Overview of single bunch asynchronous dump failures on collimators

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For the collimator team
Special thanks to R.W.Assmann, R.Bruce, A.Rossi

BE/ABP
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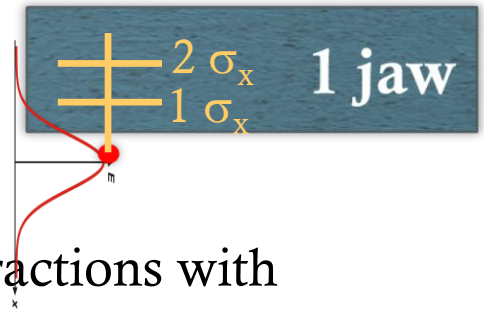
MPP meeting

Summary of what was done

- Scan over the MKD *pre-fire pulse form* to find the angle for which the TCDQAs are by-passed for possible misalignment → for each MKD failure mode (each 1 MKD studied separately)
- Once find the angles → scan all over the LHC machine to find the elements that are touched by the beam 1 or 2 kicked, playing with the location of the faulty MKD:
  - Results for impacts with beam center
  - Results for impact with 1/2/3 sigma x



- Particular attention was done for possible interactions with TCTs and/or TCLAs.

Reference case

"Configuration for 2012"

- Collision energy = 4TeV, **7TeV**
- Crossing and Spectrometers switched ON
  [4TeV→145 μrad half crossing angle in IP1 and IP5]
- Physics run with 0.6 m beta* in IP1/5 & 3.0 m beta* in IP2/IP8 (i.e. SEP OFF), **ON**
- Ref. optics "as-built" thin V6.503
- Transverse normalized emittance 3.5 μm rad **2.5**

