

RD_MUCOL

Preparazione incontro con referee INFN @ inizio giugno

- Grande attività a livello internazionale
- Incontro con il Presidente e GE @ 8 aprile
- Attività Milestones 2021
- Piani 2022

Dal 2021: RD_MUCOL (@ CSN1) ~17.5 FTE / 90 fis/ing in 13 sezioni
Attività in progetti EU: aMUSE, I.FAST, AIDAinnova + altri in preparazione

Contesto internazionale

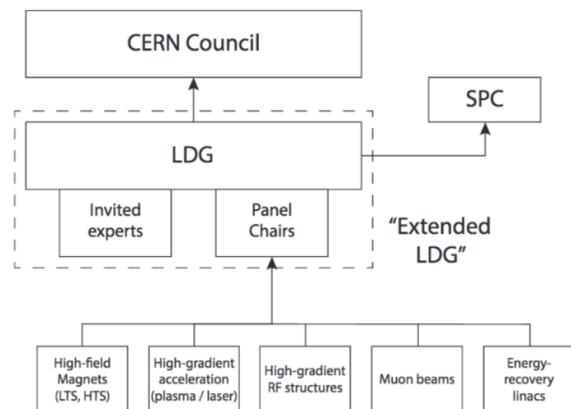
- CERN Medium Term Plan 2021-2025 - dedicated budget line – 2MCHF/year
mainly to cover machine up to MDI activities: (5 FTE staff, 6 fellows, 4 students, 1 associate)/year
- International Design Study based at CERN → MoC ready to be signed
the project encompasses physics, machine, detector and Machine Detector Interface
- European LDG Accelerator R&D Roadmap by end 2021
dedicated Muon Beams Panel - but also High field magnets, RF and ERL
- European ECFA Detector R&D Roadmap by end 2021
Muon collider @ 10 TeV is considered as one of the targeted facilities emerging from the EPPSU
- US SnowMass Muon Collider Forum since 2021
share ideas and studies across frontiers
- Snowmass/P5 process in the US by spring 2023
Many Lol presented – White papers due by March 2022

European Accelerator R&D Roadmap

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

Panels

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



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>

RF

Magnets

High-energy complex

Muon production and cooling

Proton complex

Beam Dynamics

Radiation protection and other technol.

MDI

Synergies

Test facilities

Muon Beam Panel

Community Meeting May 20-21:

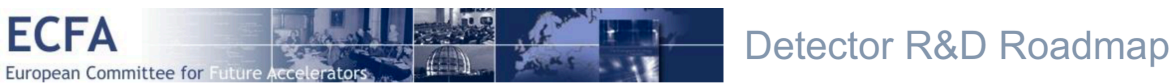
<https://indico.cern.ch/event/1030726/>

First Community Meeting @ Maggio

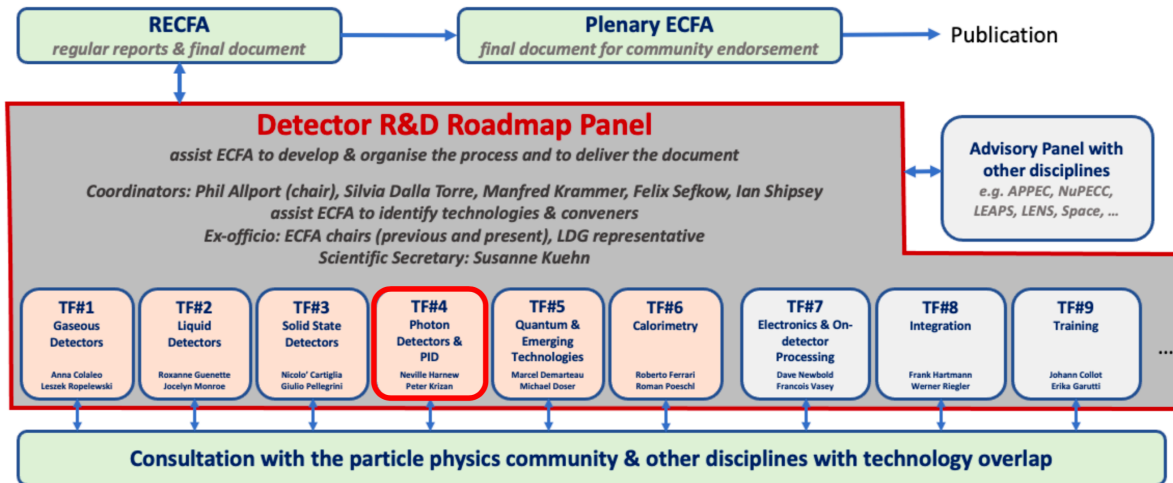
- Goal is to identify what is required to scientifically justify the approval of the demonstrator and what the scope of the demonstrator should be.
- Propose realistic but ambitious targets for the performance goals of the different collider systems. In particular what could be demonstrated in a test facility starting in 5 years, as well what one can anticipated to be available in 15-20 years (i.e. for the first collider stage) and in 30-40 years (for an energy upgrade).
- A tentative scope of the test facility will also be discussed.

