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Two pulses tests with a single LTD cavity *

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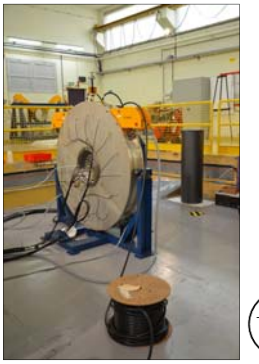
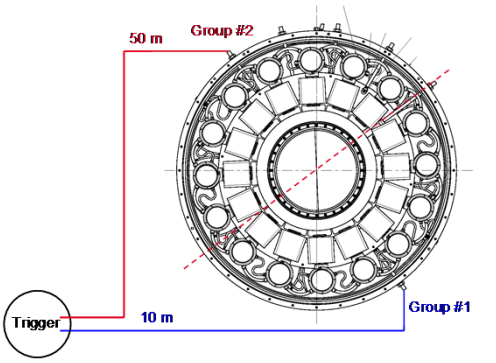
Abstract

A two pulses driver could be interesting for flash X-ray radiography or other applications. A LTD generator can potentially work in dual pulse mode in which two pulses are produced if the bricks of each cavity are triggered in two separate groups. We present here the first two pulses tests done with one single cavity. Two pulses within a delay of 246 ns were obtained at full voltage on a resistive load (1.1 Ω). The second pulse (70 kV) exhibits reduced amplitude in comparison to the first one (100 kV). This behavior results from a resonance effect between the two groups of bricks. A solution is also proposed to mitigate the effect and to balance out the two voltage pulses.

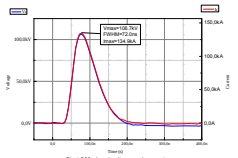


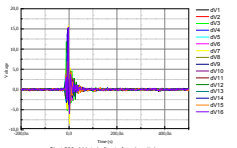


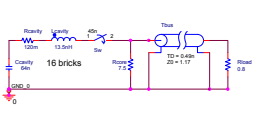
Experimental device : the trigger circuit of a LTD cavity has been separated in 2 circuits in order to trig separately two groups of 8 bricks

The 16 bricks of a LTD cavity ([1], [2]) has been trigged in two separate groups in order to produce 2 pulses on a resistive load.
The delay between the 2 pulses is due to the difference of length of the 2 trigger cables (10 and 50 m).
Vdots in front of each switch are used to monitor the timing of the bricks firing.

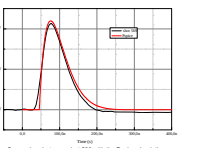
Shot 569 : the two groups have been trigged at the same time (identical length of trigger cable)


Shot 569 : Load voltage and current


Shot 569 : Vdots in front of each switch

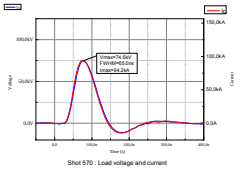


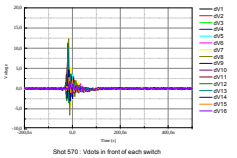
Pspice model of the LTD cavity

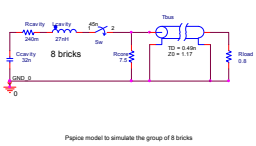

Comparison between shot 569 with the Pspice simulation

Shot 570 : only one group was trigged. The 2nd group didn't fire.

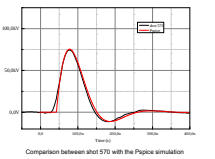
C/2, 2xL & 2xR


Shot 570 : Load voltage and current

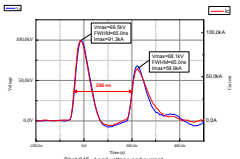

Shot 570 : Vdots in front of each switch

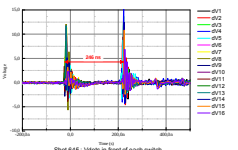


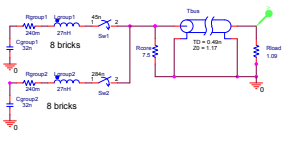
Pspice model to simulate the group of 8 bricks


Comparison between shot 570 with the Pspice simulation

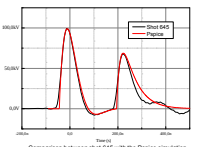
Shot 645 : the two groups have been trigged at different time. Two pulses were produced within a delay of 246 ns. The 2nd pulse (70 kV) is lower than the first one (100 kV) due to a resonance effect between the two groups.

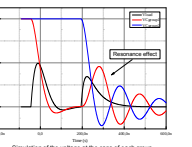

Shot 645 : Load voltage and current


Shot 645 : Vdots in front of each switch



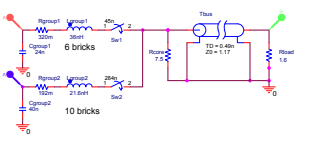
Pspice model to simulate the two pulses test


Comparison between shot 645 with the Pspice simulation

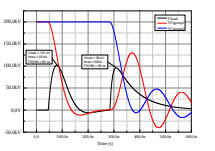


Simulation of the voltage at the caps of each group

To mitigate the resonance effect, the groups should be not identical. Simulations show that a good compromise could be a first group with 6 bricks and a second group with 10 bricks. In this case 2nd pulse (95 kV) is close to the first one (101 kV).



Pspice model to simulate tests with non identical groups


Simulation of two groups of respectively 6 and 10 bricks

Conclusion

It is possible to produce two high voltage pulses with a LTD cavity by splitting the trigger circuit in two groups of bricks. Complementary tests with a second trigger generator will allow to set up and increase the delay between the two pulses to more than 1 µs. Groups with different numbers of bricks will be tested as well in order to make the shapes of the 2 pulses as close as possible.

References

[1] A. A. Kim et al., "Super fast 75 ns LTD stage", Proceedings of the International Pulsed Power Conference, p 148-151, 2007.
[2] F. Bayol et al., "Development of a 1 MV ultra-fast LTD generator", Proceedings of the International Pulsed Power Conference, p 619-624, 2011.

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