



FREQUENCY AND BANDWIDTH AGILE PULSER FOR USE IN ELECTRICAL AND BIOLOGICAL EFFECTS TESTING

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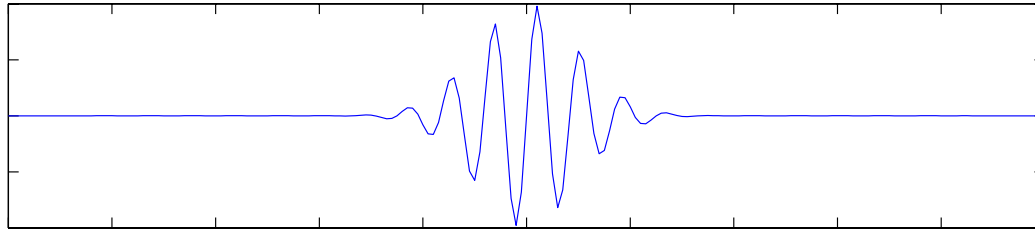
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Acknowledgements

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- Compact Portable Pulsed Power MURI (AFOSR)

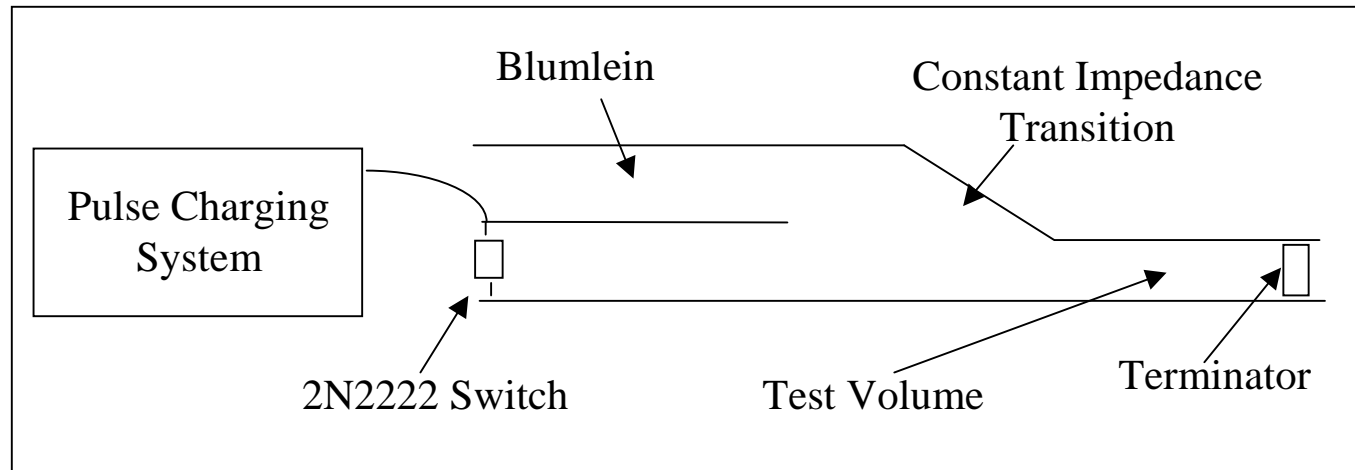


Motivation



- Increasing need for pulser systems to be used to characterize the interaction of *non-ionizing* transient (WB/UWB) electromagnetic fields with electrical/biological systems
- Most available devices can test a single parameter set, or at best, a small region of the parameter space
- We want a source (or set of sources) that can be tuned in amplitude, pulse width, center frequency, bandwidth, rise time, etc.

