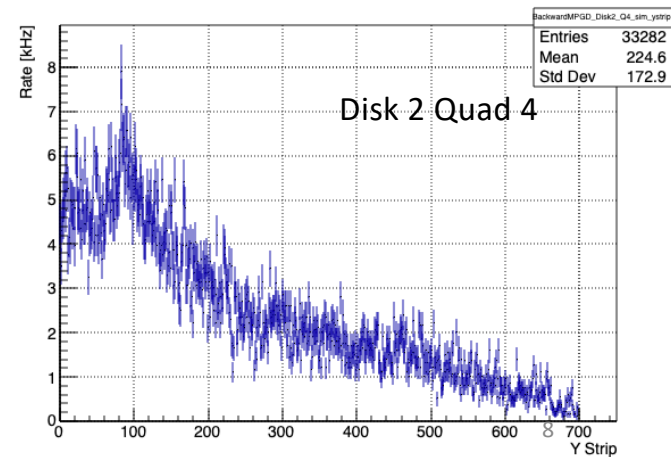
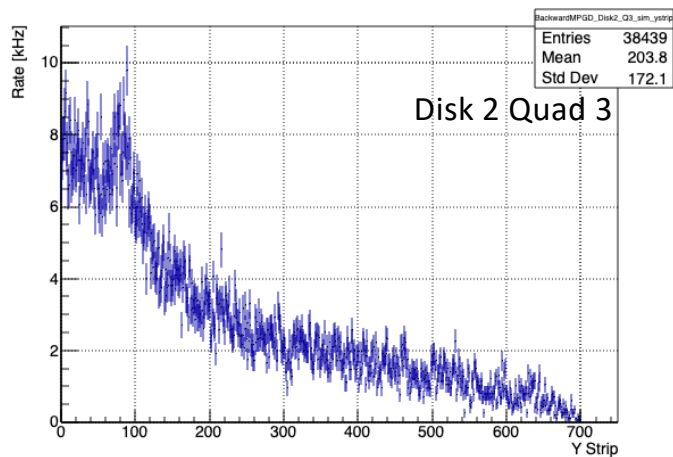
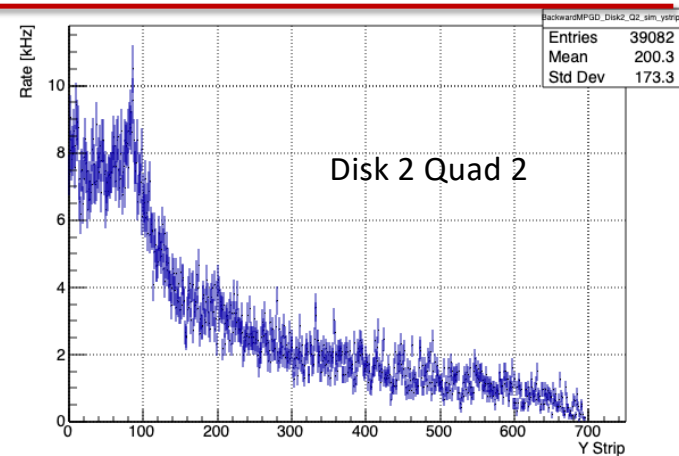
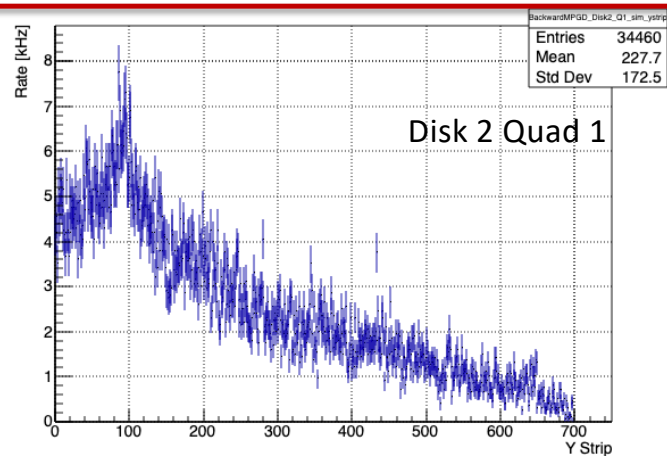
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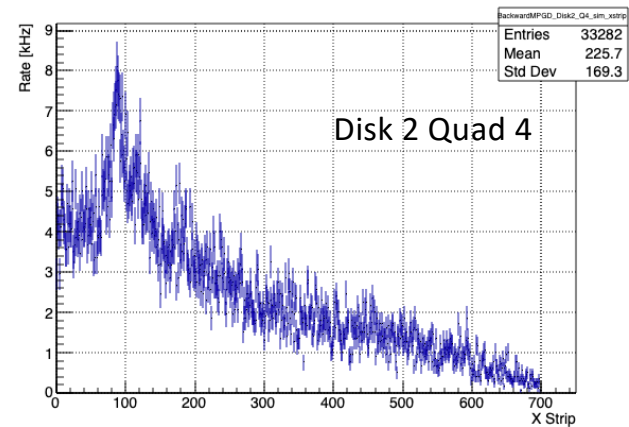
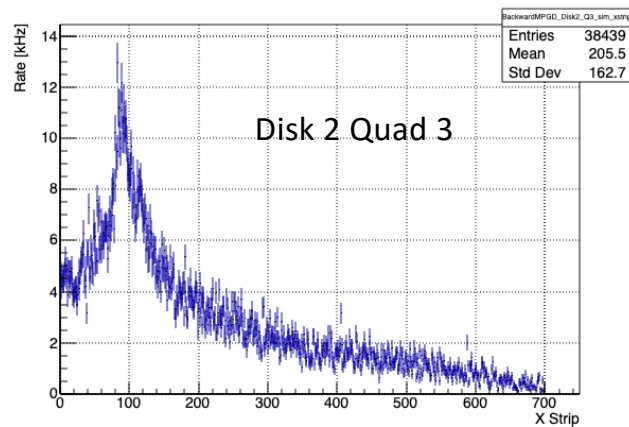
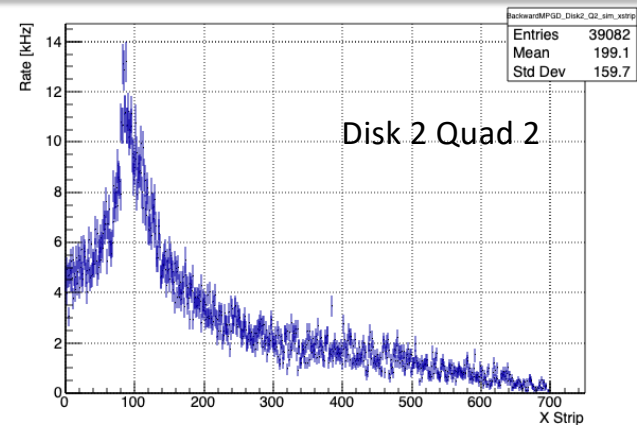
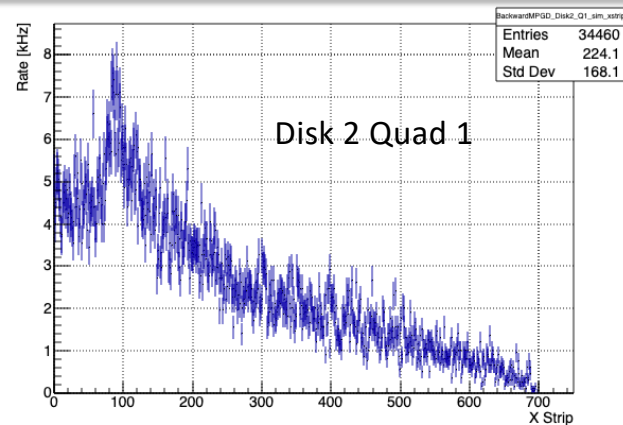
Backward ECT: Disk 1 X-Strip Rate



