John Jowett

From: John Jowett
Sent: Thursday, 10 February, 2005 19:15
To: Oliver Bruning; Alessandra Lombardi; Andre Verdier; Bernard Jeanneret; Bruno Autin; Charles Hill; Dobrin Kaltchev; Eric D'Amico; Francesco Ruggiero; Frank Schmidt; Frank Zimmermann; Guillaume Robert-Demolaize; Helmut Burkhardt; Igor Bayshev; Ivar Waarum; Jean-Pierre Riunaud; Karlheinz Schindl; Louis Rinolfi; Massimo Giovannozzi; Michel Martini; Ralph Wolfgang Assmann; Richard Scrivens; Stefano Redaelli; Stephane Fartoukh; Thys Risselada; Verena Kain; Walter Wittmer; Werner Herr; Simone Gilardoni; Riccardo De Maria
Cc: Samy Chemli; Moira Gresham (moira@alumni.reed.edu); Mike Lamont; Stephan Maury; Gianluigi Arduini; Hans Braun
Subject: LHC Aperture Model

Dear Colleagues,

As requested at Tuesday's LHC Optics meeting, I have generated a complete model of the LHC aperture that can be used with MAD-X. The method is based on the tools developed with Moira Gresham back in 2003.

What's new now is that the model is based as far as possible on the beam screen definitions extracted directly from the LHC Functional Layout Database. The other aperture model in the sequence file created by Thys is used to fill in gaps greater than 7 m long (e.g. the warm sections). The 7 m is a parameter. There is also a comparison between the two models.

Further details are at:

http://proj-lhc-optics-web.web.cern.ch/proj-lhc-optics-web/V6.5/ApertureModel/readme.html

I had to make a number of algorithmic decisions. These may need to be refined or changed following further discussion but they are fully documented. (See the detailed notes and analysis of the FL database information in the main notebook, in particular the beam screen shopping list.)

So, this may not be the last word. But the aperture definition files do work with MAD-X and I hope they will fulfil the immediate urgent need. They assign apertures to all existing elements and do not introduce any new markers.

Please send me your comments. I will be away for the next week at Brookhaven but email will work.

John

P.S. I don't know how this compares in detail with Stefano's model for Sixtrack.

P.P.S. Some people were also asking me about using the graphics functions. I'll get back to you but meanwhile there are examples and documentation in the main notebook.

P^3.S. The aperture derived from the sequence file in IR7 doesn't look terribly well matched to the injection beam. See the last image on the page

http://proj-lhc-optics-web.web.cern.ch/proj-lhc-optics-web/V6.5/ApertureModel/HTMLLinks/default_26.html

I suppose it's probably a compromise between the two beams (?)

Office: +41 22 76 76643 [you can leave voice mail]
Fax: +33 680 60 89 84
Postal address: CERN, CH-1211 Geneva 23, Switzerland
http://cern.ch/jowett/
Location: Room R-020, Building 9, CERN Meyrin Site

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
  - Not immediately convertible 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

To be done (as of 8 Feb 2005)

- Merge warm aperture data from sequence file
  - *Done 10/2/2005:* new description includes Beam Screen Markers augmented with data from V6.5.aperture.seq in all gaps longer than 7 m.
    - Other algorithms or parameter choices possible
    - See detailed analysis of gaps
    - Includes differences in arc-lengths between rings.
- Apply apertures to all magnetic and other elements
  - *Done 10/2/2005:* two MAD-X files to read in (for LHCB1 and LHCB2).
  - Fill in drift spaces with aperture markers à la carte, can be done, as before.
- Further automation via Mathematica link to XML and Java ?
  - Might avoid exporting intermediate files from database
  - Not done so far.

P:\cern.ch\eng\lhc\spdyn\OpticsWebPages\V6.5\ApertureModel\readme.html - Microsoft Internet Explorer provided by CERN

File Edit View Favorites Tools Help

Links Google I-LHC MAD HEP Search Madtomma

Address P:\cern.ch\eng\lhc\spdyn\OpticsWebPages\V6.5\ApertureModel\readme.html Go

A New Model of the LHC Aperture - under test!

Warning, if you are browsing from Windows: *unless you have changed the file associations for MAD files on Windows, don't click on the links below. Rather right-click and save copies of the files.*

This new model merges the aperture information of beam screen markers from the LHC Functional Database with information from the hand-made sequence file for gaps between the beam screens of more than 7 m.

