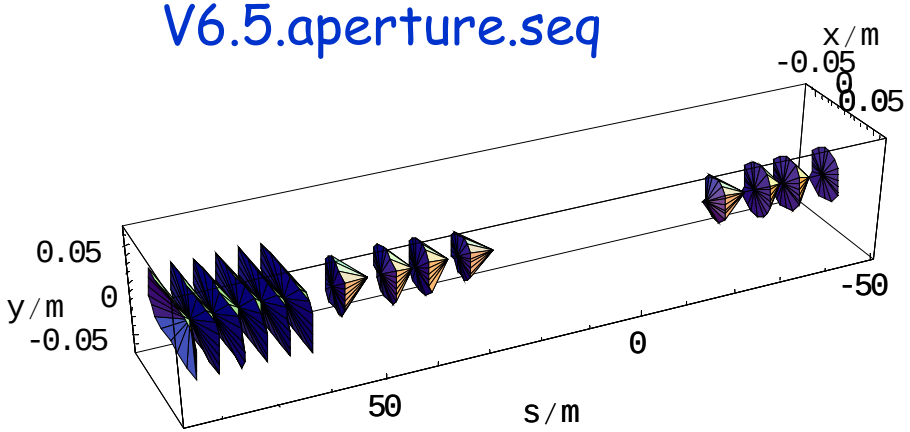
Two Sources of LHC Aperture Information

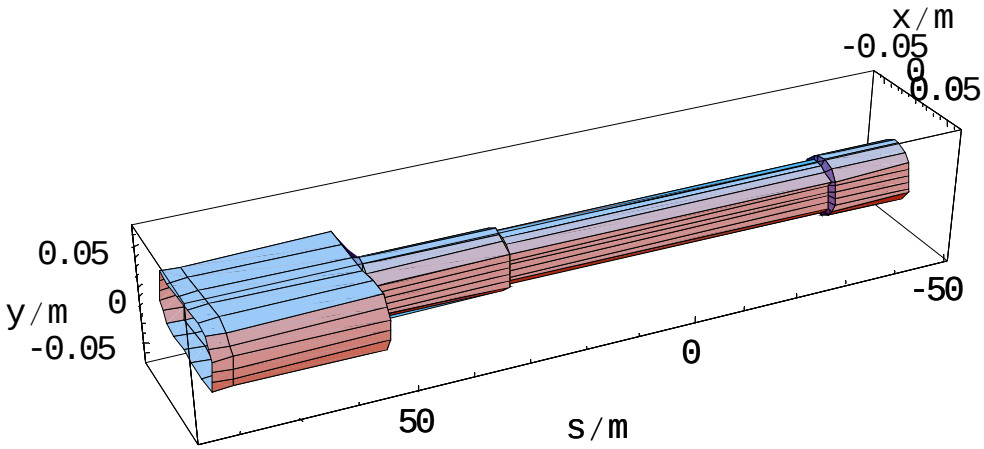
- LHC Functional Layout Database (Oracle)
  - Set of beam screen markers for each ring
  - Covers cold sections only
  - Ring 1 and Ring 2 mixed together in one table
  - So far not converted to MAD format (overlaps of elements to be dealt with, etc.)
  - Beam screen types defined in separate table
  - Data extractable in XML or Excel format
- Sequence file V6.5.aperture.seq
  - Covers full machine (?)
  - Aperture defined at only a sample of elements
  - No aperture types
  - Many zero aperture components
  - Easily extended to complete homogeneous (RECTELLIPSE) aperture description of ring (with no zero components) using Madtomma packages
  - Very small compressed definition available
  - See my talk in aperture meeting 10/9/2003

