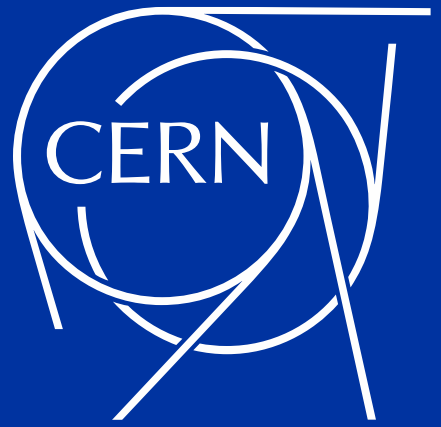


Proposal for adjusted BCCM thresholds

Cédric Hernalsteens

230th Machine Protection Panel – 21 October 2022

BCCM thresholds overview

- **BCCM developed as a mean of interlocking on (global) losses**
  - Redundancy w.r.t the BLM system
- **BCCM provides a safety net in case of BLM system failure**
  - Not meant to be the primary interlock in case of beam losses
- **Need to have margin between the BCCM beam loss thresholds and the BLM thresholds**
  - BLM have a local protection role
  - BCCM only has a global role

Pre-commissioning BCCM thresholds

- **Only 2 energy levels: < 0.5 TeV and >= 0.5 TeV**
- **6 integration windows**

Energy	Integration window length					
	1	4	16	64	225	1125
	89 us	356 us	1.4 ms	5.7 ms	20.0 ms	100.1 ms
	Dump threshold levels in 10^{11} charges					
< 0.5 TeV	6	6	6	6	6	6
>= 0.5 TeV	3	3	3	3	2	0.5

Pre-commissioning BCCM thresholds

Range		Refreshing		Shift Register Name	Running Sum Name
40 µs steps	Ms	40 µs steps	ms		
1	0.04	1	0.04		RS00
2	0.08	1	0.04		RS01
8	0.32	1	0.04	SR1	RS02
16	0.64	1	0.04		RS03
64	2.56	2	0.08	SR2	RS04
256	10.24	2	0.08		RS05
2048	81.92	64	2.56	SR3	RS06
16384	655.36	64	2.56		RS07
32768	1310.72	2048	81.92	SR4	RS08
131072	5242.88	2048	81.92		RS09
524288	20971.52	32768	655.36	SR5	RS10
2097152	83886.08	32768	655.36		RS11

- **Only 2 energy levels: < 0.5 TeV and >= 0.5 TeV**
- **6 integration windows**

Corresponding BLM RS

Energy	Integration window length					
	1	4	16	64	225	1125
	89 us	356 us	1.4 ms	5.7 ms	20.0 ms	100.1 ms
	RS2	RS3	RS3 – RS4	RS4 – RS5	RS5 – RS6	~ RS6
	Dump threshold levels in 1011 charges					
< 0.5 TeV	6	6	6	6	6	6
>= 0.5 TeV	3	3	3	3	2	0.5

Run III collimator BLM thresholds

Assuming global losses dominated by collimator losses, BCCM thresholds should be based on BLM IR7 thresholds, which are based on damage limits.

Other “local losses” cannot be protected against with the BCCM.

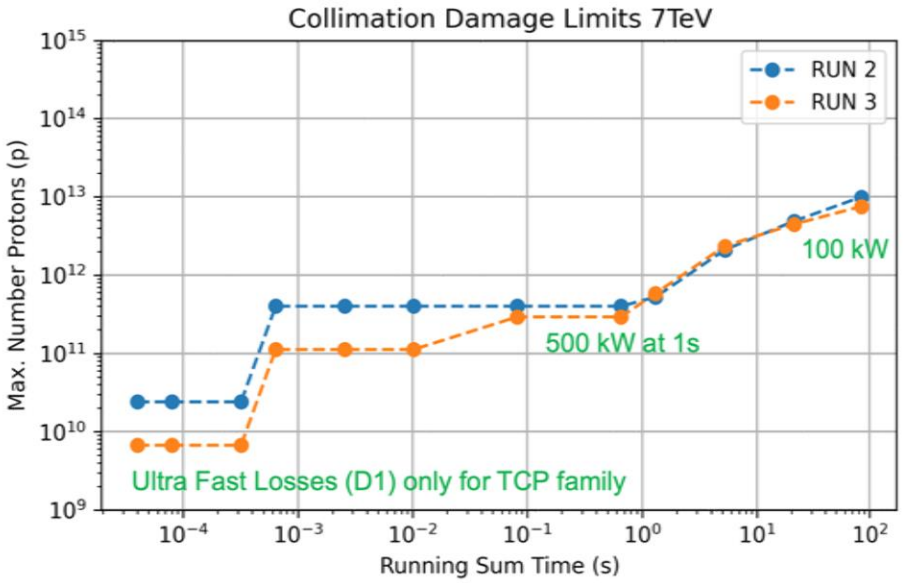
Update of damage limits

New limits summarized by F.Carra 74th BLMTWG based on Quench Test and HiRadMat results.

