WP2 Meeting #149

Tue 28 May 2019, 10:00 – 11:00

Chair:	R. Tomás
Speakers:	N. Karastathis
Participants:	A. Alekou, S. Antipov, E. Cruz-Alaniz, S. Kostoglou, A. Kurtulus, E. Métal, N. Mounet, Y. Papaphilippou, F. Plassard, K. Skoufaris, G. Sterbini, F. Van Der Veken

AGENDA

The meeting was devoted to the problem of optimizing Dynamic Aperture at HL-LHC Injection

MEETING ACTIONS

Nikos	Investigate DA for larger chromaticity and lower octupole current and for tunes closer to the diagonal
Elias	Provide an update on beam stability at injection and possible new Q', octupoles and tunes based on simulation predictions and latest MD observations.

GENERAL INFORMATION (R. TOMÁS)

In the absence of Gianluigi Rogelio is chairing the meeting. Minutes of the previous meeting have not been released yet.

1 DYNAMIC APERTURE AT HL-LHC INJECTION (N. KARASTATHIS)

Nikos presented results of a parametric study of Dynamic Aperture (DA) at Injection with high chromaticity, octupole current, and long-range beam-beam. The study has been performed using the parameters from the OP Note with a 2.5 μm emittance in order to provide some margin.

Beam intensity does not play a big role in DA degradation, but an increase of the octupole current from 20 to 40 A, on the contrary, shrinks DA significantly. This is so because the beam-beam tune shift is of the order of 10^{-4} and it is in the shadow of the octupole detuning, which is of the order of 10^{-2}.

The optimal Working Point (WP) depends on the octupole polarity. In general, the negative polarity provides a slightly larger maximum attainable DA close to the diagonal due to the impact of a 3rd order resonance. At the nominal WP of (0.27, 0.295) the DA is about 3σ for -20 A and about 4σ for +20A; for the OP octupole current of -40 A the DA is below 3σ. According to a scan of octupole currents and chromaticities, in order to achieve a DA above 6σ one needs the octupole not to exceed -12 A for Q' = 20 for the negative polarity or +15 A for the positive polarity.

Magnetic field errors may further decrease the DA by up to 0.5σ depending on the octupole current and the WP. This margin has to be taken into consideration. Accounting for the errors, at Q'= 15 one finds a range of acceptable DA of 7σ for WPs between (0.282, 0.297) and (0.295, 0.310) and octupole currents between -10 A and + 10 A.

- **Elias** noted that based on the simulation results, the values of octupole current at chromaticity presented in the OP Note seem unfeasible and have to be optimized. **Yannis** emphasized that the simulated DAs are consistent with present experience at LHC. **Rogelio** raised a question on the need to have margin in emittance and octupole strength. **Nicolas** pointed out that in 2018 there were many days when LHC had to operate at 45-50 A.
- **Elias** raised a concern that the demonstrated area of large DA might be incompatible with beam stability. **Nicolas** proposed investigating larger Q' as it seems more effective in stabilizing the beam at Injection that the octupole current. **Nikos** noted that Q' does not have a large impact on DA. **Rogelio** proposed to conduct a search for a region of larger Q' and lower required octupole current (Action: **Elias, Nikos**).
- **Elias** mentioned that the need for beam stabilization comes primarily from the electron cloud trapped in the quadrupoles, which drives instabilities in both transverse planes. Studies suggest the impact will be less critical at larger intensities; this is currently being investigated. **Rogelio** proposed to have a presentation at WP2 with a review of the injection instabilities and parameter phase space (Action: **Elias**). **Sergey** suggested not to rely on the favorable dependence of the electron cloud density as a function of bunch population as it might be challenging to control.

- **Rogelio** inquired why the WPs near the diagonal were excluded from consideration. **Elias** answered the linear coupling is the reason. **Rogelio** suggested to look at coupling corrections; conceptually one should be able to control both linear coupling and Laslett tune shifts to work closer to the diagonal. **Yannis** suggested it would provide some enhancement of DA, although not a large one.

Reported by S. Antipov