Extraction line orbit correction / Feedback

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7th ATF2 Project Meeting
15 December 2008

Outline

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Description of the task

It is needed to :

- Simulate ATF2 with agreed errors (e.g. list by G. White).
- Analyze the effects on the stability and the size of the beam.
- Development of several algorithms (from various contributors).
- Compare the results of all.
- Implementation in the Flight Simulator.
- Explicit reconstruction and control of the orbit.
- Make GUI and User's guide.
- Study the FB implementation, interactions with others.

People involved

Current contributors :

- Y. Renier - LAL (task leader)
- J.R. Lopez - Oxford University
- G. White - SLAC
- A. Scarfe - Manchester & Cocroft Institute
- K. Kubo - KEK

If someone else is interested, please contact me.

Agreed errors (thanks to Glen)

Relevant Error Parameter for EXT section

Error Type	Level
x/y/z Post-Survey	200 um
Roll Post-Survey	300 urad
BPM - Magnet field center alignment (initial install) (x, y)	30 um
BPM - Magnet alignment (post-BBA, if BBA not simulated) (x, y)	10 um
Relative Magnetic field strength (dB/B) (systematic)	1e-4
Relative Magnetic field strength (dB/B) (random)	1e-4
C/S - band BPM nominal resolution (x, y)	100 nm
Stripline BPM nominal resolution (x, y)	10 um
IP BPM nominal resolution (x, y)	2 nm
EXT magnet power-supply resolution	11-bit
FFS magnet power-supply resolution	20-bit
Corrector magnet pulse-pulse relative field jitter	1e-4