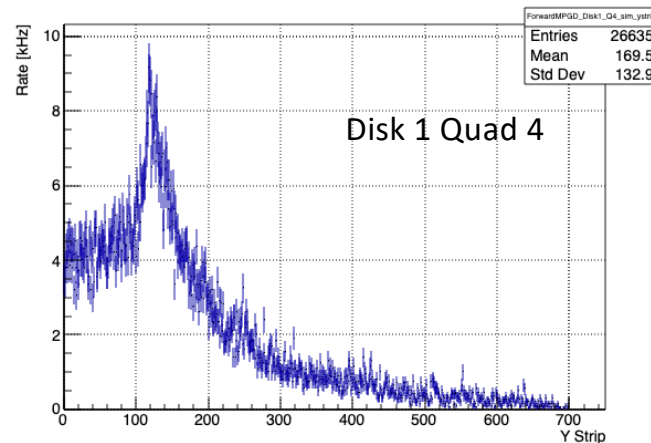
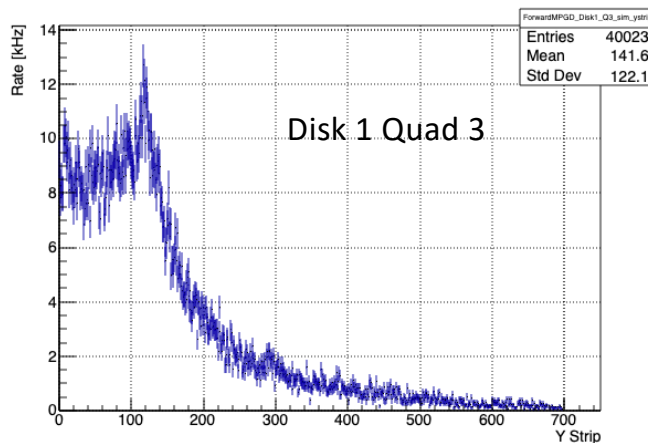
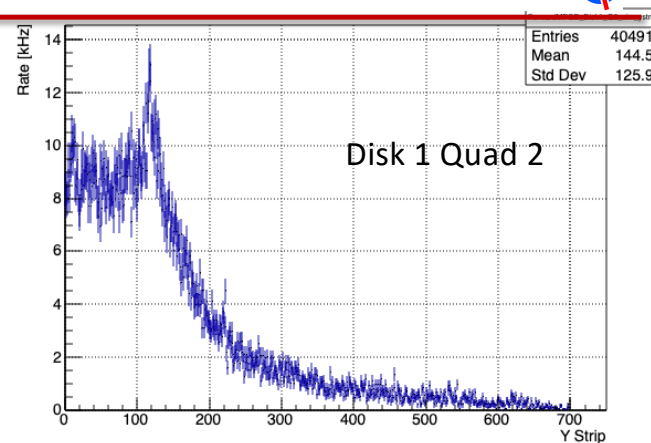
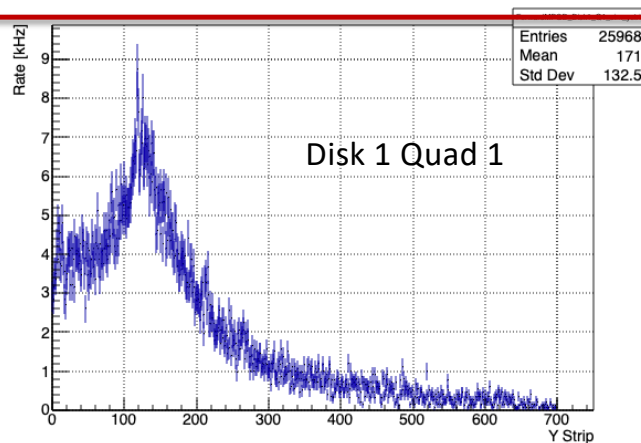
Backward ECT: Disk 2 Y-Strip Rate



