PEEK Shape Studies

Laura, 2024-05-15

Past Studies

- PEEK is designed to minimize the amount of elastically scattered electrons entering the GEMs
- Previous studies done by Cameron and Kate for the old chamber design
  - Rate numbers come from here
- Results of their studies:

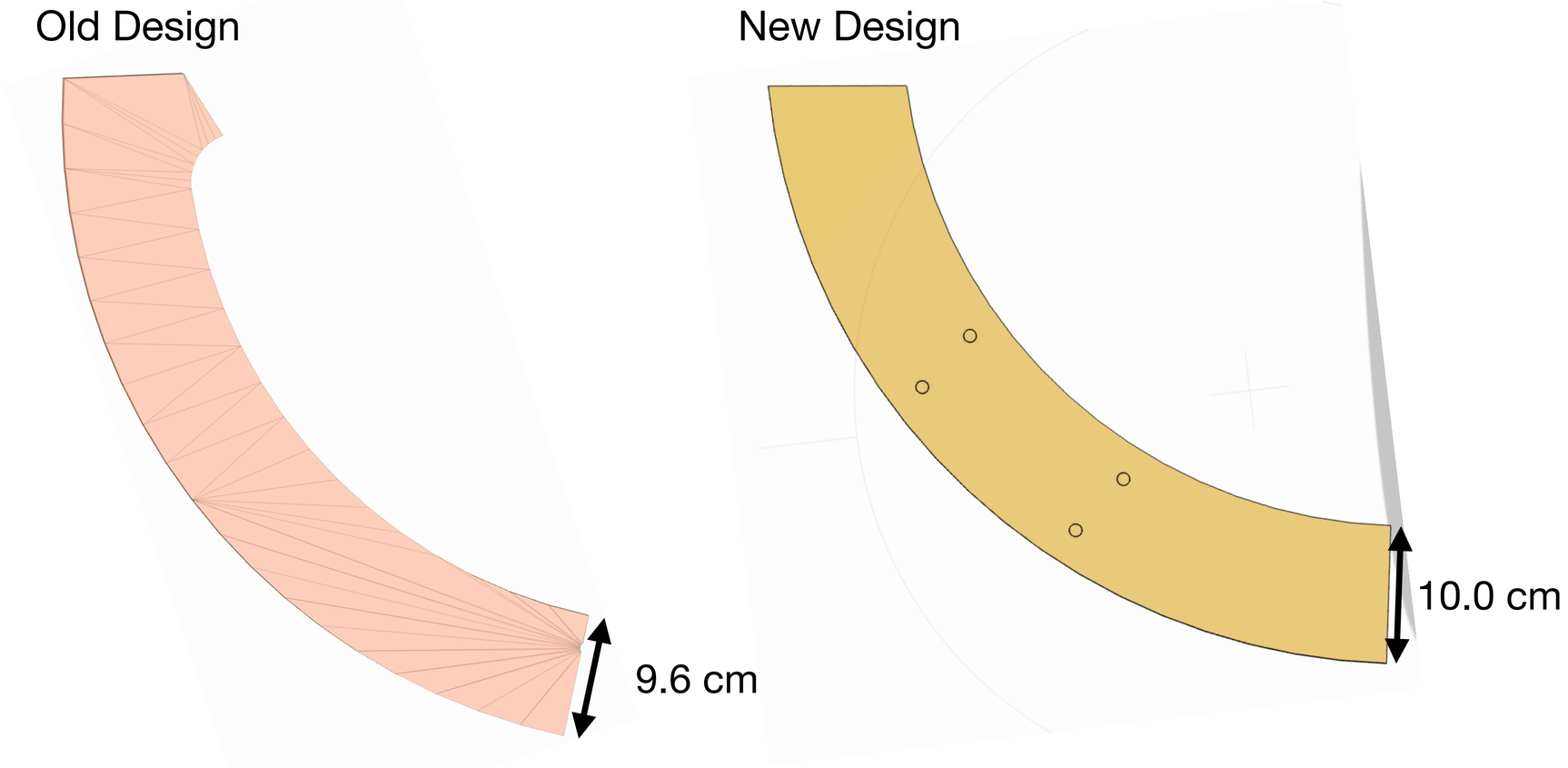
Chamber Design	Fraction of events with e- hits	Total e- rate (Fraction x 380 MHz)	Fraction of events with e+ hits	Total e+ rate (Fraction x 4.43 GHz)
Nominal chamber	0.021	7.9 MHz	1E-04	443 kHz
Solid PEEK	0.00248	0.94 MHz	1E-05	44 kHz
PEEK with middle third removed	0.00064	243 kHz		

Replicating with new design

- Discrepancies (in a bad way) between the old and new design

Chamber Design		Fraction of events with e- hits		Total e- rate		Fraction of events with e+ hits		Total e+ rate	
		Old design	New design	Old design	New design	Old design	New design	Old design	New design
Solid PEEK		0.00221	0.00356	839 kHz	1.35 MHz	1E-04	2.8E-05	443 kHz	124 kHz
PEEK with middle third removed		0.000627	0.00503	238 kHz	1.91 MHz	1E-05	3.3E-05	44 kHz	146 kHz

