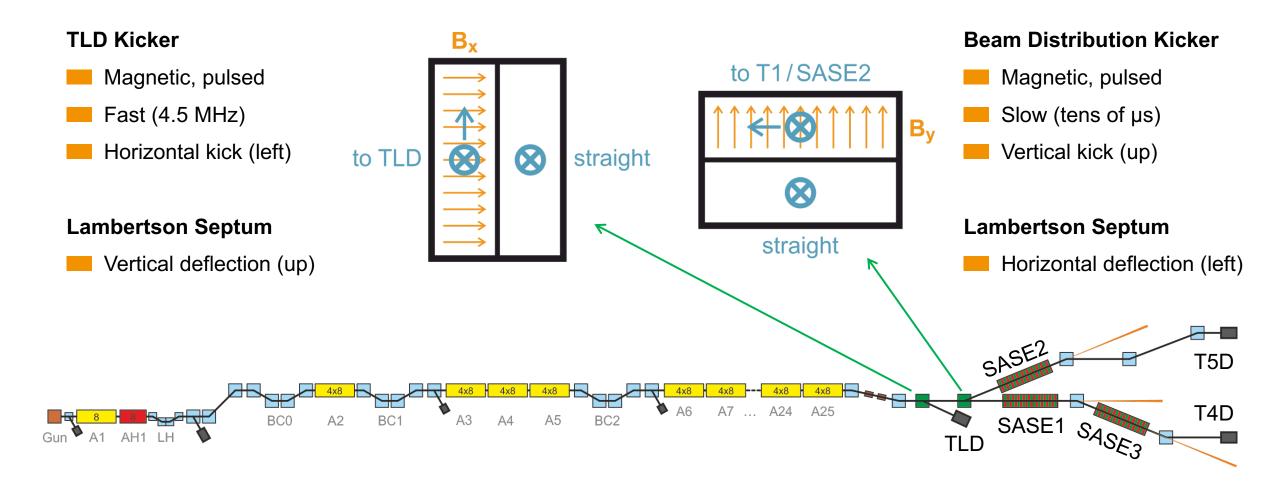
Bunch Patterns and Beam Distribution

Patterns, Kickers, Multi-Beamline Operation





Beam Distribution Scheme





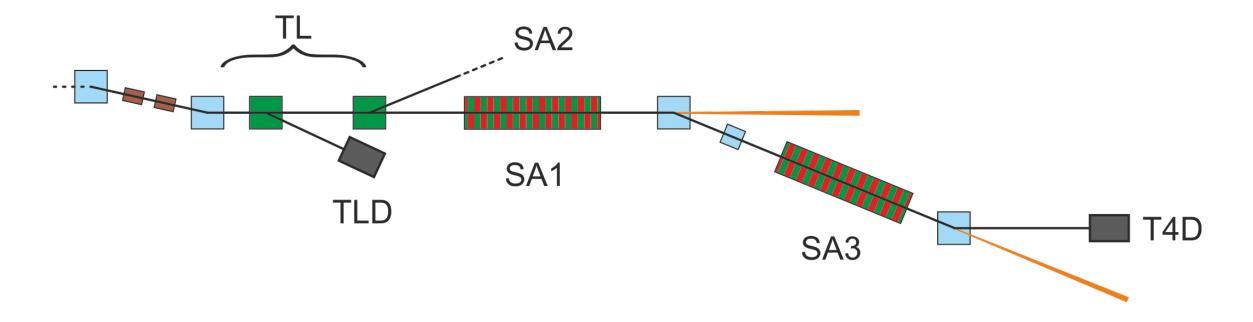
3

Fresh Bunch Mode: Implementation

Lasing in SA1 induces energy spread => less or no lasing in SA3

Lasing can be suppressed

- on individual bunches
- by exciting a trajectory oscillation with a fast kicker (soft kick).



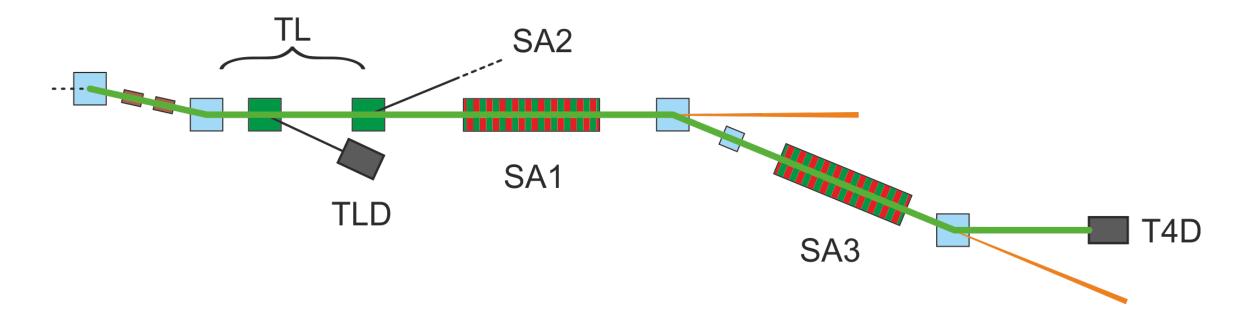


Fresh Bunch Mode: Implementation

Lasing in SA1 induces energy spread => less or no lasing in SA3

Lasing can be suppressed

- on individual bunches
- by exciting a trajectory oscillation with a fast kicker.





