CI Update

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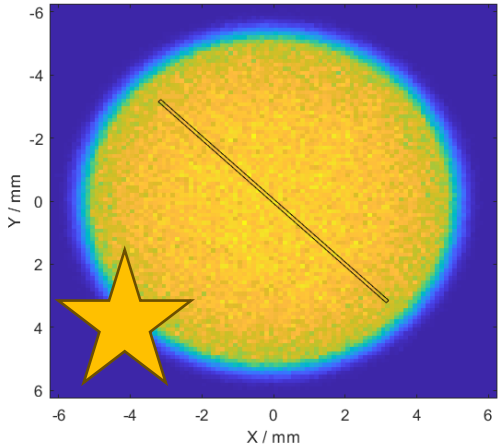
LHC Designs – Ne gas throughout

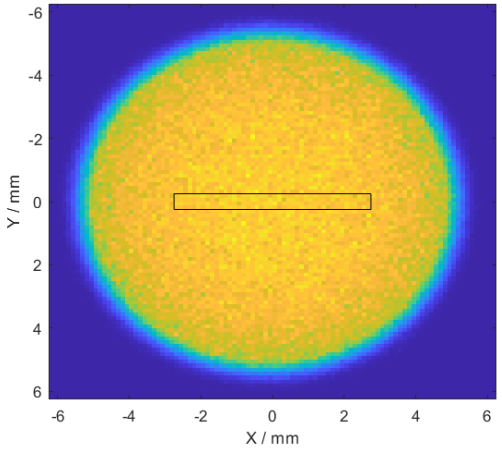
Skimmer Options

See .docx file for summary document of concepts



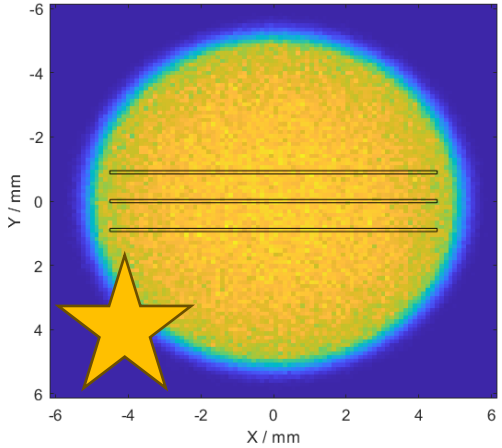
1.1 – Thin Curtain

Reduce thickness smearing for 2D profile



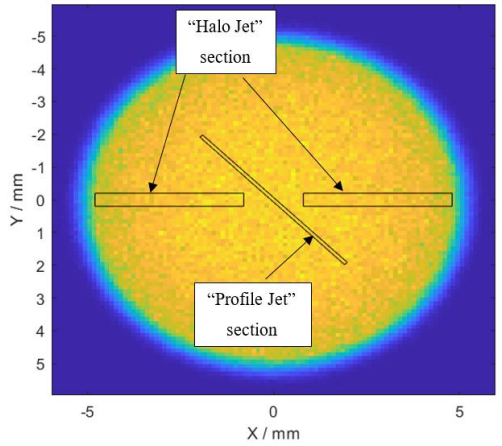
1.2 – Halo Single

Maximise losses for halo detection



1.3 – Halo Multi

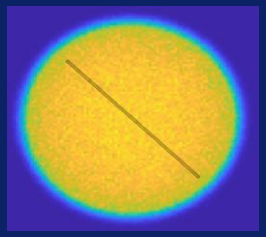
Same as 1.2, but reduced chance of misalignment



1.4 – Profile & Halo

Combination of 1.1 and 1.2 (shared positives and negatives)

Design 1.1 – Thin Curtain



Design	Density / m^{-3}	Length / mm	Width / mm	BG Pressure / mbar
V3	1.15×10^{17}	21.0	0.68	4.7×10^{-8}
Thin Curtain	1.01×10^{17}	17.2	0.22	4.8×10^{-9}
Delta	-12.9%	-17.9%	-67.1%	-89.7%

