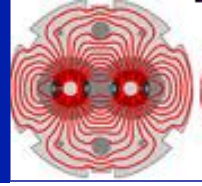


Beam impact parameters for horizontal RPs in IR5 due to a MKD kick.

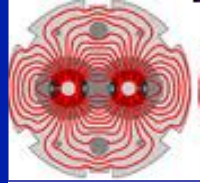
D. Wollmann,

on behalf of

V. Boccone, R. Bruce, F. Cerutti, M. Deile, A. Lechner,

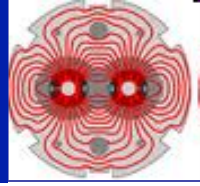
S. Redaelli, R. Schmidt, J. Wenninger, M. Zerlauth, …

Motivation



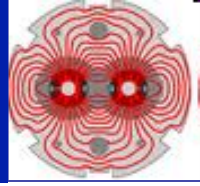
- Follow-up on special MPP on Roman Pot operation (Dec. 2011).
- Understand the **energy deposition** in nearby and downstream **magnets** due to beam impacting on Roman Pots.
- Evaluate the **damage risk** in case of such an event.
- Considered **worst case failure** scenarios:
  - **Asynchronous beam dump** during RP operation close to beam ➔ hor. RPs
  - Intercepting beam during **alignment**.
- Input for FLUKA studies:
  - Phase advance between MKD and Roman Pots
  - Impact parameter and impact angle of beam due to MKD kick
  - Local beta functions at the respective RPs ➔ beam size

Assumptions for optics calculations



- LHC version 6.503
- 4 TeV, β^*: 0.6m / 3.0m / 0.6m / 3.0m, $\varepsilon = 2\ \mu m$
- MadX single turn
- Nominal collimator settings (i.e. TCSG in IR6: 7.1 σ)
- Kick in all MKDs
- Asynchronous dump during RP operation:
  - Jaw position of horizontal Roman Pot at 4 σ (half gap opening).
  - Impact parameter 3 σ, i.e. beam offset 7 σ.
  - MKD kick strength chosen accordingly.

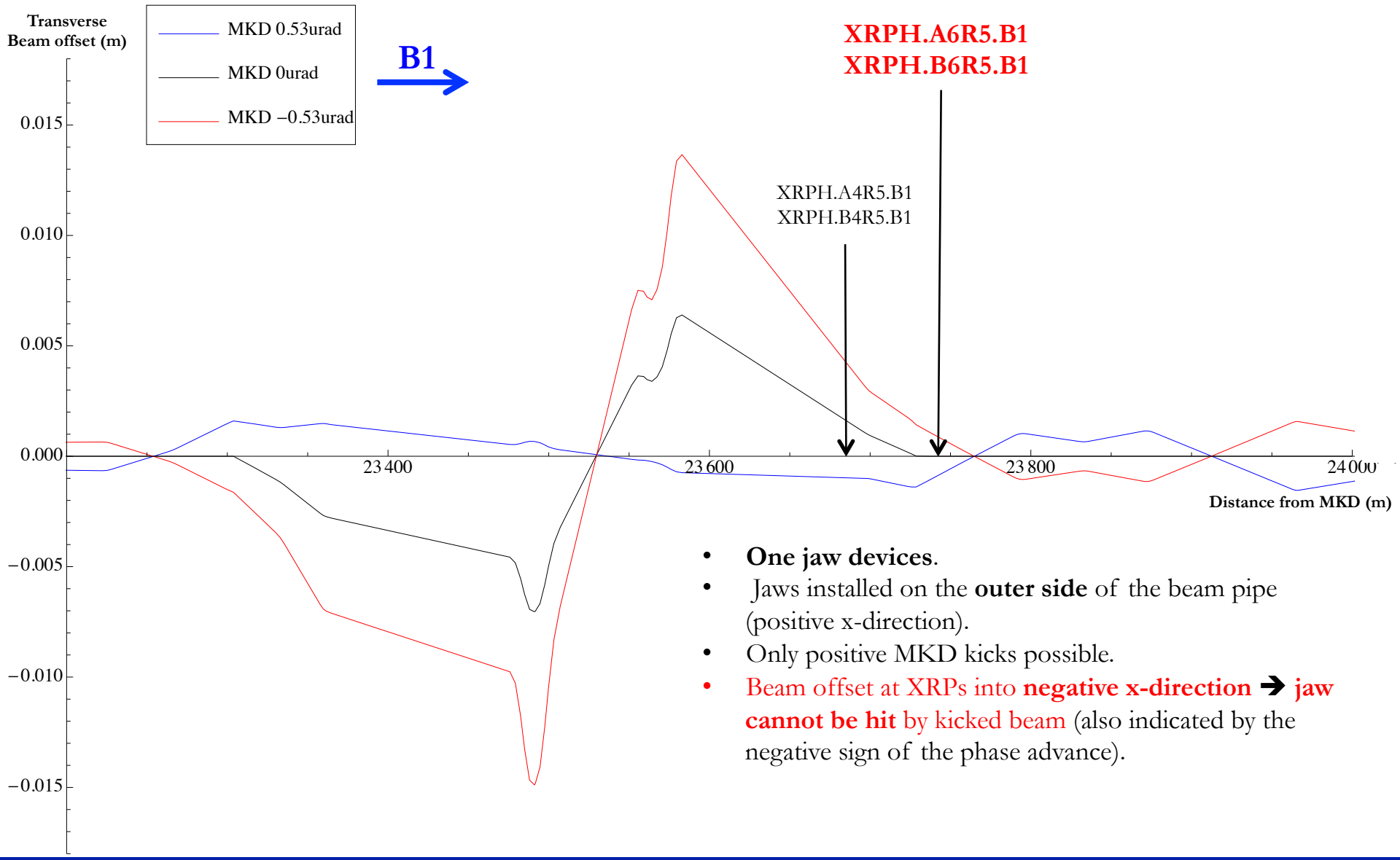
Horizontal XRP B1
(closed orbit – no MKD kick)