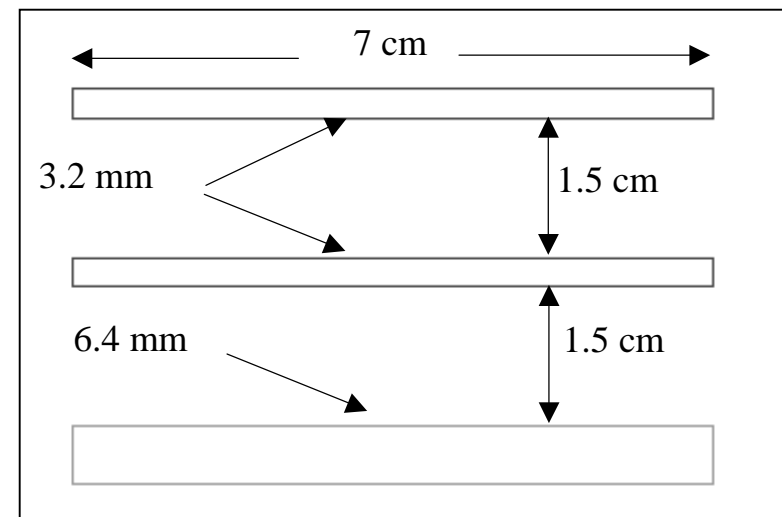
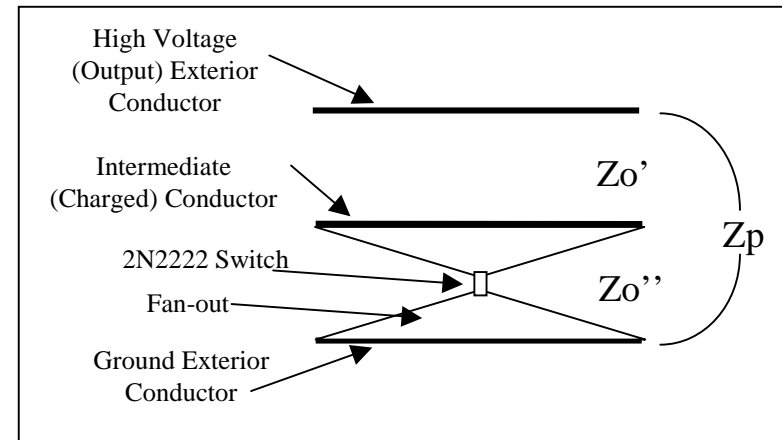
General Experimental Topology



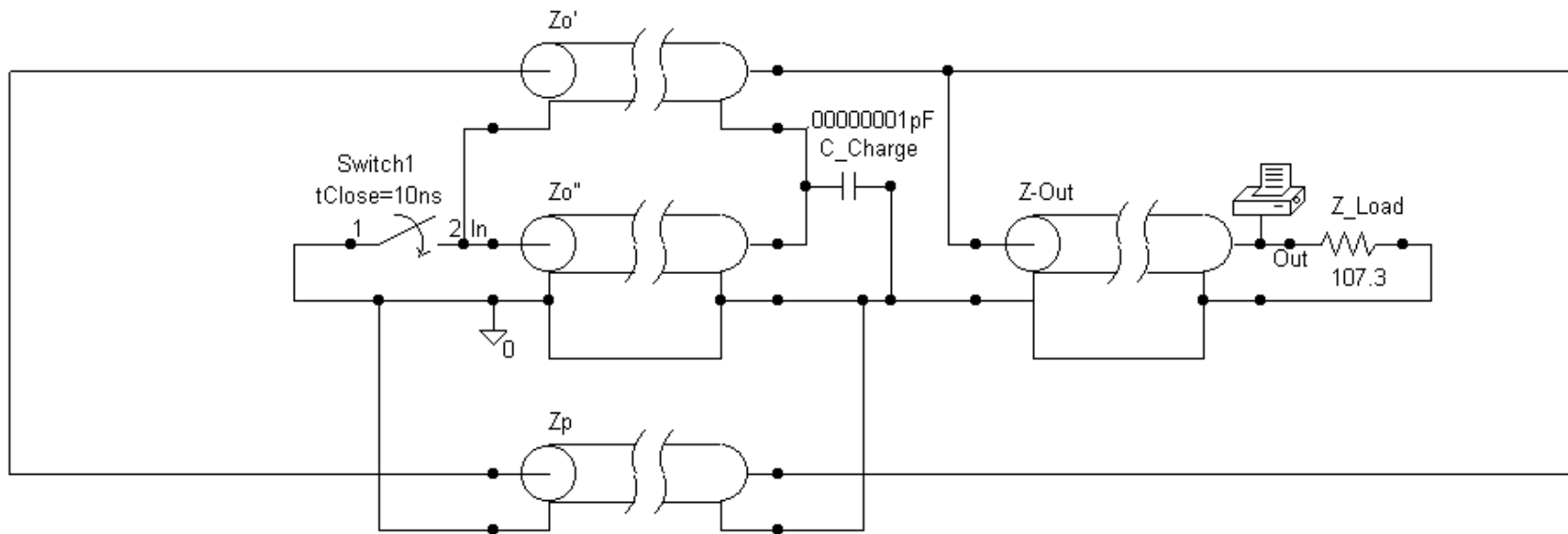
- Pulsed power system based on a 30 kV supply and a gas switch
- PFN composed of a parallel plate Blumlein
- Initial low-voltage tests performed with a 2N2222 triggered avalanche transistor

