Update on CMS stray field (Injection)

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Thanks to Rogelio Tomás, Stephan Russenschuck, Bernhard Auchmann

This work was supported by the European Community-Research Infrastructure Activity under the FP6 "Structuring the European Research Area" programme (CARE, contract number RII3-CT-2003-506395).

Contents

- Solenoid in the code
- Model of CMS fields
- Coupling
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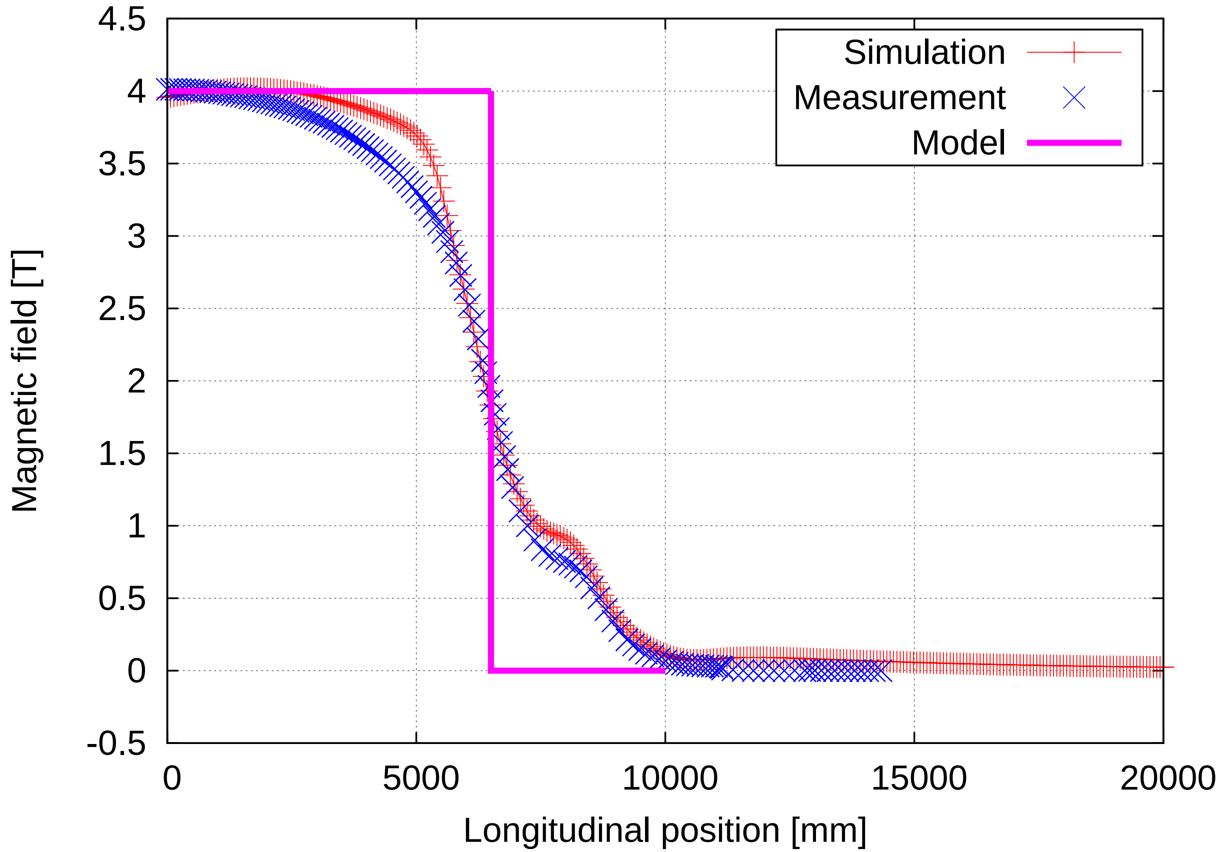
Thin Solenoid in the code

- MADX convertor: c6t.c
- G. Ripken and F. Schmidt, CERN/SL/95-12
- Added and debugged for all subroutines (Y.-P. Sun and F. Schmidt)
  - 8 tracking routines (4D, 6D)
  - 2 Differential Algebra routines
  - 6 other routines (linear optics and resonances)
- Pure solenoid + fringe field (linear) (derived by F. Zimmermann)

