Agenda MPWG 14 February 2003

- Comments to minutes
- General Information

- Machine failures and triplet protection contd
- Reliability of BLMs

- AOB

Unsynchronised beam dump

….several discussions with R.Assmann, W.Herr, J.B.Jeanneret and J.Wenninger

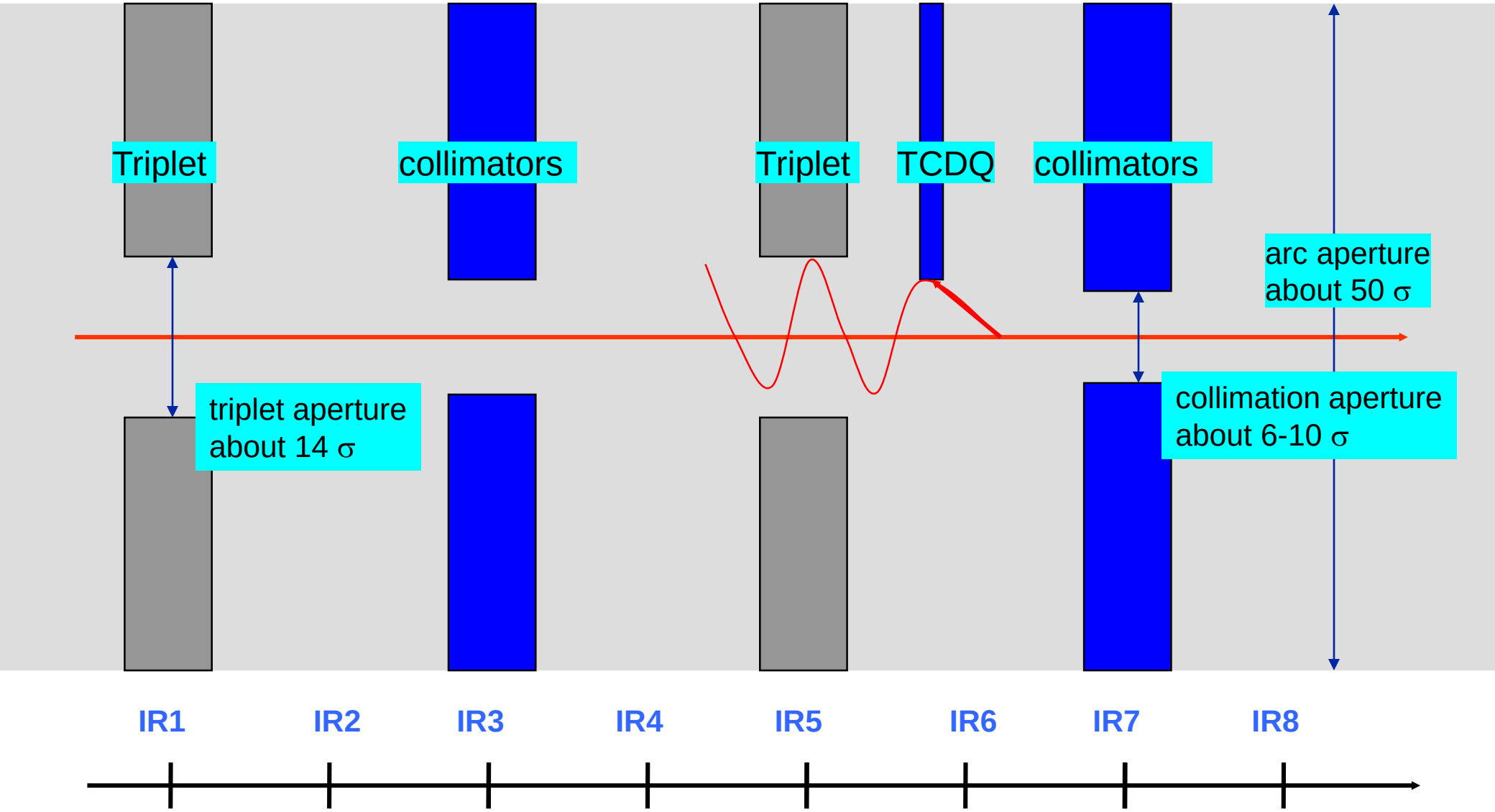
Failure scenario

- An asynchronous beam dump is assumed.
- The TCDQ is in place, either at 10 sigma, or with an offset
- For beam 1, the cleaning insertion 7 is between IR6 and IR1 (ATLAS) and limits particles with large amplitudes (…if the collimators are at the correct position)
- The following results are for beam 2 - there are no other collimators between the kicker and the triplet in IR5

