Status of the ATF2 Ultra-low β FFS.

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PLAN OF THE TALK

- Beam size dependence on the horizontal emittance for the ATF2 Ultra-Low β Lattice.

2. Possible corrections.
   1. Insert a Dodecapole Magnet.
   - Matching for a New ATF2 Ultra-Low βy Lattice considering Magnetic errors.
     - Properties of the New ATF2 Ultra-Low βy Lattice.
3. Misalignments
   1. Effect of Individual Misalignment.
   2. Comparison of SD4 Misalignment.
   3. Comparison of SD0 Misalignment.
   4. Comparison of Knob <x,x>
4. First FFS Tuning.
5. Conclusions and Future Plans.

1. ATF2 ULTRA-LOW LATTICE WITHOUT MULTIPOLAR ERRORS.

BETA FUNCTIONS @IP:

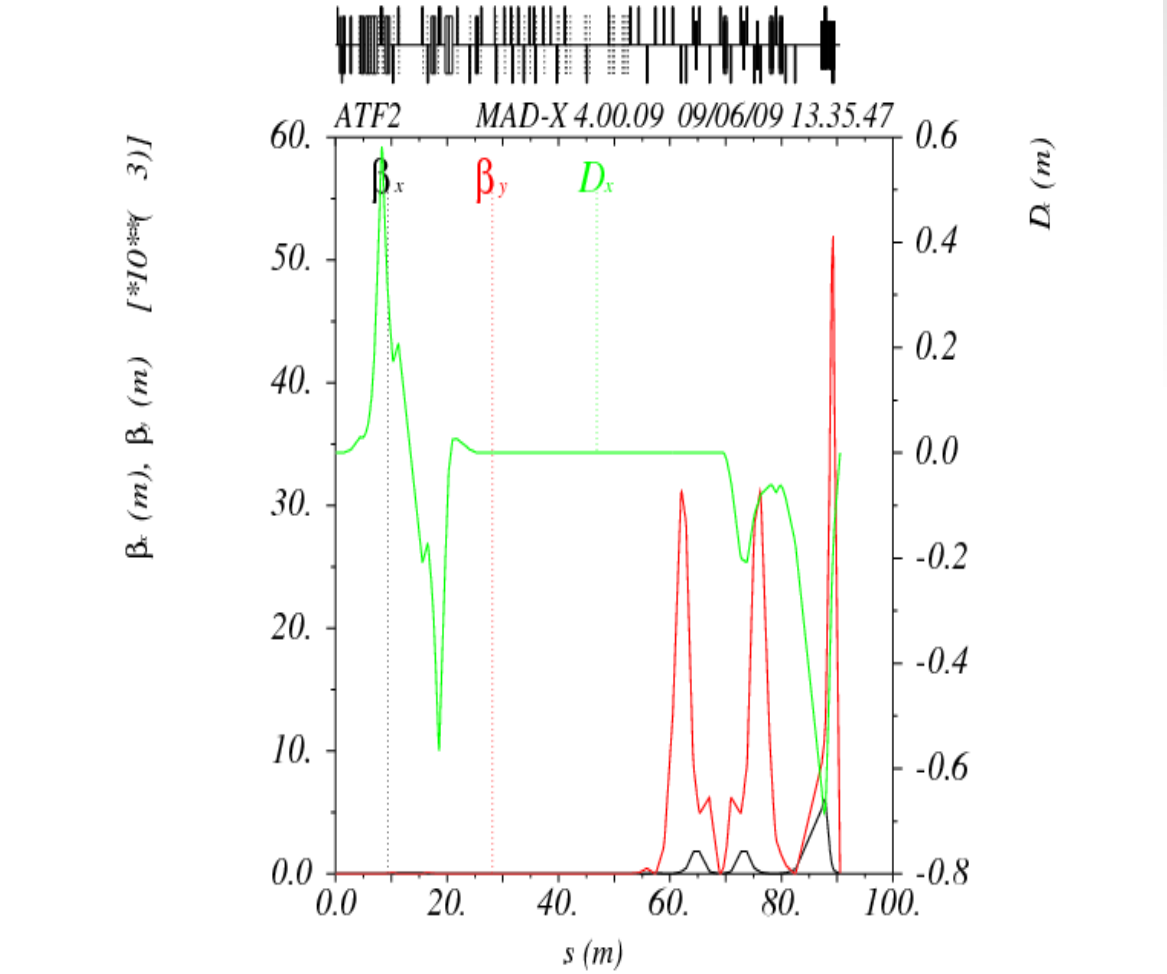
- $\beta x = 4.0$ mm ; $\beta y = 25.0$ μm

BEAM SIZES @IP:

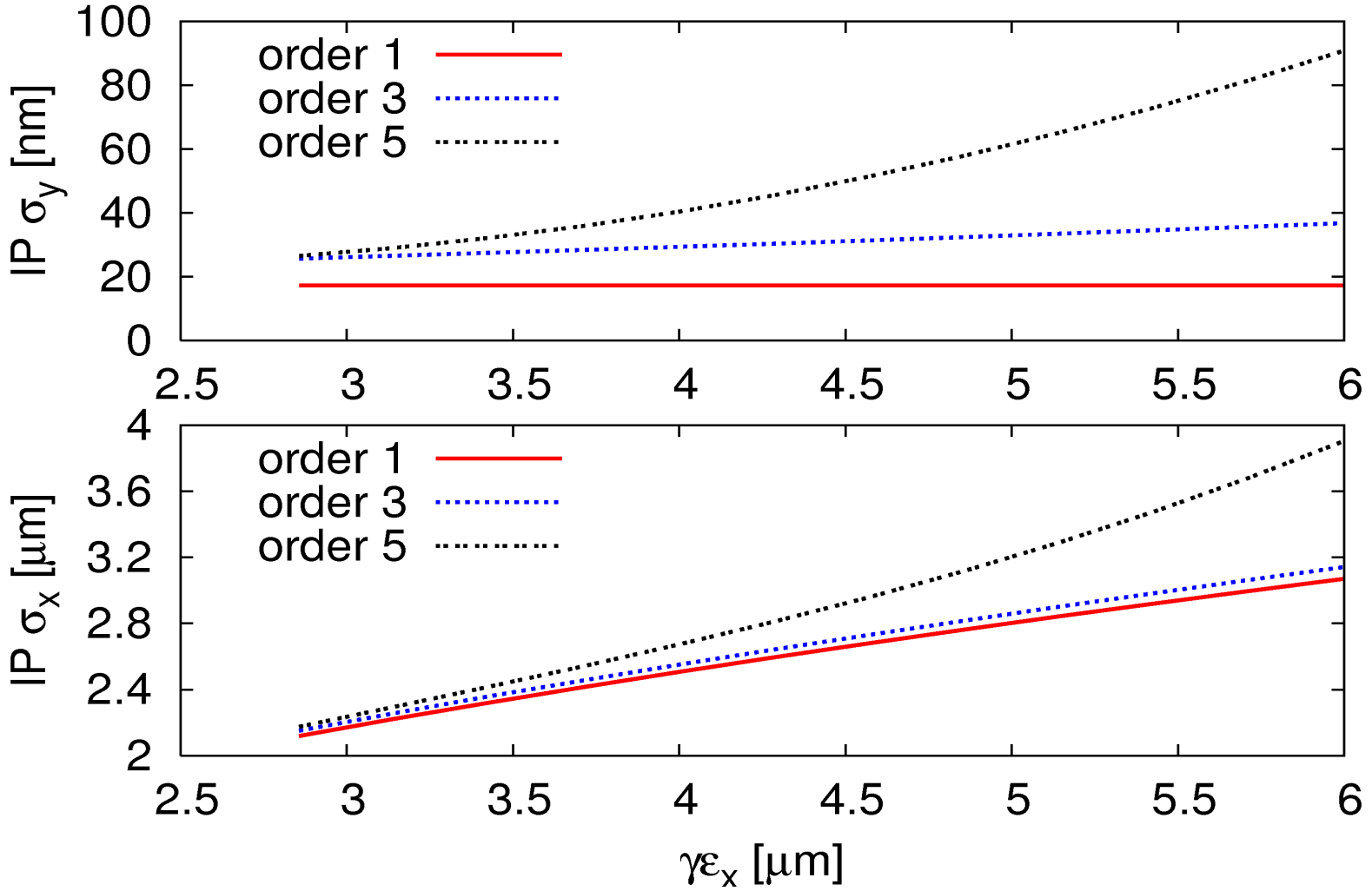
- $\sigma x = 2.14$ μm ; $\sigma y = 22.8$ nm

FRAMEWORK:

- Beam sizes @ IP
- Implementing: MAPCLASS code (up to 5 order)
- Range values for $\gamma \cdot \varepsilon_x$ [μm] : {2.8 , 6.0}
- Value for $\gamma \cdot \varepsilon_y = 3.8$ nm



1.2 BEAM SIZE DEPENDENCE ON ε_x FOR ULTRA-LOW LATTICE.



NOTE: similar behavior as the ATF2_Nominal Lattice case.

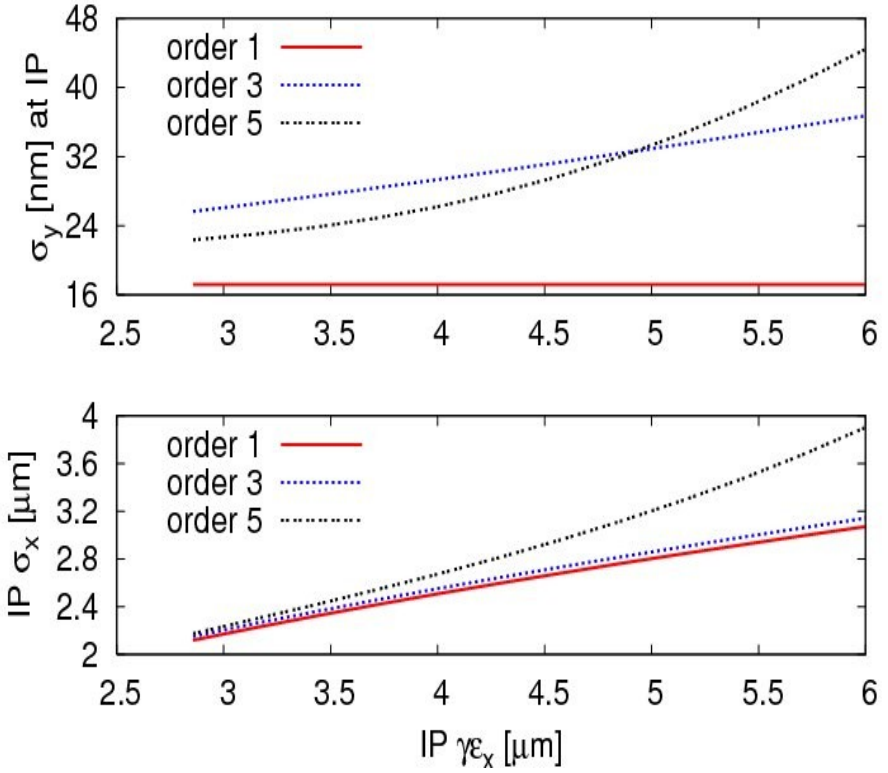
1.2 SOLUTIONS

- Possible solutions...
  - Insert a Dodecapole Magnet.
  - Develop a New lattice increasing β_x.

NOTE: same kind of solutions were used for the study of ATF2 Nominal Lattice with multipolar errors, with excellent results.

