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INTENSITY LIMITS FOR BI SYSTEMS

Estimated Intensity Limits for BI

- BPM System
  - A bunch of 2.8e11 with length 1ns gives >50V at the button output
  - Limiting components are the resistances on the 70MHz input filter
    - These see approximately half the button output voltage
      - Can withstand 200V so no issue with peak voltage
    - Their 0.25W rating gives the overall power limit
      - Allows 2808 bunches with 2.8e11 spaced by 25ns
  - No fundamental intensity limit from BPM system for next few years
- BLM System
  - Not concerned with bunch characteristics
- BSRT Systems
  - No major problems envisaged
  - Only issue may be intensity dependent beam spot displacement
    - Suspect EM coupling heating the extraction mirror or mirror support
    - Can normally be easily recovered by steering of the telescope

Estimated Intensity Limits for BI

- BCT Systems
  - DCCT
    - No anomaly seen during MD with single bunches of 2.8e11
    - New test bench being prepared to check the DCCT beyond 400mA
      - Equivalent to 1380 bunches of 1.6e11 at 50ns
  - FBCT
    - MD with bunch intensity of 2.8e11 and 1.1ns bunch length
      - Non filtered systems saturated while 75MHz low pass filtered systems OK
      - All systems are now equipped with 75MHz low pass filters
    - Attenuation required if bunch length reduced or intensity increased

- Head-Tail & BI Wall Current Monitor
  - Both systems OK for bunch intensities of 2.8e11 and lengths of 1.1ns
    - Gives >500V at the monitor output
    - Now attenuated by 46dB to match allowed oscilloscope input level
      - OK provided the bunch length/charge ratio does not exceed this by 20-30%
  - Power per bunch for this intensity < 10 mW
    - No issue in terms of power - 20W for 2808 bunches at 1.8e11

Estimated Intensity Limits for BI

- Wire Scanners
  - Wire-scan limits determined by the BLM thresholds
    - Based on overall intensity.
      - 2.1e13 @ Injection
      - 4.9e12 @ 3.5TeV
  - Reduction of emittance will impact
    - Number of points for the fit
    - Wire-melting limit (3e13 for 3um emittance)
      - Still higher than BLM threshold for 1.5um emittance
- BBQ Systems
  - No impact expected
  - Saturation experienced due to short bunch lengths & high charge mitigated by using several diodes in series
- BGI
  - No impact

BUNCH BY BUNCH MEASUREMENT PROSPECTS FOR BI

Bunch by Bunch Measurement Prospects

- BSRT for 2011
  - Standard camera in gated mode
    - Acquisition will remain as it is
      - 1Hz acquisition with 2-3 acquisitions per measurement
    - For measurements at injection
      - Bunch by bunch not possible (takes over 1 hour)
      - Propose to measure each PS batch
        - Would allow measurement of all batches in ~2 minutes for 1380 bunch fills
  - Fast camera
    - Installed for both beams & currently undergoing testing
      - Capable of 3564 frames per second (transfer & processing time not yet known)
      - Acquisition time required will also depend on light available & sensitivity of camera
        - Looks OK for single bunch single turn measurement at 3.5TeV
      - No time estimate yet on when this can be made operational
        - Still some fundamental issues to be sorted out with camera readout & control
- BSRT for the future
  - Standard camera in gated mode
    - Can be run at up to 25Hz
      - Would allow complete bunch by bunch beam size acquisition in a few minutes
    - Requires new frame grabber & FPGA code development to perform on-line processing
      - No resources yet allocated to this

Bunch by Bunch Measurement Prospects

- Schottky
  - Chromaticity at Injection
    - Studies ongoing to see if reliable spectra can be obtained at injection for Physics fills with many bunches (not bunch by bunch)
      - Chromaticity derivation from asymmetry of Schottky sidebands difficult at 4.8GHz
        - Width from dp/p is factor 50-100 larger than asymmetry from typical Q'
  - Bunch by bunch Tune
    - Successfully used in MD mode for beam-beam studies
    - B1H always gives much cleaner spectra than all other planes
      - Needs to be understood
- Fast BCT
  - No further changes foreseen
    - Now provides bunch intensity measurements with accuracy better than 1%
      - BUT cannot distinguish between main bunches & ghosts/satellites
- LDM
  - Correction algorithms being evaluated
  - Full integration into controls system underway
- Head-Tail
  - Instability trigger added & also made available to ADT

Conclusions

- Intensity Limits for BI in 2011/2012
  - No Total Intensity Limits foreseen
  - No Bunch Intensity Limits foreseen
- Bunch by bunch measurements
  - No major changes foreseen in 2011
    - Only small improvements to existing systems