IMCC Annual Meeting

JICLAB – June 22, 2023

International Collaboration Board Report

Nadia Pastrone

PARTICIPANTS

155 + 30-late	Annual Meeting
74 (partially overlapping)	Synergy Workshop

Agenda

18:00 → 18:20	ICB chair report	Nadia Pastrone
18:20 → 18:35	IMCC Project Leader : key points - including publication policies proposal	Daniel Schulte
18:35 → 18:50	Steering Board chair: key points to CB	Steinar Stapnes
18:50 → 19:05	MuCol EU project: plans and key points	Roberto Losito
19:05 → 19:20	Resources: status of contributions and future plans	Luca Bottura et al.
19:25 → 19:45	Publications/authors policies: discussion	
19:50 → 20:00	AOB - any news	

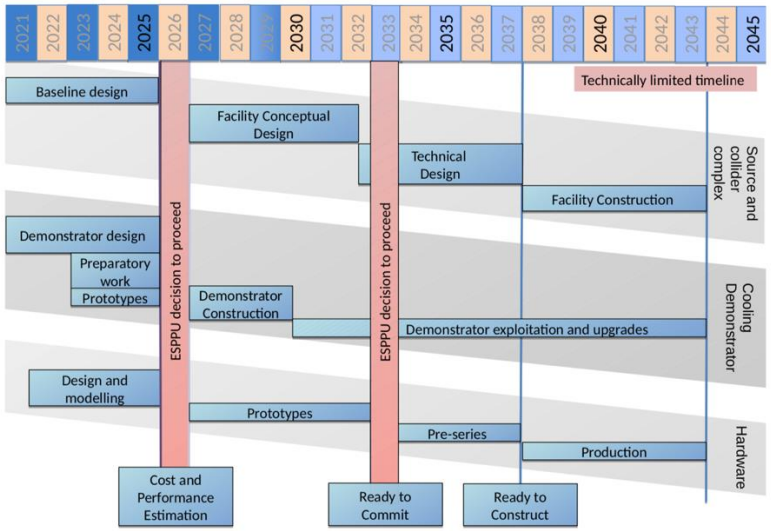
Crucial time to enlarge and strengthen the community!

Very OPEN ICB:

- ✓ SL and deputies – SB full committee – IMCC and MuCol Coordination Committee
- ✓ Institutes – MoC signed/considering
- ✓ Institutes – EU MuCol beneficiaries/associated
- ✓ US laboratories waiting for P5 final report

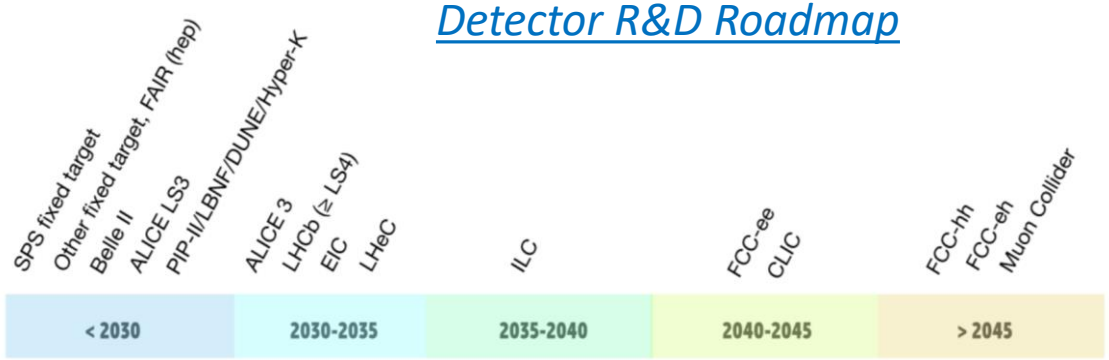
Interesting and challenging time …..

International MUON Collider Collaboration



[Accelerator R&D Roadmap]

[Detector R&D Roadmap]

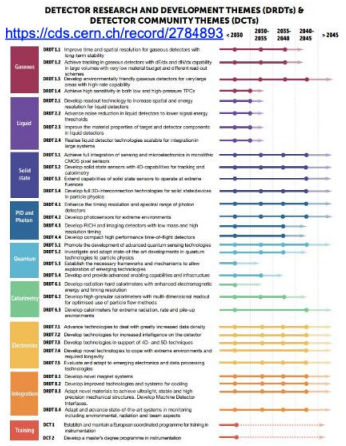


Instrumentation R&D

- DOE Detector R&D BRN Report, Snowmass Instrumentation Report – US;
- 2021 ECFA Detector R&D Roadmap – Europe.

