The authors would like to thank the reviewers for their constructive and helpful feedback. We believe the paper is in a much better state thanks to the suggested changes.

Reviewer 1:

1. Has it been tried to re-coat a cavity without CBP. Could the performance enhancement simply due to curing of tin depleted regions?

Response: We have not tried just doing recoating, but we are planning to experiment with this technique on its own in the future. It is unlikely that the recoating on its own will have an impact on tin depleted regions, since they are typically located beneath the surface of the film where Sn diffusion is very slow.

1. Even if this could be ruled out, could it be that the performance increase was du to the thinner film and not a lower roughness. This should at least be discussed and potentially tested.

Response: Yes, the film thickness could also be a cause of the performance increase due to more efficient heat transfer through the film. We have added a discussion of this effect to the discussion section of the paper.

1. Furthermore, could it be that the effect of the recoating was rather due to annealing and that the tin did not play the important role? While this might be unlikely, it would be good to discuss this at least.

Response: We have added a comment to the discussion explaining this possibility.

1. It would be important to know what the roughness of the substrate was for samples and cavity.

Response: The samples and cavity were electropolished using the standard 100 + 5 micron cold EP treatment before the coating. A surface roughness of around 20nm can be expected. We have added a statement in the paper that the samples and cavity were electropolished before coating.

1. There are some technical deficiencies in the paper. Figures 4 and 5 are not mentioned in the text and their content is not discussed to an appropriate level.

Response: See comment number 8.

1. The whole manuscript has very few citations, which are in many cases self citations. I highlight below a few suggestions where I feel more citations would be appropriate but that issue is found throughout the paper.

Repsonse: Several new references have been added to the paper.

1. Paragraph 1: Some references would be appropriate here. Medical applications are not typical for SRF so especially here some references would be appropriate. It is not correct that SRF cavities yield higher gradients than normal conducting cavities.

Response: We have specified that the medical applications for SRF cavities refers to the NioWave radioisotope production facility and a reference has been added to support this statement. We have clarified that SRF cavities yield higher gradient in the continuous wave operating mode.

1. Paragraph 2: Some low frequency Nb cavities are operated at 4K (LHC, ISAC-II…). Be more specific here. Provide a more comprehensive list of references for the maximum fields instead of a single self citation.

Response: Several new references have been added to the statement of the Nb3Sn superheating field. We have added an example of Nb cavities operated at 2K to the text (LCLS-II).

1. Paragraph 3: Provide references for the process, especially the grain size obtained. Does the Nb3Sn grain size depend on the Nb substrate grain size?

Response: The Nb3Sn grain size has no correlation with the substrate grain size and is instead determined by the coating temperature and duration. We have added references for further information on the vapor diffusion method.

1. A Paragraph 1 – 6 g does not look like an appropriate unit. 6G or 60N?

Response: We have changed this number to an appropriate SI unit for acceleration.

1. Paragraph 2 - The removal rate of different abrasive materials has been studied by Palczewski, et. al for Nb  mention explicitly that these studies were for Nb

Response: The text was changed to specifically state that the studies refer to Nb cavities.

1. How was the height map obtained? It looks like it was done using confocal microscopy. Please clearly state this. What is the lateral resolution of this technique?

Response: The height maps were obtained by laser confocal microscopy. This information and the resolution of this technique has been added to the text in the figure caption and the sample analysis section of the paper.

1. Fig.2: What was the roughness of the substrate without coating. Can this image be added?

Response: The surface roughness of the substrate is approximately 20nm after electropolishing. This information has been added to the paper.

1. Fig. 3: What is the information obtained from the lower figure. Please provide some explanation in the text.

Response: The lower part of figure 3 shows the power spectral density of the surface map, which is an indicator of the surface roughness at different length scales. An explanation of this calculation and references to past studies using this technique have been added to the analysis of figure 3 in the text.

1. Fig. 7 – A comparison to an as coated sample would be good. If not available, could a literature reference be given. Please provide some information how one can see from the figure that the Nb3Sn layer is disordered for readers less familiar with the technique.

