

# MAD9 Task Force Meeting 14/2/2000, Agenda

## JMJ:

recent changes and fixes,  
status and future of MAD9 development

## FCI:

status of fast STATIC,  
MAD9 in general

## AFG:

plots and matching



## OB:

loading two rings ...

## AOB

# Changes and Bugs fixed recently

- ❑ Implementation of the distinction between “=” and “:=“ in assignments.
  - “:=“ means that the assignment will reflect future changes to variables on RHS (as in MAD8, Mathematica and MAD9 up to now)
  - “=“ means that the RHS will be evaluated and a constant assigned (as in MAD8’s SET command, Mathematica and with `eval(...)` in MAD9 up to now)
  - Some implications for used with legacy input files, e.g., in some cases LHC strength files need to be read before the sequence files.
- ❑ Indexing of arrays, evaluation of certain array expressions
  - `/afs/cern.ch/user/j/jowett/public/MAD9/Playground/IndexBug.mad`
  - Now OK as far as I know ...
- ❑ Dispersion components of TWISS tables were not copied to DOOM
  - Traditional MAD plots available → Angeles

# Apprehending MAD9's innards

## □ MAD9

450 classes;

80000 lines of C++ code (*not* including comments)

## □ Where are we?

Full understanding of MAD9 requires expertise in C++ and OOP *plusplus* time to understand the implementation.

We lack both so can only try to gain somewhat superficial understanding in time available.

**This is extremely difficult.**

Nevertheless the fact that the program is clearly written and structured means we can hope to be able to find and fix at least some bugs.

Plan to try out the process of adding new functionality (which has been sketched out).

## □ Future resources for MAD9

JMJ, SF, JP, A. Adelman from PSI will visit.

Tech-X ? Could be very helpful, modulo legalities and control issues.

Really need more local technical help.

# LHC Database ↔ MAD9 testing

❑ These activities are quite strongly coupled.

❑ Maximum and minimum strengths of elements to be implemented as element attributes

Essential to develop matching scripts that will not need to be tinkered with again, see transparencies from meetings of 11 and 25 October 1999..

❑ Aperture definitions

As for max and min strengths.

❑ Two rings, separation, arc lengths

Don't restart that discussion now.

❑ Project names

Aim to translate names of quadrupoles at least.

Translation to optics names is not complete: some more rules needed.

Will be packaged as a single Mathematica function.