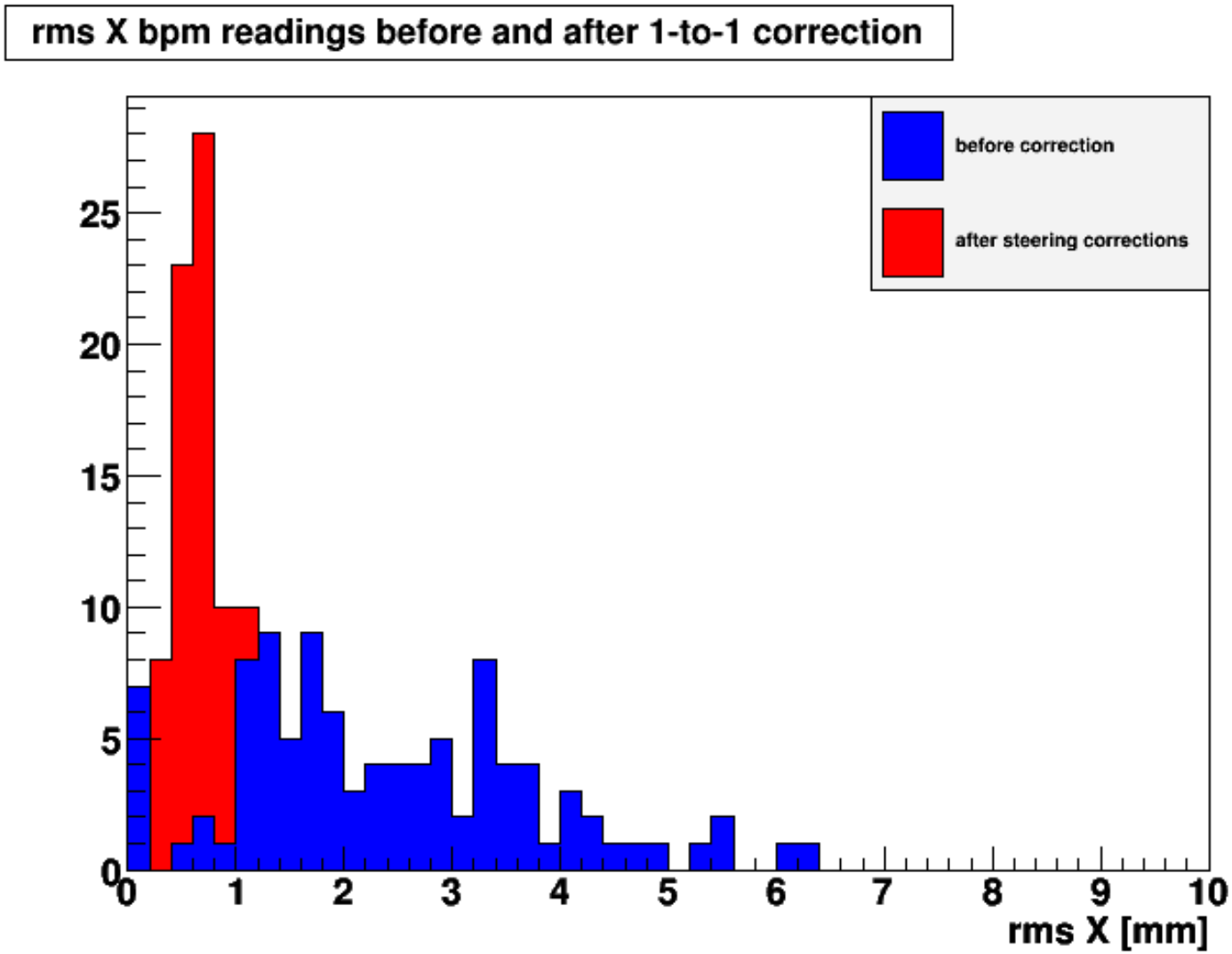
Status of the work

General status

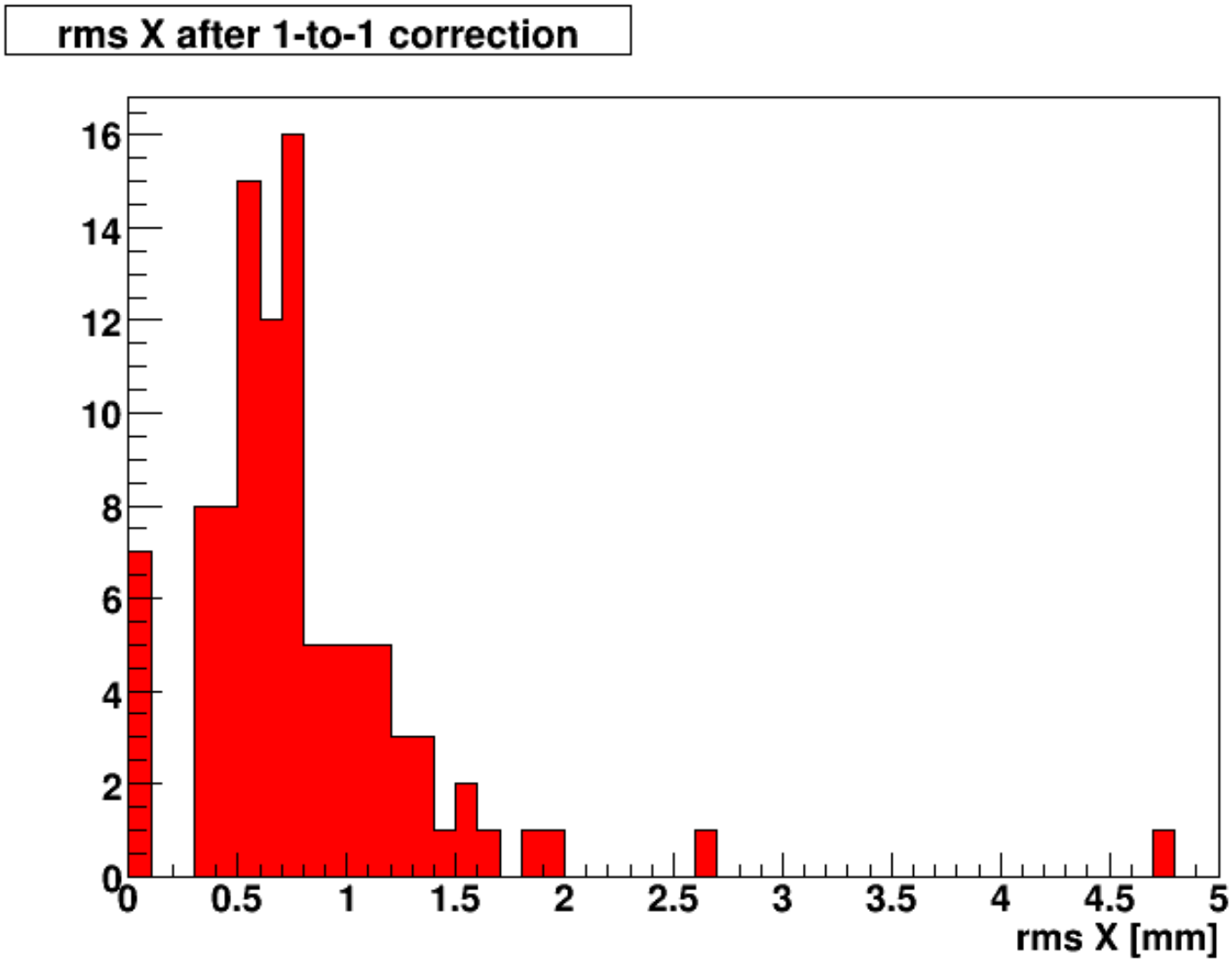
- All agreed errors were implemented in each simulations.
- "1 to 1" methods were implemented.
- Now let's present the results to compare.
- Relative orbit reconstruction performed in ATF EXT line on may shifts data, unsuccessful due to missing data.
- Attempt to make relative and maybe absolute orbit reconstruction in EXT during FS shift tomorrow.

Outline

X steering in EXT for nominal misalignments



X steering in EXT for nominal misalignments



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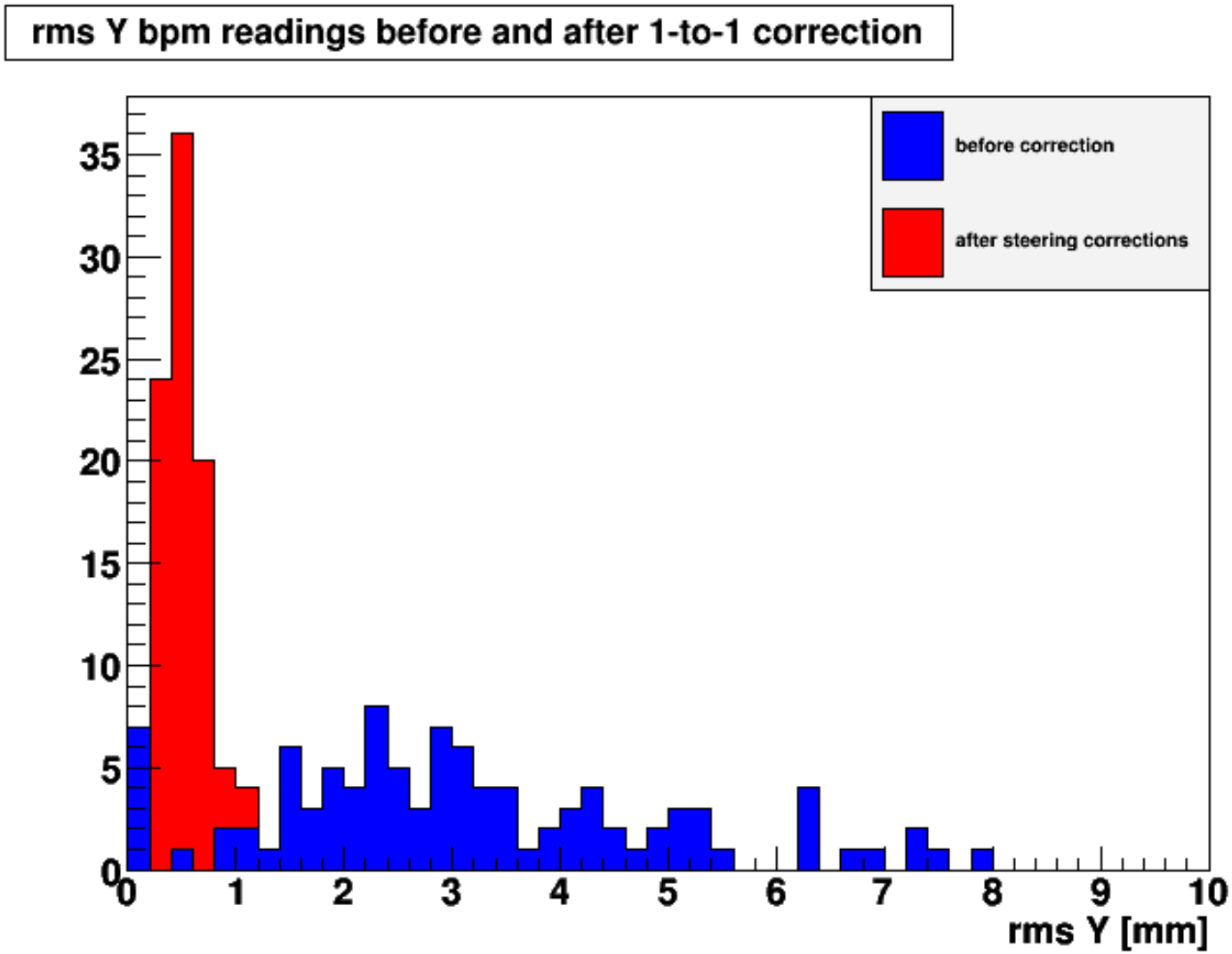

