

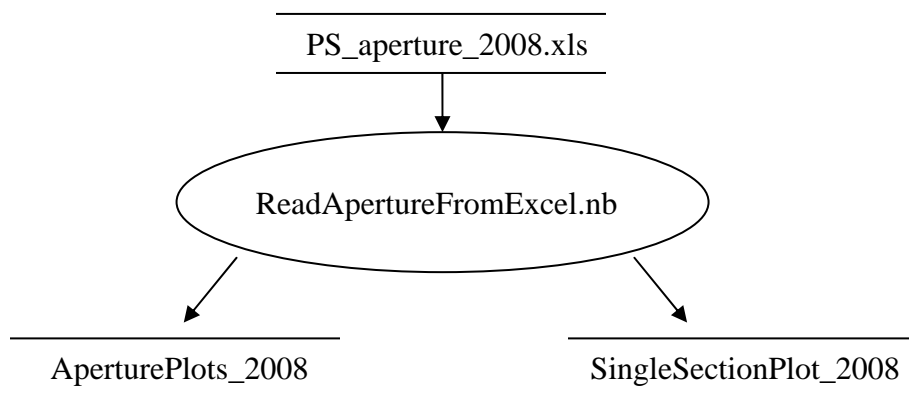
ReadApertureFromExcel.nb:

A program to generate the PS aperture

ReadApertureFromExcel.nb: A program to generate the PS aperture..... 1
Structure of the program: ReadApertureFromExcel.nb..... 1
Description of the input file: PS_aperture_<year>.xls..... 2
How to use the output files: AperturePlots_<year> and SingleSectionPlot_<year>..... 5
Plot the aperture 5
Plot the cross-section of a vacuum chamber 6
Make a list of the aperture function around the machine..... 7

Structure of the program: ReadApertureFromExcel.nb

The program: ReadApertureFromExcel.nb is written in Mathematica.
It reads the file: \\cern.ch\dfs\users\b\berriq\Public\PS_aperture_2008.xls
and generates the files:
\\cern.ch\dfs\users\b\berriq\Public\AperturePlots_2008
and
\\cern.ch\dfs\users\b\berriq\Public\SingleSectionPlot_2008:



Description of the input file: PS_aperture_<year>.xls

The file: PS_aperture_2008.xls is written in Excel. Each line corresponds to a vacuum chamber or a part of a vacuum chamber. Each time the aperture changes a new line is added:

1	2	3	4	5	6	7
SS	Drawing SS	Drawing vac chamber SS	Section	Start	End	Total
Magnet	Drawing Magnet	Drawing vac chamber Magnet	Type	Position	Position	Length
1	PS LM 0012	PS LM 0212	1	0	2450	2450
1	PS LM 0013	PS LM 0229	2	0	4941.4	4941.4
2	PS LM 0014	PS LM 0302	0	0	1050	1050
2	PS LM 0015	PS LM 0229	2	0	4941.4	4941.4

Each section in the PS consists of the straight section (Color light blue) and a combined function magnet (color white).

Column 1: Contains the section number (PS has sections from 1 to 100).

Column 2: Contains the drawing of straight sections or the combined function magnet.

Column 3: Contains the drawing of the vacuum chamber for either the straight section or the combined function magnet.

Column 4: Section type. 0=Short straight section(1050mm), 1=Long straight section(2450mm), 2=Magnet(4941.4mm). ReadApertureFromExcel.nb checks that the total length of each section type is always the same, e.g. even though a straight section consists of several different vacuum chambers, their total length must still add up to 1050 mm (if it is a short straight section). Every 5'th straight section is a long straight section, the rest are short straight sections. The straight sections and the magnets are connected with bellows of length 5.895. Adding all up, gives the total length of the PS = $80 \cdot 1050 + 20 \cdot 2450 + 100 \cdot 4941.4 + 100 \cdot (5.895 + 5.895)$ mm = 628.319 m, which corresponds to $2 \cdot \pi \cdot 100$, i.e. a radius of PS of 100m.

Column 5,6,7: The Start position, End position and accumulated Length of each vacuum chamber.

1	8	9	10	11	12	13	14	15
SS						Chamber	Chamber	
Magnet	Type US	Type DS	Hor	Hor.ext	Hor.Int	Offset Ray	Offset Olav	Ver
1	st	st	146	73	73	not available	not available	70
1	st	st	146	73	73	0	0	70
2	st	st	146	73	73	0	0	70
2	st	st	146	73	73	0	0	70

Column 8,9: Contains the Up Stream / down Stream cross-section type of the vacuum chamber.




