



Comprehensive redesign of CLIC MB Injector

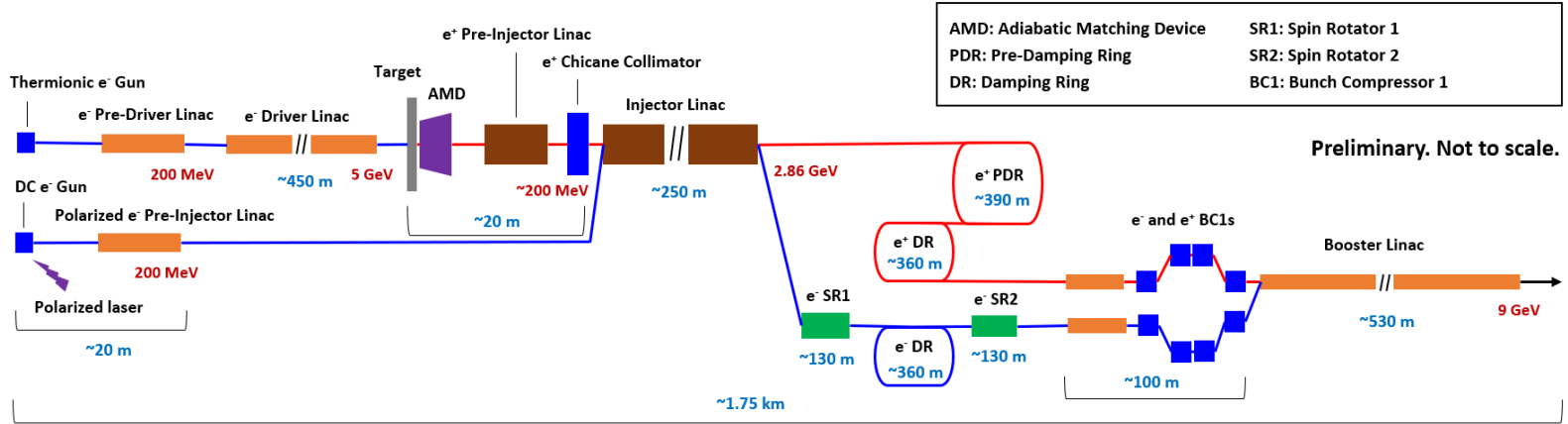
Y. Zhao, S. Doebert, A. Grudiev, A. Kurtulus, A. Latina, CERN

