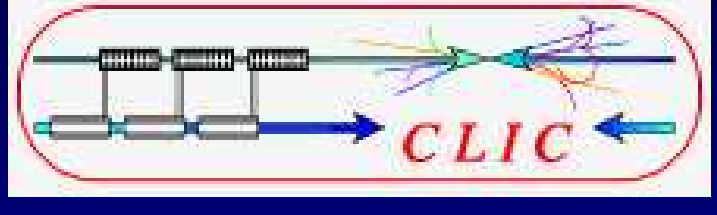
CLIC BDS alignment and FFS tuning also for ATF2 ultra-low betas

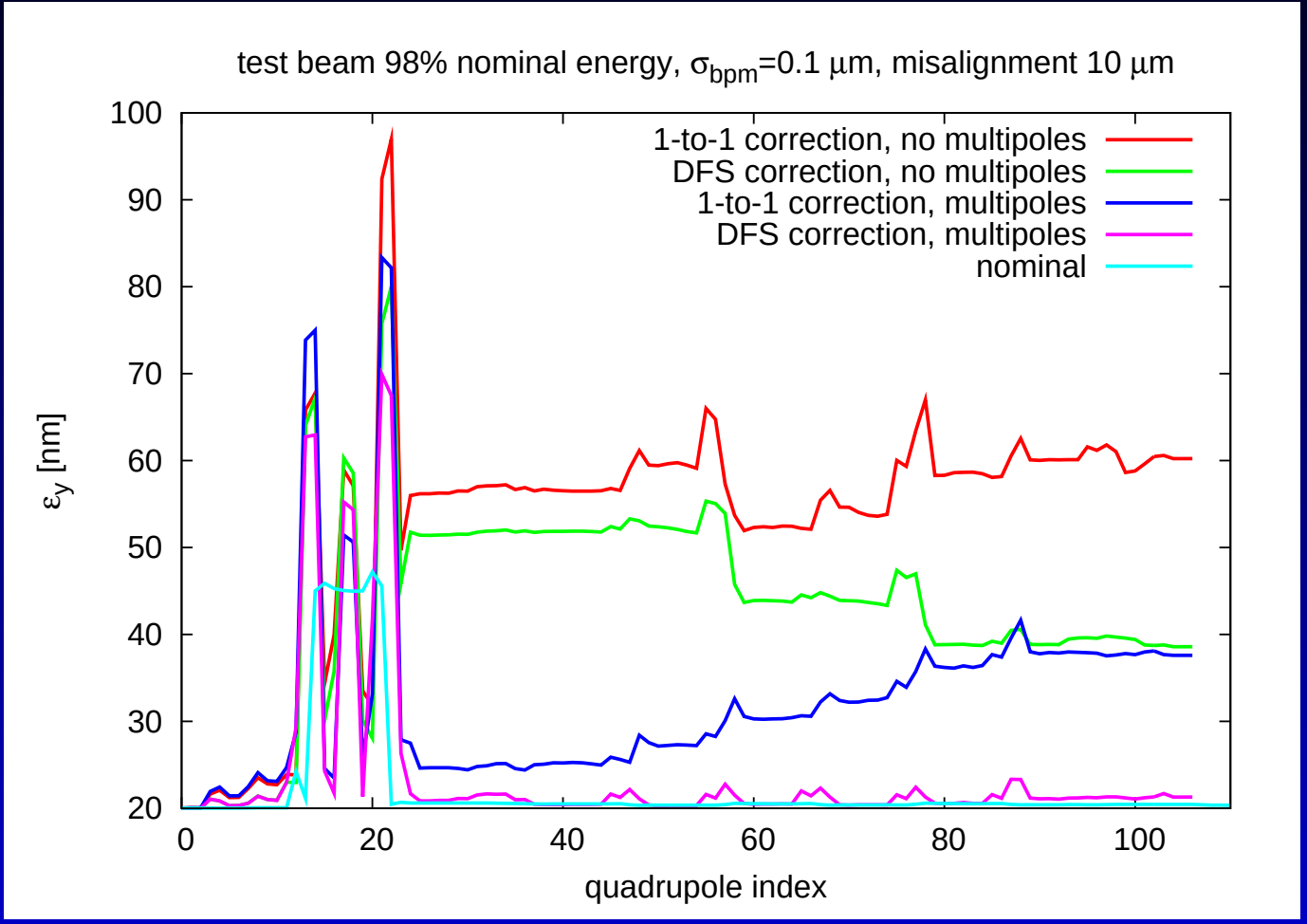


R. Tomás

Thanks to A. Latina, G. White, D. Schulte, Y. Renier, P. Bambade, S. Bai, F. Zimmermann, etc

