Agenda MPWG 13 December 2002

- **Comments to minutes**
- **General Information**

- **Update on the beam dump aperture (B. Goddard, M. Gyr, R.Schmidt)**
- **Update on D1 failures (M.Zerlauth, F.Bordry)**
- **AOB**
  - **LCC discussion on access and beam dump --->** to be discussed in MPWG
  - **Chamonix workshop**

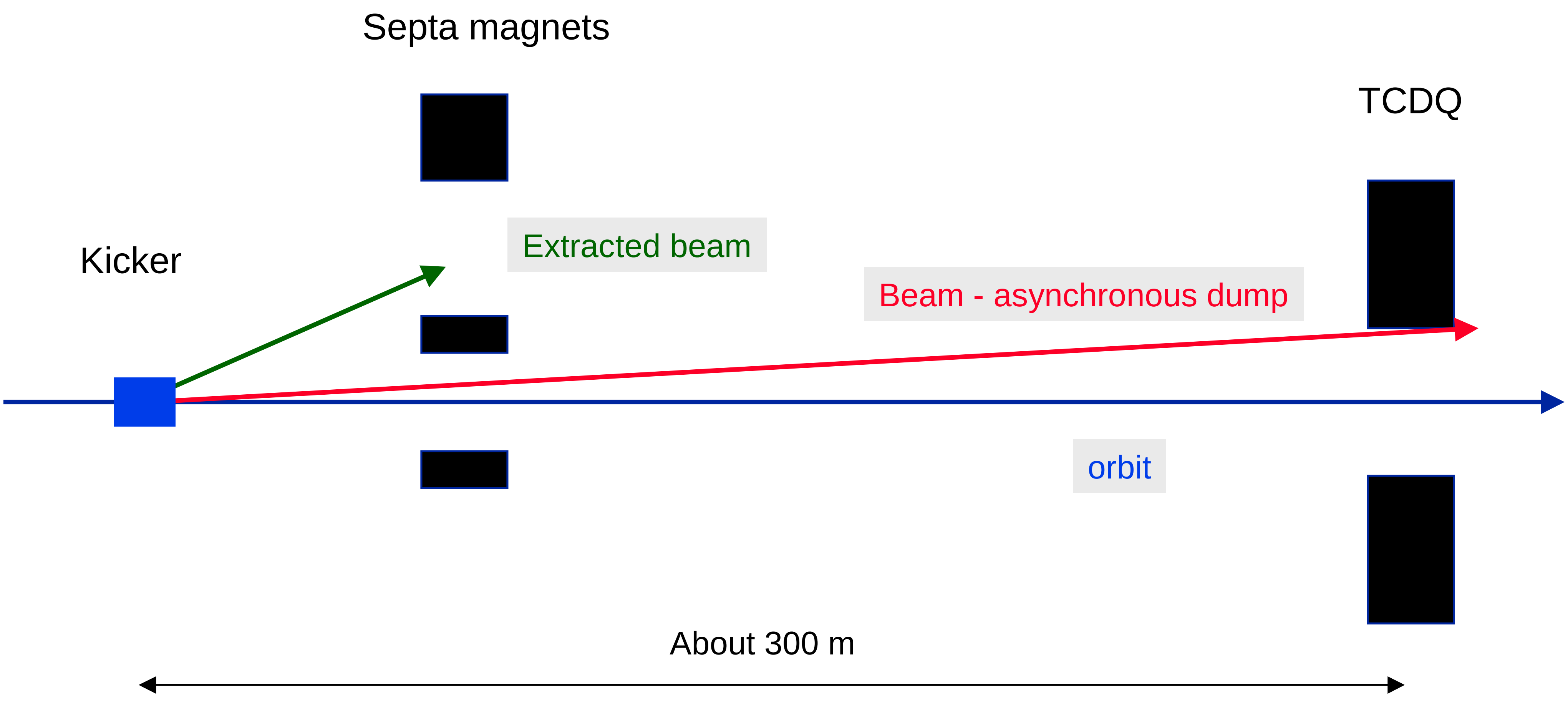
- **Next meeting(s)**
  - **Meeting on 17/1/2003**

Asynchronous beam dump firing

What happens with the particles in case of spontaneous kicker firing…?

