Summary of tune shift measurements

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Measuring the variation of the tune with intensity gives information on the total reactive transverse impedance according to Sacherer's theory.

To determine the impedance budget of the PS at different energies, the tune shifts have been measured at different energies to understand the contribution effect of the space charge impedance.

Measurements have been performed on four different cycles, allowing calculate the transverse impedance at the kinetic energy of 2, 14 and 25 GeV. The scans have been performed changing the intensity from about $60 \cdot 10^{10}$ ppb to $450 \cdot 10^{10}$ ppb.

On the vertical plane, the measured impedance at 2 GeV is 8.5±0.3 MΩ/m, that is in agreement with the impedance evaluated in 2012 (before LS1).

At 25 GeV, the calculated vertical impedance is 2.6±0.3 MΩ/m. This value is smaller respect to the impedance measured in 2012 (about 4.5 MΩ/m). In order to verify this result, we performed other measurements at 25 GeV correcting the radial position of the beam, varying the bunch length and changing the type of excitation (chirp, kicker). All the result confirmed an impedance of 2.6-2.9 MΩ/m, that is not in agreement with previous measurements.

We encountered the same problem measuring the tune shift at the intermediate energy of 14 GeV: we expected an impedance of 3 MΩ/m, while we measured 2 MΩ/m.

After these results, we supposed that tune shift measurements are sensitive to chromaticity. To verify that, we measured tune shift on the flat plateau at 14 GeV changing the chromaticity on the working point. For a given intensity, we acquired 11 tunes at different chromaticity. The calculated impedance varies from 2 MΩ/m to 3.5 MΩ/m: the maximum of the impedance is obtained for ξv=-0.18. More investigations at different energies are in plan to understand this dependency.

More details about the tune shift measurements results can be found on the PS impedance website:

http://impedance.web.cern.ch/impedance/