

Problems and Considerations about the Injection Philosophy and Timing Structure for CEPC



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Introduction

In this paper we will show the injection philosophy and the design of timing and filling scheme for high luminosity CEPC scheme under different energy modes. It is found that the RF frequency choice in CDR cannot meet the injection requirements for the bunch number at Z pole. A modified scheme was proposed to support the design luminosity, which basically meets our current design requirements and retains more flexibility for future high luminosity upgrade.

f (MHz)	Linac	DR	booster	collider
CEPC	2860/5720	650	1300	650

Top-up injection

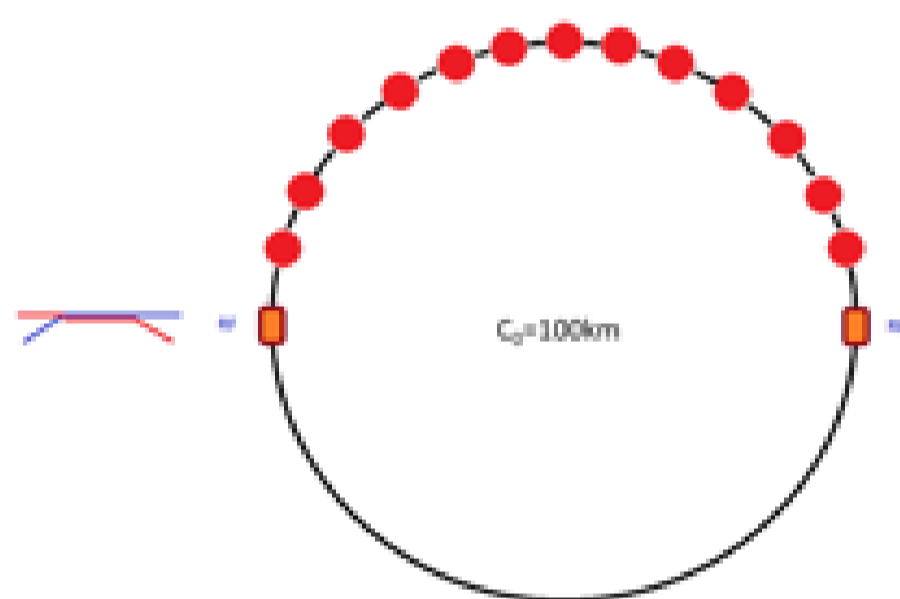
(a) tt mode

Injection to booster @ 20 GeV

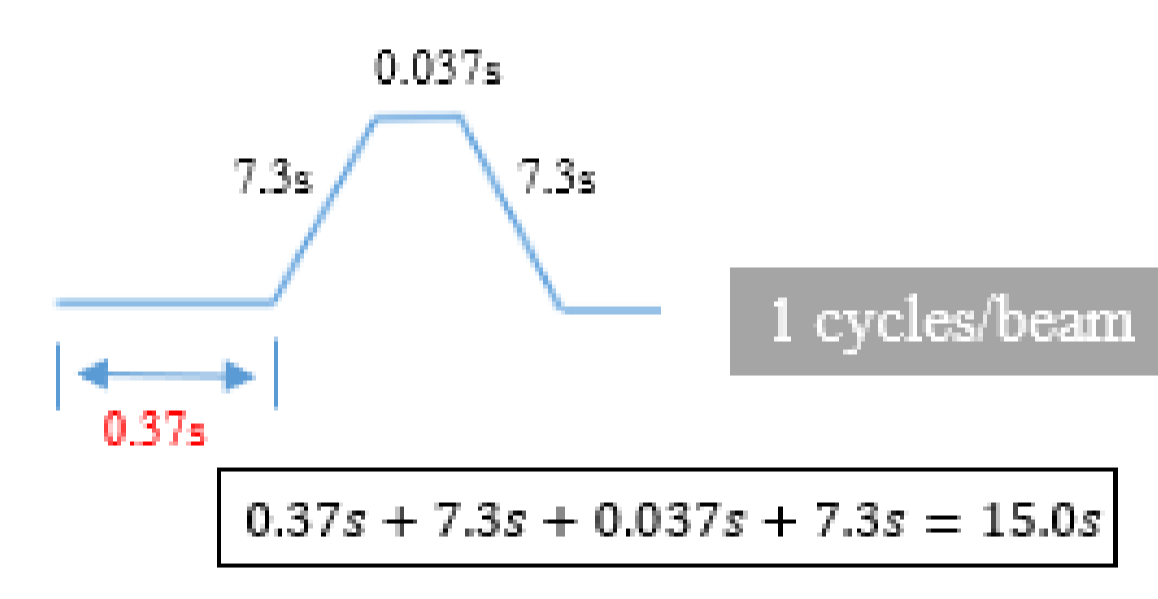
	tt
Energy (GeV)	20
Bunch number	37
Bunch separation (us)	4.2
Injection scheme	bunch by bunch
Kicker frequency(Hz)	100
Kicker pules duration (us)	<8.4
Kicker rise up/ fall down (us)	<4.2
Timing delay(us)	4.2
Injection duration (s)	0.37