ECFA initiative to establish new detector R&D “groups” (DRD”X”).
CPAD initiative planning new detector research consortia (RDC”X”).
The two initiatives closely connect in structure and objectives.

RD	Topic
RDC1	Noble elements Detectors
RDC2	Photodetectors
RDC3	Solid State Tracking
RDC4	Readout and ASICs
RDC5	Trigger and DAQ
RDC6	Gaseous Detectors
RDC7	Low-background detectors
RDC8	Quantum and Superconducting Sensors
RDC9	Calorimetry
RDC10	Detector Mechanics



to promote collaboration
participating to common R&D efforts

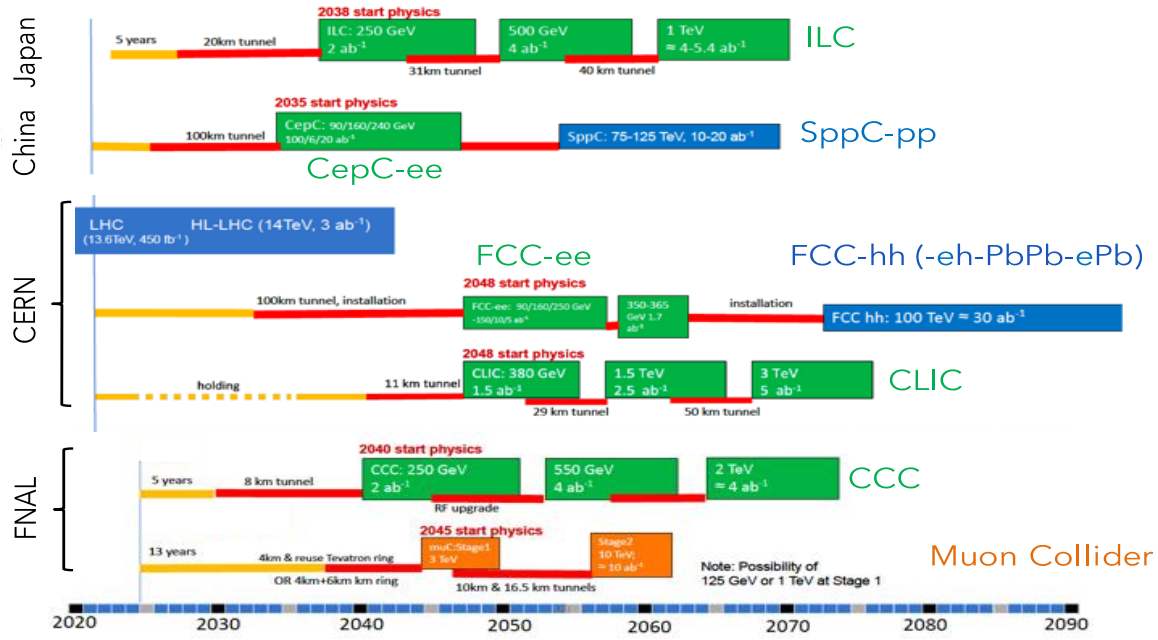
Shared aspiration

Advances in detector and accelerator pair with the opportunities of the physics case

International MUON Collider Collaboration

MuCol

Objective:
In time for the next ESPPU, the Design Study based at CERN aims to **establish whether the investment into a full CDR and a demonstrator is scientifically justified**.
It will **provide a baseline concept….**
It will also **identify an R&D path to demonstrate the feasibility of the collider**.



Scope:

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

Snowmass future collider planning schedule

preparation construction - physics ee hh μμ

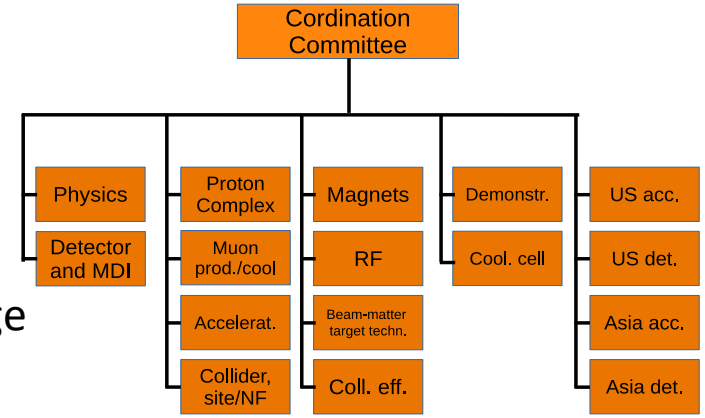
Muon Collider Forum Report

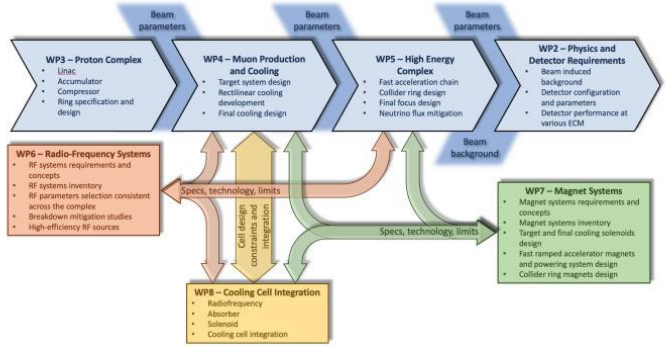
Institutes/Countries/Funding Agencies

International MUON Collider Collaboration

We need:

1) all our enthusiasm!
2) our diverse great knowledge
3) **better shared rules to**:
4) identify **resources**
5) **publish our results** in a fair way
6) **recognize authorship**
7) ……





	IMCC Activities	MuCol
1	Physics	WP2
2	Detector	WP2
2	MDI	WP5
3	Proton Complex	WP3
4	Muon Prod/cooling	WP4
5	Accelerator	WP5
6	Collider	WP5
7	Magnets	WP7
8	RF	WP6
9	Beam matter/target	
10	Collective effects	
11	Demonstrator	
12	Cooling Cell	WP8

- 49 + 4 (+ 4 considering) institutes Memorandum of Cooperation signed
- 2 institutes only MuCol beneficiaries
- 5 institutes only MuCol associates (including BNL)
- a few URGENT to investigate (i.e. IFAE….)
- 3 + ? DOE laboratories
- Japan ?

Grey Book @ CERN – Future Collider

Research Programme

LHC
SPS
PS
AD
ISOLDE Facility
Irradiation Facility
Neutrino Platform
GRADE
CTF3
R&D
Non-accelerator experiments
Approved Studies for Future Projects

Research Activities

Experiments and Projects under Study
External Experiments
Recognized Experiments
Completed Experiments

Related Links

EP Department
Users' Office
Scientific Committees
Conditions for experiments
Accelerators and Beams
Accelerator Schedules

IMCC

International Muon Collider Collaboration

Synonym:
Research Programme: FCOLLIDER
Approved:
Beam:
Status: Preparation

Overview | Teams | Participations

Spokesperson:	SCHULTE, Daniel
Deputy spokeperson(s):	ROGERS, Christopher Thomas WULZER, Andrea LUCCHESI, Donatella
Contact person:	PASTRONE, Nadia
Experiment secretariat e-mail:	muon.collider.secretariat@cern.ch

Number of Institutes:	0
Number of Countries:	0
Number of Participants:	0
Number of Authors:	0

Status History

Status	Start Date	End Date
Preparation	08-06-2023	

IMCC finally included as one of the:
"Experiments and Projects under Study"
https://greybook.cern.ch/experiment/detail?id=IMCC

Grey Book @ CERN – get ready to join!

International MUON Collider Collaboration

- ✓ To join and Institute has to be signed the MoC (Memorandum of Cooperation)
- ✓ There are already recognized institutes at CERN – but we can add others
- ✓ All the rules are at: [Team Leaders' corner | Users Office (cern.ch)]
- ✓ We can start to list the institutes and for each of them (Team)
  a Team leader and a deputy should be identified and they should get ready to join following the rules
- ✓ We will send a dedicated email to each eligible institute and try to facilitate the enrollment aiming to populate the grey book asap
- ✓ By end of July a specific Muon Collider User Unit will be available to collect all institutes and partecipants to IMCC projects as CERN users.