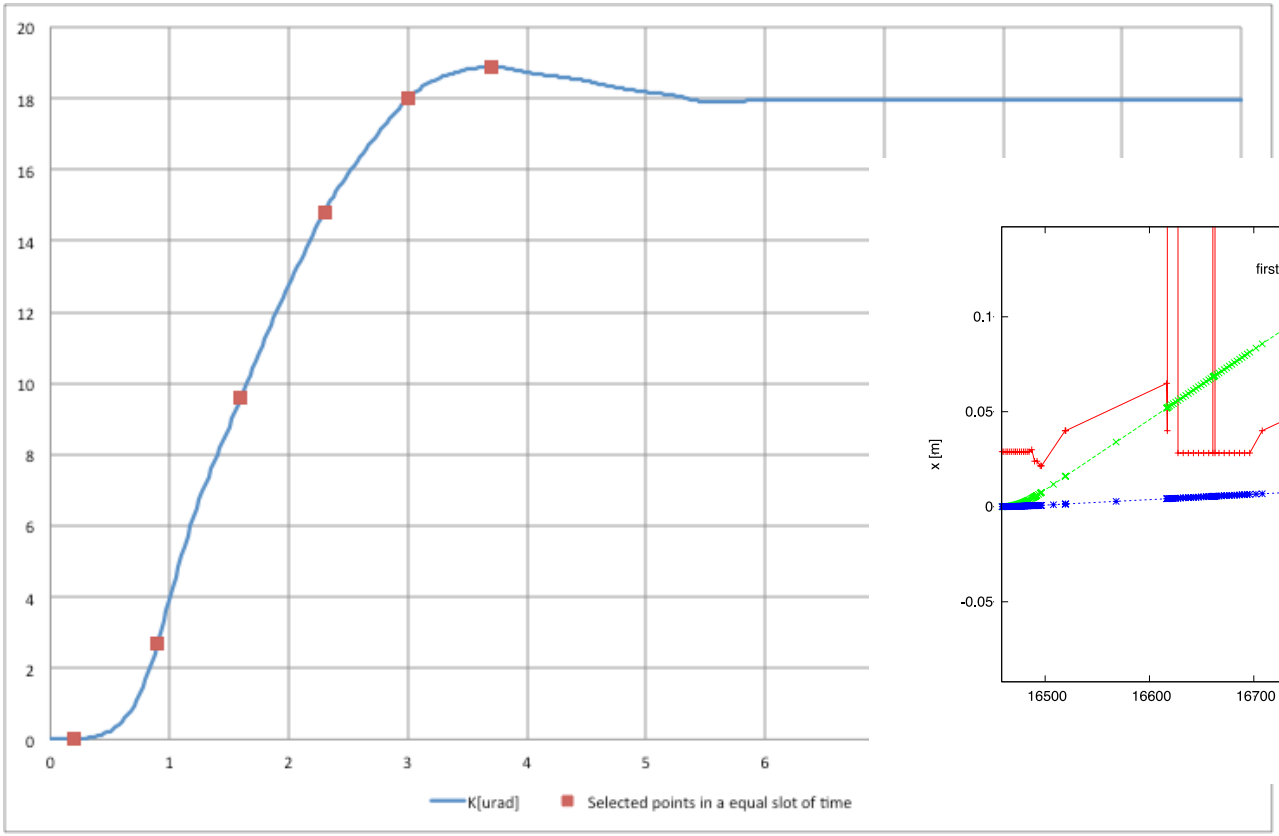
Collimator Aperture → 4 TeV

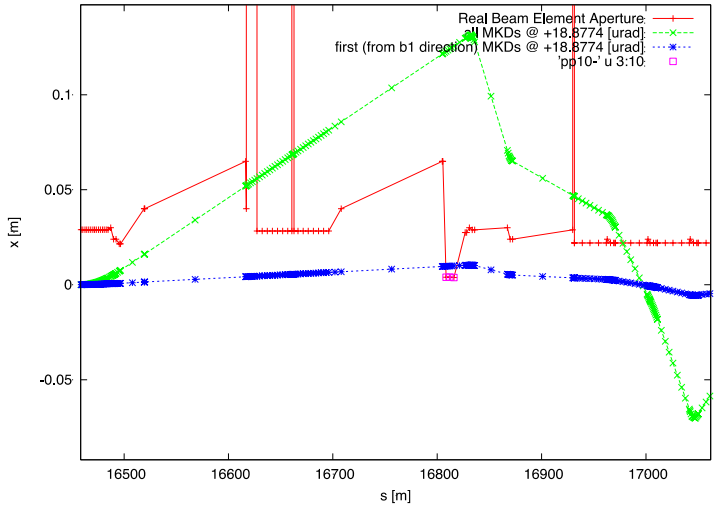
Ref: Evian 2011 – R.Bruce

Beam 1 & Beam 2

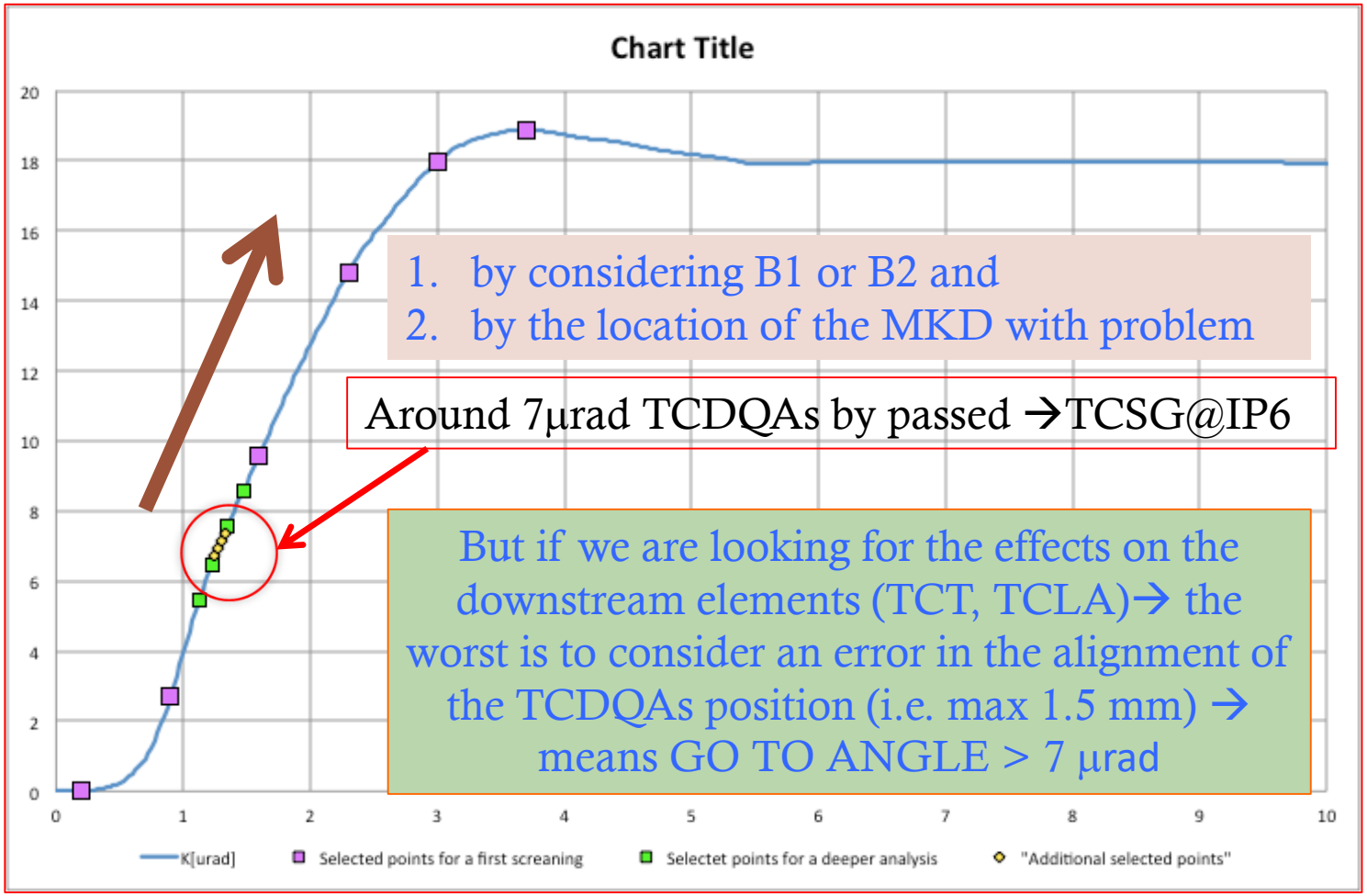
TCP.IP7	4.3
TCSG.IP7	6.3
TCLA.IP7	8.3
TCP.IP3	12
TCSG.IP3	15.6
TCLA.IP3	17.6
TCT.IP1.IP2.IP5.IP8	9.0
TCL.IP1.IP5	10
TCLI/TDI.IP2	Tot opened
TCDQ.IP6	7.6
TCSG.IP6	7.1