Continuous and Compressed Aperture Model

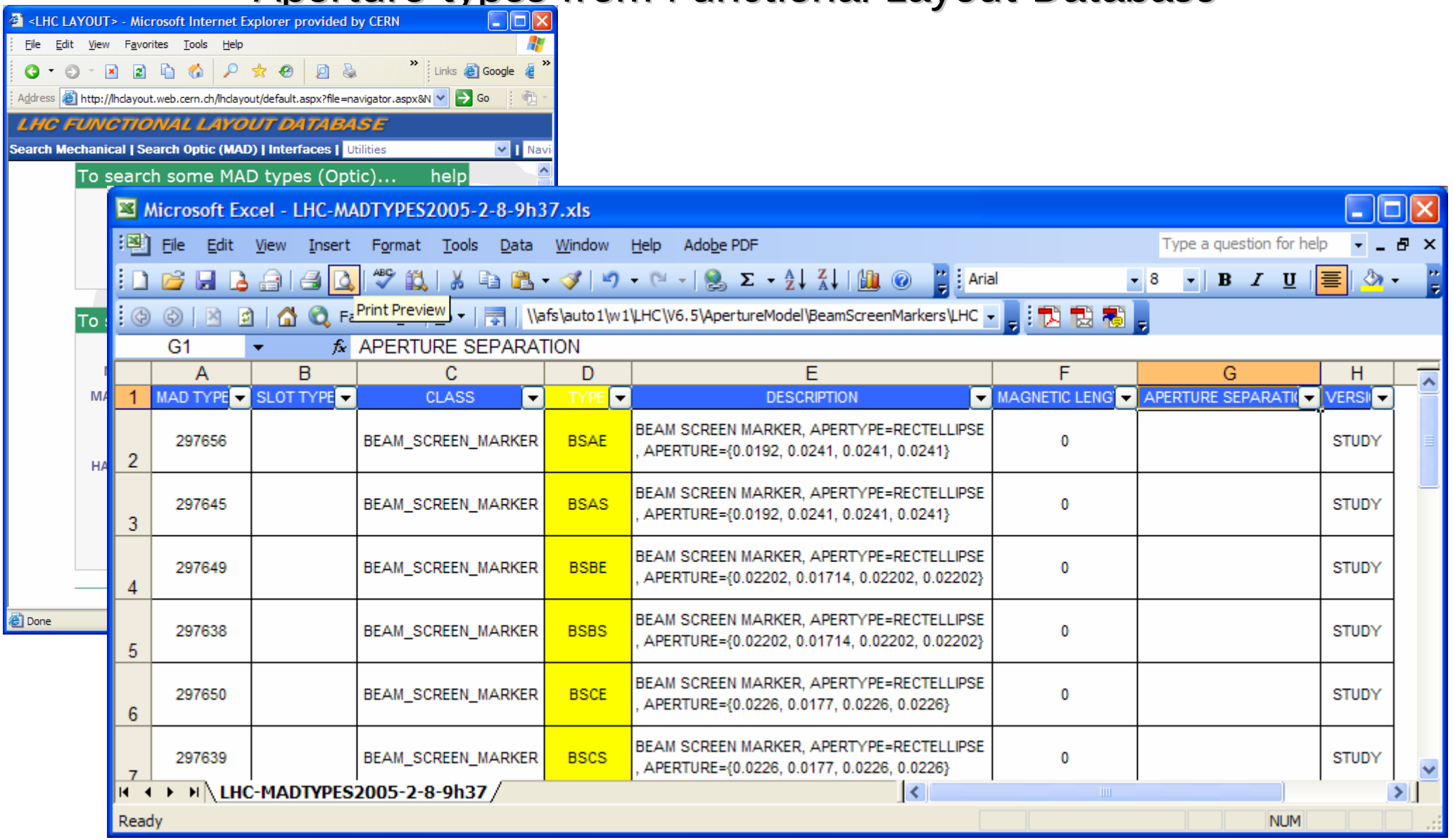
V6.5.aperture.seq



Functions to "intelligently" interpolate apertures to any value of s.
Makes it easy to generate SEQEDIT objects to programmatically add apertures anywhere and improve tracking inside MAD-X.