This file and all related material is located on CERN AFS at the location

/afs/cern.ch/eng/lhc/spdyn/OpticsWebPages/V6.5/ApertureModel

or, equivalently, from the Web

http://proj-lhc-optics-web.web.cern.ch/proj-lhc-optics-web/V6.5/ApertureModel/

or, equivalently, with AFS on Windows in CERN

P:\cern.ch\eng\lhc\spdyn\OpticsWebPages\V6.5\ApertureModel

Please look there to find the material.

The two files,

LHCB1FullAperture.mad LHCB2FullAperture.mad

can be read into MAD-X after the usual sequence file and will assign apertures to every element (except drifts).

Comments invited in my email to LOC Team on 10/2/2005.

Local intranet

Beam Screen Shopping List for Ring 1

The frequencies of occurrence of beam screens of given lengths (rounded to nearest mm), first for Ring 1

```
TableForm[
 Flatten/@
  Frequencies[
   Partition[Transpose[mfsColumn[LHCBeamScreenMarkers["LHCB1"], {"TYPE", "POSITION"}]], 2] /.
    {{ts_, s_}, {te_, e_}} → {StringDrop[ts, -1], Round[1000 (e - s)]/1000.}]]
```

4	BSA	8.659
7	BSB	0.002
1	BSB	0.004
7	BSB	0.005
1	BSB	0.006
362	BSB	5.795
52	BSB	7.066
16	BSB	8.463
8	BSB	9.435
8	BSB	12.577
8	BSB	13.517
1232	BSB	15.455
4	BSC	7.066
4	BSC	10.837
1	BSC	11.789
4	BSD	8.659
4	BSE	6.086
4	BSE	8.754
4	BSE	9.794
4	BSE	13.196
2	BSF	10.535
5	BSF	10.705
2	BSG	0.003
6	BSG	0.004
4	BSG	10.804
4	BSH	7.066
4	BSH	10.837
1	BSH	11.789
4	BSJ	6.086
4	BSJ	9.794
6	BSJ	12.08
4	BSJ	13.196
5	BSK	10.705

Number of required beam screens of given type and length for Ring 1 according to the LHC Functional Layout Database.

LHCApertureModel.nb

Beam Screen Apertures from LHC Functional Layout Database

The following subsections are devoted to going through this calculation for the first time, working out how to treat the problem and checking the integrity of the data. This is a bit long but necessary in order to develop the method and to show exactly what is, and is not, being done. However once the required functions are developed, there are in fact a fairly small number of essential step in the construction of the new aperture description. The input cells for these steps are coloured with a yellow background (and also made into initialisation cells in view of later re-use).

Technically, most function definitions are made using the dynamic programming idiom so, provided two variables defining the input files are correctly defined, you do not even have to worry about any procedural aspects.

- **Getting Data from the LHC Functional Layout Database**
- **Exploring the Beam Screen Marker Data**
- **The Gaps Between the Beam Screens**
- **Understanding how to Treat the Arc-length Slippage**

ApertureTypes

- **The Aperture Types of the Beam Screens**
- **Construction of the Beam Screen Markers**
- **Compressed Aperture Description Based on Beam Screen Markers**

Unified Aperture Description

- **Comparison of Beam Screen Marker Aperture and Aperture from Sequence File**
- **Merging the Two Sources of Aperture**
- **Apply apertures to elements in the MAD description of the LHC**
- **Test the aperture definition files by running through MAD**

100%

KEDIT - [P:\cern.ch\eng\lhc\spdyn\OpticsWebPages\V6.5\ApertureModel\LHCB1FullAperture.mad]

File Edit Actions Options Window Help

MB : Templates

```
* * * Top of File * * *
;
OPTION,ECHO;
! <LHCB1 aperture definitions derived from the LHC Functional Layout Database, augmented wi
OPTION,ECHO;
OPTION,-ECHO;
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IR11$START, APERTYPE=RECTELLIPSE,APERTURE={0.0192, 0.0241, 0.0241, 0.0241};
IP1, APERTYPE=RECTELLIPSE,APERTURE={0.0192, 0.0241, 0.0241, 0.0241};
TAS.1R1, APERTYPE=RECTELLIPSE,APERTURE={0.0192, 0.0241, 0.0241, 0.0241};
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BPMSW.1R1.B2, APERTYPE=RECTELLIPSE,APERTURE={0.0192, 0.0241, 0.0241, 0.0241};
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MCBX.1R1, APERTYPE=RECTELLIPSE,APERTURE={0.0192, 0.0241, 0.0241, 0.0241};
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MCBX.2R1, APERTYPE=RECTELLIPSE,APERT
MQXB.B2R1, APERTYPE=RECTELLIPSE,APER
TASB.3R1, APERTYPE=RECTELLIPSE,APERT
|...+....1....+....2....+....3....+.
MQSX.3R1, APERTYPE=RECTELLIPSE,APERT
MQXA.3R1, APERTYPE=RECTELLIPSE,APERT
MCBXA.3R1, APERTYPE=RECTELLIPSE,APER
MCX3.3R1, APERTYPE=RECTELLIPSE,APERT
MCX2.3R1, APERTYPE=RECTELLIPSE,APERT
DFBXB.3R1, APERTYPE=RECTELLIPSE,APER
BPMSY.4R1.B1, APERTYPE=RECTELLIPSE,A
BPMSY.4R1.B2, APERTYPE=RECTELLIPSE,A
MBXW.A4R1, APERTYPE=RECTELLIPSE,APER
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MBXW.F4R1, APERTYPE=RECTELLIPSE,APER
TAN.4R1, APERTYPE=RECTELLIPSE,APERTU
IR11$END, APERTYPE=RECTELLIPSE,APERT
TCL.4R1.B1, APERTYPE=RECTELLIPSE,APE
BPMWB.4R1.B1, APERTYPE=RECTELLIPSE,A
MBRC.4R1.B1, APERTYPE=RECTELLIPSE,AP
====>
```