500kW up to 10 s

Study damage effect (fragmentation, plastic deformation, etc.) for different collimator materials.
Numerical Simulations + Experimental Test
Presented at MPP workshop 2019

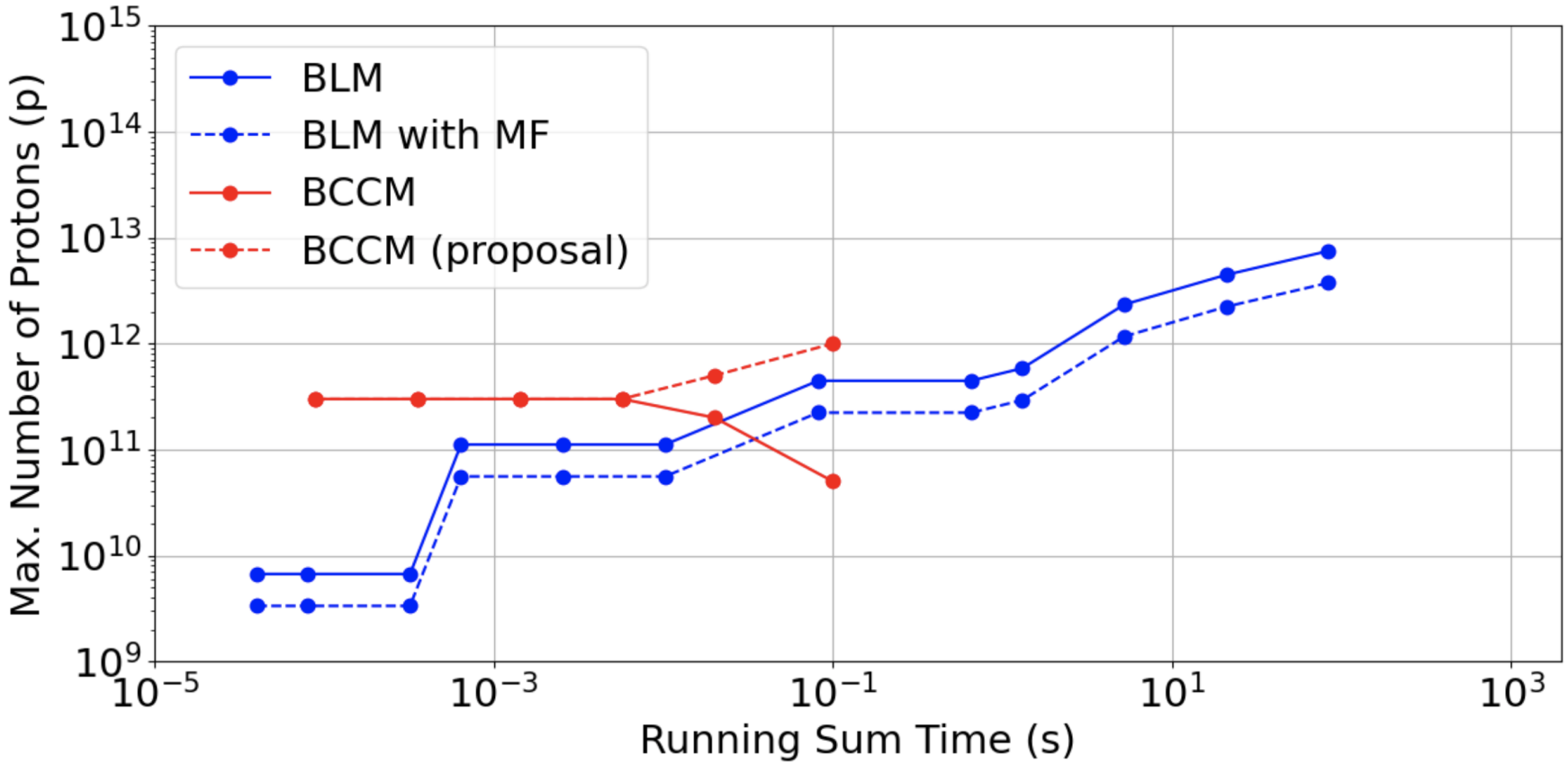
RS	Times	Max. Values
RS01 - RS06	40 µs - 0.01 s	125 kW x 1 s
RS07	0.08 s	500 kW x 1 s
RS08 - RS10	0.6 s - 5.2 s	500 kW
RS11	20.9 s	500 kW x 10 s
RS12	83 s	100 kW