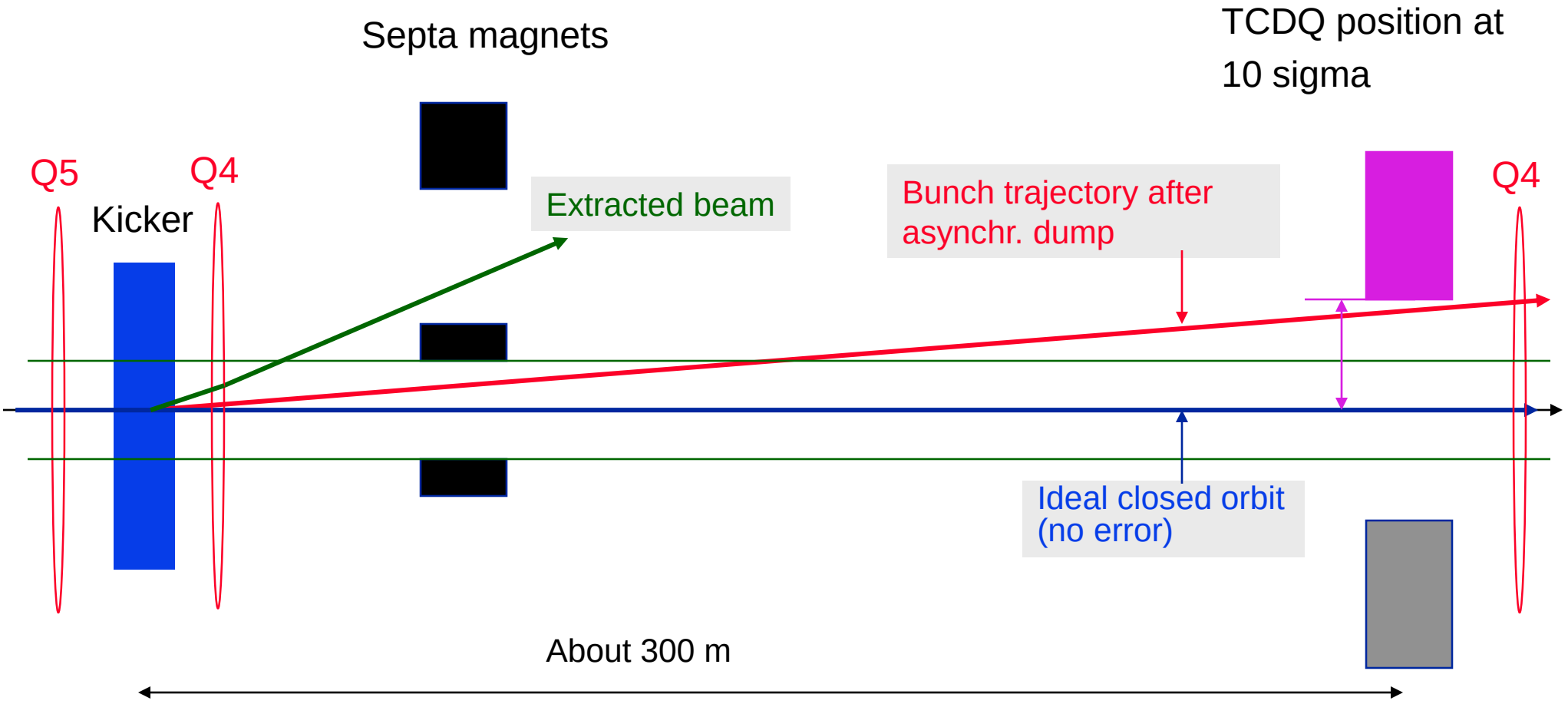
- The bunch oscillates around the closed orbit in the horizontal plane

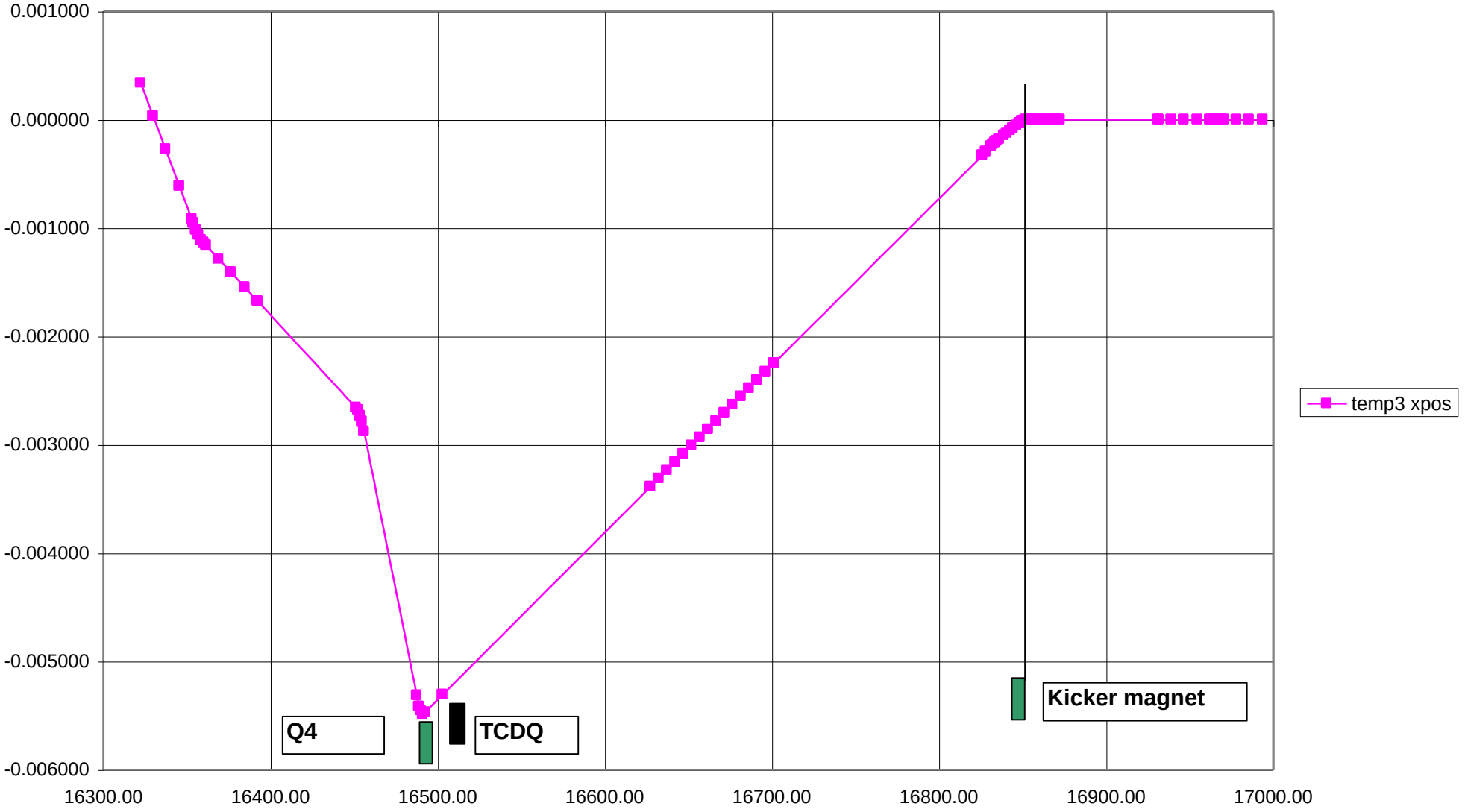
Critical apertures around the LHC (in units of beam size)