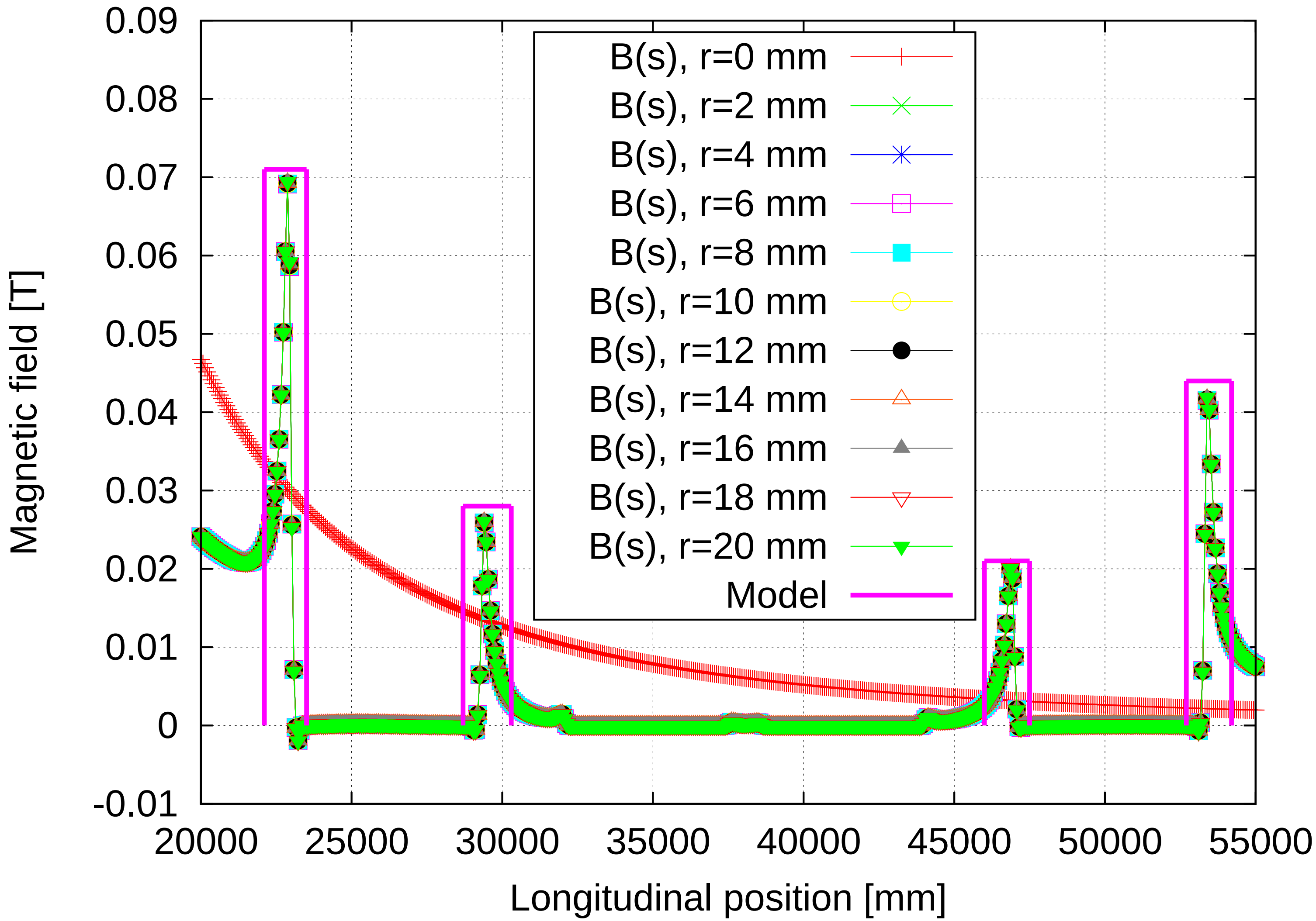
Model: CMS main



Hard-edge model; 4T, 11 m long

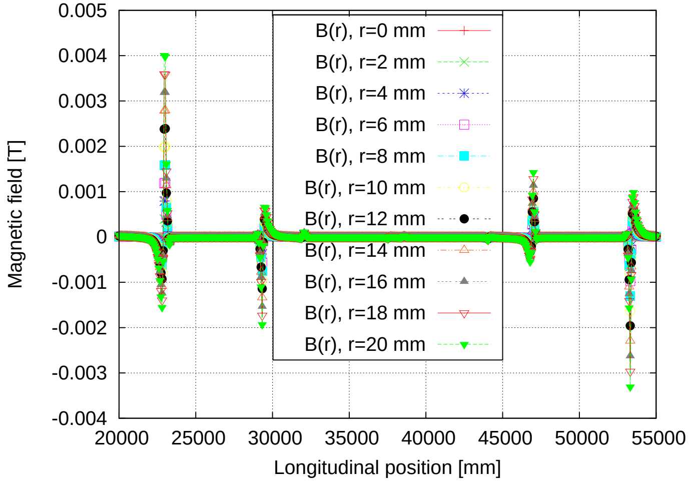
B. Dalena, Measurement data; S. Russenschuck and B. Auchmann, simulation data

