Passive SC HC with collective effects in SOLEIL II

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Preliminary model: TDR 1

Impedance model – TDR1

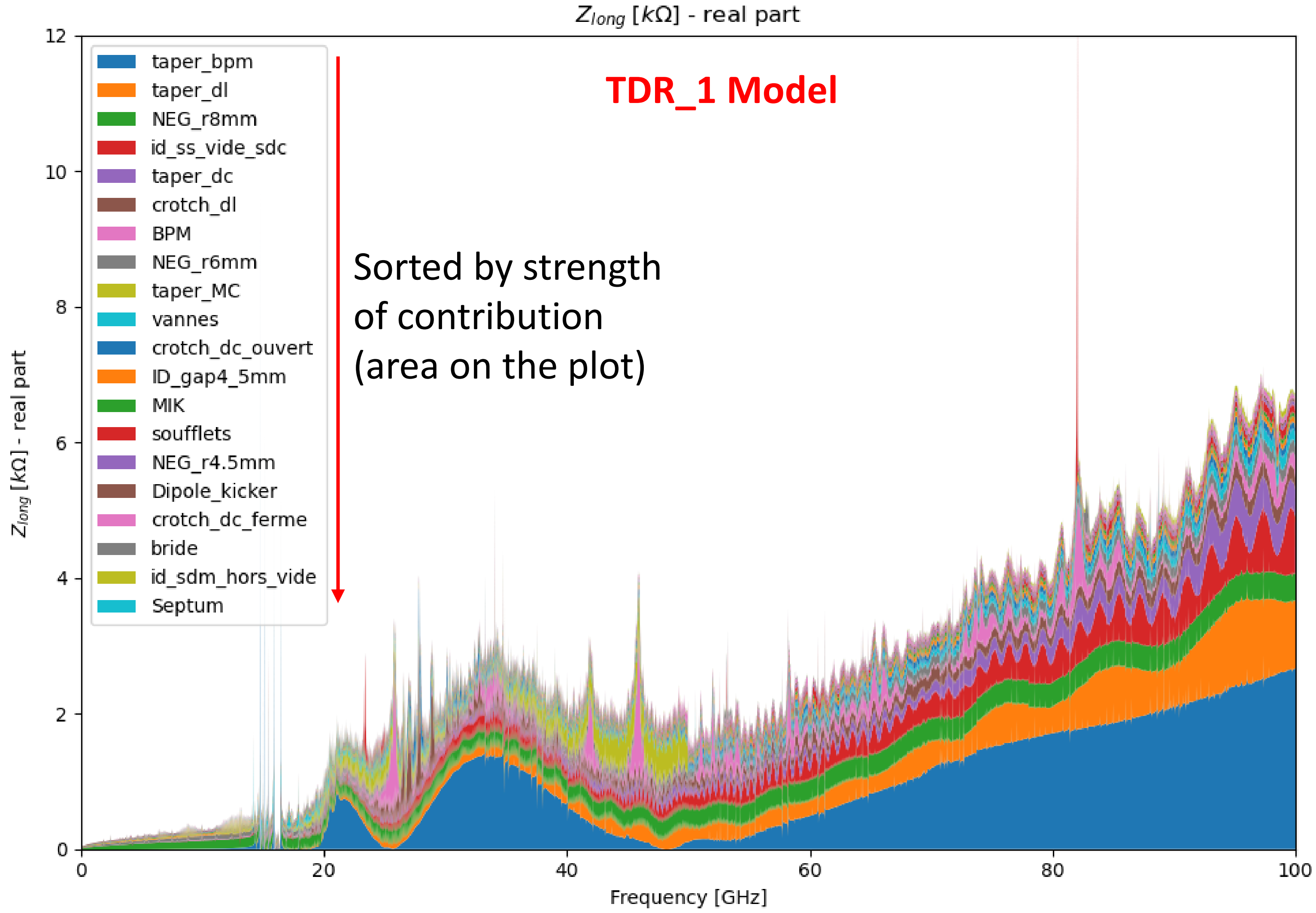
Impédance géométrique :

Objet	Modèle	Nombre
BPM	BPM_retrait200 avec corps en cuivre	180
Bride	Retrait de 50 um sur 1.6 mm	448
Vannes	Lame RF avec courbure de 1 mm	40
Soufflets	Transition à peigne. (7b_v4)	220
Crotch	Dipôle court avec sortie 0°	40
Crotch	Dipôle court fermé	40
Crotch	Dipôle long fermé	64+12
Tapers	Dipoles longs	76
Tapers	Dipoles courts	40
Tapers	BPM	180
ID sous vide	SDC	8
ID hors vide	SDM	7
Taper	Cavité principale	1

Impédance resistive wall :

Objet	Modèle	Longueur
Chambre à vide r=6mm	NEG 0.5 um + cuivre Circulaire r= 6 mm	82.3 m
ID hors vide	NEG 0.5 um + cuivre Circulaire r= 4.5 mm	17.5 m
Dipôles + Blocs BPM	NEG 0.5 um + cuivre Circulaire r= 8 mm	152+68+18.9 = 238.9 m
ID sous vide	Cuivre Plaque parallèles gap = 4.5 mm	16 m
MIK	MIK_upgrade_Ti20um_real	7 x 0.15 = 1.05 m
Dipole Kicker	Dipole_kicker_wake	4 x 0.4 = 1.6 m
Thin Septum	Thin_septum_wake	0.6 m

Impedance model – Re(Zlong)