Injection to collider @ 180 GeV

	tt
Energy (GeV)	180
Bunch number	37
Bunch separation (us)	4.2
Injection scheme	bunch by bunch
Kicker frequency(Hz)	1000
Kicker pules duration (us)	<8.4
Kicker rise up/ fall down (us)	<4.2
Timing delay(us)	4.2
Injection duration (s)	0.037



Bunch distribution in collider @tt



Injection time structure @tt

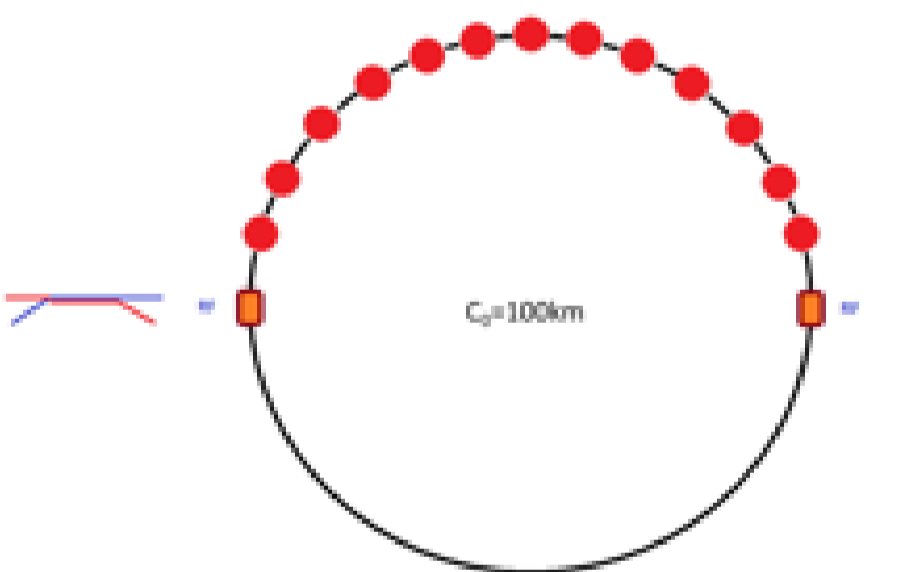
(b) Higgs mode

Injection to booster @ 20 GeV

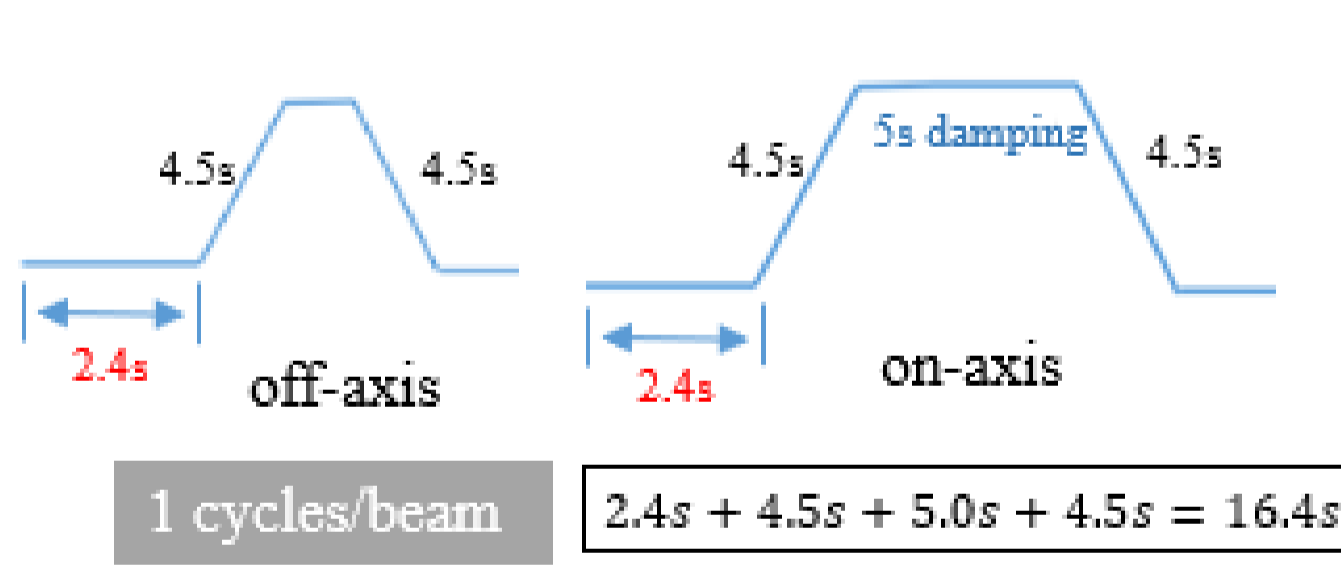
	H
Energy (GeV)	20
Bunch number	240
Bunch separation (us)	0.647
Injection scheme	bunch by bunch
Kicker frequency(Hz)	100
Kicker pules duration (us)	<1.29
Kicker rise up/ fall down (us)	<0.647
Timing delay(us)	0.647
Injection duration (s)	2.4