Blumlein PFN

- Parallel-Plate Blumlein to match to balanced test volume
- Charge in parallel, discharge in series
- Open configuration provides parasitics that must be considered in analysis
- Tunability realized by movement of the center conductor



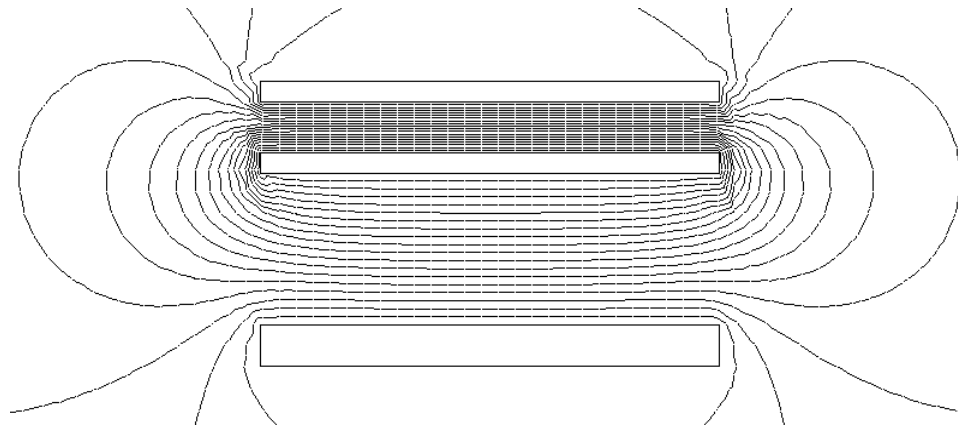
PSpice Circuit Model



- Compute impedances using Electro E-statics code for various configurations of the Blumlein
- Build a PSpice model for circuit/transmission line
- Predict output waveform for configurations

Blumlein Configurations Tested

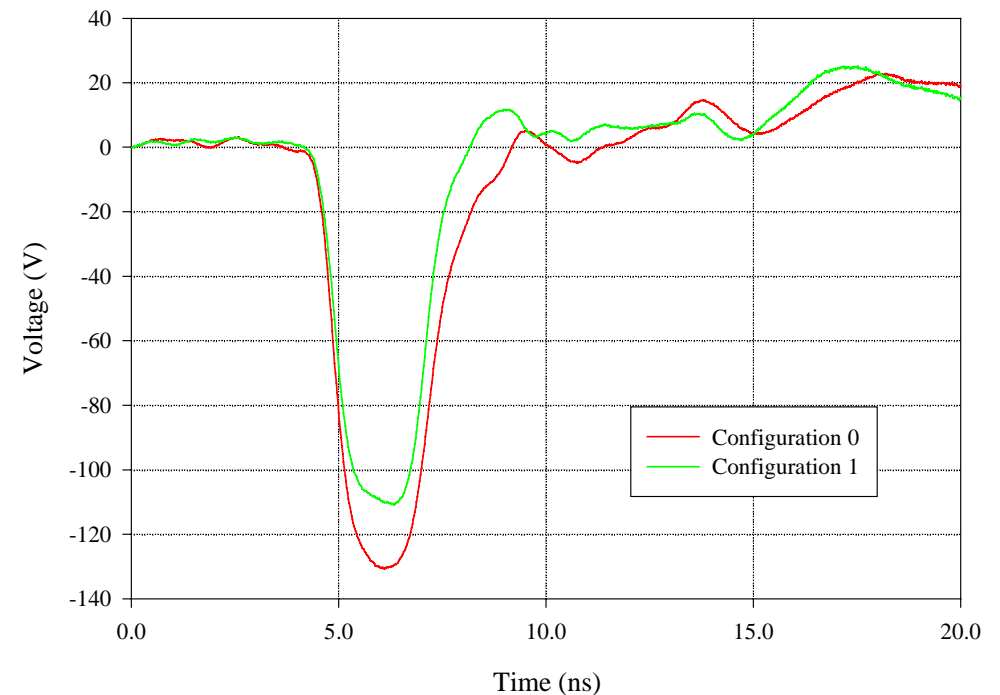
Configuration #	Center Electrode Width	Center Electrode Offset
0	21 cm	0 cm
1	7 cm	0 cm
2	7 cm	-3.8 mm
3	7 cm	-7.6 mm
4	7 cm	-12.4 mm
5	7 cm	+12.4 mm