CDR Model

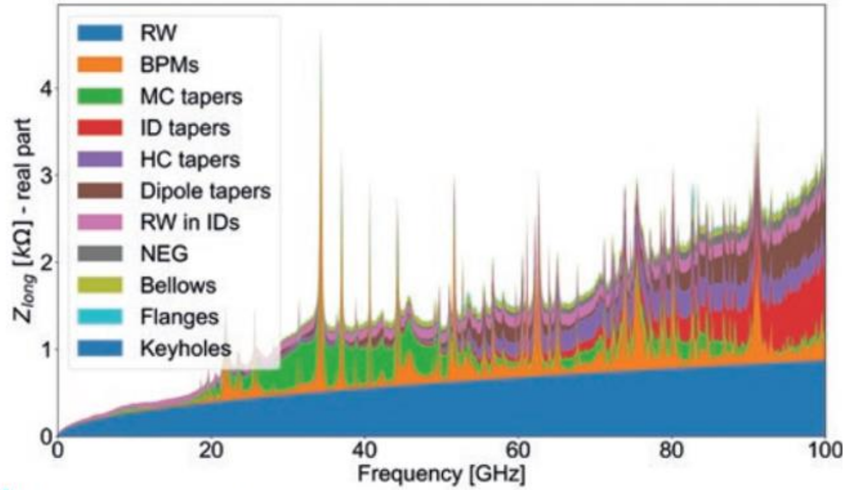
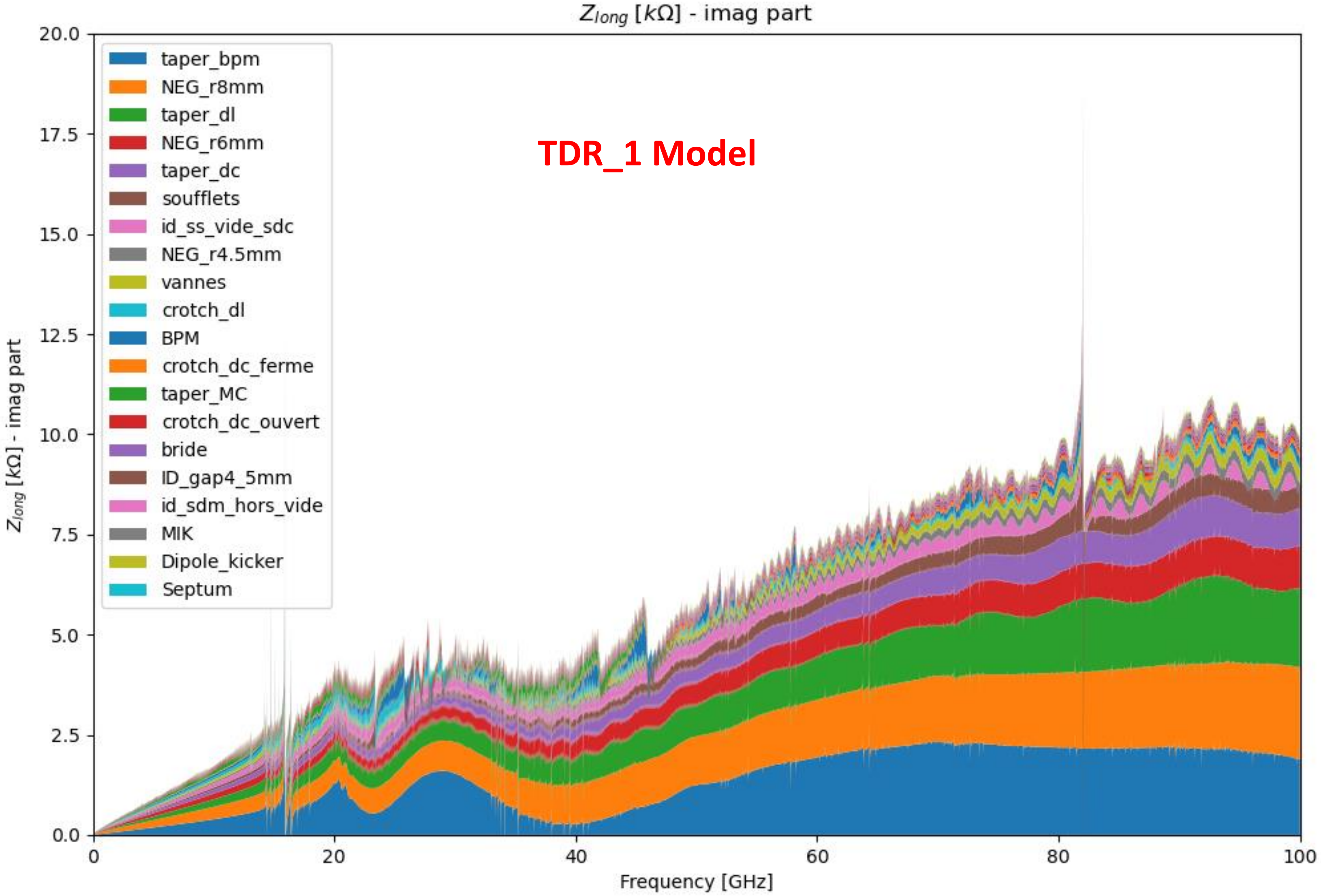


Figure 31: Real part of the longitudinal impedance

Impedance model – Im(Zlong)



CDR Model

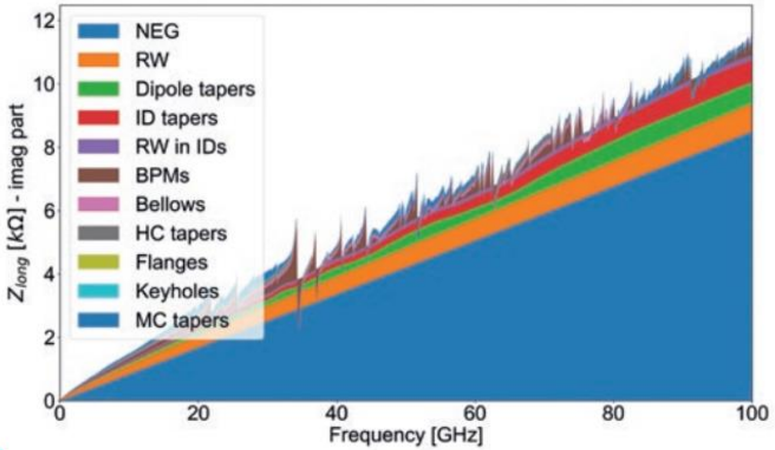
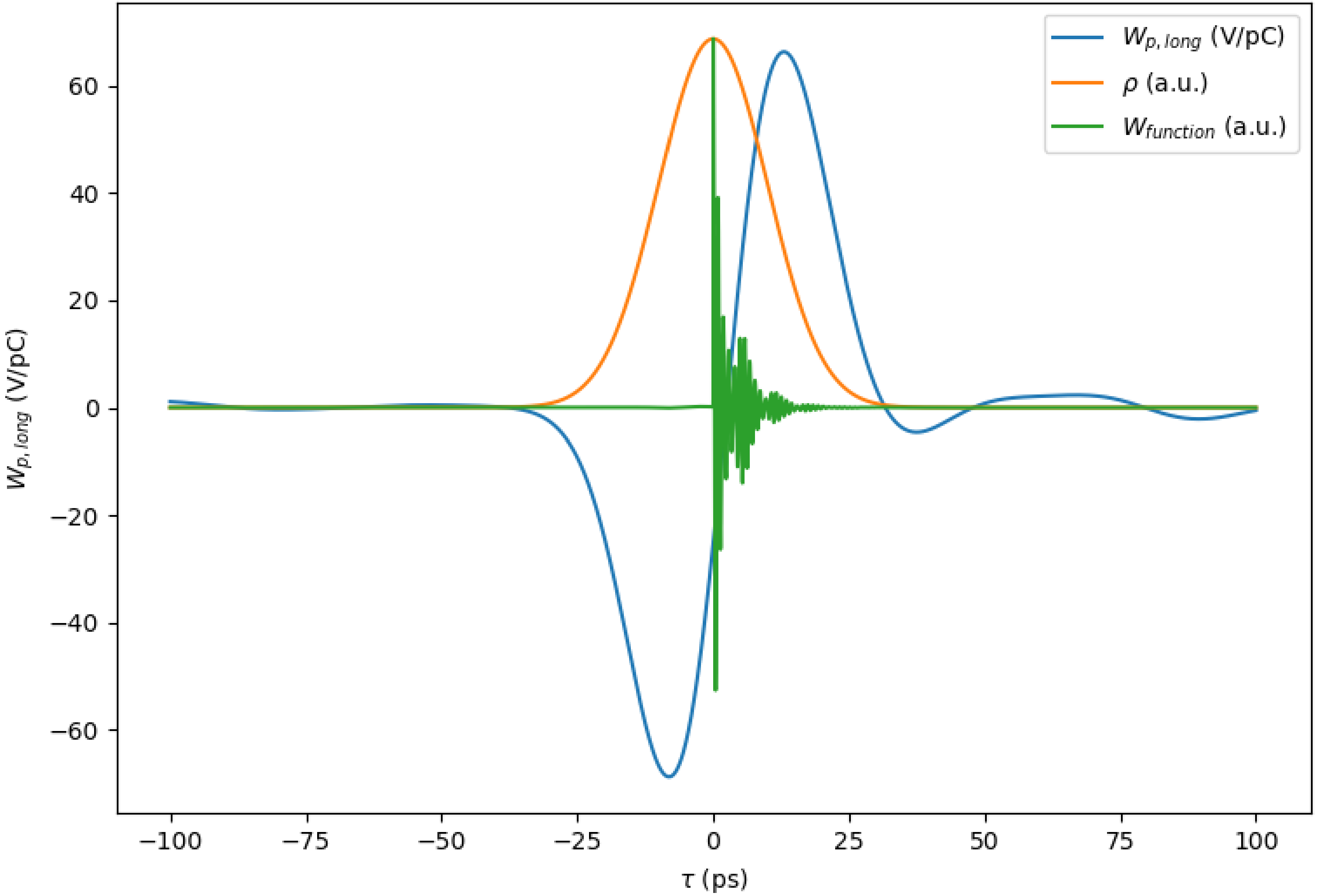