PEEK height and shape has changed



- Electrons are now clipping the corner closest to the target chamber and slowing down enough to exit the PEEK and go into the GEMs
- Acceptance window has also changed slightly (from 1.5 to 1.35 degrees)

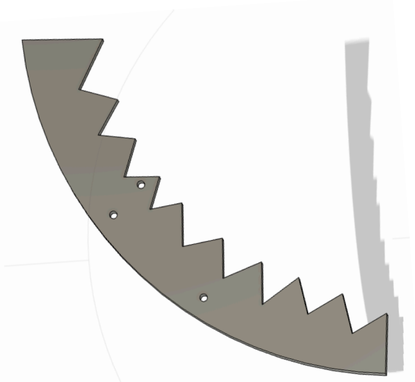
Replicating with new design (plus shorter PEEK)

- Focusing on the electron arm for now

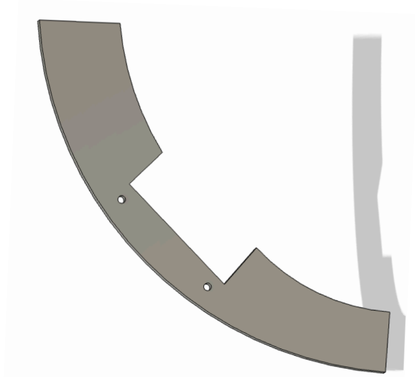
PEEK shape	Fraction of events with e- hits	Total e- rate
Old chamber with solid PEEK	0.00221	839 kHz
New chamber with 10 cm tall PEEK	0.00356	1.35 MHz
New chamber with 9.6 cm tall PEEK	0.00297	1.13 MHz
New chamber with 9.0 cm tall PEEK	0.00226	859 kHz
New chamber with 8.5 cm tall PEEK	0.00171	650 kHz
New chamber with 8.0 cm tall PEEK	0.00144	547 kHz
New chamber with 7.5 cm tall PEEK	0.00145	551 kHz
New chamber with 7.0 cm tall PEEK	0.00154	585 kHz
New chamber with 7.5 cm tall PEEK at bottom, 10.0 cm tall at top	0.00106	403 kHz

Various options for PEEK shapes

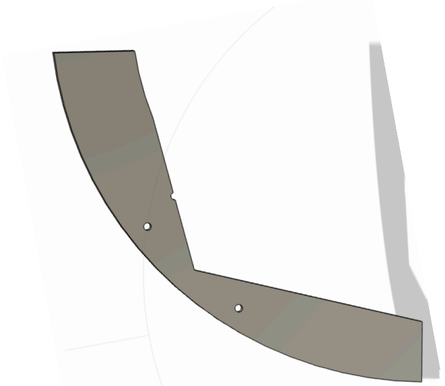
- Use the right diagram as a base, try some other shapes