European Detector R&D Roadmap

<https://indico.cern.ch/event/957057/>



Organization for Consultation of Relevant Communities



- Symposia completed
➔ Recorded
- Questions on:
 - ✓ Dose/fluence
 - ✓ Trigger

• May 25 meeting:
Each TF reports including draft outline of the chapter (at least bulleted text) assuming 15 pages with pre-agreed format. Discussion of overlaps and gaps.

Grouped targeted facilities/areas emerging from the EPPSU

1. Detector requirements for full exploitation of the HL-LHC (R&D still needed for LS3 upgrades and for experiment upgrades beyond then) including studies of flavour physics and quark-gluon plasma (where the latter topic also interfaces with nuclear physics).
2. R&D for long baseline neutrino physics detectors (including aspects targeting astro-particle physics measurements) and supporting experiments such as those at the CERN Neutrino Platform.
3. Technology developments needed for detectors at e^+e^- EW-Higgs-Top factories in all possible accelerator manifestations including instantaneous luminosities at 91.2 GeV of up to $5 \times 10^{36} \text{ cm}^{-2} \text{ s}^{-1}$.
4. The long-term R&D programme for detectors at a future 100 TeV hadron collider with integrated luminosities targeted up to 30 ab^{-1} and 1000 pile-up for 25ns BCO.
5. Specific long-term detector technology R&D requirements of a muon collider operating at 10 TeV and with a luminosity of the order of $10^{35} \text{ cm}^{-2} \text{ s}^{-1}$.

Session B08: Muon Collider Symposium I

[Focus](#) [Live](#) [Mini-Symposium](#)

Sponsoring Units: DPB DPF
Chair: Nadia Pastrone, INFN

Saturday, April 17, 2021 10:45AM - 11:21AM Live	B08.00001: The Case for a Future Muon Collider Invited Speaker: Nathaniel Craig Preview Abstract
Saturday, April 17, 2021 11:21AM - 11:33AM Live	B08.00002: Simulation of Beam induced Background at Muon Collider and Study of its properties Camilla Curatolo, Donatella Lucchesi, Francesco Collamati, Alessio Mereghetti, Paola Sala, Nikolai Mokhov, Nazar Bartosik, Massimo Casarsa, Sergio Jindariani, Mark Palmer, Simone Pagan Griso, Ron Lipton Preview Abstract
Saturday, April 17, 2021 11:33AM - 11:45AM Live	B08.00003: Physics Object reconstruction optimization at Muon Collider within the ILCSoftware Nazar Bartosik, Paolo Andreotto, Alessio Gianelle, Lorenzo Sestini, Massimo Casarsa, Laura Buonincontri, Chiara Aime, Cristina Riccardi, Federica Legger, Tova Holmes, Paola Sala, Karri DiPetrillo, Christian Herwig, Lesya Anna Horyn, Stefan Spanier Preview Abstract
Saturday, April 17, 2021 11:45AM - 11:57AM Live	B08.00004: WIMPs at High Energy Muon Colliders Zhen Liu, Tao Han, Xing Wang, Lian-Tao Wang Preview Abstract
Saturday, April 17, 2021 11:57AM - 12:09PM Live	B08.00005: Jet Reconstruction performance at Muon Collider with Beam-induced Background Lorenzo Sestini, Donatella Lucchesi, Davide Zuliani, Alessio Gianelle, Paolo Andreotto, Laura Buonincontri, Nazar Bartosik, Nadia Pastrone, Massimo Casarsa, Maximilian Swiatlowski, Marco Valente, Ivano Sarra Preview Abstract
Saturday, April 17, 2021 12:09PM - 12:21PM Live	B08.00006: Determination of the double Higgs cross section and trilinear Higgs coupling sensitivities at Muon Collider Laura Buonincontri, Donatella Lucchesi, Camilla Curatolo, Lorenzo Sestini, Sergio Jindariani, Alessio Gianelle, Paolo Andreotto, Nazar Bartosik, Massimo Casarsa, Katherine Pachal, Hannsjoerg Weber, Lawrence Lee, Simone Pagan Griso, Karol Krizka, Maximilian Swiatlowski, Marco Valente Preview Abstract
Saturday, April 17, 2021 12:21PM - 12:33PM Live	B08.00007: nuSTORM accelerator: challenges and opportunities Jonathan Gall, Jaroslaw Pasternak, Chris Rogers Preview Abstract