Scan over the MKD *pre-fire pulse form (1)*

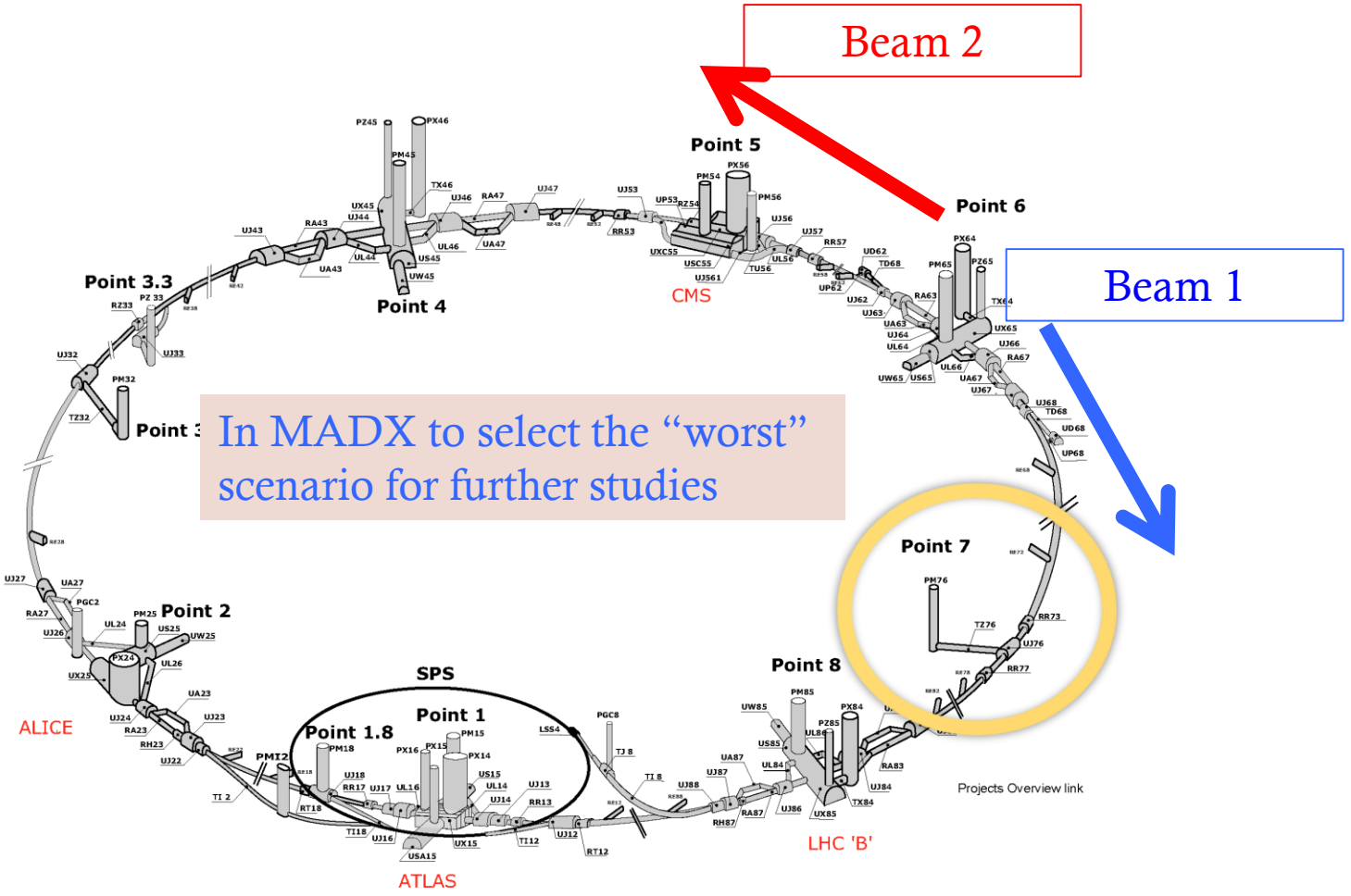




Scan over the MKD *pre-fire pulse form (2)*



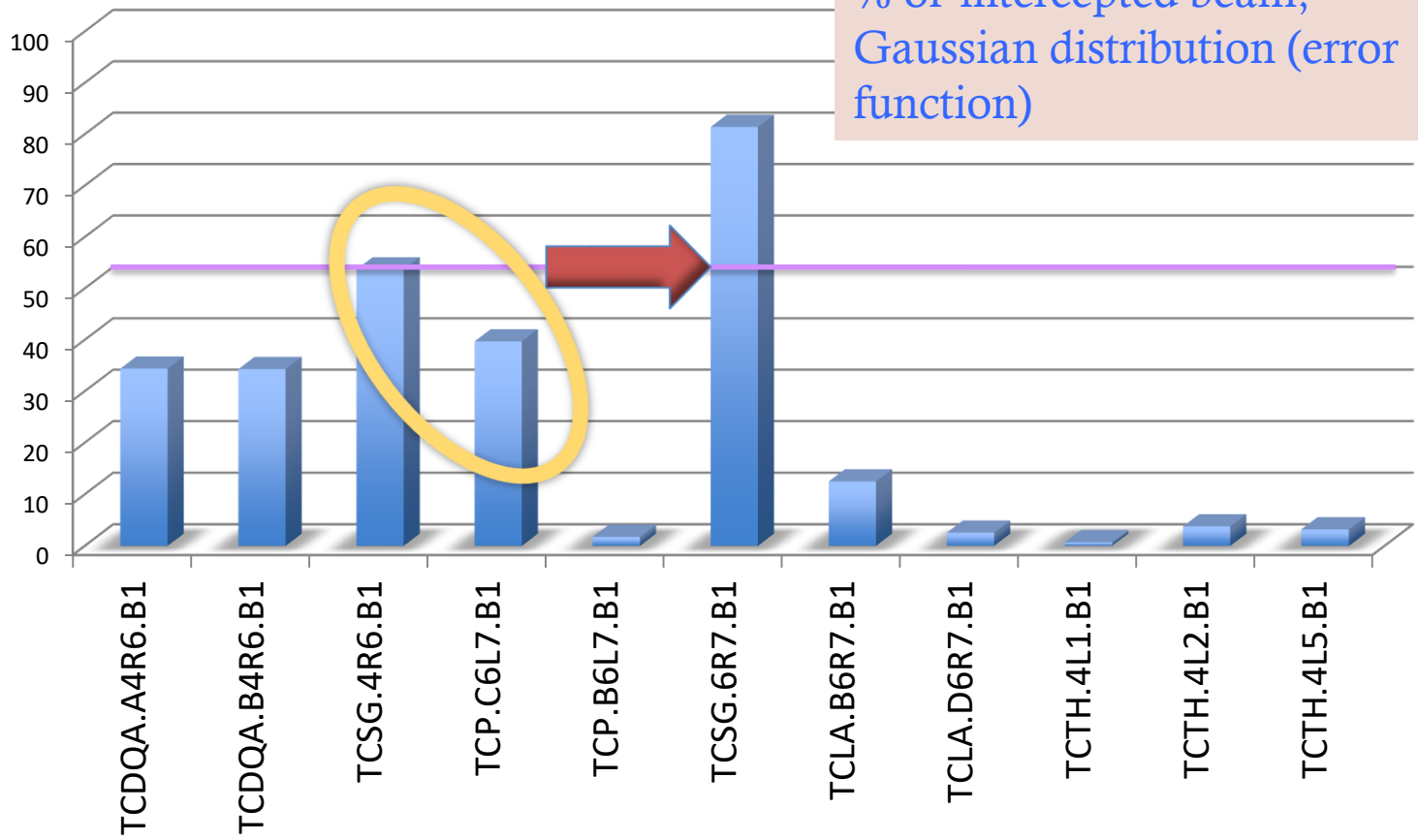
Point 7!


Beam 2
Beam 1
Point 1
Point 2
Point 3.3
Point 4
Point 5
Point 6
Point 7
Point 8
Point 1.8
SPS
CMS
ALICE
ATLAS
LHC 'B'
In MADX to select the "worst" scenario for further studies
Projects Overview link

Beam1

Failure MKD.A5L6.B1
1.95 [μs]; +12.39910241 [μrad]