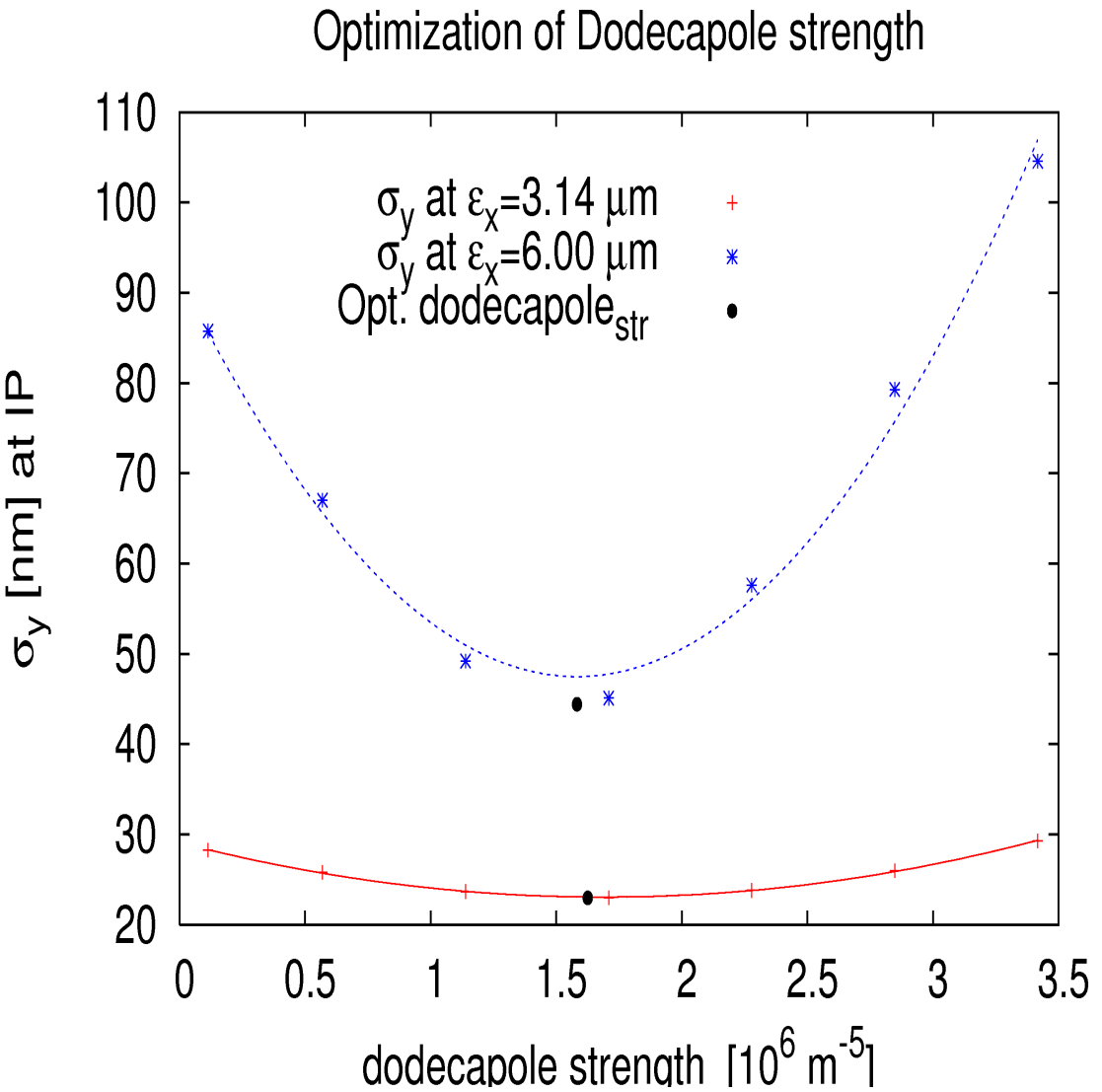
2.1.2 DODECAPOLE's optimization

- Optimum Dodecapole strength $=1.58 \cdot 10^{6} m^{-5}$



- Optimum IP beam sizes:

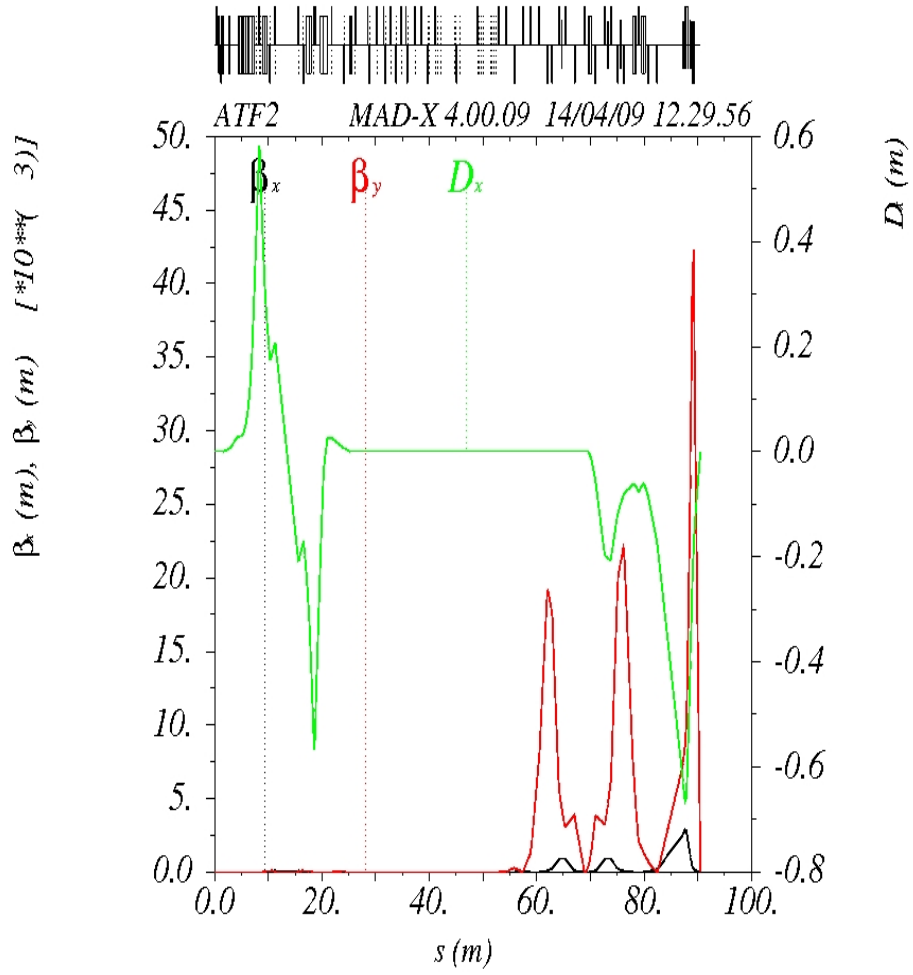
  $\sigma_{y,\,high} = 44.4$ nm ; $\sigma_{x,\,high} = 3.9$ μm