[Show Abstract](#)



APRIL MEETING 2021

April 17-20 | Online

Session D14: Muon Collider Symposium II

[Show Abstracts](#)

[Live](#) [Mini-Symposium](#)

Sponsoring Units: DPB DPF
Chair: Vladimir Shiltsev, FNAL

Saturday, April 17, 2021 1:30PM - 2:06PM Live	D14.00001: The Muon Collider Invited Speaker: Daniel Schulte Preview Abstract
Saturday, April 17, 2021 2:06PM - 2:18PM Live	D14.00002: Muon Cooling Channel Design Status Diktys Stratakis Preview Abstract
Saturday, April 17, 2021 2:18PM - 2:30PM Live	D14.00003: Magnet Needs for a Muon Collider Soren Prestemon Preview Abstract
Saturday, April 17, 2021 2:30PM - 2:42PM Live	D14.00004: Progress on Radio Frequency Cavities for Use in Muon Cooling Channels Daniel Bowring, Alan Bross, Ben Freemire, Yagmur Torun, Katsuya Yonehara Preview Abstract
Saturday, April 17, 2021 2:42PM - 2:54PM Live	D14.00005: Electroweak Couplings of the Higgs Boson at a Multi-TeV Muon Collider Xing Wang, Tao Han, Ian Low, Da Liu Preview Abstract
Saturday, April 17, 2021 2:54PM - 3:06PM Live	D14.00006: Track Reconstruction at a Muon Collider in the Presence of Beam-induced Background Massimo Casarsa, Alessandro Montella, Paolo Andreotto, Laura Buonincontri, Alessio Gianelle, Lorenzo Sestini, Donatella Lucchesi, Nazar Bartosik, Nadia Pastrone, Sergio Jindariani, Hannsjoerg Weber, Karol Krizka, Simone Pagan Griso, Elodie Resseguie, Lawrence Lee, Federico Meloni, Philip Chang, David Yu Preview Abstract
Saturday, April 17, 2021 3:06PM - 3:18PM Live	D14.00007: Muon Collider Lattice Design Eliana Gianfelice-Wendt Preview Abstract

Session H08: Muon Collider Symposium III

Live

Sponsoring Units: DPB DPF
Chair: Eric Prebys, UC Davis

Sunday, April 18, 2021
10:45AM - 11:21AM

Live

[H08.00001: Design a detector for a Muon Collider experiment](#)

Invited Speaker: Simone Pagan Griso, Sergio Jindariani, Ron Lipton, Nadia Pastrone, Donatella Umberto Dosselli, Massimo Casarsa, Lorenzo Sestini, Nazar Bartosik, Cristina Riccardi, Francesco Collamati, Hannsjoerg Weber, Maximilian Swiatkowski, Lawrence Lee, Federico Meloni, Paola Sala, Tova Holmes, Elizabeth Brost, Mia Liu, Katherine Pachal, Ivano Sarra, Isobel Ojalvo, Lian-Tao Wang