❑ Filename conventions

See transparencies from meeting of 20 September 1999

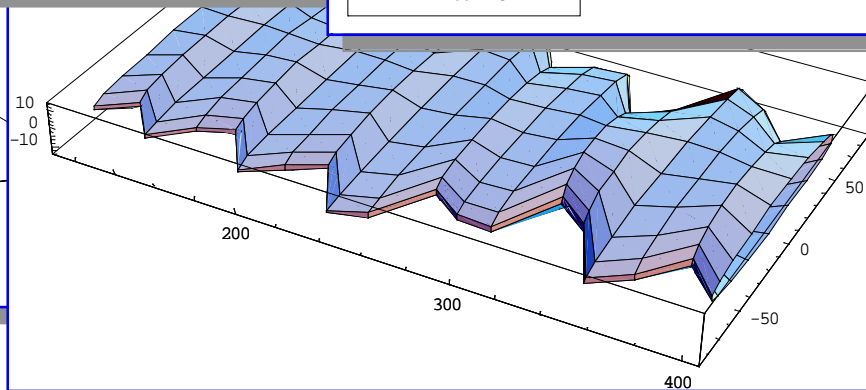
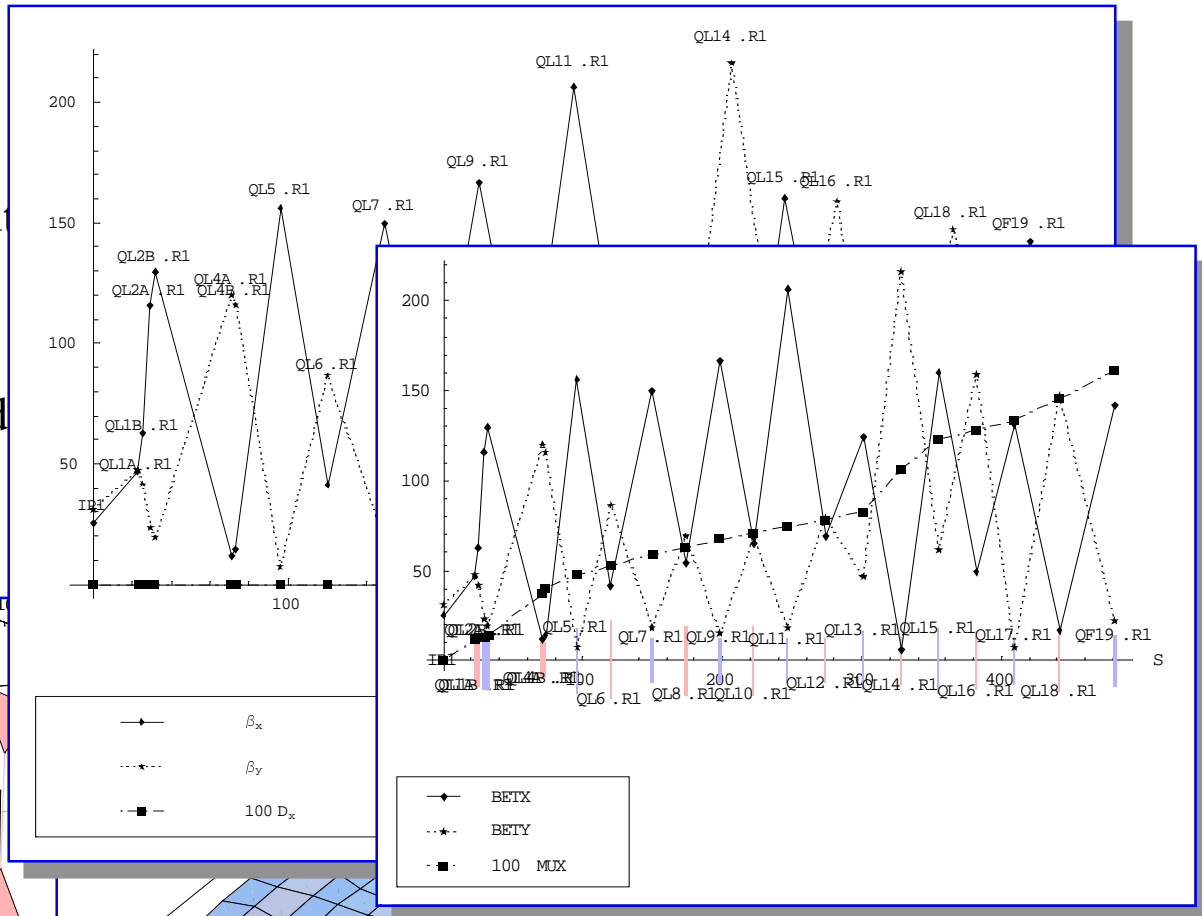
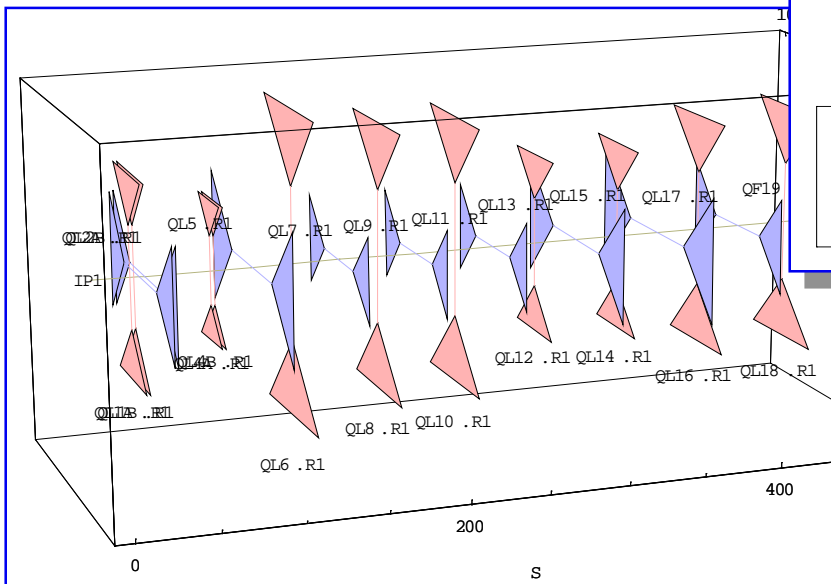
# Plots from MAD via Madtomma packages

## Basic plotting

Use standard packages (Mfs) for access to MAD tables and standard Mathematica graphics. Flexible but requires some programming.

## Beam optics-specific plotting

“Object-oriented package” was under development by K. Goral when he left. Parts work but not finished...



