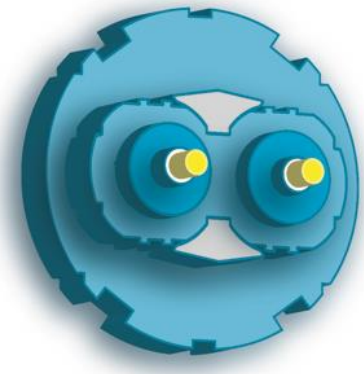


High Luminosity LHC

Powering aspects for discussion

G. Arduini, A. Ballarino, J-P. Burnet, R. De Maria,
S. Fartoukh, M. Fitterer, M. Giovannozzi, E. Todesco.

The HiLumi LHC Design Study is included in the High Luminosity LHC project and is partly funded by the European Commission within the Framework Programme 7 Capacities Specific Programme, Grant Agreement 284404.

Open questions

- Choice of triplet powering scheme:
  - Impact on ripple on largest tune spread scenario (new simulations)
  - Impact on slow ripple effects (input needed)
- Choice of triplet power converter:
  - Expected triplet discharge time (to be compared with MQ) during ramp down or pre-cycle.
- Choice of the MQYY power converter:
  - Expected Q4 discharge time during the squeeze
- Replace Q5 power converter in IR1 and IR5:
  - Expected Q5 discharge time during the squeeze

