



This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under GA No 101004730.

I.FAST online kick-off meeting, 4 May 2021

MUon collider STRategy network - MUST

Nadia Pastrone INFN-Torino

for the MUST team

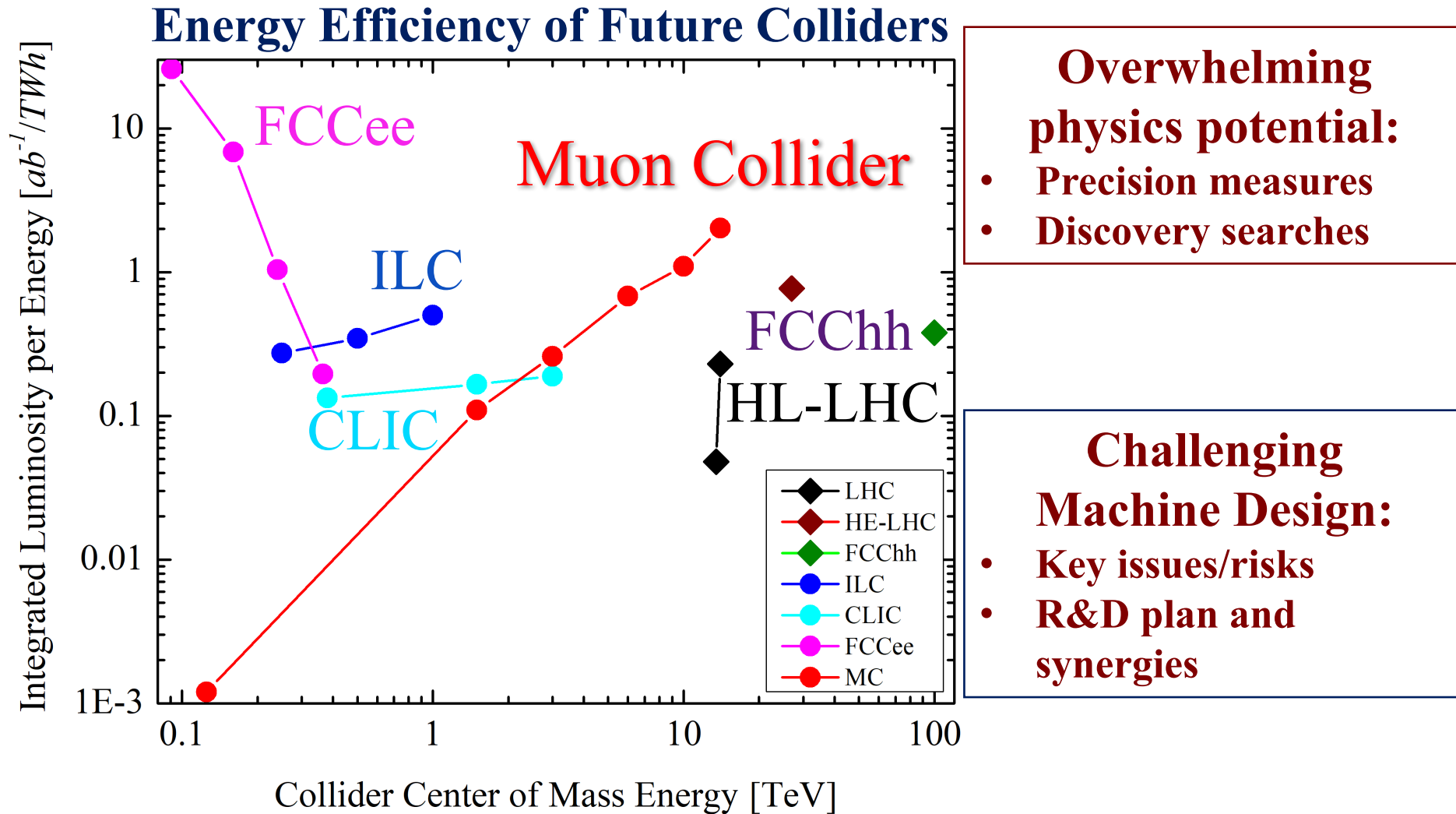
INFN - CERN (+BINP) - CEA

IJCLAB – KIT – PSI – UKRI



Why a multi-TeV Muon Collider?

[arXiv:2007.15684](https://arxiv.org/abs/2007.15684) [physics.acc-ph]



MUon collider STRategy network - MUST

INFN, CERN (+BINP), CEA, IJCLAB, KIT, PSI, UKRI (USA not beneficiary)

Task 5.1

*A collider of muons could be a compact and efficient way to reach energies of interest for future physics discoveries; but, a substantial R&D program is needed to prove its **feasibility** and to assess its **cost**. The first Strategy group in WP5 will prepare the ground for a future high-energy muon collider, by comparing alternative options for muon production and cooling, **by developing a baseline collider scenario**, and by **devising the optimum test facilities to prove its feasibility**.*

It will serve as the common ground for a growing international muon-collider collaboration.