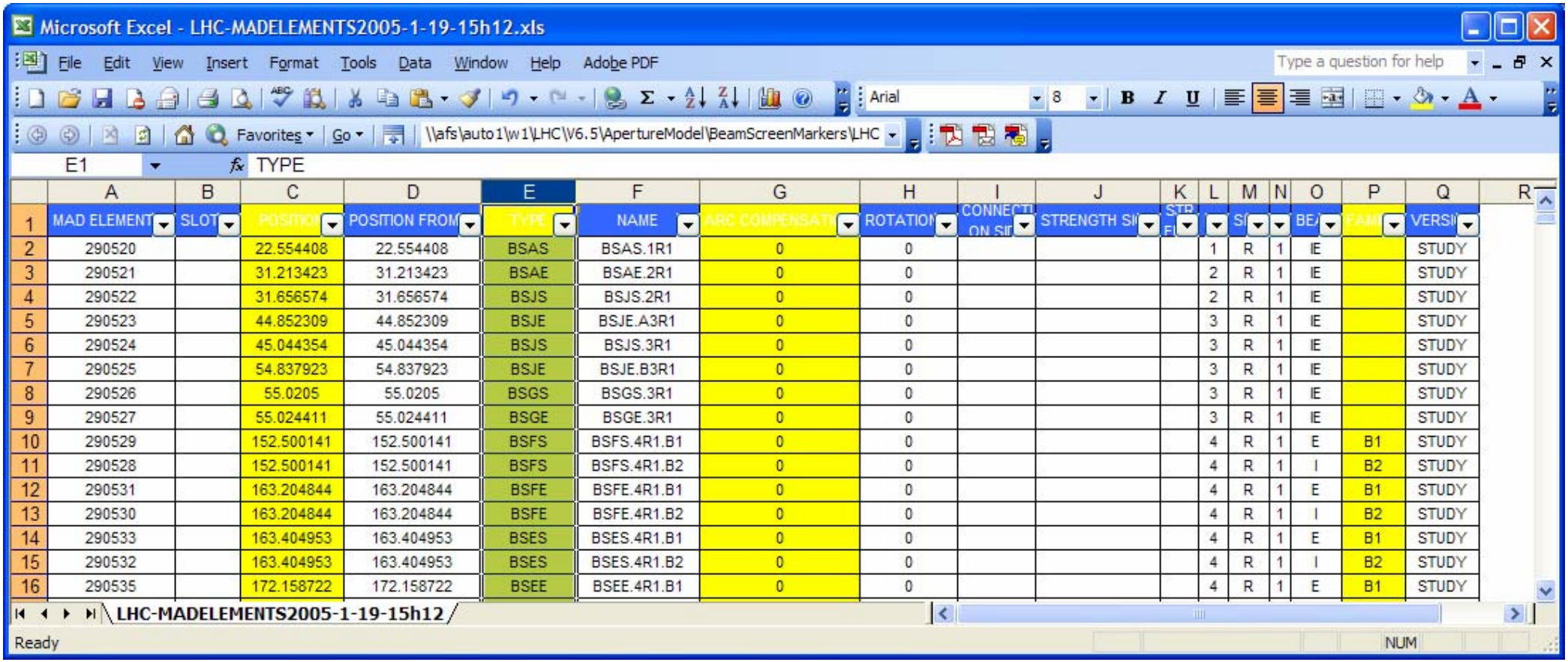
Aperture types from Functional Layout Database



	A	B	C	D	E	F	G	H
1	MAD TYPE	SLOT TYPE	CLASS	TYPE	DESCRIPTION	MAGNETIC LENG	APERTURE SEPARATI	VERSI
2	297656		BEAM_SCREEN_MARKER	BSAE	BEAM SCREEN MARKER, APERTYPE=RECTELLIPSE , APERTURE={0.0192, 0.0241, 0.0241, 0.0241}	0		STUDY
3	297645		BEAM_SCREEN_MARKER	BSAS	BEAM SCREEN MARKER, APERTYPE=RECTELLIPSE , APERTURE={0.0192, 0.0241, 0.0241, 0.0241}	0		STUDY
4	297649		BEAM_SCREEN_MARKER	BSBE	BEAM SCREEN MARKER, APERTYPE=RECTELLIPSE , APERTURE={0.02202, 0.01714, 0.02202, 0.02202}	0		STUDY
5	297638		BEAM_SCREEN_MARKER	BSBS	BEAM SCREEN MARKER, APERTYPE=RECTELLIPSE , APERTURE={0.02202, 0.01714, 0.02202, 0.02202}	0		STUDY
6	297650		BEAM_SCREEN_MARKER	BSCE	BEAM SCREEN MARKER, APERTYPE=RECTELLIPSE , APERTURE={0.0226, 0.0177, 0.0226, 0.0226}	0		STUDY
7	297639		BEAM_SCREEN_MARKER	BSCS	BEAM SCREEN MARKER, APERTYPE=RECTELLIPSE , APERTURE={0.0226, 0.0177, 0.0226, 0.0226}	0		STUDY