Figure 32: Imaginary part of the longitudinal impedance

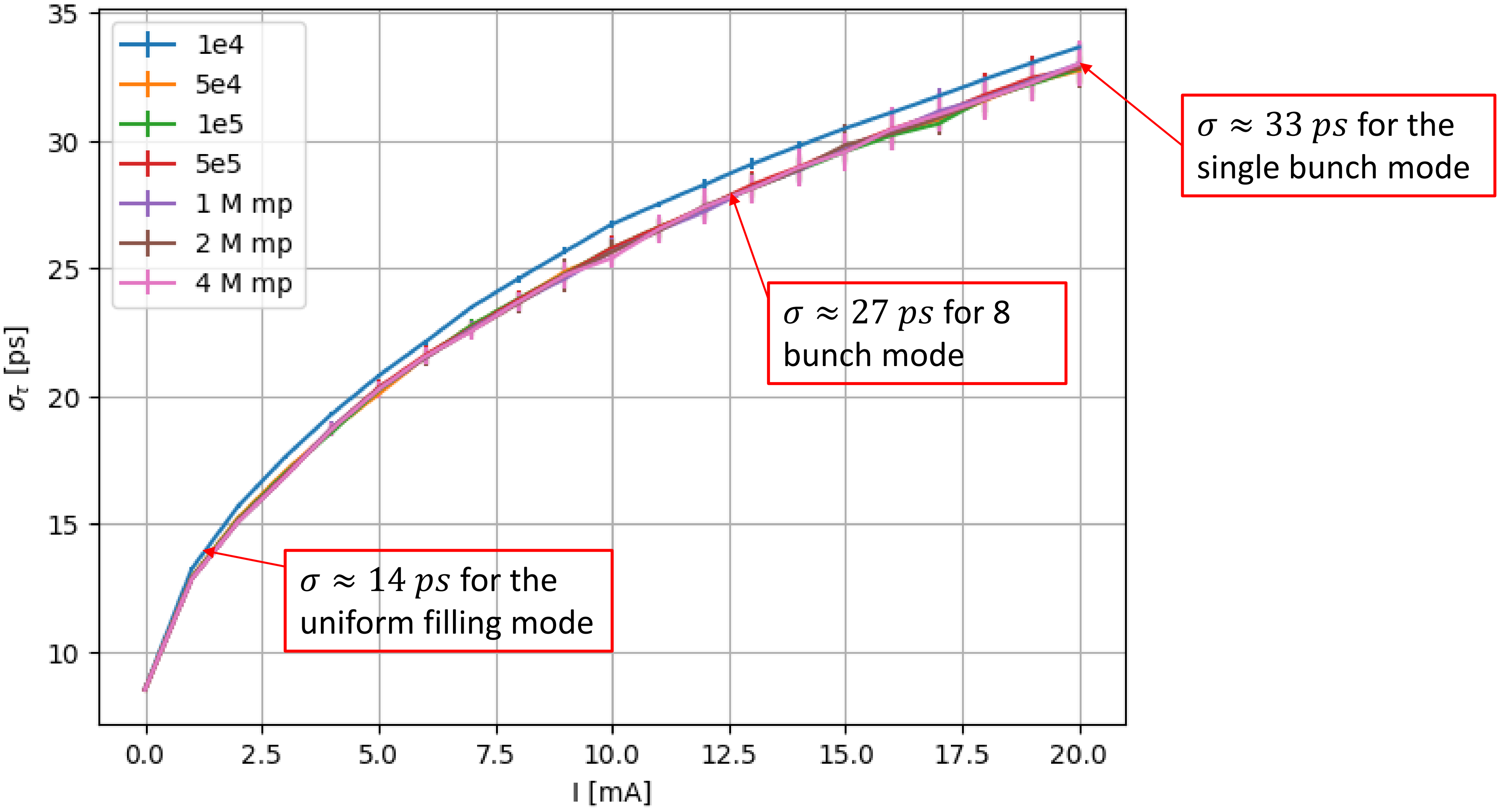
Reduction of NEG layer from 1 um to 0,5 um in the TDR_1 model

