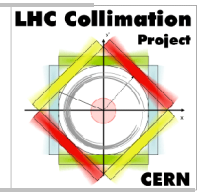
Status of energy deposition studies at IR7

Collimation Meeting
21-03-2005

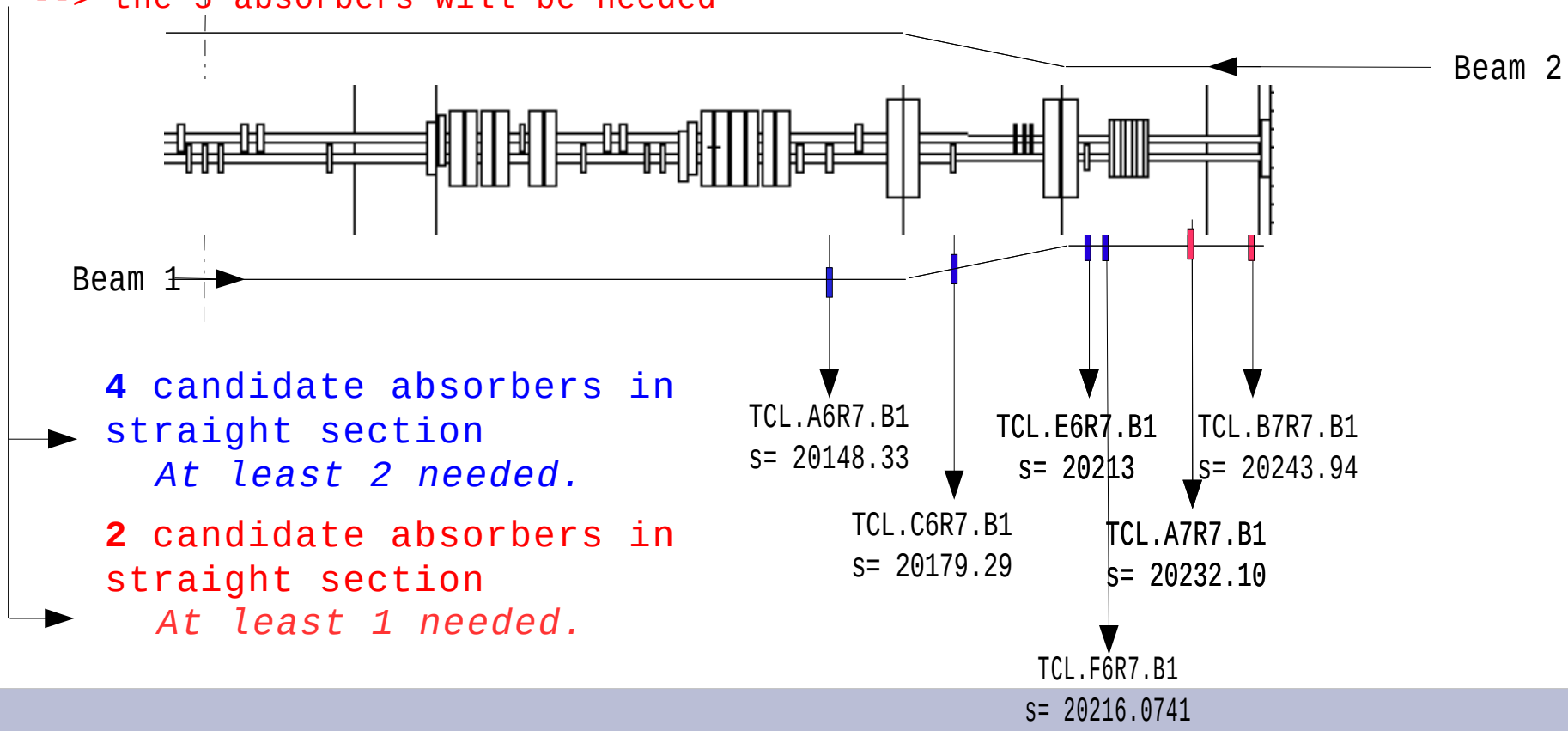


A. Ferrari, M. Magistris, M. Santana, V. Vlachoudis

Implementation of vertical and horizontal absorbers.