2.2.1 Matching for a new Ultra Low β_y Lattice.

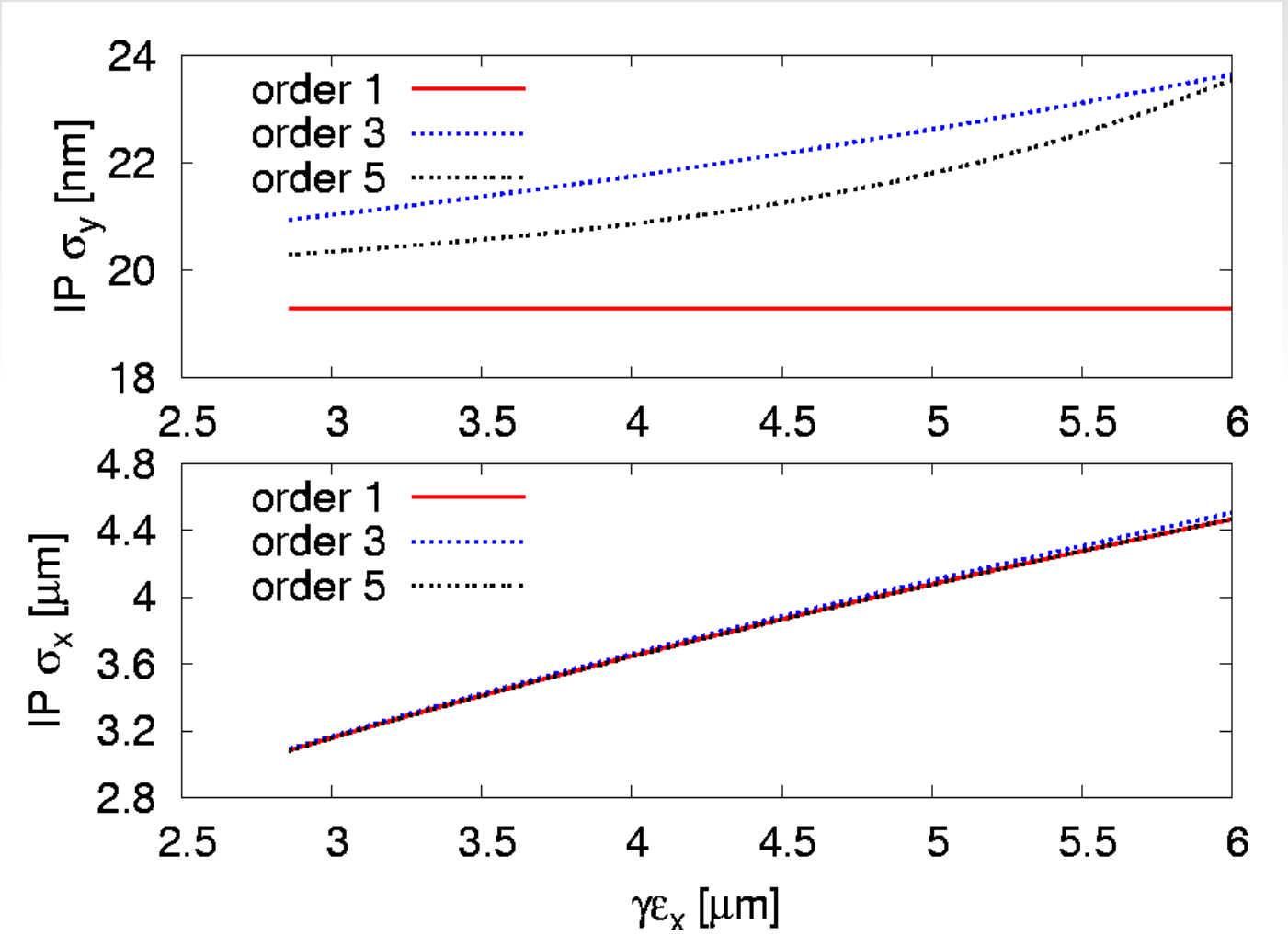
- Matching via Mad-x & Mapclass using the Simplex algorithm
  - Including Multipolar errors.
  - Constraints: increasing βx
  - Variables: Quads & Sexts strengths & SF1 SD0 Tilts

- Beta functions @ IP:
  - β_x = 8.4608 mm ; β_y = 31.5727 μm
- Beam sizes @ IP:
  - σ_x = 3.08 μm ; σ_y = 20.3 nm