[Preview Abstract](#)

Sunday, April 18, 2021
11:21AM - 11:33AM

Live

[H08.00002: Advancing physics simulations at a Multi-TeV Muon Collider](#)

Richard Ruiz, Antonio Costantini, Luca Mantani, Olivier Mattelaer, Fabio Maltoni, Xiaoran Zhao

[Preview Abstract](#)

Sunday, April 18, 2021
11:33AM - 11:45AM

Live

[H08.00003: Studies of Tracker Timing and Granularity for the Muon Collider Environment](#)

Hannsjoerg Weber, Sergio Jindariani, Ron Lipton, Simone Pagan Griso, Nazar Bartosik, Massimo Casarsa, Lawrence Lee

[Preview Abstract](#)

Sunday, April 18, 2021
11:45AM - 11:57AM

Live

[H08.00004: Muon Ionization Cooling Experiment: Results & Prospects](#)

Chris Rogers, Daniel Kaplan

[Preview Abstract](#)

Sunday, April 18, 2021
11:57AM - 12:09PM

Live

[H08.00005: Muon source from positron on target \(LEMMA\)](#)

Mario Antonelli, Maria Enrica Biagini, Manuela Boscolo, Oscar Blanco-Garcia, Andrea Ciarna, Anna Giribono, Susanna Guiducci, Cristina Vaccarezza, Fabio Anulli, Matteo Baucce, Gian Mario Cesarini, Francesco Collamati, Alessandro Variola, Roberto Li Voti, Iryna Chaharova, Robert Chehab, Alberto Bacci, Iliya Drebrot, Stefano Luizzo, Pantaleo Raimondi, Donatella Lucchesi, Peter Sievers, Lewis Keller, Nadia Pastrone

[Preview Abstract](#)

Sunday, April 18, 2021
12:09PM - 12:21PM

Live

[H08.00006: Composite resonances at a multi-TeV muon collider](#)

Ke-Pan Xie, Da Liu, Lian-Tao Wang

[Preview Abstract](#)

Sunday, April 18, 2021
12:21PM - 12:33PM

Live

[H08.00007: No-Lose Theorem for Discovering the New Physics of \$\(g - 2\)_\mu\$ at Muon Colliders](#)

Rodolfo Capdevilla, David Curtin, Yoni Kahn, Gordan Krnjaic

[Preview Abstract](#)

[Show Abstract](#)



APRIL MEETING 2021

April 17-20 | Online

Session Y07: Muon Collider Symposium IV

Live

Sponsoring Units: DPB DPF
Chair: Lian Tao Wang, U Chicago

[Show Abstracts](#)

Tuesday, April 20, 2021
1:30PM - 1:42PM

Live

[Y07.00001: Presentation of the High Intensity Frontier Initiative \(HIFI\) to design a nuSTORM and-a Neutrino Factory based on the ESSnuSB facility](#)

Jean-Pierre Delahaye, Marcos Dracos, Tord Ekelof

[Preview Abstract](#)

Tuesday, April 20, 2021
1:42PM - 1:54PM

Live

[Y07.00002: Target System for Collimated Muon Beam Production](#)

Matteo Baucce, Roberto Li Voti, Gian Mario Cesarini, Gianluca Cavoto, Fabio Anulli, Francesco Collamati

[Preview Abstract](#)

Tuesday, April 20, 2021
1:54PM - 2:06PM

Live

[Y07.00003: Complementary Probes of Lepton Flavor at a Muon Collider](#)

Qianshu Lu, Samuel Homiller, Matthew Reece

[Preview Abstract](#)

Tuesday, April 20, 2021
2:06PM - 2:18PM

Live

[Y07.00004: Testing Positivity at Muon Colliders](#)

Jiayin Gu, Liantao Wang, Cen Zhang

[Preview Abstract](#)

Tuesday, April 20, 2021
2:18PM - 2:30PM

Live

[Y07.00005: A final word on electroweak Dark Matter models at future lepton colliders](#)