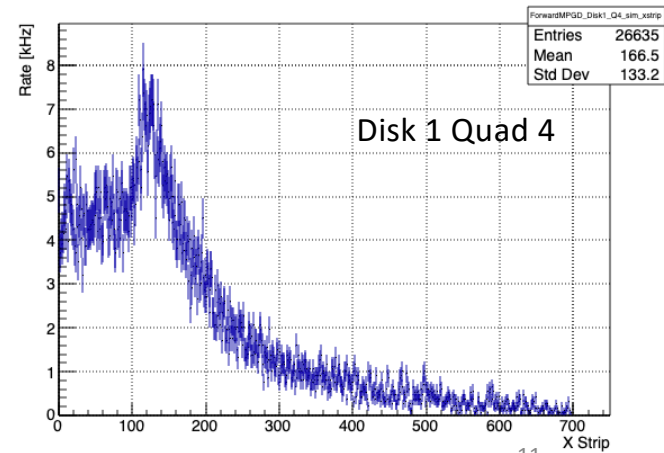
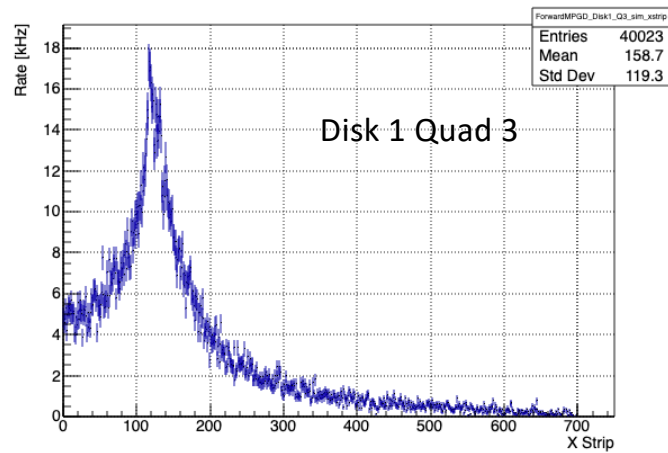
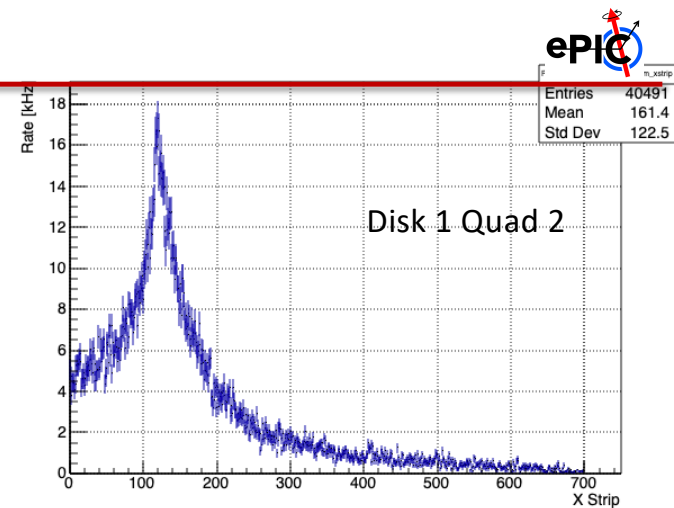
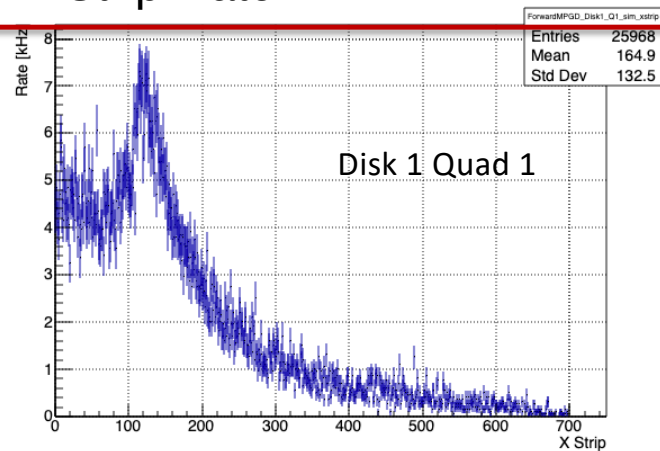
Backward ECT: Disk 2 X-Strip Rate