Name	Distance from MKD [m]	Phase advance from MKD [degree]	σ_x [mm]	σ_y [mm]	beam offset (x) [mm]	beam angle (x') [µrad]
XRPH.A4R5.B1	23678.8	-56.5	0.493	0.819	1.909	-46.84
XRPH.B4R5.B1	23679.4	-56.6	0.488	0.819	1.879	-46.84
XRPH.A6R5.B1	23744.5	-89.9	0.110	0.393	0	0
XRPH.B6R5.B1	23748.9	-77.3	0.087	0.372	0	0

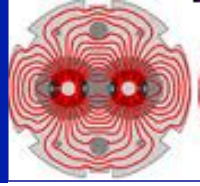
B1: Beam offset at hor XRPs in IR5

MKD kick 0.53 µrad (single pass)



- **One jaw devices**.
- Jaws installed on the **outer side** of the beam pipe (positive x-direction).
- Only positive MKD kicks possible.
- Beam offset at XRPs into **negative x-direction** ➔ **jaw cannot be hit** by kicked beam (also indicated by the negative sign of the phase advance).

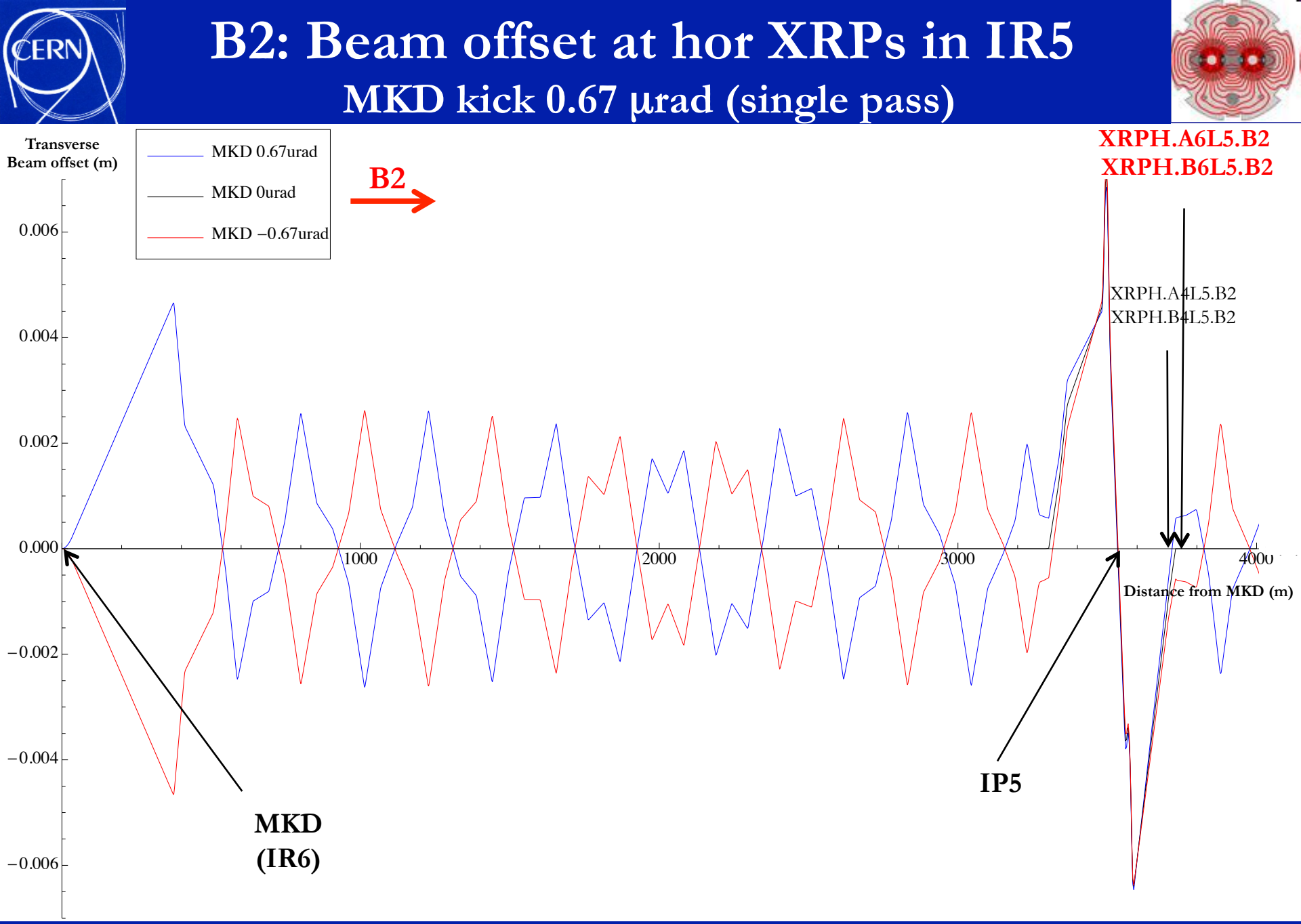
Horizontal XRP B2
(closed orbit – no MKD kick)



Name	Distance from MKD [m]	Phase advance from MKD [degree]	σ_x [mm]	σ_y [mm]	beam offset (x) [mm]	beam angle (x') [µrad]
XRPH.A4L5.B2	3684.61	5.47	0.493	0.819	-1.908	46.84
XRPH.B4L5.B2	3685.24	5.54	0.488	0.819	-1.879	46.84
XRPH.A6L5.B2	3750.29	**40.23**	0.109	0.407	0	0
XRPH.B6L5.B2	3754.77	**52.78**	0.088	0.385	0	0