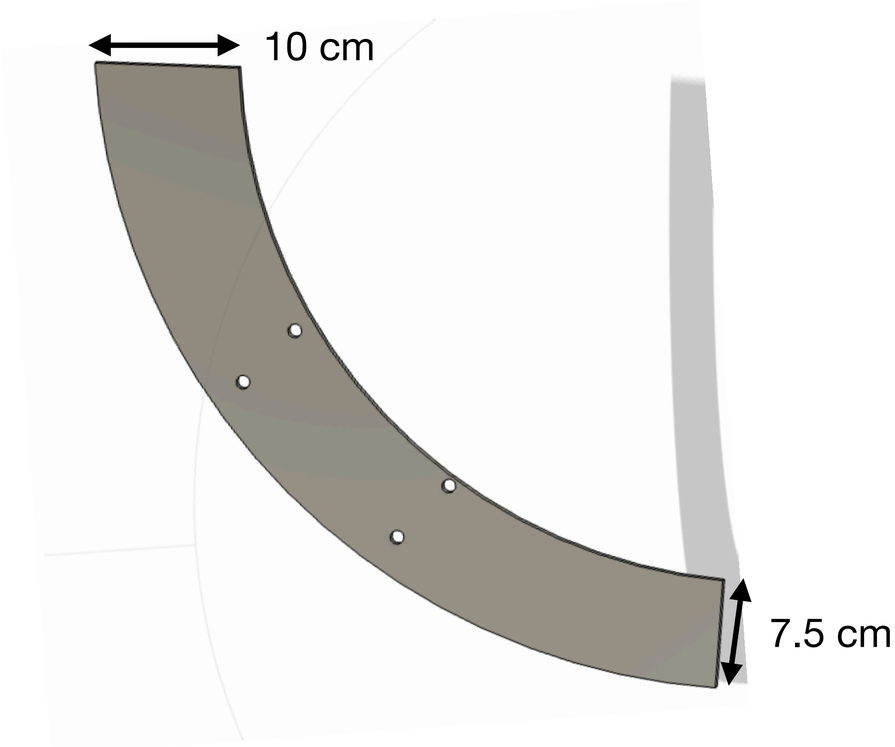
#1: Shark teeth

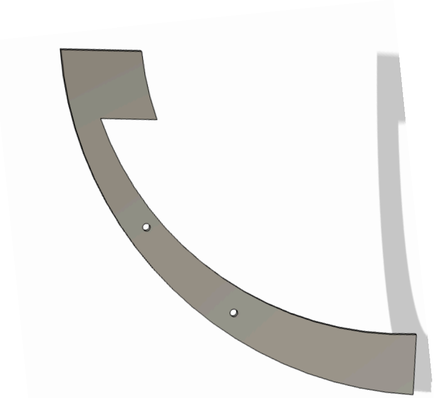


#2: Gap

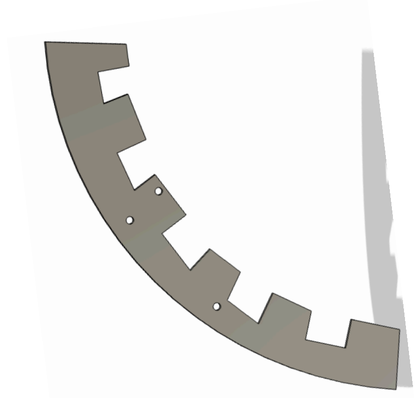


#3: Triangle

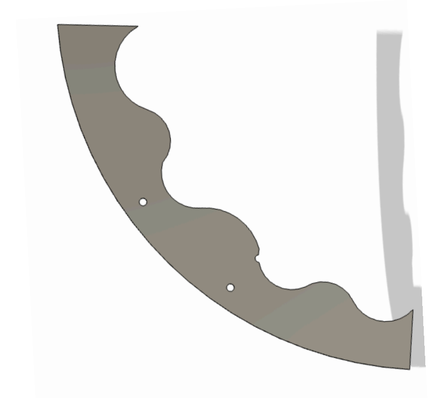




#4: Cane



#5: Herbivore teeth



#6: Wave

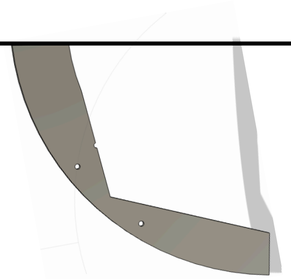
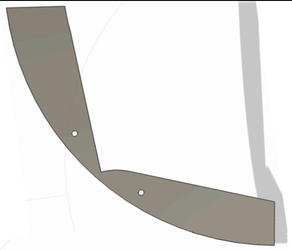
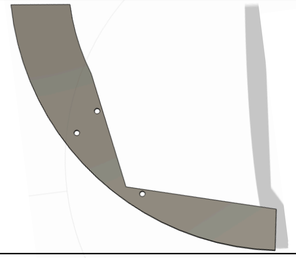
Various options for PEEK shapes

- Use this as a base, try some other shapes

Shape	Fraction of events with e- hits	Total e- rate
Shark teeth (1)	0.00292	1.11 MHz
Gap (2)	0.00291	1.11 MHz
Triangle (3)	0.000882	335 kHz
Cane (4)	0.00356	1.35 MHz
Herbivore teeth (5)	0.00156	593 kHz
Wave (6)	0.00757	2.88 MHz

Various options for PEEK shapes

- Since triangle performs best, try some variations on it

Shape		Fraction of events with e- hits	Total e- rate
Triangle		0.000882	335 kHz
Rounded triangle		0.000655	249 kHz
Triangle (7 cm on bottom, 10 cm on top, more obtuse angle)		0.000550	209 kHz

Summary

- Main takeaway for now: will need to shorten the electron arm PEEK at the end closest to target chamber
  - Big culprit for events in the e- arm are e- skimming the “bottom” portion of the PEEK
- From what I’ve tested so far triangle shape seems to work the best
  - Probably some fine tuning of angles/distances/heights needed
  - Does this work from the engineering side?
- This week: need to figure out positron arm (need more stats so takes longer to run, plus may want to try some different shapes)
  - Next slide has the numbers from the runs done for the e- arm values, if curious

Preliminary Positron Rates

- Current stats are only 100k for most of these, so take with a grain of salt

PEEK shape	Number of events	Number of events with e+ hits
Old chamber with solid PEEK	100M	1509
New chamber with 10 cm tall PEEK	1M	11
New chamber with 9.6 cm tall PEEK	100k	3
New chamber with 9.0 cm tall PEEK	100k	2
New chamber with 8.5 cm tall PEEK	100k	3
New chamber with 8.0 cm tall PEEK	100k	2
New chamber with 7.5 cm tall PEEK	100k	4
New chamber with 7.0 cm tall PEEK	100k	2
New chamber with 7.5 cm tall PEEK at bottom, 10.0 cm tall at top	100k	2

Preliminary Positron Rates

- Current shapes do not do any better than the solid PEEK currently used

Shape	Number of events	Number of events with e+ hits
Shark teeth (1)	1M	11
Gap (2)	1M	24
Triangle (3)	1M	27
Cane (4)	1M	11
Herbivore teeth (5)	1M	16
Wave (6)	1M	12