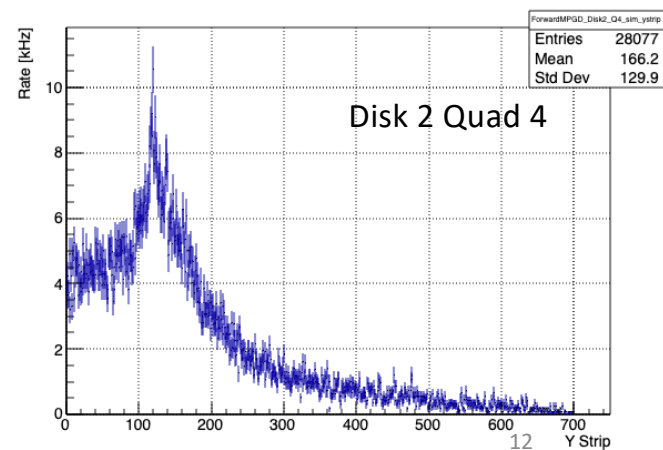
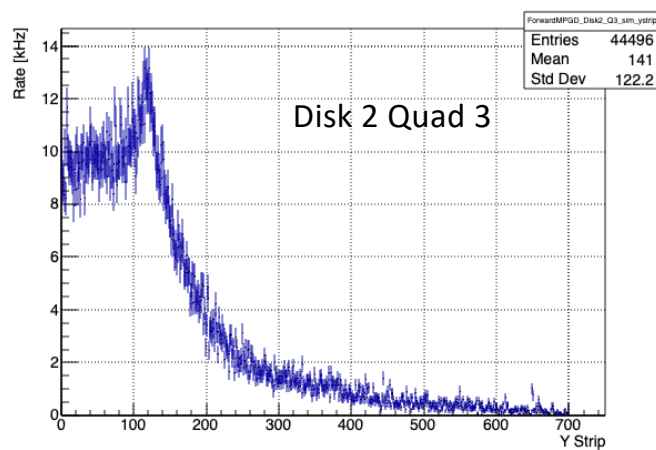
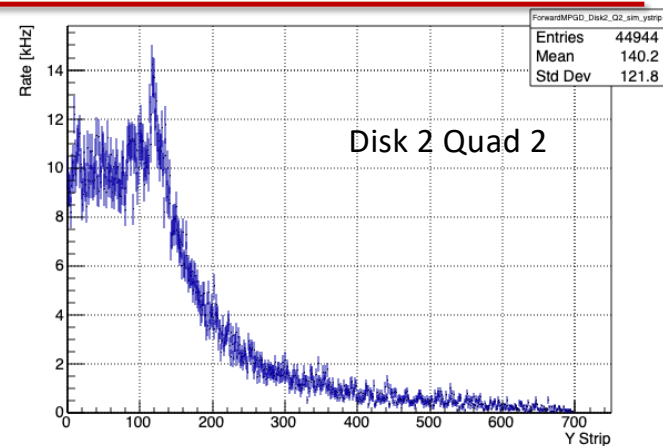
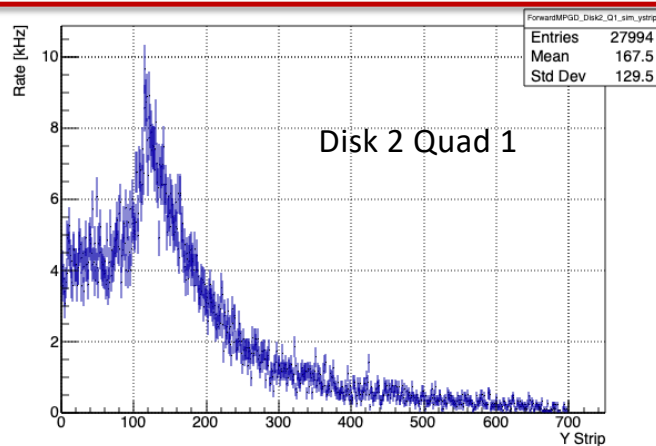
Forward ECT: Disk 1 Y-Strip Rate



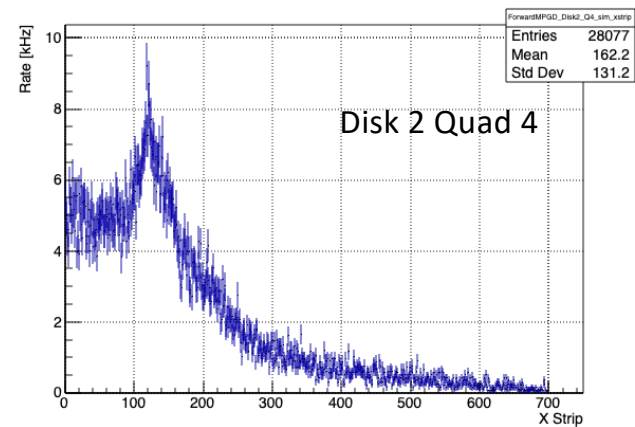
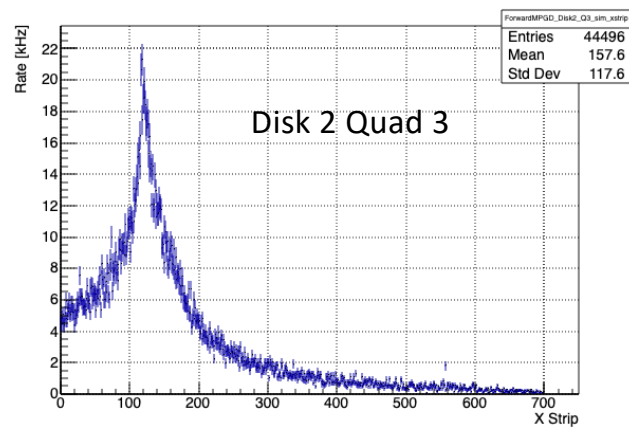
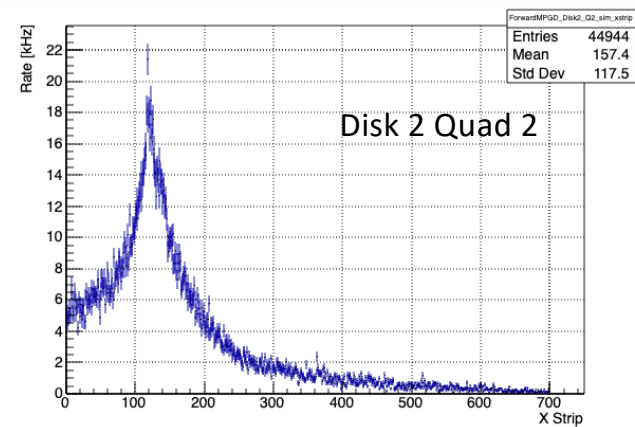
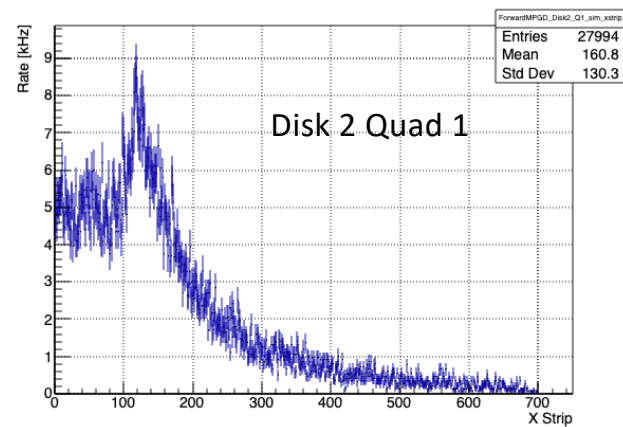
Forward ECT: Disk 1 X-Strip Rate