Injection to collider @ 120 GeV

	H-off axis	H-on axis
Energy (GeV)	120	120
Bunch number	240	7*
Bunch separation (us)	0.647	22.1
Injection scheme	bunch by bunch	bunch by bunch
Kicker frequency(Hz)	1000	
Kicker pules duration (us)	<1.29	<1.29
Kicker rise up/ fall down (us)	<0.647	<0.647
Timing delay(us)	0.647	22.1
Injection duration (s)	0.24	0.007



Bunch distribution in collider @Higgs



Injection time structure @Higgs

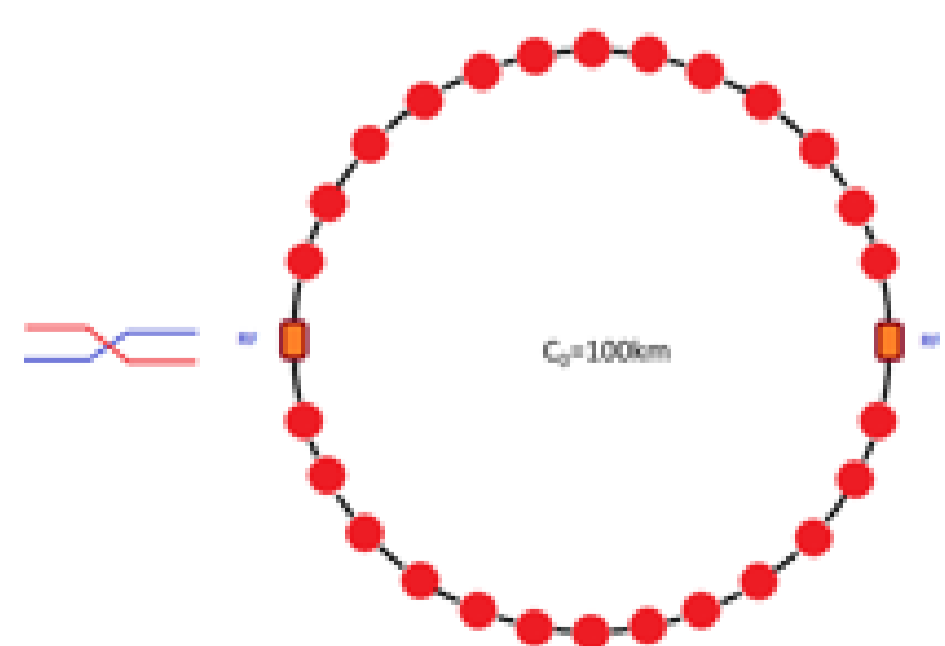
(c) W mode

Injection to booster @ 20 GeV

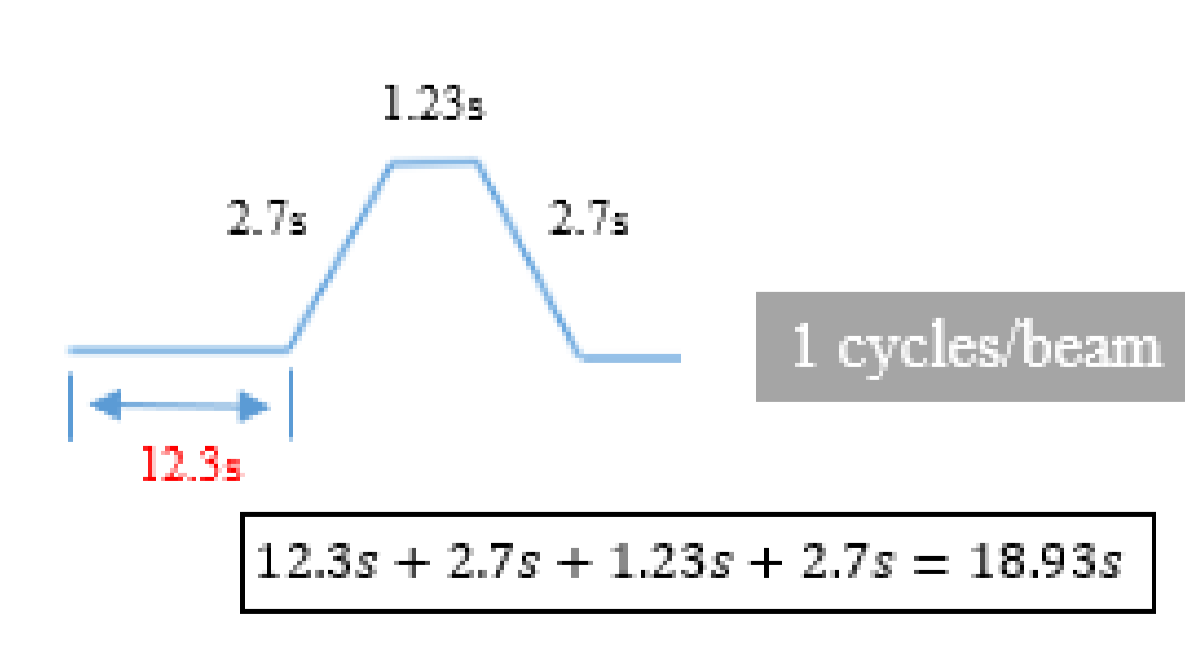
	W
Energy (GeV)	20
Bunch number	1230
Bunch separation (us)	0.2677
Injection scheme	bunch by bunch
Kicker frequency(Hz)	100
Kicker pules duration (us)	<0.535
Kicker rise up/ fall down (us)	<0.2677
Timing delay(us)	0.2677
Injection duration (s)	12.3

Injection to collider @ 80 GeV

	W
Energy (GeV)	80
Bunch number	1230
Bunch separation (us)	0.2677
Injection scheme	bunch by bunch
Kicker frequency(Hz)	1000
Kicker pules duration (us)	<0.535
Kicker rise up/ fall down (us)	<0.2677
Timing delay(us)	0.2677
Injection duration (s)	1.23



