Beam Dynamics meeting
Wednesday 02/06/2021, 14:00 – 16:00
(https://indico.cern.ch/event/1041985/)

Chair: Elias Métral
Speakers: Elias Métral and everybody (round table)


AGENDA

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MEETING ACTIONS

1: Everybody Continue to prepare the 2nd Community Meeting (which should start on 12/07/21):
   - 1) Try and look, all of us, at what has been done already and collect the info to document our Beam Dynamics webpage.
   - 2) Identify possible bottlenecks in the different stages of the Muon Collider Complex, which should be studied in more detail in the future.
   - 3) Perform first estimates on some (classical) mechanisms we know (BBU, beambeam, acceleration and RF power, etc..), limiting ourselves (for the moment) at the acceleration (after the cooling) and the collider ring.
- 4) Think about the main info which we could/should pass to the other WGs and which questions we would like to ask to the other WGs.
- 5) We should start to work (or plan the work) in particular on the 5 items we identified as criticality 1 (see https://indico.cern.ch/event/1041985/contributions/4377185/attachments/2253375/3825390/SummaryOfChallenges_BD-WG_27-05-21_EM-TR.pdf), looking also at the required resources.

2: Oscar
Plan a talk together, summarising the work on the LEMMA scheme over the past 2 years, for a future BD meeting.

3: Shinji
Plan a talk together on FFAs for a future BD meeting.

1 NEWS (ELIAS METRAL)

- Many thanks again for all your help and input for the 1st Muon Community Meeting!
- The workshop was a great step forward with very good summaries for the 9 Working Groups. A short document is now requested by June 7th, consisting of 2-4 pages of text and describing the process for the R&D list: one should make sure that it is done in a way the community is informed and involved. Furthermore, there should be a particle physics workshop in the last week of June, where each panel will make a 30-minute-long presentation. Daniel proposed to delay the stakeholder meeting in light of the above. There will be then an interim report (with iterations) before September and finally the end-of-the-year report of ~ 40 pages.
- Discussing the subject of combined-function magnets, MAP proposed a combined-function magnet design (there is for instance an IPAC12 paper), combining dipole and quadrupole in a nested-coil design. Recently, within the framework of the FCC-hh studies, MassimoG and EzioT proposed an asymmetric coil design that features naturally a superposition of dipole and quadrupole.

2 FOLLOW-UP OF THE 1ST COMMUNITY MEETING ON 20-21/05/21 (ELIAS METRAL)

- See our updated summary for the BD-WG: https://indico.cern.ch/event/1041985/contributions/4377185/attachments/2253375/3825390/SummaryOfChallenges_BD-WG_27-05-21_EM-TR.pdf => There is 1 change compared to the summary we produced for the 1st Muon Community Meeting (see https://indico.cern.ch/event/1030726/contributions/4350288/attachments/2249360/3815646/BD-WG_Summary-R%26D-List_EM_21-05-21.pdf): after discussion within the Muon Beam Panel, the item 5) was put back to criticality 1.
- Next (see also Action 1)
  o We will need to identify (in the future, to be decided at some point) a responsible person for at least the 5 critical items, which will need to be followed up carefully. No
commitment for the moment (as it will have to be officially approved by the management in the future), but just first discussions:

- 1) New beam dynamics regime during acceleration
   - Ivan Karpov with a Fellow joining in October: tbc in the future.
   - We should split between < 60 GeV and > 60 GeV and Ivan et al. will take care of the part > 60 GeV.
   - Tor would be pleased to work on the part < 60 GeV: he cannot really commit at the moment but he would be pleased to help supervising/advising some students.

- 2) Opposite sign bunches – beam crossing and wakes
   - Xavier Buffat with 2 master students?: tbc in the future.

- 3) Design of the full chain (acceleration in particular)
   - Elena Fol who recently joined as Fellow with Daniel Schulte: tbc in the future.
   - Scott will continue and work on it: he cannot really commit at the moment but he would be pleased to help supervising/advising some students. He planned for the moment to look at the acceleration chain, in particular at high energy, and the transitioning towards low-energy. He might do some work on wakes for pulsed synchrotrons and he would be happy to work in this area with other interested people.