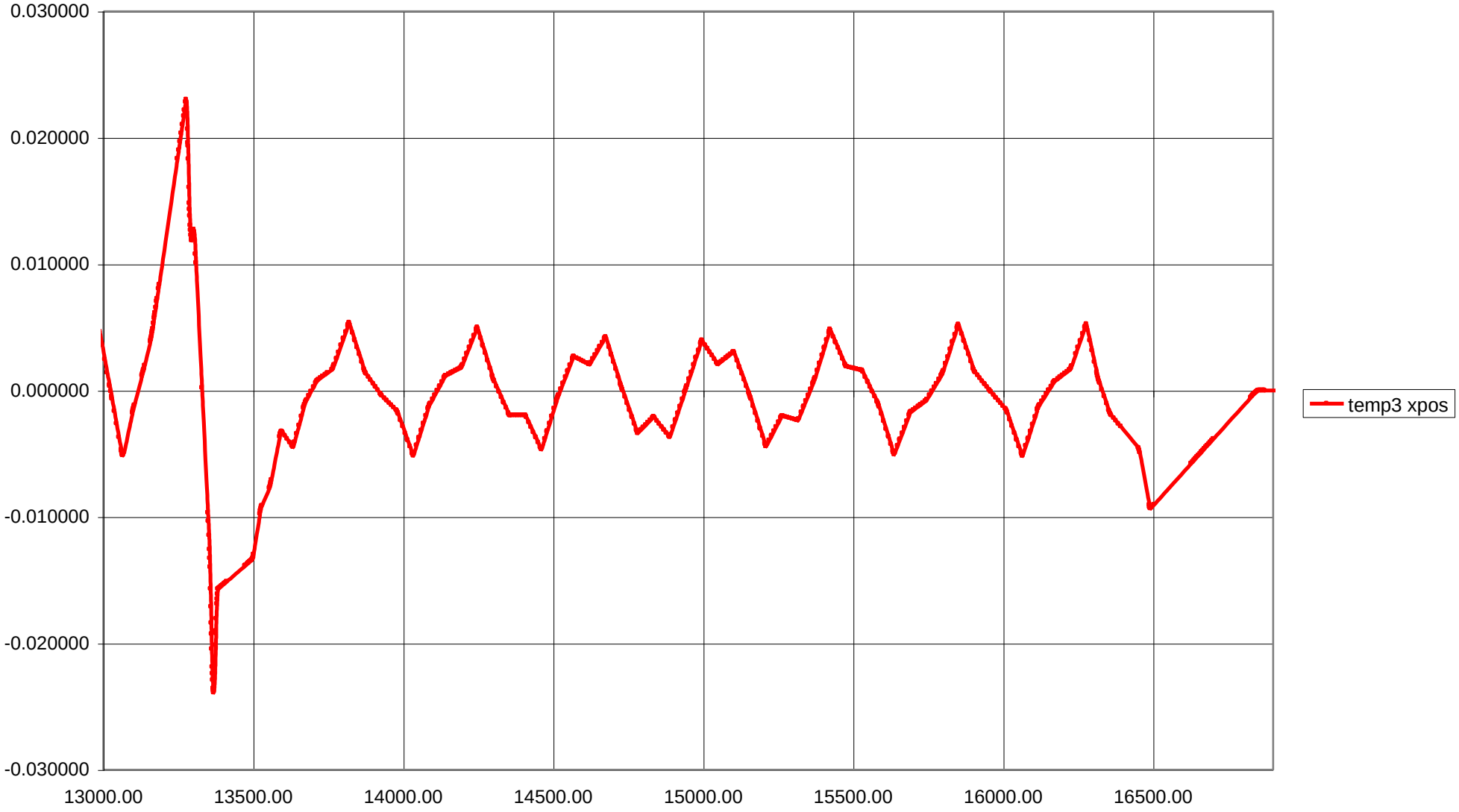
7 TeV and β* = 0.5 m in IR1 and IR5

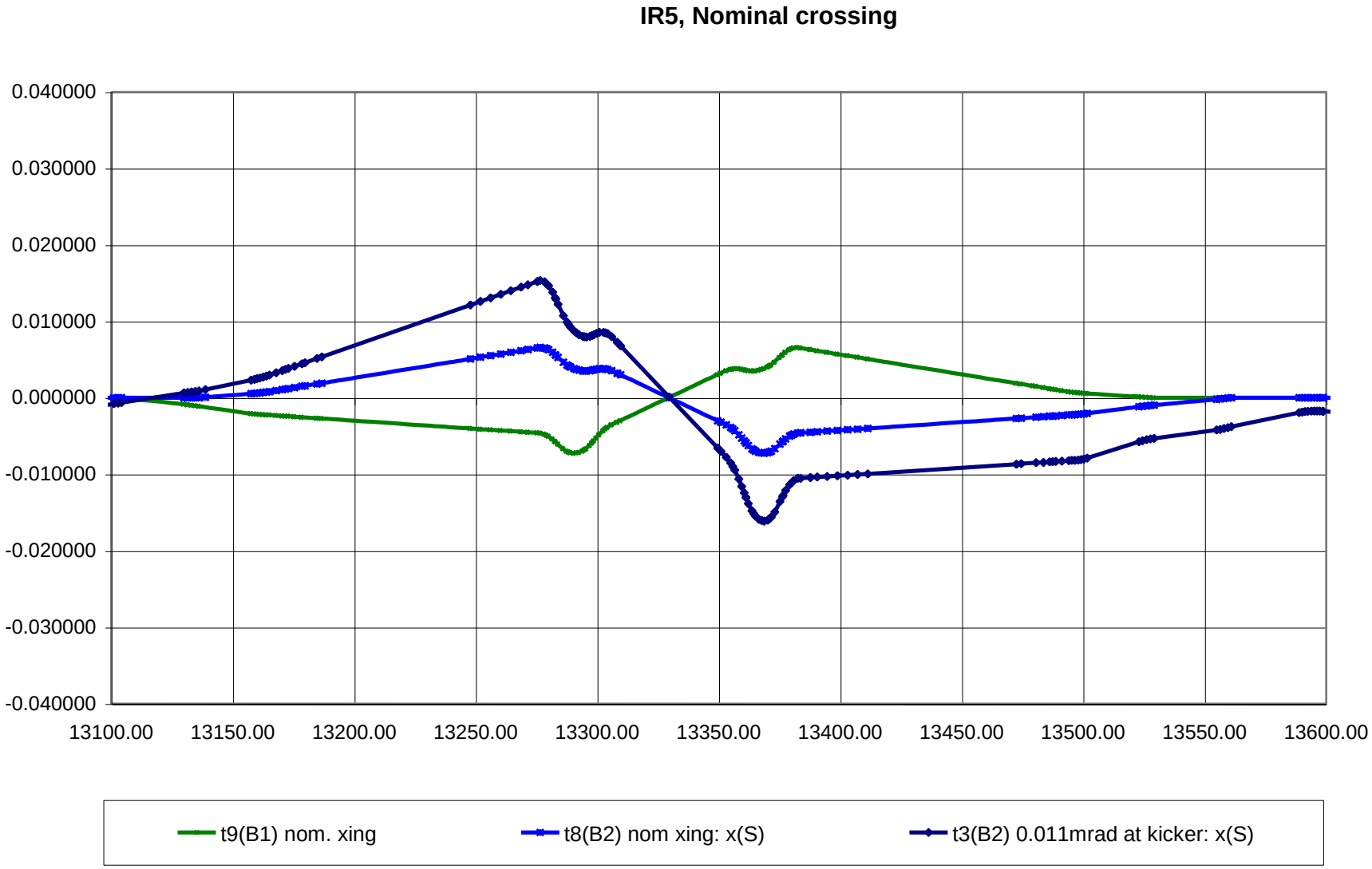


Schematic drawing of extraction trajectory in case of failure - no closed orbit errors