st = standard (Circumference = 37 cm)

sp.small = special small (Circumference = 33 cm)

sp.ext = special exterior, large (Circumference = 43.5 cm)

sp.ext.xl = special exterior, extra large (Circumference = 48.3 cm, symmetric vacuum chamber)

sp.ext.sp = special exterior, large with special shape (look at the drawing)

sp.int = special interior, large (Circumference = 43.5 cm)
 sp.int.xl = special interior, extra large (Circumference = 48.3 cm, symmetric vacuum chamber)
 sp.int.sp = special interior, large with special shape (look at the drawing)
 sp = special. (look at the drawing)
 septum = Septa in ss16, ss23, ss26, ss31, ss42, ss57, ss61: 
 sp.diamond: Used for pick-ups. 
 circle = A circular vacuum chamber
 rectangle = A rectangular vacuum chamber. Used by kickers.
 sp.mu14mu15 = 

Column 10: Width (horizontal) of the vacuum chamber in [mm].

Column 11: Horizontal distance from the beam to the exterior of the vacuum chamber in [mm]. Interior is the side of the magnet where the center of the accelerator is. Exterior is the opposite side.

Column 12: Horizontal distance from the beam to the interior of the vacuum chamber in [mm].

Column 13: Chamber offset Ray in [mm]. The overwhelming number of vacuum chambers in PS is constructed as a combination of 8 circles-pieces. Since all the vacuum chambers are vertically symmetrical, this means that the above part is made of 4 pieces of circle:

If the beam position is at the place where there are two circles on both sides, then offset Ray is zero. Offset Ray is the place where the vacuum chamber is thickest.

Column 14: Chamber offset Olav in [mm]. $\text{OffsetOlav} = (\text{Hor.ext} - \text{Hor.int}) / 2 + \text{OffsetRay}$. It gives the beam position with respect to the horizontal centre of the vacuum chamber.

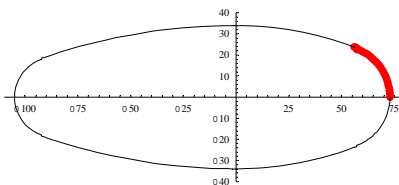
E.g. Hor.ext = 127, Hor.int = 73, OffsetRay = 0 => OffsetOlav = 27

Column 15: Thickness (Vertical) of the vacuum chamber in [mm].

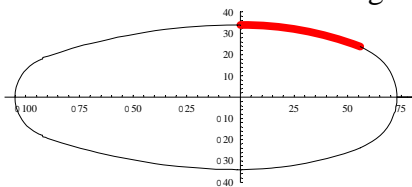
16	17	18	19	20
Outside	Outside	Inside	Inside	
R.small	R.large	R.small	R.large	R.Circle
23.807	137.5	23.807	137.5	
23.807	137.5	23.807	137.5	

23.807	137.5	23.807	137.5	
23.807	137.5	23.807	137.5	

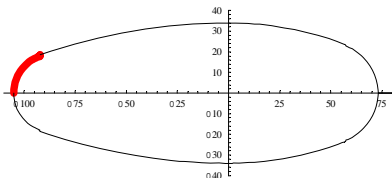
Column 16: Radius of the small circle outside the machine (i.e. beam position >0) in [mm]:



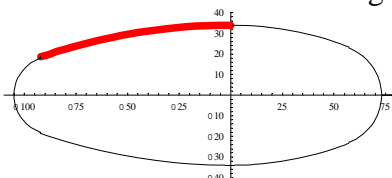
Column 17: Radius of the large circle outside the machine (i.e. beam position >0) in [mm]:



Column 18: Radius of the small circle inside the machine (i.e. beam position >0) in [mm]:



Column 19: Radius of the large circle inside the machine (i.e. beam position >0) in [mm]:



Column 20 : Radius of the vacuum chamber, but only if it is a circle. In [mm].

How to use the output files:

AperturePlots_<year> and SingleSectionPlot_<year>

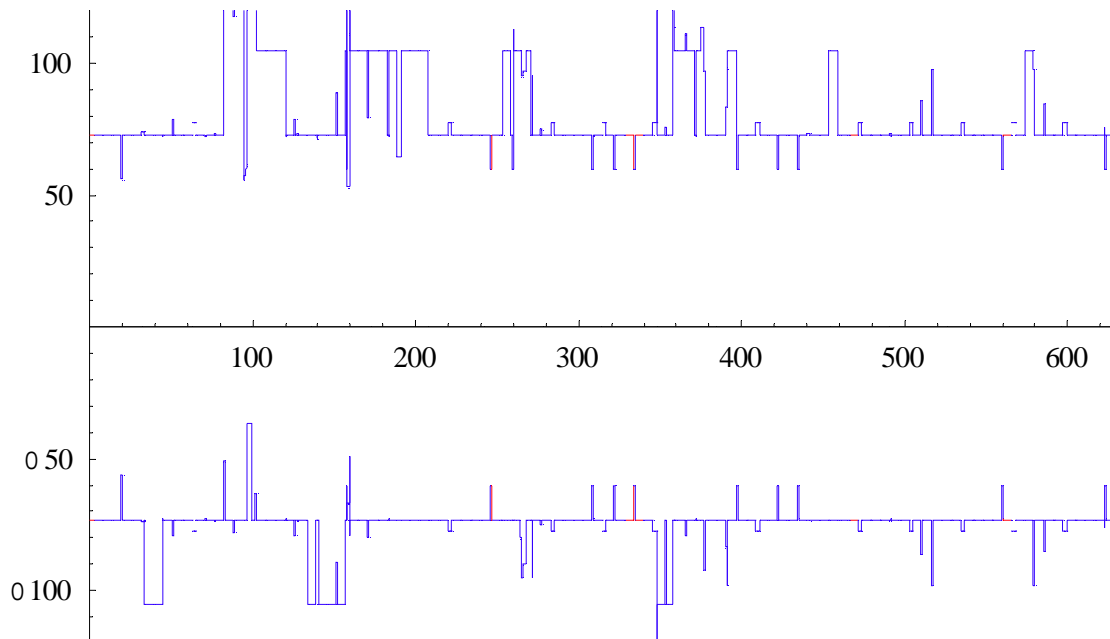
Plot the aperture

Get Horizontal Aperture function from file

```
year
2008
<< ("AperturePlots_"<>year); (*
HAo,HAi,VerA,colorlist,HorAperture,HorAperture631,HorAperture632,VerAperture *)
```

Plot HOR aperture

```
DisplayTogether [
  Plot[0, {s, 0, 628}, PlotRange1 {{0, 628}, {-120, 120}},
  HorAperture
]
```

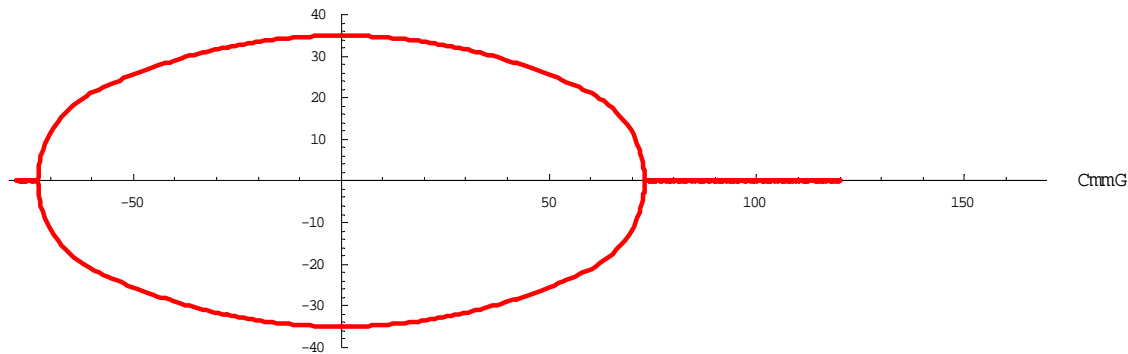


Plot the cross-section of a vacuum chamber

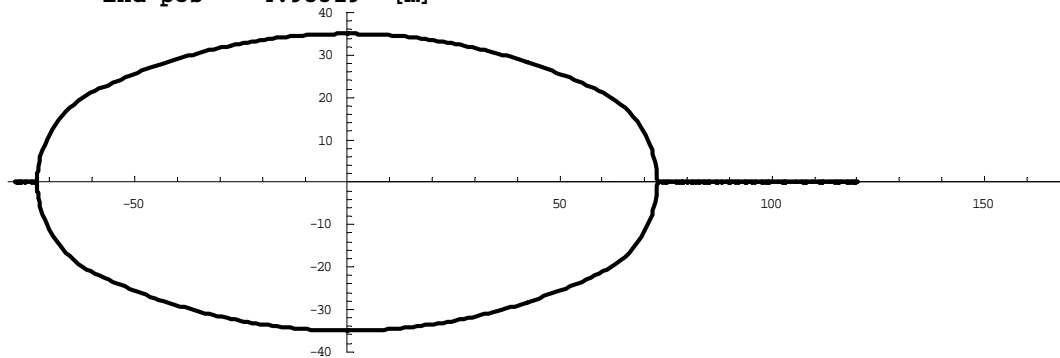
The paragraph next to the last in the program: ReadApertureFromExcel.nb contains code that can display the cross-section of a single vacuum section:

Plot single section

```
***** Start pos = 0 [m] *****  
CmmG
```



```
***** End pos = 4.95319 [m] *****
```



```
*** magnet = 1. second part
```