Ludovico Vittorio, Salvatore Bottaro, Marco Costa, Dario Buttazzo, Roberto Franceschini, Paolo Panci, Diego Redigolo

[Preview Abstract](#)

Tuesday, April 20, 2021
2:30PM - 2:42PM

Live

[Y07.00006: Constraining the Higgs potential at the Multi-TeV Muon Collider](#)

Mauro Chiesa, Fabio Maltoni, Barbara Mele, Fulvio Piccinini, Luca Mantani, Mauro Moretti, Xiaoran Zhao

[Preview Abstract](#)

Tuesday, April 20, 2021
2:42PM - 2:54PM

Live

[Y07.00007: Electroweak parton distribution functions at a high-energy muon collider](#)

Yang Ma, Tao Han, Keping Xie

[Preview Abstract](#)

Tuesday, April 20, 2021
2:54PM - 3:06PM

Live

[Y07.00008: Sensitivity on Dark Sector through the Neutralino Production and Muon Pairs Decay at Muon Collider](#)

Chiara Aime, Cristina Riccardi, Paola Salvini, Ilaria Vai

[Preview Abstract](#)

Tuesday, April 20, 2021
3:06PM - 3:18PM

Live

[Y07.00009: Tracking with ACTS for a Muon Collider detector](#)

Karol Krizka, Simone Pagan Griso, Tomohiro Yamazaki, Heather Gray, Philip Chang, Donatella Lucchesi, Nazar Bartosik, Massimo Casarsa, Sergio Jindariani, Hannsjoerg Weber, Lawrence Lee, Federico Meloni

[Preview Abstract](#)

SnowMass

Muon Collider Forum

<https://indico.fnal.gov/category/1267/>

May 19, MDI

Situazione attuale

- Collaborazione internazionale basata al CERN
 - ➔ Design Study progetta una facility con sito @ CERN
- Lavoro Design Study suddiviso in WP
 - Distribuzione impegni come input al Collaboration Board ➔ Addenda al MoC
 - ➔ forte connessione con preparazione Roadmap – Muon Panel
 - Discussione e assegnazione attività da cofinanziare su prossimi progetti EU -Design Study ➔ riunione 12/4: test facility o parti cruciali della macchina
 - Stakeholders meeting (7 giugno tbc) per discutere contributi e impegno
- Si parla di test facilities e di dimostratore ➔ certamente necessario dimostrare alcuni stadi di muon cooling (finale?) e farlo al CERN
 - Si prevede un programma di studi di prototipi in parallelo
 - Piani finanziari diversi a seconda del livello di preparazione della test facility:
 - Definizione dello scopo: CDR, TDR, ...
 - Preparazione hardware necessario (test RF, disegno magneti, ...)
 - Sinergie da esplorare: ad es. con ESS, nuSTORM/ENUBET
- Workshop Physics&Detectors 2-4 giugno organizzato da D.Lucchesi&A.Wulzer ++ per coordinare al meglio