Impedance model - tracking

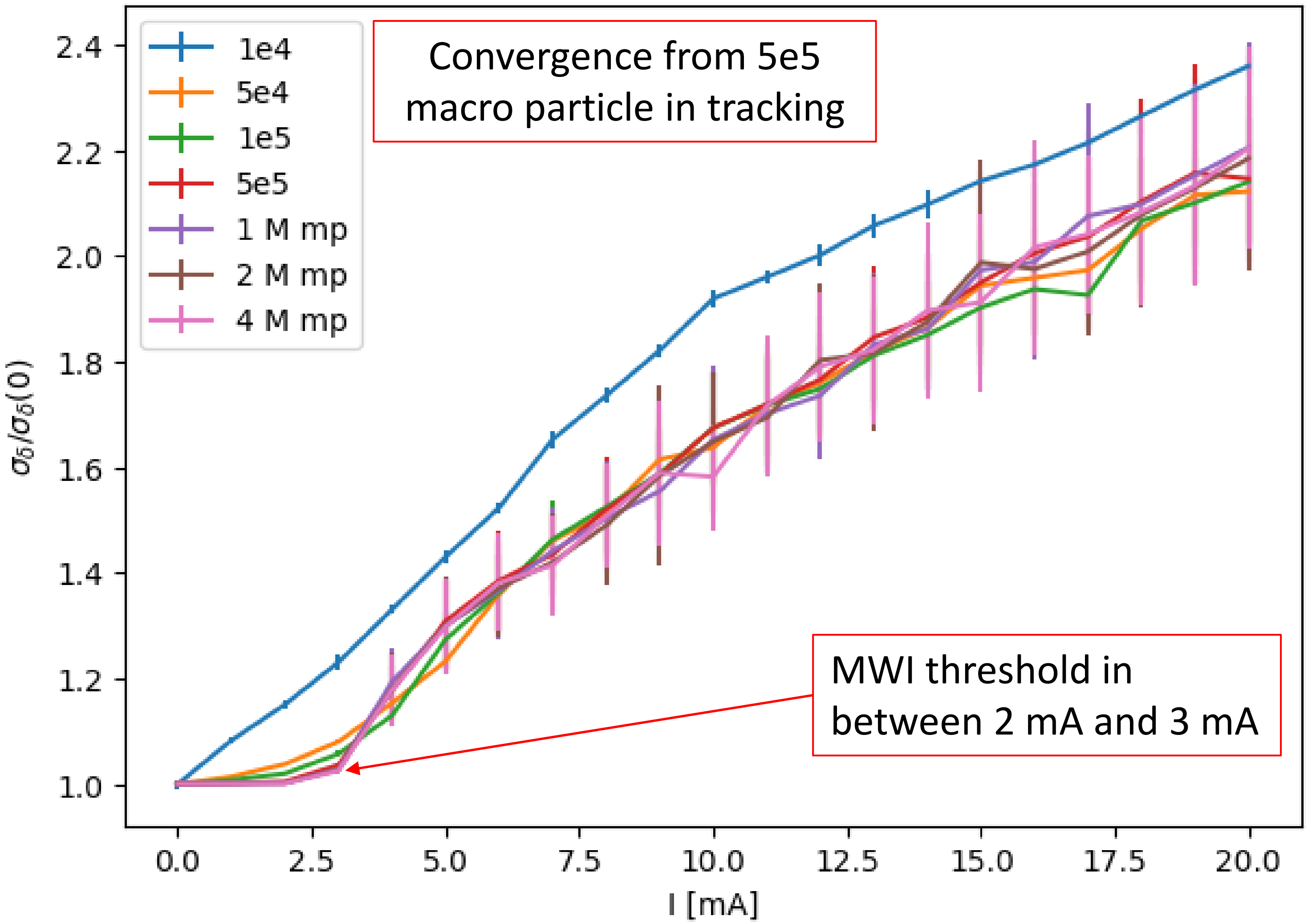


Tracking w/ model TDR1
(using v0356 lattice)