Studied locations

Limit may be 1 mW/cm3 instead or 5 mW/cm 3
--> the 5 absorbers will be needed



4 candidate absorbers in straight section
At least 2 needed.

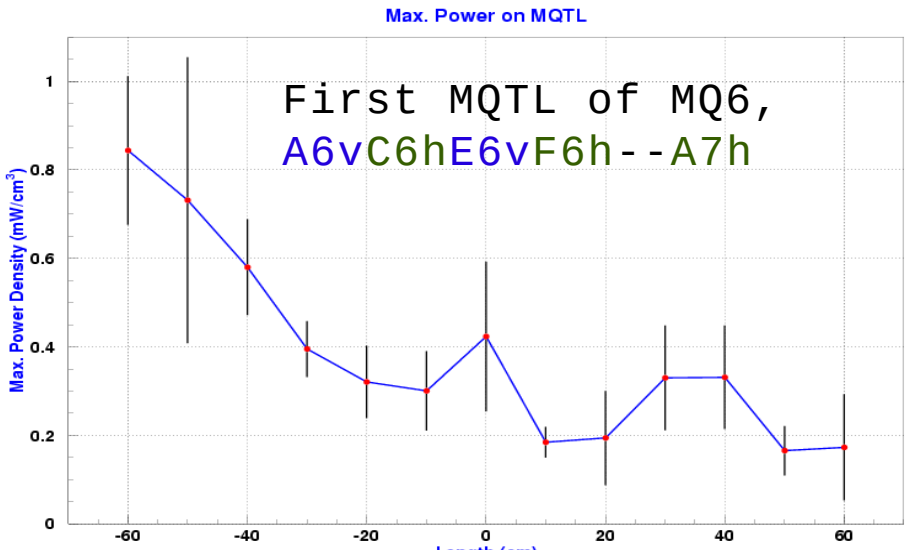
2 candidate absorbers in straight section
At least 1 needed.

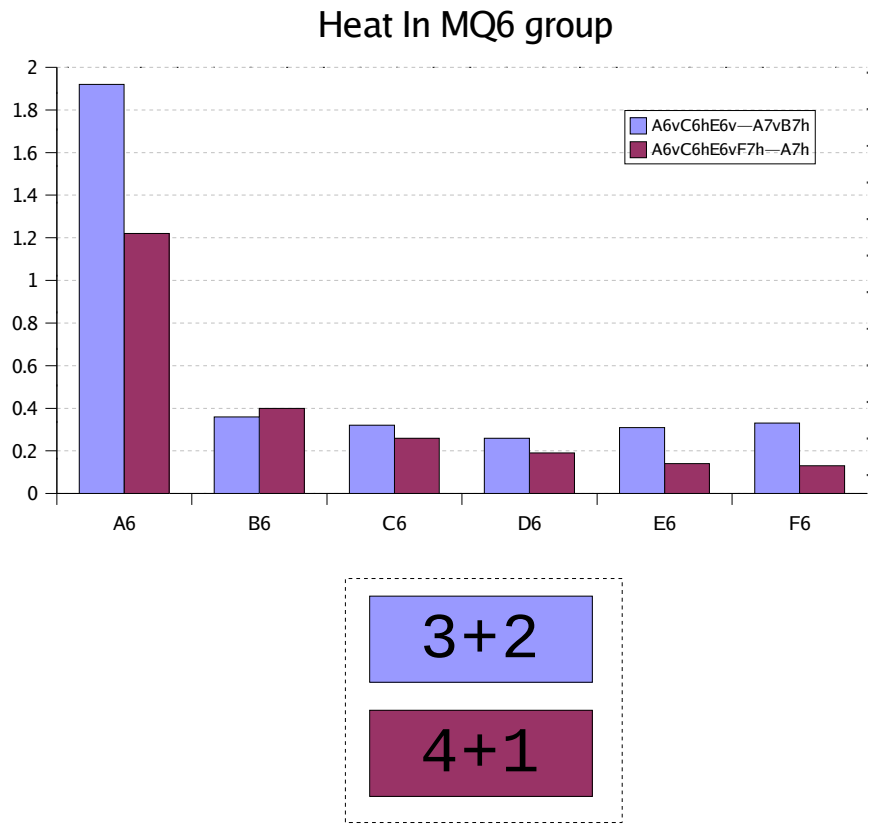
Straight section. MQ6 (MQTLHA6R).