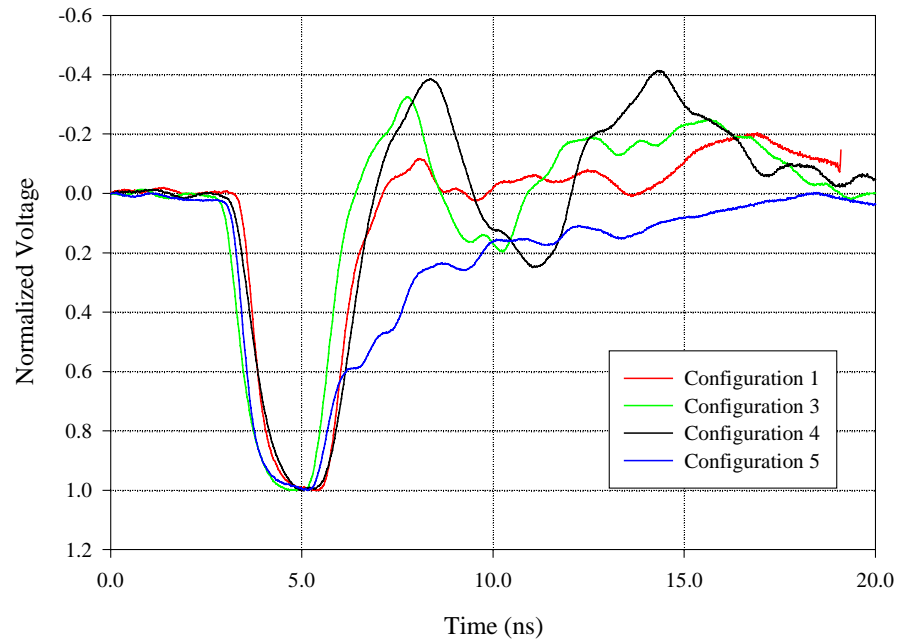
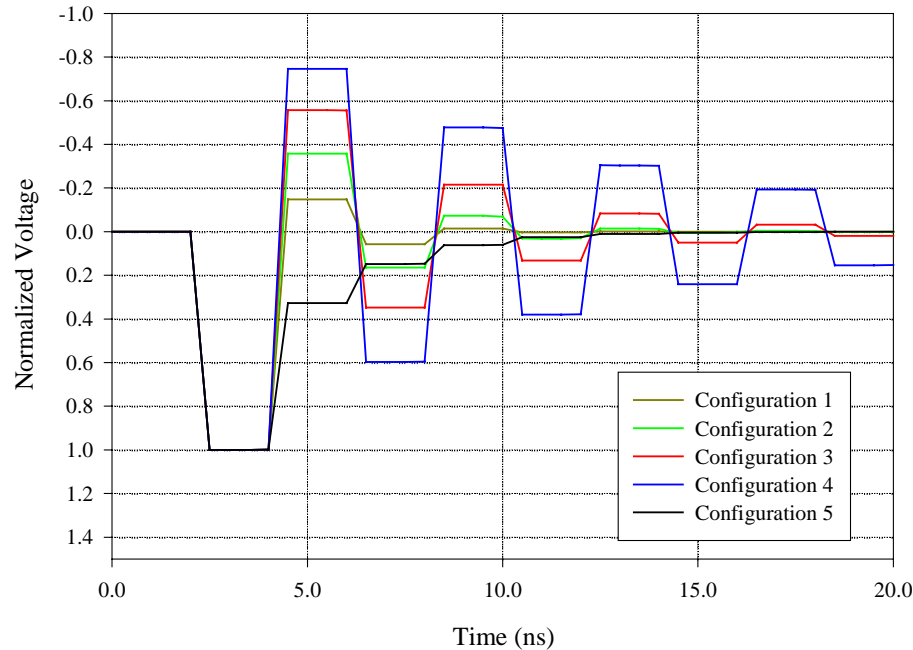
Equipotentials for configuration #5