CLIC MB Injector Meeting

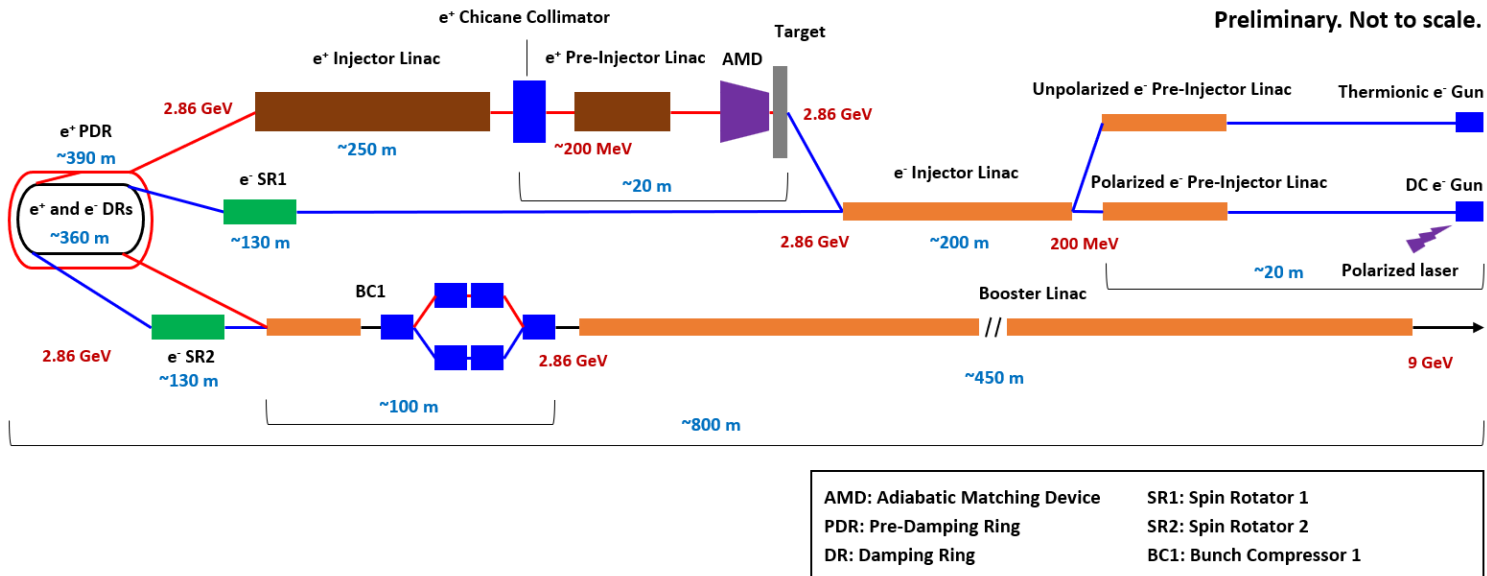
02/12/2024

Layout

- Old (baseline)

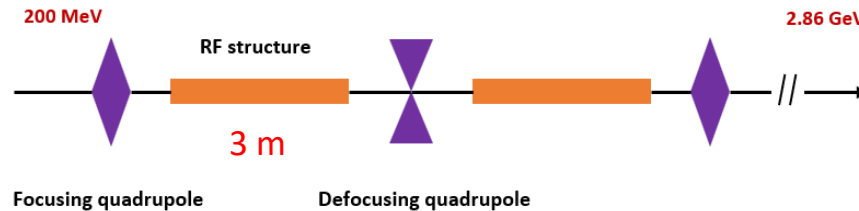


- New (alternative)



New e- Injector Linac

- Layout



- RF structure

- $f = 2 \text{ GHz}$, $L = 3 \text{ m}$, $\Delta\phi = 2\pi/3$ per cell, $N_{\text{cell}} = 30$, $G = 16.48 \text{ MV/m}$ ($\leq 16.74 \text{ MV/m}$), $\phi = 0^\circ$
- $a_0 = (19.5+14.5)/2 = 17 \text{ mm}$, $d_0 = (2.86+4.26)/2 = 3.56 \text{ mm}$

- Beam parameters (DBA @ 380 GeV)

- $\delta_E = 1\%$, $\sigma_z = 1 \text{ mm}$, $Q_b \sim 1 \text{ nC}$
- Polarized e-: $\epsilon_{n,x,y} = 10 \text{ um}$, Unpolarized e-: $\epsilon_{n,x,y} = 50 \text{ um}$