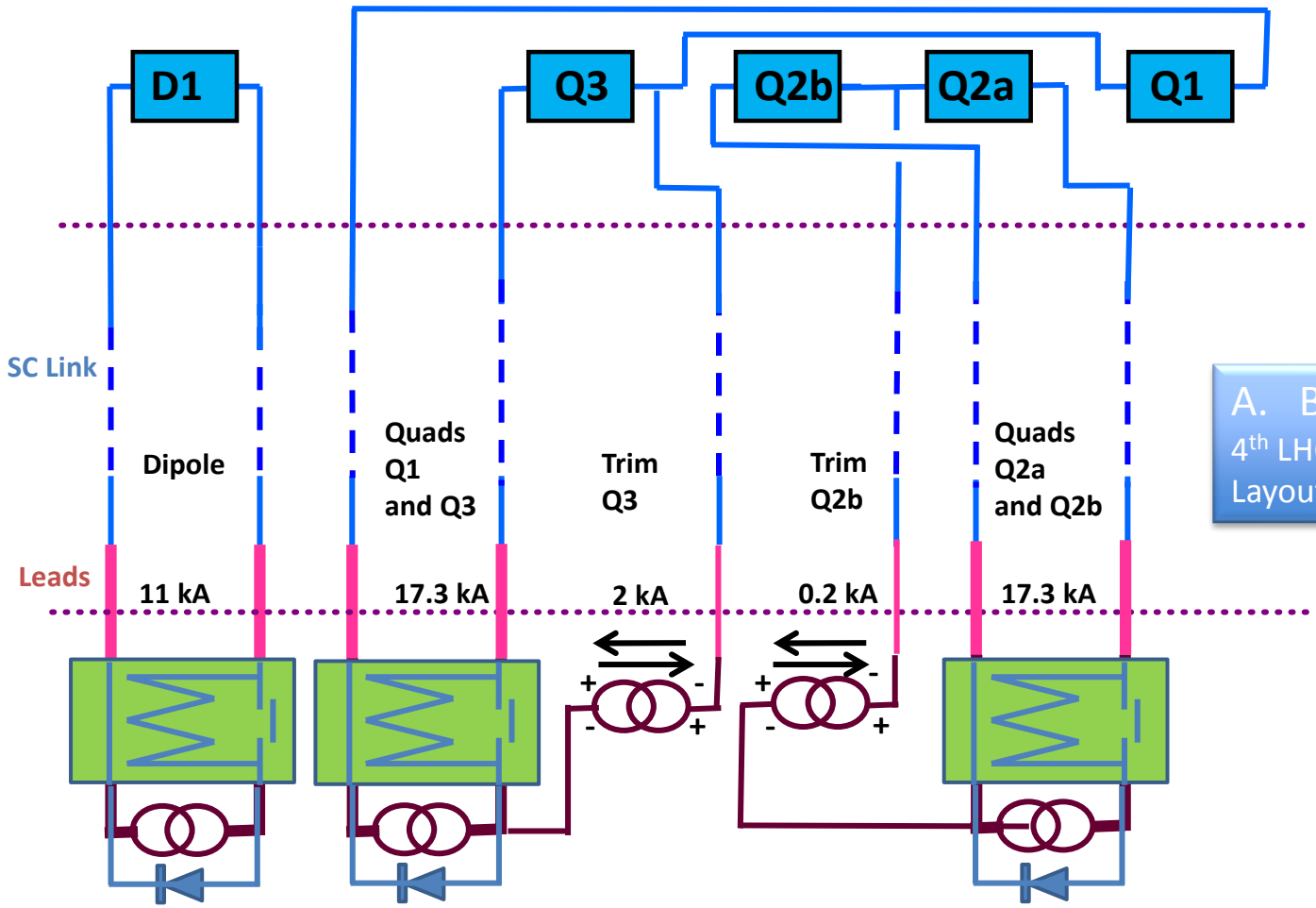
Ramp rate limitations

In order to evaluate the impact of ramp rates:

- WP2 provides gradients;
- WP3 provides currents, inductance, QPS limitations;
- EPC group computes maximum ramp rates as function of the current and total discharge time from nominal current by including in addition resistance, operating voltage and other PC limitations;
- OP compares the circuits and determines which circuit limits the minimum duration of the squeeze and the pre-cycle.

Proposed powering scheme

Proposed powering scheme HL-LHC (Baseline):

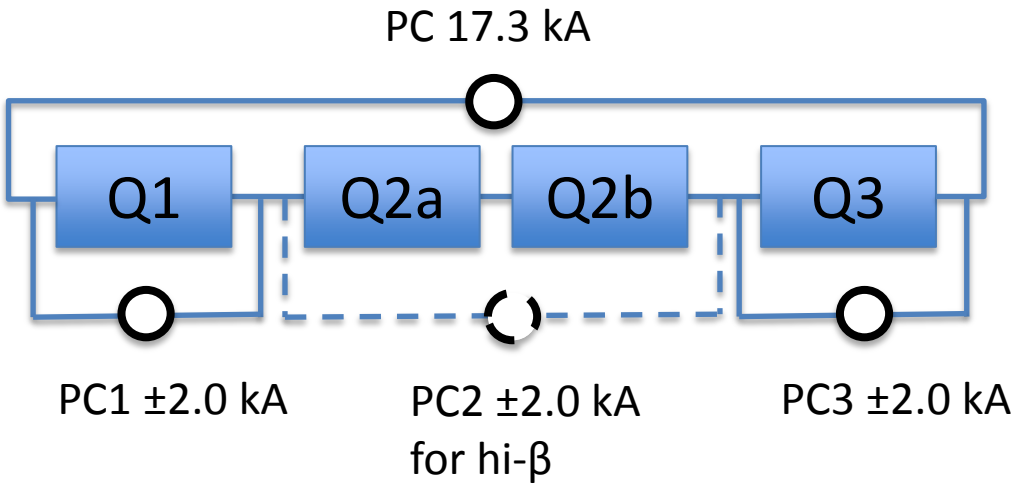


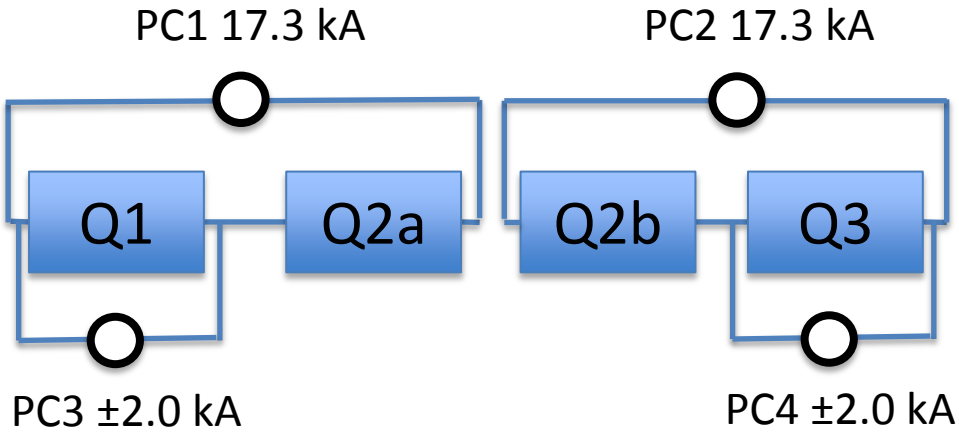
A. Ballarino,
4th LHC Parameter and Layout Committee