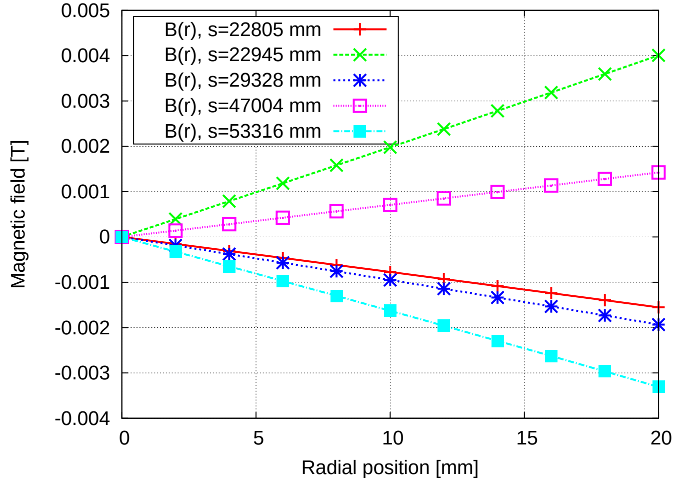
Model: CMS stray



Hard-edge model; 4 ‘small’ solenoids, 1 m long

Fringe field





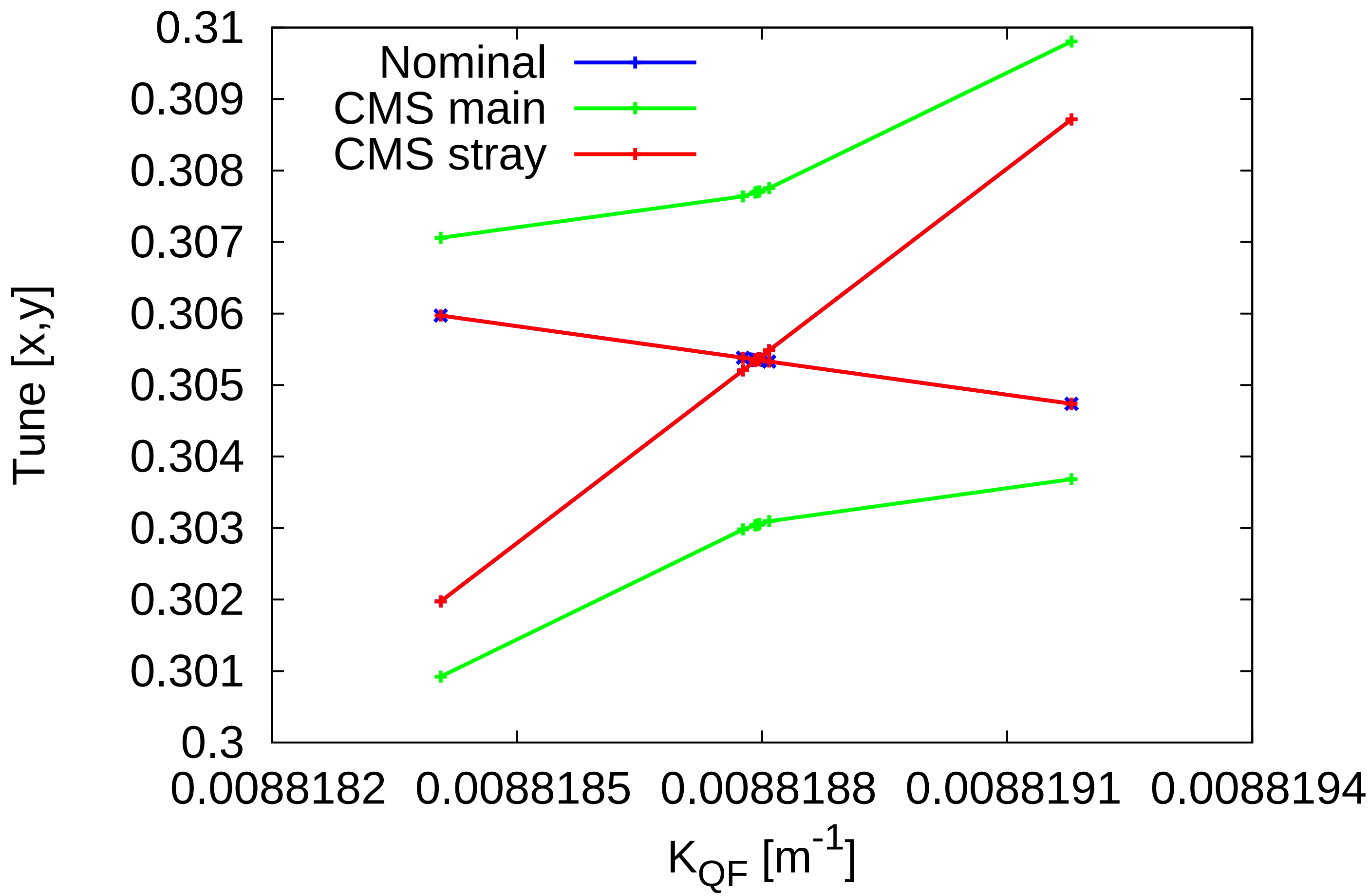
Fringe field: linear

At the entrance of the solenoid we have

$$\Delta p_x = \frac{e \cdot B_y \cdot \Delta s}{p_s} = \frac{e \cdot \Delta B_s}{2 \cdot p_s} \cdot y. \tag{1}$$

