rMPP meeting on LHCb VeLo test insertion

October 10th, 2022, via Zoom

Victor Coco, Paula Collins, Cedric Hernalsteens, Filip Moortgat, Biran Petersen, S. Redaelli, Belen Salvachua, Benoit Salvant, Josef Sestak, Matteo Solfaroli, Daniel Wollmann.

Discussion

Victor presented the results and analysis from the VeLo test insertion. On 30 September a rehearsal to 25mm with 1200b was performed. On October 4, the planned test was postponed due to a power cut impacting LHCb. On Thursday 6, the partial insertion was performed with 12 bunches (fill 8232) and with 218 bunches (fill 8233, with a reduced number of bunches compared to the initial plan of 300 due to an injection kicker issue). The test was performed using the final version of the closing manager, with manual handshake at each step.

No movement along the Y (vertical) axis was performed. An offset in vertex reconstruction is expected based on the metrology results. It was decided not to perform the correction but to first collect data at multiple horizontal (X axis) positions to take into account also rotational misalignment for the correction.

For the 12b fill, the insertion test proceeded from 27 to 2 mm with intermediate steps. The 4 mm step (half opening) was kept for 15 minutes and the final 2 mm position during 1 h. A temperature increase of 0.3 K was observed for the 4 mm step. This increase was not observed at other position. When retracting the VeLo, the motion was stopped at 4 mm again, but the increase was not observed. Small vacuum increases were observed.

For the 218b fill the temperature increase at 4 mm was 1 K, not scaling linearly with intensity from the 12b fill. A vacuum pressure increase from 3 to 6 x 10^{-9} mbar was observed. A sharp pressure decrease was observed when moving the VeLo out.

Victor explained that also the future insertions will be done in steps to allow that vertex reconstruction data are collected. These data are used to ensure that the insertion proceeds symmetrically around the measured beam center. As the 4 mm step is problematic from a vacuum point of view, it will be excluded from the steps, with a margin of 1 mm.

Action: Propose and circulate a series of stopping points for the insertion of the VeLo to its nominal position (Victor, Paula).

It was observed that the foil temperature dropped while closing the VeLo. This is due to the improved cooling of the foil in this state.

The vertices are reconstructed from the measured tracks. The analysis is still on-going. A bulging of the foil was observed, which is compatible with earlier metrology results. Due to this bulging the effective aperture is expected to be reduced by 0.5 to 0.7 mm (half opening). This bulging is positioned 50cm from the IP (B1 upstream). So the full opening is expected to be between 2.8 and 3.0 mm instead the nominal 3.5 mm.

Daniel asked if this reduction would get worse when closing more. Victor replied that it acts as a rigid object and the conclusions will be the same. The vertices reconstruction will be improved with a smaller gap.

Action: Verify that the reduced aperture is still well within the aperture protected by the collimation system (Stefano, Collimation team).

The vertical offset was shown to be independent from the horizontal motion and will be corrected for the future insertions.

Victor concluded that LHCb collected all required data to continue the VeLo insertion commissioning. The final analysis will confirm the possible aperture reduction.

Benoit and Josef presented an analysis of the temperature and vacuum data. The temperature increase with 12 bunches would be worrying if the scaling was linear with intensity but with 218 bunches it remained of the order of 1 K. It was found that the temperatures were very sensitive to the bunch length. The pressure was correlated as well, confirming that there is an physical heating causing a pressure increase.

Josef commented that the vacuum increase with 218b was surprising. The pressure increase could be caused by synchrotron radiation light from the triplets impacting the unconditioned surface of the VeLo. The pressure stabilized when reaching 8 mm gap. Josef commented that with smoothly closing and only short stops at the dedicated positions, pressure increase issues could be limited.

Benoit concluded that the full insertion will be very similar to the partial one. Both the partial and full insertion commissioning fills can be combined from a logical point of view and a 12 bunches fill is not required again.

Daniel asked if a scaling of the temperature increase for a full machine (from 1 K to 10 K) would be acceptable. Benoit replied that it would be.

Victor asked Josef if it would make sense to try to condition the surface with a normal fill (full machine) but with a partial insertion (gap of 10 mm). Josef replied that he does not think it is recommended.

Benoit proposed to perform the intensity ramp-up with a full insertion for 300, 600 and 1200 bunches.

Daniel asked how much time will be required during these ramp-up fills and how long they should be kept at the final position. Benoit and Josef replied that the last step should be kept for 1 hour as the VeLo is reacting very fast on the change in position.

Victor asked what observation would cause us to stop the ramp-up. Benoit and Josef replied that sparks and more than linear scaling of the pressure rise could be showstoppers.

Conclusion

Daniel summarized the recommendation of the rMPP. The intensity ramp-up should be performed with 300, 600 and 1200 bunches fills before going back to a full machine. The VeLo closed position should be kept for a minimum of 1 h at these steps. The above actions should be closed before proceeding with the first attempt at a full insertion. Benoit and Josef should be informed so that the temperature and pressure can be analyzed during and after the fills to confirm that the ramp-up can proceed to the next intensity step. Victor and Paula will propose a series of intermediate steps (necessary for the reconstruction and centered insertion) that avoid the position where we have seen the temperature and pressure spikes.

Actions

The following actions were agreed upon:

1. Verify that the reduced aperture is still well within the aperture protected by the collimation system (Stefano, Collimation team).
2. Propose and circulate a series of stopping points for the insertion of the VeLo to its nominal position (Victor, Paula).