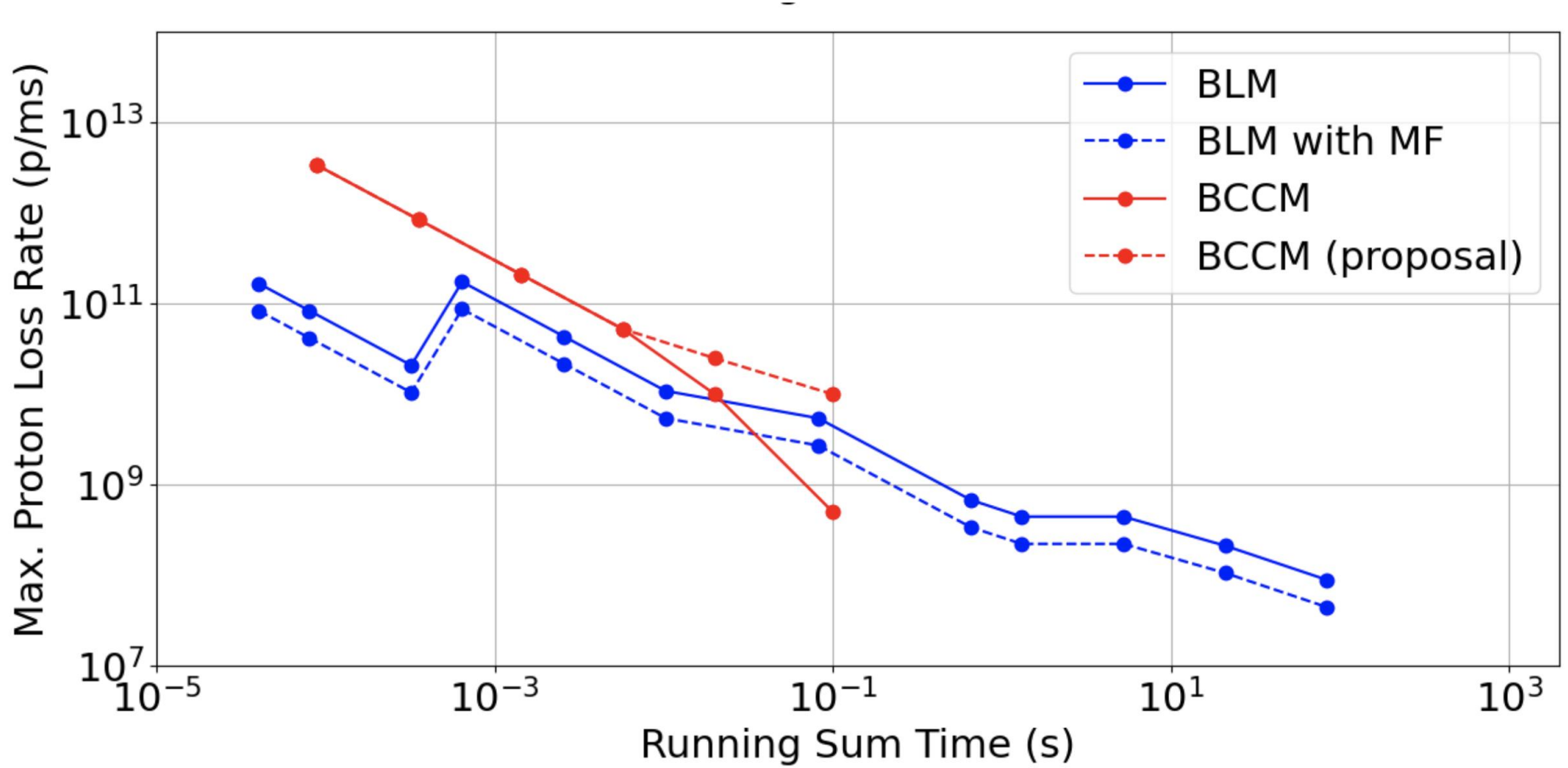
Maximum values of beam losses in the full collimation system.

