

Recent update on the MADX thintrack module

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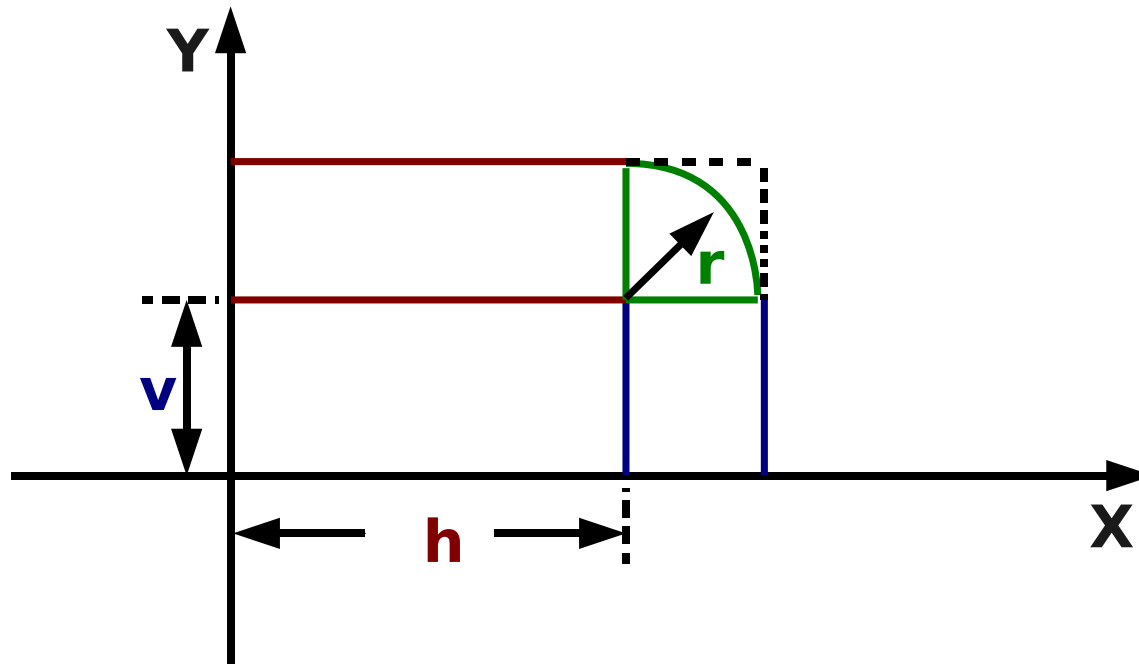
FP6 "Structuring the European Research Area" programme (CARE, contract number

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Contents

- Aperture "Racetrack"
- Closed orbit (based on Alex's work)
(In progress)
- Work to be done