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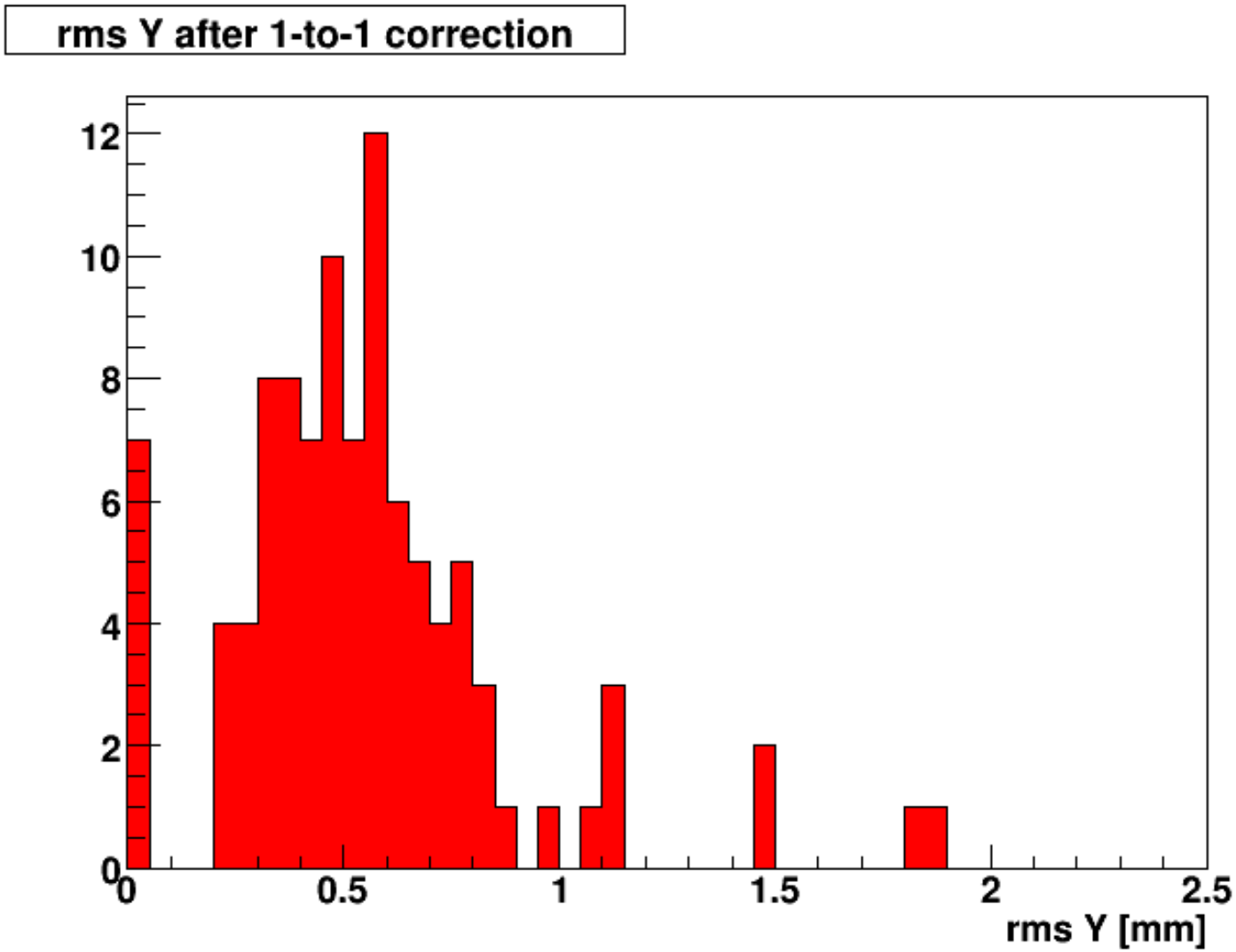
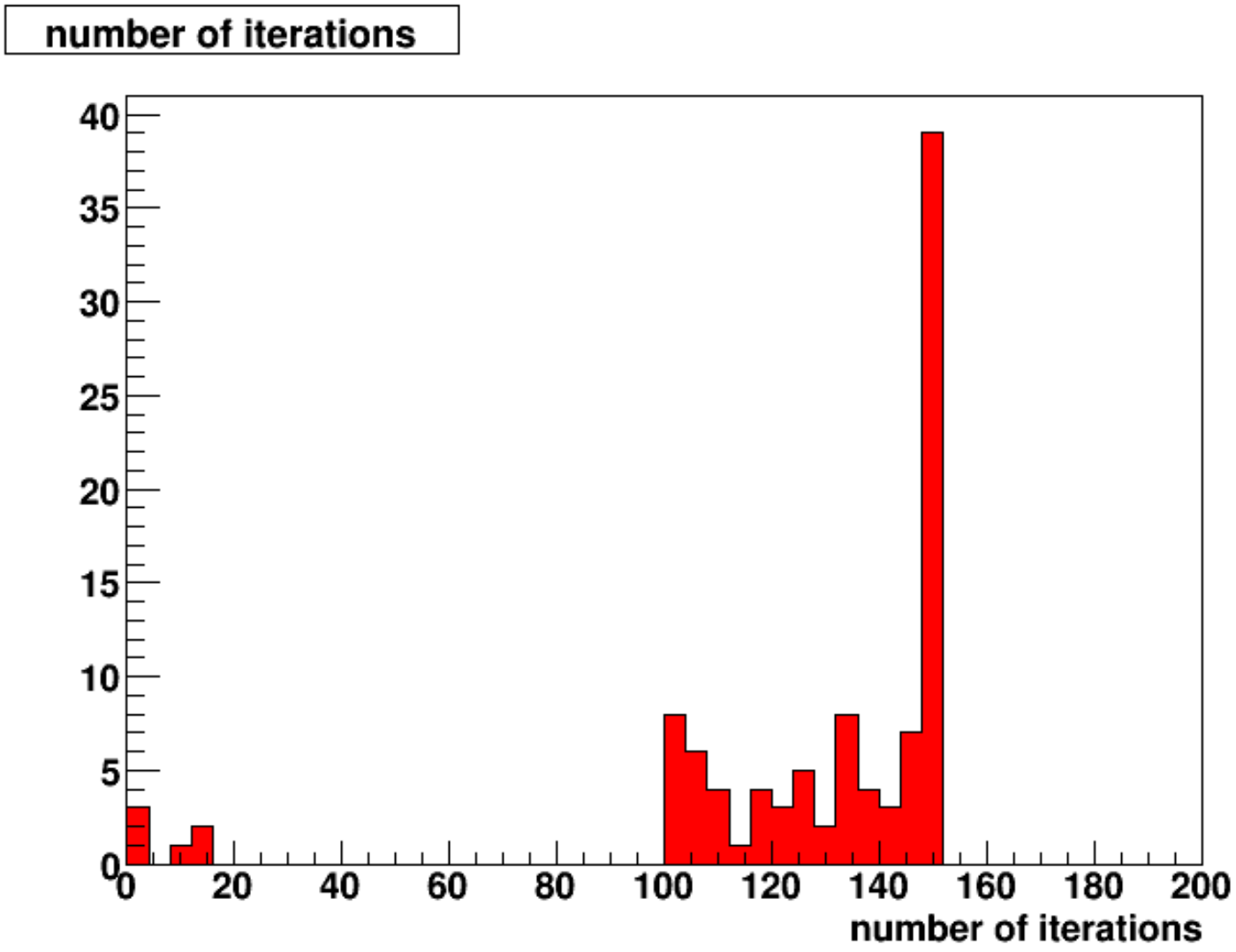


Number of iterations for nominal misalignments



Comments

Precisions

- 1 iteration is an average of 10 measurements.
- 7/100 seeds could not be simulated due to too large errors, beam loss problem must be solved.
- Present correction between 10 and 15 min ? Can be quicker, but result are worse.