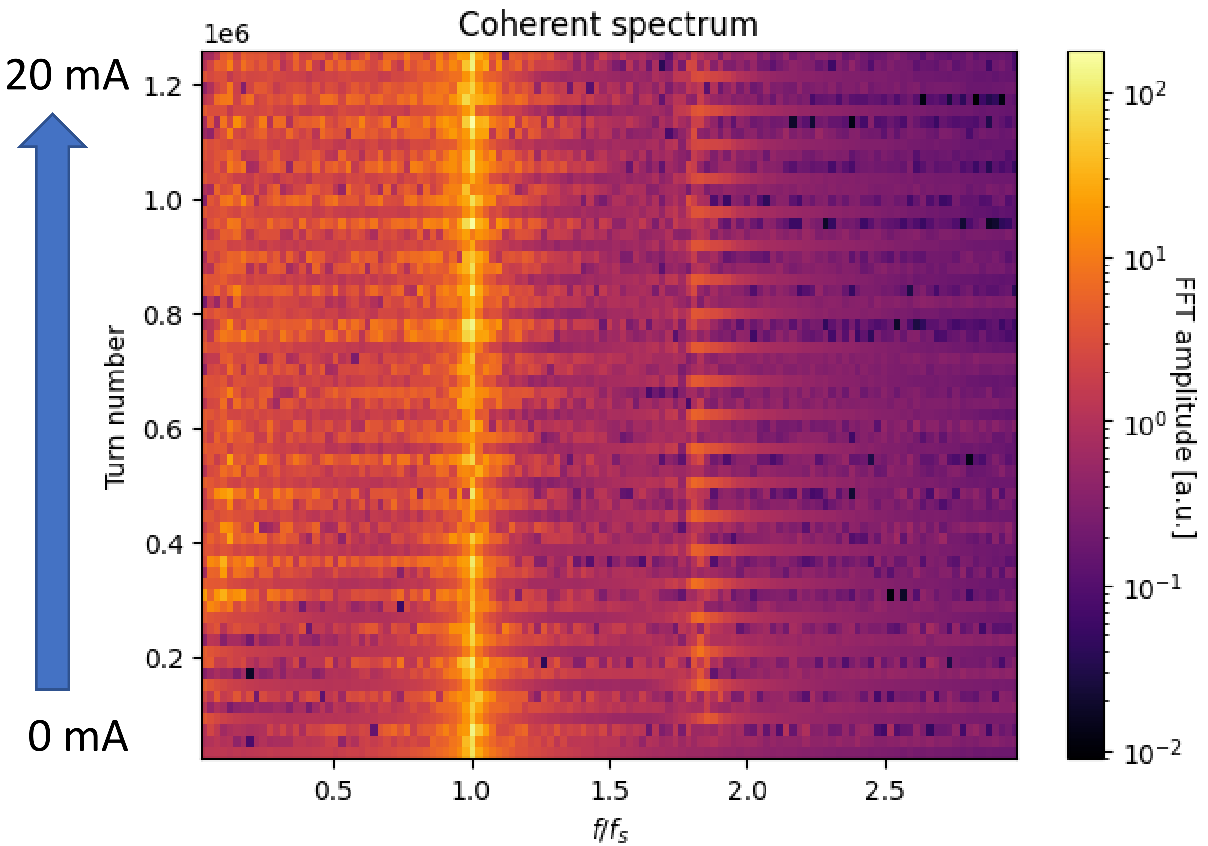
Bunch length vs current

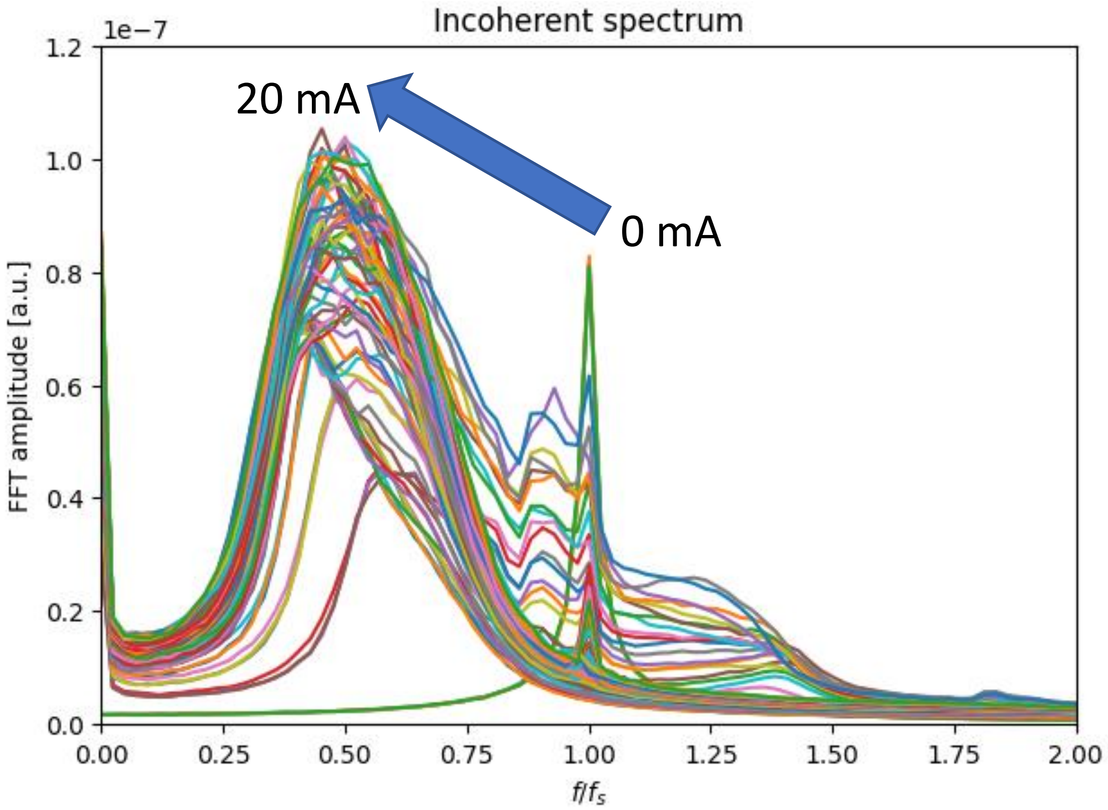


Energy spread vs current



Bunch spectrum





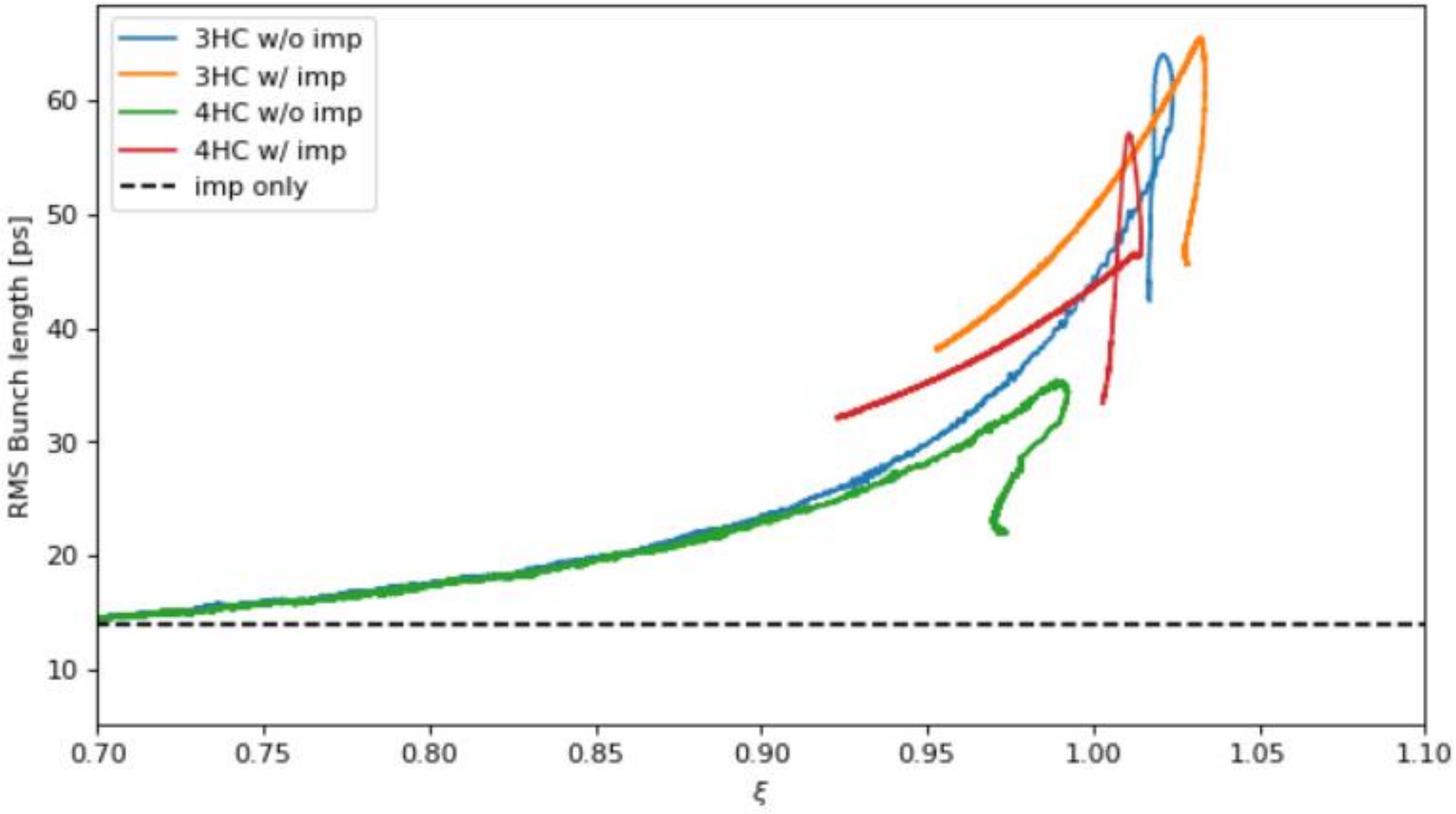
The mode m=1 is constant because the (negative) incoherent tune shift is compensated by the dynamic coherent frequency shift for mode m=1 (Ng book p.68 & p.206)

The mode m=2 (slightly shifted downward) is visible in the MWI regime.

Go from a sharp peak at zero current to a spread out bump at higher current (MWI regime) at lower frequency (incoherent tune shift).