ABSORBERS				Sim [Million p]	MQTLHA6R Peak (mW/cm3)	MQTLHA6R Coil (W)
A6v	C6h	-	-	3	5.45 (52%)	0.74 (25%)
A6v	C6h	E6v	-	20	2.15 (24%)	0.61 (6.7%)
A6v	C6h	E6v	F6h	4	0.76 (20%)	0.35 (7%)

- Further optimization may be possible by adjusting the orientation of the absorbers.
- Tertiary halo not included.

Straight section.





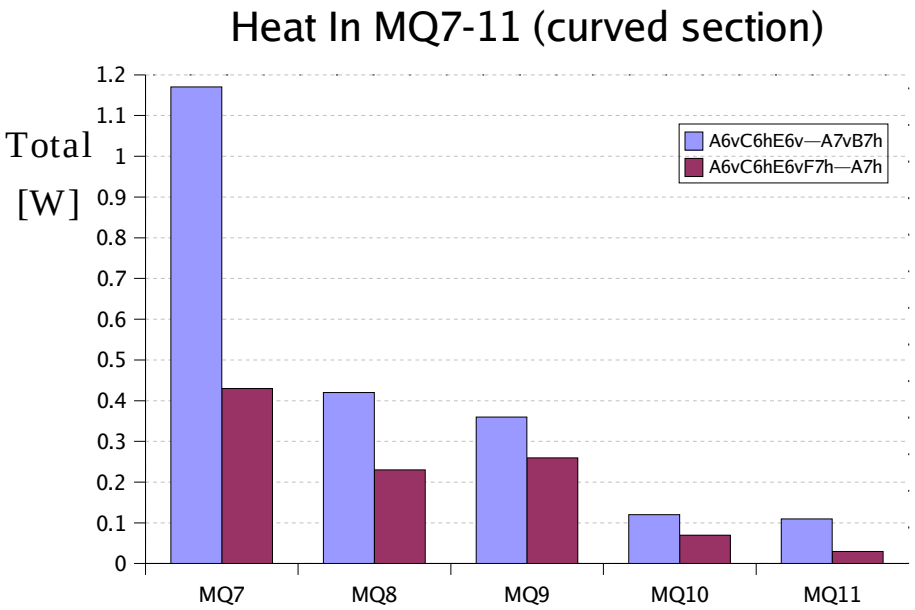
4+1: A6vC6hE6vF6h--A7h

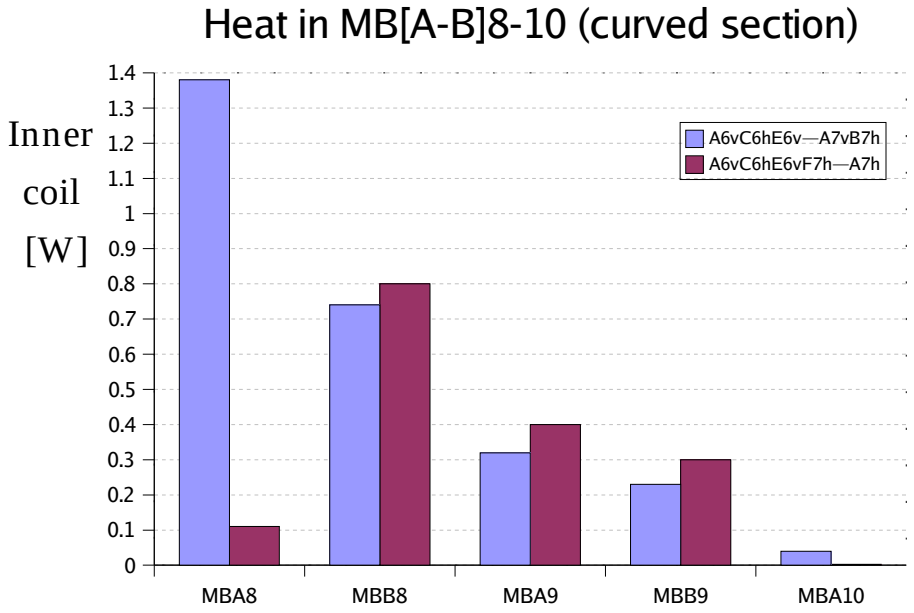
```
Number of simulations: 442
******* Straight Section *************
**    * MQTLHA6R ******************
      * max heat in coil:........     0.759 mW/cm3 (+- 19.9 %)
      * Total heat in the coil:..     0.35  W      (+- 7.00 %)
      * heat in MQ:..............     1.22  W      (+- 4.10 %)
**    * MQ6 group *****************
   MQTLHA6R      1.22 (+-  4.10 %) W
   MQTLHB6R      0.40 (+-  5.37 %) W
   MQTLHC6R      0.26 (+-  6.13 %) W
   MQTLHD6R      0.19 (+-  7.87 %) W
   MQTLHE6R      0.14 (+-  9.74 %) W
   MQTLHF6R      0.13 (+-  9.93 %) W
  ------------------------------------
      TOTAL      2.07 (+-  2.83 %) W
******* Curved Section ***************
Total energy in coils and magnets of MQ[7-11]R.
