Aperture module in MADX BJ , Loc meeting 13th April 2005

Some results and a very quick 'user manual'

This module is an implementation in MADX and in C-language of the old 'apl' PERL code used to compute aperture. The module features substantial new properties (arbitrary vacuum chambers, external files to describe detailed deformations, extended chamber and tolerances definitions, etc).

The module was entirely written by Ivar Waarum during his stay as technical student in 2004.

It would not have been nicely implemented into MadX without a lot of handshaking with the TWISS module. We are much indebted to Eric D'Amico would gave a substantial help to Ivar to understand the inside of MADX and who provided internal access to Twiss in a very clever way.

(I corrected and enlarged the last slide after the meeting. Stephane and John were perfectly right. I mixed arbitrary chamber definition and measured profile errors replacing tolerances. Sorry I was walking a bit outside my boots this morning).

MQT.13L1.B1	6.6620	6.6981	-0.0361	IR1 B1
MQ.13L1.B1	6.5790	6.5855	-0.0065	
MS.13L1.B1	7.3200	0.0000		
MCBV.13L1.B1	6.7360	6.7421	-0.0061	
MB.C13L1.B1	6.8370	6.8434	-0.0064	
MB.B13L1.B1	9.1370	9.1451	-0.0081	
MB.A13L1.B1	7.0000	6.9873	0.0127	
MQT.12L1.B1	7.4720	7.5253	-0.0533	
MQ.12L1.B1	7.3360	7.3396	-0.0036	
MS.12L1.B1	7.7460	0.0000		
MCBH.12L1.B1	7.4980	7.5085	-0.0105	
MB.C12L1.B1	6.9780	6.9650	0.0130	
MB.B12L1.B1	8.9400	8.9480	-0.0080	
MB.A12L1.B1	6.7040	6.7101	-0.0061	
MQ.11L1.B1	6.4770	6.4831	-0.0061	
MS.11L1.B1	7.3230	0.0000		
MCBV.11L1.B1	6.7420	6.7485	-0.0065	
MB.B11L1.B1	8.7760	8.7839	-0.0079	
MB.A11L1.B1	6.9990	6.9866	0.0124	
MQML.10L1.B1	7.3950	7.4055	-0.0105	
MB.B10L1.B1	7.4440	7.4235	0.0205	
MB.A10L1.B1	8.0570	8.0647	-0.0077	
MQMC.9L1.B1	7.6760	7.6833	-0.0073	
MB.B9L1.B1	8.3810	8.3891	-0.0081	
MB.A9L1.B1	10.9950	10.9703	0.0247	
MQML.8L1.B1	11.0030	11.0216	-0.0186	
MB.B8L1.B1	10.4320	10.4095	0.0225	
MB.A8L1.B1	7.9690	7.9765	-0.0075	
MQM.B7L1.B1	9.7390	9.7144	0.0246	
MQM.A7L1.B1	9.5920	9.5672	0.0248	
DFBAA.7L1.B1	10.9440	7.1747	3.7693	
MQML.6L1.B1	7.9560	7.9457	0.0103	
MQML.5L1.B1	7.0230	7.0203	0.0027	
MQY.4L1.B1	11.0780	11.0719	0.0061	
MBRC.4L1.B1	10.8540	10.8558	-0.0018	
BPMWB.4L1.B1	11.0800	0.0000		
TAN.4L1	8.8430	8.8410	0.0020	
MBXW.F4L1	12.2220	12.2391	-0.0171	
MBXW.E4L1	12.3370	12.3043	0.0327	
MBXW.D4L1	12.1730	12.0987	0.0743	
MBXW.C4L1	11.8630	11.7866	0.0764	
MBXW.B4L1	11.4580	11.4045	0.0535	
MBXW.A4L1	11.0230	10.9783	0.0447	
MQXA.3L1	10.6930	10.6816	0.0114	
MQXB.B2L1	8.8090	8.8086	0.0004	
MQXB.A2L1	8.8690	8.8692	-0.0002	
MQXA.1L1	9.1740	9.1741	-0.0001	
MQXA.1R1	10.0200	9.9929	0.0271	
MQXB.A2R1	9.2690	9.2877	-0.0187	
MQXB.B2R1	9.1630	9.1796	-0.0166	
MQXA.3R1	11.5050	11.5051	-0.0001	
MBXW.A4R1	15.1370	15.1488	-0.0118	
MBXW.B4R1	15.3670	15.3840	-0.0170	
MBXW.C4R1	15.6130	15.5624	0.0506	
MBXW.D4R1	15.4020	15.3505	0.0515	
MBXW.E4R1	15.0010	14.9665	0.0345	
MBXW.F4R1	14.3510	14.3692	-0.0182	
TAN.4R1	9.2640	9.2866	-0.0226	
BPMWB.4R1.B1	11.5240	0.0000		
MBRC.4R1.B1	10.6560	10.6567	-0.0007	
MQY.4R1.B1	9.3230	9.3230	0.0000	
MQML.5R1.B1	7.0590	7.0553	0.0037	
MQML.6R1.B1	7.9860	7.9759	0.0101	
DFBAB.7R1.B1	12.9880	12.4091	0.5789	