Outline

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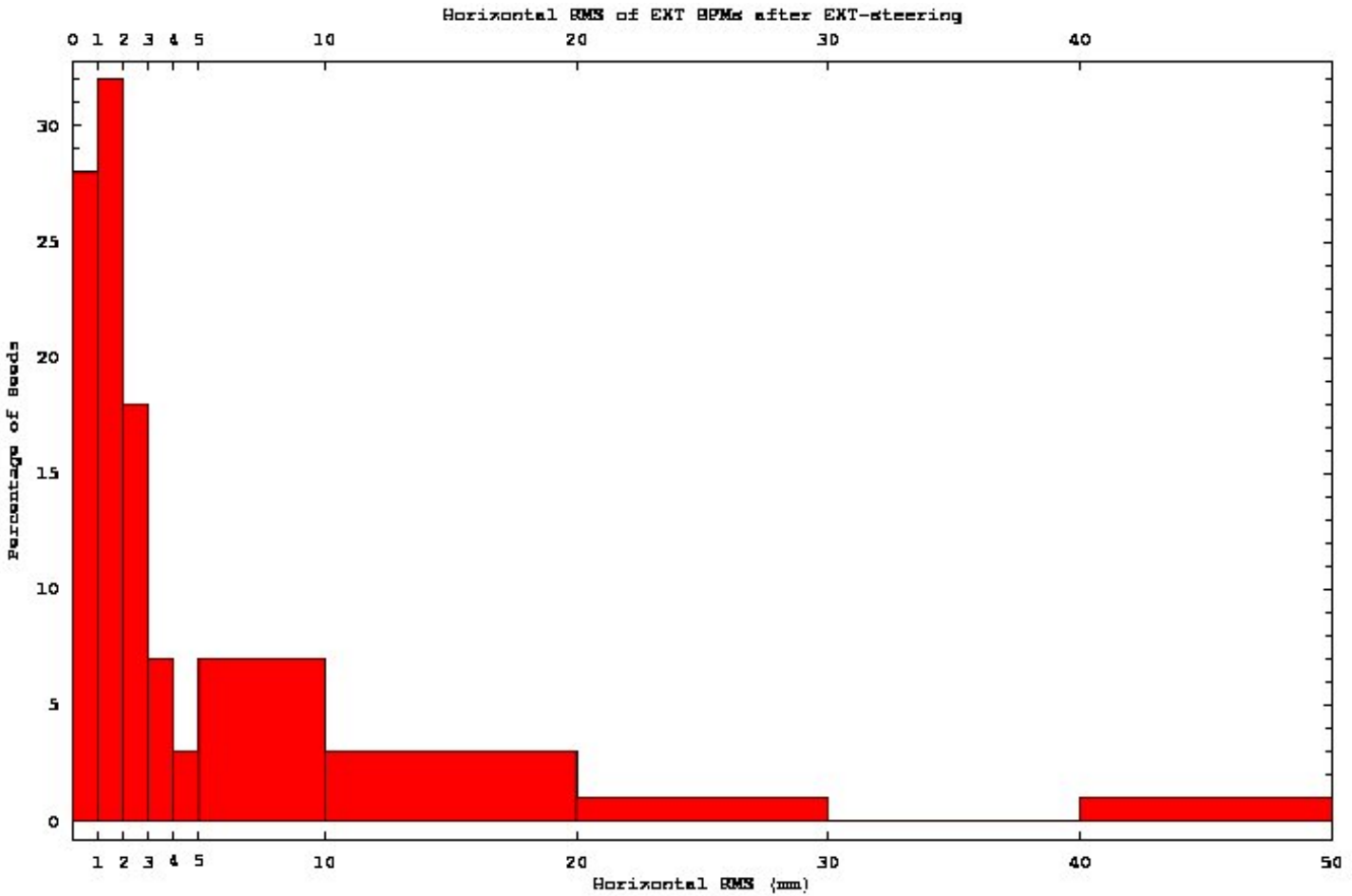

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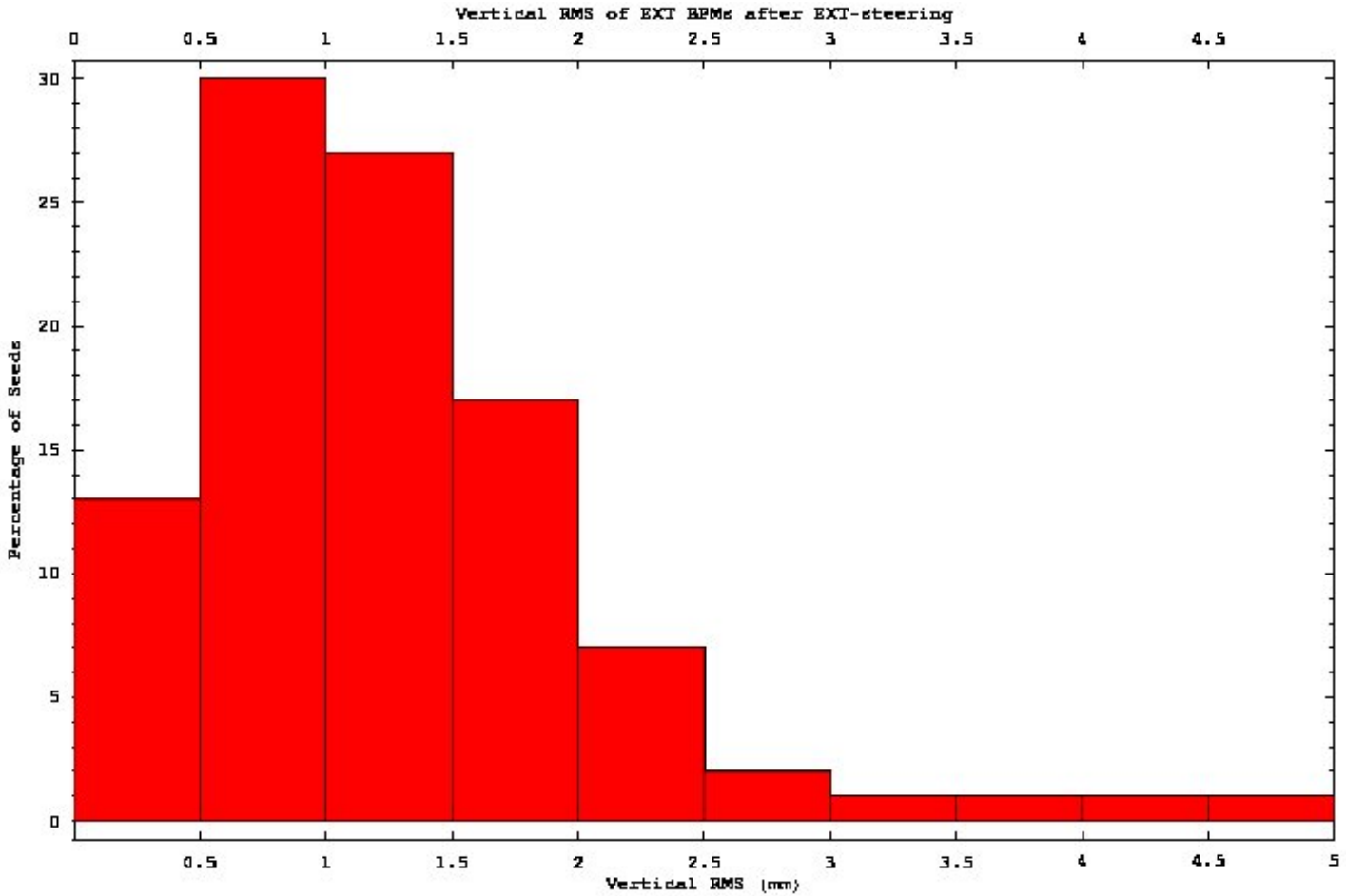