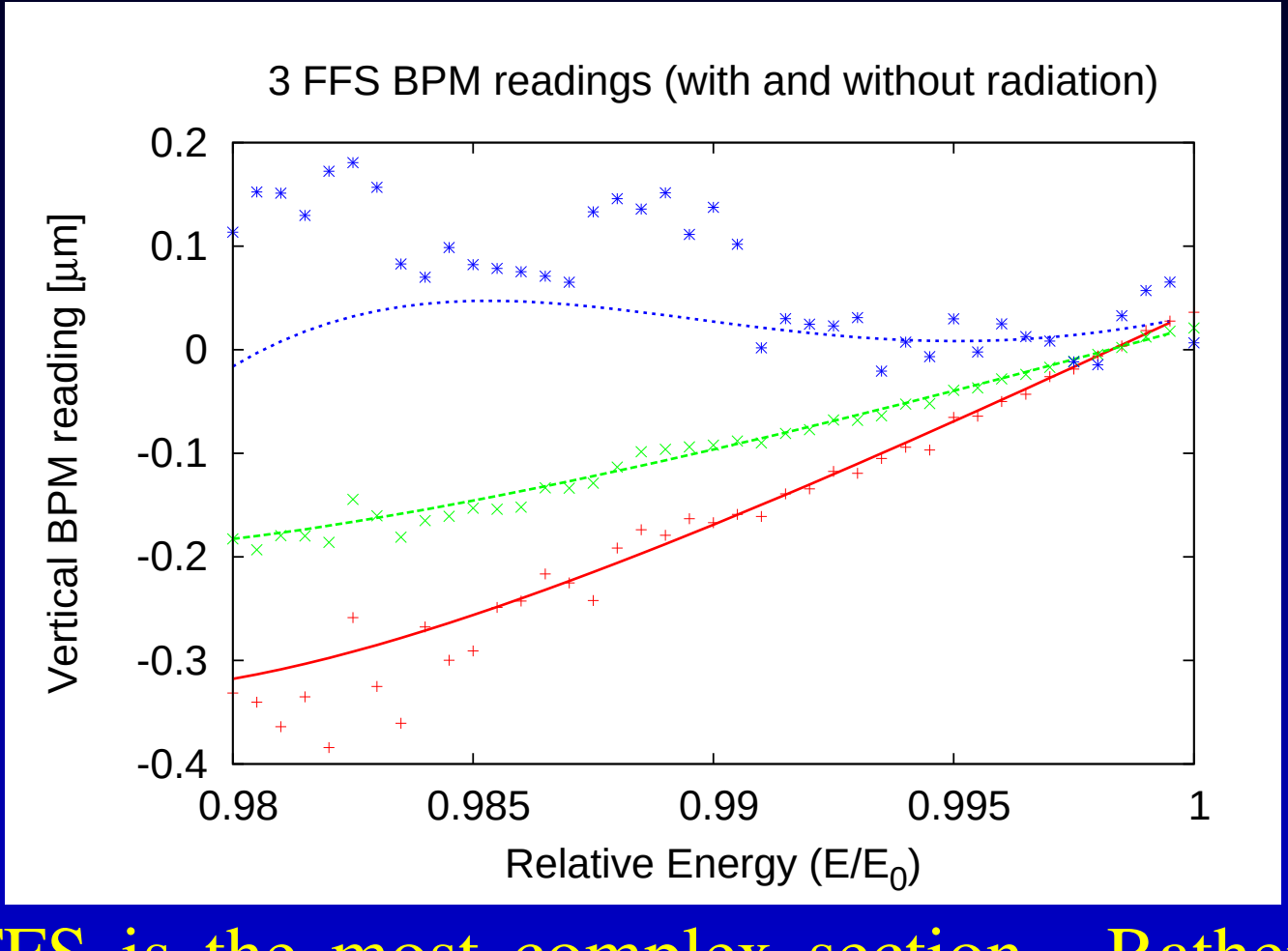
CLIC'08

Alignment of the collimation section



→ Dispersion Free Steering works in the collimation section.

The more complex FFS



The FFS is the most complex section. Rather than align the FFS, general tuning algorithms must be used.

Tuning algorithm I

- Using knobs for tuning was abandoned because of small linear range:

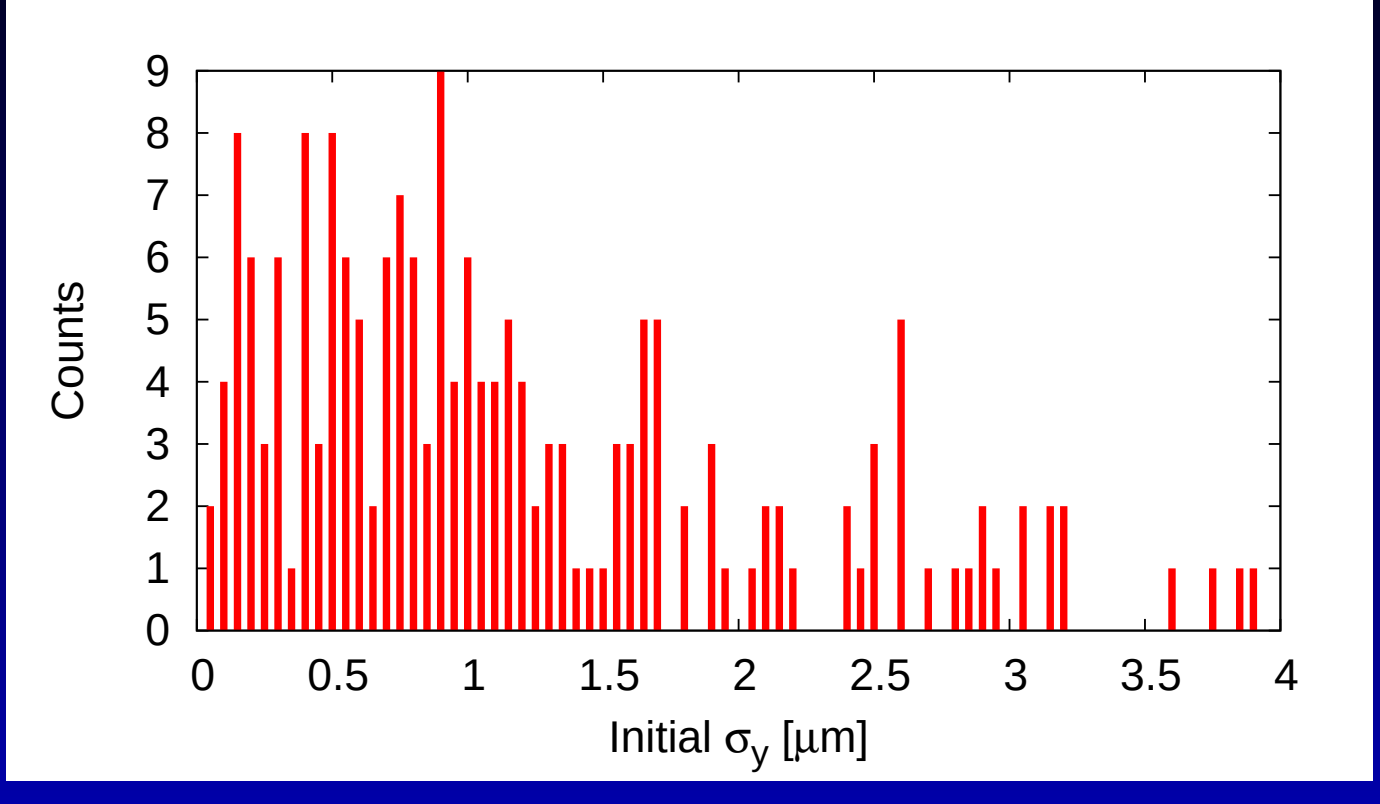
  http://accelconf.web.cern.ch/ AccelConf/e06/PAPERS/MOPLS094.PDF

- Tuning algorithm is a Simplex having:
  variables:x, y, roll and magnet strength
  observables:Luminosity and BPM reading
  optional
- However, knob generation might need to be revisited

Tuning algorithm II

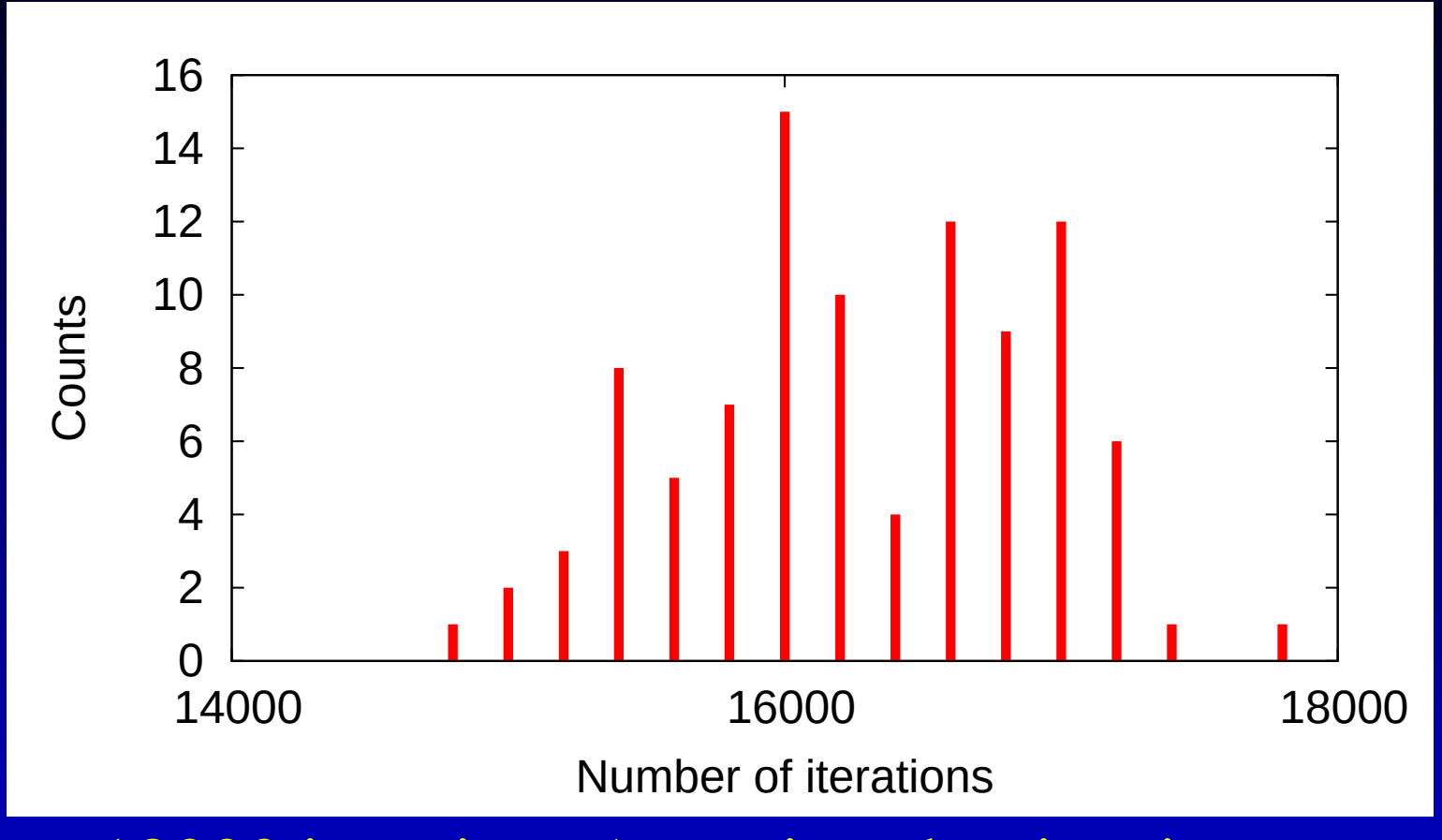
- Simplex varying all x/y/tilt displacements and strengths of FFS magnets to minimize rms σ_y and σ_x
- Includes: initial misalignments, 10^{-4} random errors in all magnet strengths, error on luminosity of 5%.
- Does not include: Jitter from DR, mover speed, mover ranges, multipolar errors...