Attività in corso

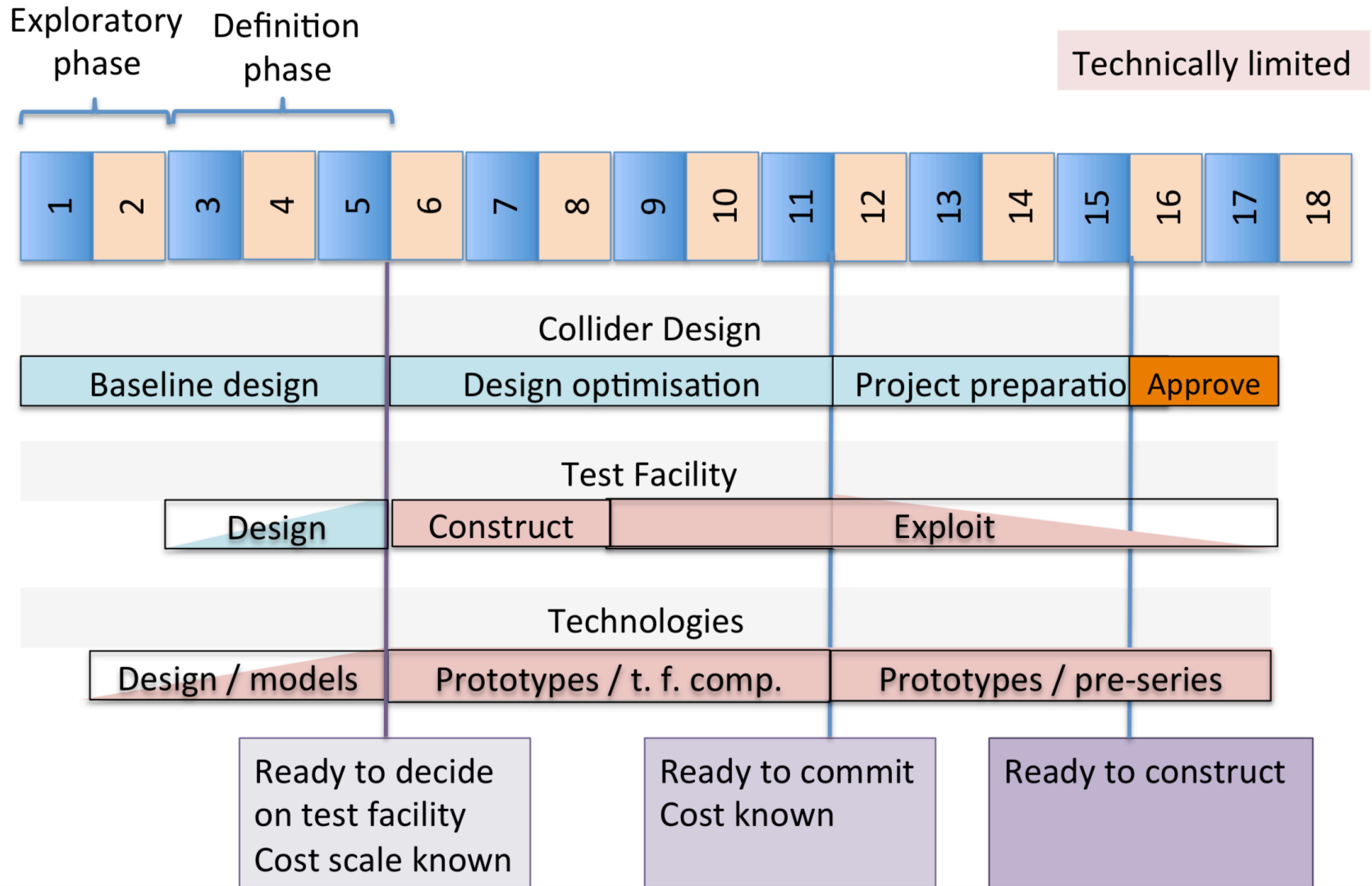
- Studi di fisica
- Full simulation: Higgs et al e detector
- Detector R&D
- MDI
- Bersagli
- Cristalli
- LEMMA test beam

Magneti da confermare
Altro?

Piani per il 2022 e oltre

-
- ...
- EU Project test facility

Long Term Timeline



Milestones 2021

31-08-2021 Sottomissione White Papers SnowMass 2021 – contributi originali

==> SnowMass in ritardo di 1 anno - potremmo sostituire con report roadmap

31-10-2021 Messa a punto simulazione MDI – test ottica MAP @ 3 TeV per produzione fondi di macchina

==> penso vada bene ma per favore confermate

30-11-2021 Studi preliminari su prototipi sensori RSD per tracciatore dedicato *==> da verificare meglio*

15-12-2021 Prime misure prototipo calorimetro a cristalli e ricerca di nuovi materiali *==> in corso*

15-12-2021 Messa punto test in laboratorio e misure su diverse tipologie di bersagli *==> in corso*

15-12-2021 Completamento costruzione componenti per test beam LEMMA *==> in corso – confermato?*

15-12-2021 Produzione di bersagli cristallini e cristalli per manipolazione bunch muoni *==> in corso*