- Injection - perfect closed orbit in IR6
- Injection - with closed orbit errors
- 7 TeV - with TCDQ at injection position
- 7 TeV - with TCDQ at 10 σ with / without closed orbit errors

Schematic drawing of extraction



Asynchronous beam dump

Injection, no closed orbit errors in IR 6

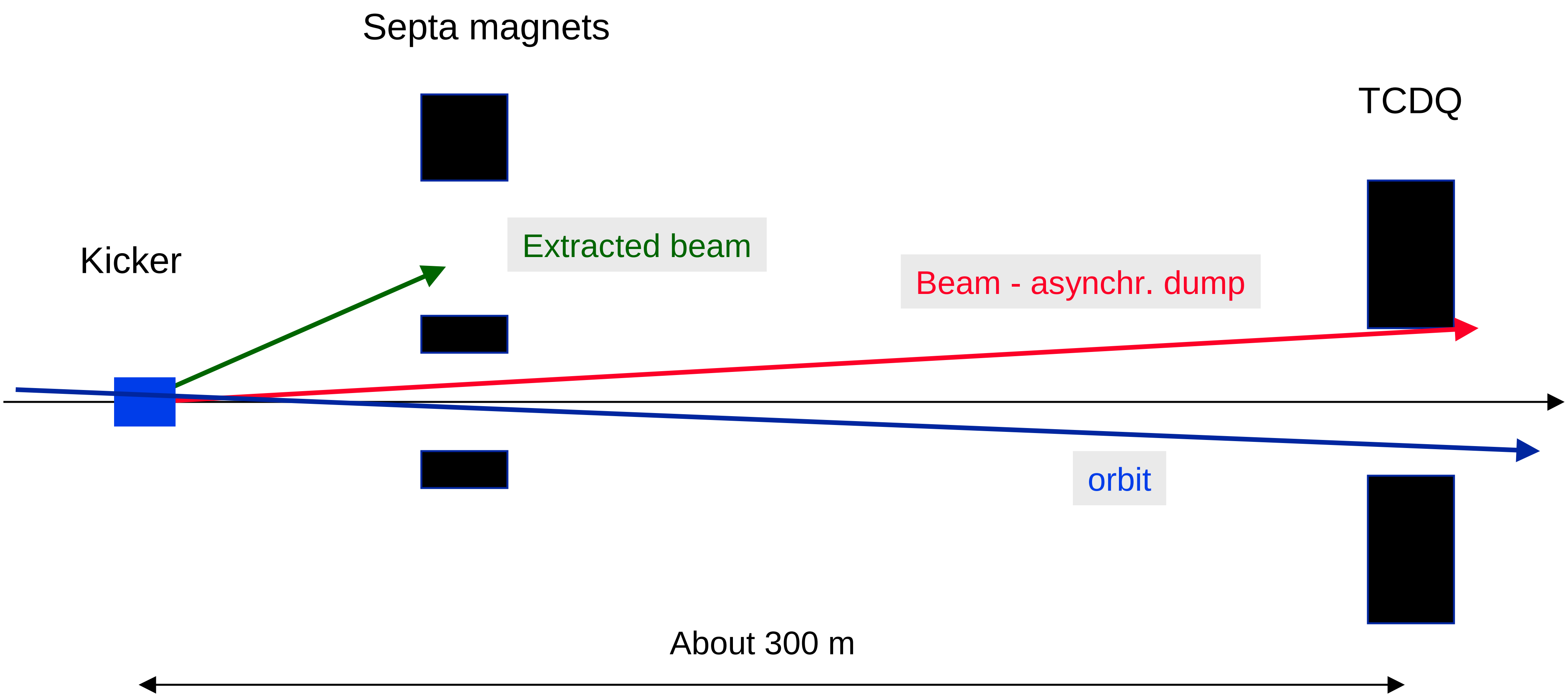
- Nominal position of TCDQ collimator is 10 $\sigma = \pm$ 20.65 mm
- Assume an asynchronous beam dump - particles can be deflected by an angle between 0 mrad and the nominal kick
- A particle that receives a kick of 0.0447 mrad just makes it through the collimator
- The particle oscillates around the closed orbit with a maximum betatron amplitude of 11.8 mm
- ….very little that one can do about it

Asynchronous beam dump - bunches that make a turn

Injection, no closed orbit errors in IR 6

- Assume that the bunch makes it through the ring, and is not caught by the collimators
- Assume a betatron tune of 64.31
- The bunch comes back to the kicker, and receives a second kick
- The position of the bunch at the kicker with respect to the nominal extraction position is 15.8 mm, and its angle is -0.0048 mrad (with the previous parameters)
- The bunch will be extracted to a position of 106 mm (far outside the aperture of the septum magnet)
- Assume that the collimators are in a position of, say, 6-7 σ
- Bunches with large amplitudes will be captures, but bunches with a smaller amplitude will get through an arrive at the septa magnets with a position between nominal, and about 80 mm (to be calculated in detail)