Sketch on Racetrack type



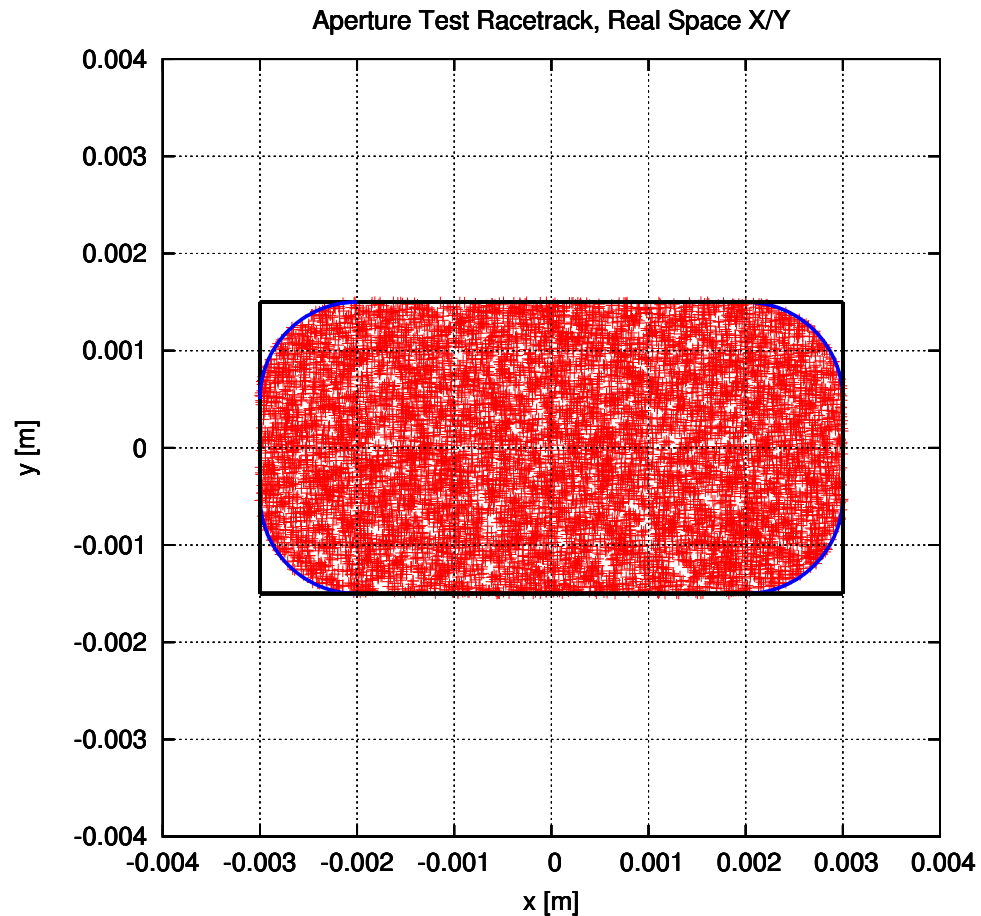
$$x < (h + r) \& y < (v + r) \& (x - h)^2 + (y - v)^2 \leq r^2$$

qd:multipole, knl={0,-0.0}, apertype= racetrack, aperture={0.002,0.0005,0.001}

Add in the trrun.F code

```
subroutine tmap (tracking per element)...
else if(aptype.eq.'racetrack') then
apx = aperture(1)
apy = aperture(2)
apr = aperture(3)
call trcoll1(4, apx, apy, turn, sum, part_id, last_turn,
last_pos, last_orbit, track,ktrack,al_errors, apr)
...
subroutine trcoll1
...
if (flag .eq. 4
.and. (abs(z(1,i)-al_errors(11))) .gt. (apr+apx)
.or. abs(z(3,i)-al_errors(12)) .gt. (apy+apr) .or.
((((abs(z(1,i)-al_errors(11))-apx)**2+
(abs(z(3,i)-al_errors(12))-apy)**2) .gt. apr**2)
.and. (abs(z(1,i)-al_errors(11))) .gt. apx
.and. abs(z(3,i)-al_errors(12)) .gt. apy)) then
go to 99
...
```