Narrow –vs- Wide Center Plate

- Increasing the width of the center conductor increases the parasitic impedance between the top and bottom plates.
- Results in a higher output voltage with minimal rise time penalty

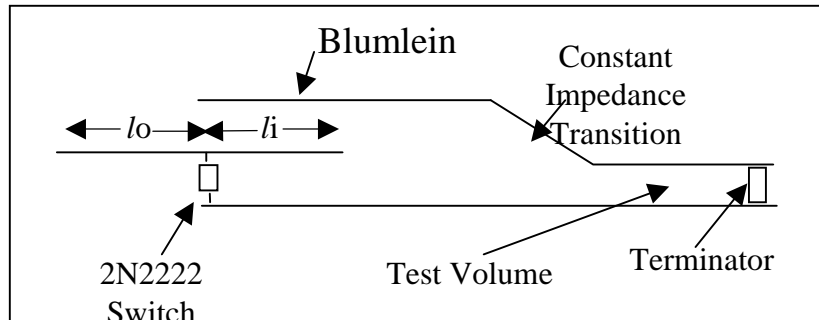


Bandwidth Tunability

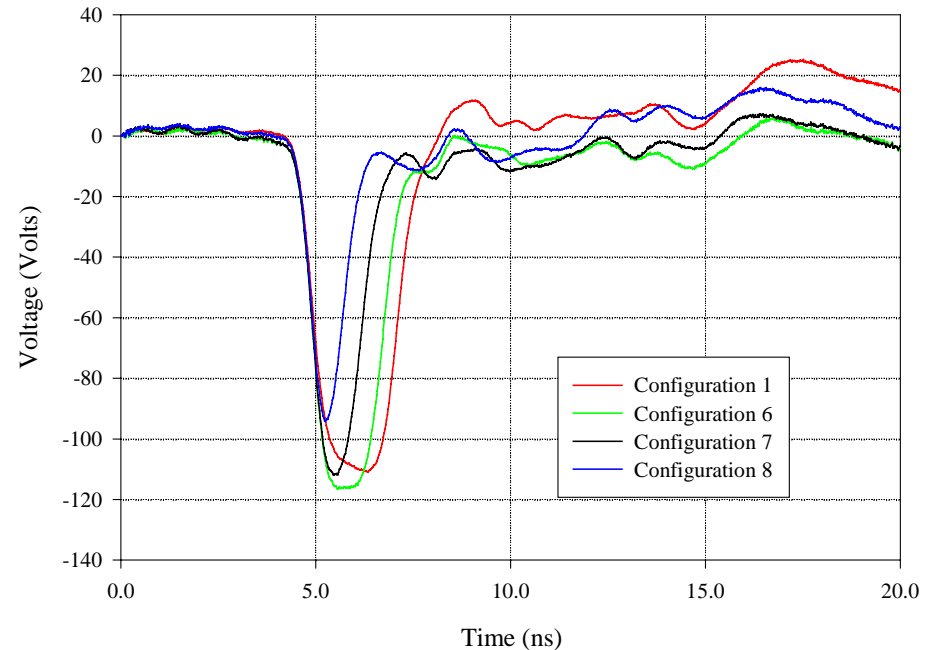


- Simulation predicts resonant performance as a function of imbalance. With center electrode moved upwards we get decay.
- Experiment shows “ringing” behavior for all configurations. Ringing increases as the imbalance increases.
- Decay (configuration 5) agrees well with the data.

Frequency (Pulse Width) Tunability



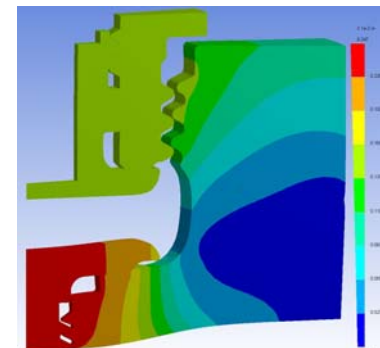
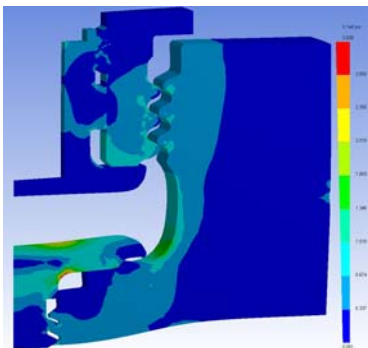
Config #	l_i (cm)	l_o (cm)
1	30.0	0.0
6	22.5	7.5
7	15.0	15.0
8	7.5	22.5



