Quench test with wire scan

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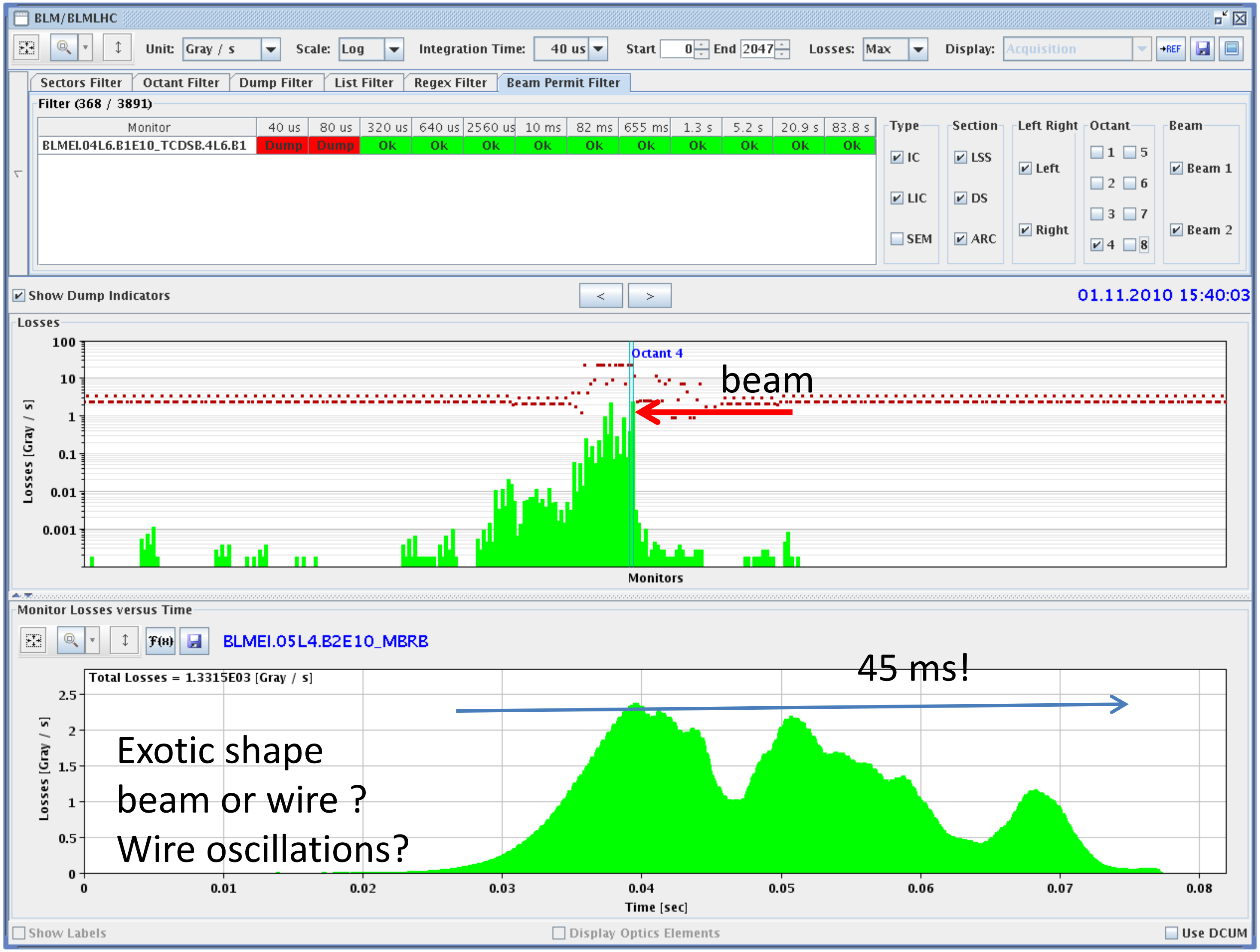
Reminder

- Date: 2010.11.01:

  first scan (1 m/s): 12:59:34 UTC

  last scan (5 cm/s): 14:40:04 UTC
- Magnet which quenched was D4 (MBRB) – 4.5 K
- The purpose was to investigate the quench limit for millisecond losses (UFO-like)
- WS is the only way to create ms-scale losses, but the specific geometry in this point makes data analysis tricky

