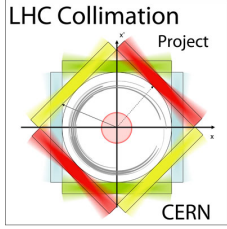

Preliminary analysis of collimation MD on ion quench test

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on behalf of the MD team

Outline

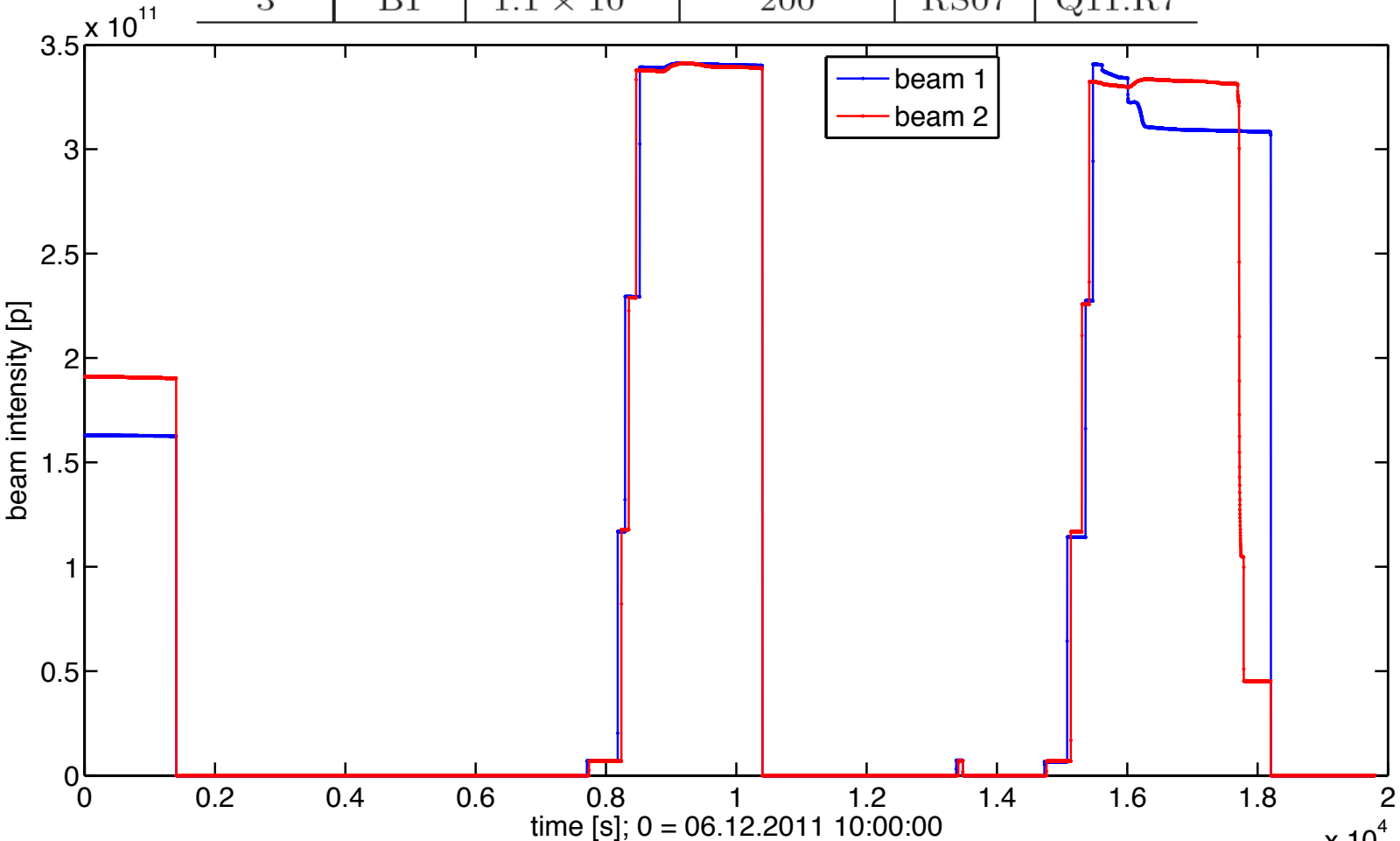
- Scope
- DS quench margin test with IONs (06.12.2011)
- Results of experiment
- Performance reach estimations for 3.5 TeV and 7 TeV
- Assumptions used for estimate