25/11/2021 B.Salvachua | LHC Operations “Evian” Workshop 8

BLM and BCCM thresholds

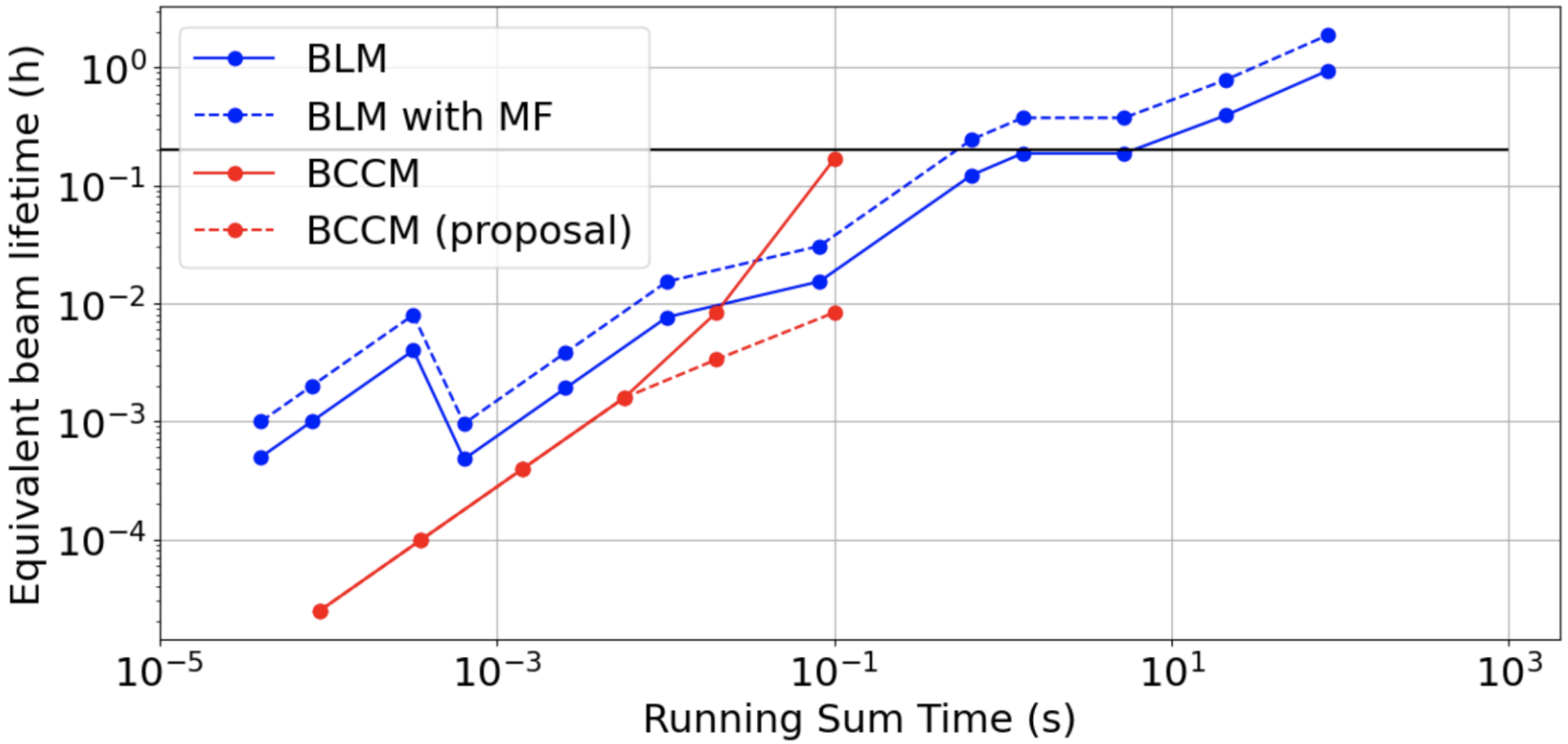


BLM and BCCM thresholds



Same, expressed in terms of loss rates

BLM and BCCM thresholds

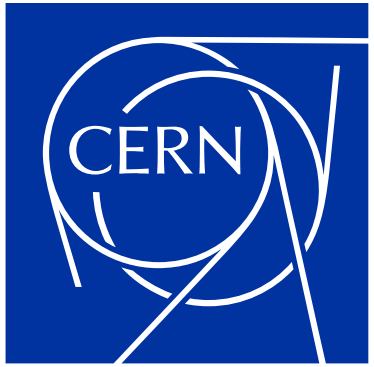


Same, expressed in equivalent beam lifetime

Proposal for BCCM threshold update

- **The high-energy thresholds for the long integration windows (225 and 1125 turns) should be increased to follow a similar structure as the BLM thresholds**

Energy	Integration window length						
	1	4	16	64	225	1125	
	89 us	356 us	1.4 ms	5.7 ms	20.0 ms	100.1 ms	
	Dump threshold levels in 10^{11} charges						
< 0.5 TeV	6	6	6	6	6	6	Initial
< 0.5 TeV	6	6	6	6	6	10	Proposal
>= 0.5 TeV	3	3	3	3	2	0.5	Initial
>= 0.5 TeV	3	3	3	3	5	10	Proposal
	Dump threshold levels in 10^{9} charges per turn						Initial
>= 0.5 TeV	300.0	75.0	18.8	4.69	0.89	0.04	Proposal
>= 0.5 TeV	300.0	75.0	18.8	4.69	2.22	0.89	



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