   MQ7    | max: 0.286 (+-99.0%) | 1.796e-01  +- 30% |  Total: 0.433 W   +- 18.0 %
   MQ8    | max: 0.699 (+-82.8%) | 1.193e-01  +- 47% |  Total: 0.227 W   +- 26.4 %
   MQ9    | max: 0.245 (+-65.5%) | 1.474e-01  +- 55% |  Total: 0.264 W   +- 33.2 %
   MQ10   | max: 0.132 (+-99.0%) | 3.124e-02  +-100% |  Total: 0.074 W   +- 46.5 %
   MQ11   | max: 0.284 (+-99.0%) | 1.566e-02  +-100% |  Total: 0.034 W   +- 49.2 %
Total energy in coils and magnets of MB[A-B][8-11]R.
   MBA8R  | 1:inner_coil   1.120e-01  +- 30% | 1:outer_coil  5.637e-02  +- 28% | max: 0.143 (+-98.2%) |
   MBB8R  | 2:inner_coil   8.321e-01  +- 17% | 2:outer_coil  4.208e-01  +- 17% | max: 0.400 (+-85.5%) |
   MBA9R  | 3:inner_coil   3.937e-01  +- 24% | 3:outer_coil  2.060e-01  +- 24% |
   MBB9R  | 4:inner_coil   3.069e-01  +- 30% | 4:outer_coil  1.721e-01  +- 29% |
   MBA10R | 5:inner_coil   3.439e-03  +- 58% | 5:outer_coil  1.343e-03  +- 59% |
   MBB10R | 6:inner_coil   2.132e-04  +- 69% | 6:outer_coil  4.892e-05  +- 69% |
   MBA11R | 7:inner_coil   2.003e-01  +- 37% | 7:outer_coil  1.135e-01  +- 36% |
   MBB11R | 8:inner_coil   1.085e-01  +- 42% | 8:outer_coil  6.023e-02  +- 42% |
```