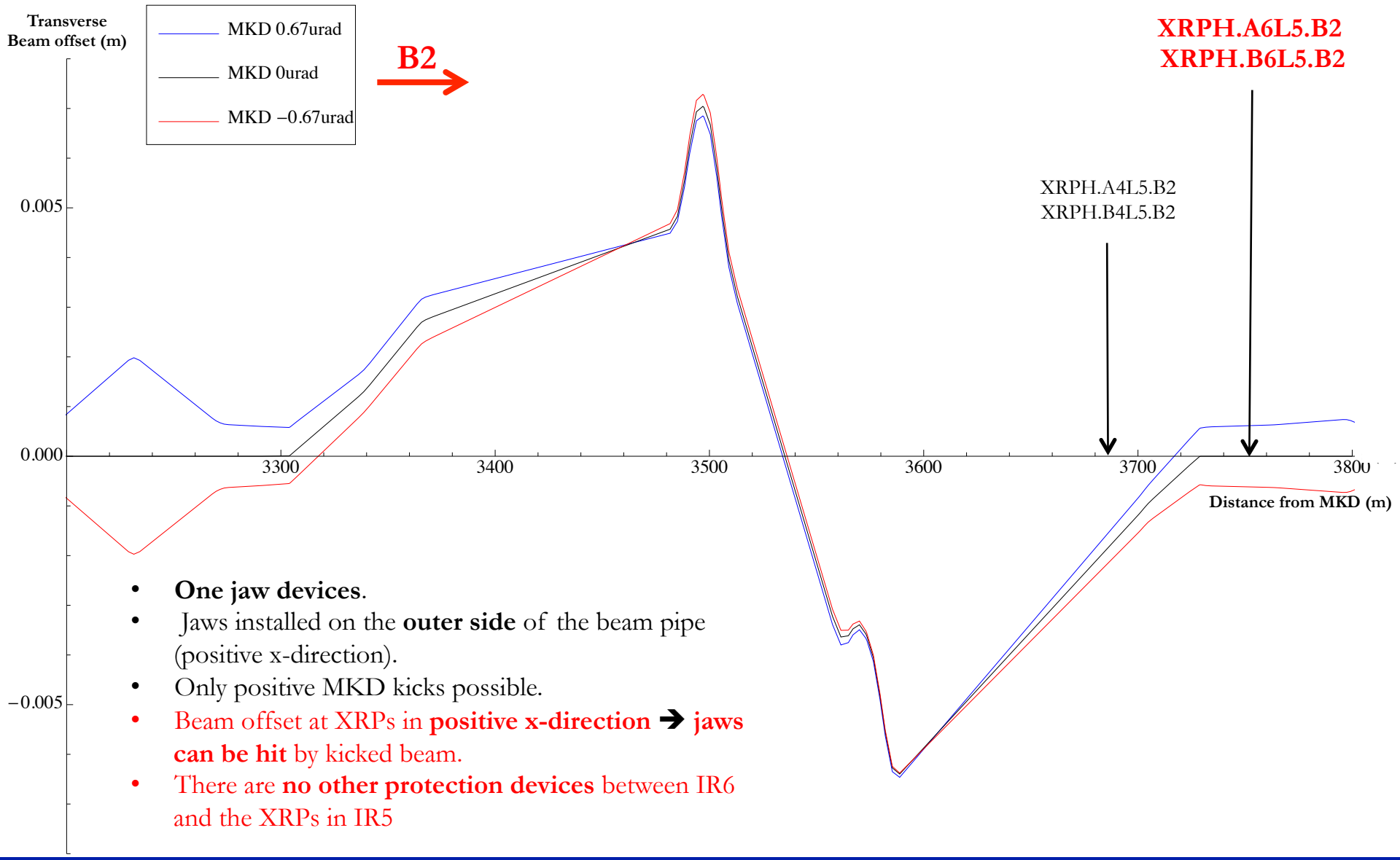
B2: Beam offset at hor XRPs in IR5

MKD kick 0.67 µrad (single pass)