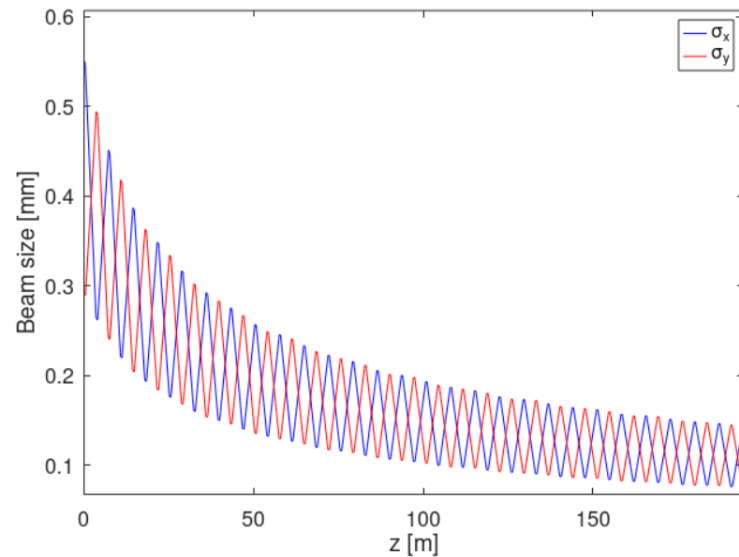
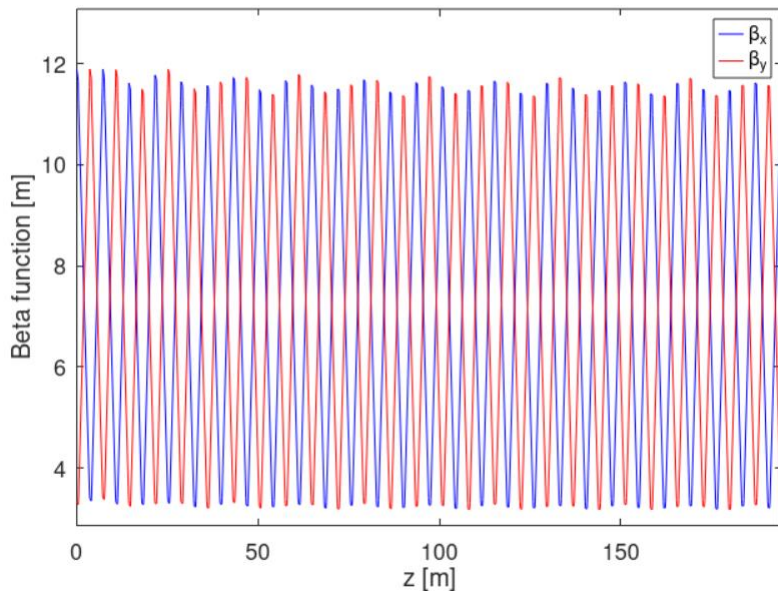
- FODO lattice

- FODO phase advance: 76.345° , $k_1 \sim 0.8584 \text{ m}^{-1}$, 54 structures (2 structures per module, not including spare module)