Forward ECT: Disk 2 Y-Strip Rate



Forward ECT: Disk 2 X-Strip Rate



ECT Strip Rate Summary: Forward Disk 1



Forward Disk 1 – Y-Strip					
Quad	Mean [kHz]	Median [kHz]	Max [kHz]	Rate 95% [kHz]	Rate 99% [kHz]
1	1.89	0.95	8.75	5.65	6.95
2	2.9	1.05	13.05	9.5	11.15
3	2.9	1.05	12.7	9.65	11.0
4	1.94	0.95	9.15	5.95	7.95

Rate 95% (99%) → 5% (1%) of occupied strips have a rate above this value

Forward Disk 1 – X-Strip					
Quad	Mean [kHz]	Median [kHz]	Max [kHz]	Rate 95% [kHz]	Rate 99% [kHz]
1	1.89	0.9	7.3	5.65	7.05
2	2.9	1.2	17.25	10.65	15.05
3	2.9	1.1	17.3	10.45	15.25
4	1.9	1.0	7.9	5.6	7.1

ECT Strip Rate Summary: Forward Disk 2



Forward Disk 2 – Y-Strip					
Quad	Mean [kHz]	Median [kHz]	Max [kHz]	Rate 95% [kHz]	Rate 99% [kHz]
1	2.03	0.95	9.65	6.4	8.05
2	3.26	1.15	14.2	10.95	12.3
3	3.20	1.15	13.15	10.7	12.3
4	2.04	1.0	10.55	6.25	8.05

Forward Disk 2 – X-Strip					
Quad	Mean [kHz]	Median [kHz]	Max [kHz]	Rate 95% [kHz]	Rate 99% [kHz]
1	2.04	0.95	8.75	6.1	7.9
2	3.24	1.25	21.4	12.45	17.55
3	3.22	1.2	21.3	11.8	17.85
4	2.03	0.9	9.2	6.1	7.25

ECT Strip Rate Summary: Backward Disk 1



Backward Disk 1 – Y-Strip

Quad	Mean [kHz]	Median [kHz]	Max [kHz]	Rate 95% [kHz]	Rate 99% [kHz]
1	1.93	1.5	6.65	4.55	5.7
2	2.35	1.45	9.4	7.5	8.45
3	2.27	1.4	8.7	7.05	7.8
4	1.91	1.4	6.85	4.9	5.8

Backward Disk 1 – X-Strip

Quad	Mean [kHz]	Median [kHz]	Max [kHz]	Rate 95% [kHz]	Rate 99% [kHz]
1	1.93	1.5	6.1	4.45	5.75
2	2.36	1.45	11.8	7.55	10.55
3	2.27	1.45	10.7	7.2	10
4	1.90	1.45	6.45	4.85	5.85

ECT Strip Rate Summary: Backward Disk 2



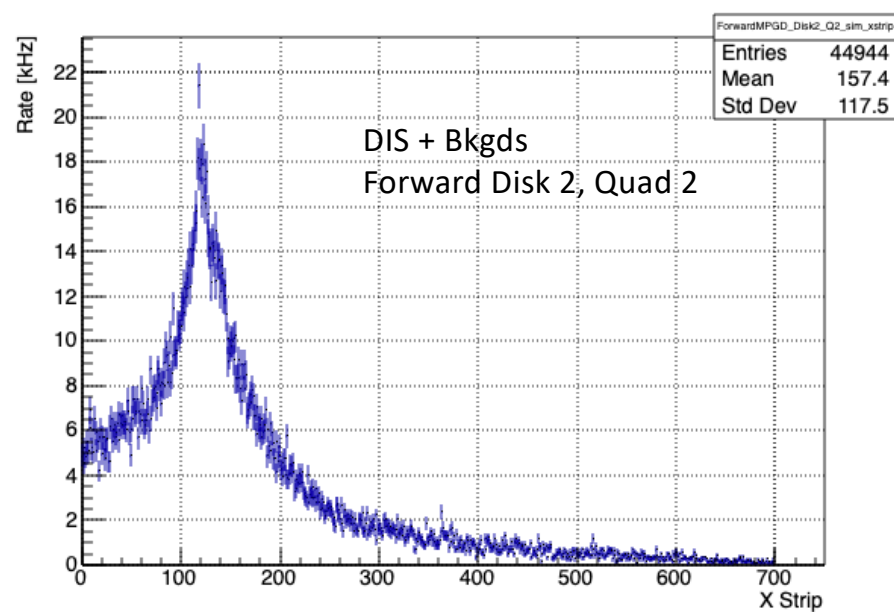
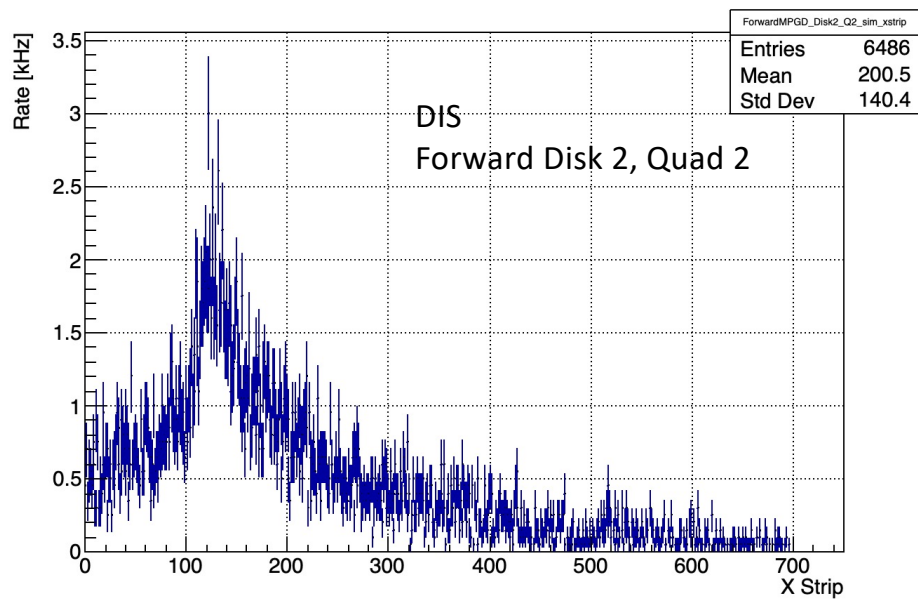
Backward Disk 2 – Y-Strip