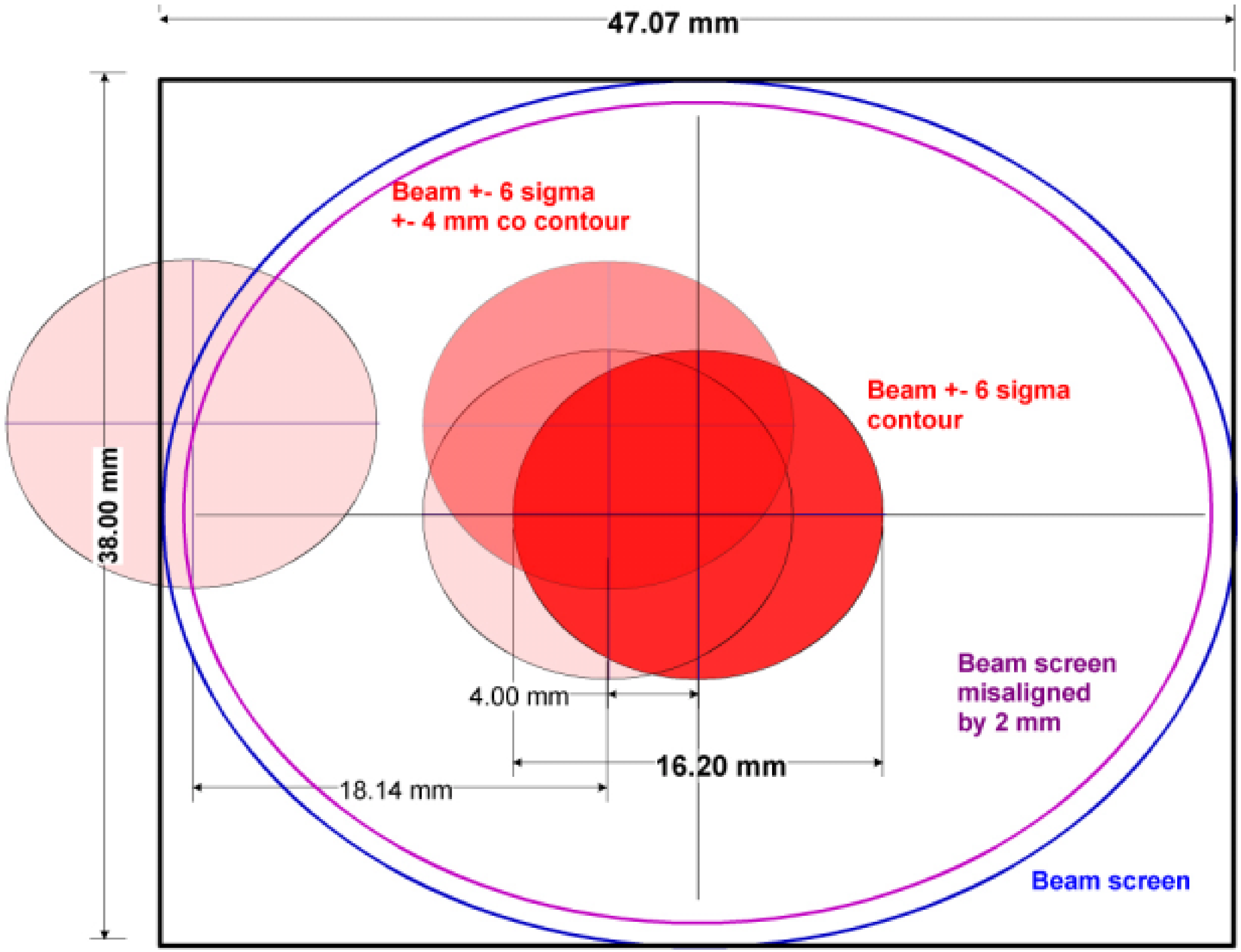
Schematic drawing of extraction - closed orbit



Asynchronous beam dump with orbit errors

Injection, closed orbit errors in IR 6

- Nominal position of TCDQ collimator is 10 $\sigma = \pm$ 20.65 mm
- Assume that the closed orbit at the TCDQ at -8.3 mm (the particles with an amplitude of 6 σ touch the collimator)
- A center of a bunch that is deflected 0.0685 mrad just makes it through the collimator
- The bunch oscillates around the closed orbit with a maximum betatron amplitude of 18.2 mm



1:0.2mm see MATHCAD failure scenarios with beam at injection, with co error in TCDQ of - 8.3 mm