Check of Racetrack type by tracking



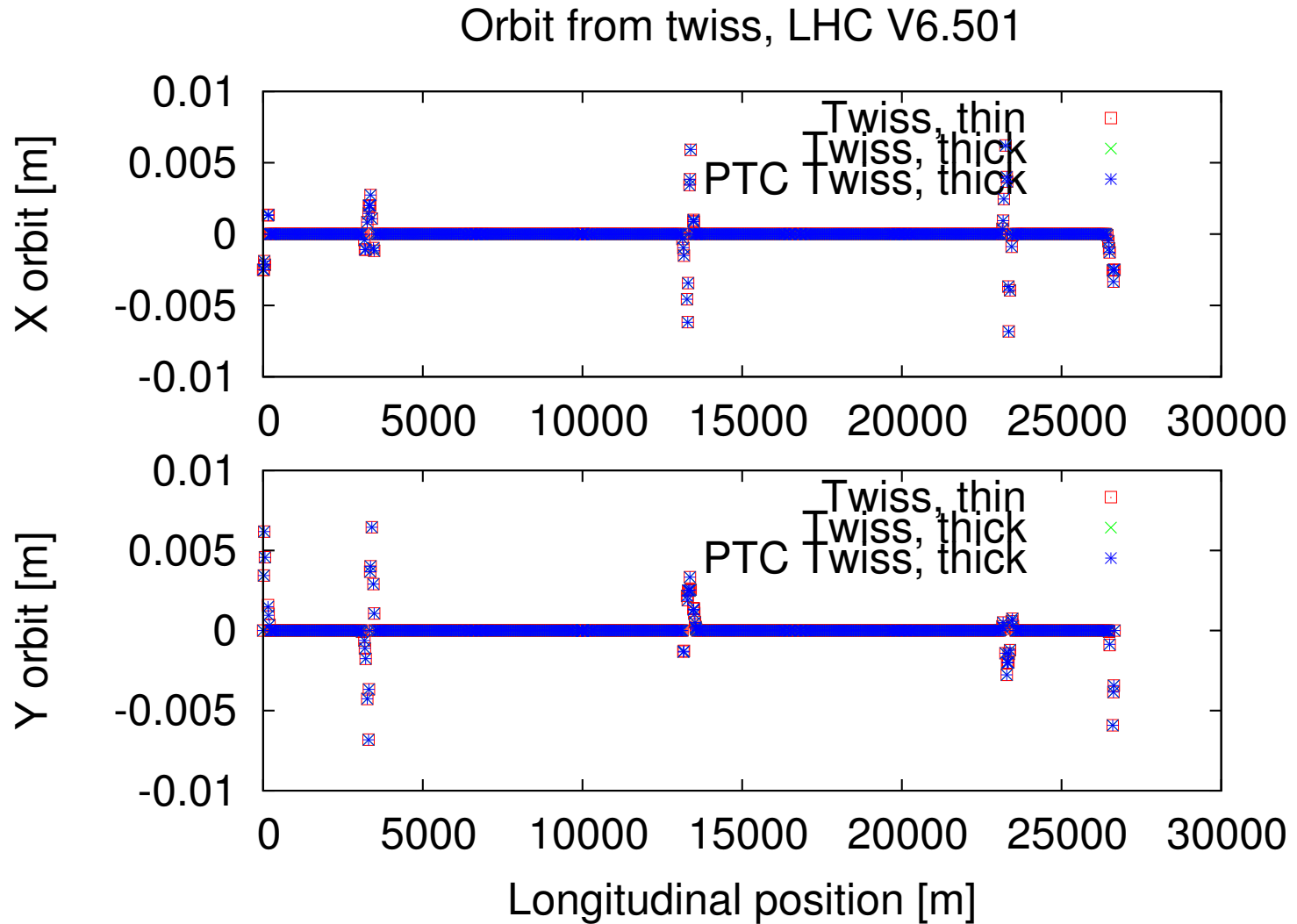
10,000 particles, onepass, one turn

"[tstTrack_ap_racetrack.madx](#)" to be added into MADX Web examples

Procedure, closed orbit

- Use LHC V6.501 sequence and injection magnets strength
- Run official MADX to get TWISS and 6-D closed orbit from its output file
- Use this 6-D closed orbit as the initial value to track for 3 turns (by thin-tracking)
- Repeat with new MADX, with my new subroutine trclor to find the correct 6-D closed orbit

Comparison of Twiss results



LHC V6.501, On momentum, pt=0

Normal MADX 3.04.56

6-D closed orbit from normal MADX as initial value

Turn	X	PX	Y
0	-0.00250002334	1.70517533e-10	-9.81634914e-11
1	-0.002500021829	2.466376904e-10	-1.484745948e-09
2	-0.002500020841	1.450511219e-10	8.797245164e-11
3	-0.002500022722	1.070036427e-10	3.165956017e-10

Turn	PY	T	PT
0	0.000159998881	1.14893938e-05	9.03907774e-07
1	0.0001599989482	1.148941021e-05	9.039077749e-07
2	0.0001599989993	1.148943495e-05	9.039077785e-07
3	0.0001599988945	1.14894569e-05	9.039077848e-07