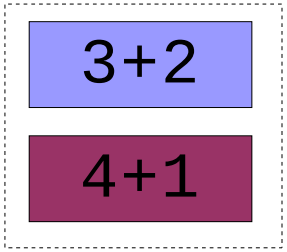
3+2: A6vC6hE6v--A7vB7h

```
Number of simulations: 279
******* Straight Section *************
**    * MQTLHA6R ******************
      * max heat in coil:........     1.654 mW/cm3 (+-   28.9 %)
      * Total heat in the coil:..     0.56  W      (+-  11.00 %)
      * heat in MQ:..............     1.92  W      (+-   5.56 %)
**    * MQ6 group *****************
   MQTLHA6R      1.92 (+-     5.56 %) W
   MQTLHB6R      0.36 (+-     6.83 %) W
   MQTLHC6R      0.32 (+-     9.84 %) W
   MQTLHD6R      0.26 (+-     9.67 %) W
   MQTLHE6R      0.31 (+-    13.33 %) W
   MQTLHF6R      0.33 (+-    14.57 %) W
  -----------------------------------
      TOTAL      2.86 (+-     4.08 %) W
******* Curved Section ***************
Total energy in coils and magnets of MQ[7-11]R.
   MQ7    | max: 0.591 (+-52.2%) |  4.939e-01  +- 14% |  Total: 1.177 W   +- 8.44 %
   MQ8    | max: 0.433 (+-99.0%) |  2.522e-01  +- 50% |  Total: 0.418 W   +- 32.2 %
   MQ9    | max: 0.508 (+-90.2%) |  2.117e-01  +- 45% |  Total: 0.395 W   +- 26.5 %
   MQ10   | max: 0.357 (+-98.2%) |  6.399e-02  +- 99% |  Total: 0.119 W   +- 58.5 %
   MQ11   | max: 0.171 (+-99.0%) |  5.450e-02  +- 87% |  Total: 0.107 W   +- 48.6 %
Total energy in coils and magnets of MB[A-B][8-11]R.
   MBA8R  | 1:inner_coil  1.383e+00  +- 13% | 1:outer_coil  5.712e-01  +- 13% | max: 1.808 (+-27.3%) |
   MBB8R  | 2:inner_coil  4.736e-01  +- 23% | 2:outer_coil  2.207e-01  +- 22% | max: 0.526 (+-67.4%) |
   MBA9R  | 3:inner_coil  3.154e-01  +- 36% | 3:outer_coil  1.586e-01  +- 36% |
   MBB9R  | 4:inner_coil  2.294e-01  +- 36% | 4:outer_coil  1.178e-01  +- 37% |
   MBA10R | 5:inner_coil  3.755e-02  +- 70% | 5:outer_coil  1.577e-02  +- 62% |
   MBB10R | 6:inner_coil  6.763e-03  +- 98% | 6:outer_coil  8.199e-03  +- 98% |
   MBA11R | 7:inner_coil  2.288e-01  +- 42% | 7:outer_coil  1.159e-01  +- 42% |
   MBB11R | 8:inner_coil  2.423e-01  +- 42% | 8:outer_coil  1.297e-01  +- 43% |
```