Asynchronous beam dump at top energy

Without closed orbit errors in IR 6

- Assume position of TCDQ collimator is left at 10 $\sigma_{injection}$ = $\pm$ 20.65 mm
- Assume an asynchronous beam dump
- A center of a bunch that receives a kick of 0.0447 mrad just makes it through the collimator
- The bunch oscillates around the closed orbit with a maximum betatron amplitude of 11.8 mm
- If the collimators in IR 3 are left at injection settings, bunches with large amplitude oscillations will come back, and then kicked into the septa magnets - without protection this could damage equipment
- If the collimators in IR3 are close to the beam…. might still be a problem for a bunch that just makes it through (to be calculated)

Asynchronous beam dump at top energy

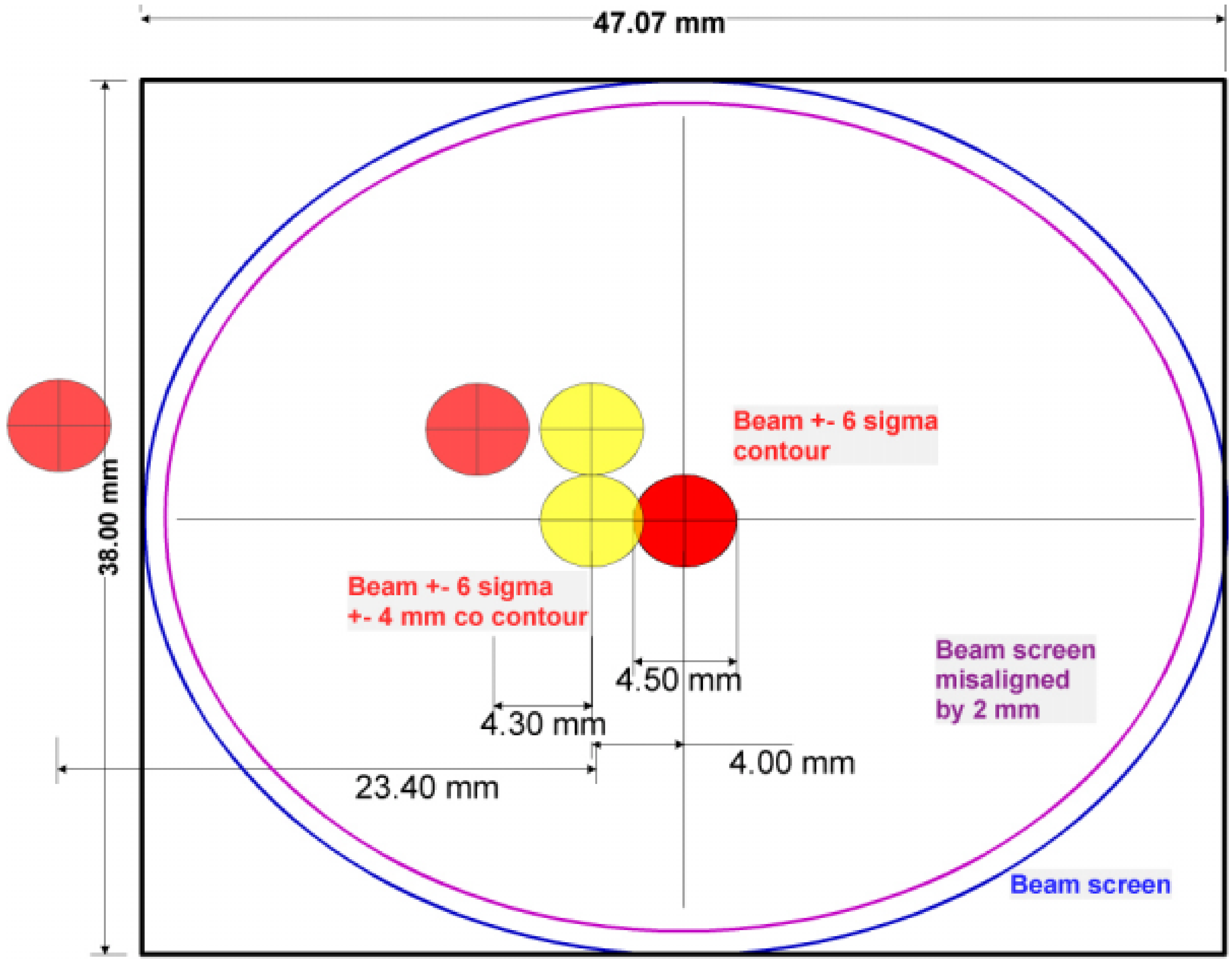
With closed orbit errors in IR 6

- Assume position of TCDQ collimator is left at 10 $\sigma_{injection} = \pm$ 20.65 mm
- Assume an asynchronous beam dump
- A center of a bunch that receives a kick of 0.0877 mrad just makes it through the collimator
- The bunch oscillates around the closed orbit with a maximum betatron amplitude of 23 mm