Initial sigma with errors



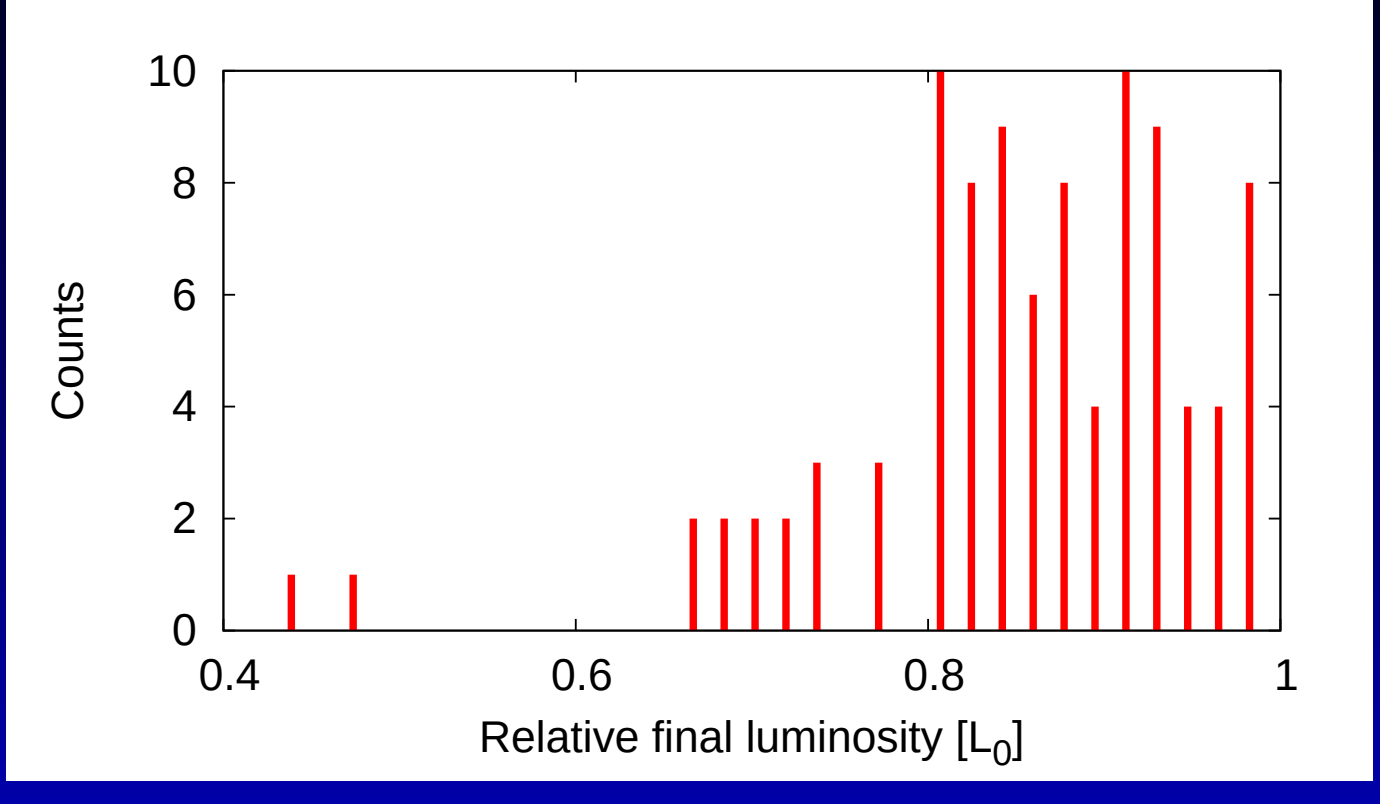
Up to 4μm to be tuned down to 1nm.

