

Francesco & MAD

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Methodical Accelerator Design

- A code developed by H. Grote and F.C. Iselin in 1980's.
- Modified by F. Ruggiero in 1995.
- New function added in 1996.
- “rgomad”, first time when I met it in 1996.

A modified version of the program MAD to improve the efficiency of tracking studies

F.C. Iselin and F. Ruggiero

April 1996

Abstract:

A set of new commands has been added to the program MAD to enhance the flexibility of tracking studies, both for LHC and for LEP. The new features include an automatic search of dynamic aperture and the calculation of early indicators, such as Lyapunov exponent smear and detuning à la Laskar. In conjunction with more conventional MAD variables, such as normal mode chromaticities and anharmonicities, these quantities can be saved in special tables to generate correlation plots or can be used as global matching constraints, for a numerical optimisation of machine parameters related to the dynamic aperture.

The new command *dynapstart* has attributes common to the MAD commands *start* and *run*. Its purpose is to define initial conditions *xstart*, *pxstart*, *ystart*, *pystart*, *tstart*, *ptstart* and tracking options for a single particle: tracking is then invoked by a subsequent call to *dynap*, which performs an automatic search of dynamic aperture and may compute several auxiliary quantities according to the additional attributes of *dynapstart*. The dynamic aperture is expressed as a fraction *dynapfrac* of the initial betatron conditions. The syntax of this new command is

**dynapstart, x=real, px=real, y=real, py=real, t=real, deltap=real, &
fx=real, phix=real, fy=real, phiy=real, ft=real, phit=real, &
method=transport|lie3|lie4, table=name, damp, &
turns=integer, step=real, chkbelow=real, fracmin=real, &
fastune, lyapunov, continue**

New matching capabilities

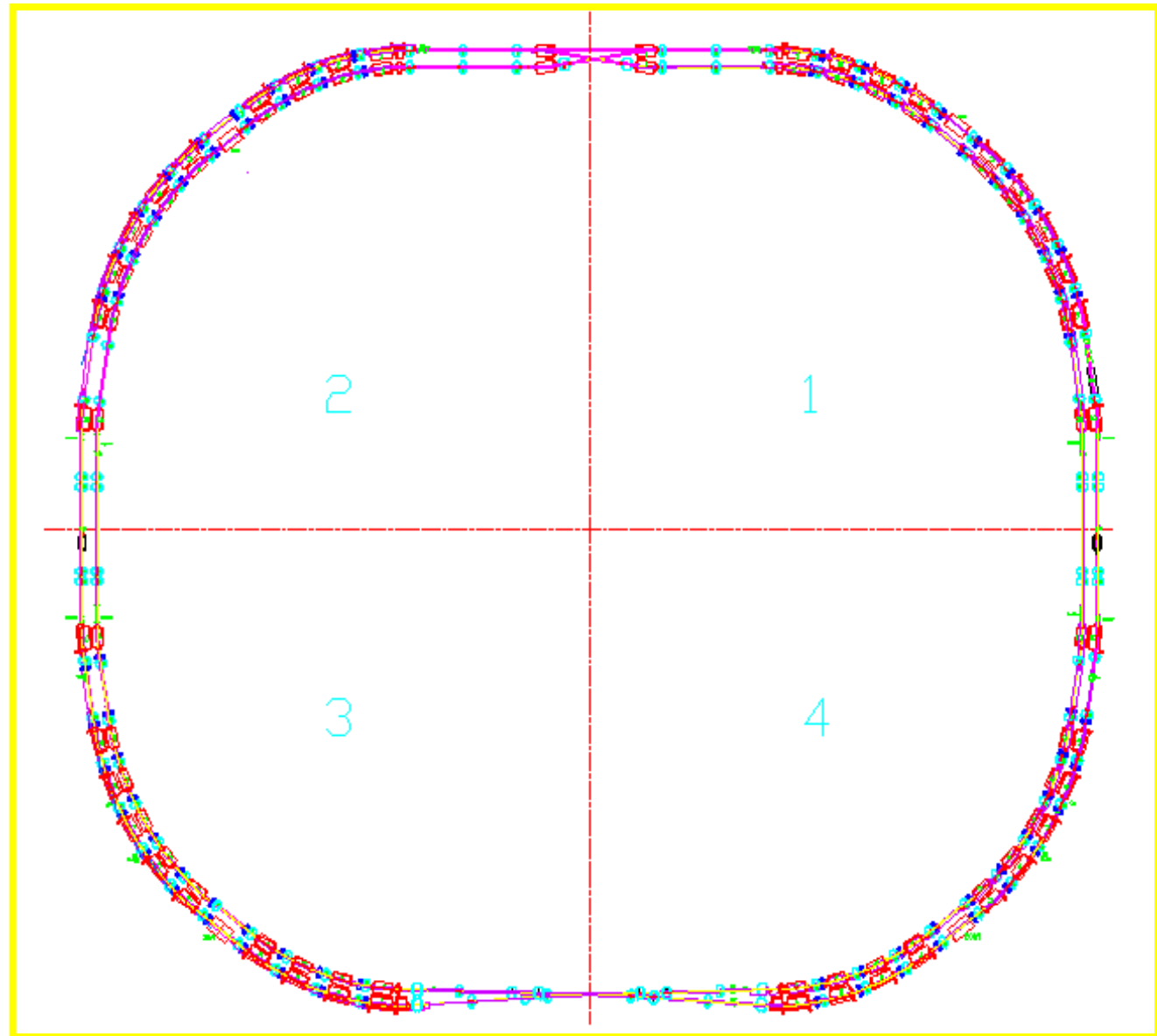
The matching module is entered by the `match` command, for insertion matching, or by the `cell` command, for periodic cell matching, and is exited by the command `endmatch`. Ideally, it should have control over all the other modules and be capable of accessing and updating any local or global variable; in future versions of MAD it may even be resident outside the main program, enable a more flexible use of minimisation packages such as MINUIT [9].