Questionnaire - Resources estimates - TEST

24 May 2023
CERN
Europe/Zurich timezone

Enter your sea

- Overview
- 1 - EXCEL File
- 2 - Registration Form

Dear IMCC Collaborators,

We write on behalf of the International Muon Collider Collaboration (IMCC), of which yc
associate, within the scope of an exercise of resources estimates. Specifically, we are colle
resources (personnel and material) engaged in the IMCC activities, presently (this year) ar
study, and pr

To this aim, and for your convenience, we would kindly ask you to:

1- Fill in the Excel file template available from the Left Menu (Warning: the file will
your computer)

Indicate the name or acronyme of your institute in cell A1, then indicate the correspondin
that the table starts from "prior to 2023", the years 2023-2027 (five years), and "after 2027 - per year".

2 - Fill in the Registration form and upload your Excel File when you are requested to proceed.

Two parts, institute data (indico registration form) and resource data (MSexcel file)

Main aim is to collect the resources committed to the study, in terms of secured material (M in kEUR) and personnel (P in FTE), as well as prospective funding.

This will give a good and quantified image of the on-going efforts.

Registration form:

- Institute, contact and status
- Activities of interest

International MUON Collider Collaboration

Personal Data

Institute *
CERN

Country *
Select a country

Main Contact - Last name *
Bottura

Main contact - First Name *
Luca

Email Address *
luca.bottura@cern.ch

IMCC MoC Signatory *
Yes No
Please indicate if your Institute has signed the IMCC MoC

IMCC Observer *
Yes No
Please indicate if your institute is an Observer in the IMCC Study

MuCol Beneficiary *
Yes No
Please indicate if your institute is a Beneficiary of the MuCol EU project

MuCol Associate Partner *
Yes No
Please indicate if your institute is an associate Partner in MuCol EU project

Other category *
Yes No

If you selected "Other category" above, please provide more details

Additional comments

Activities in IMCC-MuCol

Please indicate in which field of activities your institute is provided resources

IMCC-MuCol WP *

- [ ] Physics
- [ ] Detector, Design and Simulations
- [ ] Detector Technologies
- [ ] Accelerator Technologies (Magnets, RF, Beam Matter interaction and Target Technologies
- [ ] Accelerator Design (Protons, Muon production and cooling, Accelerators, Collective Effects, MDI, Collider Site - Neutrion flux)
- [ ] Demonstrator, Test Facilities and infrastructure

International MUON Collider

Institute (please fill-in)	Prior to 2023(6)					2023							2024							
	Secured funding(1)				Number of students(4)	Secured funding					Prospective funding(5		Secured funding					Prospective funding(5		
	External funding		Internal funding(2)			External funding			Internal funding				External funding			Internal funding				
	Personnel (in FTE)(3)	Material (in kEUR)	Personnel (in FTE)	Material (in kEUR)		Personnel (in FTE)	Number of students	Material (in kEUR)	Personnel (in FTE)	Material (in kEUR)	Personnel (in FTE)	Material (in kEUR)	Personnel (in FTE)	Number of students	Material (in kEUR)	Personnel (in FTE)	Material (in kEUR)	Personnel (in FTE)	Material (in kEUR)	
Physics																				
Detector, Design, Simulations																				
Detector technologies																				
Accelerator technologies (Magnets, RF, Beam Matter interaction and Target technologies)																				
Accelerators Design (Protons, Muon Production and cooling, Accelerators, Collective Effects, MDI, Collider Site-Neutrino flux)																				
Demonstrator, Test facilities and infrastructure																				
Comments																				

activities

year

Data in an excel file:

- prior to 2023 (cumulative
- 2023-2027 (per year)
- After 2027 (per year)

Notes to guide the collection

(1) Approved budget, collaboration contracts, grants,…

(2) From institute budget

(3) All categories included (e.g. staff, associates, post-docs, students,…)

(4) Head count, full- or partial-time

(5) E.g. requested but not yet approved, planned but not yet funded, …

(6) Report funding as cumulated efforts over the whole period of activities

(7) Report funding on a "per year" basis

Accelerator R&D Roadmap

No insurmountable obstacle found for the muon collider

- but important need for R&D

Aim at **10+ TeV** and potential initial stage at **3 TeV**

Full scenario deliverables by next ESPPU/other processes

- **Project Evaluation Report**
- **R&D Plan** that describes a path towards the collider;

Allows to make **informed decisions**

Interim report by end of 2023

Do not yet have the resources of the reduced scenario

- Following priorities and available expertise and resources
- Are approaching O(40 FTE)
- Efforts to increase resources

