IMCC
Resources : status & plan

Nadia Pastrone

a starting point to agree on principles and
call a dedicated task force meeting
to finalize methodology and confirm relevant numbers

CERN – October 11, 2022

The task force

- **There is the crucial need to monitor all resorses (manpower, material et al.) provided by institutes to the IMCC**

- **A resource task force was announced at the last Jule 1 Design Study Meeting:**

  Nadia Pastrone, Roberto Losito, Steinar Stapnes, Chris Rogers, Vladimir Shiltsev, Jingyu Tang, Andrea Wulzer, Donatella Lucchesi, Luca Bottura, Daniel Schulte… should add representatives of France and of small countries…..

- We never met all together, since it was decided that the Coordination Committee should first produce some more detailed information kindly collected by Luca Bottura as starting point

- A restricted group discussed mid September how to better organize the data to be able to easily show the financial information to anybody it may concern

Inputs with preamble

- **Many institutes gave crucial contribution already during the ESPPU**
- **The Community took advantage by MAP and MICE R&D and studies**
- **A few institutes committed already staff and hired manpower + some material**
- **CERN MTP includes Muon Collider funding line since 2021**

Roadmap Plan

The panel has identified a development path that can address the major challenges and deliver a 3 TeV muon collider by 2045

Scenarios

Aspirational		Minimal	
[FTEy]	[kCHF]	[FTEy]	[kCHF]
445.9	11875	193	2445

~70 Meu/5 years

Label	Begin	End	Description	Aspirational		Minimal	
				[FTEy]	[kCHF]	[FTEy]	[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

Main Budget categories & timeline

< 2022	2022	2023	2024	2025	2026	>2026

		< 2022					2022					2023				
Institute	source	staff	fellow	student	travel	material	staff	fellow	student	travel	material	staff	fellow	student	travel	material
CERN	MTP															
	MuCol															
	I.FAST															
	……															

3 Main Categories Including Physics and Detector

Machine

Physics & Computing

Detectors & MDI

We need to estimate the the physics and detector scenarios!