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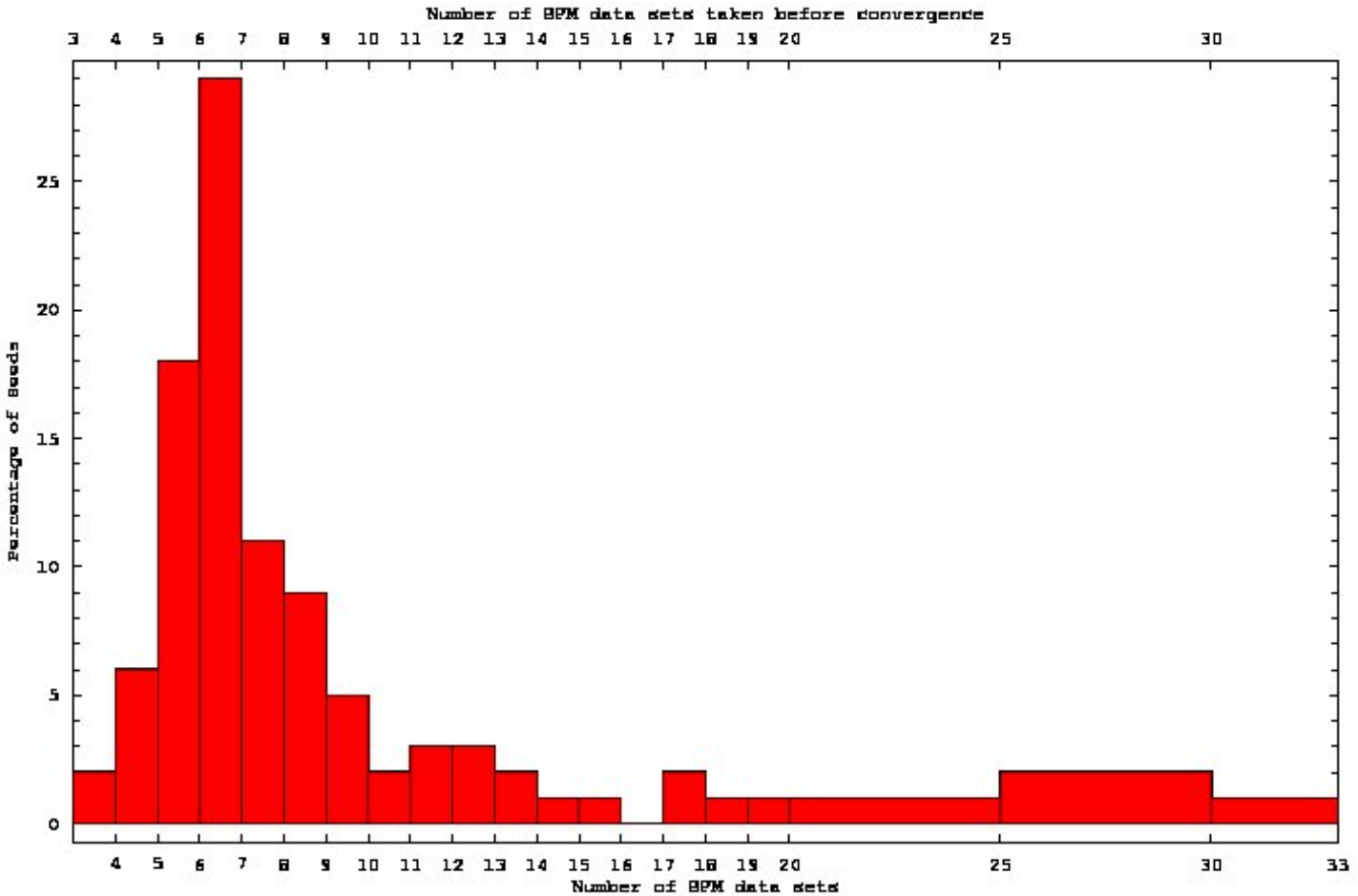


Comments

Precisions

- 1 iteration is an average of 10 BPM measurements.
- Beam jitter simulated.

Outline

Summary of steering results in FFS

quantity	resluts				
	mine	Antony's	Glen's	Javier's	Kubo-san's
rms X (EXT) [mm]	0.7 ± 0.3	2 ± 2			
rms Y (EXT) [mm]	0.5 ± 0.2	1.5 ± 1			
rms X (EXT+FF) [mm]	2 ± 1	1 ± 1			
rms Y (EXT+FF) [mm]	3 ± 3	5 ± 5			
BPM measurements	$1000 < n < 1500$	70 ± 50			

legend

- rms (EXT) : standard deviation of EXT BPM readings after EXT steering.
- rms (EXT+FF) : standard deviation of EXT+FF BPM readings after EXT steering.
- BPM measurements : number of measurements to obtain previous results.

