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Implementation of automated (store by store) calibration of SBD and FBI with respect to DCCT in the Tevatron.

A. Background:

The Tevatron wall current monitor calibration has changed in one direction by about 5% over a year. We hope/believe that a major part of this is due to a few resistors (out of the 88 in parallel total) becoming loose. The WCM resistance increases as a result and the reported number of protons and antiprotons is too high. The original resistors have been replaced this shutdown with physically larger components with more connecting solder to reduce this problem. However, periodic calibration checks will still be required and it is agreed to implement this on a store by store basis using an OAC. There is a concern that the algorithm can be wrong if there is a significant amount of beam outside the wide-gates (+/- 2 buckets around the central bunch).

Any calculated change outside certain limits (see below) will not be implemented automatically and will trigger explicit investigation.

B. summary of parameters and results from the OAC

1. Final Quantities calculated in the calibration process

T:SBDCLF SBD scale factor (a dimensionless number close to 1)

C:FBIPNS FBI Narrow Gate (NG) proton scale factor (E9/volt)

C:FBIPWS FBI Wide Gate (WG) proton scale factor (E9/volt)

C:FBIANS FBI NG pbar scale factor (E9/volt)

C:FBIAWS FBI WG pbar scale factor (E9/volt)

These are the quantities used to convert the raw data from the SBD and FBI to actual intensities.

Convenience variables:

T:SBDTCA = SBD change applied (1 = yes)

C:FBIPCA = FBI proton change applied (1 = yes)

C:FBIACA = FBI pbar change applied (1 = yes)

2. Intermediate Quantities calculated in the calibration process

T:BMIRES(0-8)

(0) = T:SBDTCC(0) = calculated factor to change for SBD

(1) = (1) = statistical uncertainty

T:SBDCLF(new) = T:SBDCLF(old) x T:SBDTCC(0)

(2) = C:FBIPCC(0) = proton FBI NG change (assumed same for WG)

(3) = (1) = statistical uncertainty

C:FBIPNS(new) = C:FBIPNS(old) x C:FBIPCC(0)
C:FBIPWS(new) = C:FBIPNS(new)

(4) = C:FBIACC(0) = pbar FBI NG change, (assumed same for WG)

(5) = (1) = statistical uncertainty

C:FBIANS(new) = C:FBIANS(old) x C:FBIACC(0)
C:FBIAWS(new) = C:FBIANS(new)

(6) = T:SBDTCF = SBD change flag

-1 outside limit (prompts investigation)

0 no change needed

1 change recommended

(7) = C:FBIPCF = FBI proton change flag, same values as (6)

(8) = C:FBIACF = FBI pbar change flag, same values as (6)

3. Control parameters T:BMICLF(0 - 8)

T:BMICLF(0) 3 bits. If 0, no changes allowed; if 7 all changes allowed

1st bit = 1 SBD changes allowed
2nd bit = 1 FBI proton changes allowed
3rd bit = 1 FBI antiproton changes allowed

T:BMICLF(1) = T:SBDRMN lower limit on change factor for SBD

(2) = T:SBDRMX upper limit on change factor for SBD

(3) = C:FBIRMN lower limit on change factor for FBI p and pbar

(4) = C:FBIRMX upper limit on change factor for FBI p and pbar

(5) required consistency of consecutive samples (currently 2.5%)

(6) = T:SBDSFF safety factor (minimum ratio of change proposed to statistical uncertainty therein)

(7) = T:BMIDEL when to start after beginning of flattop (seconds)

(8) = T:BMINSM number of seconds over which data are taken

C. more details and description of the Calibration Procedure

1. calibrate SBD wide gate (protons plus pbars) on DCCT.

   device affected is T:SBDCLF

2. calibrate FBI narrow gates on SBD narrow gates (the FBI wide gates have their own calibration devices - the values are the same as the narrow gates).

   devices affected C:FBIPNS, C:FBIPWS, C:FBIANS, C:FBIAWS

3. use data at beginning of flat-top (20 sets of readings) - avoid cogging glitches etc.

   devices involved are T:BMIDEL (when to start after beginning of flattop)

   T:BMINSM (number of samples to take).

   T:BMIDEL is aliased to T:BMICLF[7]

   T:BMINSM is aliased to T:BMICLF[8]

4. the calculated corrections will be ACNet devices; these will be set

by the OAC independent of whether they are applied or not
devices involved are T:SBDTCC, C:FBIPCC, C:FBIACC
they will be multipliers.

5. proposed corrections will be calculated at time of taking data (ie early in the store) and e-mailed to various people including (at least) Slaughter, Annala, Meyer, Pordes, Flora.
6. changes are calculated for one store and implemented for the following store provided they meet certain criteria.
7. Controls for actually changing calibration values:

There is a control and parameter array T:BMICLF with 9 elements as described above.

* T:BMICLF[0] is an on-off switch with 3 bits. These bits override any changes suggested by the algorithm.
* changes to calibration outside certain limits (presently proposed as 2%) will not be implemented automatically.
* corrections within the limits and greater than the safety factor (currently 2) times the statistical uncertainty of the calibration calculation will be implemented automatically.
* warnings will be issued (e-mail and store-checker) if the calibration program results suggest changes greater than the above maximum.

Care has to be taken not to be confused by study stores

8. A set of variables which tells you whether or not a change was made is provided.