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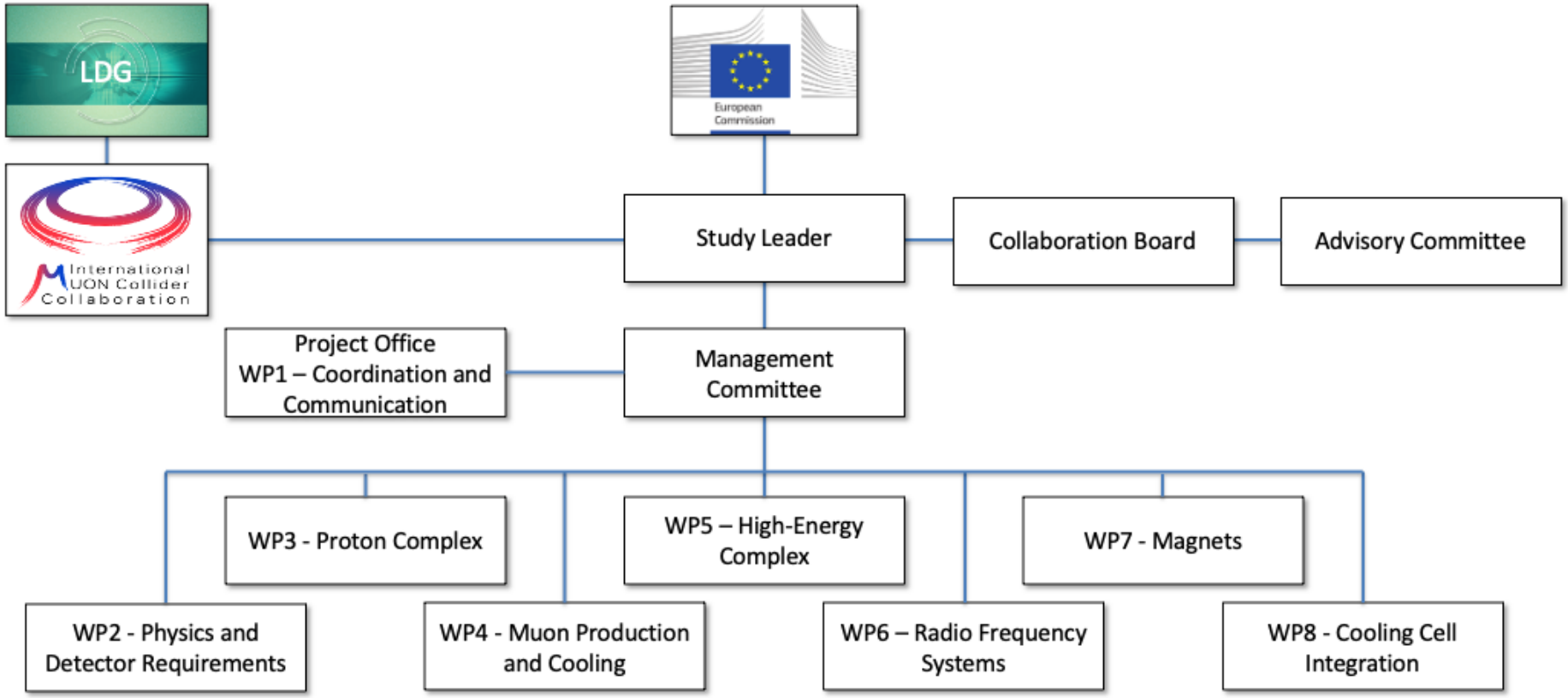
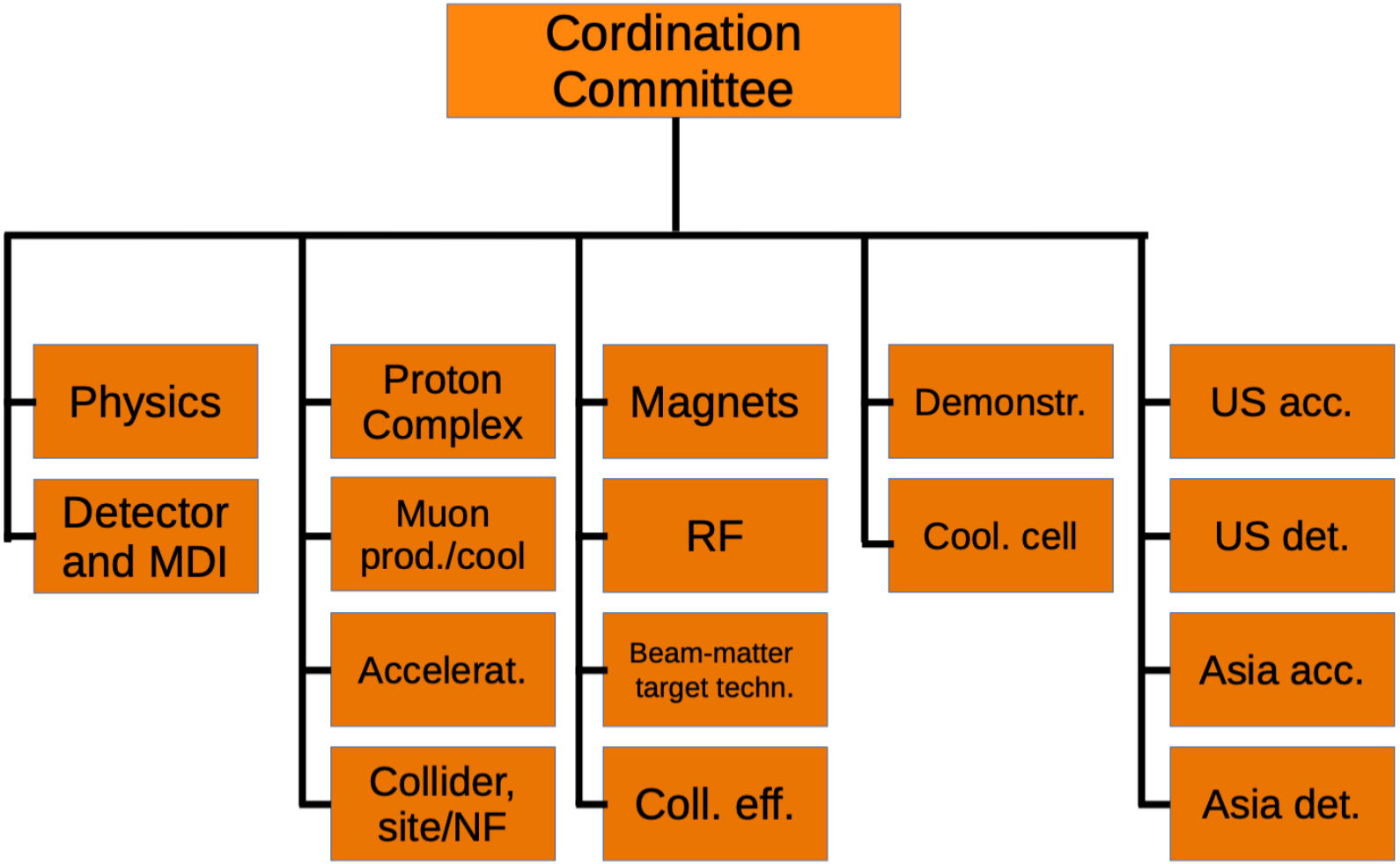
Design Study