Alternative Powering Schemes

All in series (Q1-Q2-Q3):

Concerns for magnet protection, complexity of nested circuits.
(see A. Ballarino, 4th PLC)

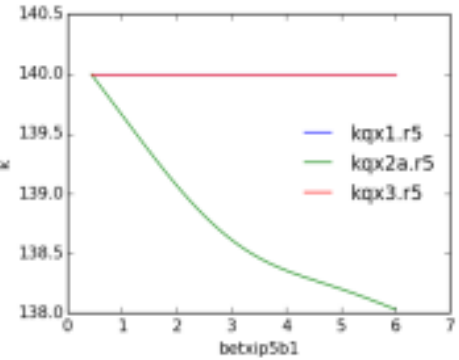


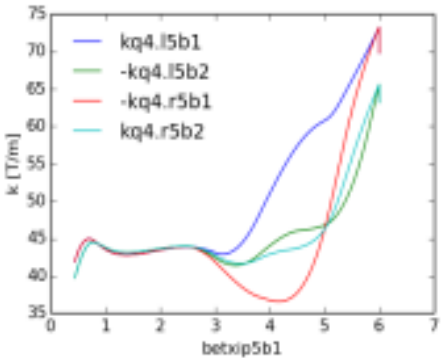


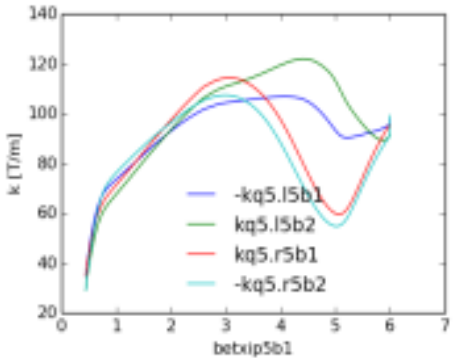
S. Fartoukh
M. Fitterer

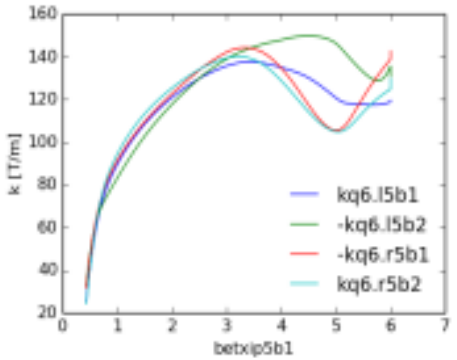
Squeeze HLLHCV1.0 (table here)