Quad	Mean [kHz]	Median [kHz]	Max [kHz]	Rate 95% [kHz]	Rate 99% [kHz]
1	2.47	2.05	7.75	5.45	6.45
2	2.82	1.95	10.5	8.05	8.85
3	2.76	2.0	9.8	7.5	8.6
4	2.39	1.95	7.9	5.45	6.35

Backward Disk 2 – X-Strip

Quad	Mean [kHz]	Median [kHz]	Max [kHz]	Rate 95% [kHz]	Rate 99% [kHz]
1	2.48	2.1	7.7	5.55	7.05
2	2.82	1.95	13.2	8.4	11.1
3	2.75	1.95	12.95	7.75	10.75
4	2.38	1.9	8.1	5.4	7.3

ECT Strip Rate Summary: Forward Disk 2



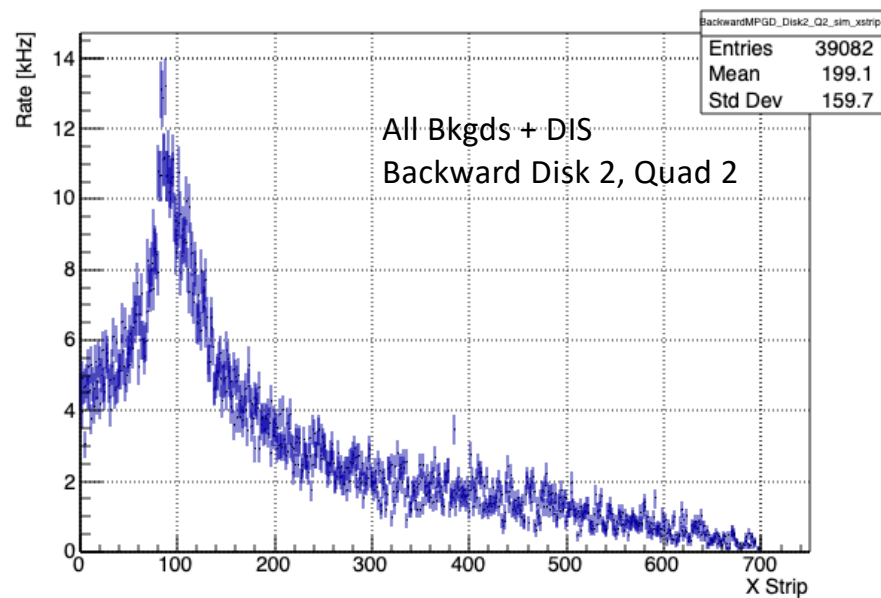
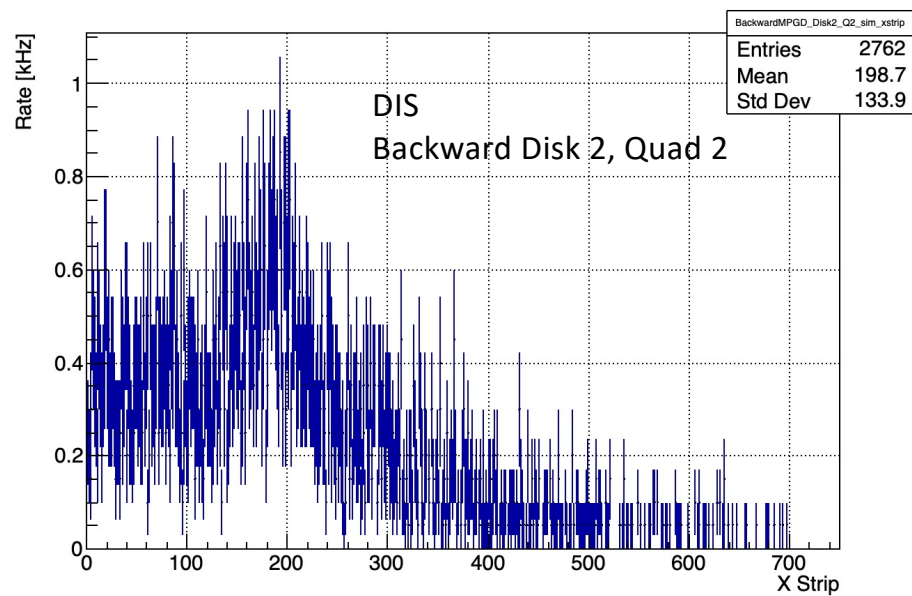
ECT Strip Rate Summary: Forward Disk 2



Forward Disk 2 – X-Strip (DIS)					
Quad	Mean [kHz]	Median [kHz]	Max [kHz]	Rate 95% [kHz]	Rate 99% [kHz]
1	0.277	0.2	1	0.65	0.85
2	0.5	0.35	3	1.5	2.0
3					
4					

Forward Disk 2 – X-Strip (All Bkgds)					
Quad	Mean [kHz]	Median [kHz]	Max [kHz]	Rate 95% [kHz]	Rate 99% [kHz]
1	2.04	0.95	8.75	6.1	7.9
2	3.24	1.25	21.4	12.45	17.55
3	3.22	1.2	21.3	11.8	17.85
4	2.03	0.9	9.2	6.1	7.25

ECT Strip Rate Summary: Backward Disk 2



ECT Strip Rate Summary: Backward Disk 2



Backward Disk 2 – X-Strip (DIS)					
Quad	Mean [kHz]	Median [kHz]	Max [kHz]	Rate 95% [kHz]	Rate 99% [kHz]
1	0.26	0.2	0.9	0.65	0.75
2	0.25	0.2	0.85	0.60	0.75
3					
4					