uniform mode @ 500 mA (1,2 mA/bunch)

bunch length vs tuning



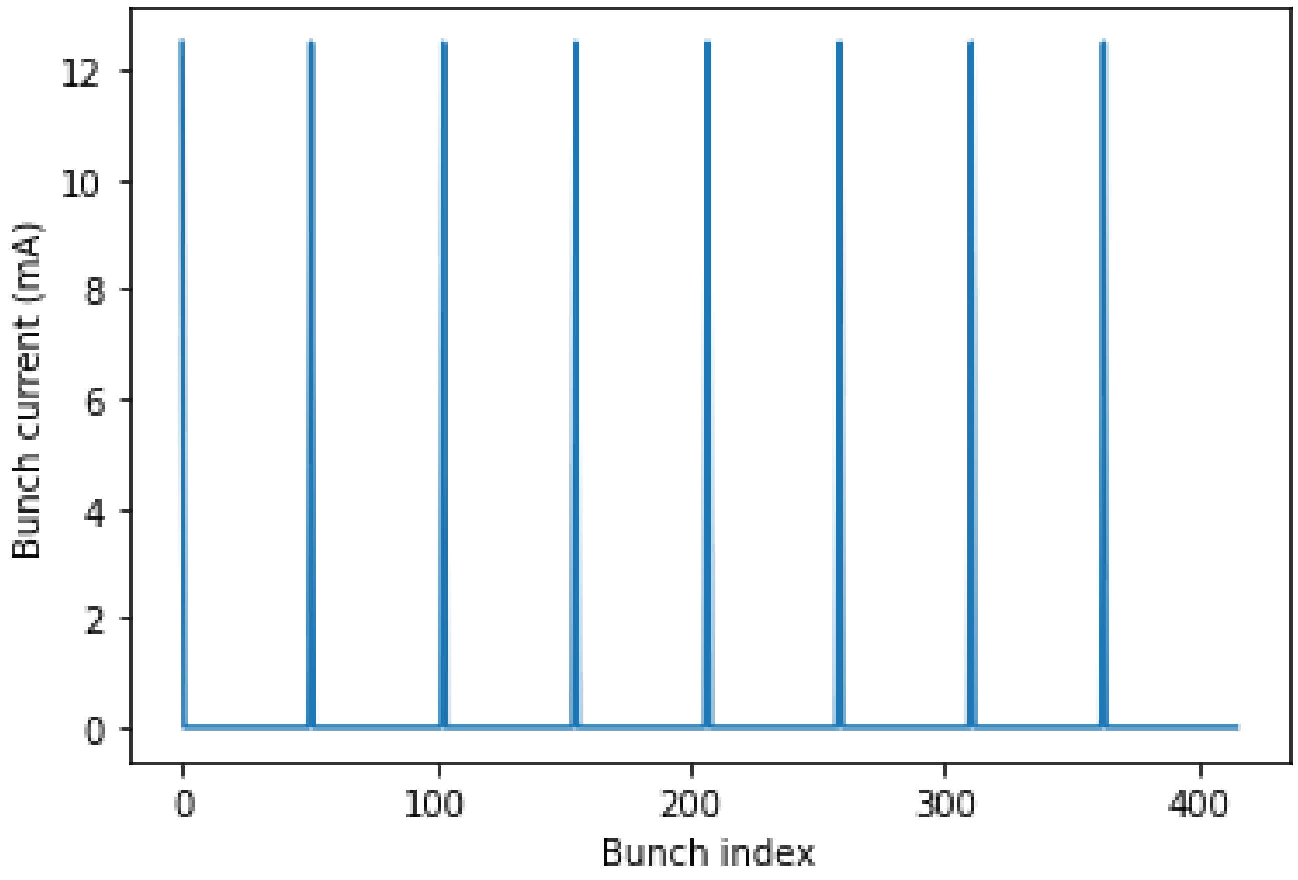
The turning point corresponds to the threshold of the l=1/PTBL instability.

As expected (from the PTBL paper), added bunch lengthening from the impedance push the threshold toward higher values.

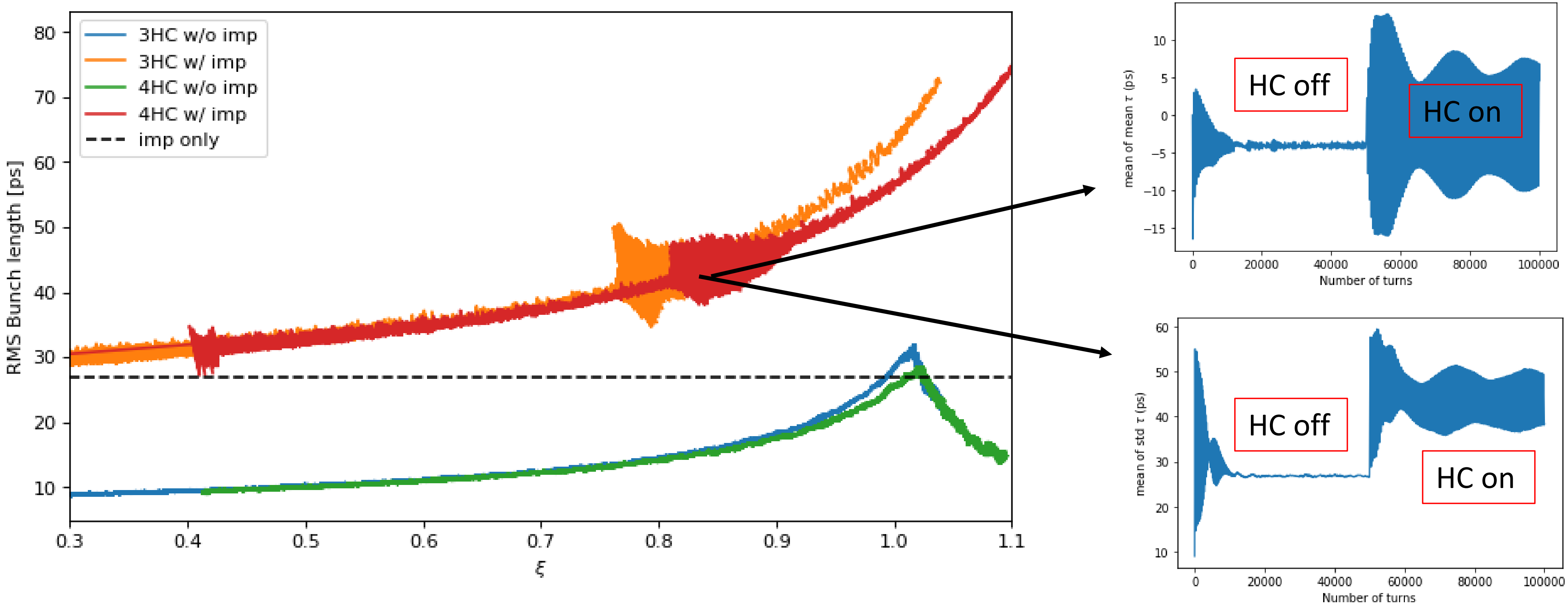
With the effect of the impedance added, the m=4 HC provide sufficient margin compared to the requirement for the main operation mode (bunch length ~= 30 ps).