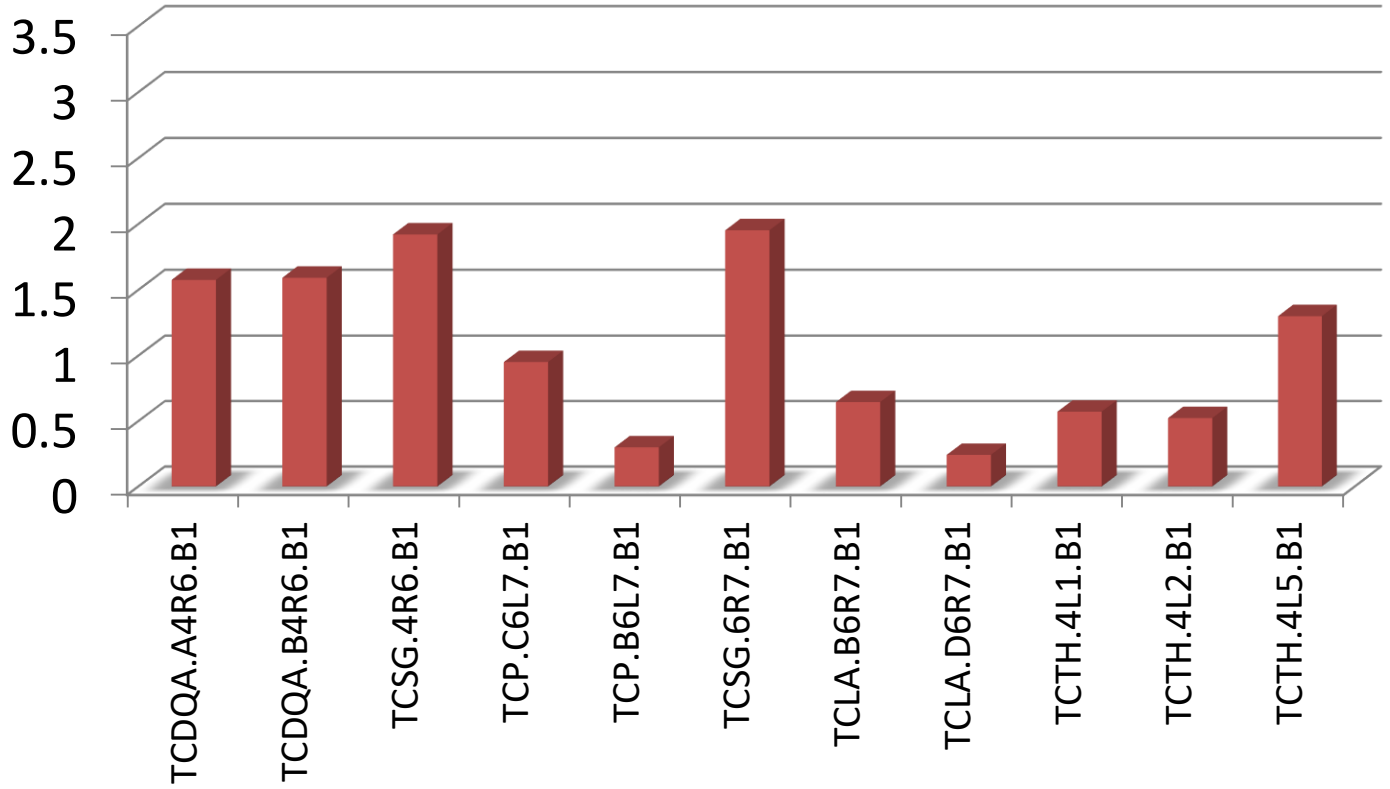
% of intercepted beam, Gaussian distribution (error function)



Beam1

Failure MKD.A5L6.B1
1.95 [μs]; +12.39910241 [μrad]

mm [abs] inside the jaw



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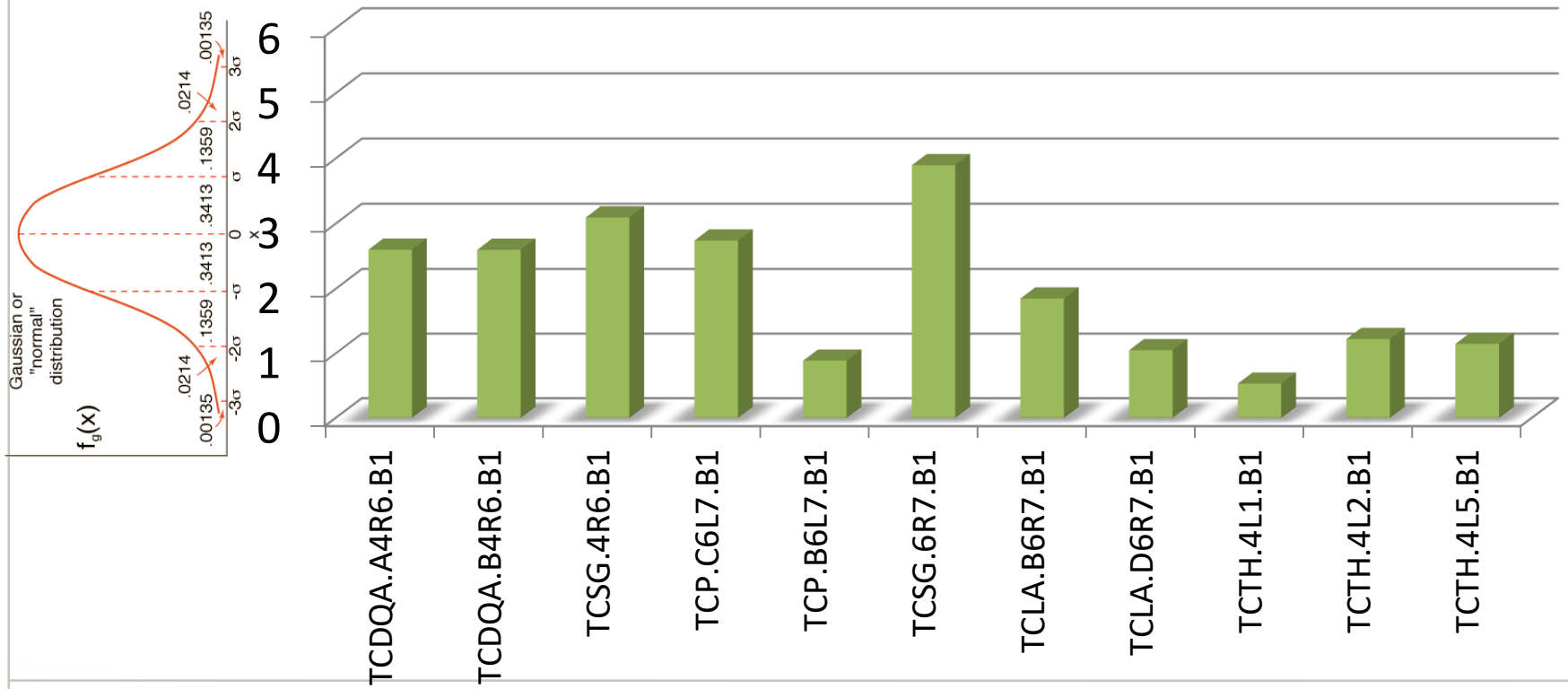
Failure MKD.A5L6.B1
1.95 [μs]; +12.39910241 [μrad]