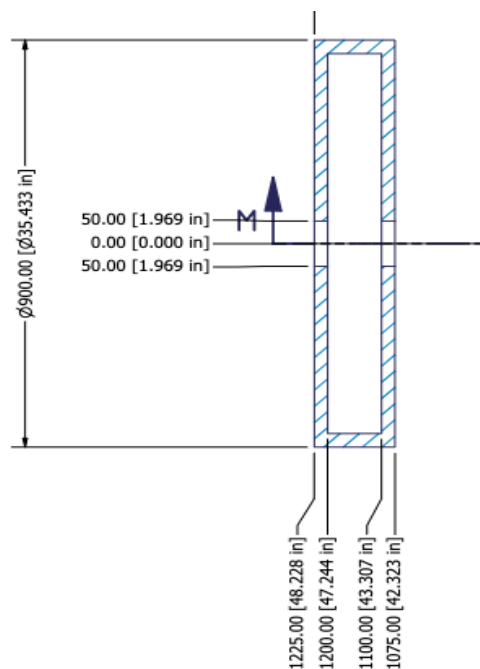
Backward Disk 2 – X-Strip (All Bkgd)					
Quad	Mean [kHz]	Median [kHz]	Max [kHz]	Rate 95% [kHz]	Rate 99% [kHz]
1	2.48	2.1	7.7	5.55	7.05
2	2.82	1.95	13.2	8.4	11.1
3	2.75	1.95	12.95	7.75	10.75
4	2.38	1.9	8.1	5.4	7.3

Geometry Issues

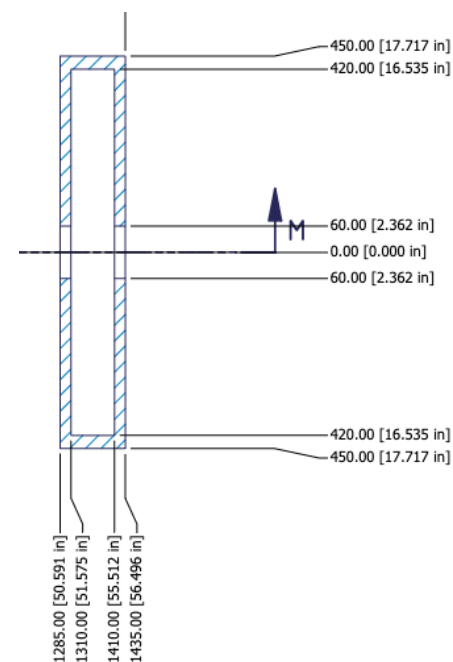


- ❑ ePIC simulation only reserves 25mm space in z
- ❑ Current design with +/-16mm z-stagger requires larger envelope:
- $Envelop = det_thickness + 2 * z_stagger$
- $= 15.65mm + 2 * 16mm$
- $= 47.64mm$