8 bunch mode @ 100 mA
(12,5 mA/bunch)

Filling pattern



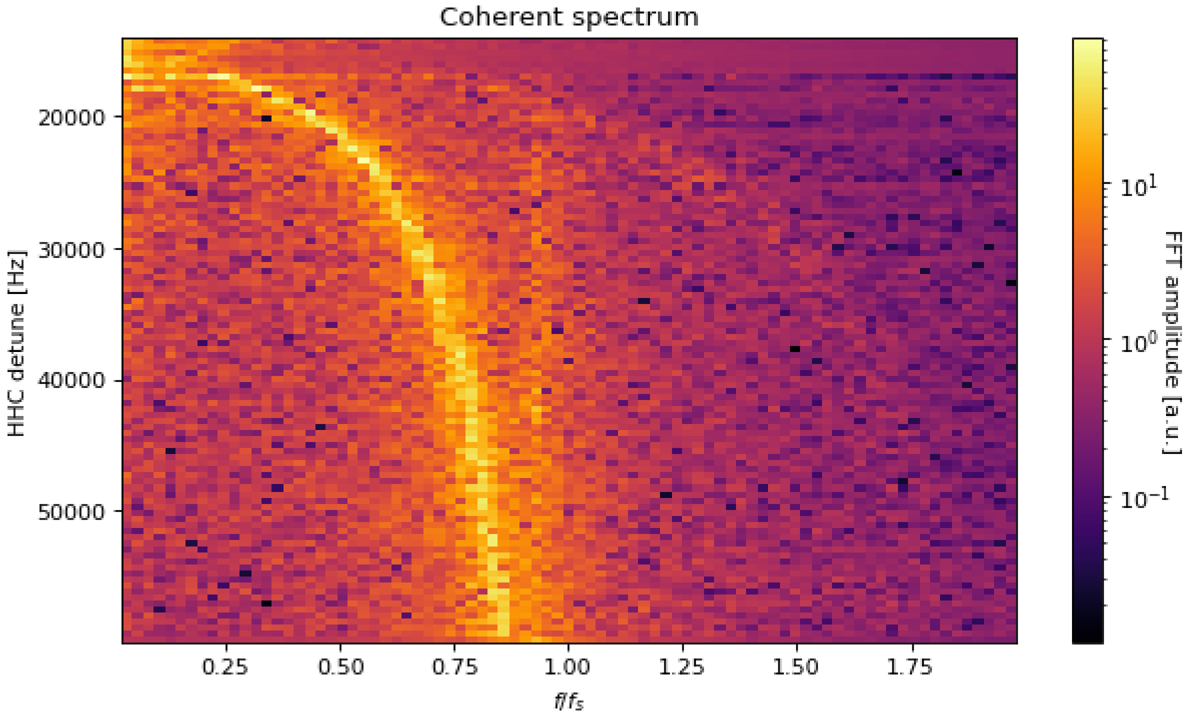
bunch length vs tuning



The instability w/ impedance is characterized by bunch position and bunch length oscillations (dipole + quadrupole)