Response: The layer appears to be disordered, since the atomic layers are not visible in the high resolution TEM image and a large amount of dislocations can be seen near the interface between the damaged layer and the ordered film. We have added this information to the analysis of figure 7. Literature references have been added that show TEM measurements of the as-coated Nb3Sn film.

1. How was the niobium cavity prepared before coating (EP?)? Was the cavity tested before coating? What roughness can be assumed for the substrate?

Response: The cavity was tested before coating and showed decent performance compared to other Nb cavities. The cavity was treated with EP and anodization before the coating, so the roughness can be assumed to be about 20nm.

Reviewer 2:

1. 2nd paragraph, line 8. The authors should cite appropriate references for the superheating field of Nb3Sn (not only Ref. [1] but also Refs. [A, B, C]), which would be very helpful for readers.

Response: The listed references were added in addition to reference [1].

1. 5th paragraph, line 1. The authors should consider citing relevant papers that discuss how roughness impacts performance, providing valuable insights for the readers. Some exemplary papers that could be cited include Refs. [D, E, F]. These citations will enhance the readers' understanding.

Response: Additional references were added to provide insight into the impacts of surface roughness.

1. 7th paragraph, line 1. The authors are encouraged to cite pertinent papers on CBP, including the pioneering work [G], in addition to Ref. [8]. Properly referencing the relevant literature, especially the pioneering paper, will strengthen the credibility of the study.

Response: References to Saito’s group at KEK were added to the discussion of CBP.

1. 1st paragraph, line 2. The authors need to revise the statement regarding the development of CBP. As documented in Cooper's paper [H], the pioneering work on CBP was carried out by Saito's group at KEK in 1995 [G]. Subsequently, around 2012, Cooper and Cooley made further advancements to CBP, achieving a mirror surface. It is essential for the authors to correct this sentence and cite the relevant papers [G, H] to accurately acknowledge the contributions of each group in the development of CBP.

Response: The development of CBP was attributed to Saito’s group in addition to the contributions by Cooper and Cooly.

1. It is crucial for the authors to provide detailed information about the operating parameters of CBP, including the rotating speed. Without this critical information, even if the same machine is used, it would be challenging for anyone to reproduce the authors' results accurately. Including these specific parameters in the study will ensure transparency and enable other researchers to replicate and validate the findings.

Response: The rotational speed of the tumbler is set to 120 RPM while polishing. The relevant information was added to the experimental details of the sample polishing section and the cavity polishing section.

1. The authors should acknowledge the pioneering work of the coupon cavity in their CBP study, a technique that was also initiated by Saito's group at KEK in 1995 [G]. In this method, small Nb samples were placed at the equator section of a cavity made of SUS (see Section 2.2 of Ref. [G]). Studying CBP using coupon cavities allowed for valuable insights, and acknowledging this earlier work will enhance the readers' understanding of the research's context and contributions.

Response: A reference to Higuchi’s work on coupon cavities at KEK was added to the coupon cavity section.

1. It is crucial for the authors to provide detailed information about the coating procedure, including the temperature profile of the coating furnace, akin to Figures 5 in Ref. [10]. This essential information is crucial for ensuring the reproducibility of the authors' results. Without such specifics, replicating the study accurately would prove to be challenging for other researchers. By including the temperature profile and other pertinent details, the authors will enhance the transparency and credibility of their work.

Response: The coating parameters for the initial cavity coating and the recoating procedure were added to the cavity polishing section of the paper. This includes the temperature set points, temperature ramp rates, and the coating durations for each process. We also added specific numbers for the amount of Sn and SnCl for each process.

1. Figure 4 and Figure 5 are currently not referenced in the main text, and their significance is not explained. The authors should ensure to refer to Figures 4 and 5 in the main text and provide detailed explanations for these figures.

Response: References to figures 4 and 5 were added in the “Surface Analysis of Mechanically Polished Nb3Sn Coated Sample” section. Further analysis of these figures was also added.