Task 5.1 MUST will support to establish an international collaboration and develop an optimised R&D roadmap towards a future muon collider, including the definition of optimum test facilities and possible intermediate steps.

Muon Collider – international scenario

International Muon Collider Collaboration - **Project Leader:** *Daniel Schulte*

Objective:

In time for the next European Strategy for Particle Physics Update, the study aims to **establish whether the investment into a full CDR and a demonstrator is scientifically justified.**

It will **provide a baseline concept**, well-supported performance expectations and assess the associated key risks as well as cost and power consumption drivers.

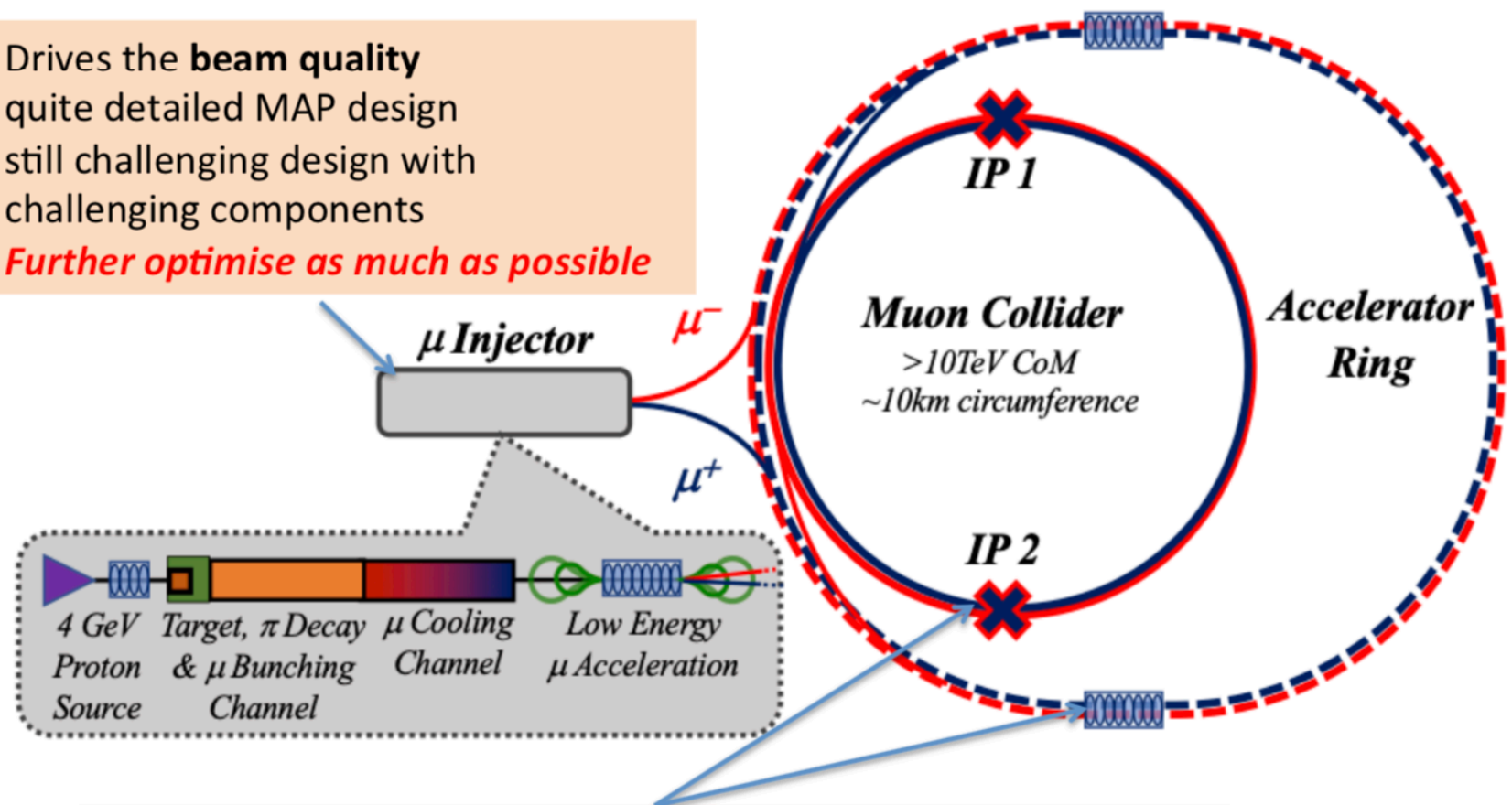
It will also **identify an R&D path to demonstrate the feasibility of the collider.**

