

International
UON Collider
Collaboration



MuCol

Status of Design Study including MuCol

D. Schulte
for the International Muon Collider Collaboration

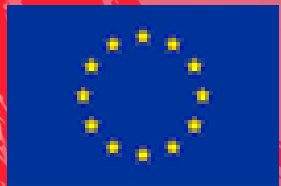
IMCC ICB, October 2023

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D. Schulte

IMCC progress, ICB meeting, October 2023

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Key Current Efforts



- The parameters document
 - Due by end of October
- The Interim Report
 - Due February 2024
 - Draft end of November
 - Review January 2024 (first IAC)
- Establishing a credible scenario with the muon collider as the next project after HL-LHC start considering a timeline consistent with an early implementation of the muon collider in the US
- Publication Policy
- Resources, Addenda, Grey Book

Note: Several MuCol milestones and deliverables were planned for June each year and delayed to August due to the approval delay. The EU officer agrees that they are delayed to October the same year.

Tentative Parameters



Have to submit by the end of the month

Many areas have already filled in the data, some are in the process

Planned process, led by Chris Rogers

- This Friday 13th October
 - All sections need to be completely finished
 - Chris Rogers and others to take a fork and do an editing pass.
 - Start building an IMCC author list, for example setting up an INDCO page for sign-ups, etc.
- Tuesday 17th October (CC meeting)
 - Returned "final" version distributed to collaboration for editing and discussion. Deadline Friday 20th October
- Friday 20th October
 - Comments received from collaboration. Editing pass by Elias Metral and others (noting Chris R is away next week)
 - Draft author list distributed. Only a few days for corrections.
- Tuesday 24th October, submission to EU portal
 - Submission to EU portal (noting Chris R is away this week).

Interim Report



Purpose

- Part of the European Accelerator R&D Roadmap
- MuCol deliverable
- Help to increase support from Council and other funding agencies
- Manage expectation for next reports
- Prepare key elements of the R&D

Plan

- Kick-off meeting next week Tuesday
- Complete draft end of November
- Full document end of the year
- Review in January
- Delivery February

Interim Report Key Messages



- Strong interest in the collaboration
 - E.g. US P5 ask
- Substantial increase in resources
 - Thanks to EU Design Study
 - More resources in institutes (e.g. CERN MTP)
- Good progress in studies
 - Many examples
- Still not at required level
 - Manage expectations for 2025/2026
- Synergies
 - Strong synergies exist, in particular for HTS magnet development, strong impact on society
- What will we need in the future?
 - RF test stand, demonstrator etc.
 - Technology developments

Interim Report Structure



Collaboration Development (Nadia Pastrone, Steinar Stapnes, Daniel Schulte, also Mark Palmer, Sergo Jindariani, Diktys Stratakis)

- Members, contributions, MuCol, US plans

Implementation Considerations

- Staging
- Maturity
- Timeline considerations

Physics Potential (Andrea Wulzer)

- Also synergy physics case

Physics, Detector and Accelerator Interface (NN)

- Physics and detector needs (NN)
- MDI (Anton Lechner)

Detector (Donatella Lucchesi)

- Concepts (Lorenzo Sestini)
- Technologies (Nazar Bartosik)
- Performance (Massimo Casarsa)

Accelerator design

- Overview
- Proton complex (Natalia Milas)
- Muon capture and cooling (Chris Rogers)
- Acceleration (Antoine Chance, Heiko Damerau)
- Collider ring (Christian Carli)
- Collective effects (Elias Metral)

Accelerator technologies

- Magnets (Luca Bottura)
- Power converter (Fulvio Boattini)
- RF (Dario Giove, Alexej Grudiev)
- Target (Marco Calviani, Anton Lechner)
- Beam-matter interaction (Anton Lechner)
- Muon cooling module (Lucio Rossi, Roberto Losito)
- Cryogenics (Rob, Patricia)
- Vacuum (Jose)
- Instrumentation (Thibaut?)
- Absorbers and beam intercepting devices (Rui, Jose, Anton)
- Radiation and protection (Claudia)
- Civil engineering (Yuri, John)
- Movers (Antii, Carlotta)
- Electric supply (EN/EL?)
- HVAC (Ingo Ruehl, just to identify risks)
- General safety considerations (Claudia to coordinate)

Synergies

- Technologies (Luca Bottura, ...)
- Facilities (Chris Rogers)

R&D programme development

- Demonstrator (Roberto Losito, Chris Rogers)
- RF test stand (Dario Giove, Alexej Grudiev)
- Magnet test facility (Lucio Rossi, Luca Bottura)
- Other test infrastructure required (HiRadMat, ...) (Roberto Losito)

Executive Summary (Nadia Pastrone, Steinar Stapnes, Daniel Schulte)

Credible Timeline



Become more specific about staging concept

Start considering realistic timelines

- 15 years to start 3 TeV construction
 - Using HTS for muon production and cooling, Nb_3Sn for collider ring (11 T, 16 cm aperture)
- 30 years to start 10 TeV construction
 - Use HTS/hybrid throughout
- About 7 years of construction for each stage
- Can operate up to 13 years at 3 TeV, overlap of construction and operation except for last two years
 - Maybe 2 years of long shutdown, luminosity ramp-up in first 2-3 years
 - Maybe 9-10 years of full luminosity, can relax luminosity target (before assumed 5 years)

Plan is consistent with human resource limitations during construction and initial operation of first stage

- Stretches budget (cost of both stages are expected to be similar)
- Allows significant technology advances between stages
- Total operation time similar to full CLIC programme (and cost maybe below)

Credible Timeline



In future will develop timeline for the

- magnet development and test station
- demonstrator
- RF technology / test station / cooling cell module
- other technologies

Focus on green field for now

- Still at the beginning
- Fair collaboration with the US and other regions

At the end will consider reusing the SPS and LHC tunnels for the muon beam accelerating stages

What to do about LHC tunnel?