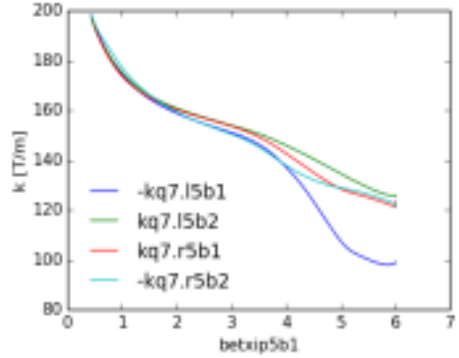
M. Korestelev

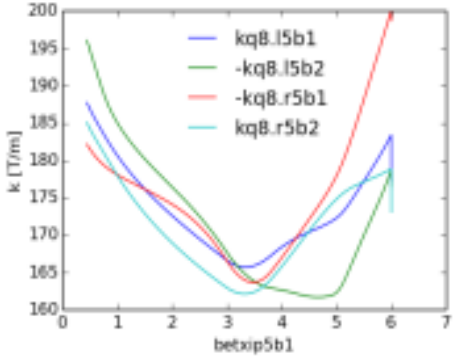


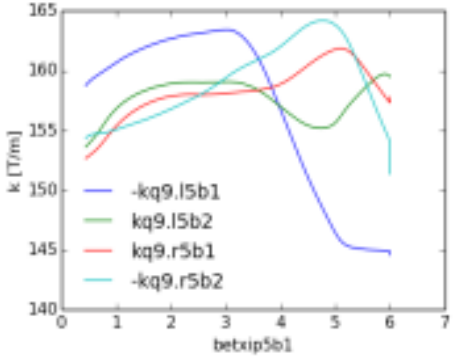


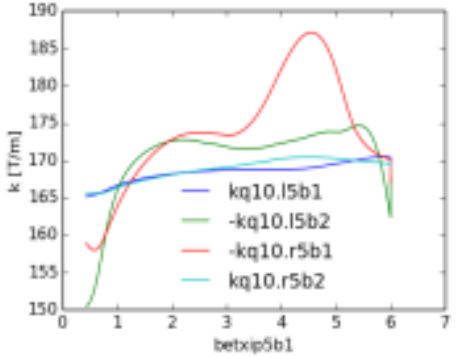


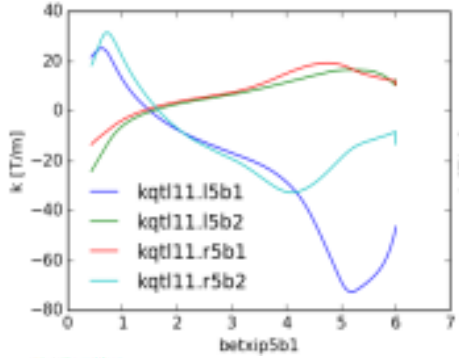


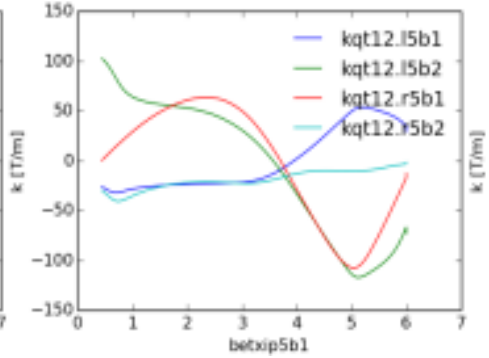