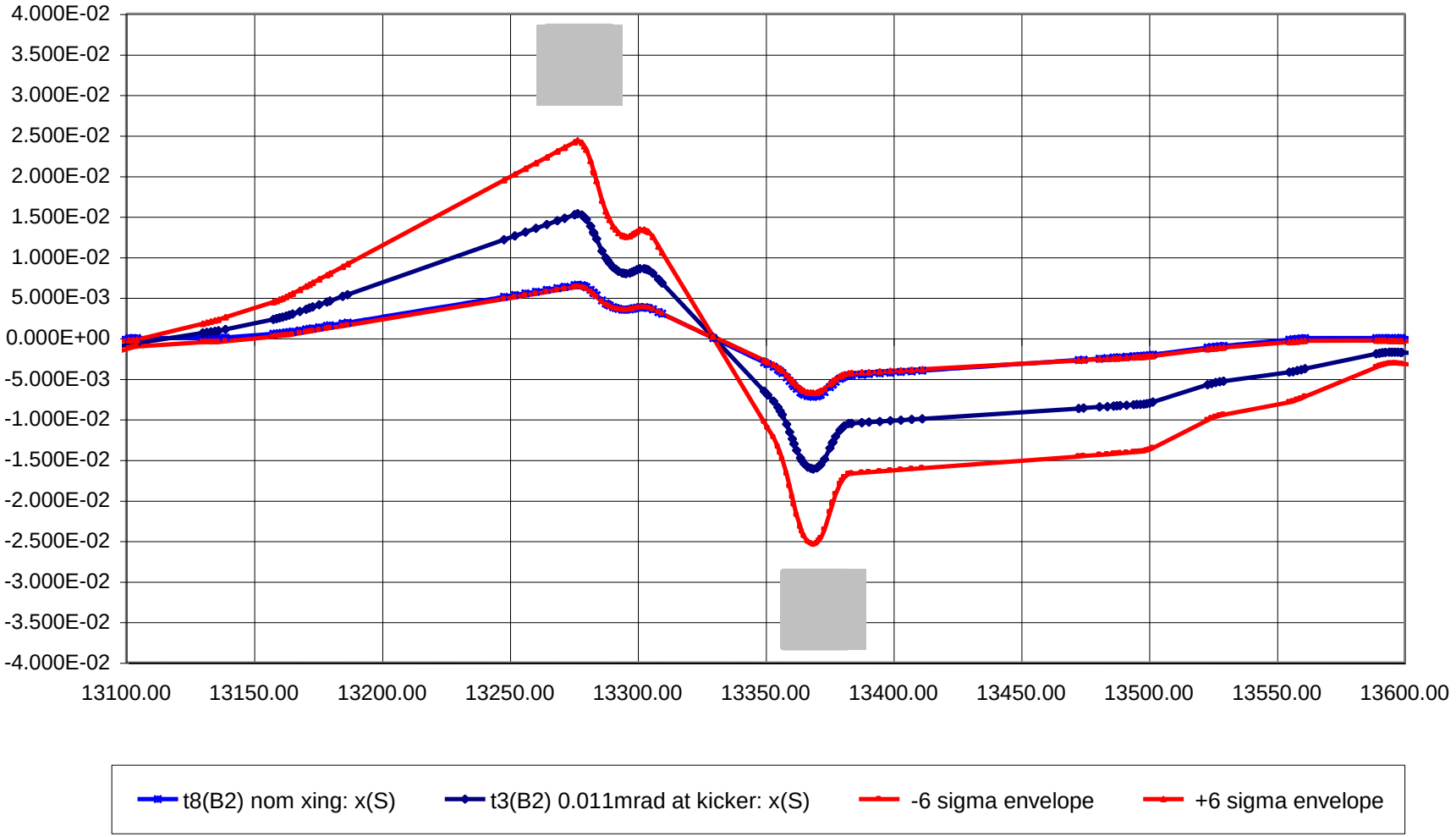



0.001000
0.000000
-0.001000
-0.002000
-0.003000
-0.004000
-0.005000
-0.006000
16300.00
16400.00
16500.00
16600.00
16700.00
16800.00
16900.00
17000.00
temp3 xpos
Q4
TCDQ
Kicker magnet


0.030000
0.020000
0.010000
0.000000
-0.010000
-0.020000
-0.030000
13000.00
13500.00
14000.00
14500.00
15000.00
15500.00
16000.00
16500.00
temp3 xpos


IR5, Nominal crossing
