**Subject:** Your_manuscript ZR10120 Fitterer
**From:** "prab@aps.org" <prab@aps.org>
**Date:** 6/9/18, 09:09
**To:** Giulio Stancari <stancari@fnal.gov>

Re: ZR10120
Effects of periodic and random excitations on the proton beam in the Large Hadron Collider with implications for pulsed hollow electron lenses
by Miriam Fitterer, Giulio Stancari, Alexander Valishev, et al.

Dear Dr. Stancari,

The above manuscript has been reviewed by two of our referees.
Comments from the reports appear below.

These comments suggest that considerable revision of your paper may be in order. If you resubmit your manuscript, please include a summary of the changes made and a suitable response to all recommendations or criticisms.

We also suggest that Reference [5] should be updated to a journal article:

[5] M. Benedikt, F. Zimmermann, ``Towards future circular colliders,'' Journal of the Korean Physical Society (2016)

and perhaps in addition to include the recent IPAC paper

[5b] M. Benedikt and F. Zimmermann,
``FCC: Colliders at the Energy Frontier,''
Proc. IPAC2018, Vancouver.

Yours sincerely,

Frank Zimmermann
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PROBLEMS WITH MANUSCRIPT:

In reviewing the figures of your paper, we note that the following changes would be needed in order for your figures to conform to the style of the Physical Review. Please check all figures for the following problems and make appropriate changes in the text of the paper itself wherever needed for consistency.

Figure(s) [3,13,21,25,29]
The abbreviation "a.u." is used to indicate atomic units only; arbitrary units are abbreviated "arb. units"; "A.U." is for astronomical units; "amu" is for atomic mass units.
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Figure(s) [4]
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Please change E1, E2, etc., to power of 10 notation (i.e., 10 with appropriate superscript). We do not print computer notation.

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The lettering in the axis labels and/or numbering size should be increased.

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Please rearrange power of 10 in axis label for clarity: Either (i) place the power of 10 as a factor, without parentheses, in front of the axis label quantity, changing the sign of the power as needed; or (ii) incorporate the power of 10 in the topmost or rightmost number on the scale. Please refer to the URL http://journals.aps.org/authors/axis-labels-and-scales-on-graphs-h18 for a pictorial representation of the preferred forms for axis labels.

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Please insert post-decimal zeros (1.0, not 1.) or delete the decimal point.

TITLE:

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The following problems were noted in your manuscript.

* Please check the changes made to the title of your manuscript.
We propose a modified and somewhat shorter title.

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Report of Referee A -- ZR10120/Fitterer

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REFEREE A - ZR10120

The paper describes quite extensive simulation and experimental work in estimating the effects of either resonant or random dipole excitations on the LHC proton beam at injection. Quantities studied

include beam loss, transverse beam profiles, and bunch length. The studies are motivated by the planned use of a hollow electron lens in the HL-LHC in pulsed mode (either resonantly with the betatron tune, or randomly). The pulsed mode should deplete the beam halo but not affect the beam core.

The paper is well written, with an excellent introduction, high quality tables and figure (a few issues are mentioned below), and very few typos. It reports in substantial detail on work performed in 2016 and 2017.

My main criticism is with the discussion and conclusion. In this section, the previous sections are summarized as one would expect, but the authors may be able to come to more pronounced conclusions. The following sentence is somewhat disappointing after such a large body of work: "However, further work is needed to identify, both in simulations and experimentally, candidate excitation patterns that are effective for halo removal and that preserve the beam core ...".

Would it be possible, for example, to summarize the beam losses of all cases studied experimentally and in simulation in a single table? What conclusions could be drawn from such a direct comparison for the cases studied? Are any of these excitation pattern viable for a hollow electron lens in the HL-LHC - which was the motivation for this work after all?

Typos and minor comments:

- Table I: "... for past, present and future colliders." Here the authors only show the colliders at their labs. The Tevatron is really only an example of 3 colliders with comparable stores energy, and the ISR (not mentioned at all) had up to several MJ of stored energy too.

- Table III: "$\mu perv$" is not an SI unit. Use "$\mu$\text{AV}^{-2/3}$".

- Table IV: MOF and MOD are not defined

- line 472: "can thus attributed" => "can thus be attributed"

- all figures: Since the paper reports on both measurements and simulations it would help the reader if the captions would start with either "Measurement ..." or "Simulation of ..." or "Calculation of ..."

- Figure 8: Can "random" be a dashed line for better distinction? Also, the emittance growth for "random" should be calculable (e.g. Handbook 1999, Syphers, Sec. 4.5.6 "Emittance growth").

- Fig. 30, 31: it is difficult to distinguish the symbols for "damper on" and "damper off"

- Ref. [15] - A better or additional reference may be X. Gu, PRAB 20, 023501, 2017.

- Ref. [41] is not used in the text - there may be more unused references

- there may be more references on emittance growth - although I could not find a specific one on resonant excitation, as the authors have pointed out

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Report of Referee B -- ZR10120/Fitterer

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REFEREE B - ZR10120

In this article various types of beam excitations are numerically and experimentally investigated, which act on proton losses, beam emittances, and beam distributions in the LHC. These studies are important for the design of hollow electron lenses (HEL) for active beam halo control of HL-LHC, where a considerable amount of energy will be stored in the beam tails.

Given the need of active halo control for HL-LHC and for future high-power accelerators such as HE-LHC and FCC-hh these investigations are very essential. The experimental work and simulation results presented in this article are excellent. In my view, the article contains too many technical details, especially too many excitation schemes that lead to confusing plots (see Figs. 17, 18, 22, 27, 28 and 32), with many detailed results that may not be of great interest for the general audience. This detailed information will certainly be very useful for colleagues working on high-power hadron colliders and should be complied in a technical note or elsewhere. Also in some of the FMA diagrams (see Figs. 9, 10 and 16) the difference between the various excitation modes are barely visible.

Sometimes plot sizes are just too small and in other cases, the difference between various settings seem to be marginal and does not contain any further findings.

Since this work is very relevant for the design and upgrade of future high-power hadron accelerators and the performed work is excellent, I suggest reducing the length and content of the paper to a more compact and comprehensible level. In particular, the number of excitation schemes displayed in individual plots should be reduced to a level that the content of the various plots is clearly recognizable.