MD 2722 - Beam Transfer Function and Landau damping

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MD Merit and machine parameters

Merit of the MD: measure the Landau damping in presence of octupole detuning, linear coupling and beam-beam interactions

Number of MD's	***1***
Time required per MD [h]	***7***
Beams required [1, 2, 1&2]	***1&2***
Beam energy [GeV]	***450 GeV and 6.5 TeV***
Optics (injection, squeezed, special)	***Collision optics, squeezed, 30 cm beta*, colliding***
Bunch intensity [#p, #ions]	***1.2E11 and lower intensity (~0.7E11)***
Number of bunches	***Fill 1: single bunch per beam; Fill2: 1 lower intensity bunch in B1 and 1 train of 48 nominal bunches in B2***
Transv. emittance [m rad]	***2-2.5 μm***
Bunch length [ns @ 4σ]	***Nominal***
Optics change [yes/no]	***No***
Orbit change [yes/no]	***Reduced crossing angles in IP1&5 and IP separations***
Collimation change [yes/no]	***TCTs moved with the crossing angle at colliding IP1 & IP5***
RF system change [yes/no]	***No***
Feedback changes [yes/no]	***Yes on single bunch ADT off and/or at reduced gain***
Tune changes	***Tune scan maximum deviation 0.01***
What else will be changed?	***Chromaticity, Octupole currents, linear coupling***
Are parallel studies possible?	***No***

MD procedure

1st Fill (injection energy):

1. Inject two nominal bunch per beam. Turn off the ADT on both beams and test BTF settings (excitation amplitude, bandwidth) for high precision measurements.
2. Introduce linear coupling in a controlled way ($C^- < 0.01$). For each linear coupling value acquire BTF measurements on B1 and B2 for several octupole currents (0 A, 6.5 A, 13A, 26 A). If high precision measurements degrade beam quality, re-inject the beams.

2nd Fill:

1. Inject 1 lower intensity bunch in B1 and a train of 48 nominal bunches in B2. Ramp beam energy with ADT and octupole nominal settings.
2. At flat top, switch off the ADT on the single bunch in B1 (ADT turned on with nominal settings on B2).
3. Correct chromaticity, introduce linear coupling in a controlled way and perform octupole current scan reaching negative octupole polarity.
4. With nominal octupole current, proceed through the full betatron squeeze.
5. At the end of the betatron squeeze correct linear coupling and perform octupole current scan.
6. With nominal octupole current, we perform a crossing angle scan in IP1 and IP5 (waiting few minutes before acquire BTF measurements at each angle step).
7. At the last step in angle we perform tune scan with BTF measurements at each tune change.
8. If time permits collide the beams with nominal collision settings and perform a separation scan in IP1 and IP5 acquiring BTF measurements at each step.

Some more details

Similar procedure (Crossing angle, linear coupling, tune scans) already performed in previous BTF and long-range MDs with trains of 48 bunches.

Usual step for the crossing angle scan :

1. Load sequence with new TCT settings (as during crossing angle levelling during STABLE BEAM)
   → Smaller β^* and crossing angle → Adjustment of the collimation sequence for crossing angle scan (in preparation by B. Salvachua, orbit changes at the TCT for different crossing angle steps have been evaluated by R. Bruce)
2. Change the crossing angle
   - → Requires maintenance of different beam processes to perform the crossing scan at the end of the squeeze or in collision, which is lengthy and error prone → use the levelling application which handles properly the interaction with the orbit feedback and was tested through the squeeze (K. Fuchsberger)