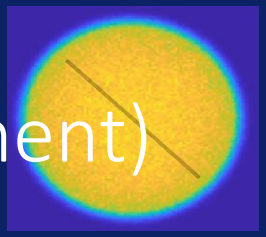
Density value seems high – not enough time to investigate, but delta's should be correct

(Includes $\sqrt{2}$ factor for thickness where appropriate)

$$Relative\ Signal = \frac{\eta_{Design} d_{Design}}{\eta_{V3} d_{V3}} = 0.28$$

Expected time to usable profile increase by ~3.5x (2 min becomes 7 min)

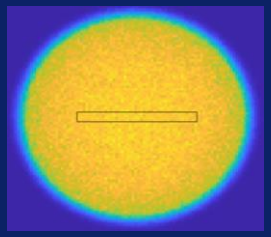
Design 1.1 – Thin Curtain (misalignment)



Additional 4th Skimmer size / mm	Pressure (IP) / mbar	V3 Delta / %	Pressure (Dump) / mbar	V3 Delta / %
+0.0 (Baseline)	5.22×10^{-9}	-88.75%	6.86×10^{-8}	-67.70%
+0.5	5.73×10^{-9}	-87.67%	6.81×10^{-8}	-67.94%
+1.0	6.23×10^{-9}	-86.58%	6.76×10^{-8}	-68.18%
+2.0	7.24×10^{-9}	-84.41%	6.66×10^{-8}	-68.65%
+3.0	8.25×10^{-9}	-82.24%	6.56×10^{-8}	-69.13%
+4.0	9.26×10^{-9}	-80.07%	6.46×10^{-8}	-69.60%

Added to the smallest dimension of the 4th skimmer, in this case – the width.

Design 1.2 – Halo Single Slit



Design	Density / m^{-3}	Length / mm	Width / mm	BG Pressure / mbar
V3	1.15×10^{17}	21.0	0.68	4.7×10^{-8}
Halo Single Slit	1.01×10^{17}	1.53	18.0	4.4×10^{-8}
Delta	-12.3%	-92.7%	$+2550\%$	-5.0%

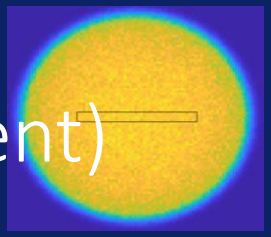
Density value seems high – not enough time to investigate, but delta's should be correct

(Includes $\sqrt{2}$ factor for thickness where appropriate)

$$Relative\ Signal = \frac{\eta_{Design} d_{Design}}{\eta_{V3} d_{V3}} = 16.4$$

Maximise losses for halo detection, 1D profile achievable, needs perfect alignment.

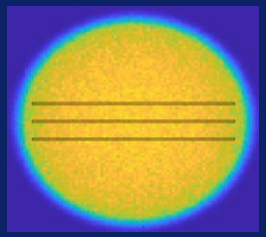
Design 1.2 – Halo Single (misalignment)



Additional 4th Skimmer size / mm	Pressure (IP) / mbar	V3 Delta / %	Pressure (Dump) / mbar	V3 Delta / %
+0.0 (Baseline)	5.55×10^{-8}	+19.4%	4.68×10^{-7}	+120.0%
+0.5	5.91×10^{-8}	+27.2%	4.64×10^{-7}	+118.3%
+1.0	6.27×10^{-8}	+35.0%	4.60×10^{-7}	+116.6%
+2.0	7.00×10^{-8}	+50.7%	4.53×10^{-7}	+113.2%
+3.0	7.73×10^{-8}	+66.3%	4.46×10^{-7}	+109.8%
+4.0	8.45×10^{-8}	+82.0%	4.46×10^{-7}	+106.3%

Added to the smallest dimension of the 4th skimmer, in this case – the length.