0.040000
0.030000
0.020000
0.010000
0.000000
-0.010000
-0.020000
-0.030000
-0.040000
13100.00
13150.00
13200.00
13250.00
13300.00
13350.00
13400.00
13450.00
13500.00
13550.00
13600.00
t9(B1) nom. xing
t8(B2) nom xing: x(S)
t3(B2) 0.011mrad at kicker: x(S)

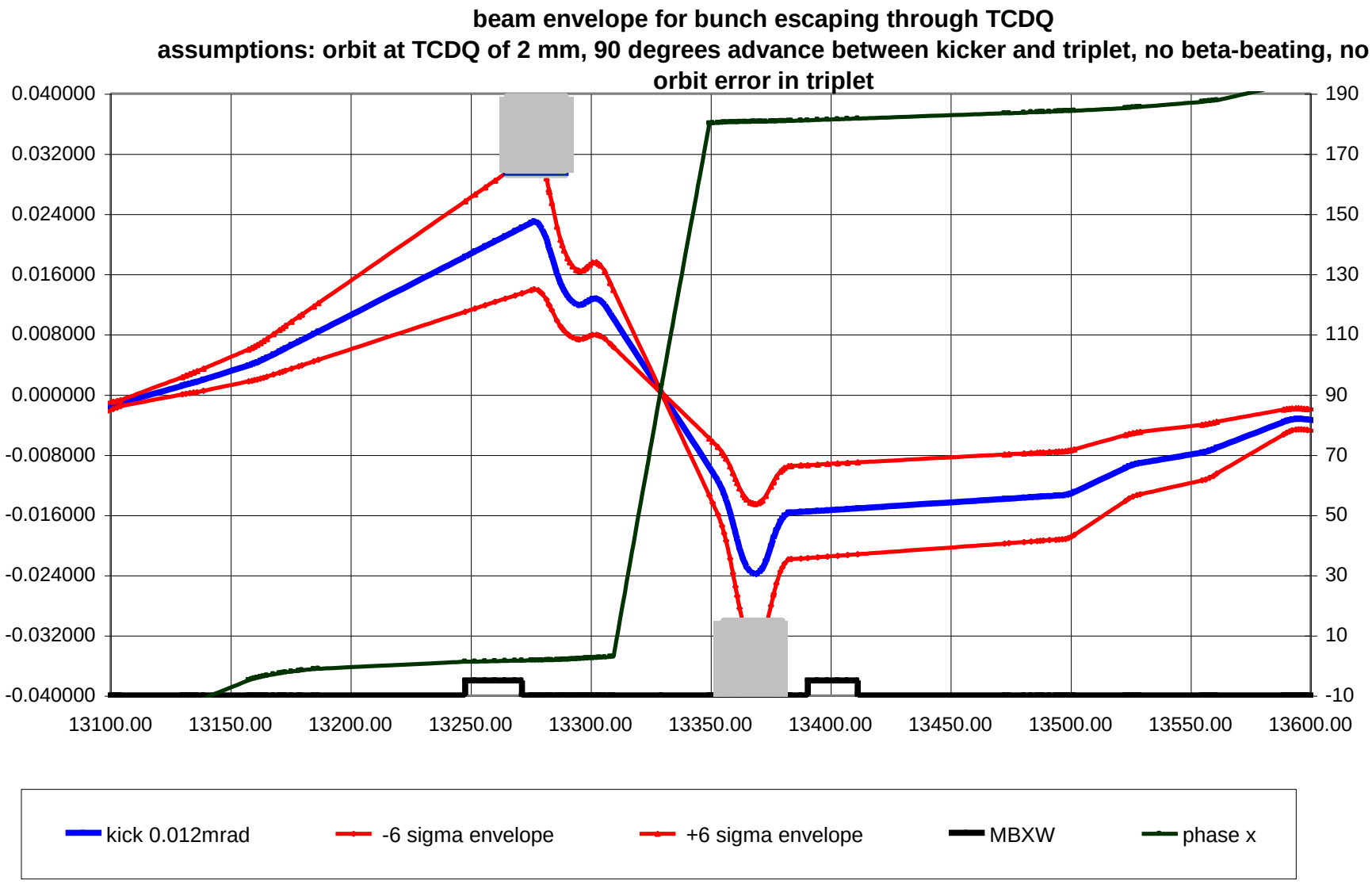
IR5, Nominal crossing , TCDQ at perfect position, phase advance for current optics, no beta beating