Bunch distribution in collider @W



Injection time structure @W

(d) Z mode

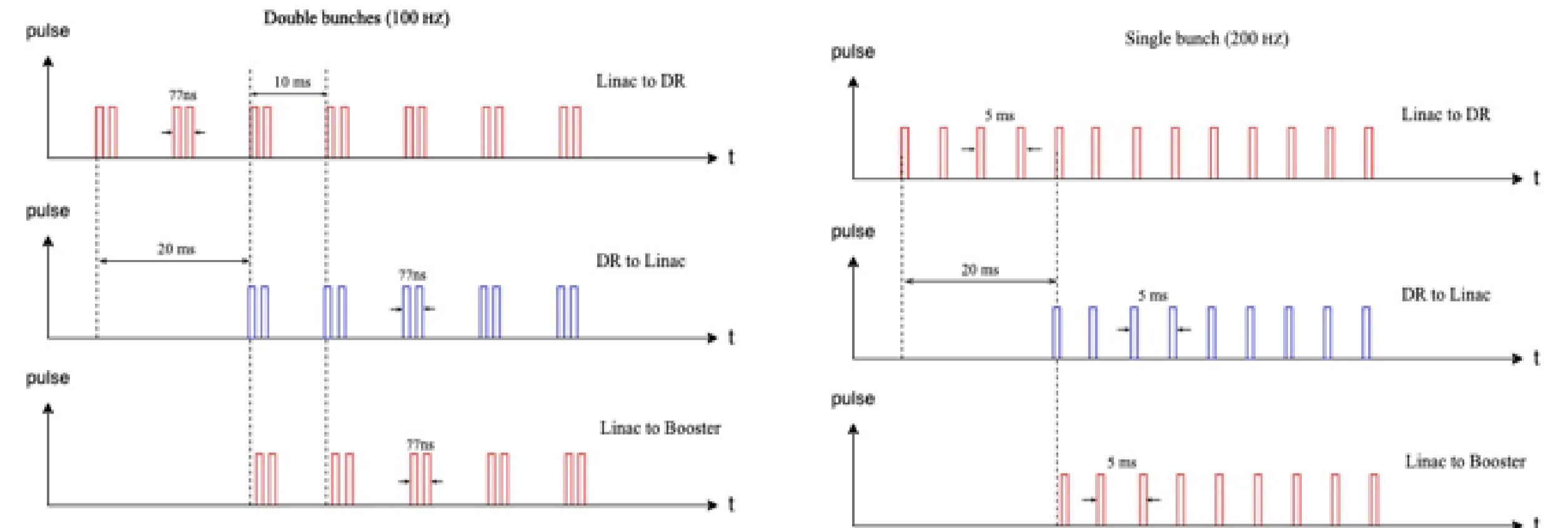
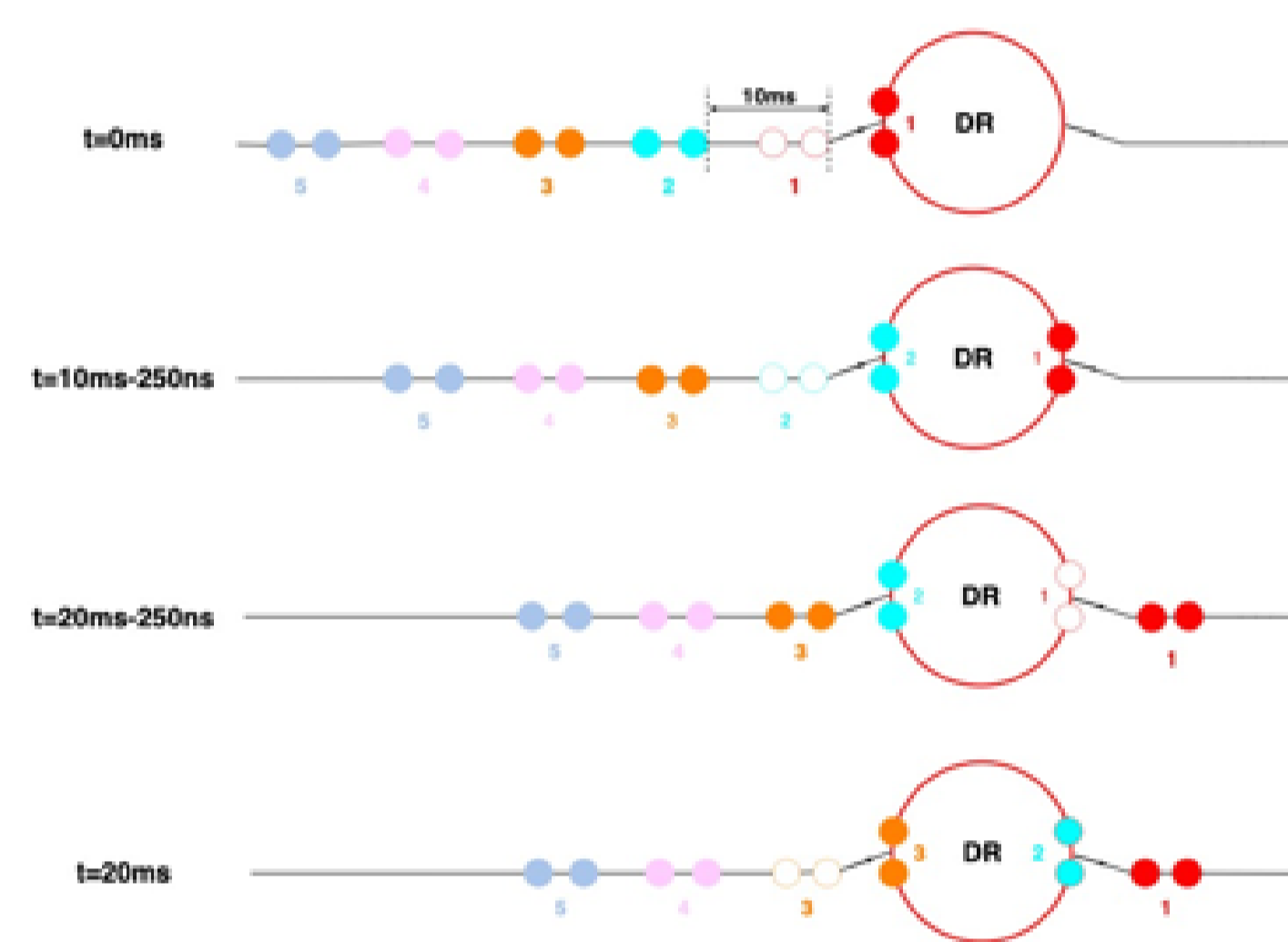