Scope

- Agree on performance reach figures from collimation cleaning for Chamonix2012, in particular:
- Review the achieved maximum loss rates (charges/s lost on TCPs)
- Check the margins to quench on different BLM integration times
- Agreed on which integration window should be used
- Agree on the assumptions for performance reach
- Calculate the performance reach in terms of total maximum beam intensity allowed (for assumptions on minimum beam lifetime)
- Ions versus protons? Need a consistent approach
- Remark: only looking at betatron cleaning, not at luminosity losses

3 Ramps, 3 experiments with B2, 1 with B1

Ramp	Beam	$(dI/dt)_{max}$ [charges/s]	$(dI/dt)_{time}$ [ms]	Dump RS	Magnet
1	B2	2.7×10^{11}	75	RS06	Q9.L7
2	B2	2.5×10^{11}	100	RS07	Q19.L7
3	B2	4.9×10^{10}	1000	-	-
3	B1	1.1×10^{11}	200	RS07	Q11.R7



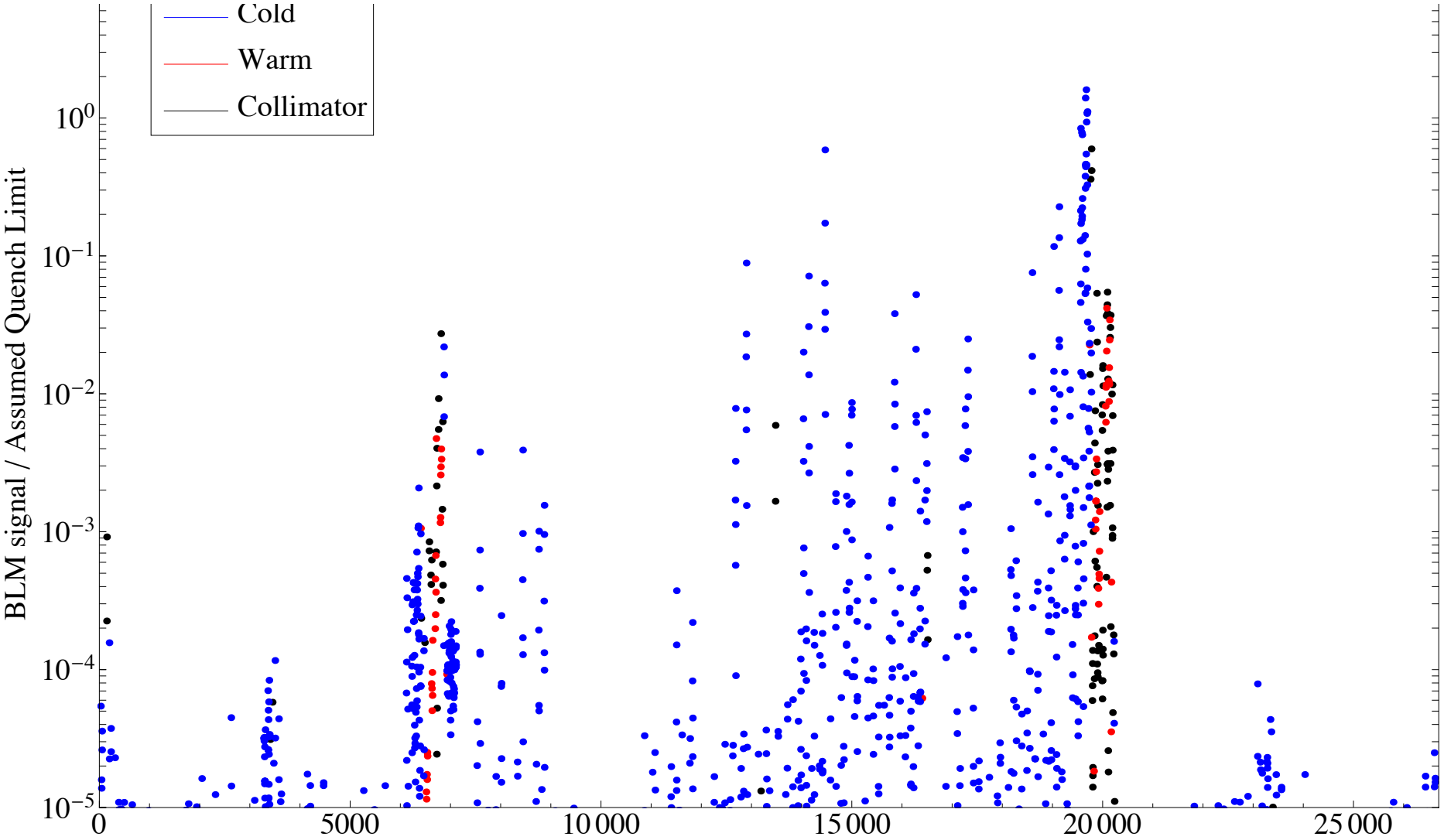
Results of experiment

Ratio of BLM-Signal to assumed quench limit (i.e. 3x operational BLM dump thresholds)

Ramp	Ratio RS02	Ratio RS04	Ratio RS06	Ratio RS07	Ratio RS09
1	MB9.L7: 0.26	MB9.L7: 0.07	Q8.L7: 0.57	Q8.L7: 1.14	MB9.L7: 0.29
2	Q8.L7: 0.08	Q8.L7: 0.16	Q8.L7: 1.66	Q8.L7: 2.35	Q9.L7: 0.49
3	MB9.L7: 0.005	MB9.L7: 0.015	Q8.L7: 0.15	Q8.L7: 1.03	MB9.L7: 1.60
3	Q11.R7: 0.01	Q11.R7: 0.03	Q11.R7: 0.46	Q11.R7: 1.16	Q11.R7: 0.55

- Dumps due to high losses in short running sums (RS06, RS07): Ramp 1, 2 (B2) and 3 (B1).
- Ramp 3 (B2): creating high slow losses by carefully approaching the third order integer resonance.