MQT.13L1.B2	7.6030	7.6584	-0.0554	IR1 B2
MQ.13L1.B2	7.4720	7.4888	-0.0168	
MS.13L1.B2	7.9020	0.0000		
MCBH.13L1.B2	7.6390	7.6520	-0.0130	
MB.C13L1.B2	7.1300	7.1096	0.0204	
MB.B13L1.B2	8.8310	8.8390	-0.0080	
MB.A13L1.B2	6.8390	6.8455	-0.0065	
MQT.12L1.B2	6.7280	6.7645	-0.0365	
MQ.12L1.B2	6.6440	6.6506	-0.0066	
MS.12L1.B2	7.3850	0.0000		
MCBV.12L1.B2	6.7990	6.8056	-0.0066	
MB.C12L1.B2	6.8990	6.9058	-0.0068	
MB.B12L1.B2	9.0210	8.9891	0.0319	
MB.A12L1.B2	6.8240	6.8113	0.0127	
MQ.11L1.B2	7.2030	7.2047	-0.0017	
MS.11L1.B2	7.8350	0.0000		
MCBH.11L1.B2	7.5810	7.5983	-0.0173	
MB.B11L1.B2	8.9090	8.9171	-0.0081	
MB.A11L1.B2	6.6790	6.6850	-0.0060	
MQML.10L1.B2	6.4690	6.4750	-0.0060	
MB.B10L1.B2	7.0060	7.0125	-0.0065	
MB.A10L1.B2	9.1860	9.1715	0.0145	
MQMC.9L1.B2	9.4690	9.4595	0.0095	
MB.B9L1.B2	9.6150	9.6000	0.0150	
MB.A9L1.B2	8.3820	8.3899	-0.0079	
MQML.8L1.B2	7.7380	7.7450	-0.0070	
MB.B8L1.B2	7.8310	7.8386	-0.0076	
MB.A8L1.B2	8.9520	8.9599	-0.0079	
MQM.B7L1.B2	10.0450	10.0182	0.0268	
MQM.A7L1.B2	9.7160	9.7248	-0.0088	
DFBAA.7L1.B2	13.3260	12.5832	0.7428	
MQML.6L1.B2	7.6750	7.6723	0.0027	
MQML.5L1.B2	6.9340	6.9298	0.0042	
MQY.4L1.B2	9.3860	9.3864	-0.0004	
MBRC.4L1.B2	10.7240	10.7237	0.0003	
BPMWB.4L1.B2	12.3040	0.0000		
TAN.4L1	0.0000	9.5915	-9.5915	
MBXW.F4L1	0.0000	14.1135	-14.1135	
MBXW.E4L1	0.0000	14.7260	-14.7260	
MBXW.D4L1	0.0000	15.1256	-15.1256	
MBXW.C4L1	0.0000	15.3494	-15.3494	
MBXW.B4L1	0.0000	15.3851	-15.3851	
MBXW.A4L1	0.0000	15.2240	-15.2240	
MQXA.3L1	11.4350	11.4353	-0.0003	
MQXB.B2L1	9.2050	9.2210	-0.0160	
MQXB.A2L1	9.3110	9.3296	-0.0186	
MQXA.1L1	10.0450	10.0328	0.0122	
MQXA.1R1	9.2070	9.2074	-0.0004	
MQXB.A2R1	8.8910	8.8917	-0.0007	
MQXB.B2R1	8.8290	8.8294	-0.0004	
MQXA.3R1	10.7280	10.7176	0.0104	
MBXW.A4R1	11.0210	11.0267	-0.0057	
MBXW.B4R1	0.0000	11.5072	-11.5072	
MBXW.C4R1	0.0000	12.0284	-12.0284	
MBXW.D4R1	0.0000	12.4513	-12.4513	
MBXW.E4R1	0.0000	12.7352	-12.7352	
MBXW.F4R1	0.0000	12.8546	-12.8546	
TAN.4R1	0.0000	9.1916	-9.1916	
BPMWB.4R1.B2	12.5480	0.0000		
MBRC.4R1.B2	11.8320	11.8215	0.0105	
MQY.4R1.B2	11.1540	11.1470	0.0070	
MQML.5R1.B2	7.0290	7.0270	0.0020	
MQML.6R1.B2	7.7330	7.7300	0.0030	
DFBAB.7R1.B2	11.4010	6.8106	4.5904	