…cannot be tolerated

- Assume the position of TCDQ collimator is left at 10 $\sigma_{injection} = \pm$ 5.2 mm
- The bunch oscillates around the closed orbit with a maximum betatron amplitude of 4.4 mm

…can be tolerated



1:0.2mm see MATHCAD failure scenarios with beam, 7 TeV, TCDQ at 10 sigma

Conclusions - for discussion

- The TCDS protecting the outside of the MSD is probably required
- The TCDQ should move towards during the energy ramp
  - Therefore the collimators in IR7 must also move in
  - This will protect the machine
  - This will reduce the number of bunches that hit the collimators
  - The position of the collimators need to be established

LCC - discussion on access and beam dump
Conclusion for machine protection

- There is **no safe way to stop the beam** when the **Beam Dump Kicker would not fire**
- If ever such an accident happens, it is most likely after a quench, or another failure
- Whatever alternative to stop the beam - damage would be done

- **For today's discussion on EIS**
  - The **beam dump** should be the **first EIS**
  - The D1 magnet could be the third EIS (that makes sure that no beam can circulate - **NOT to stop the beam**)
  - For the INB authorities, a **massive absorber** could be the **second EIS**

- **For machine protection:** To prevent damage to machine equipment - **massive absorbers close to the beam might prevent more severe equipment damage** (sacrificial absorbers)

- **WORK IS ONGOING ADRESSING THE ISSUE**

Chamonix workshop

One session for protection

One session for controls issues related machine safety and reliability

Session 5: Operating with unprecedented stored beam energy

Chair R. Schmidt

Scientific Secretary J. Wenninger

How can we lose the beam? Beam loss scenarios for protection design. Failure scenarios for beam losses, magnet failures, other failures, … what is the consequence for protection, protection philosophy, the role of collimators in the protection …	R.Schmidt	20’
Apertures during Beam Abort Aperture for extracted/circulating beam, dependence on orbit, emittance, after failures	B.Goddard	20’
Collimators and Cleaning, could this limit the LHC performance? Layout, cleaning efficiency, impact on luminosity and machine protection, dependence on beam and machine parameters (optics)	R.Assmann	20’
Appropriate materials for LHC collimators Collimators designed to stand without damage a) continuous losses, b) losses of several bunches, with damage but preventing worse c) all bunches	P.Sievers L.Bruno	20’
Orbit control, what’s required for machine operation and protection? Local feedback versus Global Feedback, time constants, deterministic control, orbit changes during LHC operation	J.Wenninger	20’
Abort gap cleaning and RF system What happens for failures of the RF system? Particle build up in the abort gap, how to clean it depending on the energy? Monitoring of abort gap, use of transverse damper for cleaning	Elena Chapochnikova	20’

Session 6, Controls for safe operation of the LHC

Chair B Frammery

Scientific secretary R. Lauckner

6.1	**Do we need collimators in the transfer lines?** (failure scenarios, how many, at what phase?, H+V?, tolerances, movable or fixed?, ..)	H.Burkhardt	20’
6.2	**Safe injection into the LHC** How to avoid catastrophic beam losses at injection. Probe beam – associated procedures, monitoring, interlocks. Abort gap conservation during injection	E.Carlier	15’
6.3	**Interlock channels and their timescales** Brief review, 2 timescales, 2 systems, systems connected Use case 2005 fast power abort Use case Beam Abort	B.Puccio	15’
6.4	**Beam Instrumentation for Machine Protection** Beam monitors in the protection logics, Setting of thresholds – associated integrity, variation with energy BLMs, BPMs. Limitations due to cross talk between beams	B.Dehning	20’
6.5	**How can we guarantee quench protection and beam availability?** Availability of power-permit, reliability of the quench protection system. Protect magnets and protect beam	F.Rodriguez-Mateos	20’
6.6	**What do we see in the Control Room?** Understanding what happened and what to do Permanent monitoring: emittance, temperatures, avoiding quenches. Stopping operator errors.	R.Lauckner	20’
6.7	**Reliable Timing** How can timing failures lead to reduced efficiency or damage? During filling, after filling. Should users take precautions? Transmitting machine status – for who? Diagnosing timing faults.	M.Jonker	15’