15-12-2021 Articolo sottomesso su studi HH->bbbb @ 3 TeV con full simulation

==> abstract sottomesso a EPS

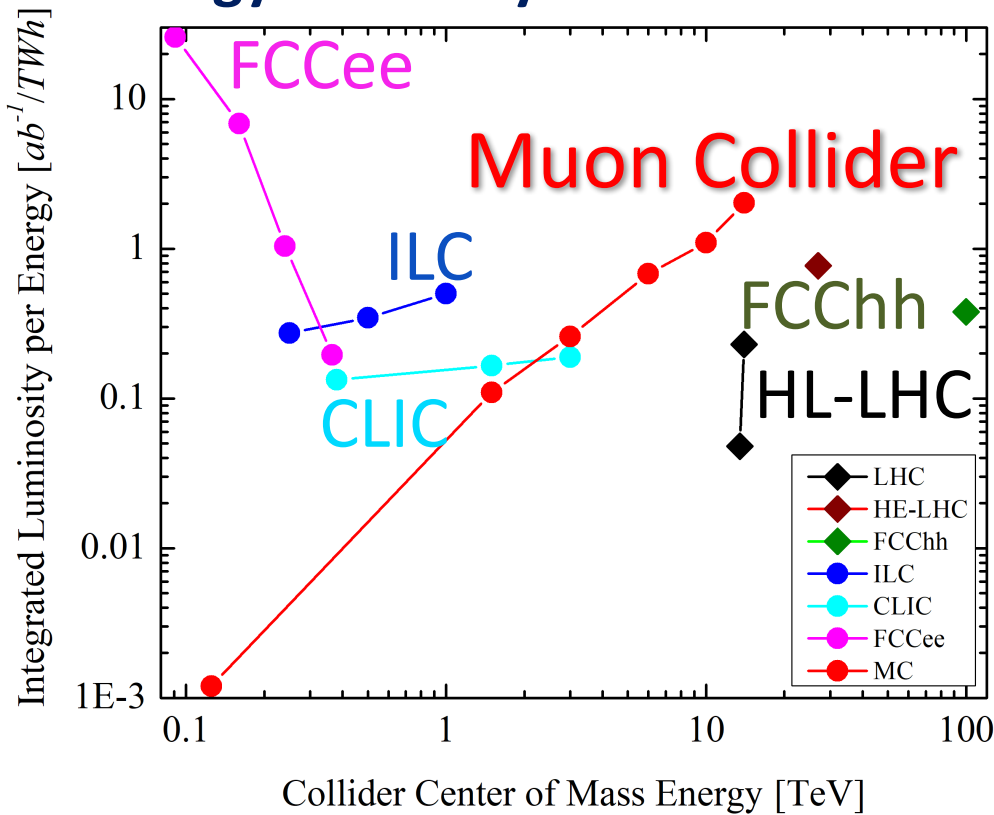
- **CERN website**
<https://muoncollider.web.cern.ch/>
- **INFN Confluence website: full simulation**
<https://confluence.infn.it/display/muoncollider>
- **International Design Study Indico @ CERN**
<https://indico.cern.ch/category/11818/>
- **Muon Collider SnowMass Forum USA**
<https://indico.fnal.gov/event/47038/>

*Please subscribe at the
CERN e-group “muoncollider”:
MUONCOLLIDER-DETECTOR-PHYSICS
MUST-phydet@cern.ch
MUONCOLLIDER-FACILITY
MUST-mac@cern.ch*

extras

Energy Efficiency of Future Colliders

<https://doi.org/10.1038/s41567-020-01130-x>



Overwhelming physics potential:

- Precision measures
- Discovery searches

Challenging Machine Design:

- Key issues/risks
- R&D plan - synergies

Proton driver production

Baseline @ International Design Study

ASSUMPTION/IP

$$\mathcal{L} = (E_{\text{CM}}/10\text{TeV})^2 \times 10 \text{ ab}^{-1}$$

@ 3 TeV ~ 1 ab^{-1} 5 years

@ 10 TeV ~ 10 ab^{-1} 5 years

@ 14 TeV ~ 20 ab^{-1} 5 years

10+ TeV
completely new regime
to explore!