- 3 TeV accelerator, but delays project
- 10 TeV accelerator, but have to consider neutrinos more

Publications



Important goals:

- Document the results of our collaboration and studies
- Make IMCC visible

Have to

- Ensure the quality of the publications
- Include everyone who contributes, even if not formal member of the collaboration
- The MoC requires open access for publications of the collaboration

This is the fruit of our collaboration and must be owned by all of us

MoC places duty to implement this on SL ("organise and guide the study", "ensure coherent communication")

- but needs to be delegated (as in most large collaborations or studies)

Proposal is Publication and Speakers Committee (PSC)

- Chair selected by SL and ICB (already done: Elias Metral)
- PSC reports to SL and ICB (and MuCol GB, to simplify our life)
- Rules to be endorsed by the ICB

Addenda, Resources Data Base, Grey Book



The Addenda to the MoC concern all Partners that signed the MoC

- A part of the MoC commitments
- Required for registration with Accelerator Sector at CERN, i.e. longer term visitors or very regular visitors

The Resources Database concerns all institutes

- Even if they did not sign the MoC
- This is important to make the study a success

The Grey Book concerns Partners of the Physics and the Detector studies that want to send personnel to CERN in a simplified way

- Nevertheless gives rights as CERN users

Addenda



MoC:

“5.1. Each Participant’s contribution to the MC Study shall be laid down in Addenda to this Memorandum, which shall be signed by the Study Leader (or his designated representative) and a representative of the Participant.”

We shall fill at least one addendum per partner. This will also be the basis for personnel of that institute to come to CERN for longer stays.

Keep it as light as possible:

- some generic text in the template that ensures the above
- a very short summary of the contribution (a few lines)

Goal is to use the resource data base information to fill the addenda almost automatically. **Consider the resource table as current best estimate of effort.**

But we have more freedom than for the MoC to make adjustments, if they are really required

Took a bit of time, the legal service had proposed something similar to FCC addenda, which are very heavy

Resources



Information about resources of the Partners are critical to:

- Organise and execute the study
- To show the support for the collaboration
 - E.g. CERN DG asked for an overview last year because CERN budget for IMCC depends on this

Even have/expect contributions from institutes that did not sign the MoC

- This can also be very useful to plan for future increases of the study
- E.g. interest of US partners

Want to make the process light

- An **INDICO web page** where each partner can enter the relevant information
- Luca will explain the process later

According to the MoC, the **Partner remains in control of its resources** and is:

- responsible for delivering their contribution, responsible for their personnel
- bears the cost of their contribution

The data is not legally binding, just on the **best effort/best guess** basis to allow project planning and to involve all the resources that could be available

Resource Data Privacy



The data remain confidential

Proposal is that they shall only be seen by:

- The SL, IMCC secretariat and resources collector (Luca Bottura)
 - The SL has to “coordinate all resources associated with the MC Study”
 - The SL requires the help of Luca Bottura and the muon collider secretariat
- The ICB chair
 - The ICB mandate is to "channel the contributions from the Participants"
 - You may want to discuss how the ICB wants to be informed
- The SB chair
 - The SB has been approved by CERN Council to oversee the implementation of the Accelerator R&D Roadmap

Sums etc. will be made available to relevant governance bodies (e.g. host laboratory management, LDG, CERN Council)

Information of MuCol members can also be used for MuCol Governance Board

Coming to CERN



MoC:

“Insofar as required, where a Participant’s personnel spend time at CERN, they may be granted the status of associate member of CERN’s personnel. The Participant agrees to, in particular, ensure that health insurance cover for such personnel at levels that are adequate in CERN’s host states, Switzerland and France, is in place for the duration of their association with CERN.”

For personnel to come to work at CERN your institute must have signed an addendum

- For the ATS sector our secretariat will prepare the papers for each visitor
 - The administration insists on an addendum, otherwise we cannot do anything

For physics and detectors your institute can do it

- Provided it is registered for the muon collider in the Grey Book

Grey Book



Institutes in the Grey Book can do the administration for their personnel to come to CERN

How to be registered in the Grey Book?

- Your institute signs an addendum to the MoC with the SL
- Your institute and the SL fill out and sign a specific form for the Grey Book
 - In this form your institute appoints a Team Leader
 - And Deputy Team Leaders
 - A Safety Officer is named
 - The SL agrees that the responsibility is transferred to your institute
- The SL informs the User Office that the institute should be added to the Grey Book and the details of Team Leader etc.
- Then the Team Leader can sign the forms for people from his institute to come to CERN
 - Taking the responsibility for insurances etc.

Note: The Grey Book form has to be signed by someone from CERN. In case a visitor has an accident we can otherwise get into real trouble. Note also that the team-leader appointment imply a transfer of CERN responsibilities to give team members “status” in the area.

Addendum, Special Case



INFN has signed on behalf of several laboratories

- Those institutes will therefore not sign the MoC individually
- The list will also change with time.

The legal service tells me that there is one vote per signatory

Problem:

How can we give voting rights to these institutes?

Solution:

Each concerned institute signs an addendum to the INFN MoC. This proves their contribution.

Similar situation very likely to apply in other cases

Conclusion



Sorry for all the formalities today

- A necessity to support the work and make it more smooth
- No time to present the scientific and technical progress

Great scientific and technical progress is being made

- It is a pleasure to work in such team
- Hope to be able to present next time

If you want to build a ship, don't get the men and women together to give them orders, to explain every detail, to tell them where to find everything...
If you want to build a ship, instill in the hearts of your men and women a desire for the sea.

Antoine de Saint-Exupéry (translated and slightly modernized)