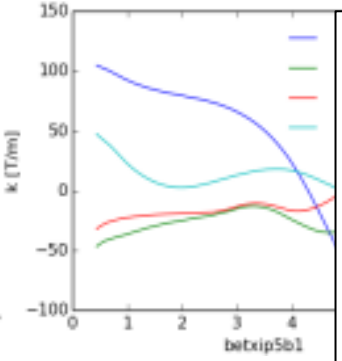






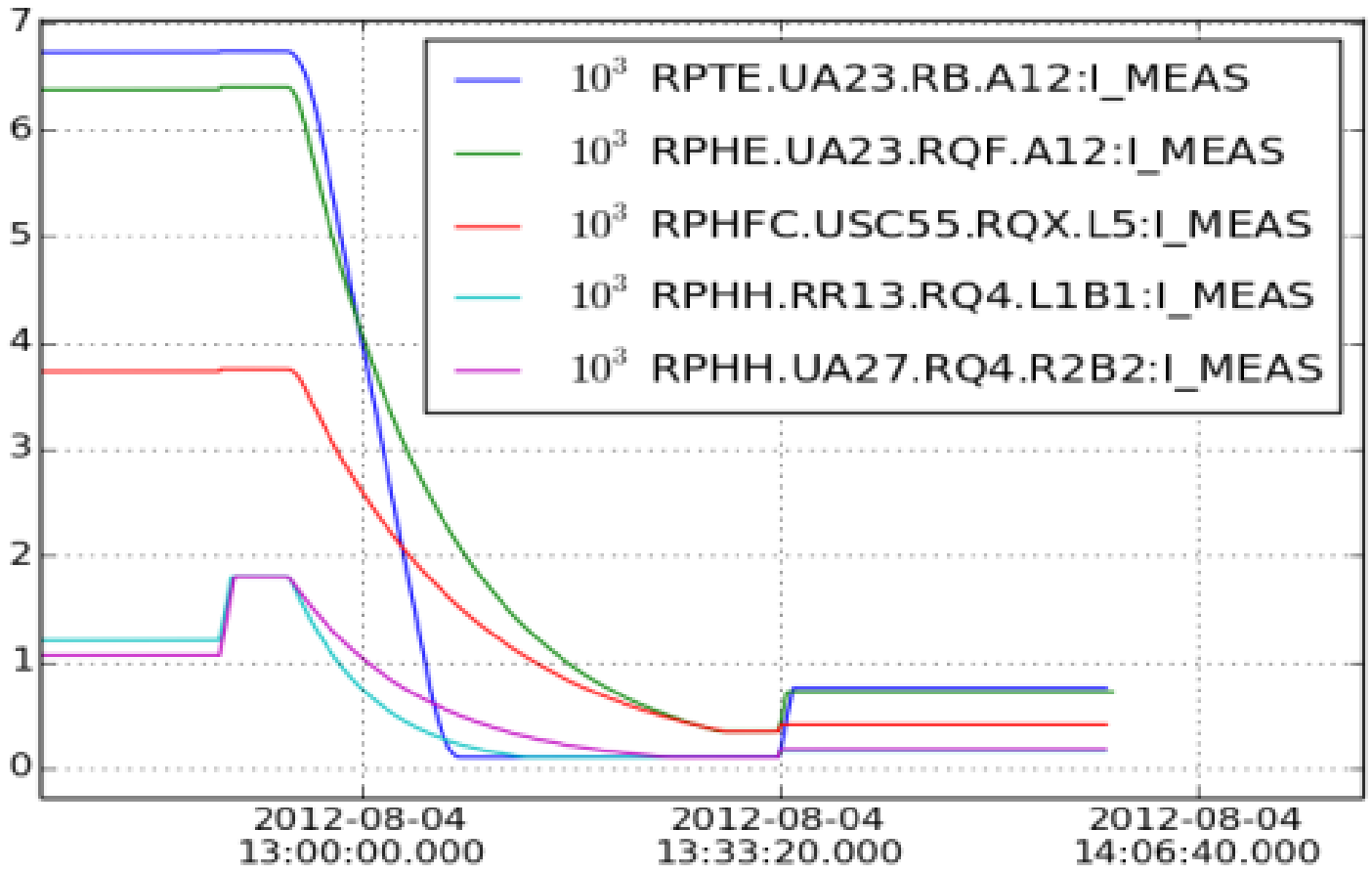






Discharge of Q4 first and Q5 later should be the one limiting the squeeze duration. Close to worst case scenario, different squeeze strategies in preparation for HLLHCV1.1.