Outline

Relative reconstruction

Principles

- any ΔE, $\Delta B \Rightarrow \Delta X(BPMs)$.
- if elem is downstream, knowing all $R(elem \rightarrow BPM_m)$, one can reconstruct $\Delta x(elem)$,$\Delta x'(elem)$, $\frac{\Delta E}{E}(elem)$ using SVD.
- Tested during bumps in QM7 during last may shift.
- x and x' was not reconstructed due to missing information.
- $\frac{\Delta E}{E}$ reconstruction looked good, special using ring's BPM.

$$\begin{pmatrix} R_{11}(\rightarrow BPM_1) & R_{12}(\rightarrow BPM_1) & R_{16}(\rightarrow BPM_1) \\ R_{11}(\rightarrow BPM_2) & R_{12}(\rightarrow BPM_2) & R_{16}(\rightarrow BPM_2) \\ & \vdots & \\ R_{11}(\rightarrow BPM_M) & R_{12}(\rightarrow BPM_M) & R_{16}(\rightarrow BPM_M) \end{pmatrix} \times \begin{pmatrix} \Delta x(elem) \\ \Delta x'(elem) \\ \frac{\Delta E}{E}(elem) \end{pmatrix} = \begin{pmatrix} \Delta x(BPM_1) \\ \Delta x(BPM_2) \\ \vdots \\ \Delta x(BPM_M) \end{pmatrix}$$

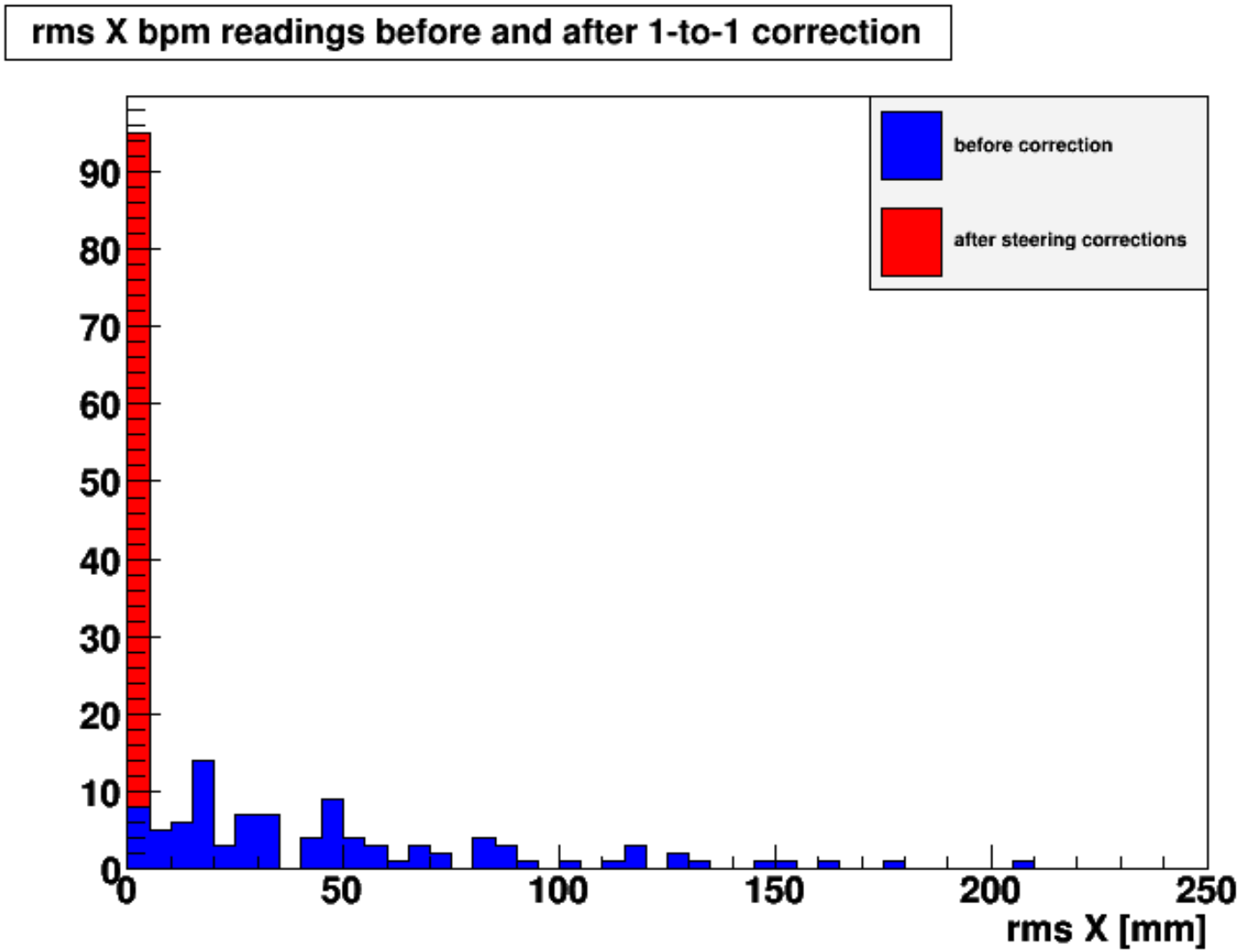
Conclusion

- Steering algorithms in EXT give good results with all errors included.
- Need results from all.
- Need performance function of iterations number.
- Relative orbit reconstruction will be tested tomorrow with FS.

Prospects

- Look at beam jitter influence.
- Meeting of all collaborators in January to chose an algorithm.
- Implement it in FS.
- Implement orbit monitoring in FS.
- Implement absolute orbit reconstruction.
- Tests in early next year.
- Couple orbit reconstruction and steering for faster results.