Trajectory of partially deflected beam (for 7 TeV) with nominal parameters

- no orbit errors in IR6
- TCDQ at 10 σ, corresponds to a distance between orbit and TCDQ of 5.23 mm
- Kick by the kicker with 0.0123mrad
- Bunch position at TCDQ is about 5.3mm (just passing through)
- No orbit errors in the triplet
- Phase advance as for optics 6.4 with sin(angle)=0.79
- No beta beating

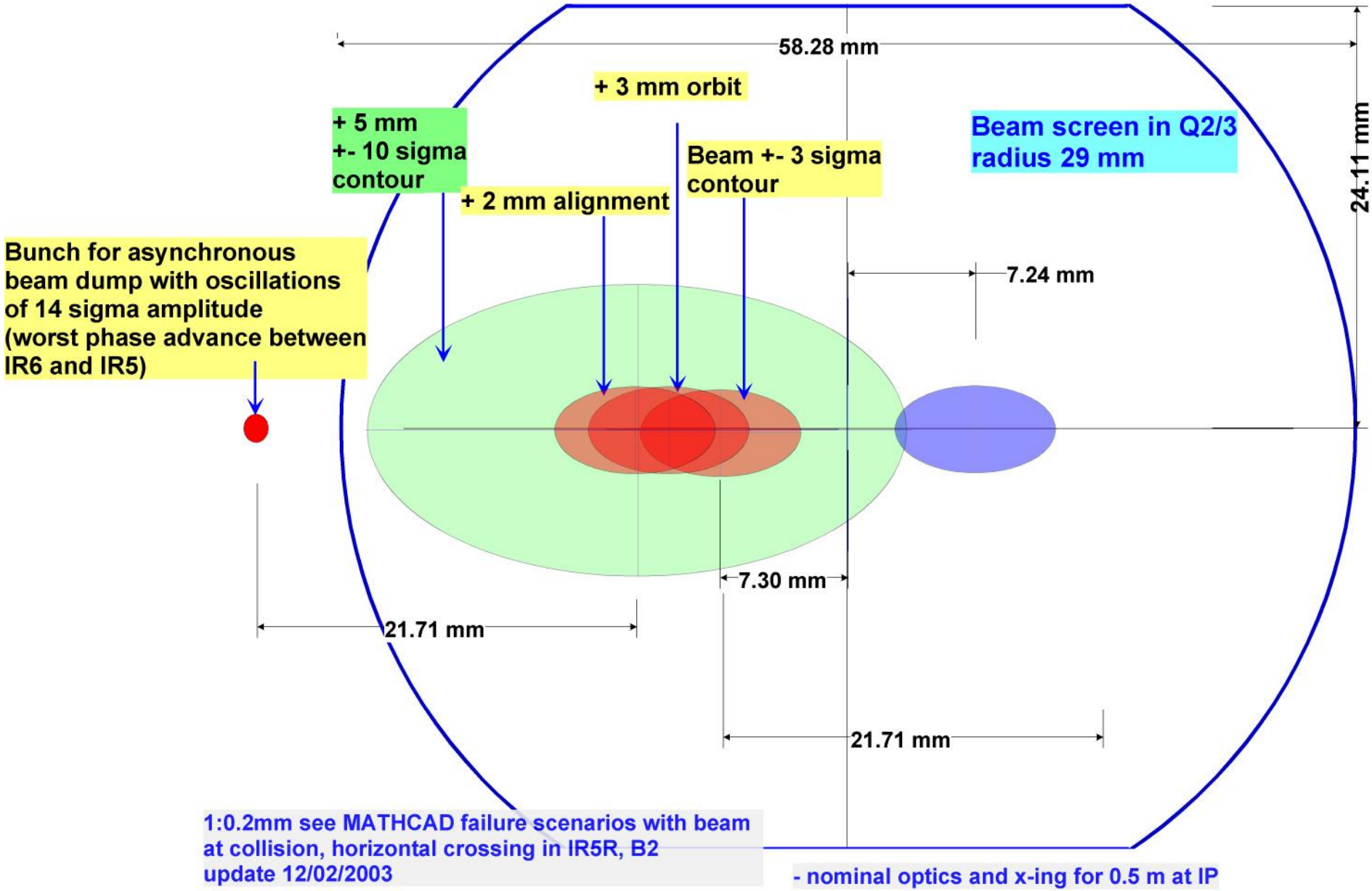
- **NO PROBLEM - Enough aperture in triplet**