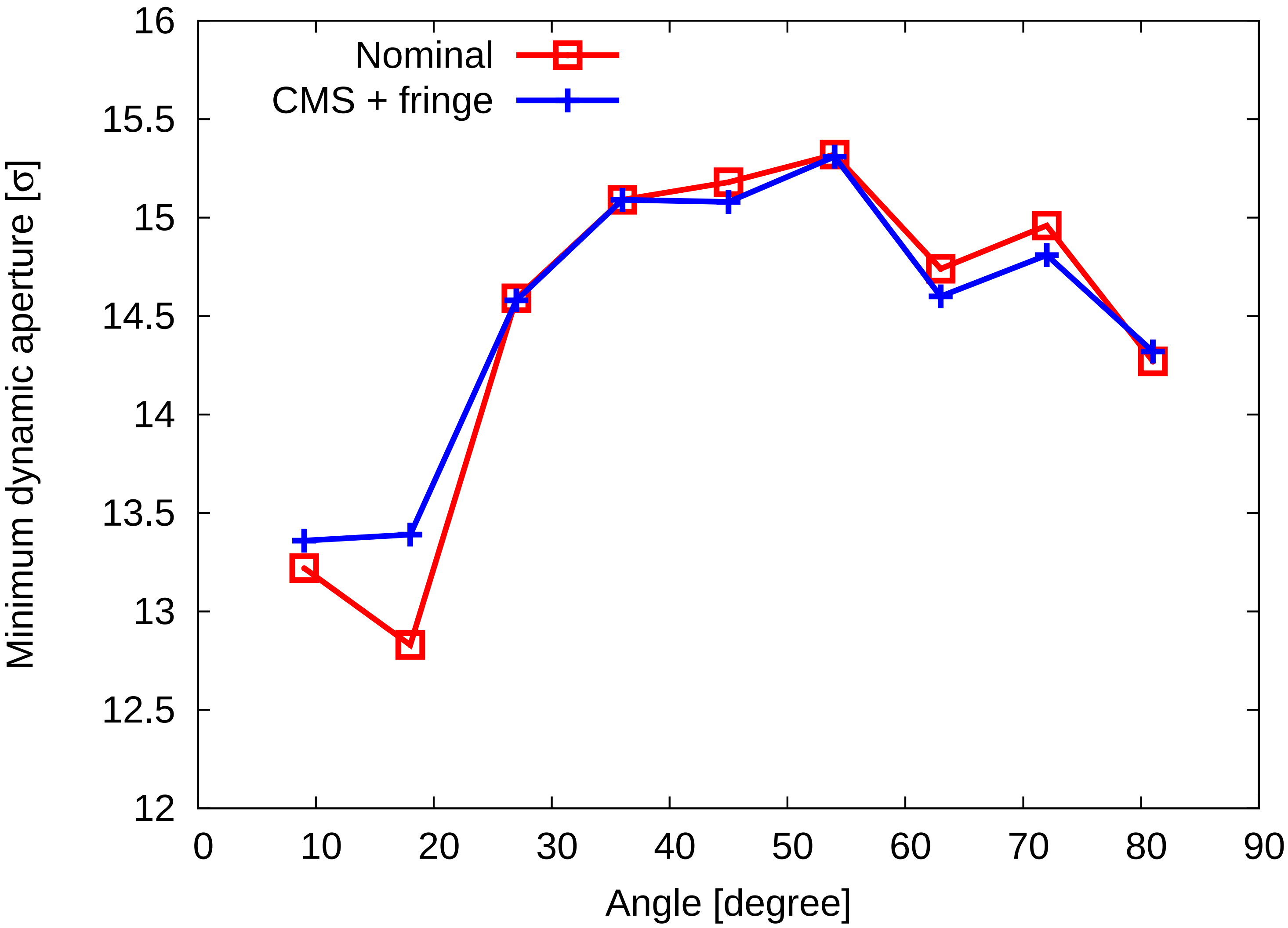
$$\Delta p_y = -\frac{e \cdot B_x \cdot \Delta s}{p_s} = -\frac{e \cdot \Delta B_s}{2 \cdot p_s} \cdot x. \tag{2}$$