## Plots in MAD9 using DOOM:

- General information: <http://wwwslap.cern.ch/act/doom/>
- LHC examples: </afs/cern.ch/user/a/afaus/public/doom/>

</afs/cern.ch/user/a/afaus/public/doom/lhc9-doom.mad>

```
//-----  
// SELECT THE LHC LATTICE VERSION from the database  
  
System,"ln -fs /afs/cern.ch/eng/lhc/optics/V6.0/mad9 db.link";  
Title,string="LHC V6.0 sample job";  
  
p0=450; // MOMENTUM on REFERENCE ORBIT FOR INJECTION  
//p0=7000; // MOMENTUM on REFERENCE ORBIT FOR COLLISION  
Beam1: Beam, particle=proton, pc=p0;  
  
//-----  
// Read in sequence and strength files  
  
Call,file="db.link/Aperture.str"; //  
Call,file="db.link/K450Is63-59nV6.0M1.str"; // V6.0 converted to mad9  
//Call,file="db.link/K7000Cs63-59nV6.0M1.str"; // V6.0 converted to mad9  
Call,file="db.link/Ring1_260199.seq"; // same as V6.-2
```

```

//-----
// Compute TWISS functions (to use after for matching purposes)

select, LINE=lhc, class=quadrupole;
select, LINE=lhc, class=IP;

// cell45
c45_Twiss: Twiss, LINE=lhc, RANGE=s.cell.45/e.cell.45, BEAM=Beam1;

// starting point for ir5
bir5_Twiss: Twisstrack, LINE=lhc, RANGE=s.cell.45/s.ds.l5,
init=c45_Twiss @ s.cell.45, BEAM=Beam1;

// cell56
c56_Twiss: Twiss, LINE=lhc, RANGE=s.cell.56/e.cell.56, BEAM=Beam1;

//-----

IR5: TWISSTRACK, LINE=lhc, RANGE = S.DS.L5/E.DS.R5,
INIT = BIR5_twiss @ S.DS.L5, METHOD = LINEAR;
//-----
//                               PLOT

Doom, shut;
System,"doom_plot -db sdb9 < plot9.mad";
Doom,open;
//-----

```

</afs/cern.ch/user/a/afaus/public/doom/plot9.mad>

```

-plot -type twiss -table IR5 -haxis s -vaxis1 betx bety
-vaxis2 dx -colour 100 -style 100

```

</afs/cern.ch/user/a/afaus/public/doom/runmad9>

```

cp $AP_GROUP_DIR/share/doom/db/doomdb.new sdb9

```

```

mad9 -db sdb9 < lhc9-doom.mad

```

## Start Matching with MAD9:

### Strength file and Installing new elements:

```
// A basic MAD9 matching job for the LHC

//-----
// install totem elements

Call,file="kir5325-9";

//-----IR5 Quadrupoles

MQY : Quadrupole, l=1.MQY, aperture=ap_MQY;

      Q4.L5 : MQY,      k1:= KQ4.L5, dBdxMax:=160. ;

Call,file="ttm5-9.seq";

//left

q2b.ttm.15 : mxq, k1:= kq2.ttm.15;
q3.ttm.15 : mxq1, k1:= kq3.ttm.15;

seqedit,sequence=lhc;
// left

select, class=q3.15;
replace, selected=true, by= q3.ttm.15;
select, clear=true;

select, class=mxq, range=q2b.15/q2b.15;
replace, selected=true, by= q2b.ttm.15;
select, clear=true;

endedit;
```



## Matching:

```
//-----  
// Matching example for ir5 of LHC V6.0  
  
IR5: TWISSTRACK, LINE=lhc, RANGE = S.DS.L5/E.DS.R5,  
INIT = BIR5_twiss @ S.DS.L5, METHOD = LINEAR;  
  
MATCH;  
  
// Vary commands  
  
VARY, name=KQ1.ttm.L5, STEP=1.0E-07;  
VARY, name=KQ4.L5      , STEP=1.0E-07;  
VARY, name=KQ5.L5      , STEP=1.0E-07;  
  
// Some strength limits  
  
CONSTRAINT, KQ4.L5 < (Q4.L5->dBdxMax)*clight/(1.e9*p0), WGT=1;  
  
// Some constraints  
  
// (Part of the ) beta limitation in the dispersion suppressor  
CONSTRAINT, VMAX(COLUMN(IR5, BETX, S.DS.L5/Q7a.L5)) < 200.0, WGT = 10;  
CONSTRAINT, VMAX(COLUMN(IR5, BETy, Q7a.l5/Q4.L5)) < 350.0, WGT = 10;  
CONSTRAINT, IR5 @ Q7b.R5 -> BETX < 200.0, WGT = 10;  
  
// Matching method  
OPTION,LEVEL=3;  
LMDIF, CALLS=200, TOLERANCE=1.E-16  
ENDMATCH;
```