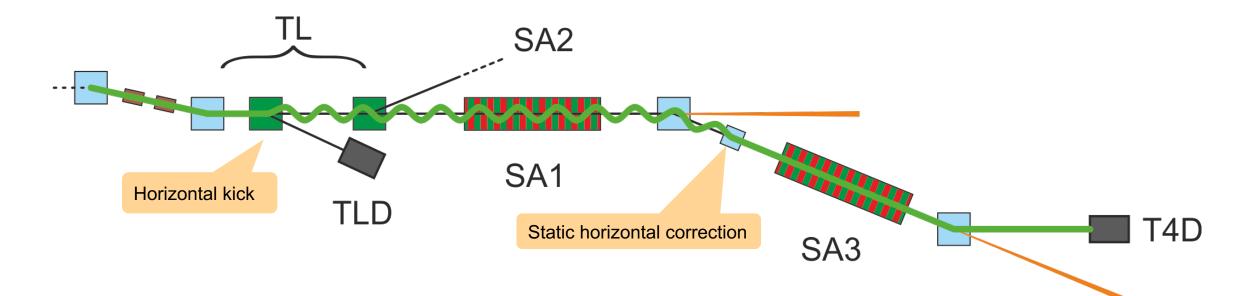
4

Fresh Bunch Mode: Implementation

Lasing in SA1 induces energy spread => less or no lasing in SA3

Lasing can be suppressed

- on individual bunches
- by exciting a trajectory oscillation with a fast kicker.



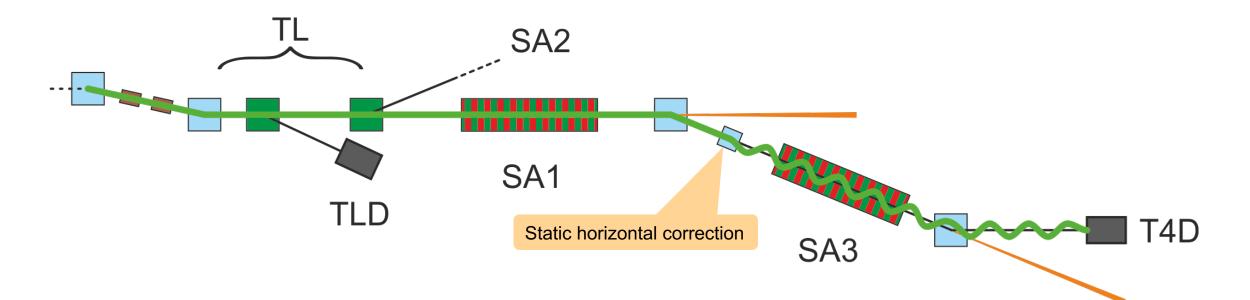


Fresh Bunch Mode: Implementation

Lasing in SA1 induces energy spread => less or no lasing in SA3

Lasing can be suppressed

- on individual bunches
- by exciting a trajectory oscillation with a fast kicker.



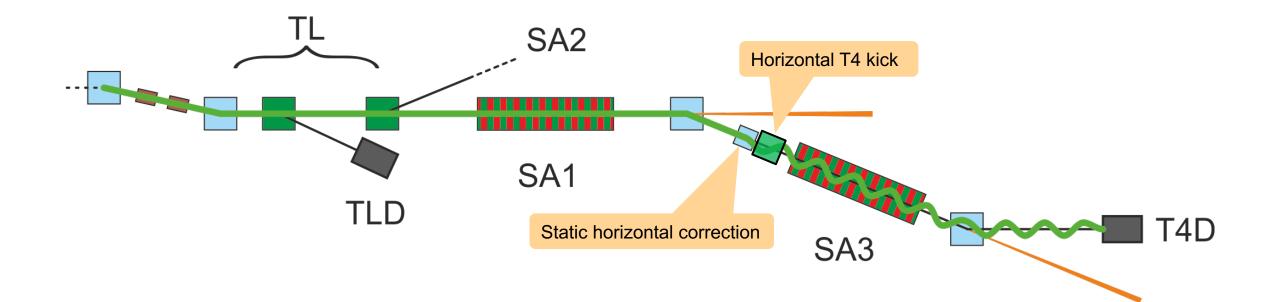


Bunch Patterns and Beam Distribution

Lars Fröhlich, 2021-04-26

Fresh Bunch Mode: Additional Kick in T4

There is a new "TLD-type" kicker in the T4 section, in front of SA3. It is fired for SA1 bunches to increase the oscillation amplitude in SA3.