Tuning iterations



Up to 18000 iterations (meaning: luminosity measurement with 5% rel. error)

Luminosity after tuning

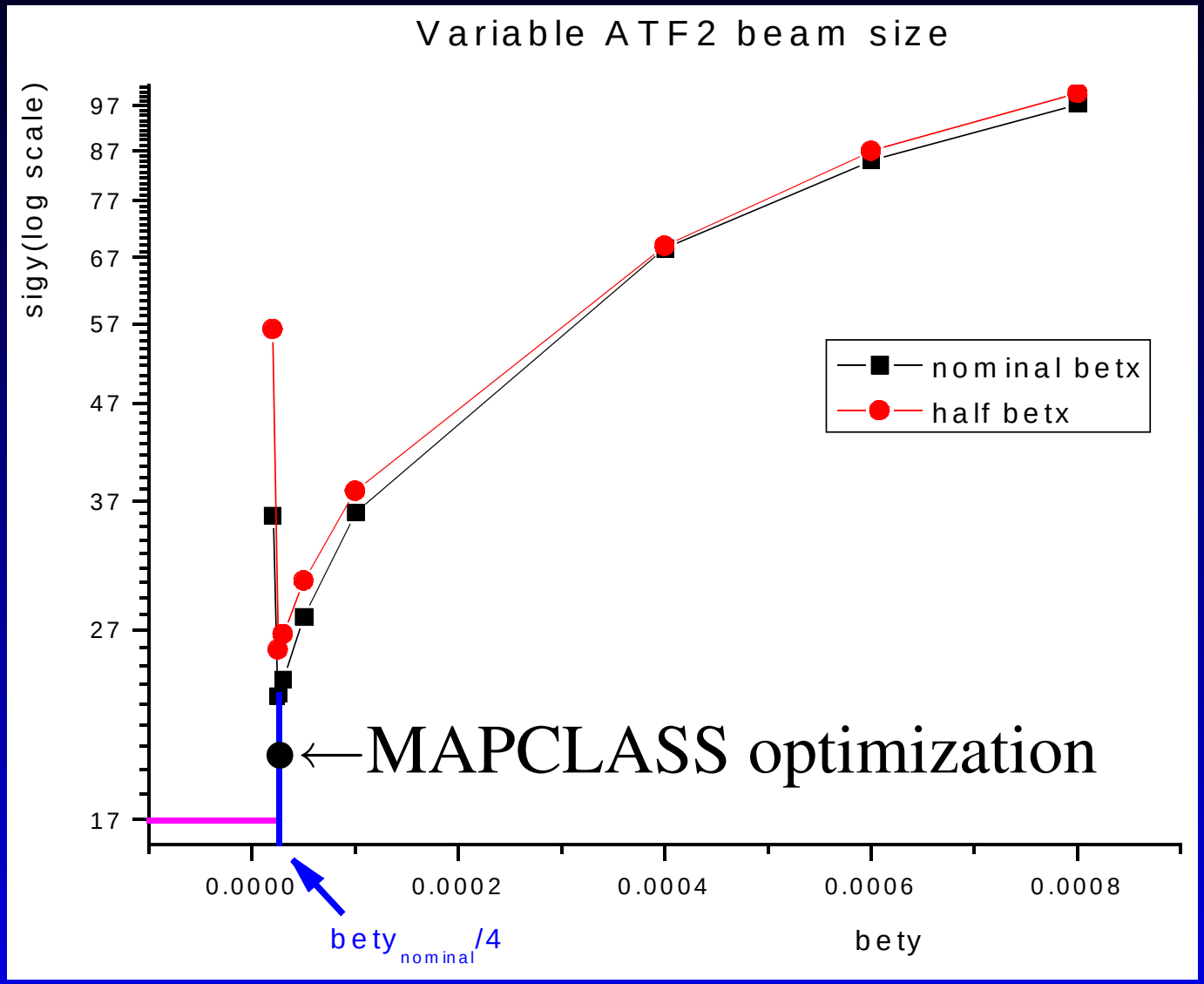


80% of the seeds give more than 80% of the design luminosity $\rightarrow$ 20% fail.

How to fix this?