X steering for nominal misalignments in EXT+FF



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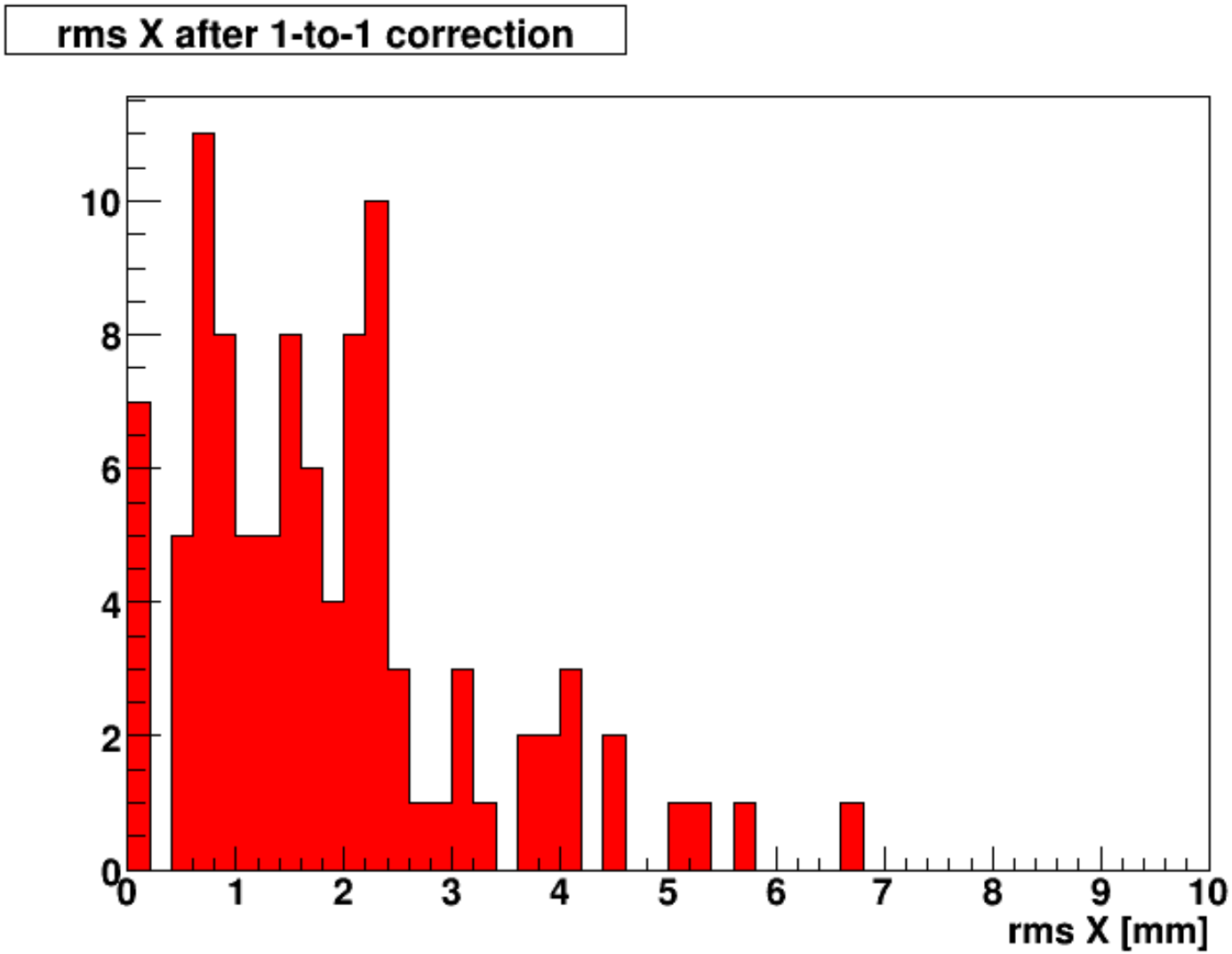

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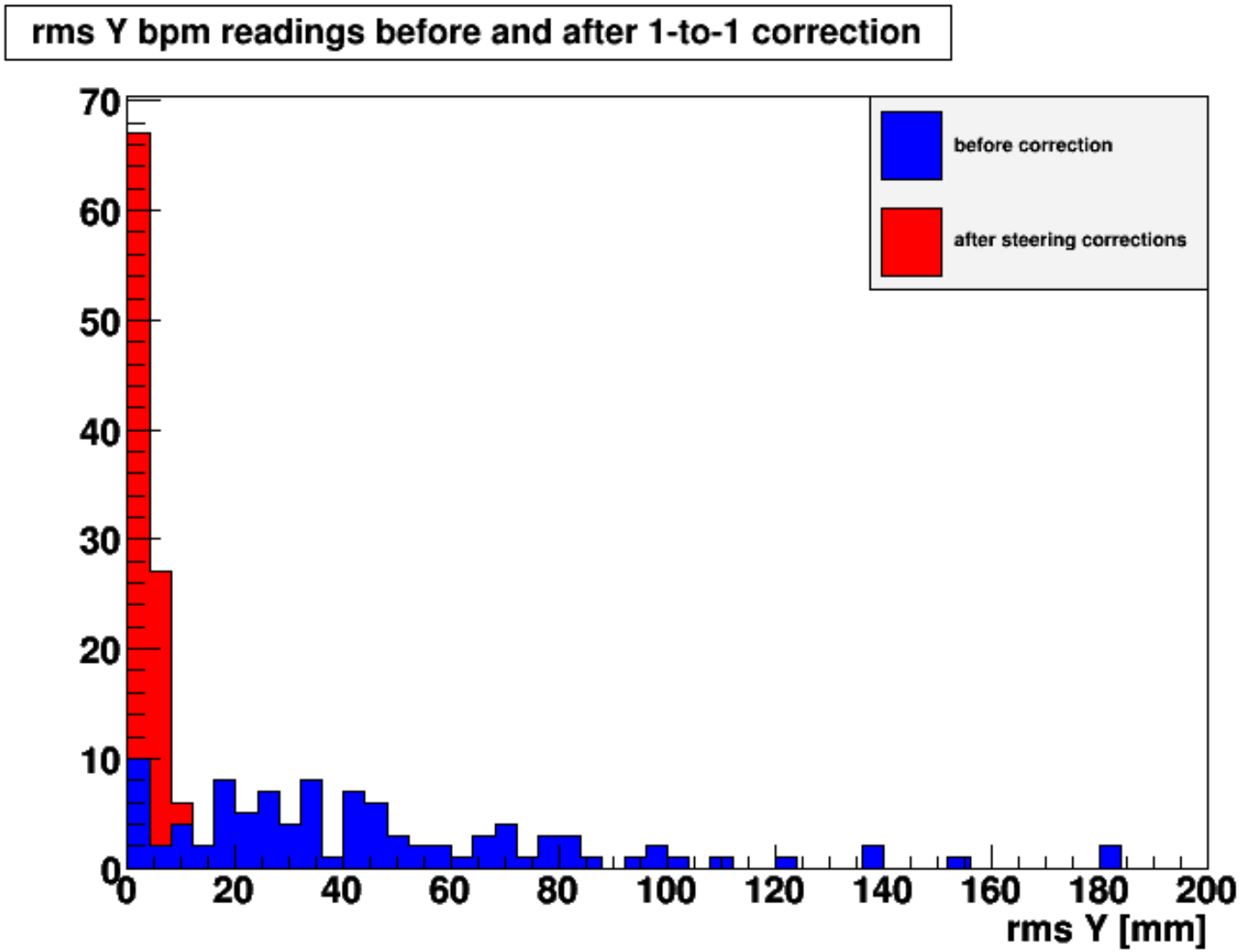