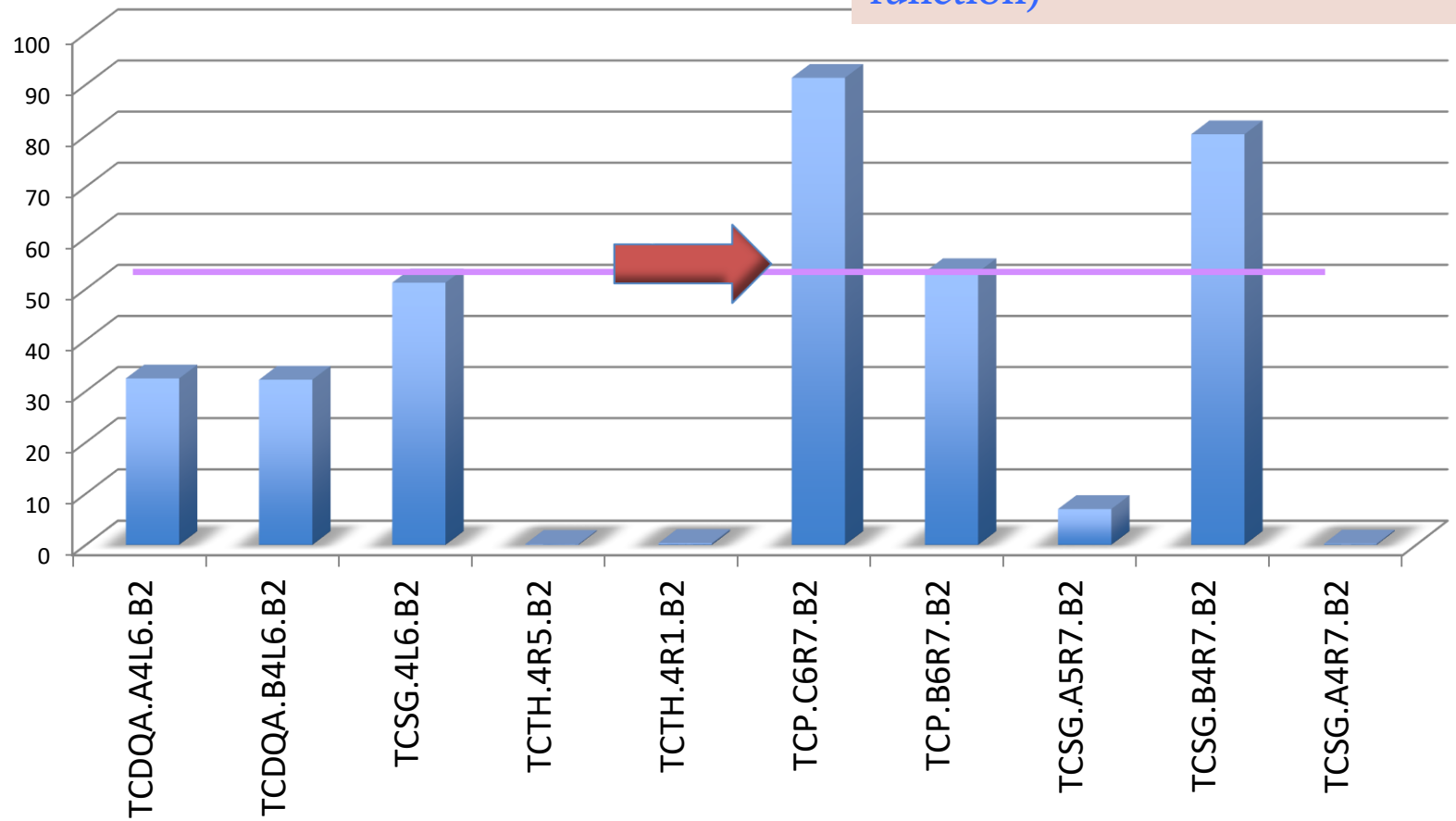
Sigma (x) inside one jaw



Beam2

Same failure situation for the different MKD locations

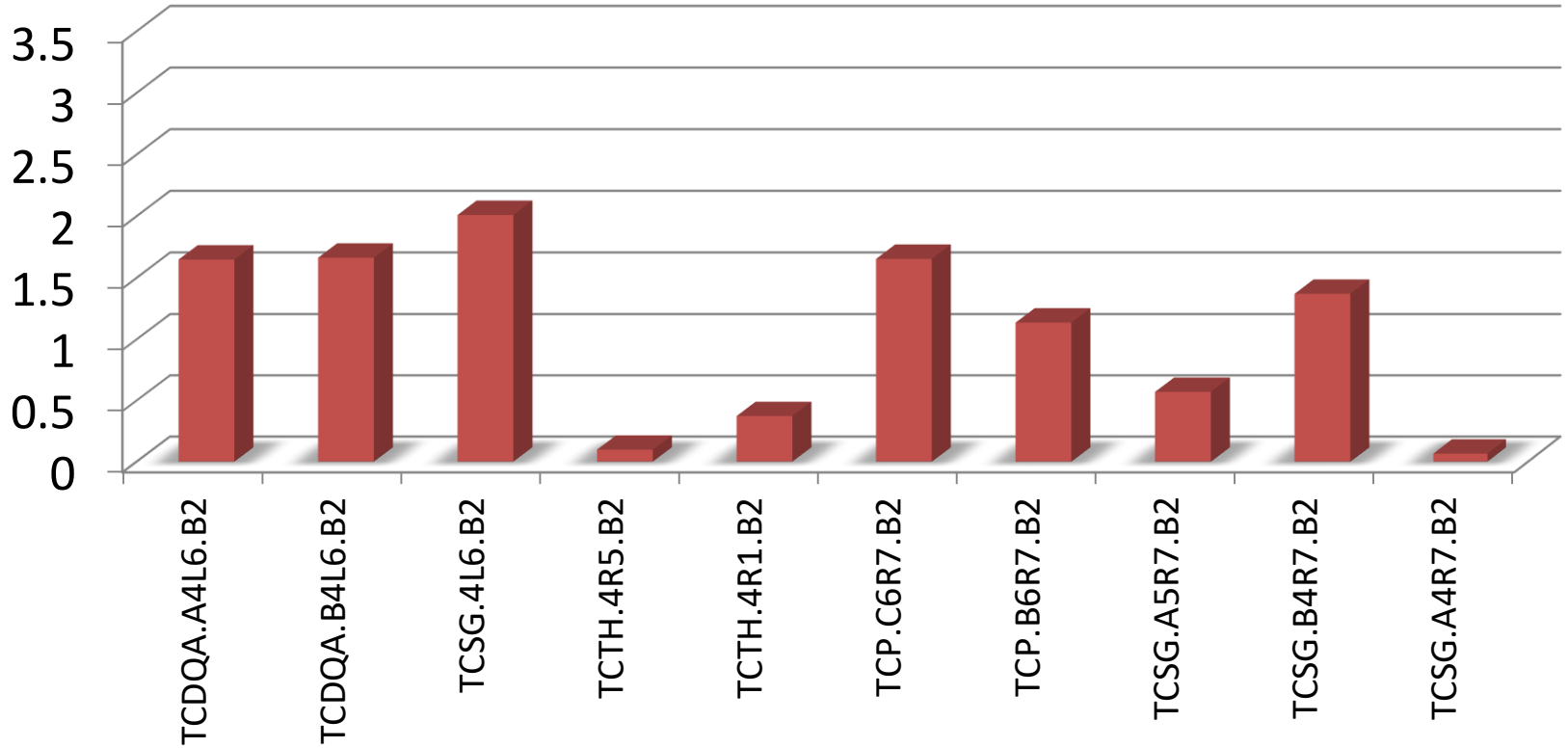
% of intercepted beam, Gaussian distribution (error function)