Scenario	FTEy	M MCHF
Full scenario	445.9	11.9
Reduced scenario	193	2.45

http://arxiv.org/abs/2201.07895

Label	Begin	End	Description	Aspirational [FTEy]	Aspirational [kCHF]	Minimal [FTEy]	Minimal [kCHF]
MC.SITE	2021	2025	Site and layout	15.5	300	13.5	300
MC.NF	2022	2026	Neutrino flux mitigation system	22.5	250	0	0
MC.MDI	2021	2025	Machine-detector interface	15	0	15	0
MC.ACC.CR	2022	2025	Collider ring	10	0	10	0
MC.ACC.HE	2022	2025	High-energy complex	11	0	7.5	0
MC.ACC.MC	2021	2025	Muon cooling systems	47	0	22	0
MC.ACC.P	2022	2026	Proton complex	26	0	3.5	0
MC.ACC.COLL	2022	2025	Collective effects across complex	18.2	0	18.2	0
MC.ACC.ALT	2022	2025	High-energy alternatives	11.7	0	0	0
MC.HFM.HE	2022	2025	High-field magnets	6.5	0	6.5	0
MC.HFM.SOL	2022	2026	High-field solenoids	76	2700	29	0
MC.FR	2021	2026	Fast-ramping magnet system	27.5	1020	22.5	520
MC.RF.HE	2021	2026	High Energy complex RF	10.6	0	7.6	0
MC.RF.MC	2022	2026	Muon cooling RF	13.6	0	7	0
MC.RF.TS	2024	2026	RF test stand + test cavities	10	3300	0	0
MC.MOD	2022	2026	Muon cooling test module	17.7	400	4.9	100
MC.DEM	2022	2026	Cooling demonstrator design	34.1	1250	3.8	250
MC.TAR	2022	2026	Target system	60	1405	9	25
MC.INT	2022	2026	Coordination and integration	13	1250	13	1250
			Sum	445.9	11875	193	2445

Table 5.5: The resource requirements for the two scenarios. The personnel estimate is given in full-time equivalent years and the material in kCHF. It should be noted that the personnel contains a significant number of PhD students. Material budgets do not include budget for travel, personal IT equipment and similar costs. Colours are included for comparison with the resource profile Fig. 5.7.

US Integration

- Participation of US experts to CC and ICB
- Preparing open data and code policy
  - You can use data and codes from the collaboration, as far as we own them
- Want to allow everyone to publish under the IMCC or to speak for the IMCC
  - Provided our procedures are respected
- Small task force to understand how a common work programme can be developed
  - Progress will have to synchronise with US progress
- Plan to review organization next year to integrate US
  - But have to wait for US decisions
- Will find common timelines/scenarios

Data/Code Access Policy

Open policy is preferred scenario

- To gain the trust of the community at large
- To help people that are not yet in the collaboration to engage
- To ease setting up servers in different locations
- To comply with EC rules

Will publish data and code once produced

- Already during the study once ready for publication
  - Check for correctness, but no need to wait for studies to have used them
  - Helps to get feedback early
- Provide a reference for each set that must be used if the data/code is used (with version)
  - Have to find way to implement versioning system

Offer lightweight registration on INDICO

- Ask people to do what is morally good
  - Provide email to establish mailing list to inform about potential updates and mistakes
  - Provide information about the (planned) use to help us justify our effort
  - Suggest to submit papers and talks to our review process

Publication Board ==> ICB role

Publication and Speakers Board

- Prefer one board at this moment but can have members with a focus more on one or the other

- Will provide quality control
  - Review and approve MuCol and IMCC publications
  - Including review of author list
  - Review and approve talks and posters

- Will foster muon collider visibility
  - Propose talks and posters for IMCC and MuCol at important conferences and workshops
  - Identify opportunities for publications

- MuCol publications and talks will also have an IMCC reference

- Members will be appointed by study leader on proposal of board chair (Elias Metral)

- Board will propose detailed procedures to the CC, CLICdp rules are an excellent starting point

- Board will report to CC/study leader

COMMENTS DUE IN TWO WEEKS!

