

# I.FAST

Innovation Fostering in Accelerator Science and Technology  
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## DELIVERABLE REPORT

# International Workshop on Muon Source Design

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### ABSTRACT

The 1<sup>st</sup> International Workshop on Muon Source Design was part of the International Muon Collider Collaboration (IMCC) Annual Meeting, organised in person at CERN on October 11-14, 2022 (M18 of I.FAST). The main goals of the Meeting were to assess the progress of the study and to define the future work programme, in particular regarding sharing the tasks among all Collaborators.

I.FAST Consortium, 2022

For more information on IFAST, its partners and contributors please see <https://ifast-project.eu/>

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### Delivery Slip

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## TABLE OF CONTENTS

<b>1</b>	<b>INTRODUCTION.....</b>	<b>4</b>
<b>2</b>	<b>FUTURE PLANS / CONCLUSION / RELATION TO OTHER IFAST WORK.....</b>	<b>5</b>
<b>3</b>	<b>REFERENCES.....</b>	<b>6</b>

## ***Executive summary***

*The International Muon Collider Collaboration (IMCC) Annual Meeting was held in person at CERN October 11-14, 2022: <https://indico.cern.ch/event/1175126/>. The main goals of the meeting were to assess the progress of the study and to define the future work programme, in particular regarding the share of tasks among all Collaborators. This will include the organization of the MuCol Design Study for which was just received a positive answer from the EU. A specific objective of MUST is to review advances and promote collaboration on the muon source. The Collaboration Board met for the first time at the Collaboration Meeting, and started activities within the scope of the study.*

## **1 Introduction**

The 1<sup>st</sup> International Workshop on Muon Source Design was part of the International Muon Collider Collaboration (IMCC) Annual Meeting, organised in person at CERN on October 11-14, 2022 (M18 of I.FAST). The main goals of the Meeting were to assess the progress of the study and to define the future work programme, in particular regarding sharing the tasks among all Collaborators.

The meeting was attended by 187 participants, with about 50 attending online. All presentations are available on the Indico site <https://indico.cern.ch/event/1175126/>.

The current effort is the design study of a multi-TeV muon collider facility by the next EPSSU, to provide a baseline concept, well-supported performance expectations and assess the associated key risks as well as cost and power consumption drivers, including the definition of test facilities and possible intermediate steps. It will also identify an R&D path to demonstrate the feasibility of the facility. The collaboration and community activities, after the review to prepare the Accelerator R&D Roadmap, are organized in working groups. The studies related to the muon source design are crucial to define the initial beam parameters of the facility. Therefore they are targeted in different dedicated working groups: Proton Complex, Muon Production and Cooling, Cooling Cell and Demonstrator. More in depth studies on enabling technologies are also addressed in Radiofrequency cavities and Magnets working groups.

The present IMCC muon source baseline option is the so called “proton driven”, previously studied by the U.S. MAP project. An intense proton beam on a target produce pions which subsequently decay to muons, demanding for a fast ionizing cooling before two intense, low emittance muon bunches could be accumulated, accelerated and brought into collision.

The individual elements of the muon source were studied in detailed by MAP, but an integrated system design and optimization still need to be performed by the present Design Study of IMCC. For example, MAP studies considered gallium, graphite and mercury as options for the production target material. There is the need to assess the expected performances of different alternatives taking into account eventual technical limitations. Some of the options, such as mercury targets, are not suitable in the European context and will not be studied further. I.FAST project is the ideal environment to foster collaboration with other interested expert groups.

The whole IMCC Annual Meeting has been organized with the I.FAST support. A dedicated session, the full day October 12, was also intended as the International workshop on the Muon Source Design, organized to fulfill milestone MS15 for WP5.1 of the I.FAST EU project.

The community presented different past and new studies and option to be discussed, aiming to define a shared strategy to finalize the integrated system design and finalize the input parameters to the facility. Special attention was devoted to explore synergies within the activities of other I.FAST WPs.

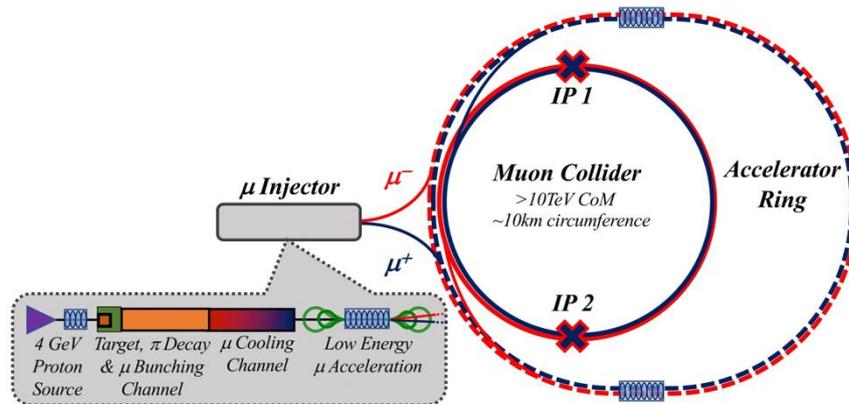


Fig. 1 The Muon Collider facility scheme. The Muon Source produces and cools two low-emittance opposite charge muons bunches to feed the first low energy  $\mu$  acceleration level, before injection into the accelerator ring, which will bring the beams to maximum energy to feed the collider ring with the two interaction points to install experiments.

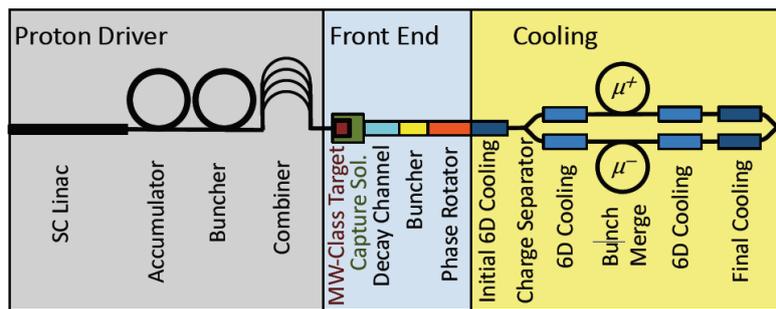


Fig. 2 The MS15 Muon Source Design Workshop focuses on specific key items of these three separate blocks: Proton Driver, Front End including Target and Capture Solenoid, Cooling at different stages including Bunch Merge.

## 2 Future plans / Conclusion / relation to other IFAST work

The workshop was well attended, focused on several essential components of the Muon Source Design. After discussing the proton driver parameter optimization, linked to possible siting, the target physics and engineering requirements were addressed as well the related radiation studies of the system. Ionizing cooling require to start working on integrating a newly developed high field solenoid to be coupled to a normal conducting cavity. The IMCC is starting to sketch out the baseline design of the a 6D cooling demonstrator: one of the mandatory goal to prepare for the next ESPPU. There is consensus to work towards a common baseline and to develop a list of technical issues to be addressed. Nothing yet can prevent a facility being constructed.

Synergies has been explored within I.FAST, mostly on target materials and thin window for target and cooling system in WP4.

## 3 References

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