Design 1.3 – Halo Multi Slit



Design	Density / m^{-3}	Length / mm	Width / mm	BG Pressure / mbar
V3	1.15×10^{17}	21.0	0.68	4.7×10^{-8}
Halo Multi Slit	1.03×10^{17}	3×0.20	20.5	1.71×10^{-8}
Delta	-10.8%	-99.0%	$+2900\%$	-63.4%

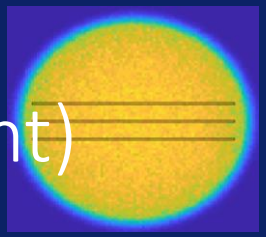
Density value seems high – not enough time to investigate, but delta's should be correct

(Includes $\sqrt{2}$ factor for thickness where appropriate)

$$Relative\ Signal = \frac{\eta_{Design} d_{Design}}{\eta_{V3} d_{V3}} = 19.1$$

Maximise losses for halo detection, Allows for +-3.5mm misalignment with beam.

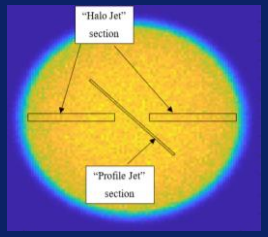
Design 1.3 – Halo Multi (misalignment)



Additional 4th Skimmer size / mm	Pressure (IP) / mbar	V3 Delta / %	Pressure (Dump) / mbar	V3 Delta / %
+0.0 (Baseline)	2.02×10^{-8}	-56.5%	1.87×10^{-7}	-12.1%
+0.5	2.54×10^{-8}	-45.3%	1.82×10^{-7}	-14.6%
+1.0	3.07×10^{-8}	-34.0%	1.76×10^{-7}	-17.0%
+2.0	4.11×10^{-8}	-11.5%	1.66×10^{-7}	-22.0%
+3.0	5.16×10^{-8}	+11.0%	1.55×10^{-7}	-26.9%
+4.0	6.21×10^{-8}	+33.6%	1.45×10^{-7}	-31.8%

Added to the smallest dimension of the 4th skimmer, in this case – the length of each 3 slits.

Design 1.4 – Profile & Halo



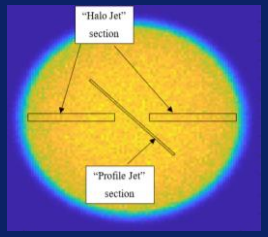
Unable to use MOGA before deadline (many assumptions breakdown)

Design	Density / m^{-3}	Length / mm	Width / mm	BG Pressure / mbar
V3	1.15×10^{17}	21.0	0.68	4.7×10^{-8}
Profile Jet	1.18×10^{17}	12.6	0.22	2.7×10^{-8}
Delta	$+1.8\%$	-40.1%	-67.3%	-42.7%
Halo Jet	1.20×10^{17}	0.91	2×9.0	2.7×10^{-8}
Delta	$+4.0\%$	-95.7%	$+1230\%$	-42.7%

$$Relative\ Signal = \frac{\eta_{Profile} d_{Profile}}{\eta_{V3} d_{V3}} = 0.33 \quad Relative\ Signal = \frac{\eta_{Halo} d_{Halo}}{\eta_{V3} d_{V3}} = 19.5$$

Profile jet to image with reduced thickness effects (x3 as long for profile) & maximise losses for halo detection – requires perfect alignment & minimum losses dictated by profile jet

Design 1.4 – Profile & Halo (misalignment)



Unable to use MOGA before deadline (many assumptions breakdown)

Additional 4th Skimmer size / mm	Pressure (IP) / mbar	V3 Delta / %	Pressure (Dump) / mbar	V3 Delta / %
+0.0 (Baseline)	2.68×10^{-8}	-42.3%	3.33×10^{-7}	+56.6%
+0.5	3.08×10^{-8}	-33.7%	3.29×10^{-7}	+54.7%
+1.0	3.48×10^{-8}	-25.1%	3.25×10^{-7}	+52.9%
+2.0	4.26×10^{-8}	-8.2%	3.17×10^{-7}	+49.2%
+3.0	5.03×10^{-8}	+8.2%	3.09×10^{-7}	+45.6%
+4.0	5.35×10^{-8}	+15.1%	3.06×10^{-7}	+44.1%

Added to the smallest dimension of the 4th skimmer, in this case – the width of profile jet & the length of both halo jets

