

HF0F0 Project Updates

August 14, 2026

<https://github.com/criggall/muon-cooling/tree/main>

URA VSP proposal draft v.1 is finished

URA VSP Project Proposal: Design of a Charge-Agnostic 6D Muon Ionization Cooling Channel Caroline Riggall August 2026		ity to de- ccelerator at the util- t in muon enhance- e HFOFO catalyzed the training ation and ermilab— work will t a 10 TeV usion and		ption is nsverse entum. e, facili- through l acts as ngitudi- l, which ter, this be per- al phase nificant ernative esigned vas first usion of ny PhD		ith the rise 30 l. For a chastic chan- o the beam con- ed for a μ^+		ed a cut observe a cut and ed a cut observe a cut and		gher-order ole) lattice gher-order ole) lattice		URA VSP orate with as an ac- lab LDRD expertise at der of my ecedented my Particle DC, 2025. ose, Kyle Gershtein, hel Man- risi, Mark Seon-Hee n, Lindley Pathways	
1 I. Overview 2 When I began my graduate studies at the University of Tennessee, I intended to be- 3 come a high-energy physicist—indeed, even my PhD advisor’s work is (to leading-order) 4 in HEP. But when I started working on a muon cooling R&D project which had been 5 abandoned for a decade due to a scarcity of accelerator expertise, I decided to shift my fo- 6 cus to accelerator physics. Beyond the excitement of the open problems in the field, what 7 really drew me in was the need. Accelerator physics in the US is facing the symptoms 8 of an aging population. The 2025 National Academies report found that “[t]he design 9 and construction of future colliders and neutrino sources will require a large number of 10 accelerator scientists. This, and the demand for such scientists in other scientific fields, 11 industry and in medicine, will create a shortfall, estimated to be a factor of 3 to 4” [1]. 12 My work on muon cooling will be the beginning of a career spent solving very necessary 13 accelerator problems—a career which will start at Fermilab, the epicenter for accelerator 14 research in the US.		get proton ave large o generate colliders), d electron, seconds in g, is being es. While le R&D is (1) E_μ is the nuon, and describes ering.		um of round bution ies’ Be sorber begins n in the imally ocusing e period icted in		4. From ntum of nt beam gated by isonable rimarily n. f replac- by con- the field proof of x coeffi- reen the solenoid		on of the ositions of ltaneously enabling a unction at		ose, Kyle Gershtein, hel Man- risi, Mark Seon-Hee n, Lindley Pathways ing exper- e fermilab posito, Do- ed param- Journal of for Matter			
15 My project also got its start at Fermilab. During the Muon Accelerator Program (MAP), 16 which ran from 2011 to 2016, FNAL accelerator theorist Yuri Alexahin pioneered the 17 HFOFO Snake concept—a solenoid-based lattice design applicable to dual-sign muon 18 ionization cooling. Unfortunately, Yuri passed away a few years after the conclusion 19 of the program, and his work on HFOFO went unfinished. That is, until I began my 20 PhD program in the Fall of 2024, when—alongside FNAL accelerator physicists Diktys 21 Stratakis, Katsuya Yonehara, and David Neuffer—I began a revival of the HFOFO Snake 22 project. This work will comprise the majority of my PhD thesis, and there is no other 23 better place for me to receive the training and mentorship required to complete the 24 project than where it started: at Fermilab. 25 Beyond being the subject of my PhD training as an accelerator physicist, muon beam 26 R&D has a range of significant applications. Low-energy muon beam experiments like 27 Muon g-2 and Mu2e have and will provide key precision measurements of properties 28 of the muon. On the energy frontier, a US-based 10 TeV muon collider has been widely 29 favored by recent NAS [1] and P5 [2] reports for its robust physics reach and ability to 30 establish a strong US presence in physics at the highest energies scales. The significant		20 20 <td data-kind="ghost"></td> <td data-cs="2" data-kind="parent"> 125 125 <td data-kind="ghost"></td><td data-cs="2" data-kind="parent"> 4000 4000 <td data-kind="ghost"></td><td data-cs="2" data-kind="parent"> 1 1 <td data-kind="ghost"></td></td></td></td>		125 125 <td data-kind="ghost"></td> <td data-cs="2" data-kind="parent"> 4000 4000 <td data-kind="ghost"></td><td data-cs="2" data-kind="parent"> 1 1 <td data-kind="ghost"></td></td></td>		4000 4000 <td data-kind="ghost"></td> <td data-cs="2" data-kind="parent"> 1 1 <td data-kind="ghost"></td></td>		1 1 <td data-kind="ghost"></td>					

Feedback is welcome!

(Deadline Aug. 31)

To-study list for next week

3

Understand relationship between dispersion, absorbers, and transverse beam size #27

 Open |  Parent: Return to dispersion and beta function |  criggall/muon-cooling Public

 criggall opened 2w ago Last edited by criggall  Owner 

☐ At z of fi
☐ Plot disp

Create sub-issue

Implement orbit-finding procedure for periodic design #30

 Open |  Parent: Create a working version of the channel with constant momentum |  criggall/muon-cooling Public

 criggall opened 2w ago Owner 

More studies might be blocking this one.

However, to start: let us manually explore the space of RF gradient and absorber thickness to evaluate if the required initial conditions to generate a periodic orbit are within a reasonable range of the known solution for the no-gradient/absorber case.

Create sub-issue  

Continuing w/ last week's studies!