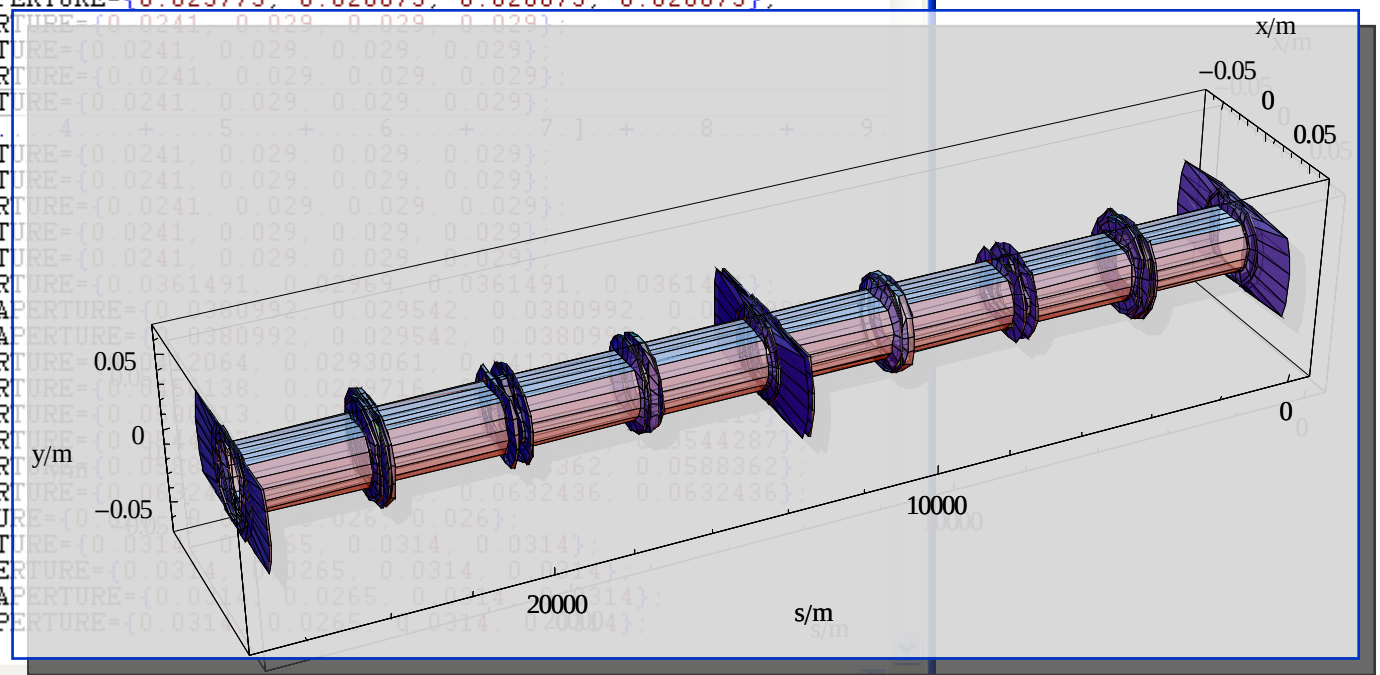

Line=19 Col=1 Alt=0,0;0 Size=5901 Files=1 Windows=1 INS R/W 9:23

Sequence file aperture for IR7

```
Show[WireFrame[ApPlotIR7], BeamPlotIR7, ViewPoint -> {-2.723, -1.984, 0.312}];
```