Beam Screen Markers from Functional Layout Database

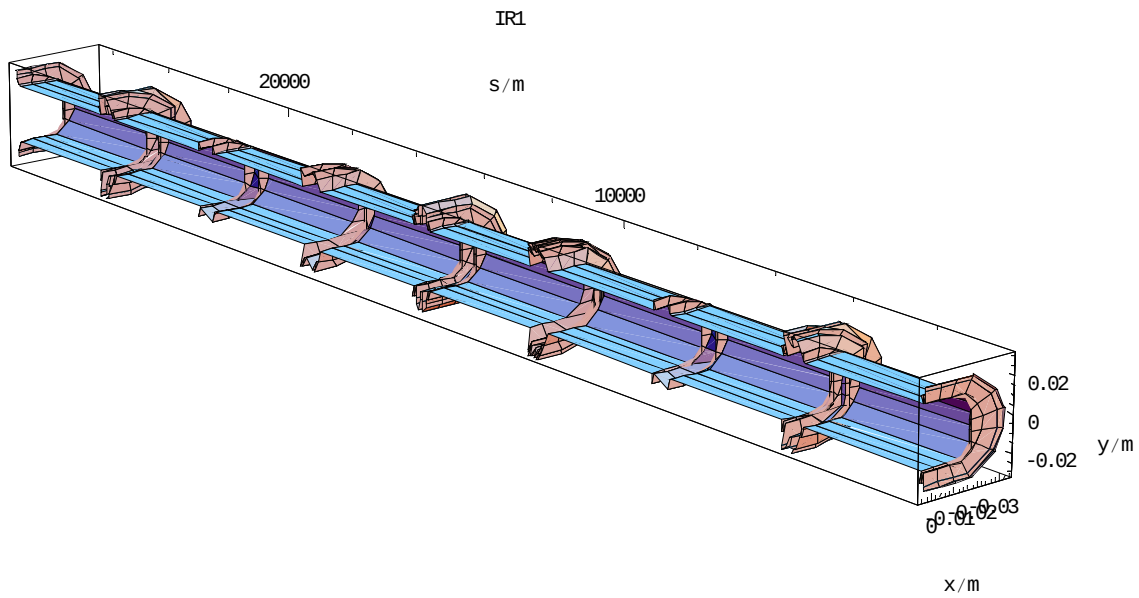
- Need to separate two rings, apply arc length corrections
  - Done using Madtomma LHC packages, build standard mfs object, compress aperture data



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	MAD ELEMENT	SLOT	POSITION	POSITION FROM	TYPE	NAME	ARC COMPENSATI	ROTATION	CONNECTI ON SI	STRENGTH SI	STR F	L	SI		BEA	FAMI	VERSI	
2	290520		22.554408	22.554408	BSAS	BSAS.1R1	0	0				1	R	1	IE		STUDY	
3	290521		31.213423	31.213423	BSAE	BSAE.2R1	0	0				2	R	1	IE		STUDY	
4	290522		31.656574	31.656574	BSJS	BSJS.2R1	0	0				2	R	1	IE		STUDY	
5	290523		44.852309	44.852309	BSJE	BSJE.A3R1	0	0				3	R	1	IE		STUDY	
6	290524		45.044354	45.044354	BSJS	BSJS.3R1	0	0				3	R	1	IE		STUDY	
7	290525		54.837923	54.837923	BSJE	BSJE.B3R1	0	0				3	R	1	IE		STUDY	
8	290526		55.0205	55.0205	BSGS	BSGS.3R1	0	0				3	R	1	IE		STUDY	
9	290527		55.024411	55.024411	BSGE	BSGE.3R1	0	0				3	R	1	IE		STUDY	
10	290529		152.500141	152.500141	BSFS	BSFS.4R1.B1	0	0				4	R	1	E	B1	STUDY	
11	290528		152.500141	152.500141	BSFS	BSFS.4R1.B2	0	0				4	R	1	I	B2	STUDY	
12	290531		163.204844	163.204844	BSFE	BSFE.4R1.B1	0	0				4	R	1	E	B1	STUDY	
13	290530		163.204844	163.204844	BSFE	BSFE.4R1.B2	0	0				4	R	1	I	B2	STUDY	
14	290533		163.404953	163.404953	BSES	BSES.4R1.B1	0	0				4	R	1	E	B1	STUDY	
15	290532		163.404953	163.404953	BSES	BSES.4R1.B2	0	0				4	R	1	I	B2	STUDY	
16	290535		172.158722	172.158722	BSEE	BSEE.4R1.B1	0	0				4	R	1	E	B1	STUDY	

Aperture of complete ring from Functional Layout Database

- Beam screen markers extended to full ring, data compressed to eliminate redundancy
- First shot, straightforward to automate
- Many possibilities for visualisation, external calculations, etc.