Respect to the reference orbit (0)
Does not close perfectly

To improve

Procedure: $\vec{x}_2 = \mathbf{M}_1 \cdot \vec{x}_1$ (\vec{x}_1 from Twiss module)

from $x_{11} = \{x + \Delta_1, px, y, py, t, pt\} \dots$, sensitivity matrix:

$$\tilde{M} = \begin{pmatrix} \frac{X_{21}-X_2}{\Delta_1} & \frac{X_{22}-X_2}{\Delta_1} & \frac{X_{23}-X_2}{\Delta_1} & \frac{X_{24}-X_2}{\Delta_1} & \frac{X_{25}-X_2}{\Delta_1} & \frac{X_{26}-X_2}{\Delta_1} \\ \frac{X_{21}-X_2}{\Delta_2} & \frac{X_{22}-X_2}{\Delta_2} & \frac{X_{23}-X_2}{\Delta_2} & \frac{X_{24}-X_2}{\Delta_2} & \frac{X_{25}-X_2}{\Delta_2} & \frac{X_{26}-X_2}{\Delta_2} \\ \frac{X_{21}-X_2}{\Delta_3} & \frac{X_{22}-X_2}{\Delta_3} & \frac{X_{23}-X_2}{\Delta_3} & \frac{X_{24}-X_2}{\Delta_3} & \frac{X_{25}-X_2}{\Delta_3} & \frac{X_{26}-X_2}{\Delta_3} \\ \frac{X_{21}-X_2}{\Delta_4} & \frac{X_{22}-X_2}{\Delta_4} & \frac{X_{23}-X_2}{\Delta_4} & \frac{X_{24}-X_2}{\Delta_4} & \frac{X_{25}-X_2}{\Delta_4} & \frac{X_{26}-X_2}{\Delta_4} \\ \frac{X_{21}-X_2}{\Delta_5} & \frac{X_{22}-X_2}{\Delta_5} & \frac{X_{23}-X_2}{\Delta_5} & \frac{X_{24}-X_2}{\Delta_5} & \frac{X_{25}-X_2}{\Delta_5} & \frac{X_{26}-X_2}{\Delta_5} \\ \frac{X_{21}-X_2}{\Delta_6} & \frac{X_{22}-X_2}{\Delta_6} & \frac{X_{23}-X_2}{\Delta_6} & \frac{X_{24}-X_2}{\Delta_6} & \frac{X_{25}-X_2}{\Delta_6} & \frac{X_{26}-X_2}{\Delta_6} \end{pmatrix} .$$

$$\tilde{M}^{-1} \Delta x_2 = \delta \text{ and } \vec{x}_3 = \vec{x}_1 + \delta$$

In the trrun.F code

subroutine trrun (tracking routine)...

!-----before tracking, trclor to improve orbit-----

!-----added by ypsun 20-11-2008-----

call trclor(orbit0)

...

subroutine trclor(orbit0)

...

!----- loop over nodes----- ...

call tmap(code,el,z,pmax,dxt,dyt,sum,turn,part_id,
last_turn,last_pos, last_orbit,aperflag,maxaper,al_errors,onepass)

...

do k=1,6

do i=1,6

a(i,k) = (z(i,k+1) - z(i,1))/ddd(i)

enddo

enddo

Interation 10 times

call dcopy(z0(1,1),orbit0,6)

How it works

AK special version 2007/12/13

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Modified by Yipeng SUN 19/11/2008

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Full 6D closed orbit search.

Initial value of 6-D closed orbit from [Twiss](#):

orbit0 -0.00250002334 1.70517533E-10 -9.81634914E-11 0.000159998881
1.14893938E-05 9.03907774E-07

=====
6D closed orbit found by [subroutine trclor](#)

iteration: 11 [error: 4.516635E-15](#) deltap: 0.000000E+00

orbit: -2.500022E-03 1.718074E-10 -4.032407E-10 1.599989E-04
1.148940E-05 9.039102E-07