In addition to conventional matching constraints, corresponding to the MAD commands `constraint`, `couple`, `rmatrix` and `tmatrix`, most of the global variables discussed in the previous sections can be constrained by the new command `global`, having the following syntax:

```
global, q1=real, q2=real, q1'=real, q2'=real, &  
       q1''=real, q2''=real, dq1de1=real, dq1de2=real, dq2de2=real, &  
       dynapfrac=real, turns=real, &  
       wxmin=real, wxmax=real, wymin=real, wymax=real, &  
       wxymin=real, wxymax=real, smear=real, &  
       tunx=real, tuny=real, dtune=real, lyapunov=real, &  
       xend=real, pxend=real, yend=real, pyend=real, tend=real, ptend=real, &  
       fixpoint, formula=real, call=name
```

Dynamic Aperture Study in BEPCII

Storage rings
of BEPCII



Dynap tracking commands for BEPCII

nsigma = 30

deltang = 0.5*pi/10.

angolo = 0

dp = 0.E-3

beam, ex=180e-9, ey=90e-9, particle=electron, radiate

do times=11

set, fxval, nsigma*cos(angolo)

set, fyval, nsigma*sin(angolo)

**dynapstart, FX=fxval, FY=fyval, deltap=dp, TURNS=1024, STEP=0.025, &
damp, quantum, FASTUNE, CHKBELow, orbit**

DYNAP

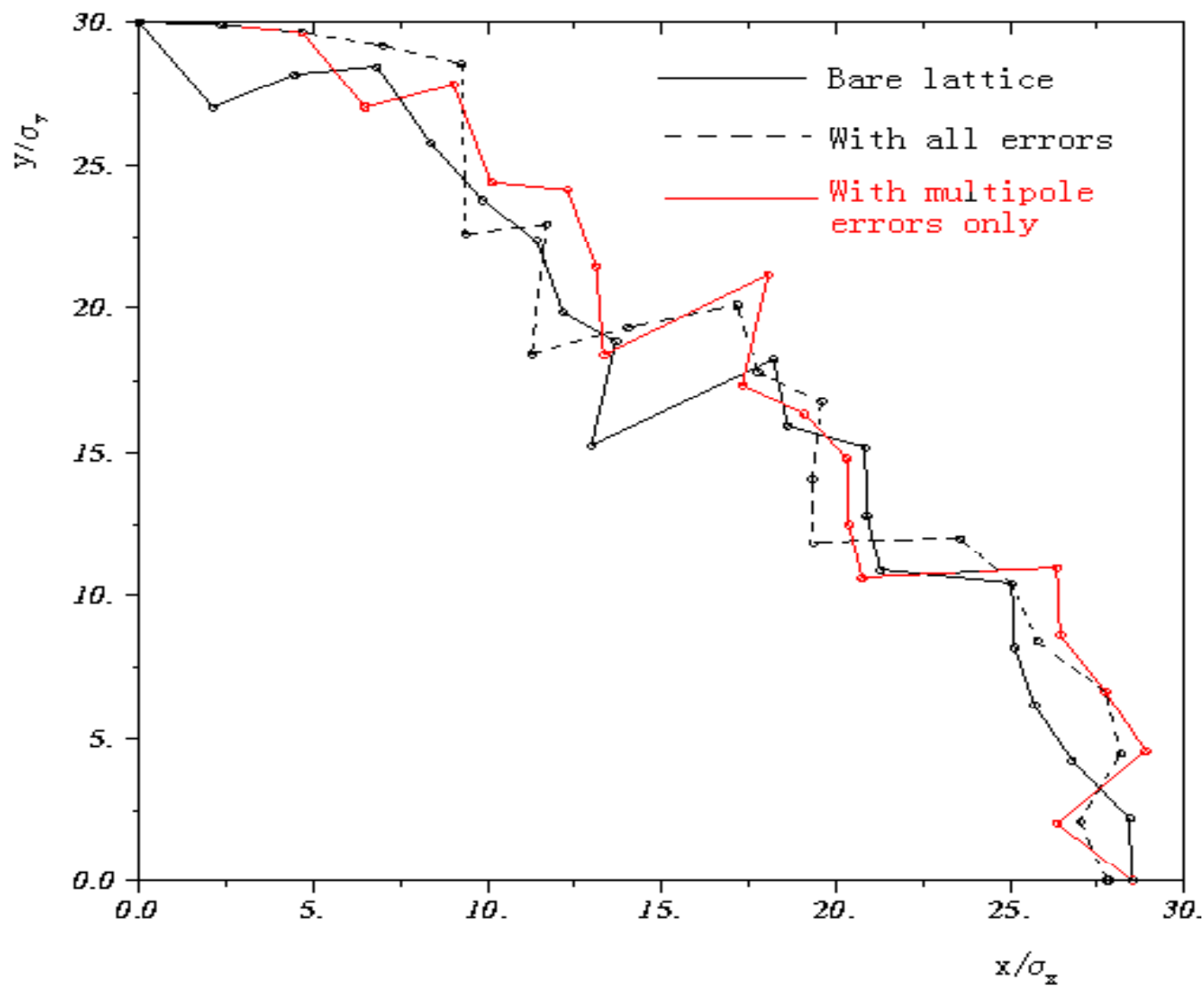
**PUSH, angolo, nsigma, fxval, fyval, &
beam[EX], beam[EY], DYNAPFRAC, SMEAR, &
XSTART, YSTART, TSTART, PXSTART, PYSTART, PTSTART, &
WXYSTART, WXSTART, WYSTART, &
WXYMIN, WXYMAX, WXMIN, WXMAX, WYMIN, WYMAX, &
TUNX, TUNY, DTUNE**