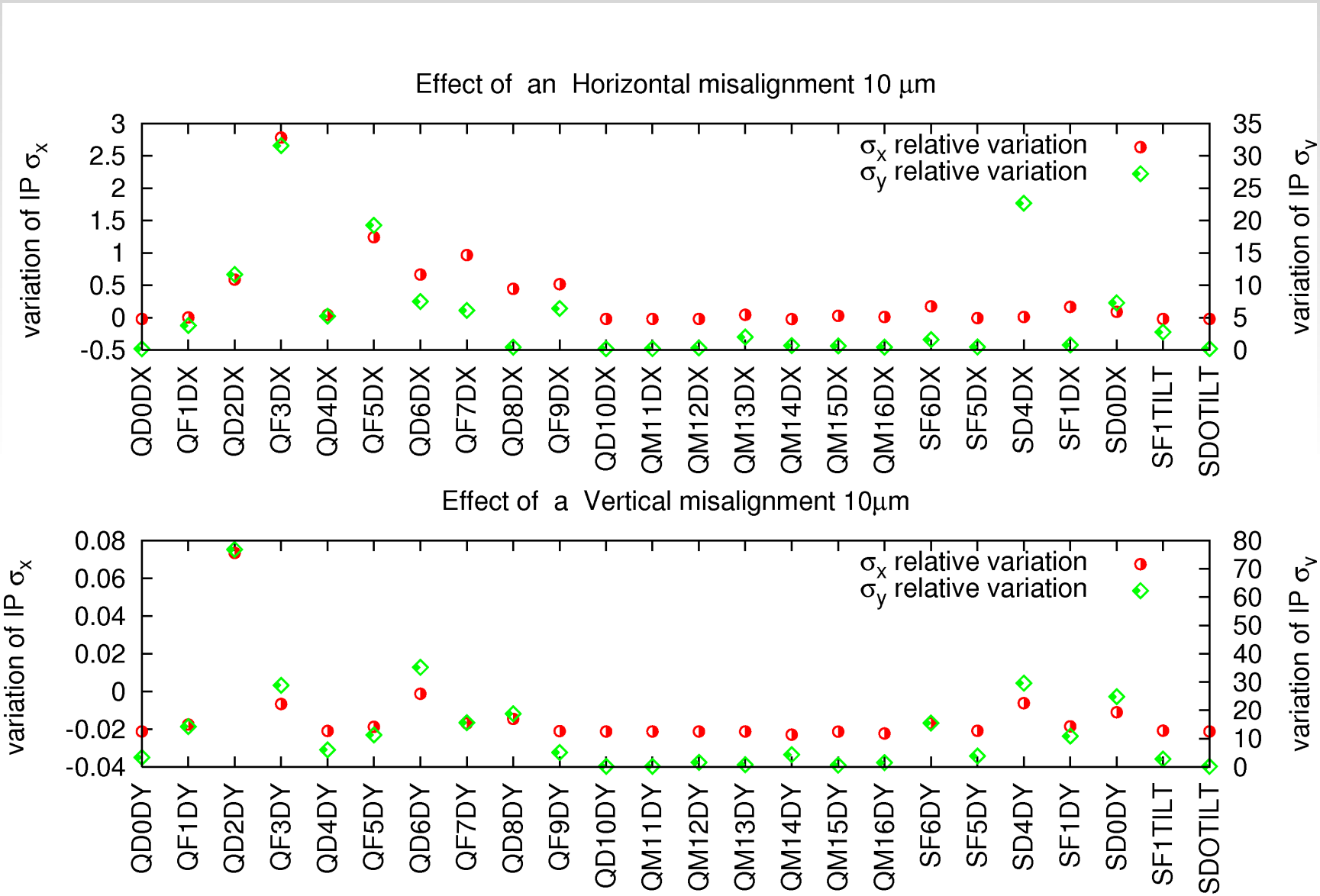


2.2.2 ATF2 Ultra-Low β_y Lattice Properties.

Emittance behavior for ATF2 Ultra-Low $\beta_{y.}$



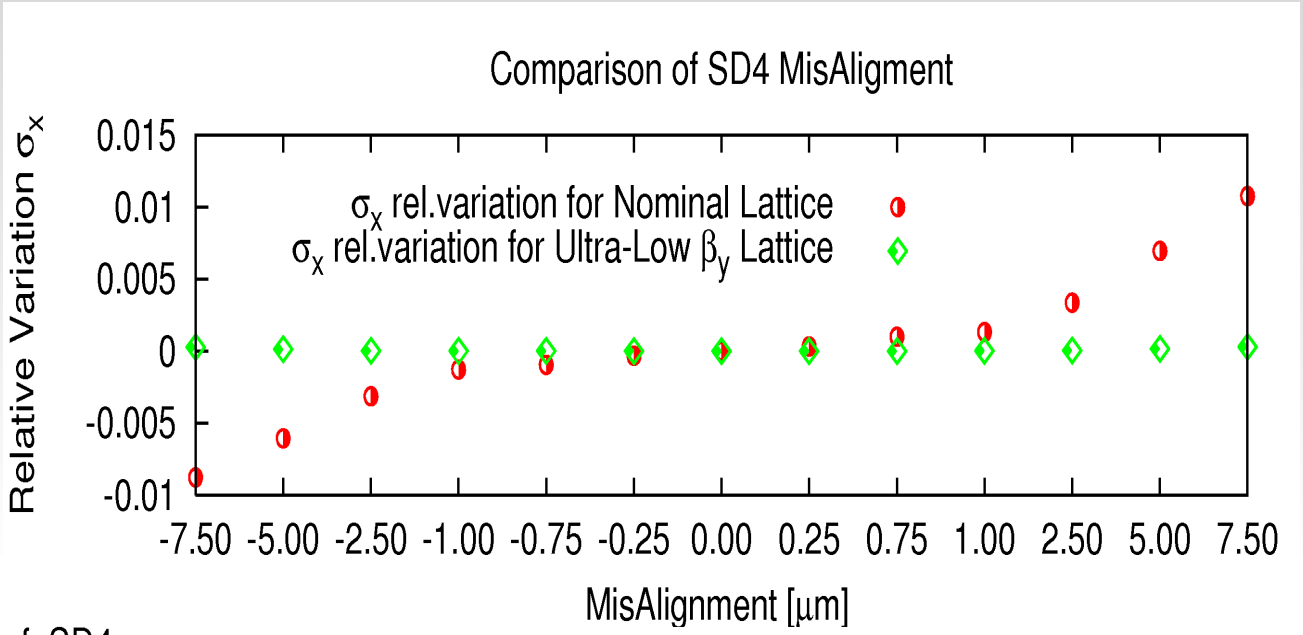
3.1 Effect of Misalignment for ATF2 Ultra-Low β_y