7

Beam Distributon: Get Your Kicks (All Four of Them)

Four types of kicks can be triggered by the timing system:

Kick to TLD (fast) Destination: TLD

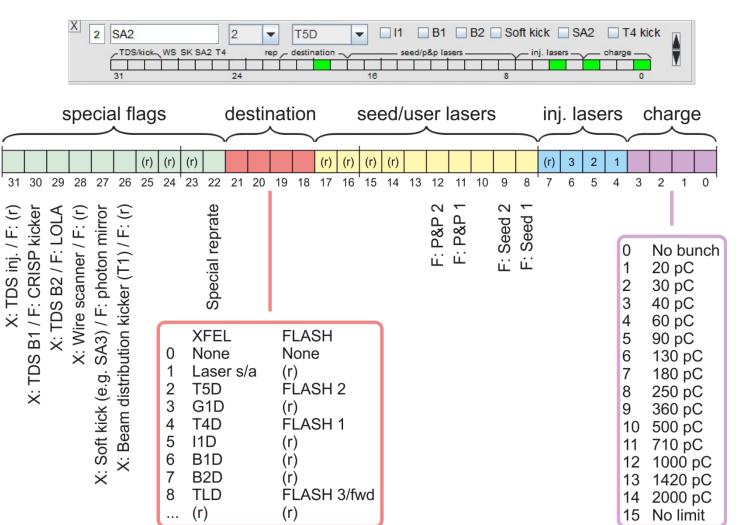
- Kick to south branch/SASE2 (slow) Destination: T5D or Bit: "SA2"
- Soft kick (fast, one of the TLD kickers) Bit: "SK" (Soft Kick)
- T4 kick in front of SASE3 (fast) Bit: "T4"

TFEL BUI 1. Injector Laser Properties						NCH PATTERN SERVER: PULSE TYPES (MACHINE PATTERN 2. Pulse Types									
ID	Description	Bunch Charge	Trigger Bits	Add Laser		ID Description	Inj.	Laser	Destination	TD	& Kickers		Add Pulse	Гуре	
0	None	0.000 nC	Laser 1 Laser 2	Laser 3	X	No bunch	0	rep _	None destination		B1 B2	Soft kick SA2	T4 kick		
1	Laser 1	0 .2€0 nC	Laser 1 Laser 2	Laser 3	X	31	24			16		8		M	
2	Laser 2	0.200 nC	Laser 1 Laser 2	Laser 3		G G1D		rep _	G1D destination		eed/p&p lasers	Soft kick SA2	- charge	\	
3	Laser 1+2	0.2000 nC	✓ Laser 1 ✓ Laser 2	Laser 3	X	I ID TDS/kick_WS_SK S	24 2 A2 T4	rep _	I1D destination	- 11	B1 B2	Soft kick SA2	T4 kick		
					X	31 b B1D	24	-	B1D 1	16	B1 B2	8 Soft kick SA2	0 2		
					V	TDS/kick_WS_SKS	24	rep /	destination	16	eed/p&p lasers	inj. lasers	0	Ī	
					X	B B2D	2 A2 T4	rep	B2D •		B1 B2	Soft kick SA2	charge		
					X	D TLD		rep -	TLD destination		B1 B2	Soft kick SA2	T4 kick		
					X	1 SA1	24 2 A2 T4	rep	T4D destination ~~	- 11	B1 B2	Soft kick SA2	0 ⊻ T4 kick		
					X	2 SA2	24	_		18	B1 B2	8 Soft kick V SA2	0 T4 kick		
						TDS/kick_WS_SK S	A2 T4	rep /-	destination	16 s	eed/p&p lasers	8	charge0	Ī	
					X	3 SA3	2 A2 T4	rep _	T4D destination		B1 B2	Soft kick SA2	charge		
					X	4 SA4	2	rep	T5D	- 11	B1 B2	Soft kick SA2	T4 kick		
						31	24			16		8	0	- 40	



The Timing Pattern in Detail

- The timing pattern is an information block that is distributed by the timing system before each macropulse.
- Based on it, timing boards generate triggers.
- Based on it, hard- and software can classify bunches/pulses.
- Table with 7200 entries
- 9 MHz raster (111 ns step)
- Covers a time span of 800 μs (RF flat-top of FLASH)
- Each entry is described by a 32-bit number (integer/word).





9

Bunch Patterns and Beam Distribution

Lars Fröhlich, 2021-04-26

Live from the Virtual XFEL



Lars Fröhlich, 2021-04-26

Subtrains – Reflecting the Pattern in the Control System

A subtrain is the set of all bunches in a macropulse that share some common feature. Five of them are defined at the XFEL.

They appear mainly in property names:

X.SA2.TRAIN.MEAN_PKPK the mean value and peak-topeak variation over all bunches of subtrain SA2 ALL contains all bunches

- **SA1** contains all bunches with destination T4D that are *not* affected by a *soft kick* in TL.
- SA2 contains all bunches with destination T5D.
- **SA3** contains all bunches with destination T4D that *are* affected by a *soft kick* in TL.
- **DUD** contains all bunches that are not going through a SASE undulator, i.e. those with destination G1D, I1D, B1D, B2D, or TLD.