B2: Beam offset at hor XRPs in IR5

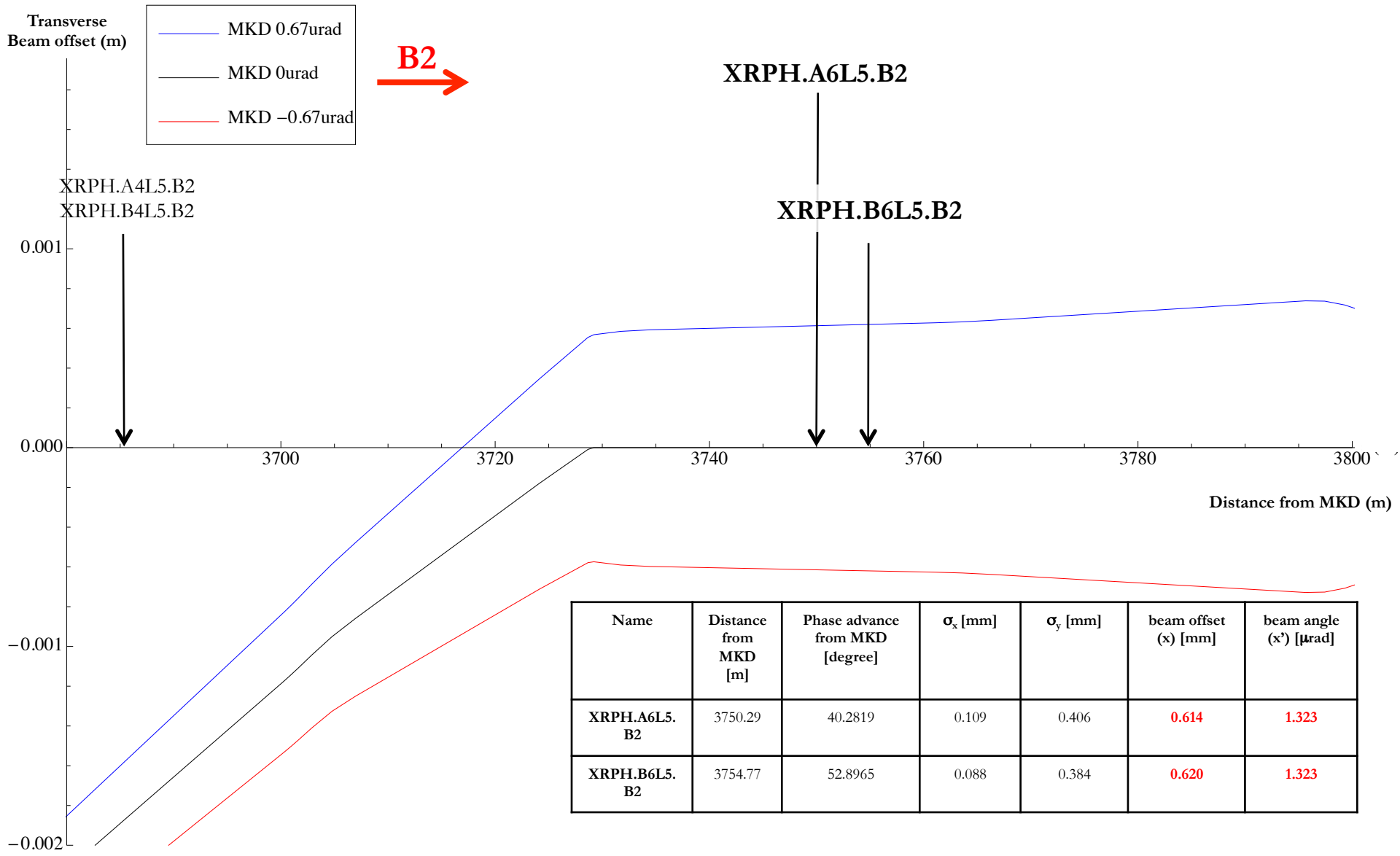
MKD kick 0.67 µrad (single pass)



- **One jaw devices**.
- Jaws installed on the **outer side** of the beam pipe (positive x-direction).
- Only positive MKD kicks possible.
- Beam offset at XRPs in **positive x-direction ➔ jaws can be hit** by kicked beam.
- There are **no other protection devices** between IR6 and the XRPs in IR5

B2: Beam offset at hor XRPs in IR5

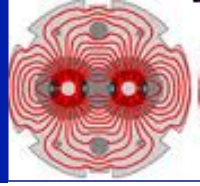
MKD kick 0.67 µrad (single pass)



Name	Distance from MKD [m]	Phase advance from MKD [degree]	σ_x [mm]	σ_y [mm]	beam offset (x) [mm]	beam angle (x') [µrad]
XRPH.A6L5.B2	3750.29	40.2819	0.109	0.406	0.614	1.323
XRPH.B6L5.B2	3754.77	52.8965	0.088	0.384	0.620	1.323

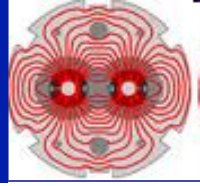
Horizontal XRP B2

MKD kick 0.67 µrad (single pass)



Name	Distance from MKD [m]	Phase advance from MKD [degree]	σ_x [mm]	σ_y [mm]	beam offset (x) [mm]	beam angle (x') [µrad]
XRPH.A6L5 .B2	3750.29	40.2819	0.109	0.406	**0.614**	**1.323**
XRPH.B6L5 .B2	3754.77	52.8965	0.088	0.384	**0.620**	**1.323**

Summary



- **Phase advance, impact parameter and angle** calculated for a beam impact on a horizontal RP in IR5 due to an asynchronous beam dump for **standard 4TeV collision optic**.
- B1: MKD kick causes negative x-offset at hor. RPs (about -90 degrees phase advance) ➔ beam **cannot hit** the single jaw.
- B2: MKD kick causes positive x-offset at hor. RPs ➔ **beam impact possible**.

➔ **A. Lechner: Results of FLUKA simulations for RP failure cases.**