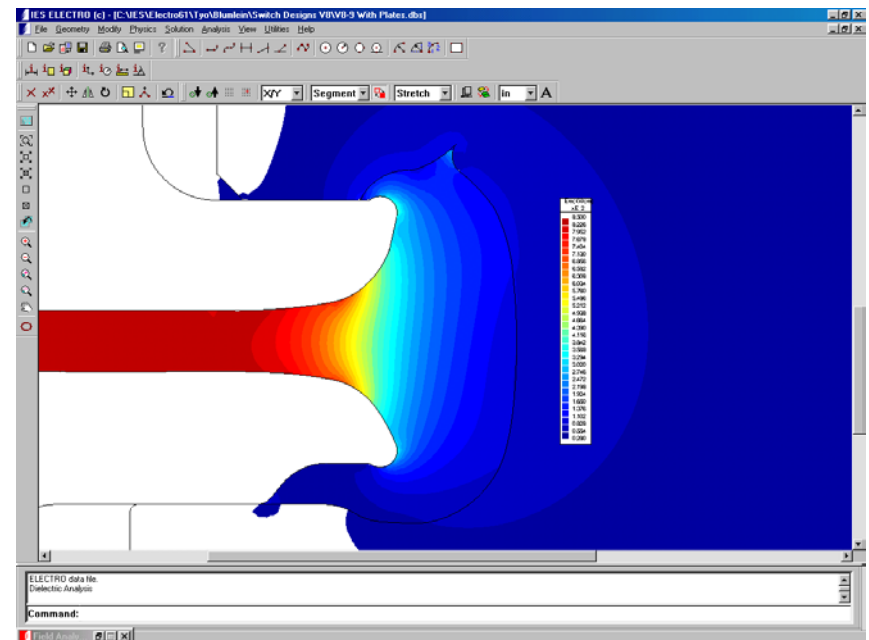
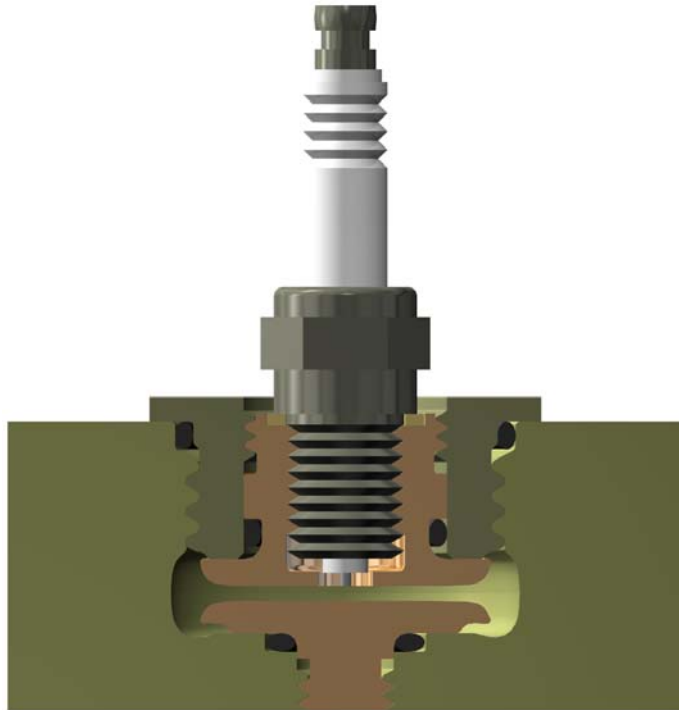
- Retracting the center conductor provides a narrowed pulse width
- No penalty in amplitude (except for rise time effects)
- Very similar late-time responses

Conclusions

- Parallel plate Blumlein structure is feasible for a tunable WB/UWB test fixture
- Fields ~ 30 kV/cm are readily attainable
- Good control over pulse width, also control over ringing/decaying waveform



Future Work



- Trigatron switch based on a miniature spark plug
- Pressurized Hydrogen for repetitive pulsing
- Challenge: Incorporate into a sliding contact for both vertical and horizontal displacement