Detailed Designs

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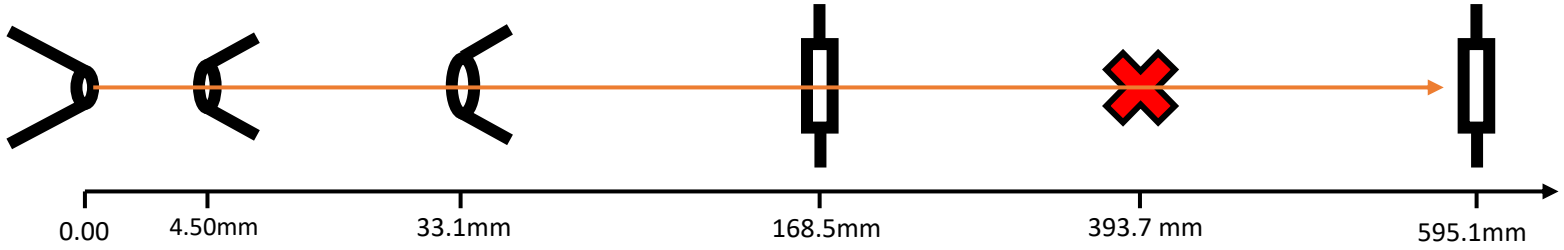
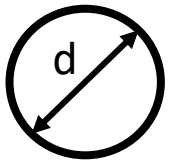
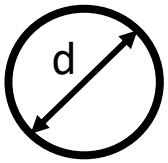
Results – V3 (Benchmark) - Ne gas



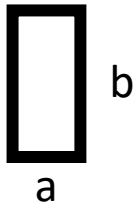
Nozzle | 1st Skimmer | 2nd Skimmer | 3rd Skimmer | IP | 4th Skimmer



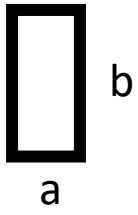
d: 400um



d: 2.00mm



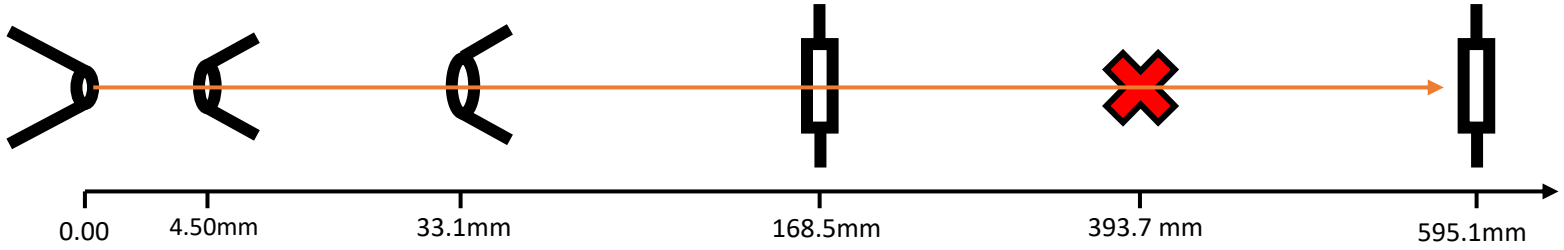
a: 0.3mm b: 9.0 mm



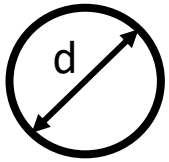
a: 7.0mm b: 31.0mm

Criteria	Density / # m^{-3}	Curtain Length / mm	Curtain Width / mm	Variation in centre / %	BG Pressure / mbar
Version 3 (LHC)	1.15×10^{17}	21.0	0.68	5.19	4.67×10^{-8}

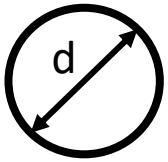
Results – Thin Curtain - Ne gas



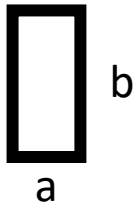
Nozzle | 1st Skimmer | 2nd Skimmer | 3rd Skimmer | IP | 4th Skimmer