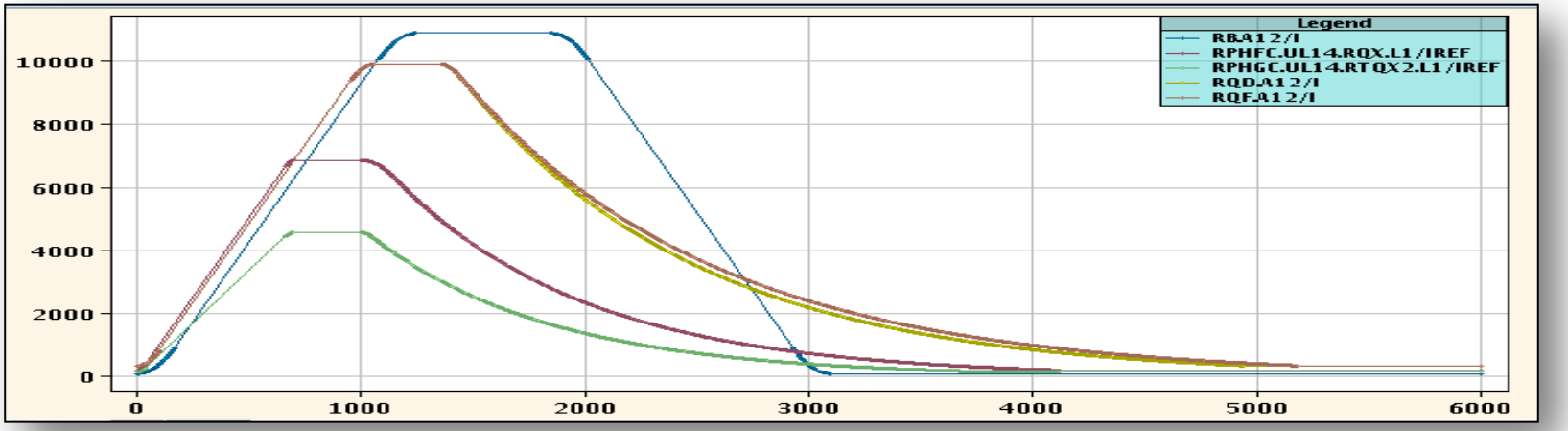
MB, MQ, Q4, triplet rampdown Run I



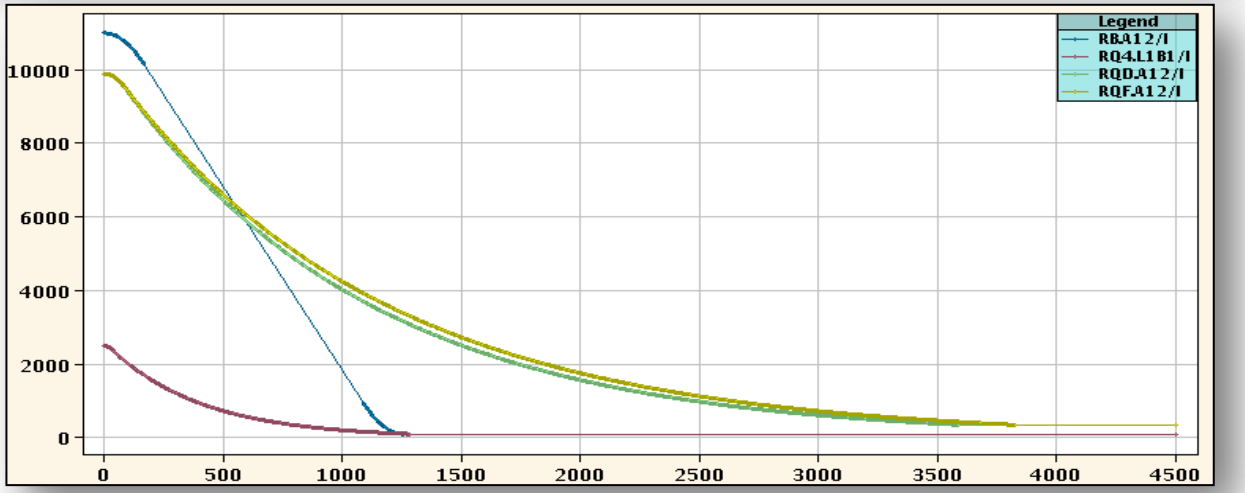
Triplets (RQX and RTQX2) and MQ limits rampdown duration, followed by the slowest Q4s.