Coupling: LHC injection



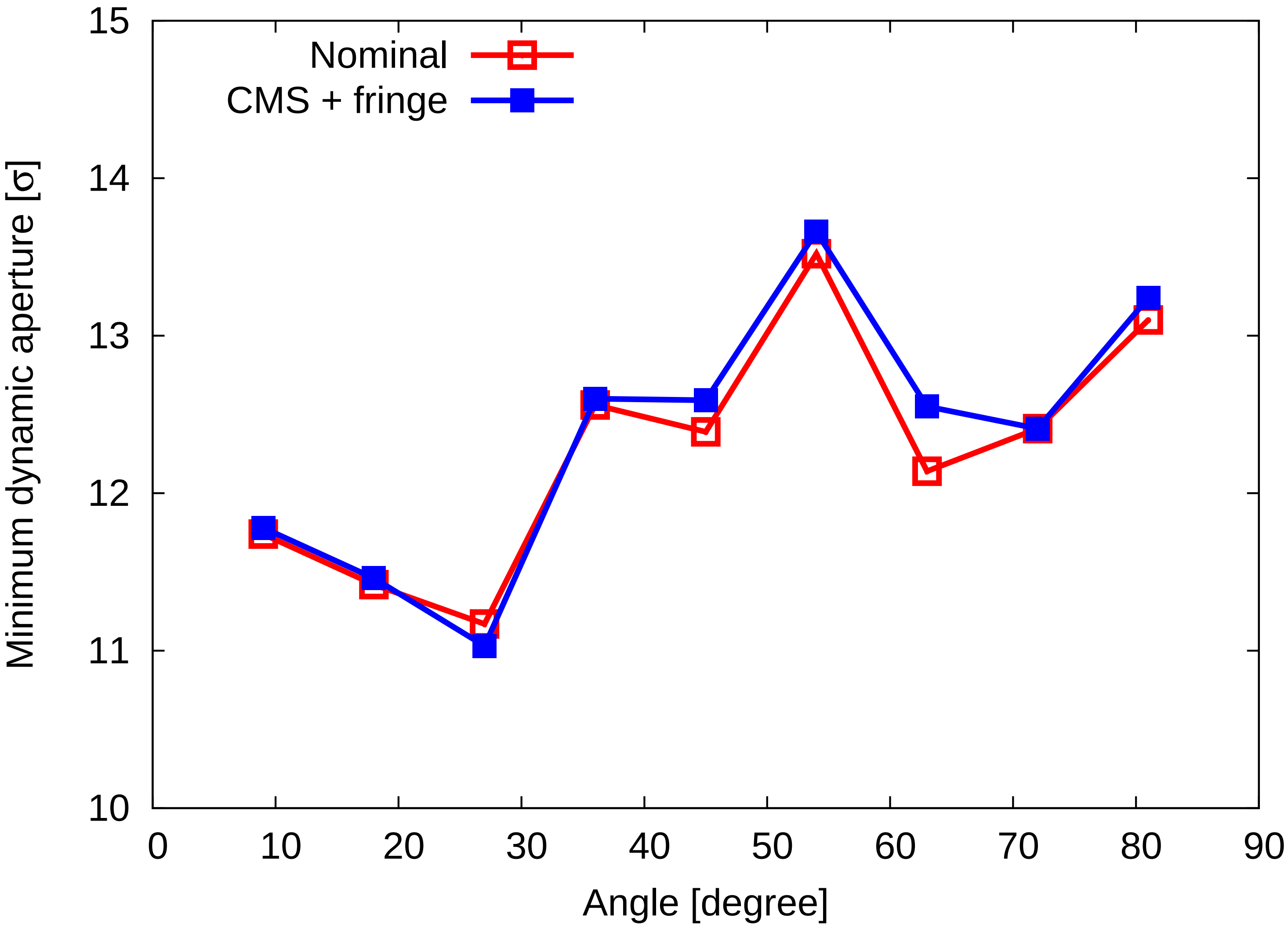
Coupling strength: 4.65E-3 (main) (Analytical: 4.67E-3, W. Herr, Chamonix XV); 2.95E-5 (stray)