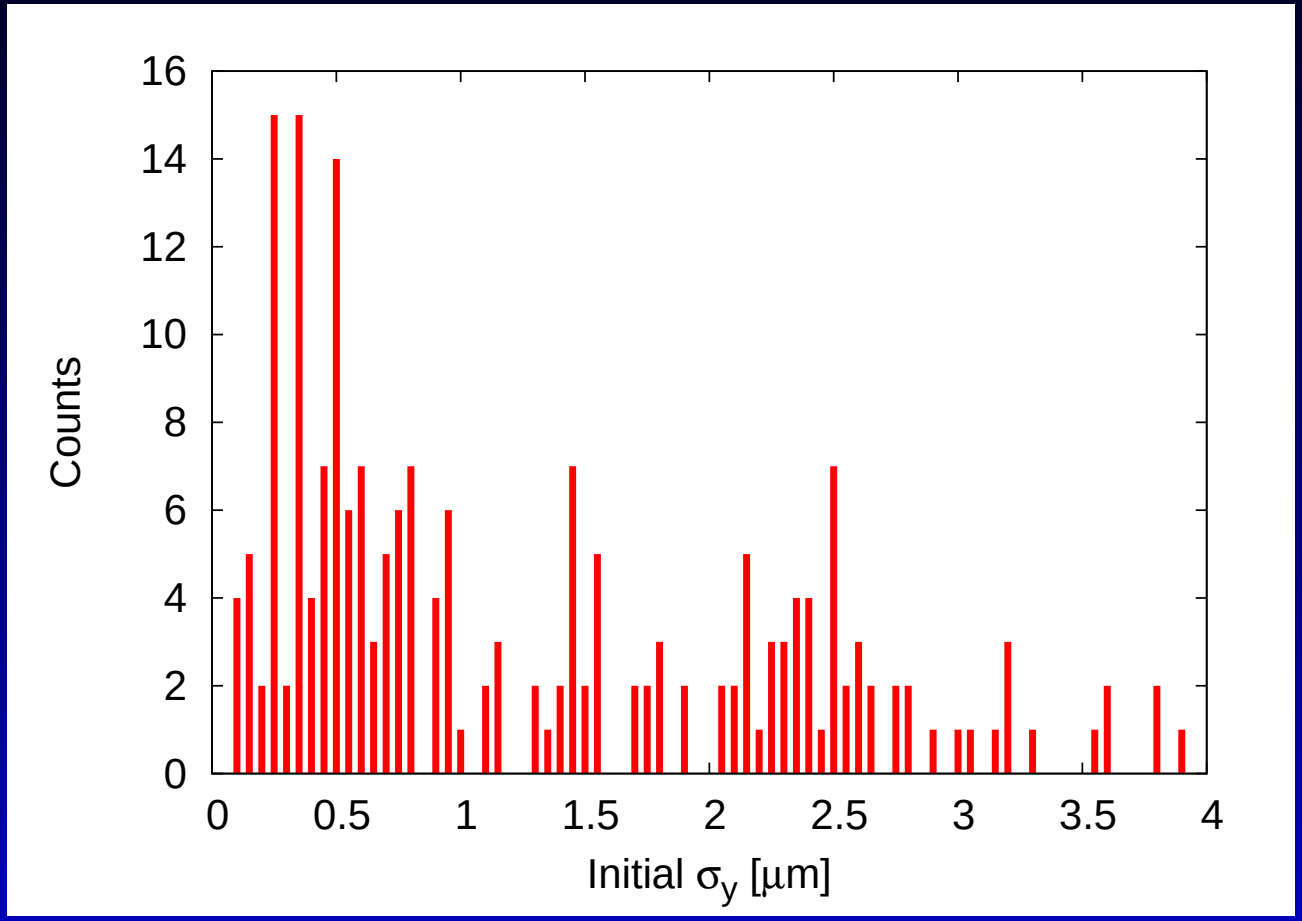
- Reduce the complexity of the system by either reducing performance or increasing the length (P. Raimondi's proposal)
- Devise more clever algorithms than the Simplex
- Test in ATF2 with the possibility of a wide range of β^*

Wide β^* range



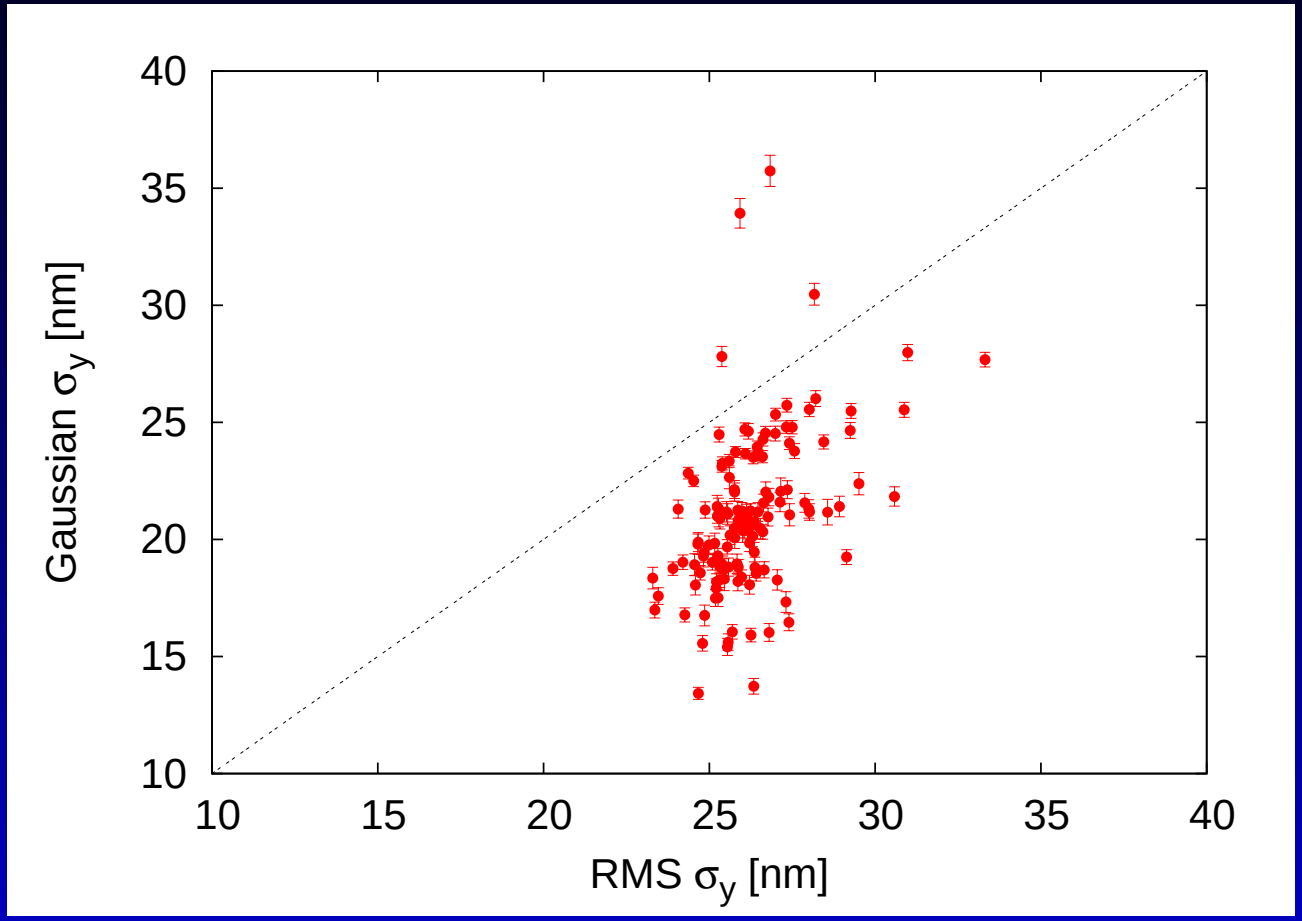
Great chance to understand tuning difficulty!