Backup

Pre-cycle and Rampdown at 6.5 TeV



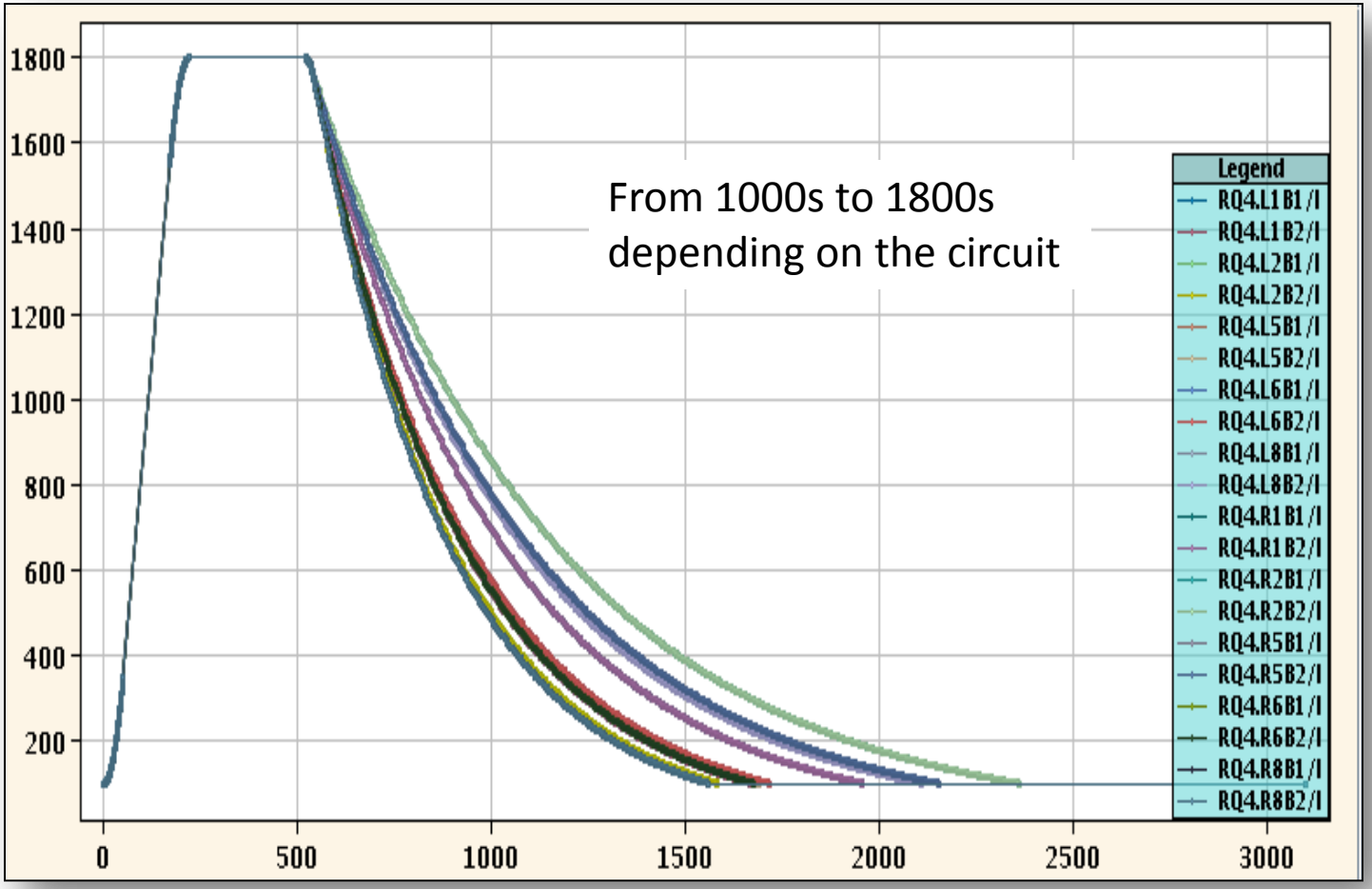
MQ discharge (~3900 s) dominates at 6.5 TeV
Followed by:
Triplets (~4100 s)
2x MQY (? s)
1x MQY (1300 s)