To be done

- Merge warm aperture data from sequence file
  - Is this the best source for now ?
- Apply apertures to all (?) magnetic and other elements
  - Or just some of them?
  - Fill in drift spaces with aperture markers à la carte ?
- Further automation via Mathematica link to XML and Java ?
  - Might avoid exporting intermediate files from database

MAD Error Settings from Magnet Measurements

- Files shown by Thys last time
  - Slot assignments, measured field errors
  - Overwrite random assignments in MAD with real

KEDIT - [P:\cern.ch\eng\lhc\optics\V6.5\errors\tables\MB_nom.tab]

File Edit Actions Options Window Help

MB : Templates

```
* * * Top of File * * *
@ NAME              %06s "NOM"
@ TYPE              %06s "NOM"
@ DATE              %08s "16/12/04"
@ TIME              %08s "12:57:51"
```

* NAME	SHORTCUT	B1	A1	B2	A2	B3	A3
$ %s	%le	%le	%le	%le	%le	%le	%le
not_found	0	0.000	0.000	0.000	0.000	0.000	0.000
sl_1.V1	01000001	5.890	0.000	−0.310	−0.340	12.290	0.380
sl_1.V2	01000001	3.320	0.000	0.930	0.870	12.840	0.050
sl_2.V1	01000002	1.120	0.000	−1.100	−0.210	10.100	−0.370
sl_2.V2	01000002	0.770	0.000	1.740	−0.500	9.960	−0.620
sl_3.V1	02000001	−2.820	0.000	−0.910	−1.340	5.660	−0.440
sl_3.V2	02000001	−2.720	0.000	0.430	−1.530	4.860	−0.760
sl_4.V1	03000001	3.300	0.000	−0.490	−0.030	4.660	−0.190
sl_4.V2	03000001	1.990	0.000	0.210	−0.270	3.880	−0.110
MB.B34R7.V1	01000003	11.000	7.350	−1.050	−2.060	9.230	−0.240
MB.B34R7.V2	01000003	9.820	5.850	0.190	−1.340	9.230	−0.220
sl_6.V1	03000002	9.250	3.910	−0.300	−0.830	6.320	−0.300
sl_6.V2	03000002	11.020	5.410	0.440	0.200	6.410	−0.010

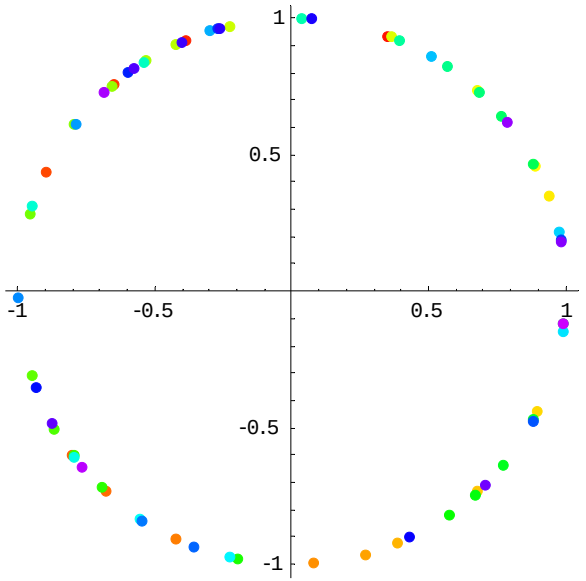
```
====>
```

Line=9 Col=1 Alt=0,0;0 Size=291 Files=2 Windows=2 INS R/W 9:52

Madtomma Function To create errors in MAD

- Transforms error table into MAD error definitions]
  - Easy to visualise distributions of occupied slots, calculate functions of errors, etc.

```
ColorListPlot[Transpose[mfsColumn[LHCB1MGassigned, {"S", "MUX"}]] /.
  {s_, mu_} → {Cos[2 π mu], Sin[2 π mu]}, AspectRatio → 1]
```




```
- Graphics -
```