New e- Injector Linac

- Results from RF-Track

Parameter	Unit	Value
Final E	GeV	2.860
Final E spread	%	0.15
Emittance growth	um	0

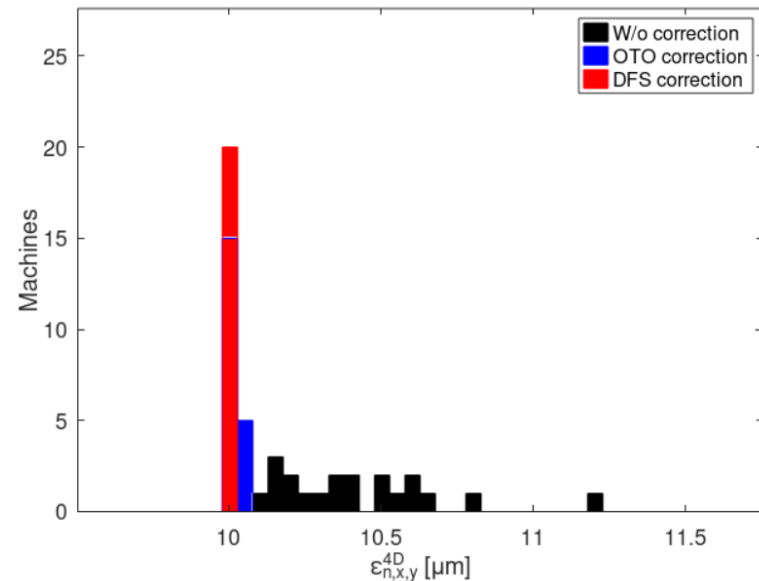
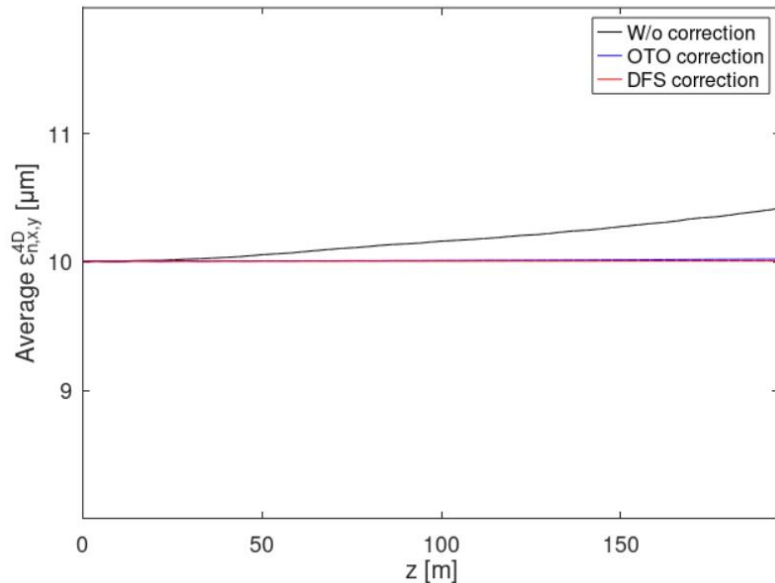