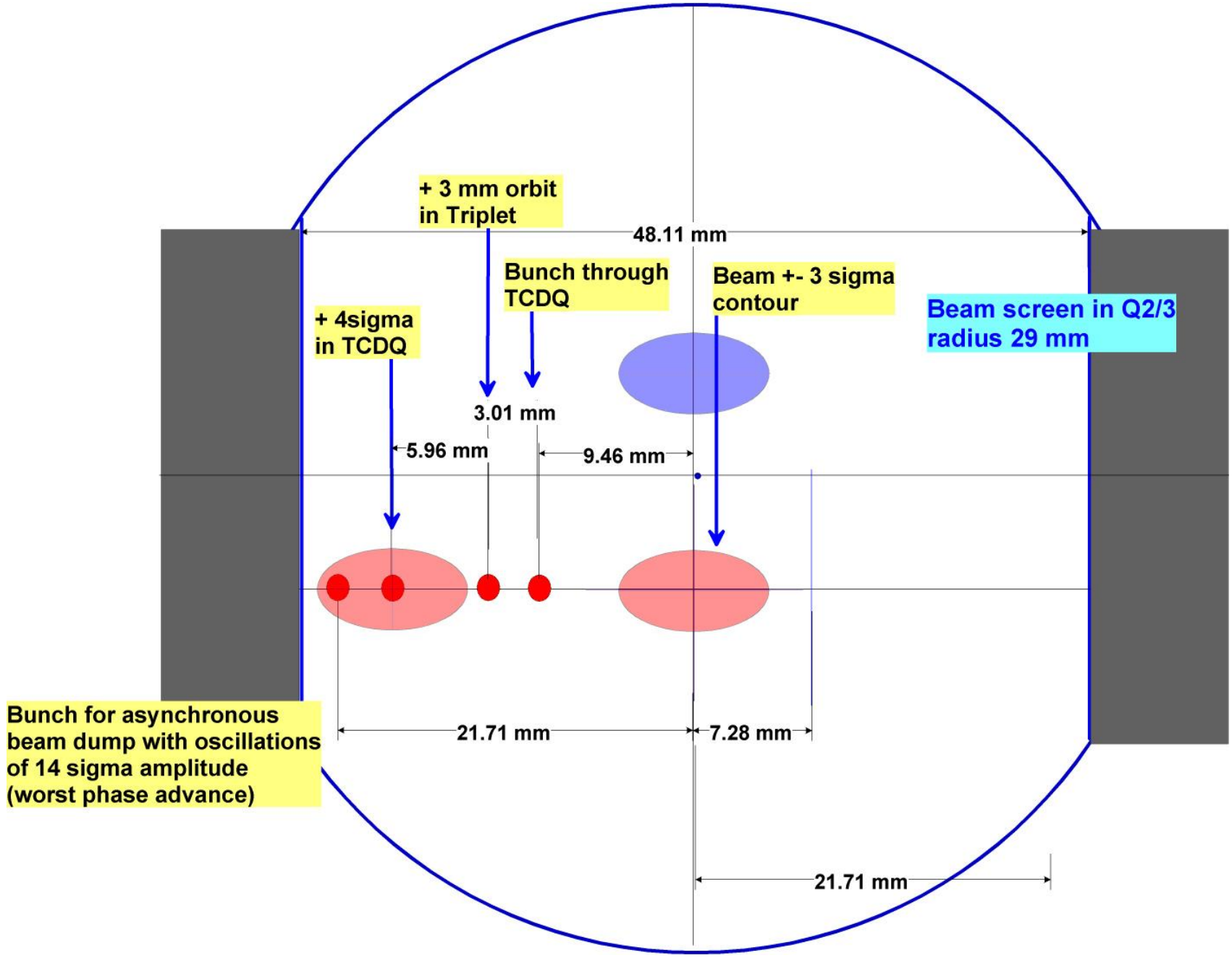

beam envelope for bunch escaping through TCDQ
assumptions: orbit at TCDQ of 2 mm, 90 degrees advance between kicker and triplet, no beta-beating, no orbit error in triplet
0.040000
0.032000
0.024000
0.016000
0.008000
0.000000
-0.008000
-0.016000
-0.024000
-0.032000
-0.040000
190
170
150
130
110
90
70
50
30
10
-10
13100.00
13150.00
13200.00
13250.00
13300.00
13350.00
13400.00
13450.00
13500.00
13550.00
13600.00
kick 0.012mrad
-6 sigma envelope
+6 sigma envelope
MBXW
phase x