- 4) Radiation mitigation by moving the beam / magnets in the collider
   - ?

- 5) Collective instabilities during ionization cooling
   - Xavier Buffat with 1-2 PHD students?: tbc in the future.

Round table (other than what was discussed above)

- Elena: 100% Fellow with Daniel, working on the integrated simple model of the acceleration chain. Working also on ICOOL (helping Bernd on the final cooling), which is quite difficult => Scott could help on this matter and she should contact him (Manual + tutorial with some examples). Will also will in the future for the development of simulation tools.

- Xavier: could/will start to write some work descriptions to get students. He will devote some time also to look at the wake inside matter, reviewing first the possibilities of the current codes (following some discussions with Scott, Rob and Alexej on some possibilities of some codes like CST, GEAN and SPACE) => See for instance https://en.wikipedia.org/wiki/Accelerator_physics_codes and https://oraweb.cern.ch/pls/hhh/code_website.startup

- Alexej said that CST is a good starting point but if we replace vacuum by matter there are issues: if we make a small hole inside it, it could maybe give some interesting results... => To be looked at. IW2D could also be used. Furthermore, in plasma there are already very powerful codes.

- Scott and Rob discussed the SPACE code by R. Samulyak => See for instance “Space code for beam-plasma interaction” (https://inspirehep.net/files/73d0f3598287a15b5e8ec11e27a51d9).

- Me: Discussing the current limits of some codes, I mentioned that for the moment we could not reach a full description of the CERN “16L2 instability” originating from a nonconformity (see last slide of
Heiko asked Scott about the energy swing he considered, who mentioned that he put the 2 RCS in the same tunnel. Scott sent us this report after the meeting: https://www.osti.gov/servlets/purl/1779395. Furthermore, Heiko asked about the gamma transition to be used in the different machines: we recall that, with FODO cells, the gamma transition is close to the horizontal tune. We said that the best is to consider it constant for the moment.

Oscar mentioned that he has been working on the LEMMA scheme and his period of 2 years will finish in ~1 month. He already delivered his final document to INFN and he would be pleased to summarise what he did: See Action 2.

Ivan showed some nice movies from the BLOND code. Scott mentioned that the oscillation seems to come mainly from the wrong aspect ratio and the associated mismatch. Ivan mentioned some poster at IPAC using ORBIT 1 D for RCS and they discovered that the equation of motion was not correct when the energy gain is too big.

Scott reminded the 2 issues linked to the discrete nature of the energy gain and the mismatch between the energy and magnetic field, mentioning that the second aspect should be the dominant effect in many cases. In the middle of 2 RF stations, it is ok but when the bunch arrives at the location of an RF cavity it is when it is the most wrong.

Using a large number of RF stations, they could recover the usual behaviour.

Next: put intensity effects.

Kyriacos reminded (for those who were not here the last time) that he is working with ChristianC for the collider design at 3 TeV.

Rob asked about the codes used by Scott: No code for the moment. But, in the past, he used Bmad which is fine for him (with hybrid lattices). Scott mentioned that ORBIT deviated from the reference orbit.

Scott would like to bring the modelling of the RCS a step further putting some quads and achromatic cells. He would like also to get the short-range wakes from the TESLA cavities to use them in some simulations with wake effects in the RCS.
3 AOB (EVERYBODY)

- Shinji informed me by email that he will present something about FFAs in the future => See Action 3.
- The currently planned next meetings (with evolving agendas) are: 16/06/21 (https://indico.cern.ch/event/1046241/) and 30/06/21 (https://indico.cern.ch/event/1046242/), knowing that the 2nd Muon Community Meeting should start on 12/07/21.
- As discussed, I created the e-group muoncollider-bd for our beam dynamics team (see https://e-groups.cern.ch/e-groups/EgroupsSearch.do) and our email list is muoncollider-bd@cern.ch. This CERN e-group is open to self-subscription. Please do not hesitate to forward this invitation to any person you think could be interested in joining the meeting or the e-group (for the moment I included into it: Scott, Tor, Rob, Shinji, Jean-Baptiste, Oscar, Xavier, Heiko, Ivan, Elena, Alexej, Daniel, Kyriacos, Bernd and me).

Reported by E. Métrot