BLM PostMortem

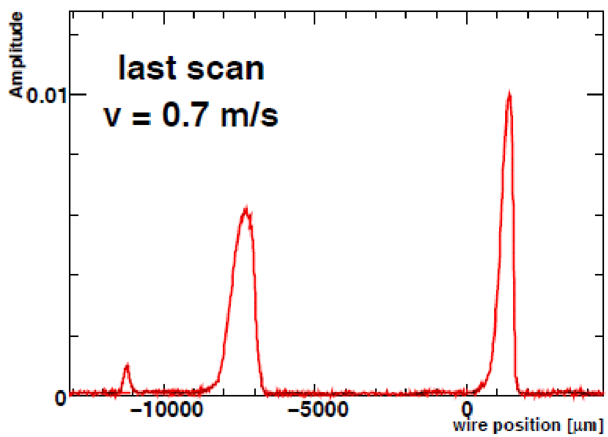


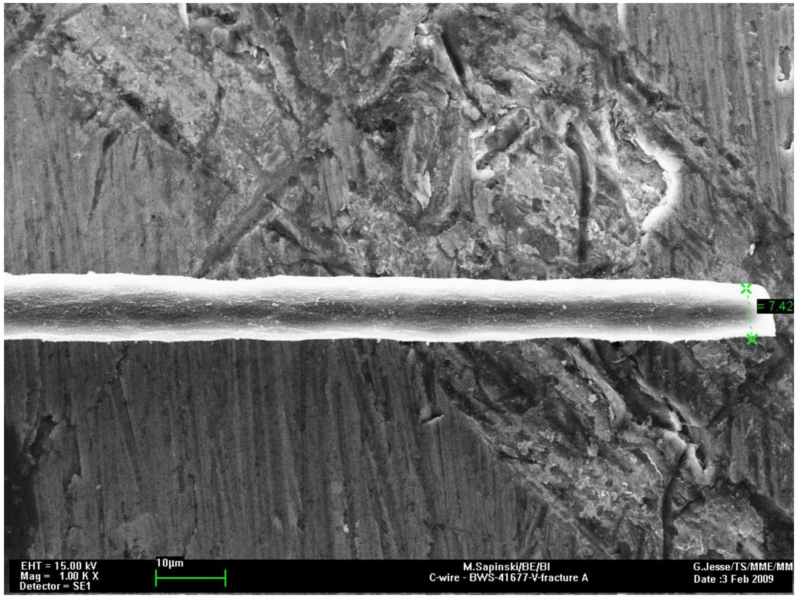
Why the wire survived?

- SPS experiment 2008, wire breakage

Table 1: Beam Conditions at Wire Breakage

scan speed	N_{prot}	σ_1 [mm]	σ_t [mm]
0.5 m/s	$2.41 \cdot 10^{13}$	0.57	0.73
0.7 m/s	$2.18 \cdot 10^{13}$	0.73	0.57





- We could not observe scan profile because WS acquisition was failing at so low speeds.

Why the wire survived? (II)