Coordination Committee



MuCol institutes and EC budgets

	Institute	MuCol	Type	Country	TOTAL [keu]	Material	Travel	Personnel	TOTAL PM
1	CERN	benef	lab		210	128	40	0	
2	DESY	benef	lab	DE	50			40	12
3	Darmstadt	benef	univ	DE	120			96,22	15
4	Rostock	benef	univ	DE	90			72	12
5	CEA	benef	FA	FR	385		6	332,1	76
6	INFN	benef	FA	IT	510	28	18	362	110
7	Milano	benef	univ	IT	300	0	10	230	46
8	Padova	benef	univ	IT	100		20	60	24
9	Twente	benef	univ	NL	120	8	4	84	14
10	LIP	benef	lab	PG	40		2	30	12
11	ESS	benef	lab	SW	240		7,68	184,3	33
12	Uppsala	benef	univ	SW	30		5	19	2
13	Imperial College	assoc	univ	UK	309		1,2	246	34,5
14	UKRI	assoc	lab	UK	196		9	147,8	28,6
15	Warwick	assoc	univ	UK	50			37,8	21
16	Lancaster	assoc	univ	UK	100			80	36
17	Southampton	assoc	univ	UK	100			80	42
18	Sussex	assoc	univ	UK	50			40	12
19	PSI	assoc	lab	SWZ					
20	Geneva	assoc	univ	UK					
21	Sun Yat-Sen	assoc	univ	China					
22	KIT	assoc	lab	DE					
23	CNRS	assoc	FA	FR					
24	ENEA	assoc	FA	IT					
25	Bologna	assoc	univ	IT					
26	Pavia	assoc	univ	IT					
27	Strathclyde	assoc	univ	UK					
28	Huddersfield	assoc	univ	UK					
29	Royal Holloway	assoc	univ	UK					
30	Oxford	assoc	univ	UK					
31	Iowa	assoc	univ	U.S.A.					
32	BNL	assoc	lab	U.S.A.					

	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	Total Person-Months per Participant
CERN	x	x	x	x	x	x	x	x	0
DESY	x	12							12
TUDa	x						15		15
UROS	x					12			12
CEA	x	12			24	22	18		76
INFN	x	12		x	12	36	32	18	110
UMIL	x			x			8	38	46
UNIPD	x	24							24
UTWENTE	x						14		14
LIP	x	12							12
ESS	x		33						33
UU	x		2						2
Imperial	x			22.5				12	34.5
UKRI	x			28.6				x	28.6
UWAR	x			21					21
ULA	x					36			36
SOTON	x						42		42
UOS	x	12							12
PSI	x						x		
UNIGE	x						x		
SYU	x	x							
KIT	x						x		
CNRS	x						x		
ENEA	x			x					
UNIBO	x						x		
UNIPV	x	x							
Strathclyde	x					x			
HUD	x				x				
RHLU	x				x				
UOXF	x				x				
ISU	x	x							
BNL	x				x				
Total PM	0	84	35	72.1	36	106	129	68	530.1