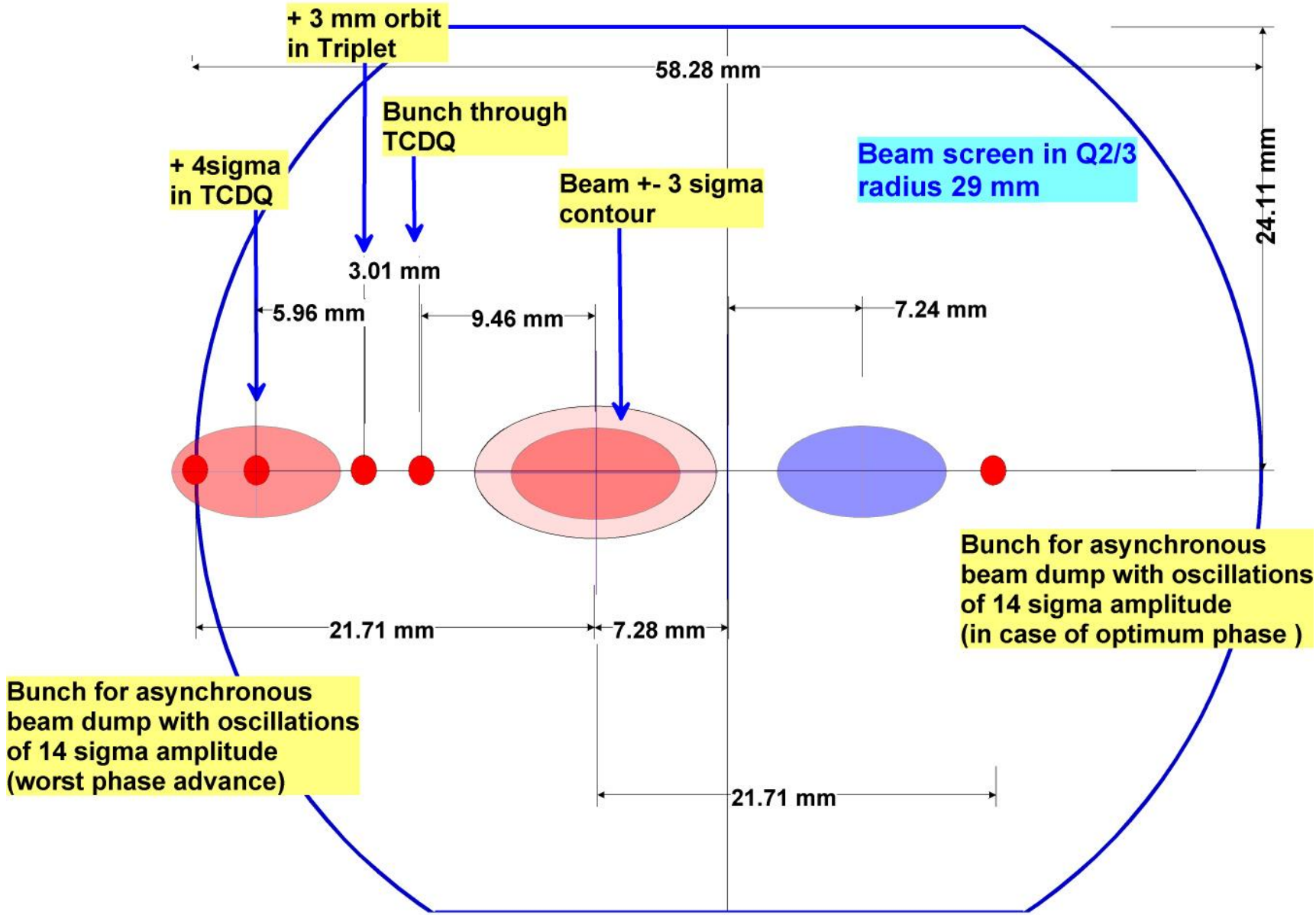
Trajectory of partially deflected beam (for 7 TeV) with errors

- orbit errors in IR6 - TCDQ not exactly at 10 sigma
- phase advance between kicker and triplet not nominal optics 6.4, but 90 / 270 degrees
- non-perfect orbit in triplet (at beta = 5000 m)
- beta beating, both in triplet and in IR6
- already 10-20 % difference in beta function in IR6 for B1 and B2
- alignment tolerance in IR5

- **aperture in triplet limited - risk to damage triplet**


58.28 mm
24.11 mm
+ 3 mm orbit
+ 5 mm
+- 10 sigma
contour
Beam +- 3 sigma
contour
Beam screen in Q2/3
radius 29 mm
+ 2 mm alignment
Bunch for asynchronous
beam dump with oscillations
of 14 sigma amplitude
(worst phase advance between
IR6 and IR5)
7.24 mm
7.30 mm
21.71 mm
21.71 mm
1:0.2mm see MATHCAD failure scenarios with beam
at collision, horizontal crossing in IR5R, B2
update 12/02/2003
- nominal optics and x-ing for 0.5 m at IP


+ 3 mm orbit
in Triplet
48.11 mm
Bunch through
TCDQ
Beam +- 3 sigma
contour
+ 4sigma
in TCDQ
Beam screen in Q2/3
radius 29 mm
3.01 mm
5.96 mm
9.46 mm
Bunch for asynchronous
beam dump with oscillations
of 14 sigma amplitude
(worst phase advance)
21.71 mm
7.28 mm
21.71 mm



1:0.2mm see MATHCAD failure scenarios with beam at collision, horizontal crossing in IR5, EXCEL update 6/02/2003

Conclusions - for discussion

- An absorber in front of the triplets in the **non-crossing plane** can be installed without any loss of aperture - such mask **could be fixed**
  - such an absorber in the h-plane for CMS would require change from h-crossing to v-crossing
- An absorber in the **crossing plane** would possibly **slightly reduce the** aperture
  - it would be preferable to have a movable device
- Position of such absorber / collimator
  - between D1 and the triplet … is there space?
  - behind D1 towards the arc - should be still ok since very little phase advance between triplet and D1
- With such absorbers **the operational flexibility** would **increase in a significant way**
  - larger orbit excursions in IR5, IR1 and IR6 (TCDQ) are acceptable without dumping the beam - crossing angle can be optimised
  - relaxing parameters for the cleaning insertion (see Ralph - last MPWG)
  - we do not rely only on the exact positions of the collimators in IR3 and IR7 for protecting the triplets