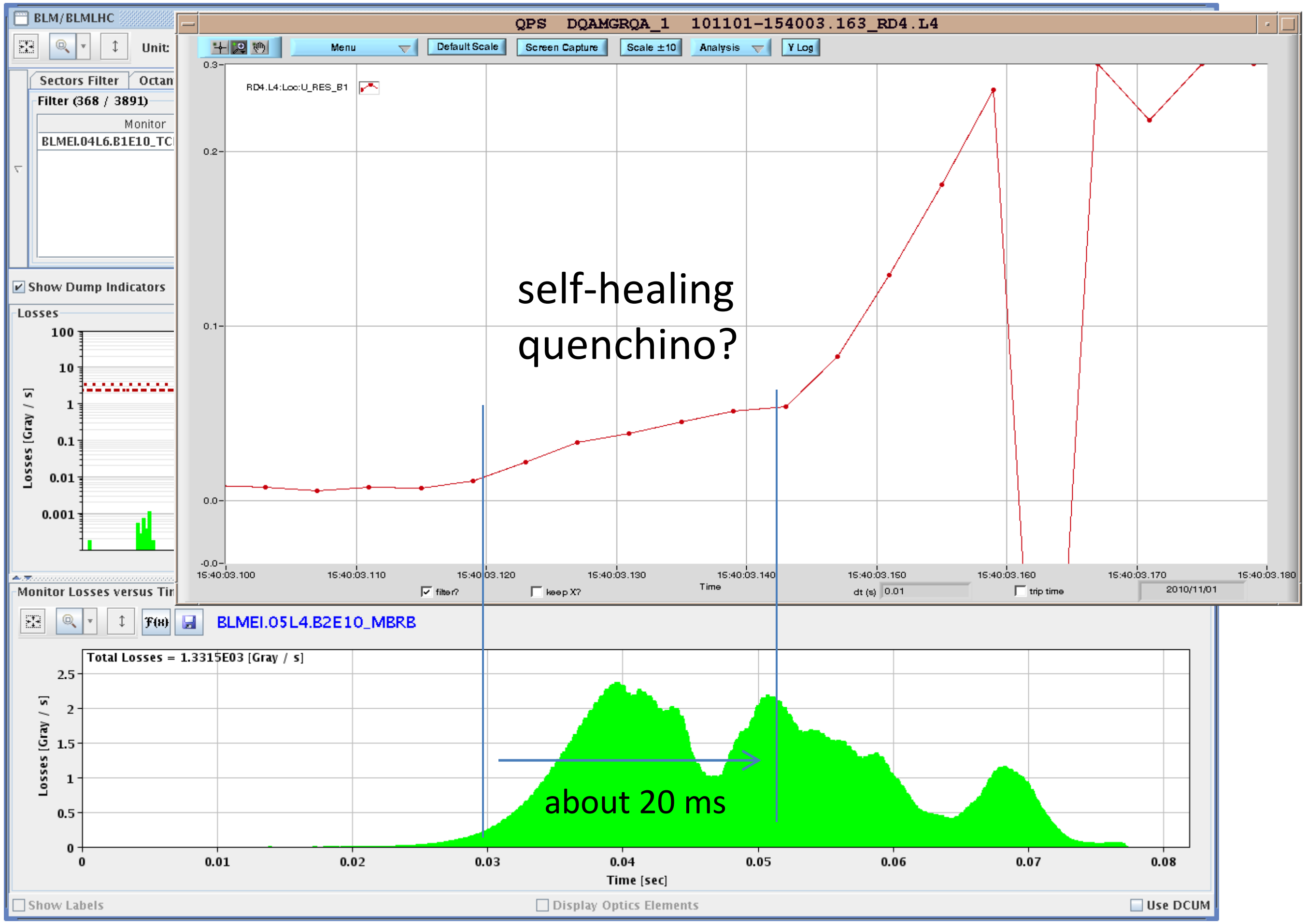
- Energy density

$$\mathcal{E} = \frac{N_{part} d_{wire} E_{dep}}{\sqrt{2\pi}\sigma_t v_{wire} \tau_{revol}} \left[\frac{MeV}{mm}\right]$$

- SPS experiments: $2.7 \cdot 10^{11}$ and $2.3 \cdot 10^{11}$ [MeV/mm]
- LHC last scan: $8.5 \cdot 10^{11}$ [MeV/mm]
- Possible explanation – wire history? Sigma different than we think? (we don't have transv. sigma measurements)
- Wire will be investigated during winter shutdown.

Why have we quenched at so slow?

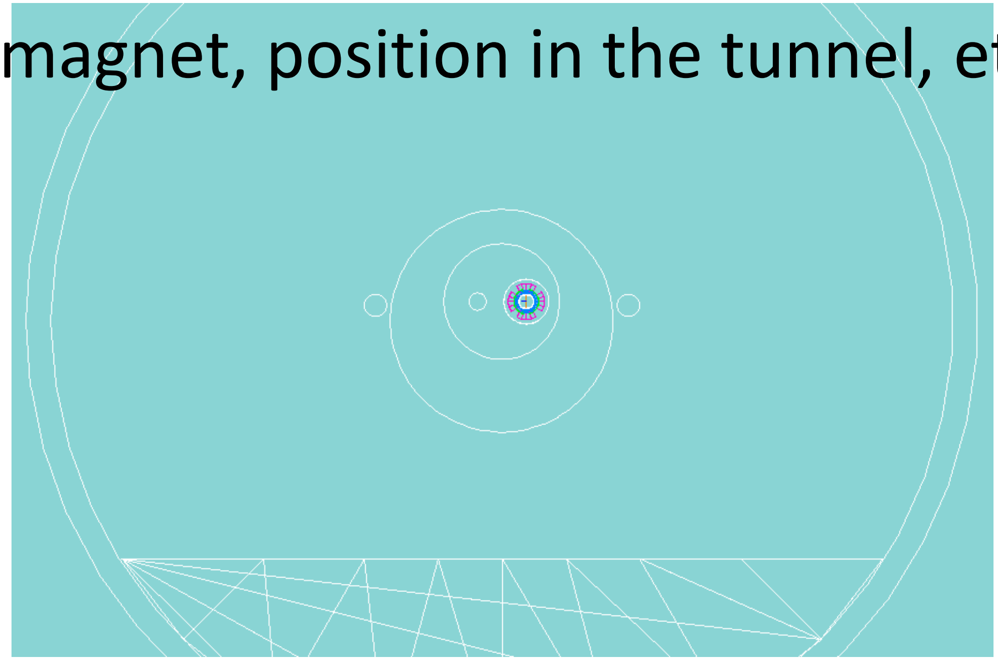
Arjan's observation: we would quench with half of the protons at 5 cm/s or with the same number of protons at 10 cm/s.