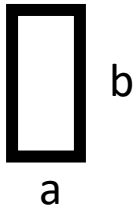
d: 400um



d: 2.00mm



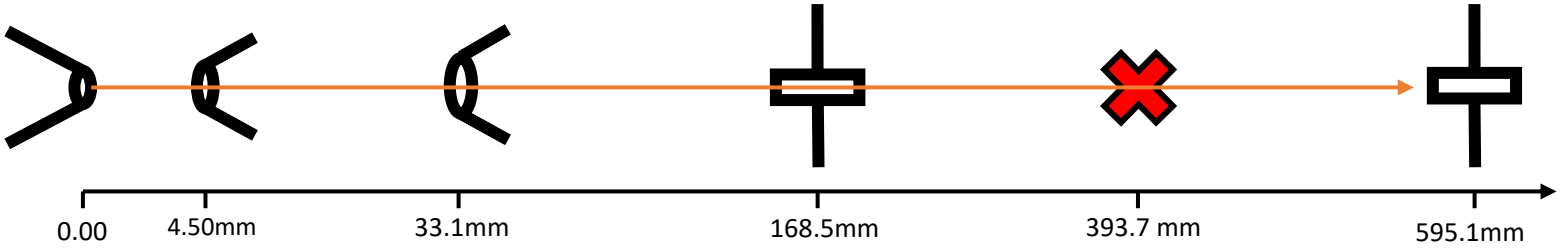
a: 0.1mm b: 7.5 mm



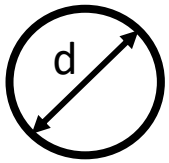
a: 0.8mm b: 26.4mm

Criteria	Density / # m^{-3}	Curtain Length / mm	Curtain Width / mm	BG Pressure / mbar
Thin Curtain	1.01×10^{17}	17.2	0.22	4.8×10^{-9}

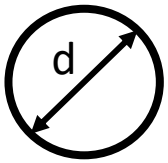
Results – Halo Single Slit - Ne gas



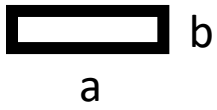
Nozzle | 1st Skimmer | 2nd Skimmer | 3rd Skimmer | IP | 4th Skimmer



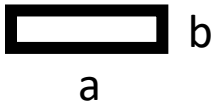
d: 400um



d: 2.00mm



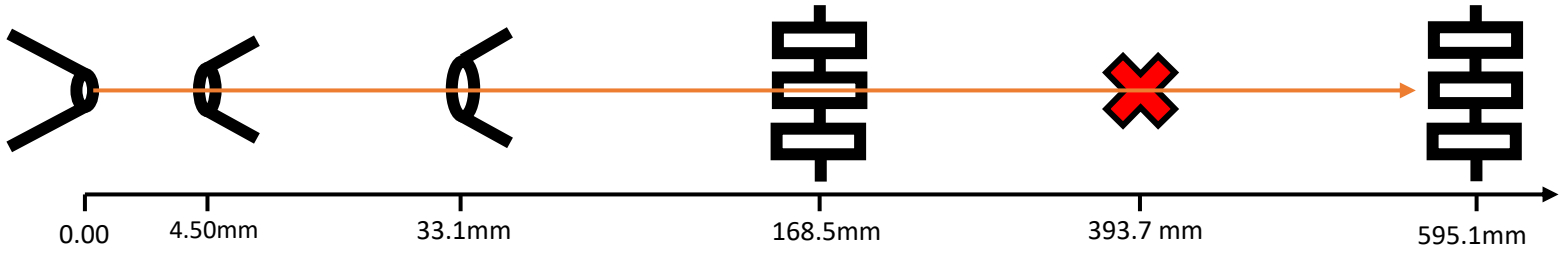
a: 7.8 mm b: 0.7 mm



a: 27.0 mm b: 3.2 mm

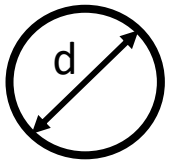
Criteria	Density / # m^{-3}	Curtain Length / mm	Curtain Width / mm	BG Pressure / mbar
Halo Single Slit	1.01×10^{17}	1.53	18.0	4.4×10^{-8}

