

Collaborator Comments

Paul Soler

Comments accepted

Dan Kaplan

2. First mention of "ionization cooling" in abstract comes undesirably late. The general reader will be unfamiliar with the term in the title and will want an explanation sooner. I suggest moving the sentence beginning "Ionization cooling is" on line 8 to the end of line 2, before "Muon beams may..." (which may call for a bit of patching in the surrounding verbiage)

Nature demands our abstract conforms to :

One or two sentences providing a basic introduction to the field, comprehensible to a scientist in any discipline.

Two to three sentences of more detailed background, comprehensible to scientists in related disciplines.

One sentence clearly stating the general problem being addressed by this particular study.

So following their requirements, the general problem (i.e. ionization cooling) only comes in sentence 5-6, which is what I have done.

9. line 94: Why are we citing the rectilinear-channel work and not the HCC, which also achieves a 10^5 cooling factor in simulation (see K. Yonehara, "Helical six-dimensional muon ionization cooling channel with gas-filled RF cavities," 2018 JINST 13 P09003)?

The rectilinear-channel is closer to the MICE cooling channel. I had to choose something, as we are limited to 50 references.

12. line 128: is there a reason to cite Francois Drielsma's thesis here and not also Tanaz Mohayai's?

Francois studied kNN analysis of density, which is presented here. Tanaz studied only KDE.

14. Fig. 1 and caption: the figure does not show the LiH absorber and the caption does not mention it. I would at least mention in the caption (or in the text?) that other absorbers were also studied.

This is clear from the rest of the paper.

19. line 234: "Data-taking for each absorber was separated..." ... can be omitted with no loss of important meaning or content => omit

I disagree, the long-term stability of the apparatus is important.

31. line 704: better to be specific: insert "TOF" before "detectors"

TKU was also used in TKD reconstruction

35. Author list: I'm not sure I understand the rationale for which authors who did not participate in Step IV should be included - could it be explained to the collaboration?

This was decided by the collaboration board.

And I'm not sure I understand the rationale for the order of institutes - or maybe it has some errors?

RAL official address is Harwell Campus, Didcot so "Didcot". I moved the other institutes around.

Chris Booth

line 156: I would delete "in flip mode". I don't think it adds anything here.

It is pretty important for the beam optics so I think it deserves to remain.

Henry Neb

3) Line 1 "Accelerated beams of charged particles comprised of electrons, protons or ions have influenced..."

I don't like this, as an electron beam is clearly not comprised of protons... does just

"Accelerated beams of electrons, protons or ions have influenced nearly every scientific discipline."

make the same point?

Charged particles as distinct from lasers. It sets the context for biologists. I'm not sure what you mean by "electron beam is not comprised of protons", the text says electrons, protons OR ions (and it is clear from the context that this is EX-OR).

at some point we have to bite the bullet of providing lists of run numbers used in the various cases in the analysis.

I have the list already in electronic format but is it really necessary to go in the paper?

Kevin Ronald

electromagnetic beamline elements → magnetostatic

There is longitudinal capture by RF as well, at least in muon collider/neutrino factory designs.

Line 343 Remove This effect can only occur ... process

I think emphasising this point is essential – we are trying to explain why ionization cooling is special.

Line 675 remove "a coincidence of signals ... slab in TOF1"

The methods section doesn't have a word limit and the extra detail is probably helpful. Otherwise it isn't clear how TOF1 triggers data storage.

Line 727 "momentum acceptance" → "configured momentum acceptance"

I don't know what configured momentum acceptance means.

John Cobb

I'm not sure that moving the maths/theory section out of the main text to save space is a good idea because it leaves too many things which appear in the text undefined.

The general reader who wants to understand quantitative details of how we calculate the quantities, I am afraid, must go to the Methods section.

Brightness

Brightness was chosen because most people have a qualitative idea that brightness is “sort of like intensity”; so it is accessible to a general audience. In the context of accelerators, brightness specifically means current/(4D volume), which is I think a good figure of merit for muon accelerators. I toyed with “intensity”, but that really is current/(beam area) which depends on the beta function.

See e.g. Reiser (cited) or <https://bt.pa.msu.edu/FEIS2013/talks/musumeci.pdf>

I added a definition to the methods section to be clear.

Line 113 The z-axis is the nominal beam axis → move to previous sentence

The previous sentence is quite long enough already.

Line 125 what does “normalised” mean

The curious reader has to look in the Methods section.

Line 158 Suspension system → suspension

I don't know what a suspension is (except in chemistry context)

Line 190 optimal cooling performance

The optimisation is acceptance vs equilibrium emittance. No space to explain in the paper, but just so you know.

Fig.2 Not Distributions

How are they not distributions? I agree they do not show histogram of $f(x)$ but they do show $f(x)$ i.e. you can count (well, if you had a microscope) the number of points in a particular region – arguably better than in a histogram because the points are all represented.

Line 310: Shorter tails ... arise from scraping in the diffuser → is that true?

Yes it is – I checked with a quick simulation a few months ago.

Line 345: Liouville's theorem does not apply

We have not defined Liouville's theorem

Line 376: modest cooling → quantify

It is quantified in the methods section

Line 404: There is no error on ρ

Yes there is – the width of the line corresponds to the error on ρ . This is mentioned in the caption. It is not a very wide line because the errors seem well controlled.

Maurizio Bonesini

line 1 comprised of -> including

That isn't really the meaning I was trying to convey.

Figure 3 : points are quite small

Figure 4 : it is difficult to see points

I had to get the balance between making the points too big, so that we can't see the detail, and making them too small. I think I got the right balance.