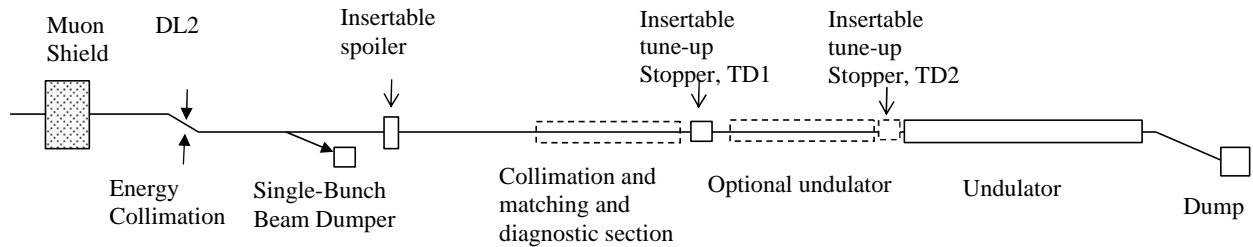


LCLS Undulator MPS Logic Requirements



The following fault detectors are planned:

Beam loss:

1. Distributed loss monitor, e.g. long ion chamber cable, PLIC
2. Localized protection ion chambers, PICs between undulator segments
3. Beam current Toroid comparators
4. Beam shut-off ion chambers, BSOIC

Pre-emptive failure conditions

1. Undulator orbit measured on RF BPMs, exceeds tolerance or stops reading
2. Launch orbit measured on RF BPMs, exceeds tolerance or stops reading
3. Launch orbit feedback, freezes or orbit rms fit error exceeds tolerance
4. Launch energy out of tolerance
5. Launch matching and collimation section quads magnet power supply current monitor out of tolerance
6. Undulator position monitors: stretched wire and hydrostatic leveling monitors out of tolerance
7. vacuum out of tolerance

The following devices passively protect the undulator. These devices are interlocked so that if they are open no beam permissive is given unless they have been manually bypassed.

1. Energy collimation in DL2
2. Transverse collimation in the matching section, in both planes for both betatron phases plus scattered halo removal

The following interlocked devices are to facilitate tuning

1. Insertable tune-up dump TD1 at the end of the matching/collimation section
2. Optional insertable tune-up dump TD2 at the end of the optional undulator section
3. Insertable beam spoiler to lower the charge per bunch to 50 pC after collimation (note: requires both spoiler and collimator interlocks to be made up before opening TD1)

Active protection devices

1. Single-bunch beam dumper that can transmit
 - a. 120 Hz normal operation
 - b. 10 Hz rate limit (e.g. while TD1 is in)
 - c. 1 Hz rate limit
 - d. operator requested 1-shot
 - e. zero rate
2. linac-gun-laser veto

Operational modes

1. No faults. Any rate requested.
2. Linac rate-enabled, Single beam dumper will zero rate beam for any undulator fault or pre-emptive fault, unless
 - a. TD1 or TD2 IN
 - b. Spoiler IN and transverse collimators IN tolerance (i.e. low charge)
3. Linac-gun-laser will veto if
 - a. Undulator fault even though single beam dumper at zero rate (dumper fault)
 - b. Beam loss monitor exceeds tolerance indicating beam is lost elsewhere than at dumps or tune-up monitors.
4. Recovery of rate from single beam dumper inhibits by either
 - a. Inserting TD1 or TD2
 - b. If fault is downstream of TD2 then manually selecting 1 Hz.
 - i. MPS will trip if fault still present
 - ii. Limit the number of resets permitted
 - c. In addition, hardware faults (BPM not reading, magnet current, vacuum) require manual reset before clearing
5. Raising rate from 1 Hz to 10 Hz to 120 Hz at operator request. MPS will rate limit to 1 Hz if fault threshold exceeds tolerance 1 and zero rate if exceeds tolerance 2.