Publication/Conference talk

The present working **MuonCollider-ConferencePreparationTeam**
will keep acting as the Publication Board with

Elias Metral

elected for the MuCol project as ***Dissemination and Communication Officer***

MuCol EU project: Organisation

https://mucol.web.cern.ch/

- The consortium includes ~~32~~ 31Institutes:
  - CERN as coordinator and beneficiary
  - 11 more Beneficiaries (no UK Institutes)
  - 19 Associated Partners

- **Study Leader :** *Daniel Schulte (CERN)*

- **Technical Coordinator** (WP1 leader) : *Roberto Losito (CERN)*

- **Deputy Study Leader:** *Chris Rogers (UKRI)*

- Transversal Roles :
  - **Gender Adviser Officer :** E.J. Bahng (Iowa State University)
  - **Communication and dissemination Officer:** Elias Metral (CERN)

- **WP Coordinators:**
  - **WP1**: Roberto Losito (CERN)
  - **WP2**: Donatella Lucchesi (UNIPD)
  - **WP3**: Natalia Milas (ESS)
  - **WP4**: Chris Rogers (UKRI)
  - **WP5**: Antoine Chance (CEA)
  - **WP6**: Claude Marchand (CEA)
  - **WP7**: Luca Bottura (CERN)
  - **WP8**: Lucio Rossi (UNIMI)

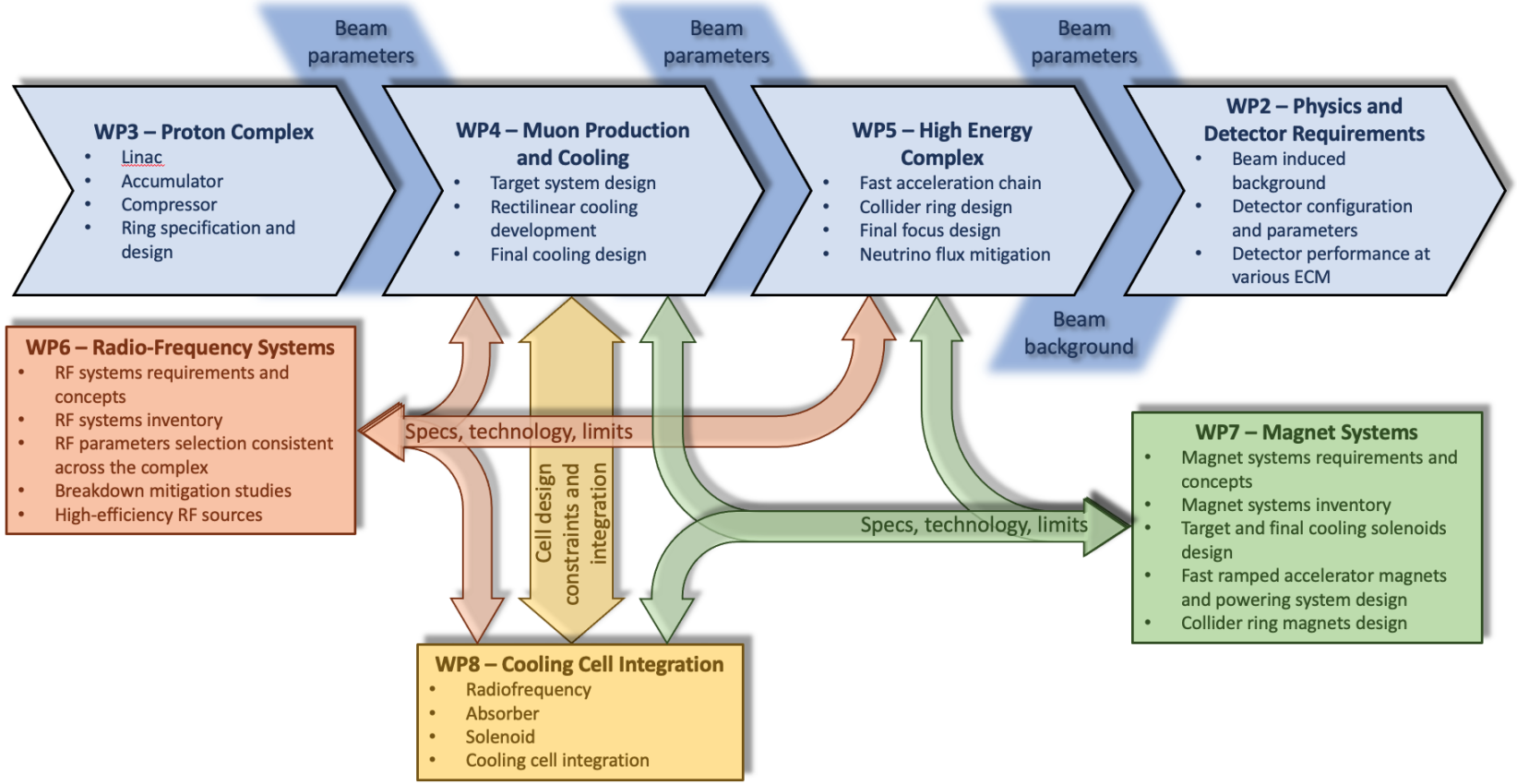
An excellent reviewers score 14.5/15!