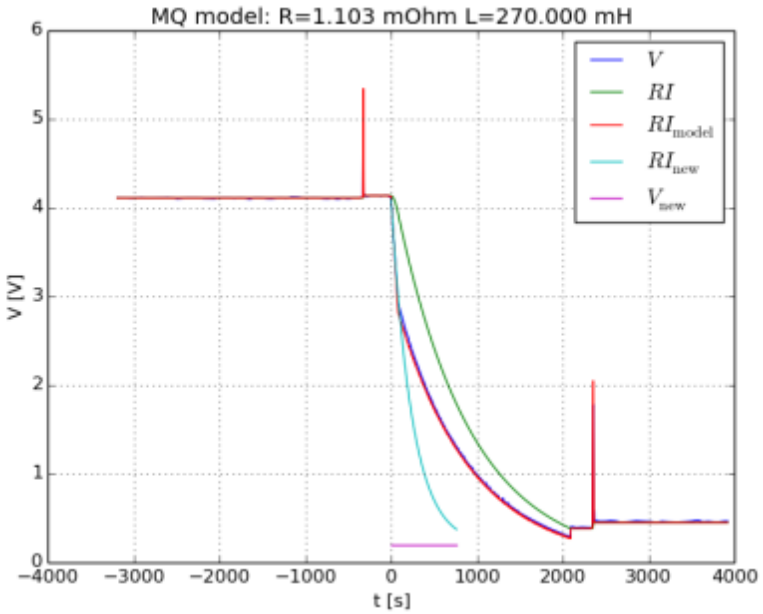
M. Solfaroli, Chamonix '14

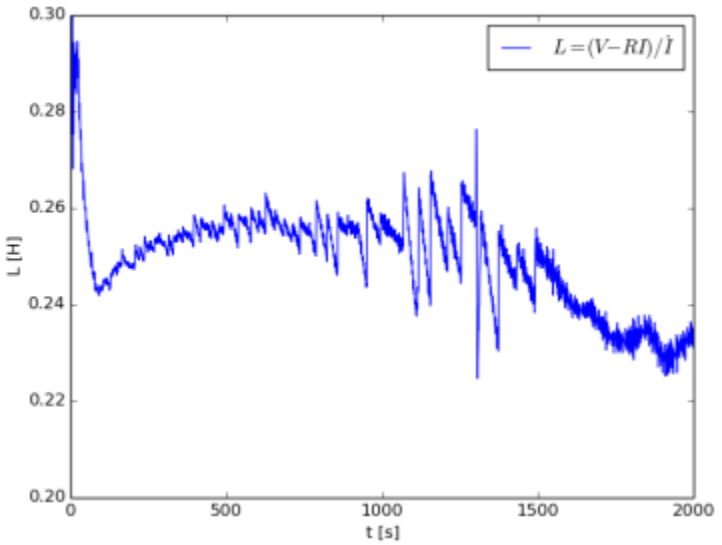
Precycle 4.0 TeV: Q4s

M. Solfaroli,
Chamonix '14



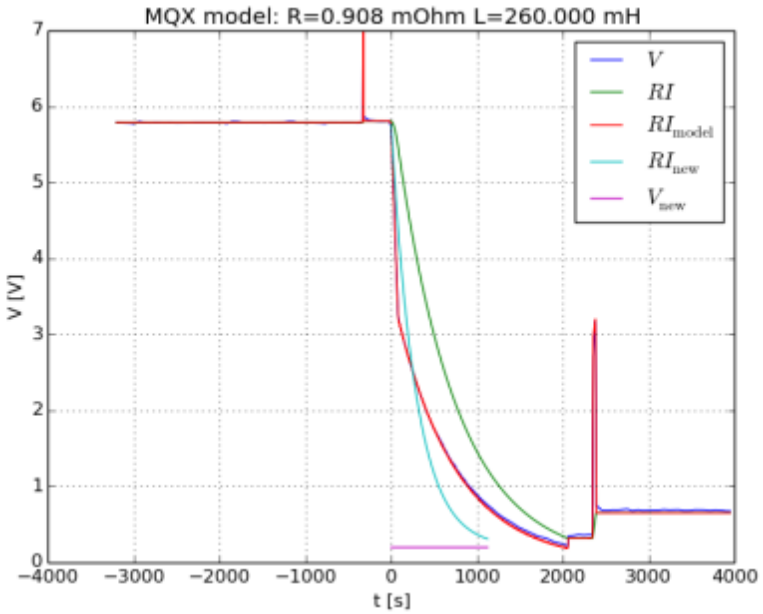
MQ rampdown measurements

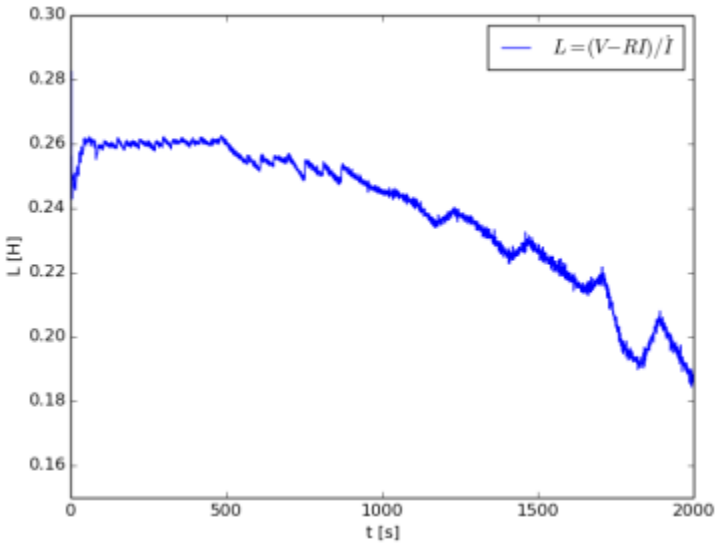




Ciruit discharge time constant= 245 s

Triplet rampdown measurements





Circuit discharge time constant= 288 s