Accelerator Design meeting

Monday 06/03/2023, 16:00 – 17:00

(https://indico.cern.ch/event/1260422/)

Chair	Daniel Schulte
Speakers	Kyriacos Skoufaris
Participants (Zoom)	Alex Bogacz, Andrea Bersani, Antoine Chancé, Anton Lechner, Bernd Stechauner, Cary Yoshikawa, Chris Rogers, Claude Marchand, Claudia Ahdida, Daniel Novelli, Daniel Schulte, David Amorim, Elias Metral, Fabian Batsch, Fulvio Boattini, Heiko Damerau, Ivan Karpov, Jean-Pierre Delahaye, J. Scott Berg, Jose Antonio Ferreira Somoza, Kyriacos Skoufaris, Marco Statera, Massimo Casarsa, Max Topp-Mugglestone, Nadia Pastrone, Pantaleo Raimondi, Patricia Borges de Sousa, Philip Burrows, Roberto Losito

Meeting Actions

- None

1. News (Daniel Schulte)

- The MuCol EU project has official started on 1st March
- Information for the kick-off meeting (28th March, via Zoom) will be sent soon. Program will be structured as:
  - Morning + beginning of afternoon: presentation of Work Packages
  - Afternoon: meeting of the Governing Board (equivalent to the Collaboration Board of the IMCC)
- A Muon Collider Workshop is taking place in Santa Barbara (CA, USA) on theory aspects, but also with topics on accelerators and detectors. A panel discussion will take place on Friday 10th March
  - Information on the workshop: https://www.kitp.ucsb.edu/activities/muoncollider-m23
  - Link to the presentation recordings: https://online.kitp.ucsb.edu/online/muoncollider-m23/

2. Current status of the 10 TeV collider (Kyriacos Skoufaris)

- Kyricaos Skoufaris presented the current progress on the 10 TeV collider lattice design. The previous optics design (v0.4) had several issues, now solved with v0.5
- Three of the main constraints driving the optics design are:
  - The small β^* (1.5 mm) required at the Interaction Points (IP), leading to large β functions in the Final Focusing (FF) region and in turn large chromatic aberrations
  - The large energy spread (δ=0.1 %)
  - The muon decay which requires to minimize straight sections length
- The resulting lattice has a racetrack shape to accommodate the two IP
  - Extensive use of combined function magnets is made, for example with dipole-sextupole magnets in the Chromatic Correction (CC) region
- Final Focus region of v0.5
  - The maximum allowed field is up to 20 T (assumes the use of HTS magnets) compared to 16 T in v0.4
  - The new scheme provides smaller β functions: 4 km versus 400 km in v0.4
  - Montague functions W remain large, especially with the large energy spread δ
- Chromatic Correction region of version 0.5
  - The dipole-sextupole magnets are now spaced by a perfect -I transform, which improves the dynamic aperture (version had a small deviation from a perfect -I transform leading to poor DA)
  - Smoother reduction of the W functions compared to v0.4, but they do not reach exactly zero at the IP. Impact on luminosity is shown in slide 18. This issue is solved with the lattice v0.6
- Arc design of v0.5
  - The arcs should compensate the momentum compaction factor contribution of the CC region
  - For this, Flexible Momentum Compaction (FMC) cells are used to generate negative dispersion
  - The β and dispersion functions are much smaller than in v0.4, reducing the magnet aperture needed.

- Full lattice and tracking studies with v0.5
  - The non-zero Montague function at the IP would have an impact on luminosity that need to be addressed
  - With tracking, large tune shifts for particles with large energy spread are observed. This is a sign of the importance of high-order chromaticity.
- A v0.6 lattice is being developed, it includes the improvements of v0.5, and adds more knobs to control W functions and higher-order chromaticity

- Alex Bogacz asked if the arcs are made of FODO cells and what is the total momentum compaction factor. Kyricaos answered that the FMC cells of the arcs are each made of two FODO cells and that the total momentum compaction is of the order of 10^{-8}. The negative dispersion introduced by the FMC cells compensates the contribution from the Chromatic Correction region.
- Scott Berg asked which magnet technology is assumed (Nb_3Sn or HTS) for the field limits
  - Kyriacos and Christian Carli explained that the design assumes 16 T or 20 T for the IR magnets, independently of a specific magnet technology. Iterations will happen with the inputs from magnets design. In particular the shield design will impact the aperture and maximum field available.
  - Daniel Schulte added that a small set of different scenarios for the magnet technologies could be assumed and studied
- Antoine Chancé asked how much the beam-beam effects will affect Dynamic Aperture.
  - Kyricaos answered that indeed this will have an impact, but the first step is for the lattice to reach the target DA (5σ) before checking the impact of beam-beam.

3. AOB (Everybody)

- A seminar on CERN's future collider projects will take place on Tuesday 14th March at 11:00 (Geneva time). Link to the Indico page: https://indico.cern.ch/event/1260648/
- There will be no Design Meeting on March 13th, the next meeting will take place on 20th March

Reported by D. Amorim, E. Métral and D. Schulte