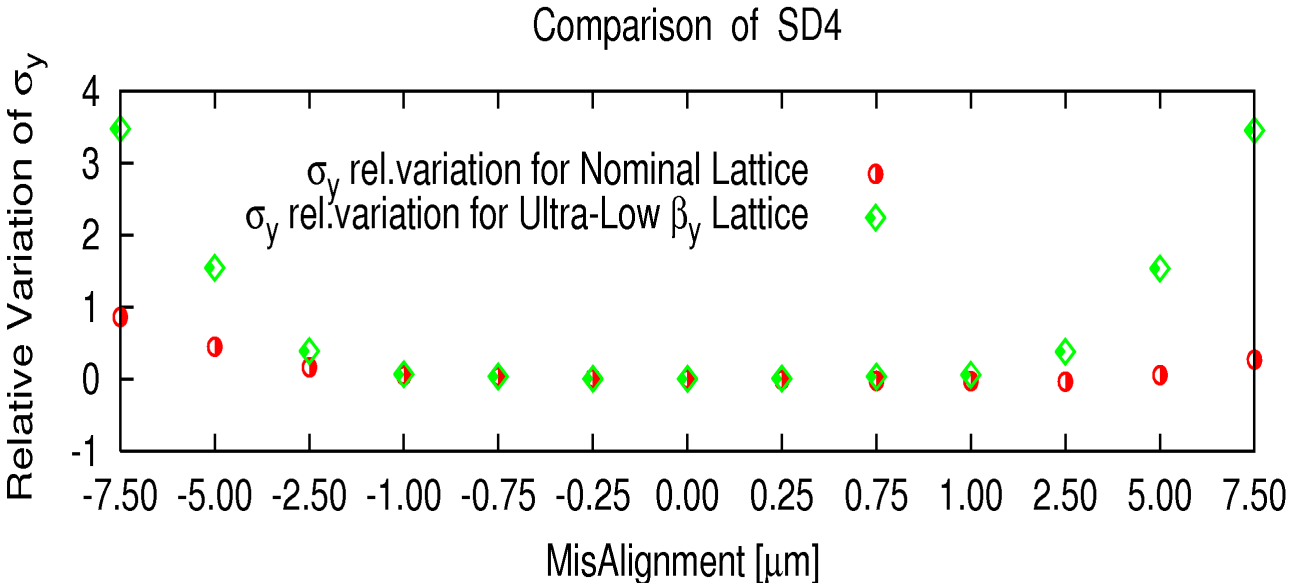


3.2 Effect of SD4 Misalignment.

Sext. Strengths Nominal Lattice:

- SD0 = 4.367344565 m^{-3}
- SF1 = -2.549000405 m^{-3}
- SD4 = 14.92233907 m^{-3}
- SF5 = -0.810845702m^{-3}
- SF6 = 8.564015604 m^{-3}





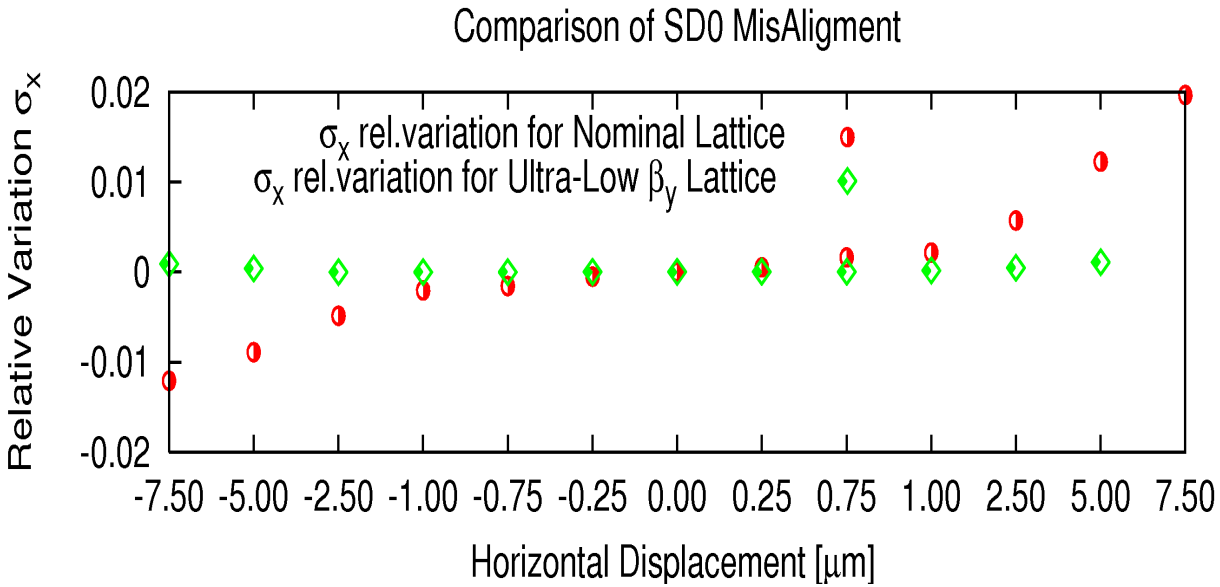
Sext. Strengths Ultra-Low Lattice:

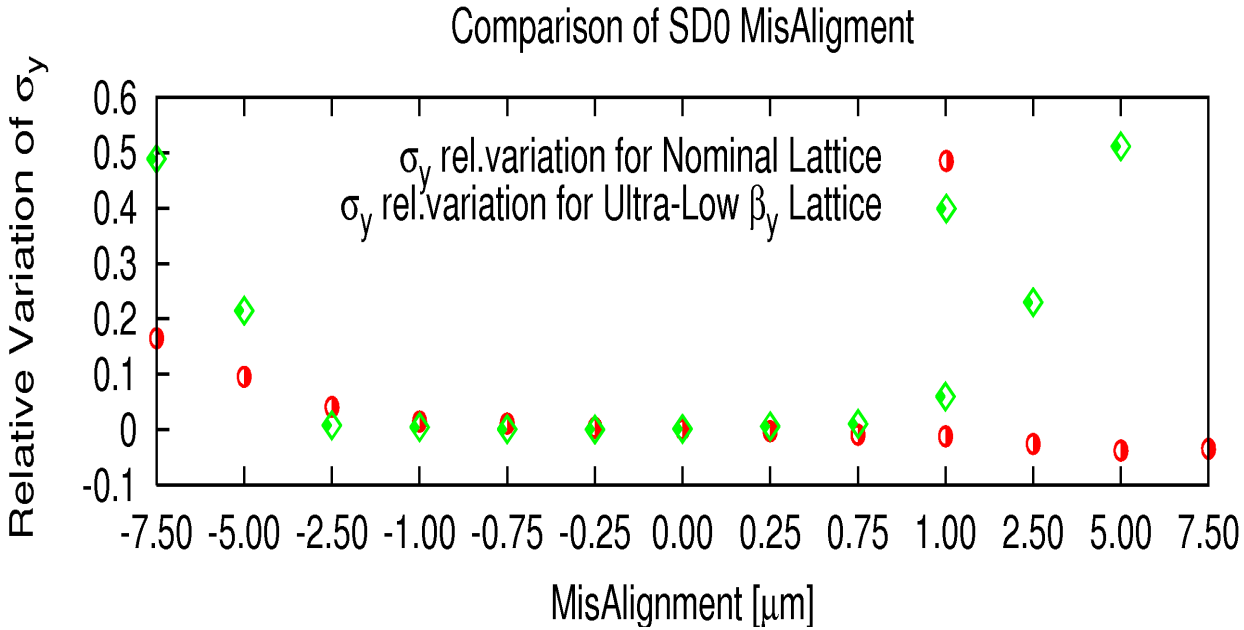
- SD0 = 4.441109237 m^{-3}
- SF1 = -2.538370139 m^{-3}
- SD4 = 15.81285482 m^{-3}
- SF5 = -2.164724541 m^{-3}
- SF6 = 6.58114331 m^{-3}

3.3 Effect of SD0 Misalignment.

Concerning σx:

A wider linear regime for SD0 horizontal displacement in the ATF2 Ultra-low βy.