MoC institutes

		Institute	MuCol	Type	Country
1	CERN	CERN	benef	lab	
3		Darmstadt	benef	univ	DE
4		Rostock	benef	univ	DE
5	CEA	CEA	benef	FA	FR
6	INFN	INFN+Univ TO	benef	FA	IT
6		INFN+Univ PD	benef	FA	IT
6		INFN+Univ MI	benef	FA	IT
6		INFN+Univ PV	benef	FA	IT
6		INFN+Univ TS	benef	FA	IT
6		INFN+Univ BA	benef	FA	IT
6		INFN+Univ RM1	benef	FA	IT
9		Twente	benef	univ	NL
11		ESS	benef	lab	SW
12		Uppsala	benef	univ	SW
13		Imperial College	assoc	univ	UK
14		UKRI	assoc	lab	UK
15		Warwick	assoc	univ	UK
18		Sussex	assoc	univ	UK
19		PSI	assoc	lab	SWZ
20		Geneva	assoc	univ	UK
27		Strathclyde	assoc	univ	UK
28		Huddersfield	assoc	univ	UK
30		Oxford	assoc	univ	UK
31		Iowa	assoc	univ	U.S.A.
32		Winsconsin	NO	univ	U.S.A.
		Austria-HEP	NO	acad	A
	IHEP	China-IHEP	NO	FA	China
		Tampere	NO	univ	F
		Riga	NO	univ	Latvia
		Durham	NO	univ	UK

We can group institutes by Country/Funding Agency

MuCol institutes no MoC

2		DESY	benef	lab	DE
7		Milano	benef	univ	IT
8		Padova	benef	univ	IT
10		LIP	benef	lab	PG
16		Lancaster	assoc	univ	UK
17		Southampton	assoc	univ	UK
21		Sun Yat-Sen	assoc	univ	China
22		KIT	assoc	lab	DE
23		CNRS	assoc	FA	FR
24		ENEA	assoc	FA	IT
25		Bologna	assoc	univ	IT
26		Pavia	assoc	univ	IT
29		Royal Holloway	assoc	univ	UK

Budget source

- CERN MTP
- MuCol EU project
- Other EU/nonEU projects (I.FAST, AIDAinnova, aMUSE…)
- Funding Agency
- New EU project TECH…

GOALS/main chapters

- **Physics + Computing + Detector R&D**
- **Proton Complex + Muon Production & Cooling + High-energy Complex**
- **Radio Frequency Systems + Magnet Systems + Other technology**
- **Cooling Cell Integration + Demonstrator**

Next step forward

- Do the exercise to verify at which level the committed resources so far (MTP, MuCol with matching funds +++)
  are approximating the Roadmap plan at minimal scenario
- According to priorities where do we stand and what we can do…

extras

MUon collider STrategy network – MUST

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

May 1, 2021 – April 30, 2024

Task 5.1

….

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

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

AIDA innova Detector R&D

aMUSE

1 January 2022 - 31 December 2025 EU RISE project

aMUSE further provides an excellent platform for an ambitious EU-US network to advance the development of muon beams.

Objectives WP3 – leader: Donatella Lucchesi

- Study techniques of unstable particles beam cooling muon beams at different energies, aiming to validate the simulation with experimental tests
- High energy muon beams: determine the optimal interaction region configuration by studying the beam induced background and new detector technologies able to handle it
- Design and simulate detector for different centre of mass energies
- Evaluate the radiation hazards related to the neutrino flux emitted by the muon beams.

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WP 2: Physics and Detector Requirements
Leader Univ. PD

WP 3: The Proton Complex
Leader ESS

WP 4: Muon Production and Cooling
Leader STFC

WP 5: High-energy Complex
Leader CEA

WP 6: Radio Frequency Systems
Leader CEA

WP 7: Magnet Systems
Leader CERN

WP 8: Cooling Cell Integration
Leader CERN+Univ. MI