New e- Injector Linac

- Imperfections

- **Position** error (x, y): $\sigma = 100 \mu\text{m}$ (Quads, RFs, BPMs)
- **Angular** error (roll, pitch, yaw): $\sigma = 100 \text{urad}$ (Quads, RFs, BPMs)
- **BPM resolution**: $\sigma = 1 \mu\text{m}$

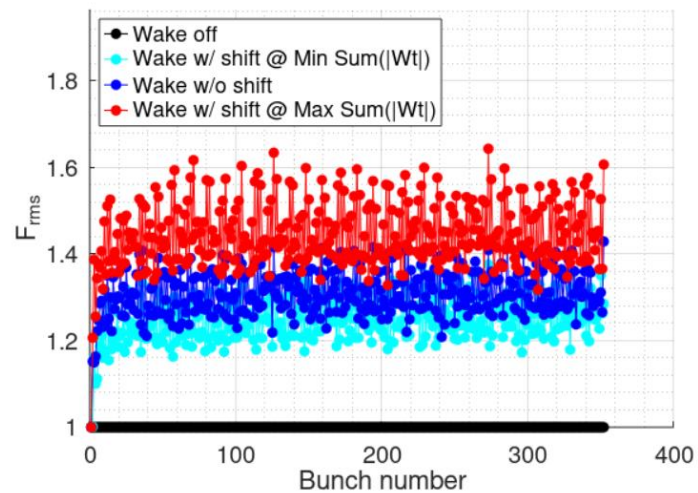
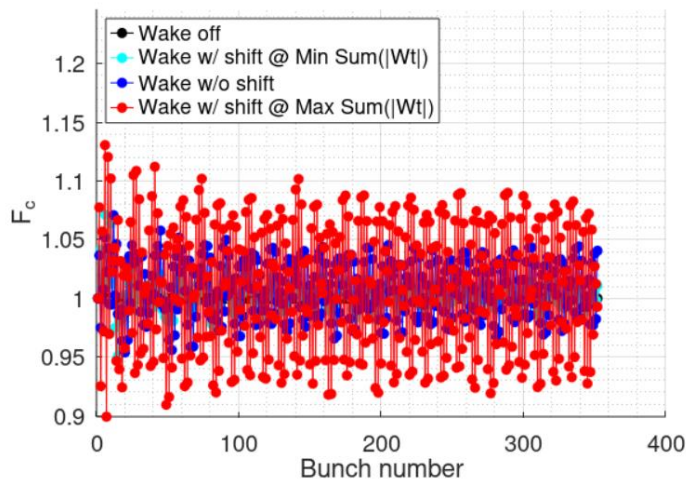
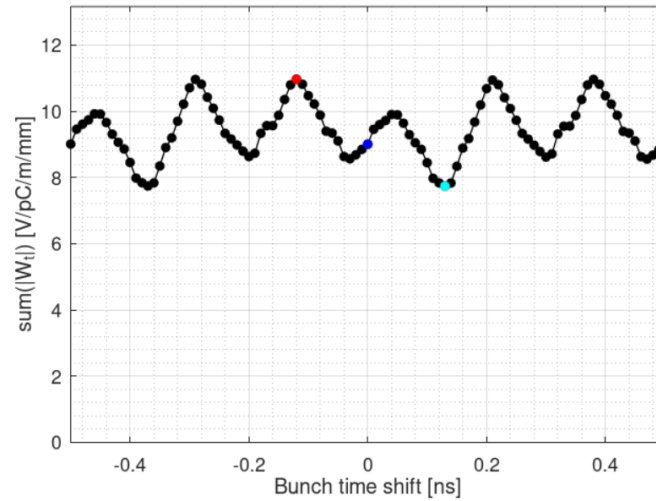
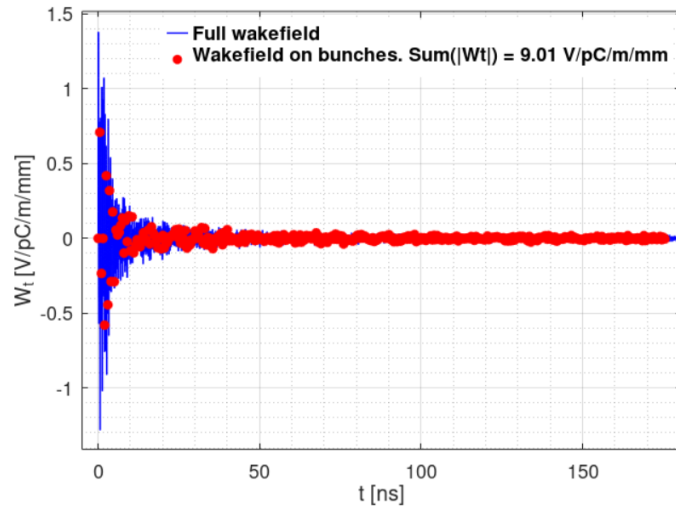
- BBA