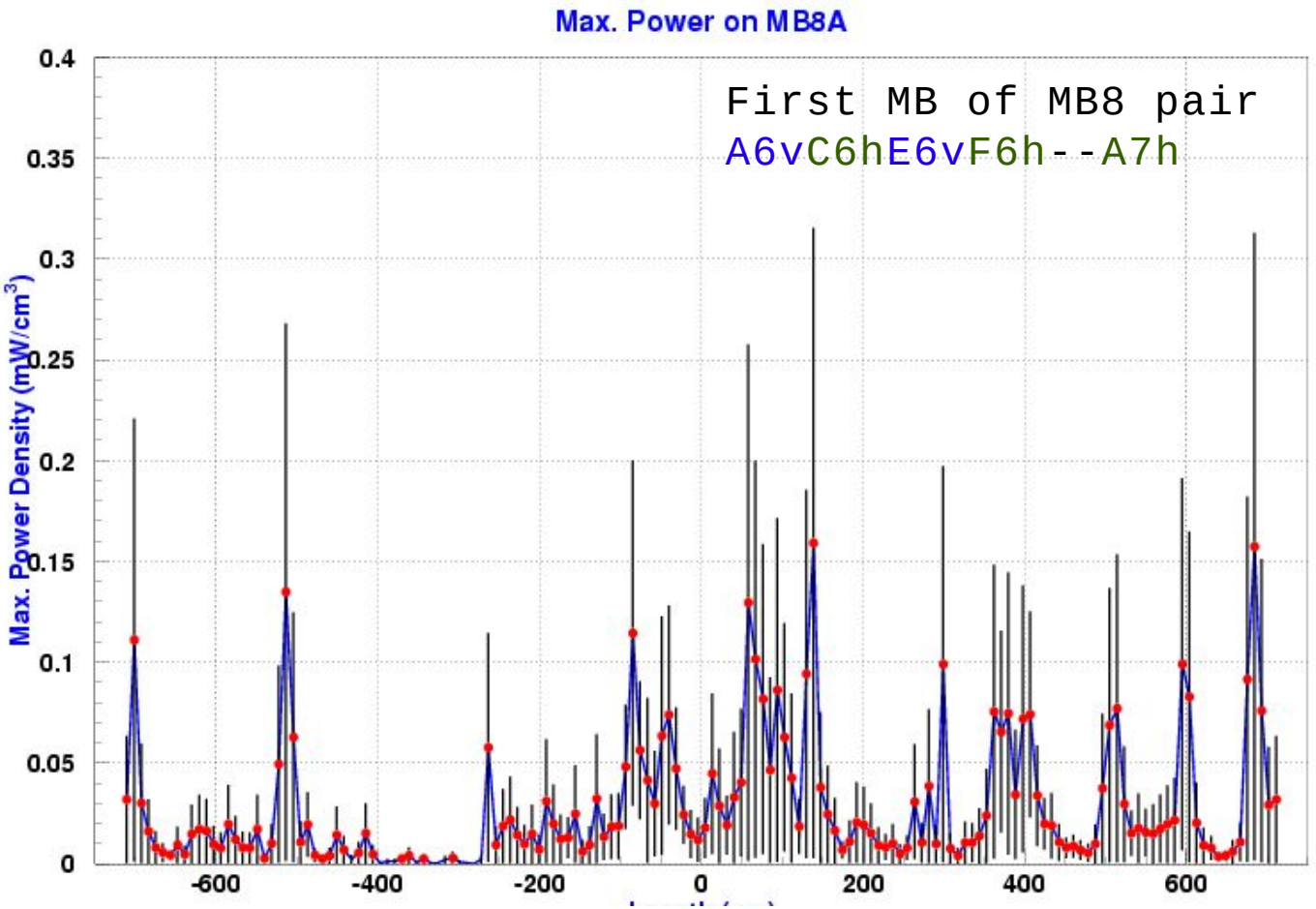
Curved section. MQ's and MB's







Heat spikes in MB's



Conclusions

A systematic study has been carried out for many configurations.
Results, equivalent to a 2.8GHz CPU processor working continuously for *5 years* have been analyzed and understood.
These are the conclusions:

- The lowest doses is found for the case of 4+1 absorbers (A6vC6hE6vF6h--A7h), both for the MQTLH and for the elements in the curved section. 3+2 looks less effective.
- The use of a fourth (F6h) absorber in the straight section reduces the dose in the MQTLH by a factor 2.
- The most compromised element is the MQTLHA6R, where the simulated peak density 0.87 (+- 20 %) mW/cm3 is close to some suggested quench limits (1 mW/cm3).
- Once the positions frozen, further minimization may be obtained by turning the absorbers.
- Further study will include the contribution from the tertiary halo.