"The scientific goals of the project are clear and important"

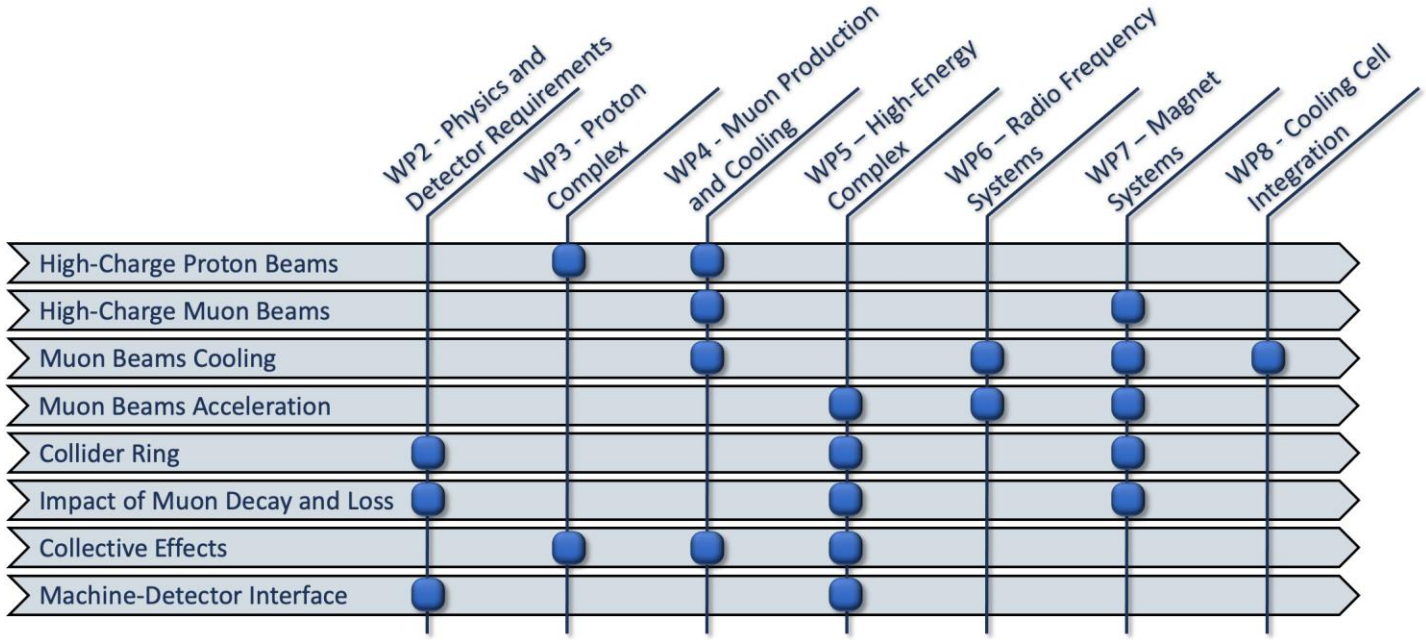
"A muon Collider offers a way (..) that is **novel** and **complementary** to existing approaches"

Goals of the project

- MuCol has been shaped to coordinate the effort of the International Muon Collider Collaboration towards the specific goal of providing a comprehensive input for the next European Strategy for Particle Physics Update
- The main deliverables will be yearly progress reports, that will be used to edit the report that will be submitted to the ESPPU in 2025/26 as input from the Collaboration.
- The same material can be used by the collaboration to provide input to other prioritization processes/funding agencies (e.g. P5 in US).