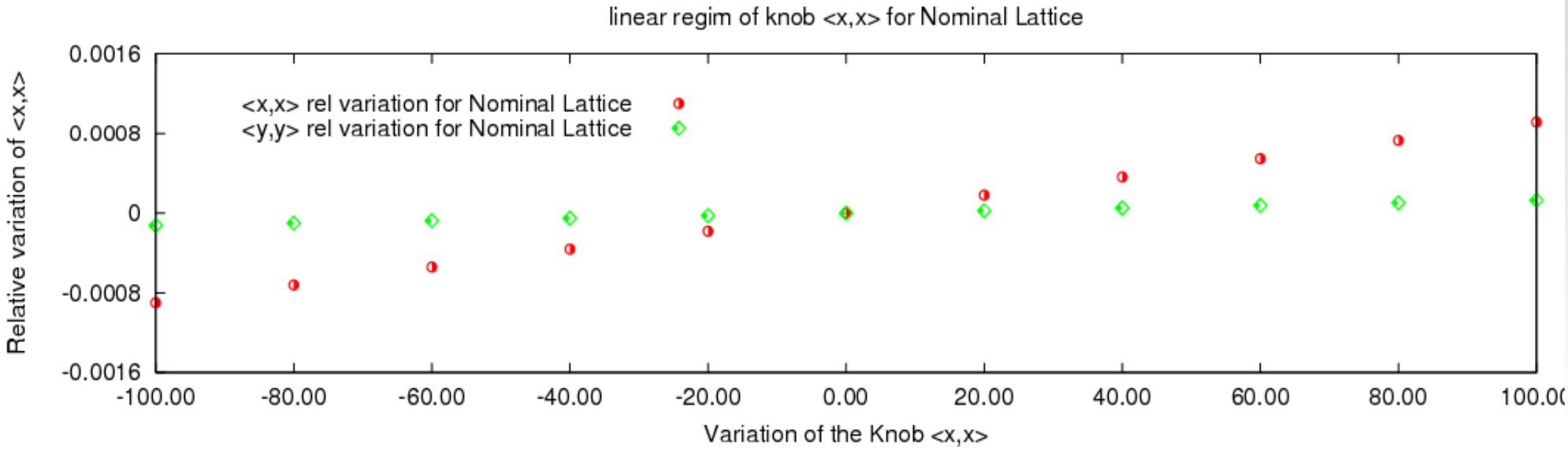


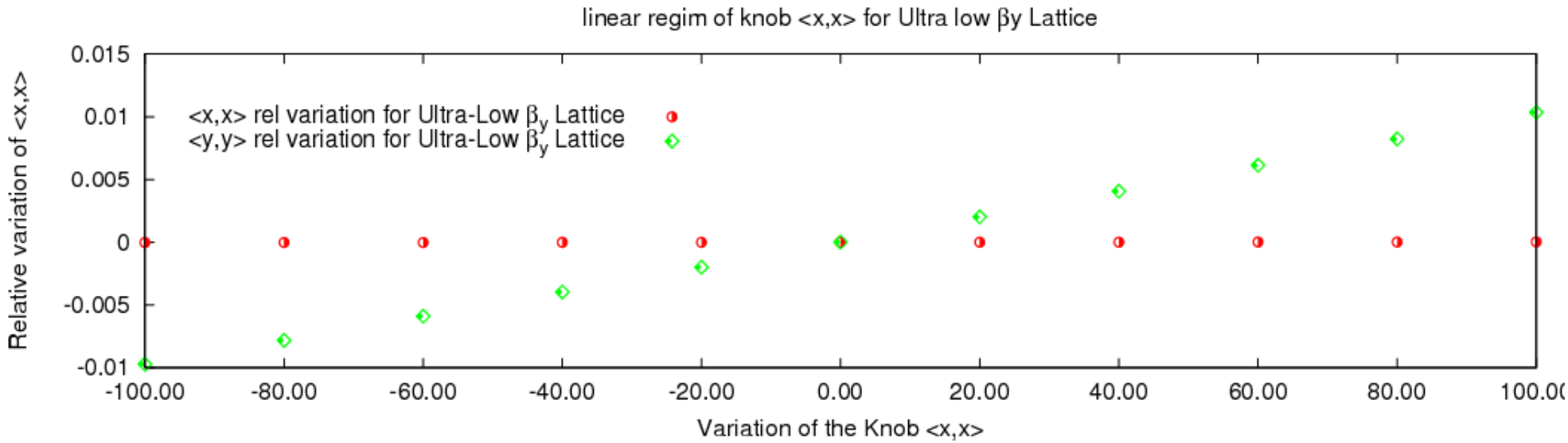


Concerning σy:

A short linear regime for SD0 horizontal displacement in the ATF2 Ultra-low βy.

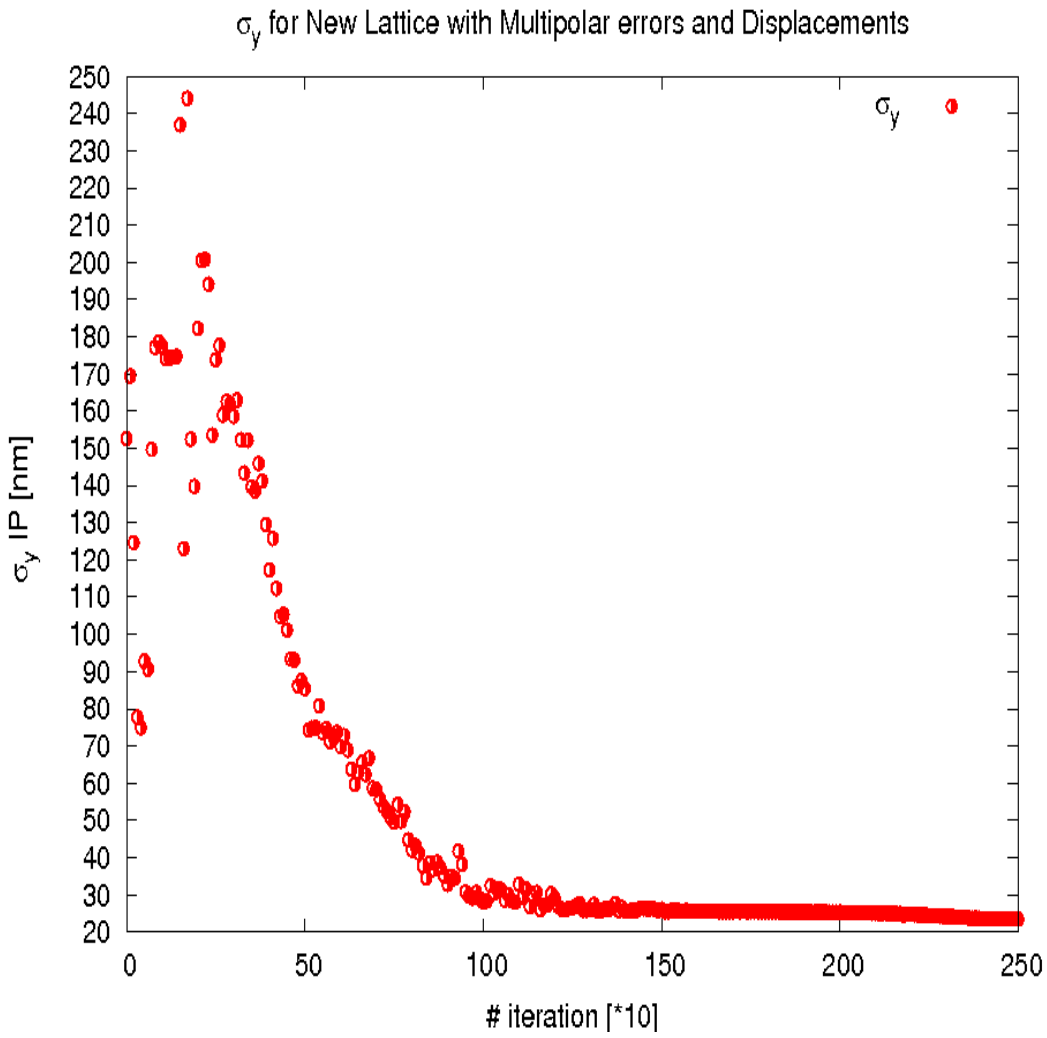
3.4 Effect of Knob_(σ_x) for Ultra-low Lattice.





4. First FFS Tuning.

- Ideal Tuning via Mad-x & Mapclass using the Simplex algorithm
  - Including Multipolar errors.
  - Constraints: minimizing σy
  - Variables: Misalignments of Quads & Sext



- Number of iterations needed ~ 1000.

(Non realistic tuning)

5. CONCLUSIONS & FUTURE PLANS

- The Dodecapole magnet alone solution is not sufficient.
- The ATF2 Ultra-Low β_y Lattice including multipolar errors and Misalignments has been obtained with a final σ_y =23.8 nm.
- Initial ideal Tuning without knobs.
- Knob generation under development

To be done...

- Obtaining valid Knobs for ATF2 Ultra-Low β_y Lattice.
- Realistic tuning performance with and without knobs.