Short term DA, 1k turns



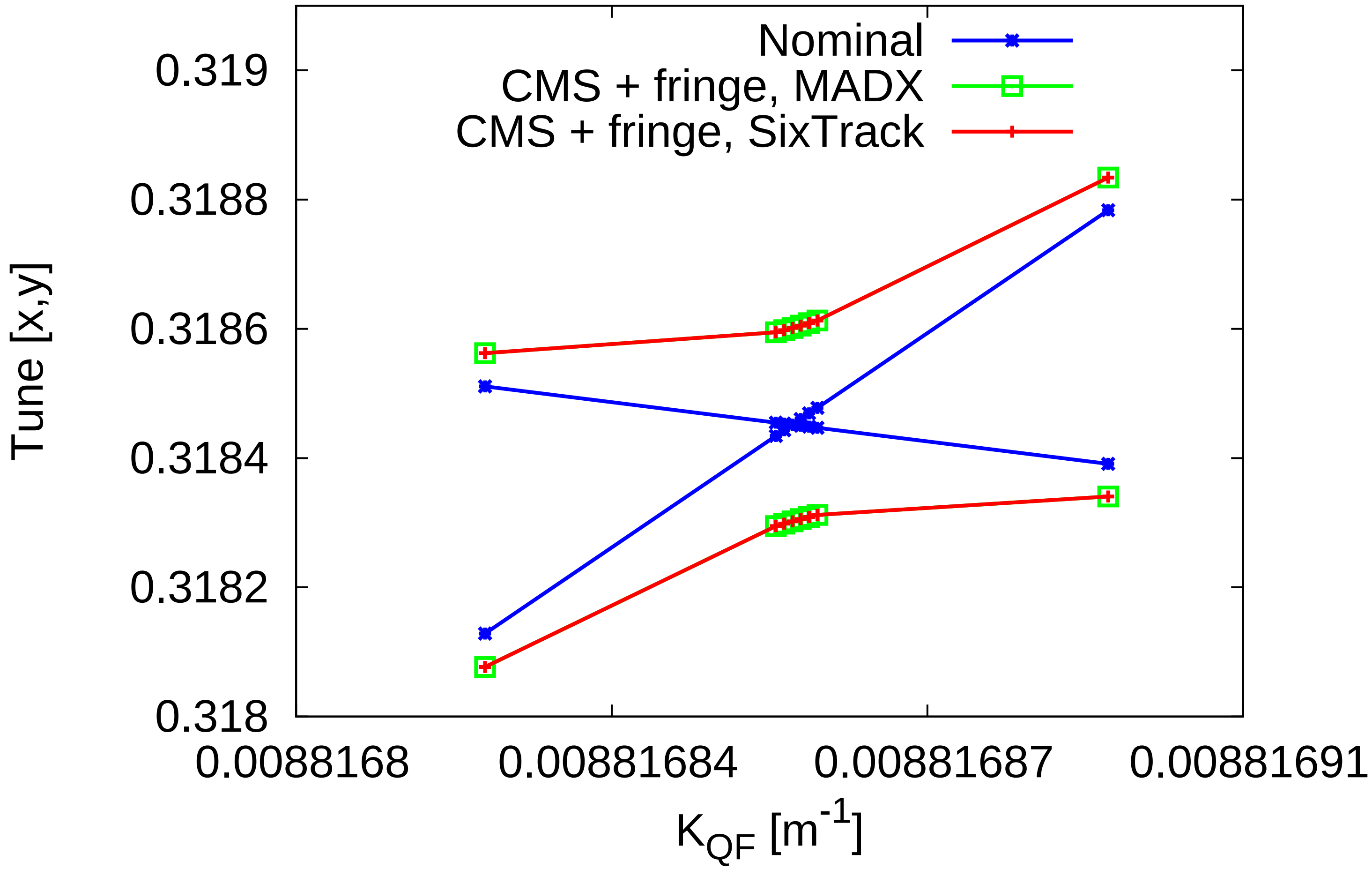
Minimum over 60 seeds. Small difference.

Long term DA, 100k turns



Minimum over 60 seeds. Small difference.

Backup slide (1)



Benchmark between MADX and SixTrack, LHC collision

Backup slide (2)

- LHC collision + CMS 4 T (IP5)

	Tune x	Tune y
MADX	64.30999975	59.31999956
SixTrack	64.3099997390	59.3199995587

- LHC collision + CMS 40 T (IP5)

	Tune x	Tune y
MADX	64.30998594	59.32001341
SixTrack	64.3099859354	59.3200134058

Backup slide (3)

Fringe field

At the entrance of the solenoid we have

$$\Delta p_x = \frac{e \cdot B_y \cdot \Delta s}{p_s} = \frac{e \cdot \Delta B_s}{2 \cdot p_s} \cdot y. \tag{3}$$

$$\Delta p_y = -\frac{e \cdot B_x \cdot \Delta s}{p_s} = -\frac{e \cdot \Delta B_s}{2 \cdot p_s} \cdot x. \tag{4}$$

At the exit of the solenoid we have

$$\Delta p_x = -\frac{e \cdot B_y \cdot \Delta s}{p_s} = -\frac{e \cdot \Delta B_s}{2 \cdot p_s} \cdot y. \tag{5}$$

$$\Delta p_y = \frac{e \cdot B_x \cdot \Delta s}{p_s} = \frac{e \cdot \Delta B_s}{2 \cdot p_s} \cdot x. \tag{6}$$

with

$$\frac{e}{p_s} = \frac{1}{B \cdot \rho}. \tag{7}$$

where e denotes the particle charge, p_s the momentum, $B \cdot \rho$ the beam rigidity.