set, angolo, angolo + deltang

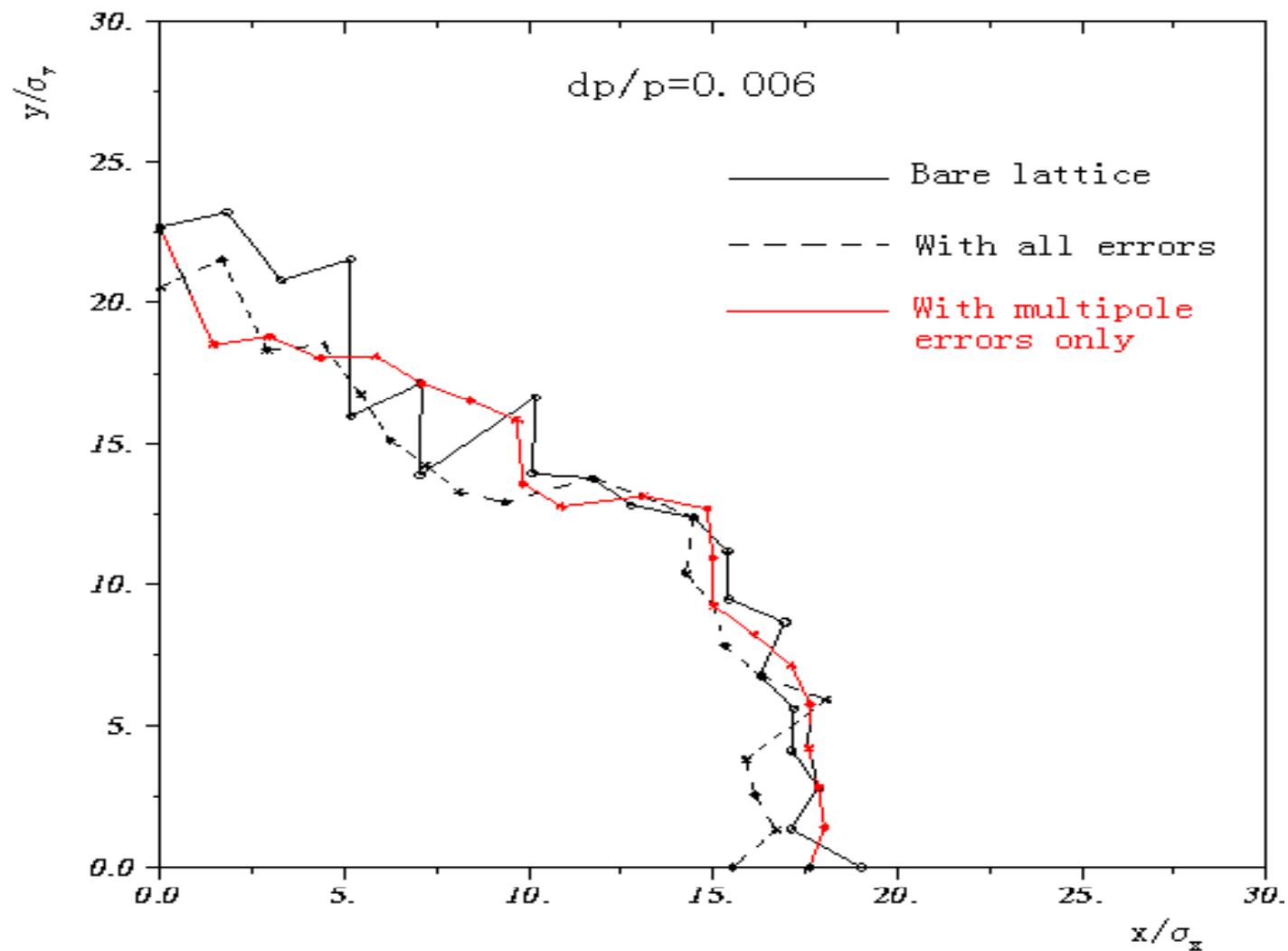
enddo

ENDPUSH, SAVE="SPECIAL.CONTOUR"

Dynamic Aperture done with “DYNAPSTART”



Dynamic Aperture done with “DYNAPSTART”



Francesco and I

- I knew him at CERN 12 years ago when I worked at SL/AP, 1995~1996.
- Impressed me most --- diligent, intellectual, humorous, heartfelt,
- Though hadn't worked together, but I learnt a lot from his talks, papers, discussions, etc.
- Francesco's contributions to AP is forever.