- RS09: MB9.L7 reached 1.6 x assumed quench limit
- Peak losses at different magnets depending on the time scale

Ration of BLM signal to assumed quench limit (Ramp 3 B2, RS09)



Performance estimate with Ions for 3.5TeV and 7TeV

- Ion design intensity: $N_{tot,des}$= 4.1e11 ions * 82 = 3.4e12 charges
- **Measured** loss rate for long slow losses: **4.9e10 charges/s**
- Performance **improvement** compared to design loss rate (τ = 0.22h, $N_{tot,des}$: 4.3e9 charg/s ➔ 4.9e10 / 4.3e9 **= 11.4**
- **Scaling** from 3.5 to 7 TeV: decrease of **quench limit** [mJ/cm^3] : factor ~4.5 (source A. Verweij); **deposited energy** per charge increases ~ 2; I.e. scaling by ~**1/9** ➔ 11.4 / 9 = **1.3**
- **Cleaning**: same at 3.5 TeV and 7 TeV (?)
- **Estimated total intensity** with Ion at 7TeV taking into account that lifetime τ_{meas} **> 1h** (4.5 x 0.22h): $N_{tot,est}$= 1.27 x 4.5 = **5.7 x $N_{tot,des}$**
- Note that the MD was done with **relaxed collimator settings**

Assumptions / Uncertainties

- No quench achieved, i.e. these figures are conservative.
- Used loss rate of Ramp3 (B2): losses in the ~1s regime.
- Uncertainty in scaling of quench limit from 3.5 TeV to 7 TeV (1/9 compared to the 1/3).
- Cleaning at 7 TeV with nominal settings. Can we quantify the factor?
- Same lifetime assumed for 7TeV as measured in 3.5TeV.
- Different loss patterns in the fast and slow loss cases. Does this have beam dynamics reasons?
- Peak loss rate was not achieved for times > 1s