Scope:

- Focus on two energy ranges:
 - **3 TeV** if possible with technology ready for construction in 10-20years
 - **10+ TeV** with more advanced technology, **the reason to chose muon colliders**
- Explore synergy with other options (neutrino/higgs factory)
- Define **R&D path**

Baseline facility sketch

Drives the **beam quality**
quite detailed MAP design
still challenging design with
challenging components
Further optimise as much as possible



Alternative Muon production Sources, such as LEMMA, could be considered

Cost and **power** consumption drivers, limit energy reach
e.g. 30 km accelerator for 10/14 TeV, 10/14 km collider ring
Also impacts **beam quality**
Drives **neutrino radiation** and **beam induced background**
Improve compared to MAP design and design for high-energy

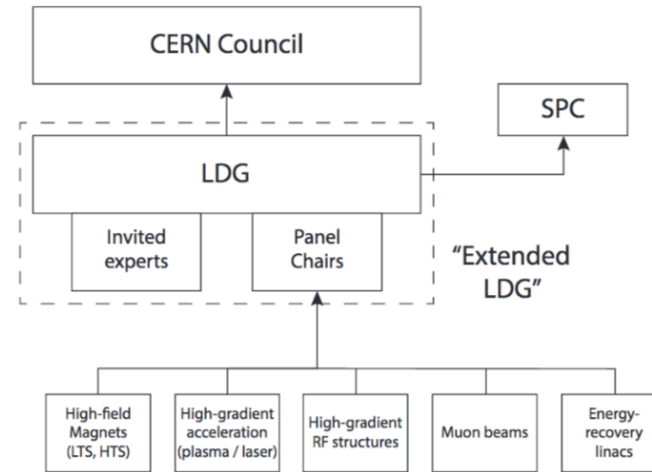


European Accelerator R&D Roadmap

Council charged Laboratory Directors Group (LDG) to deliver European Accelerator R&D Roadmap

Panels

- Magnets: P. Vedin
- Plasma: R. Assmann
- RF: S. Bousson
- Muons: D. Schulte
- ERL: M. Klein