FIG.1. Injection process from Linac to DR.

➤ Double bunch(100Hz)



➤ 200Hz

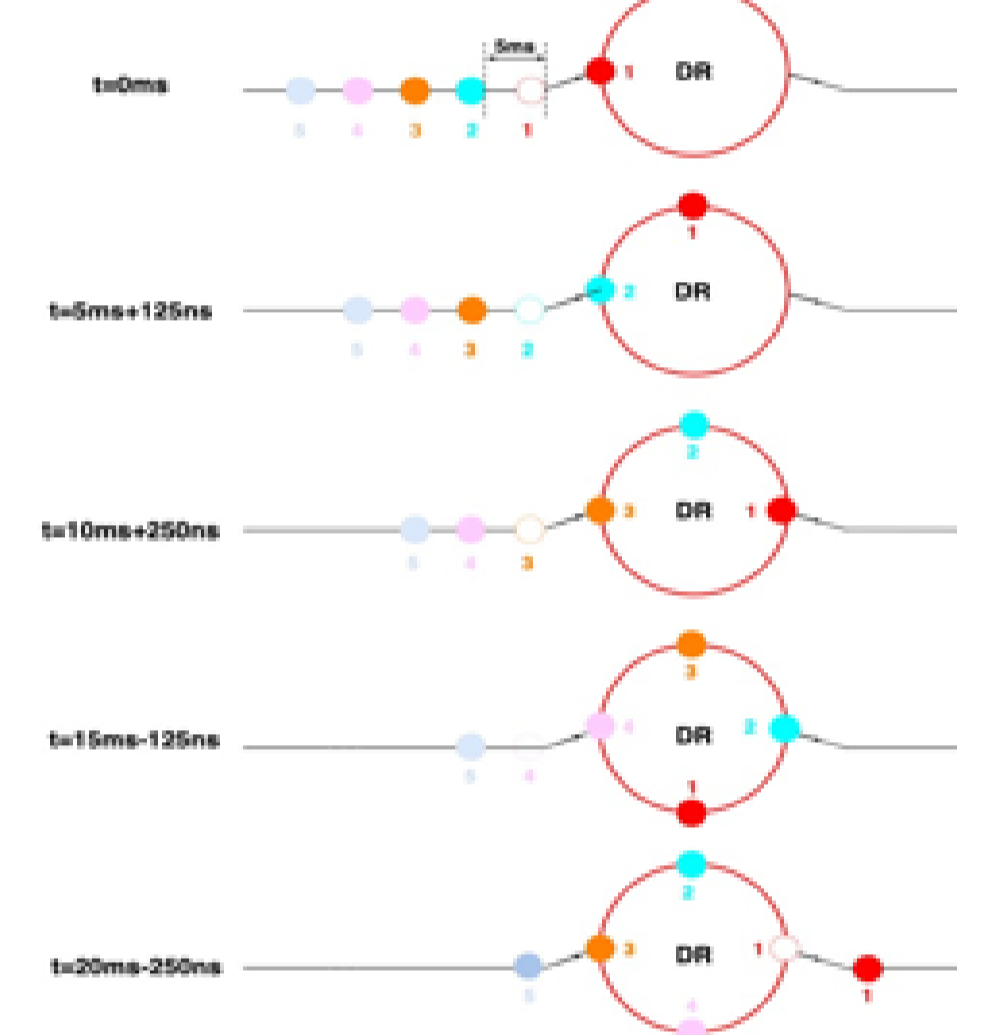


FIG.2. Time structure from Linac to Booster.