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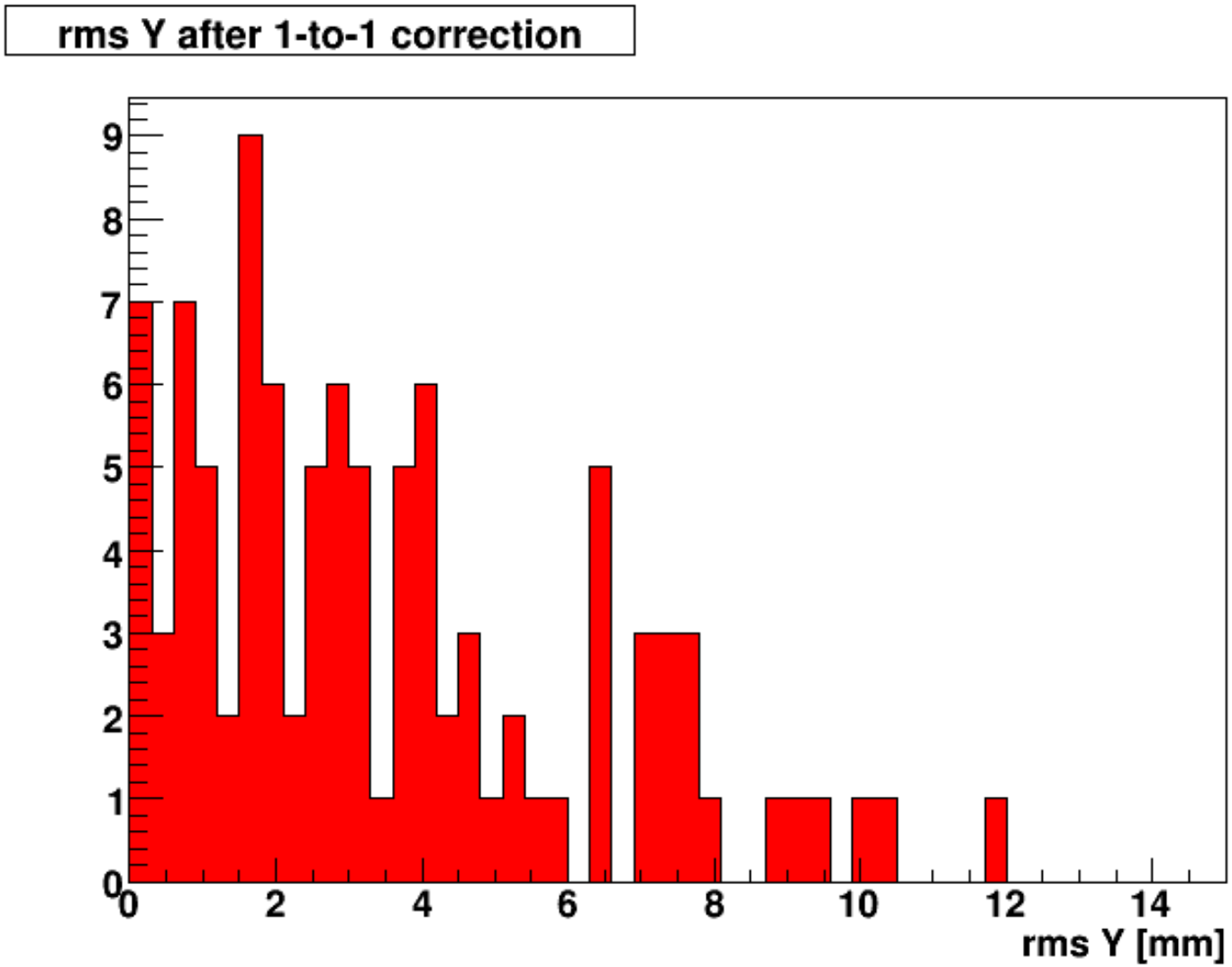

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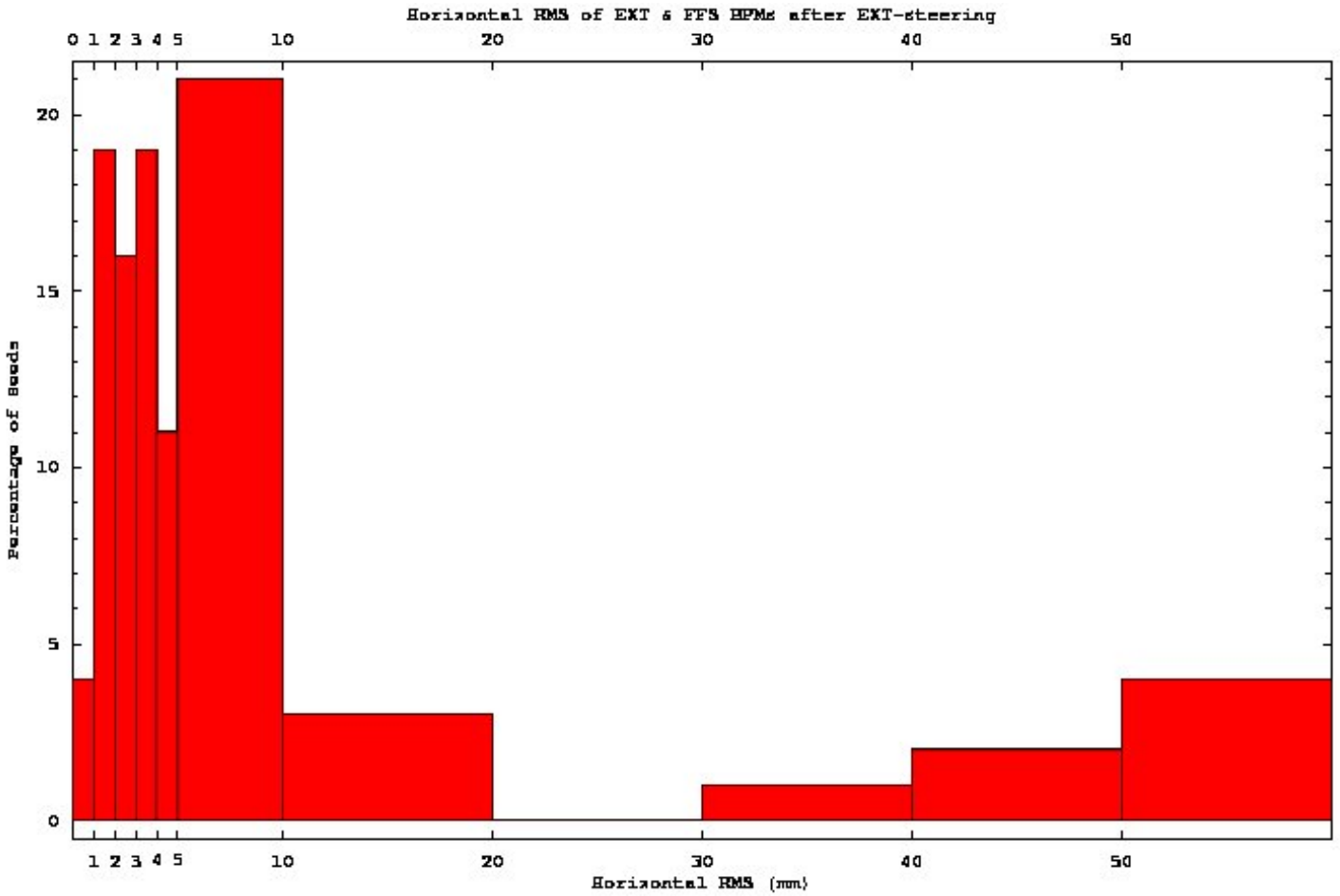

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