**Muon Beam Panel
Community Meeting May 20-21:**

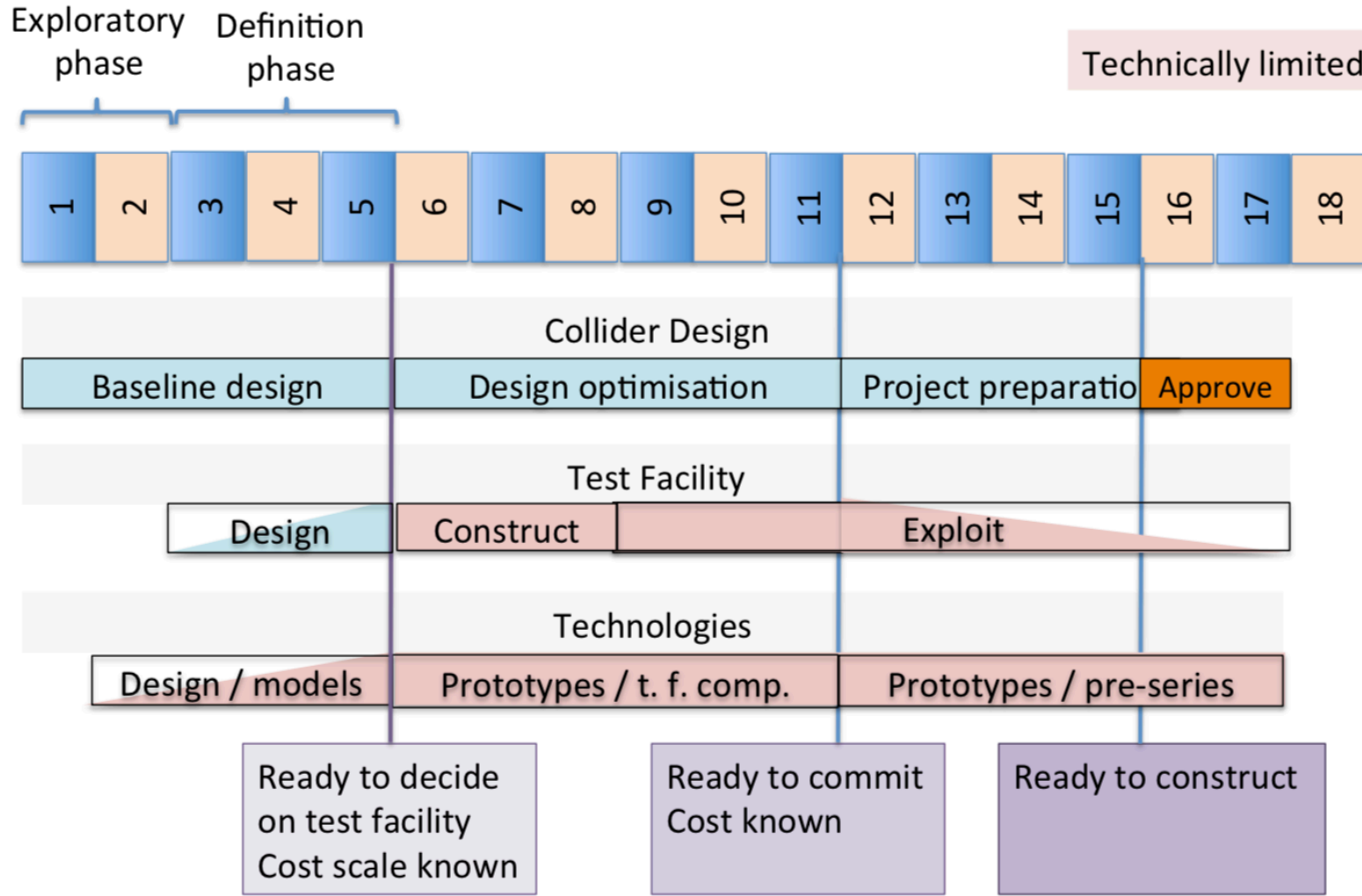
<https://indico.cern.ch/event/1030726/>

*RF
Magnets
High-energy complex
Muon production and cooling
Proton complex
Beam Dynamics
Radiation protection and other technologies
MDI*

Muon Beam members: Daniel Schulte (CERN, chair), Mark Palmer (BNL, co-chair), Tabea Arndt (KIT), Antoine Chance (CEA/IRFU) Jean-Pierre Delahaye (retired), Angeles Faus-Golfe (IN2P3/IJClab), Simone Gilardoni (CERN), Philippe Lebrun (European Scientific Institute), Ken Long (Imperial College London), Elias Metral (CERN), Nadia Pastrone (INFN-Torino), Lionel Quettier (CEA/IRFU), Tor Raubenheimer (SLAC), Chris Rogers (STFC-RAL), Mike Seidel (EPFL and PSI), Diktys Stratakis (FNAL), Akira Yamamoto (KEK and CERN)

Roles of panel members and European (other regions to be added) contact persons at <https://muoncollider.web.cern.ch/organisation>

Potential long-term timeline



Web page:

<http://muoncollider.web.cern.ch>

Mailing lists to subscribe:

Login at: <https://e-groups.cern.ch>

search for “muoncollider”

i.e. -FACILITY@cern.ch

MUST activities and goals

INFN, CERN (+BINP), CEA, IJCLAB, KIT, PSI, UKRI /STFC

- Support the effort to design a muon collider and to project and plan the required R&D
- Consolidate the community devoted to develop an international future facility
- Prepare the platform to disseminate the information (website, meetings, simulation tools)
- A Europe-wide network is essential for the development of the collider design and technology, which will serve as a common forum to coordinate with the growing international muon-collider efforts, including the US-MAP collaboration, sharing data and results.
- The muon collider requires an intense muon source, fast muon acceleration to high energies and efficient collisions to provide high luminosity:
 - The fast acceleration stage and the collider ring are critical for the collider cost, power consumption and performance, and technologies that can be developed in synergy with other future projects.
 - The decay of muons produces intense fluxes of neutrinos and electrons, sources of background in the machine and in the detector. Dedicated technology development and close collaboration between the accelerator and the detector will be needed to address this issue.
- This task will provide a platform to discuss the plans for key R&D and test facilities as well as disseminate the information on muon colliders activities.

MUST deliverables and milestones

- **D5.1:** International collaboration plans towards a multi-TeV muon collider **M46**
Report on established collaboration and results disseminated by the action
- **MS15:** International workshop on muon source design **M18**
Report
- **MS16:** International workshop to define R&D plans **M36**
Report

Budget: 240 keu + overhead
Total manpower: 58 PM

Planning ahead

- **AMBITION**: successful implementation of an **international plan** to address all studies and key issues towards the design of a muon collider capable to reach multi-TeV collision energies with an adequate luminosity for high-precision measurements and new discoveries.
- **CHALLENGES**: establish an organized international collaboration to address key issues and plan future steps. Evaluate reuse of existing infrastructures taking into account neutrino radiation hazards. Design of needed **test facilities** to address final feasibility.

MUST will actively contribute:

- Seeking for new EU et other regions collaborators
- Network in EU & other regions: USA – ASIA - activities ongoing at SnowMass21 process
- Promote synergies with other projects/industries for technologies R&Ds



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Thanks for the attention!