Make a list of the aperture function around the machine

Get Horizontal Aperture function from file

```
SetDirectory["G:\users\B\Berrig\Public"];
If[Directory[] & "G:\\users\\B\\Berrig\\Public",
  Print["***** Error. Could not go to directory: G:\users\B\Berrig\Public"];
  Abort[];
];
```

```
Directory[]
G:\users\B\Berrig\Public
```

```
<< "AperturePlots_2006"; (* HAO, HAI, VerA, VerAP, colorlist, HorAperture,
                          HorAperture631, HorAperture632, VerAperture *)
```

```
HAO[0]
```

```
73.
```

```
VerA[0, 20.]
```

```
35.
```

```
AperT=Table[{s, HAO[s], HAI[s], VerA[0, s]}, {s, 0, 1, 0.01}]
{{0, 73., 073., 35.}, {0.01, 73., 073., 35.}, {0.02, 73., 073., 35.},
 {0.03, 73., 073., 35.}, {0.04, 73., 073., 35.}, {0.05, 73., 073., 35.},
 {0.06, 73., 073., 35.}, {0.07, 73., 073., 35.}, {0.08, 73., 073., 35.},
 {0.09, 73., 073., 35.}, {0.1, 73., 073., 35.}, {0.11, 73., 073., 35.},
 {0.12, 73., 073., 35.}, {0.13, 73., 073., 35.}, {0.14, 73., 073., 35.},
 {0.15, 73., 073., 35.}, {0.16, 73., 073., 35.}, {0.17, 73., 073., 35.},
 {0.18, 73., 073., 35.}, {0.19, 73., 073., 35.}, {0.2, 73., 073., 35.},
 {0.21, 73., 073., 35.}, {0.22, 73., 073., 35.}, {0.23, 73., 073., 35.},
 {0.24, 73., 073., 35.}, {0.25, 73., 073., 35.}, {0.26, 73., 073., 35.},
 {0.27, 73., 073., 35.}, {0.28, 73., 073., 35.}, {0.29, 73., 073., 35.},
 {0.3, 73., 073., 35.}, {0.31, 73., 073., 35.}, {0.32, 73., 073., 35.},
 {0.33, 73., 073., 35.}, {0.34, 73., 073., 35.}, {0.35, 73., 073., 35.},
 {0.36, 73., 073., 35.}, {0.37, 73., 073., 35.}, {0.38, 73., 073., 35.},
 {0.39, 73., 073., 35.}, {0.4, 73., 073., 35.}, {0.41, 73., 073., 35.},
 {0.42, 73., 073., 35.}, {0.43, 73., 073., 35.}, {0.44, 73., 073., 35.},
 {0.45, 73., 073., 35.}, {0.46, 73., 073., 35.}, {0.47, 73., 073., 35.},
 {0.48, 73., 073., 35.}, {0.49, 73., 073., 35.}, {0.5, 73., 073., 35.},
 {0.51, 73., 073., 35.}, {0.52, 73., 073., 35.}, {0.53, 73., 073., 35.},
 {0.54, 73., 073., 35.}, {0.55, 73., 073., 35.}, {0.56, 73., 073., 35.},
 {0.57, 73., 073., 35.}, {0.58, 73., 073., 35.}, {0.59, 73., 073., 35.},
 {0.6, 73., 073., 35.}, {0.61, 73., 073., 35.}, {0.62, 73., 073., 35.},
 {0.63, 73., 073., 35.}, {0.64, 73., 073., 35.}, {0.65, 73., 073., 35.},
 {0.66, 73., 073., 35.}, {0.67, 73., 073., 35.}, {0.68, 73., 073., 35.},
 {0.69, 73., 073., 35.}, {0.7, 73., 073., 35.}, {0.71, 73., 073., 35.},
 {0.72, 73., 073., 35.}, {0.73, 73., 073., 35.}, {0.74, 73., 073., 35.},
 {0.75, 73., 073., 35.}, {0.76, 73., 073., 35.}, {0.77, 73., 073., 35.},
 {0.78, 73., 073., 35.}, {0.79, 73., 073., 35.}, {0.8, 73., 073., 35.},
 {0.81, 73., 073., 35.}, {0.82, 73., 073., 35.}, {0.83, 73., 073., 35.},
 {0.84, 73., 073., 35.}, {0.85, 73., 073., 35.}, {0.86, 73., 073., 35.},
 {0.87, 73., 073., 35.}, {0.88, 73., 073., 35.}, {0.89, 73., 073., 35.},
 {0.9, 73., 073., 35.}, {0.91, 73., 073., 35.}, {0.92, 73., 073., 35.},
 {0.93, 73., 073., 35.}, {0.94, 73., 073., 35.}, {0.95, 73., 073., 35.},
 {0.96, 73., 073., 35.}, {0.97, 73., 073., 35.}, {0.98, 73., 073., 35.},
 {0.99, 73., 073., 35.}, {1., 73., 073., 35.}}
```

```
Export["ApertureList.csv", AperT]
```

```
ApertureList.csv
```