New e- Injector Linac

- Jitter amplifications

$a_0 = 17 \text{ mm}$

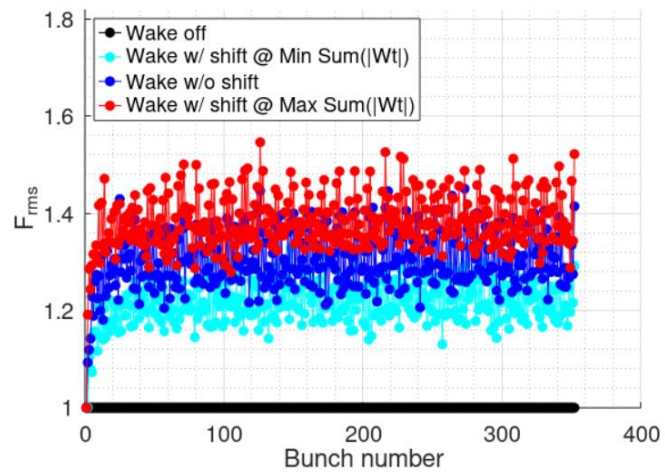
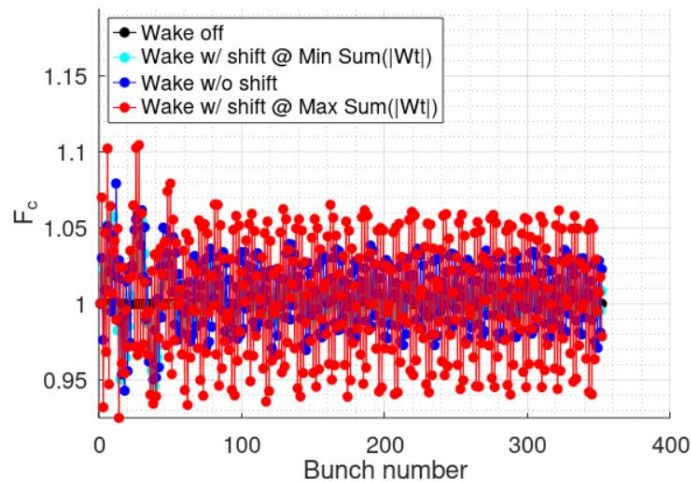
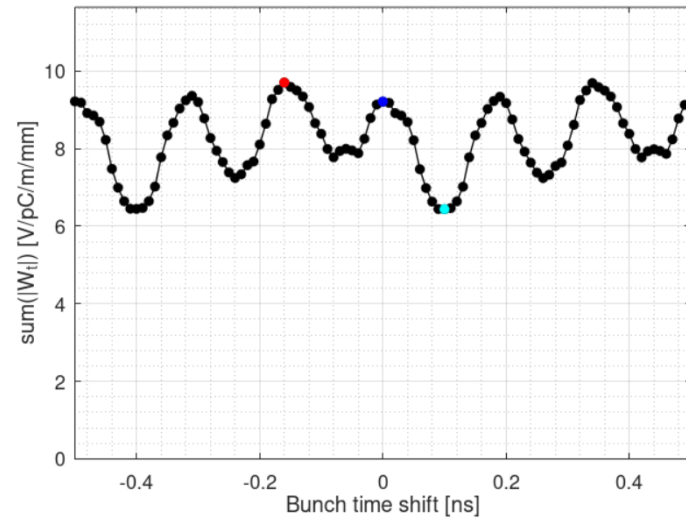
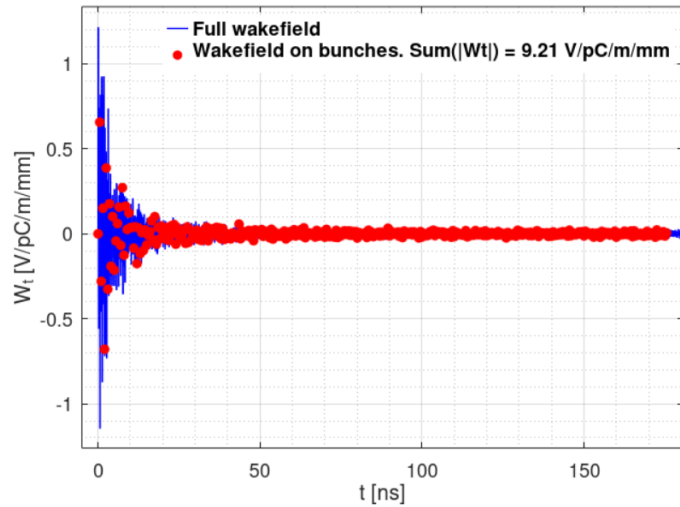


New e- Injector Linac

- Jitter amplifications

$a_0 = 18 \text{ mm}$

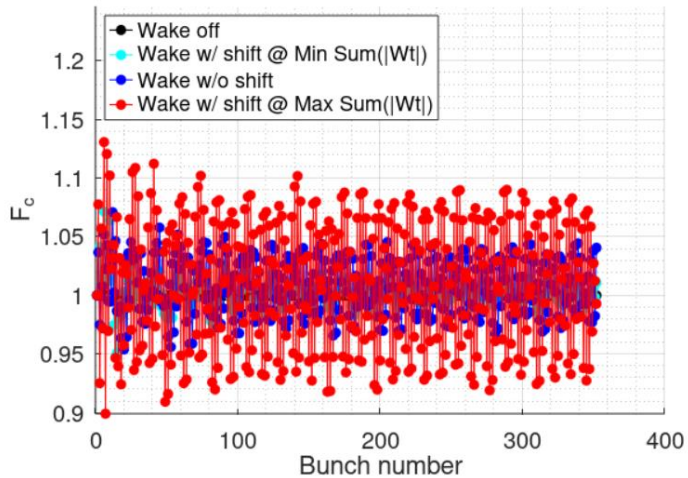
Average, Max, Min are smaller than $a_0 = 17 \text{ mm}$