Results – Halo Multi Slit - Ne gas



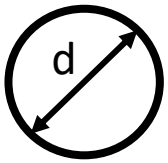
Nozzle

1st Skimmer



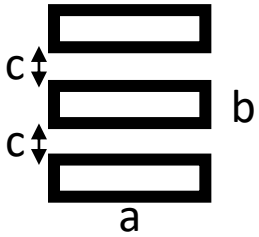
d: 400um

2nd Skimmer



d: 2.00mm

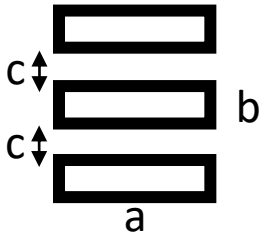
3rd Skimmer



a: 8.9 mm b: 0.08 mm
c: 1.0 mm

IP

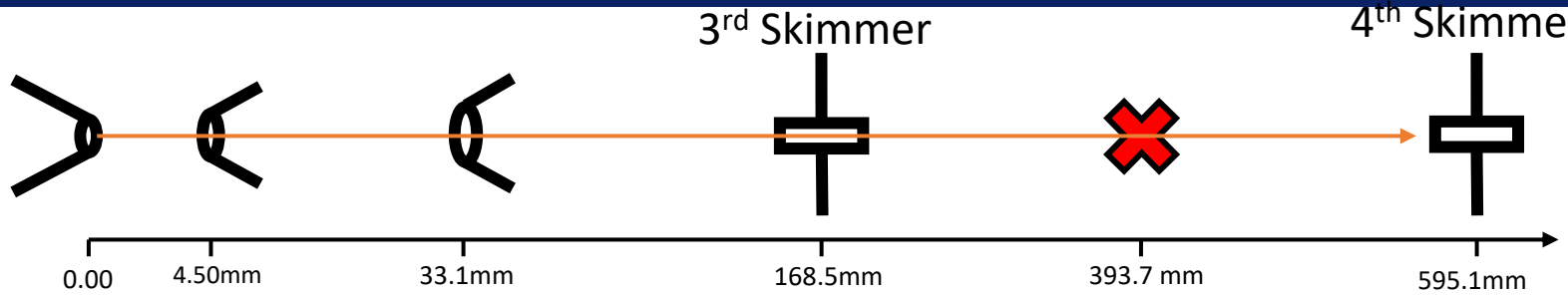
4th Skimmer



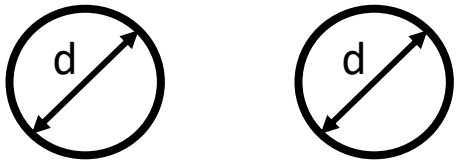
a: 31.7 mm b: 1.0 mm
c: 3.6 mm

Criteria	Density / # m^{-3}	Curtain Length / mm	Curtain Width / mm	BG Pressure / mbar
Halo Multi Slit	1.03×10^{17}	3×0.20	20.5	1.71×10^{-8}

Results – Halo Single Slit - Ne gas



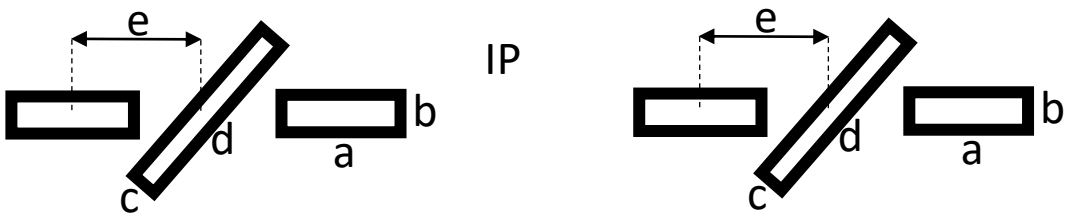
Nozzle 1st Skimmer 2nd Skimmer



d: 400um

d: 2.00mm

IP



a: 4.0 mm b: 0.4 mm
c: 0.1 mm d: 5.5 mm
e: 2.8 mm

a: 14.4 mm b: 1.7 mm
c: 0.7 mm d: 20.0 mm
e: 10.0 mm

Criteria	Density / # m^{-3}	Curtain Length / mm	Curtain Width / mm	BG Pressure / mbar
Profile	1.18×10^{17}	12.6	0.22	2.7×10^{-8}
Halo	1.20×10^{17}	0.91	2×9.0	2.7×10^{-8}