Beam gap cleaning with LHC damper – possibilities and limitations

The LHC damper can be used to apply an excitation to beam drifting or captured in the beam gap. The aim is to reach amplitudes of 7 σ (for betatron cleaning) faster than beam can enter the gap. Vertical or horizontal excitation is possible, or a combination.

Boundary conditions:

Location of gap must be identified in time (failure scenarios ?)
Excitation at a betatron frequency, < 1 MHz for good efficiency
Excitation must not effect beam adjacent to gap

Performance of LHC transverse damper

following equipment performance specification
(no change / see 7th SLTC / 6th LCC / 16th LCC):

choice:	electrostatic kickers ("base-band")
	aperture 52 mm

kickers per beam and plane	4
length per kicker	1.5 m
nominal voltage up to 1 MHz	+/- 7.5 kV
kick per turn at 450 GeV/c (total)	2 μrad

rise-time 10-90%, $\Delta V = +/- 7.5$ kV	350 ns
rise-time 1-99%, $\Delta V = +/- 7.5$ kV	720 ns

kick voltage at 20 MHz	+/- 600 V

Capabilities of damper (H/V plane)

	integrated kick (avail -> 1 MHz)	time to reach 7σ (assume β=150 m at kicker)
450 GeV	2 urad	50 turns / 4.4 ms
7 TeV	0.128 urad	195 turns / 17.3 ms

Limitations

edges of gap (500 ns) cannot be cleaned very well

no cleaning for satellite bunches < 50 ns

fail safe application not obvious, different procedures possible:
  excitation on 100 % of time
  excitation on demand

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