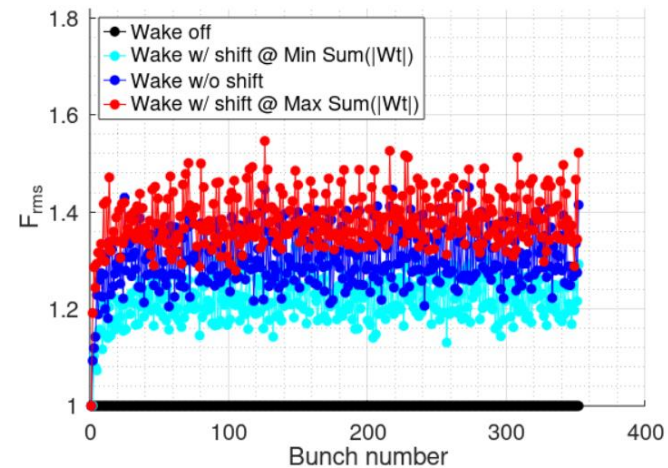
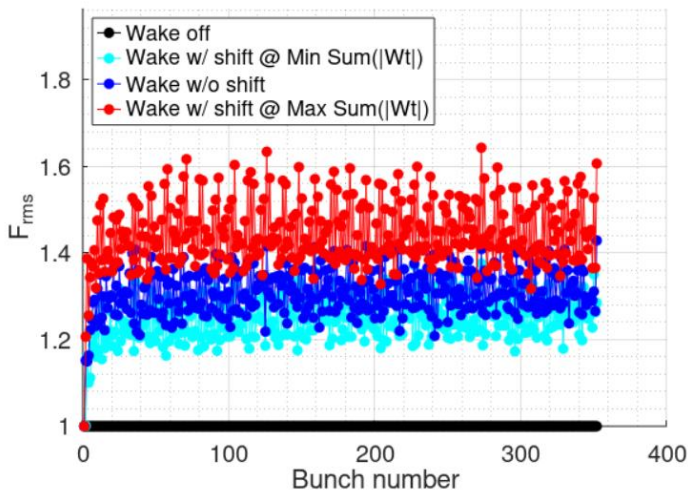
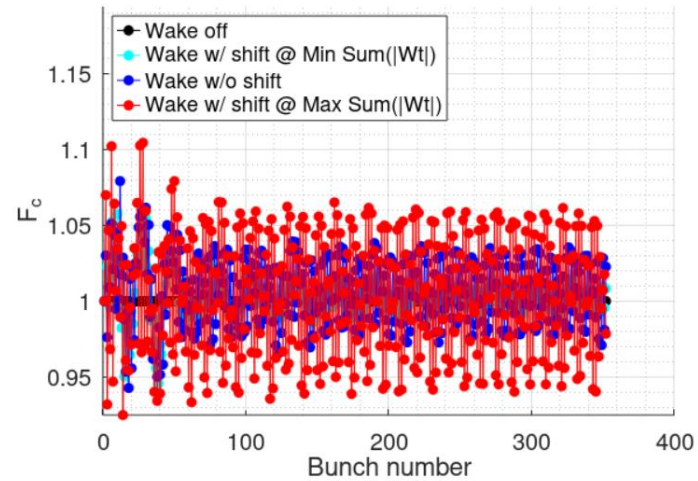
New e- Injector Linac

- Jitter amplifications

$a_0 = 17 \text{ mm}$



$a_0 = 18 \text{ mm}$



Conclusions

- For long-range wake, $a_0 = 18$ mm seems better than $a_0 = 17$ mm.
- e- Injector Linac well designed. No emittance growth. Final energy spread is 0.15% @ 2.86 GeV. BBA works very well. Jitter amplification seems OK ($F_c \sim 1.0$, $F_{rms} \sim 1.4$).
- e+ Injector Linac design, simulation and jitter amplification study in progress

BACKUP