MBRC.4L2.B2	16.5200	16.5212	-0.0012	IR2 B2
BPMWB.4L2.B2	20.5670	0.0000		
CHAM2L.B2	17.5220	0.0000		
X2ZDC.4L2.B2	18.8370	18.8342	0.0028	
LUM2L.B2	15.8160	0.0000		
FLD2L.B2	24.2400	0.0000		
MBX.4L2	9.6440	9.6431	0.0009	
MQXA.3L2	8.1800	8.1837	-0.0037	
MQXB.B2L2	7.3510	7.3516	-0.0006	
MQXB.A2L2	7.3830	7.3828	0.0002	
MQXA.1L2	7.9020	7.9014	0.0006	
MQXA.1R2	8.0520	8.0477	0.0043	
MQXB.A2R2	6.9340	6.9535	-0.0195	
MQXB.B2R2	6.8710	6.8902	-0.0192	
MQXA.3R2	9.6650	9.6446	0.0204	
MBX.4R2	0.0000	12.8104	-12.8104	
FLD2R.B2	20.6070	0.0000		
LUM2R.B2	17.4810	0.0000		
X2ZDC.4R2.B2	20.2040	20.1948	0.0092	
CHAM2R.B2	19.6540	0.0000		
BPMWB.4R2.B2	21.8280	0.0000		
MBRC.4R2.B2	19.2970	19.2968	0.0002	

```
option, -echo, -info,  warn;
call,   file = "/afs/cern.ch/user/j/jbj/ap05/madx_input/bjtol";
call,   file = "/afs/cern.ch/user/j/jbj/ap05/madx_input/seq_sf_b";
call,   file = "db/V6.5.inj.str";
option,  echo,  info,  warn;
```

…

```
set, format="8.3f";
use,period=lhcb1;
select,flag=twiss,clear;
select,flag=twiss,range=s.DS.L1.B1/E.DS.R1.B1,
column=name,betx,bety,dx,dy,x,y,n1;
twiss,  sequence=lhcb1, file="twn_ir1_b1";

select,flag=aperture,column=name,s,betx,bety,dx,dy,x,y,n1;
aperture, range=s.DS.L1.B1/e.DS.R1.B1, cor=0.004, spec=7, interval=1.0,
offsetelem="offset_ir1_b1",file="ap_ir1_b1";
plot, table=aperture, noline, haxis=s, vaxis=on_elem, n1,
spec,vmin=0,vmax=12,co
lour=100;

SETTING APERTURE DEFINITIONS IN the sequence :

MB : SBEND, L := l.MB;
MB, APERTYPE=RECTELLIPSE, APERTURE={0.0000, 0.01714, 0.02202, 0.02202};
MB, APER_TOL={r.MB, h.MB, v.MB};
```

Aperture definition with a polygon given numerically:

```
MB: SBEND, L := 5, APERTYPE=myfile;
```

The syntax of myfile should be like this:

```
x0   y0
xi   yi
...
xn   yn
```

Tolerance can be replaced by measured profiles : add the following in the aperture command :

`trueprofile=filename,`

with filename being a file containing a list of element names and measured points along their vacuum chamber as follows, with columns being s,x,z data:

! a first element
mb.a14r1.b1
0 0.0002 0.000004
7.15 1.4e-5 0.3e-3
14.3 0.0000000032 4e-6

! second element
aname
s0 x0 z0
…
sn xn zn