Scientific and technical organization



- All along the duration of the project we will animate a table of parameters, covering both the accelerator layout and the main technologies (magnets, RF, beam diagnostics…)
- Overleaf document being edited, during the project we will publish
  - M6: Tentative Parameters
  - M18: Preliminary Parameters
  - M30: Consolidated Parameters

Milestones & Deliverables

- **Milestones for year 1**:
  - *Website online*, M2: **WP1 (CERN)**
  - *Kick-off meeting*, by M3: M2
  - *Tentative Parameters available*, M6: **WP1 (SL) + all**
  - *Training on detector design and physics performance tools*, M6, **WP2**

Deliverable No	Deliverable Name	Work Package No	Lead Beneficiary	Date
D1.1	Data-management plan	WPI	1 -CERN	5
D1.2	Preliminary ESPPU report No. 1	WPI	1 - CERN	12
D1.3	Preliminary ESPPU report No. 2	WPI	1 -CERN	24
D1 .4	Intermediate ESPPU report	WPI	1- CERN	36
D1.5	Consolidated ESPPU report	WPI	1 - CERN	48
D2.1	Beam-induced background and detector configuration	WP2	8 - UNIPD	30
D2.2	Detector performance by using physics processes	WP2	2 - DESY	36
D3.1	Final report on parameters and initial study for the Proton Complex	WP3	11 -ESS	45
D4.1	Development of BDSIM simulation	WP4	16 -UKRI	24
D4.2	Preliminary Report on key subsystems for ESPPU input	WP4	16 -UKRI	33
D4.3	Consolidated Report on key subsystems	WP4	16 -UKRI	45
D5.1	Report on the collider ring design	WP5	5 - CEA	44
D5.2	Report on the design of the HEC	WP5	5 - CEA	45
D6.1	Report on design of high power and high efficiency RF power sources	WP6	5 - CEA	42
D6.2	Report on RF for MCC and HEC	WP6	5 - CEA	45
D7.1	Preliminary report on muon collider magnets	WP7	1 - CERN	33
D7.2	Consolidated report on muon collider magnets	WP7	1 - CERN	45
D8.1	Presentation of cooling cell conceptual design	WP8	7 - UMIL	15
D8.2	Final report on cooling cell design	WP8	7 - UMIL	42

Milestone No	Milestone Name	Work Package No	Lead Beneficiary	Due Date (month)
1	Website Available	WP1	1 -CERN	2
2	Kick-off meeting	WP1	1-CERN	3
3	Tentative parameters available	WP1	1-CERN	6
4	First annual meeting	WP1	1 -CERN	15
5	Preliminary parameters	WP1	1-CERN	18
6	Second annual meeting	WP1	1-CERN	27
7	Consolidated parameters	WP1	1-CERN	30
8	Third annual meeting	WP1	1-CERN	39
9	Training on detector design and physics performance tools	WP2	8-UNIPD	6
10	Workshop on MDI and IR design	WP2, WP5	8-UNIPD	13
11	Release of simplified detector performance model (DELPHES card or/and similar format)	WP2	8-UNIPD	18
12	Workshop on detector design and physics performance with a public lecture on Muon Collider	WP2	8-UNIPD	25
13	Publication of report of detector performance with major physics process at several ECM	WP2	8-UNIPD	48
14	Mini-Workshop on pulsed magnets	WP7, WP5	5-CEA	15
15	Tentative design of the interaction region	WP2, WP5	1-CERN	18
16	Tentative optics of the collider ring and pulsed synchrotrons	WP5	5-CEA	19
17	Tentative design of the FFA	WP5	5-CEA	25
18	Tentative impedance budget in the collider and pulsed synchrotron	WP5	5-CEA	26
19	Workshop on ultra-high-field solenoids	WP7	1 -CERN	30
20	Workshop on high-field collider magnets	WP7, WP5	1-CERN	42
21	Cooling cell design 3D model	WP8	7-UMIL	33

Next steps to enlarge the international collaboration

Both partecipation and resources!

- IMCC
- EU project MuCol
- US Muon Collider Coordination Group
- P5
- INFRA-TECH
- Detector R&D:
  - DRD – Implementation of Roadmap coordinated by ECFA
  - CPAD initiative – new detector research U.S. consortia –
- Accelerator R&D:
  - Roadmap coordinated by LDG
  - Strong motivation through the U.S. Snowmass/P5 process
- IMCC Interim Report

Many important places to show our updated progress as a strong community!

MUST— I.FAST

The I.FAST (Innovation Fostering in Accelerator Science and Technology) Innovation Pilot project for the Particle Accelerator community is organising its second Annual Meeting in Trieste, Italy 17–21 Apr 2023

https://indico.cern.ch/event/1204855/

Be aware of synergies to enlarge for IMCC

International MUON Collider Collaboration

extras