HiLumi WP13 meeting #3

Monday 7 May 2018
14:01

#3 WP13 meeting on Monday 7 May (https://indico.cern.ch/event/716574/) in room 866-1-A04

Agenda:

14:00 → 14:10 Approval of minutes and highlights from Chamonix
14:10 → 14:40 BGV status & plans for 2018 – Benedikt Würkner
14:40 → 15:10 Discussion on needs for 2nd undulator – Enrico Bravin
AOB¶

Thibaut:

Rhodri will present highlights from HL-LHC C&S review at the next meeting.

Benedikt: BGV Status 2017 and plans for 2018

B. presents the summary of 2017 and results and plans for 2018

Theoretical max of what we can measure

Increasing gas pressure increases rate of events.
Using statistics we can deduce beam size.

Correlation method: one does not directly measure the position, but the correlation between 2 tracks from the same primary vertex. The error of the measurement (extrapolation error of tracks to the entire volume) cancels out.

A continuous measurement: every time we reach a certain limit we make a plot. Increasing integration time gives better precision. Result is a histogram.

Geometric effect (lower detector coverage on left and right side) induces a systematic error (Monte Carlo - MC - study) : round beams are not seen as round. Values corrected against MC to compensate for lack of acceptance.

Thibaut: Vertical beam size more affected, why? Should you not exactly the same?
B: correlation method is heavily influenced by tracks that are parallel or antiparallel to each other (cos=1 and cos=-1) and since the regions with lower acceptance are opposite of each other this effect is increased.
Simulation is the LHCb full blown physics simulation.
B: insists cause is geometrical and not physical. Simulations give round beam if taking all tracks from one vertex, while asymmetry is reproduced if only taking tracks on current detector.

Statistics method works as expected: precisions improves as 1/sqrt(N)

Increasing beam energy gives reducing size: this detector can measure during energy ramp.

Comparing to BSRT, better agreement at higher beam energy (20sec integration time for the BGV).

BSRT to be checked over what it integrates. Should give per bunch then average over all bunches.

Measurements during ramp (40sec integration) scale correctly with sqrt(energy)
Thibaut: During measurements we may have non-constant emittance.
Sotiris: But we take raw measurements so we can always fold in the emittance.

BCID = Bunch Crossing: Beam width vs BCID, the beam width of individual bunches.

Expected 2018 performance: Assuming 10kHz (effective) (as it can be derived …), 8% precision in 5min data taking @ 6.5TeV.

This year would like to continue measurements: BGV operational? B: Access needed to connect cable.
Continuous data recording = too much data (1GB/30s). Human intervention required to turn on gas every 4h. Data could be taken, analysed and dumped. At least for development continuous running is beneficial (data accessible only to BI). Solution to find how to manage data can be found.
ACTION???

BSRT can be affected by diffraction, would be interested to compare to BGV and understand.

Measurements=3D track. Plot goes into the plane and show 2D projection. Angle only in x,y.
To reduce the influence of wrongly reconstructed tracks only tracks that have a minimal distance in z are compared in 2D.
For a direct vertex plot only vertices made up of ≥ 4 reconstructed tracks (before was 3, now cleaner) are used. Rotation missing in the correlation formula (now assumed to be negligible).

Geometric errors of detector have been corrected before-hand, of course there is still something. Should investigate all errors coming in the tracks.

Enrico: WP13: BSRT modifications for HL-LHC

SR: EM radiation emitted by bent trajectory charged particles. In wrigglers, particles wobble inside and emit SR.
Rad in visible range, go to mirror and sent to a camera from which beam size inferred.

- Beam 1 and Beam 2
  - BSRT: Refracting imaging telescope for online emittance measurement (limited by diffraction)
  - BSRA: Abort gap monitor
  - BSRL: Longitudinal density monitor (high dynamic range longitudinal profile with 50ps resolution)
- Beam 1
  - Double slit interferometer R&D (absolute beam size measurement not limited by diffraction)
  - Scanning slit with PMT (alternative to II+camera)
- Beam 2

- Coronagraph for the measurement of the beam halo (HL-LHC R&D)

For HL (too many for one light source):

- Keep telescope, go to reflective system (to reduce/rid chromatic aberration) Double slit interferometer for beam size.
- BSRA: Abort gap monitor
- BSRL: Longitudinal density monitor (high dynamic range longitudinal profile with 50ps resolution)
- Coronagraph in operational way.
- Streak camera probably removed, not at correct phase advance.

At the moment undulator only on D3 B2. Proposal to do the same and with an undulator in or behind Q5 on B1 (to be checked if additional SR - reflected - affects the measurements of the BGC at HEL). Without undulator the new source can only be used for beam energies above 1.5 TeV.

Critical energy at 6.5TeV ~200nm (we use 250nm). From dipole at injection energy = no rad in the visible (that is the reason why undulator is required).
Wavelength of radiation emitted on axis = Lamda coherent which depends on distance of undulator modules.
Rad at 3nm could be used for Xray pin-hole camera at the place of the extraction mirror. Hole size compromise between signal level and diffraction. Actual design still to be worked out.

- Spectrum of rad from edge of dipoles different than from core.
- Undulator as source negligible > 1TeV.
- Undulator kept at constant field throughout cycle because if ramped magnets D3 quenches.
- Continuous 3nm radiation affects mirror, so we would like to be able to ramp up-down.

Halo monitor would not see anything at injection; halo measurements needed when crabbing on, so ok.

For optional pin-hole, second dedicated source with undulator will be needed.

Summary: question still open. Second undulator would give more flexibility.

Present undulator: wavelength goes with gamma square, for ions SR in non-visible, so no measurements for ions.

Synchrotron Radiation extraction tank needs design: installation would be for LS3.