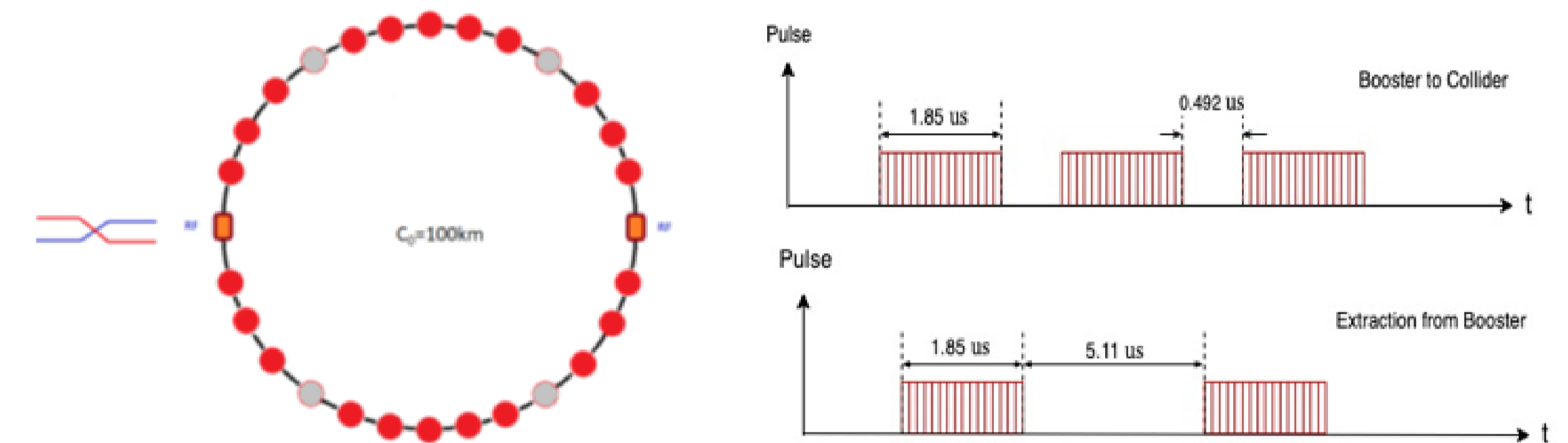


FIG.3. Bunch distribution in collider and time structure in booster and collider at Z pole.

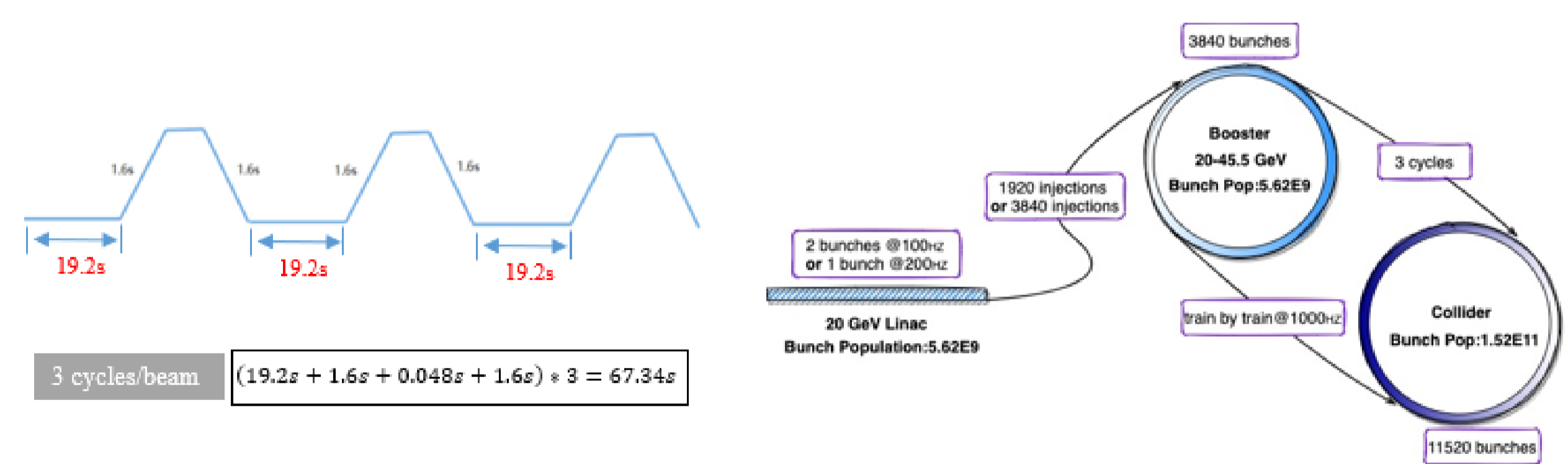


FIG.4. The process of booster ramping and top-up injection at Z pole.