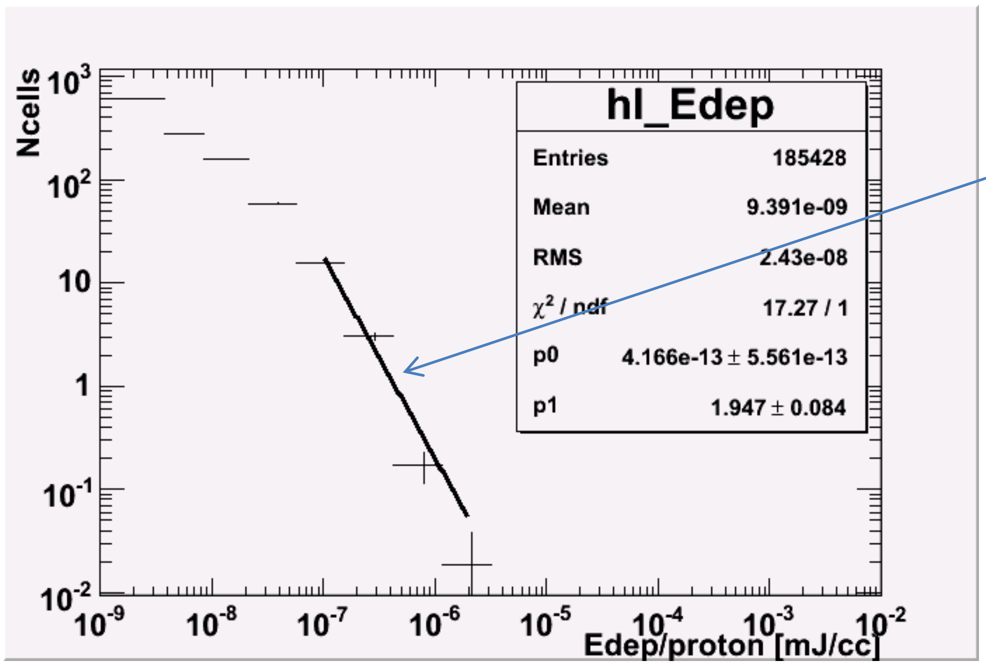
How to estimate energy density in coil?

- Monte Carlo simulation, the best would be to have both: Geant4 and FLUKA
- Old Geant 4 geometry, a lot to improve

(magnetic field, amount of material in front of the magnet, position in the tunnel, etc, etc)



Energy density in the coil - trying



Fitting the tail of the distribution and extrapolating 5 orders of magnitude

Multiplying by the number of protons which interacted with the wire (about $6 \cdot 10^{14}$)

1 cell corresponds to 17 mJ/cc

The reality might be orders of magnitude different – before Xmass new result.
For comparison, for MB at 20 ms has about 8-10 mJ/cc - quench margin.
The fact that obtained number makes sense is purely accidental but…

Next Steps

- Ultimately accuracy better than factor 3 can be reached (what FLUKA usually states)
- The important is comparison with simulation where protons are lost on beam screen inside/close to the magnet
- We should check a possibility to perform quench test with a bump on the same magnet
- How to conclude about arc geometry from that?
- Finally a decision will be needed:
  can we set thresholds in ms scale to UFO-like loss scenarios?