MADX new thintrack

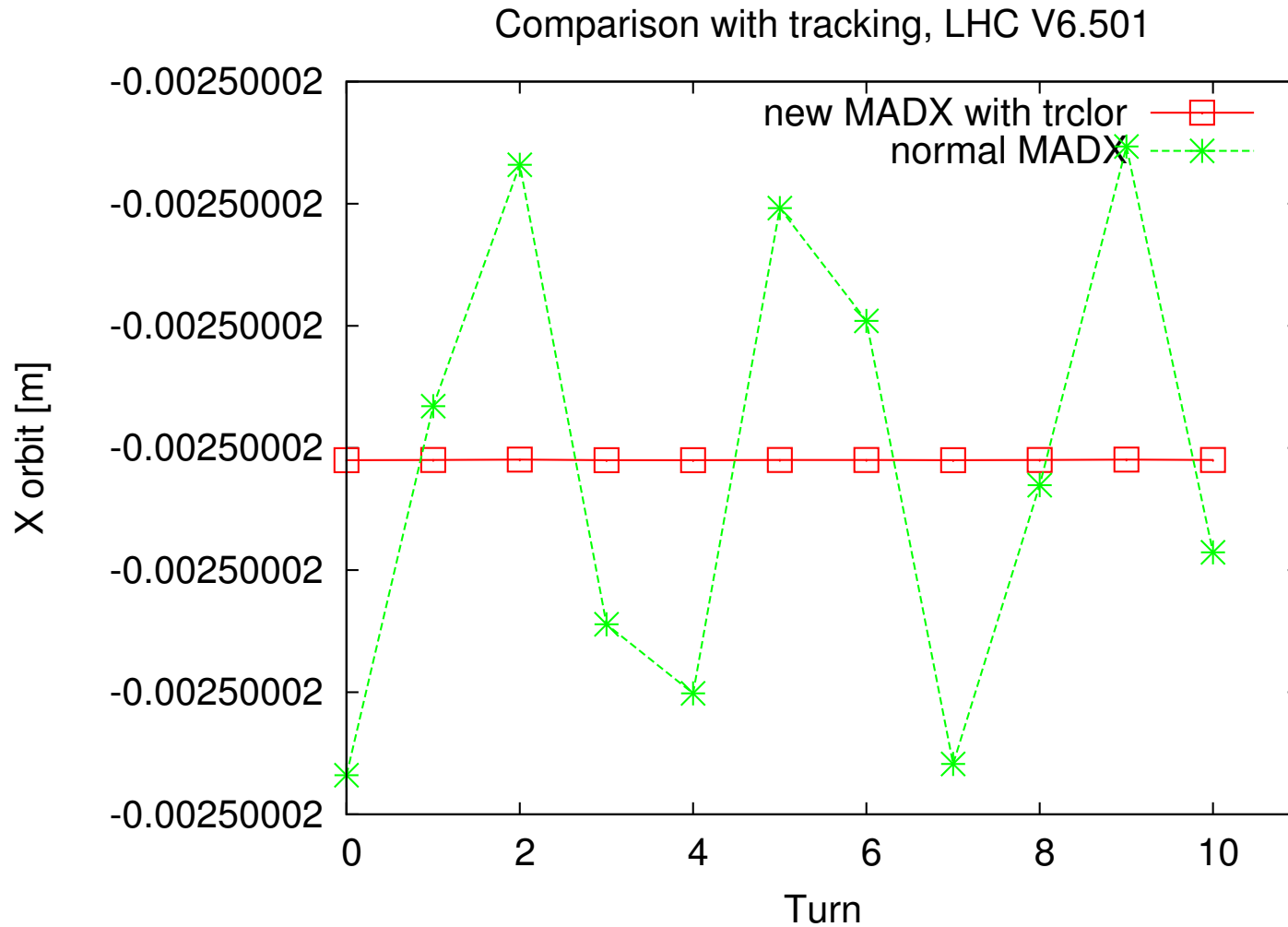
6-D closed orbit from the new subroutine "trclor" as initial value

Turn	X	PX	Y
0	-0.00250002205	1.71807351e-10	-4.03240672e-10
1	-0.002500022049	1.718545898e-10	-4.082270901e-10
2	-0.002500022048	1.717896435e-10	-3.995692568e-10
3	-0.00250002205	1.717667459e-10	-4.009574369e-10

Turn	PY	T	PT
0	0.000159998942	1.14893971e-05	9.03910221e-07
1	0.0001599989424	1.148939709e-05	9.03910221e-07
2	0.0001599989425	1.148939711e-05	9.03910221e-07
3	0.000159998942	1.148939711e-05	9.03910221e-07

Respect to the reference orbit (0)
Close perfectly

Comparison of tracking



LHC V6.501, injection strength

Work to be done

- Check and clean the code
- Other?