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Beam-beam and Luminosity MDs

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Outline

- Beam-beam MDs
  - Long-range effects and compensation
  - Head-on and noise effects
  - Beam-beam and optics
  - Coherent effects (see E.Metral presentation)
- Luminosity MDs

Long-range B-B MDs

- Round optics (operational but also pushed β*)
  - LR limits (crossing angle vs. lifetime and losses)
    - Part of commissioning for nominal 25ns scheme and operational β*
    - Different chromaticity, octupole and triplet corrector settings (MD385, MD449)
    - IP1/5 phase advance scan
    - Higher intensity/brightness tests (ultimate 25ns, BCMS)
  - Tune-scan (MD395)
    - For each fill before physics
  - Working point close to half integer tune (MD405)

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  - Tune-scan (MD395)
    - For each fill before physics
  - Working point close to half integer tune (MD405)
- Flat optics
  - Passive compensation of tune during leveling (MD417)
  - LR limits (crossing angle vs. lifetime and losses, MD437)
- ATS optics
  - LR limits (crossing angle vs. lifetime and losses)

Long-range Wire Compensation MDs

- Four DC wires embedded in collimators (TCTs)
  - Two per IP compensating only beam 2
  - Under production, to be installed in LHC (2017-2018)

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- Four DC wires embedded in collimators (TCTs)
  - Two per IP compensating only beam 2
  - Under production, to be installed in LHC (2017-2018)
- Prove compensation of long range effect
  - At flat top, with trains vs. a few bunches (weak-strong regime)
  - Various observables
    - Lifetime, halo (special diagnostics), tune-spread
  - Tests with wires first in IP5 (2017) and then IP1 (2018)
    - Squeezed optics in 1 IP, un-squeezed and separated in the other
- More details in LMC presentation (February, 24th)

Head-on B-B and noise MDs

- Head-on beam-beam limit and leveling by separation (MD402)
  - In parallel plane (HV in IR1/5), or crossing plane (VH in IR1/5), or skew plane (45deg/135 deg)
  - End of fill MD with trains

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  - End of fill MD with trains
- High frequency noise on colliding beams (MD400)
  - Emittance growth for "single" colliding bunches with different brightness against noise levels and damper gain
- Effect of low frequency noise
  - Mimicking triplet eigen-frequencies (MD453)
  - Effect 50Hz noise (PC filters)
    - Short test at injection and/or in conjunction with other MDs

B-B and optics MDs

- Chromaticity variation due to LRs (MD664)
  - Measure chromaticity of pilot vs train
  - Vary crossing angle
  - Can be combined with tune-spread measurements @ collision
- Beta-beating driven by beam-beam (MD979)
  - Pilot vs High-brightness bunch,
  - Beta-beating measurement and correction
  - Injection and then flat top

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- Beta-beating driven by beam-beam (MD979)
  - Pilot vs High-brightness bunch,
  - Beta-beating measurement and correction
  - Injection and then flat top
- Un-squeezed optics in 1 IP (BBLR compensation, triplet correction)
  - 1 IP (preferably IP5) fully squeezed, the other un-squeezed and separated
  - Pilot and then bunch trains

Luminosity MDs

- Evolution of the beam distribution through the LHC cycle (MD 204)
  - Single bunches with different brightness and profile measurements
  - Can be parasitic (transverse and longitudinal profile logging)
- Observation of single beam parameter evolution (MD470)
  - Non-colliding bunches emittance evolution (parasitic MDs)
  - Stability (different chromaticity and octupoles)
  - Dependence on number of LRs

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- "OP scans" for determining emittance through luminosity
  - Parasitic MDs
  - Beam stability for scans at IP1
  - Perform scans at both IPs simultaneously
  - Impact of longitudinal profiles

Summary

Theme	LHC	HL-LHC	FCC	Shifts	Priority
LR limits nominal optics (angles, Q', octupole)	x			1	1
LR limits ATS/flat/low β* optics	x	x		3	2
LR limits tune-scan	x	x		Physics fills	1
LR limits close to half integer tune	x	x		1	2
LR limits phase advance scan and pile-up		x		0.5	2
LR wire compensation (optics preparation + compensation)	(x)	x	(x)	2 + 4	1
HO beam-beam limit and leveling		x	x	1	1
High/Low frequency noise	x	x	x	3	1
Beta-beating/chromaticity due to BB		x	x	1	2
Evolution of beam distributions	x	x	x	1	2
Evolution of single beam parameters through cycle	x	x	x	Physics fills	1
OP scans	x	x		Physics fills	1