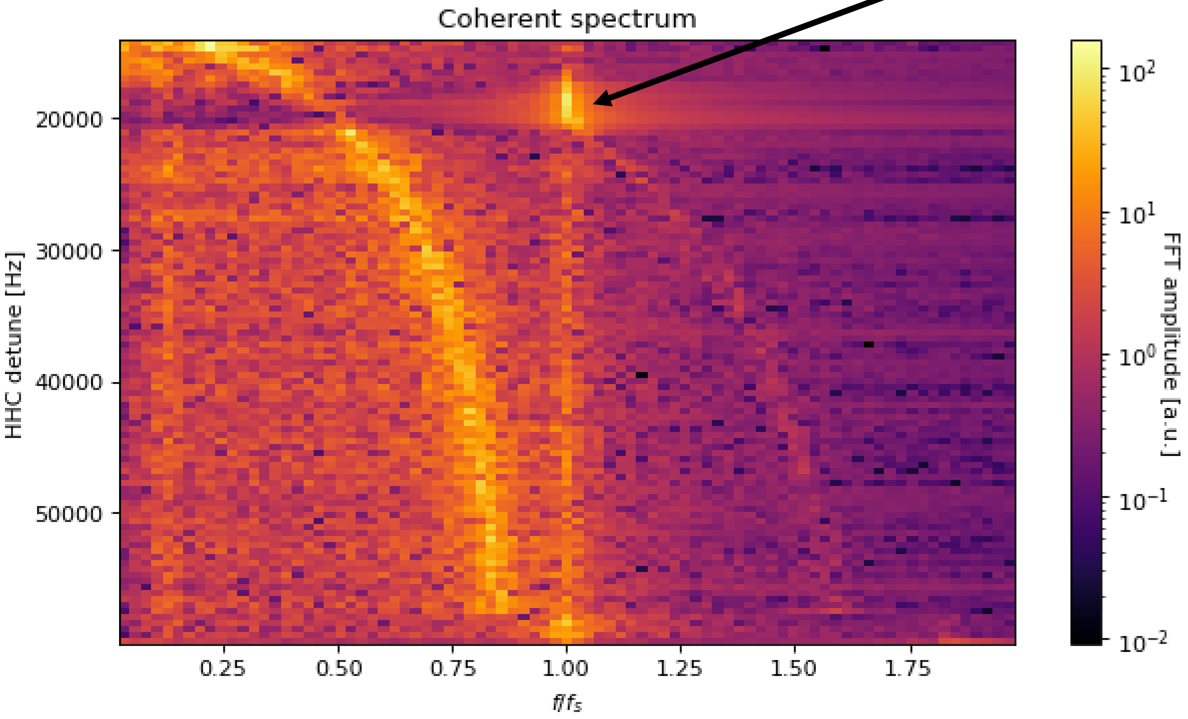
Bunch spectrum for 3HC

3HC only



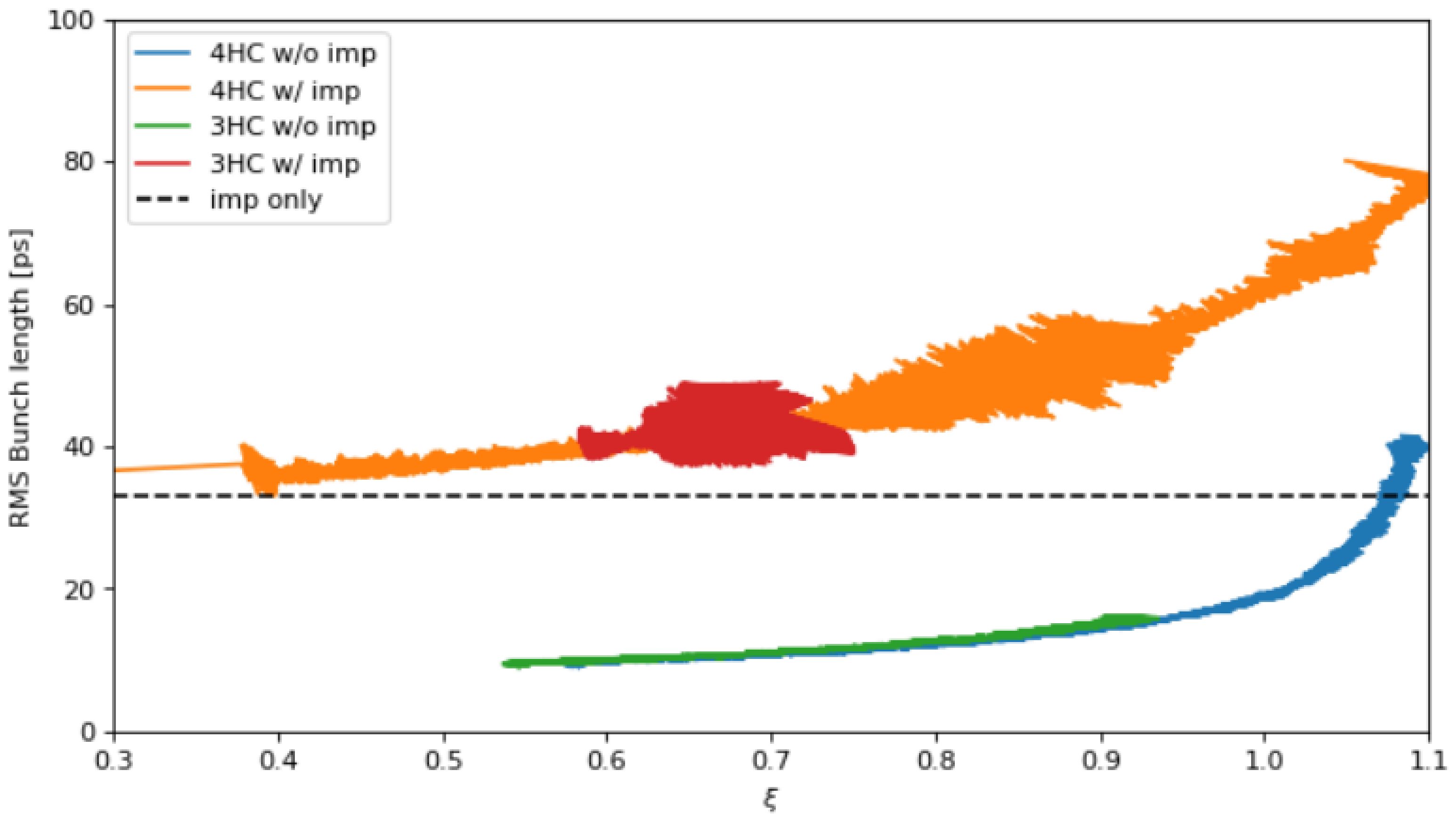
3HC + impedance

Dipole-Quadrupole instability



single bunch mode @ 20 mA

bunch length vs tuning

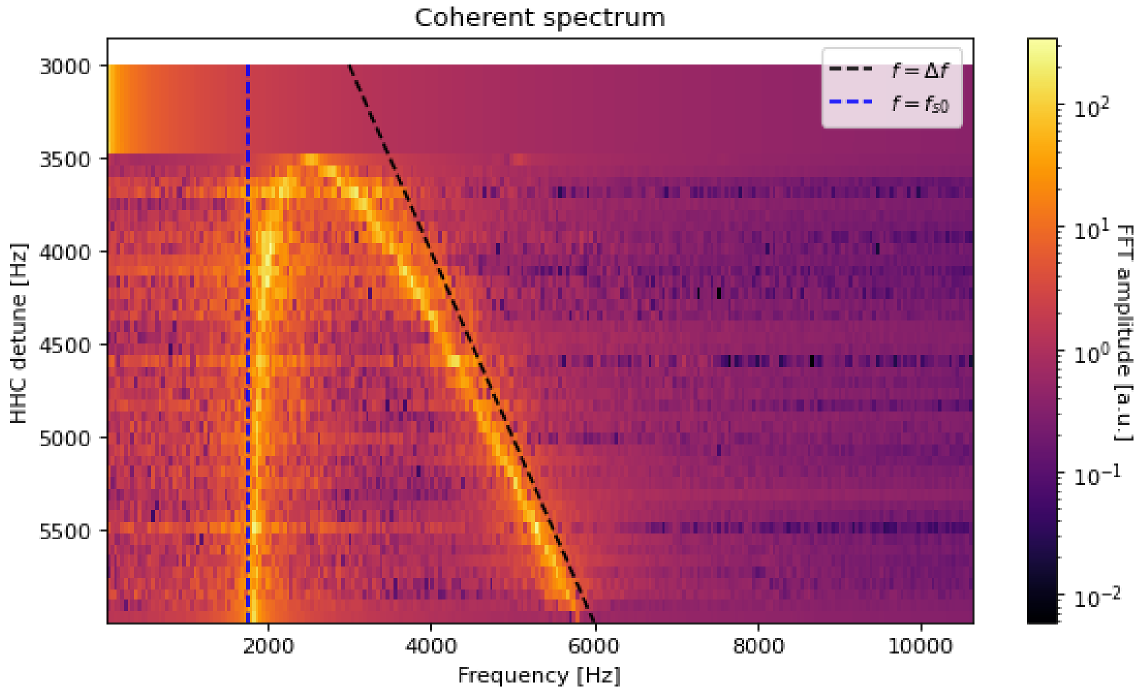


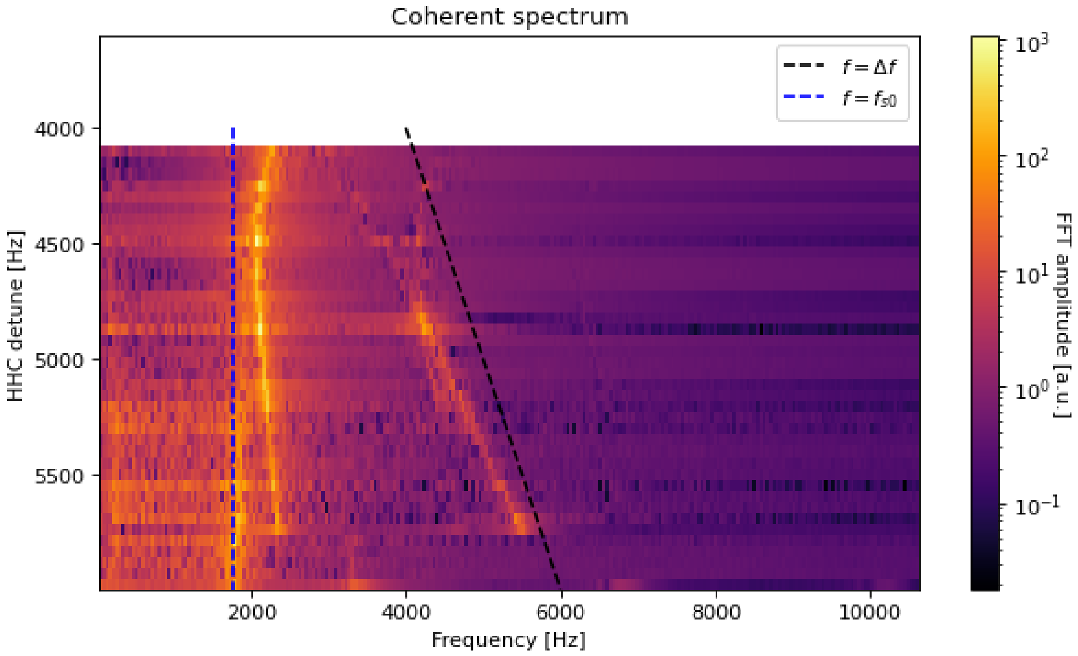
The same kind of dipole-quadrupole oscillations as in 8 bunch mode is observed when impedance is added.

In addition, fast beam loss is observed (w/ and w/o impedance) due to the "fast mode coupling instability" (?).

The fast beam loss happens sooner (in ξ and in detuning) when the impedance is taken into account.

bunch length vs 3HC tuning





4HC spectrum