1. 1st paragraph, line 5. The authors should provide a comprehensive explanation for why utilizing alumina is favored over Si. While the authors already mention that alumina helps avoid Si contamination of the furnace, it is essential to clarify whether alumina has any adverse effects on the furnace. This clarification is particularly valuable for readers who are not experts in coating processes, as it sheds light on the significance of this choice.

Response: Alumina is used as an insulator for power cables and thermocouples in the Nb3Sn coating furnace and has been shown to be stable at coating temperatures. Silica, on the other hand, is not stable at this temperature and can release silicon that reacts with the Nb3Sn to produce poorly superconducting niobium-tin-silicide phases. This information has been added to the “Centrifugal Barrel Polishing” subsection.

1. 2nd paragraph, line 5. The authors should provide clarity on whether using "one third of the normal amount of Sn" in the recoating process is considered optimal. It would be beneficial for readers to understand if the recoating process has been optimized and if not, the authors can mention the areas that require further investigation or improvement. Addressing this point will add important insights to the study, giving readers a better understanding of the methodology and its potential for refinement.

Response: The amount of Sn has not been optimized since we have only had the chance to recoat one cavity so far. Several new paragraphs were added to the discussion section addressing potential future directions for research on the topic of polishing Nb3Sn cavities.

1. The authors should include relevant information about the Nb cavity below the Nb3Sn layer, such as the Residual Resistivity Ratio (RRR) of the Nb material, the thickness of the Nb cavity, and other pertinent parameters. These factors play a crucial role in influencing the performance of the Nb3Sn cavity, particularly concerning thermal resistance.

Response: The nominal RRR and thickness of the cavity was added to the cavity polishing section. However, these number are not necessarily reflective of the actual values since the cavity has gone through surface treatments and electropolishing many times before this experiment was performed.

1. The authors should clarify if they have tested only one cavity in their study. If this is the case, they should emphasize this fact and underscore the need for further testing in the future. Conducting tests on a single cavity may limit the generalizability of the results, and it is crucial to acknowledge this limitation and highlight the importance of conducting more extensive testing to validate and broaden the study's findings. Emphasizing the necessity for additional testing will encourage further research in the field.

Response: This clarification has been added to the paper’s discussion section.

1. The authors should provide a more extensive discussion and interpretation of Figure 8. Specifically, they should address why the curve of the "recoated" cavity follows that of the "as-coated" cavity at 4.4 K but not at 2.0 K. This discrepancy warrants further explanation and analysis to help readers understand the underlying factors influencing the behavior observed in the graph.

Response: The behavior of the as coated cavity is not typical of a Nb3Sn cavity, so the cause of this anomaly is hard to determine without inspecting the surface an performing more testing of the as-coated cavity, which was not the intention of our study. We speculate that the behavior was caused by a surface defect which was later removed by the polishing procedure. This explanation has been added to the VTS testing section of the paper.

1. 4th paragraph, line 2. After addressing several potential causes of performance degradation in the third paragraph, the authors introduce their speculation about the function of recoating, stating, "We theorize that the polishing step..." However, this speculation may not necessarily align with the aforementioned potential causes of performance degradation. To ensure coherence in the discussion, it is essential for the authors to clarify the relationship between their speculation and the identified causes, allowing readers to better understand the context and implications of the recoating process in mitigating performance issues.

Response: This paragraph was rewritten to clarify the relationship between the potential causes of the performance degradation and how the recoating procedure might remediate these causes. We also clarify that the polishing procedure may expose pre-existing defects in the film in addition to introducing new defects and that the recoating procedure can repair both of these types of defects.

1. To ensure the best readability for readers, especially those new to the topic, the authors should consider citing a more extensive selection of relevant papers. This will facilitate understanding for students who have recently joined the field, ensuring they can access all the necessary literature to grasp the article's background and contents correctly. In addition to Refs. [A, B, ..., H], the authors are encouraged to include citations for all other pertinent papers that contribute to a comprehensive understanding of the subject matter.

Response: Several new references have been added to the paper including the references listed in the reviewer’s response.