Backward MPGD ECT



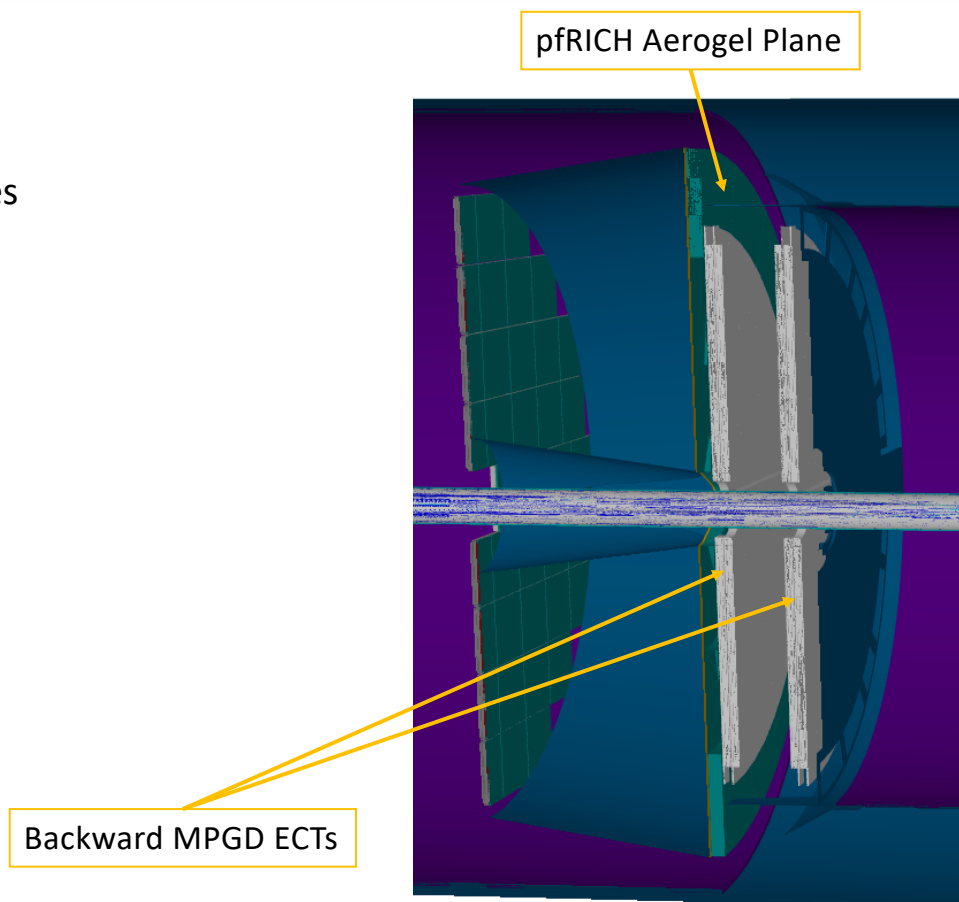
Forward MPGD ECT



Backward Endcap



- ❑ Backward ECT now clears support obstacles

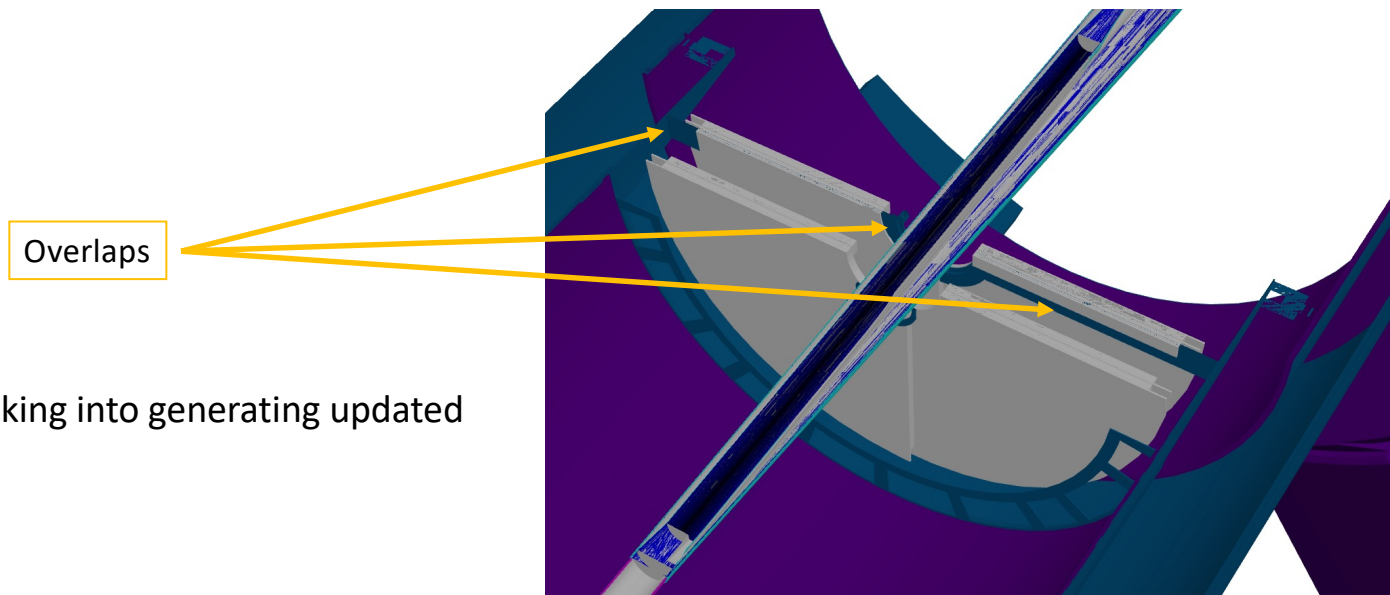


Forward Endcap



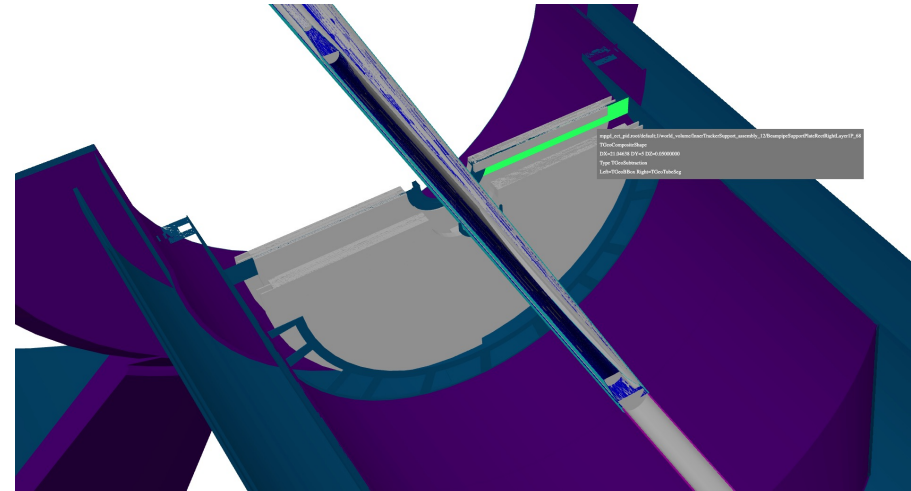
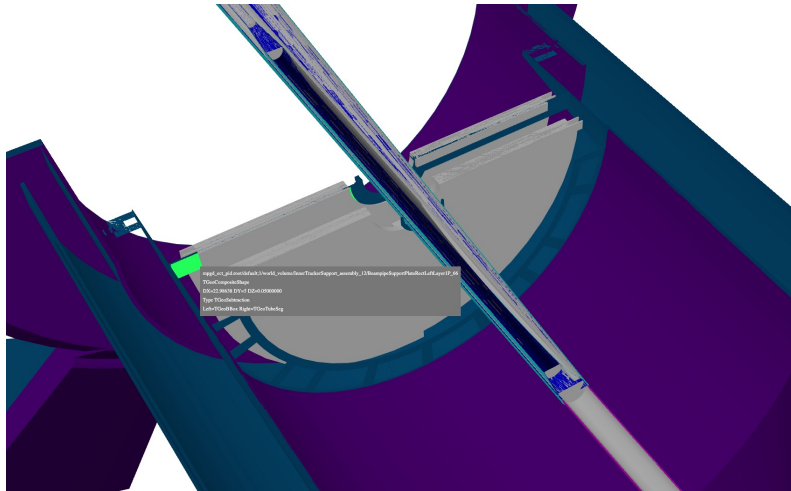
❑ Overlaps with support structures

- Can push one disk back, but would change distance between disk 1 and 2
- Will check with tracking how positions of supports are determined



❑ Marco started looking into generating updated material map

Forward Endcap



Calculating Data Rates



➤ Calculating data rates requires knowing which strips belong to which FEBs

➤ Path to DAQ rate estimate

1. Obtain ECT hit rate vs x and y
2. Obtain from ECT CAD/gerber
 - X/Y positions of strips (gerber_strip)
 - Map of strip number to FEB card
3. Map ECT X/Y hits to gerber_strip
4. Map gerber_strip to FEBs to calculate FEB rates

➤ Potential challenges

1. Mismatch between simulation and cad geometry → potential x/y mismatch
 - Integrate cad geo into sim and live with overlaps (SimHits still created), or
 - Run sim with only ECT detector --> will miss knock-ons and particle sprays from missing detector materials

Cartoon for illustration

