

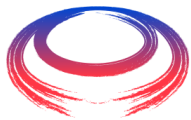
International
Muon Collider
Collaboration



Proton driver session introduction

S. Gilardoni, F. Gerigk
CERN-SY

1st Community meeting of the International
Muon Colliders Design Study - 20 May 2021

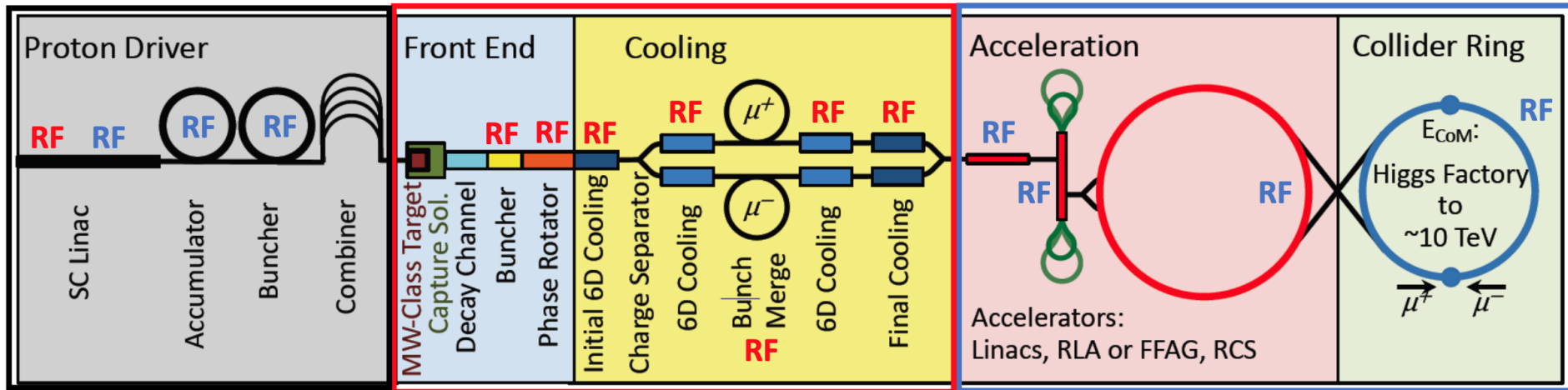


International
UON Collider
Collaboration

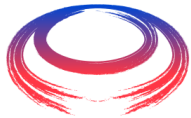
Setting the scene

Muon capture and cooling

Acceleration and collider rings



Courtesy of A. Grudiev et al.