ATF Initial σ_y for 150 seeds



Up to 4μm of initial σ_y (same as CLIC!).

ATF2 β_y^*=0.025mm



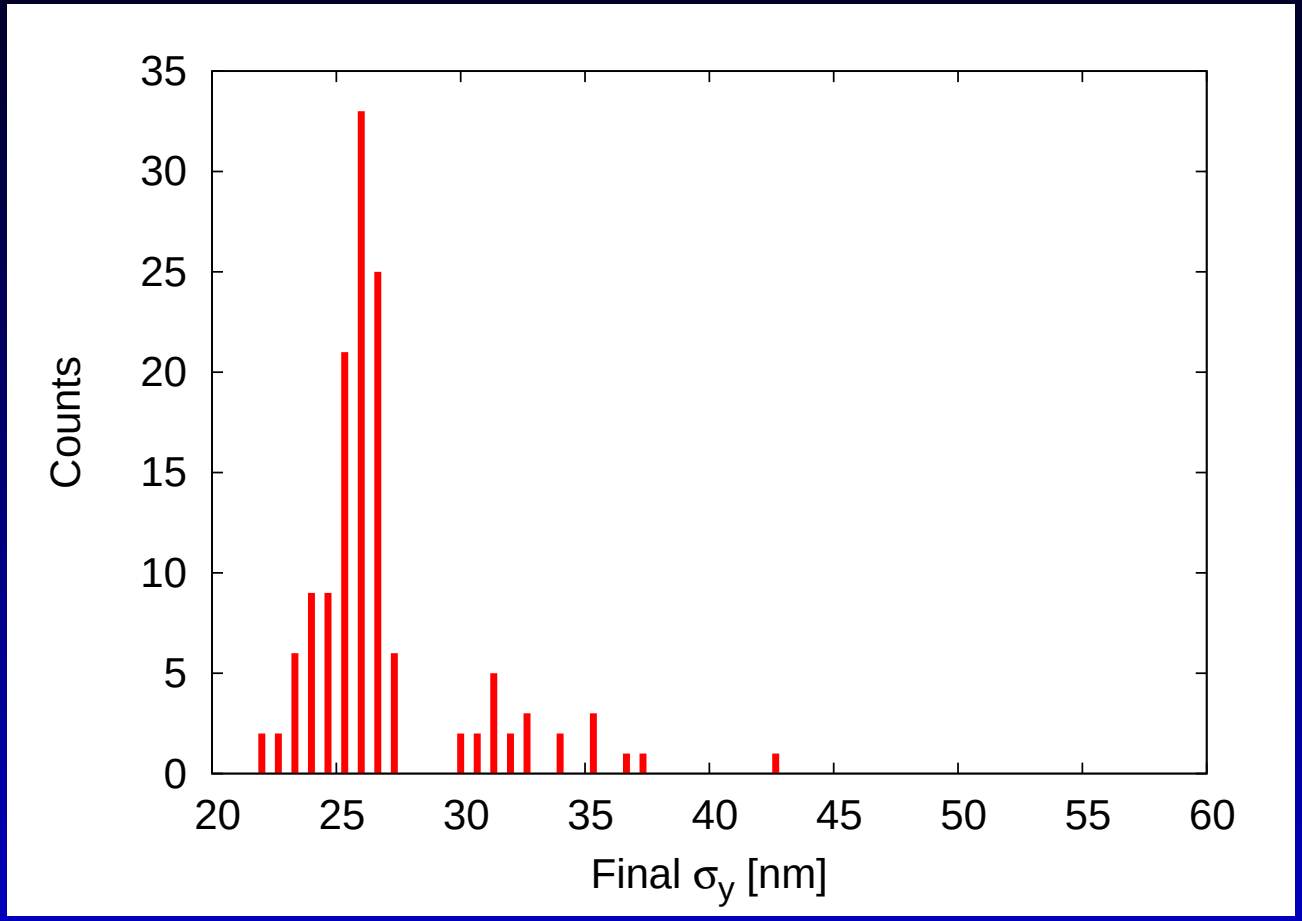
Rising discrepancy between rms and Gaussian fit, what does the Shintake monitor do?