Full injection from empty

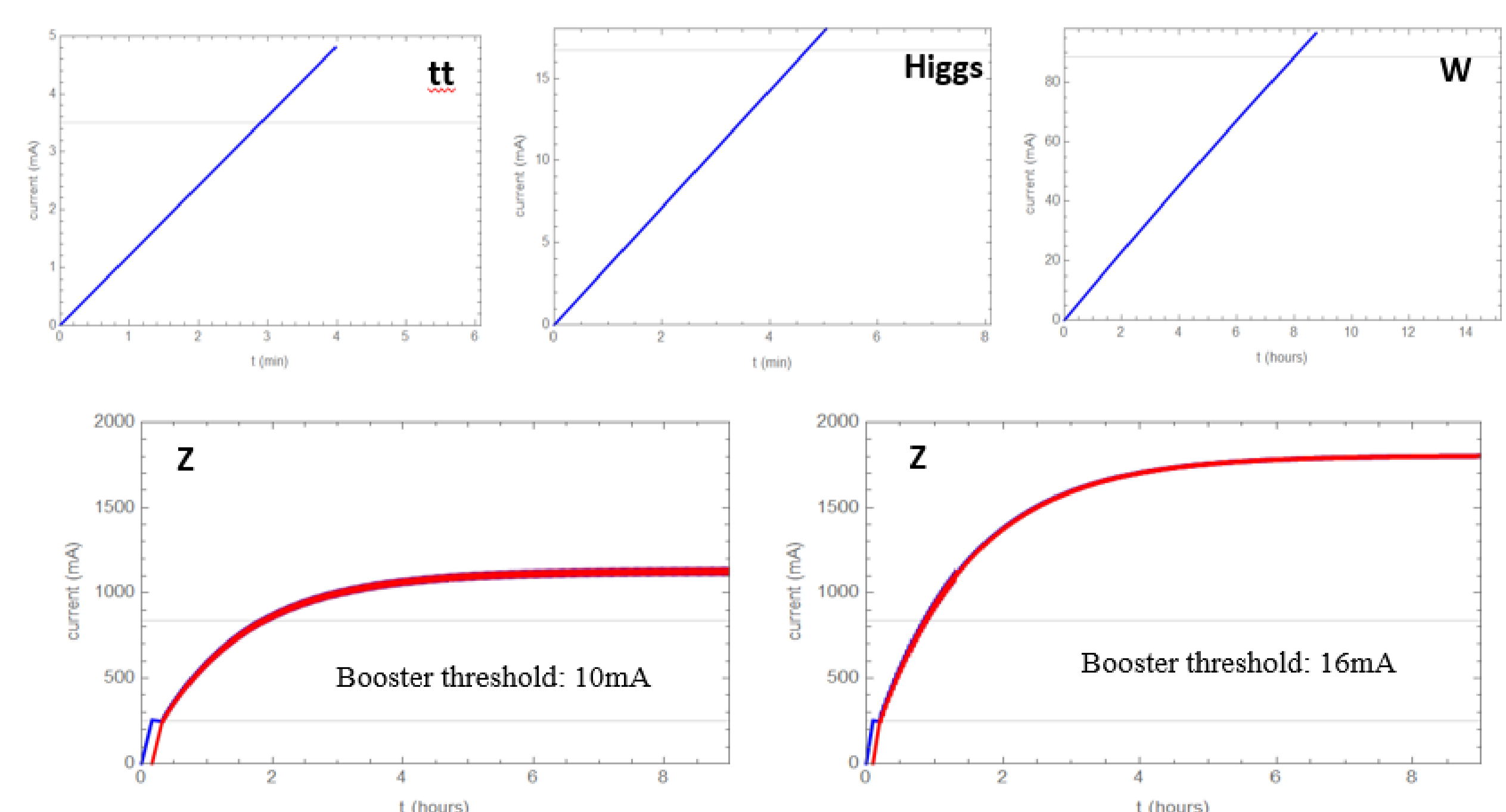


FIG.5. The variation of current in the collider with time.