International
UON Collider
Collaboration

A first tentative parameter table

System			Driver		Front-End			Cooling		Acceleration			Collider	Total
Sub-system			Driver Linac H- (SPL like)		Accum & Comp		Initial	6D (2 lines)	Final (2 lines)	Injector Linac	RLA	RCS	Ring	
Reference expert			F.Gerigk		?	D.Neuffer	C.Rogers	D.Stratakis	C.Rogers	A.Gogagz	S.Berg	E.Gianfelice		
			NC	SC										
	Energy	GeV/c	0.16	5	5	0.255	0.255	0.255	0.255	1.25	62.5	1500	1500	
	# bunches ($\mu+$ or $\mu-$)	#	40 mA		1	12	12	1	1	1	1	1	1	
	Charge/bunch	E12			500	3.60	2.57	7.27	4.43	3.59	3.05	2.22	2.20	
	Rep Freq	Hz	5	5	5	5	5	5	5	5	5	5	5	
Beam (system exit)	Norm Transv Emitt	rad-m				1.5E-02	3.0E-03	8.3E-05	2.5E-05	2.5E-05	2.5E-05	2.5E-05	2.5E-05	
	Norm Long Emitt	rad-m				4.5E-02	1.5E-02	1.9E-03	1.1E-02	1.1E-02	1.1E-02	1.1E-02	1.1E-02	
	Pulse/Bunch length	m	2.2 ms		0.6 (2ns)	1.1E+01	1.1E+01	9.2E-02	9.2E-02	4.6E-02	2.3E-02	2.3E-02	5.0E-03	
	Power ($\mu+$ and $\mu-$)	W	6.40E+04	2.2E+06	2.0E+06	1.8E+04	1.3E+04	3.0E+03	1.8E+03	7.3E+03	3.1E+05	5.4E+06	5.3E+06	
	Technology		Linac4HP	SC		0	NC	Vacuum	NC	SRF	SRF	SRF	SRF	
	Number of cavities	#	23	244		120	367	7182	32	52	360	2694	?	11074
	RF length	m	46	237		30	105	1274	151	82	1364	2802	?	6091
	Frf	MHz	352	704	4 ?	326to493	325	325-650	20-325	325	650-1300	1300	800	4 to 1300
	Grf	MV/m	1-3.7	19 - 25		20	20 to 25	19-28.5	7.2-25.5	20	25 to 38	35	?	7 to 35
RF cavities	Magnetic Field	T	0	0		2	3T	1.7-9.6	1.5-4	0	0	0	0	0 to 9.6
	Installed RF field	MV	169	5700		434	2618	30447	1836	1640	50844	98062	250	1.92E+05
	Energy gain	MeV	160	4840		0	0	0	0	1250	62500	1437000	0	1.51E+06
	Recirculations	#	1	1		1	1	1	1	1	4.5 to 5	13 to 23	1000	1 to 1000
	RF Power	MW	25	282		?	?	?	?	52	360	48	?	?
	Technology		klystron	klystron						Klytron-IOT				
	Cavities/Power Source	#	23	244		4				1 to 2	1 to 2			
	RF Pulse (beam) duration	ms	2.42	2.42		4.08E-04	5.04E-04	4.08E-03	5.64E-04	6.36E-04	3.72E-02	1.28E+00	8.70E-01	
	Prf/Power Source	MW	11.7	2.47						1	1			
RF power sources	Total Power Sources	#	17	244		30				52	341			?
	Installed RF Power	MW	34	352		164				52	341			?
	Total RF Energy	MJ	2.99E-01	3.00E+00		3.35E-01	1.55E-01	4.26E-01	1.56E-02	8.63E-03	3.66E-01	6.13E+00	0.00E+00	10.74

Courtesy of
J.P. Delahaye et al.

Personal green-field vision

- Energy : 2 \rightarrow 8 GeV
- Power on target : 1 \rightarrow 4 MW
- Rep rate: to be adjusted depending on energy for a given power
- Bunch length: few ns (2--10 ns) depending on final design of phase rotation/cooling channel
- Target spot size - final focusing : to be revised depending on target design

Questions we would like to reply

- Is the p-driver for the muon collider well within reach?
- Can we extrapolate from existing proton sources?
- Which kind of challenges we could expect?
- Which kind of R&D, studies are missing to bring us to a reliable multi-MW proton source for collider operation?

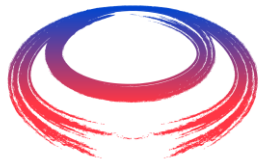
Program for today

14:00	Brief introduction	<i>Dr Simone Gilardoni</i>
	<i>Zoom</i>	14:00 - 14:15
	High power study of J-PARC Rapid Cycling Synchrotron (RCS)	<i>Kazami Yamamoto</i>
	<i>Zoom</i>	14:15 - 14:40
15:00	Thoughts on proton drivers for a muon facility	<i>Shinji Machida</i>
	<i>Zoom</i>	14:40 - 15:05
	SPL-II	<i>Frank Gerigk</i>
	<i>Zoom</i>	15:05 - 15:30
	Coffee break	
	<i>Zoom</i>	15:30 - 15:50
16:00	SNS perspective (tbc)	<i>Andrei Shishlo</i>
	<i>Zoom</i>	15:50 - 16:15
	PIP-II challenges	<i>Arkadiy Klebaner</i>
	<i>Zoom</i>	16:15 - 16:40
17:00	Discussion	<i>Simone Gilardoni</i>
	<i>Zoom</i>	16:40 - 17:15
	PDAC challenges	<i>Elias Metral</i>
	<i>Zoom</i>	17:15 - 17:40

Plus tomorrow: “High-charge 2ns protons bunches from the ESS linac for muon cooling test”
Dr. Ekelöf in the Beam Dynamics session

Strategy

- Learn as much as possible from existing facility
 - Multi-MW proton drivers are now a reality
- Wrap-up past studies
 - PDAC schemes and challenges
- Explore alternative
 - Trying to inject also some innovation
- Optimize energy/power/final focusing depending on optimization of the rest of the complex
 - Target system
 - Cooling performances
- Will organize follow-up meeting and relevant working-group
- International support is fundamental



International
UON Collider
Collaboration



*Thank you
very much for your support
and for your attention*