Beam2

Same failure situation for the different MKD locations

mm [abs] inside the jaw



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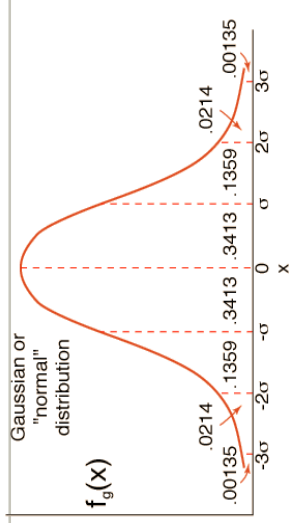
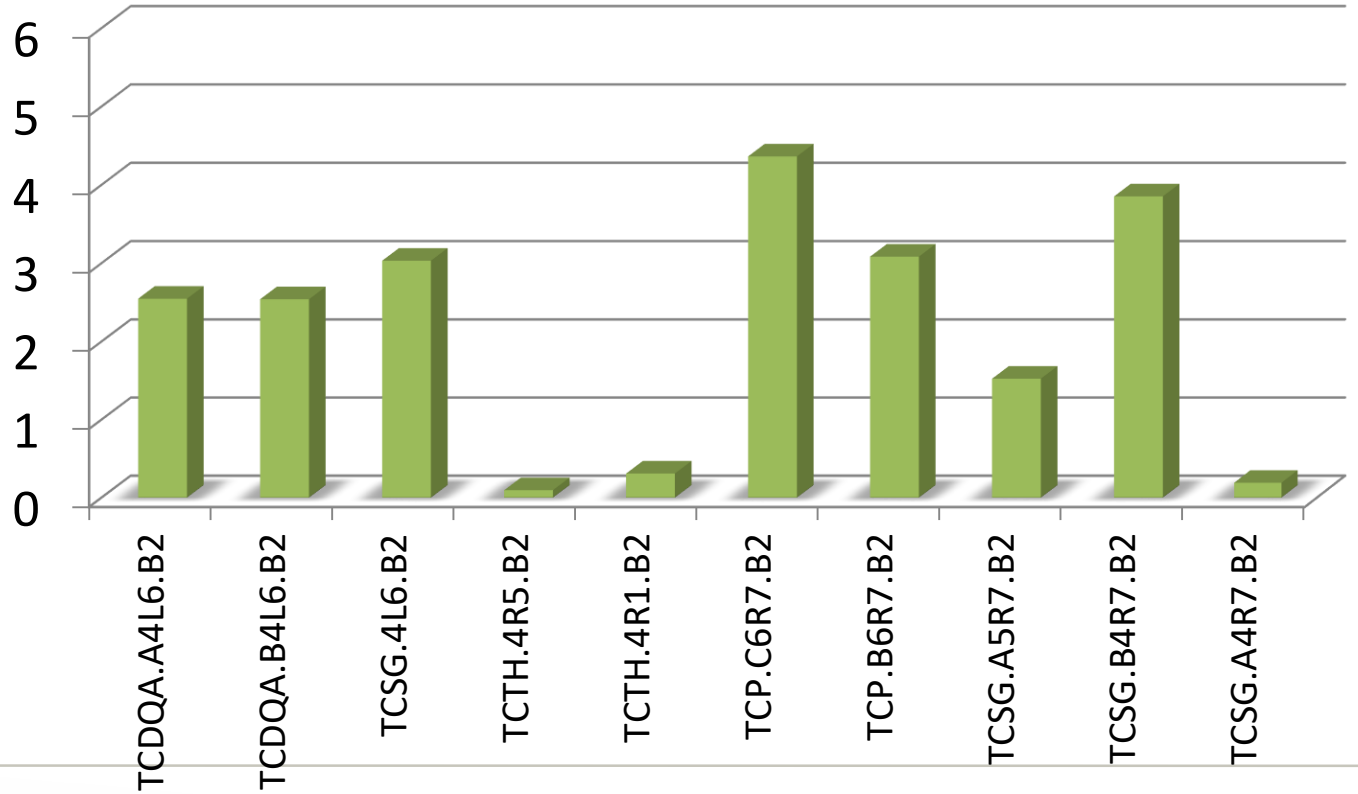
Same failure situation for the different MKD locations

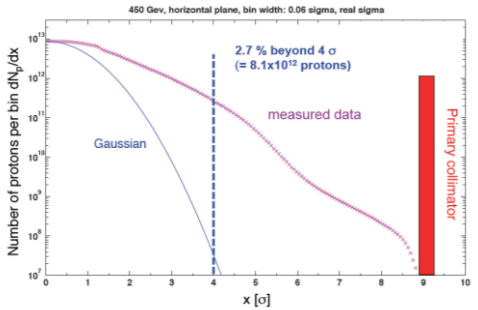
Sigma (x) inside one jaw





Conclusion → Next steps

- First selection of cases for B1 and B2 using this preliminary studies with tight collimation settings.
- Following SixTrack simulations using realistic beam distribution.



Courtesy F. BURKART

- Consider magnet errors could change the hierarchies of the impacted collimators.
- Changing the aperture of collimators → change the pattern of the loads on downstream collimators/beam elements (needed FLUKA simulations).

Additional slides

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Collimator Aperture → 7 TeV

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TCLA.IP7	10 → 8.3
TCP.IP3	15 → 12
TCSG.IP3	18 → 15.6
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TCT.IP1.IP2.IP5.IP8	8.3 → 9.0
TCL.IP1.IP5	10
TCLI/TDI.IP2	Tot opened
TCDQ.IP6	8 → 7.6
TCSG.IP6	7.5 → 7.1

Optics IP6

Beam 1 & Beam 2