Summary table

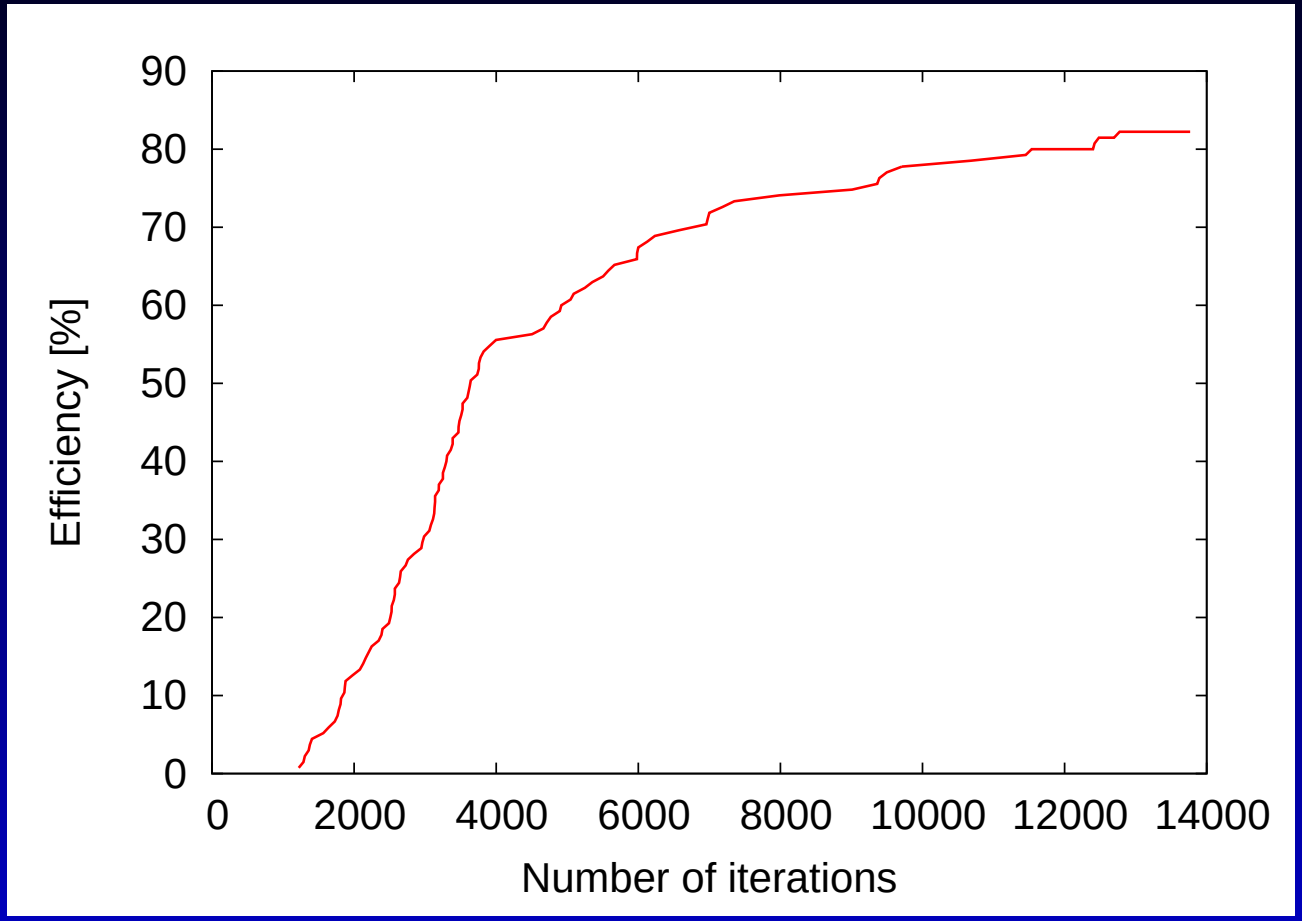
case	Max. tuning time	Ratio of success
β_y=0.1mm	5.5 days	100%
β_y=0.05mm	8 days	90%
β_y=0.025mm	10 days	80%

Very preliminary results but clear conclussion:
tuning difficulty increases for smaller β_y
$\rightarrow$ Another ATF2 challenge!

Final spot size for β_y=0.025mm



Success versus time, β_y=0.025mm



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