



Compact Sealed Spark Gaps

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Objective

Investigate the practicality of a sealed spark gap switch that is smaller than commercially available spark gap switches.

Technology Impact

Enable long shelf life, compact pulsed power systems by removing the gas systems required for typical spark gap switches.

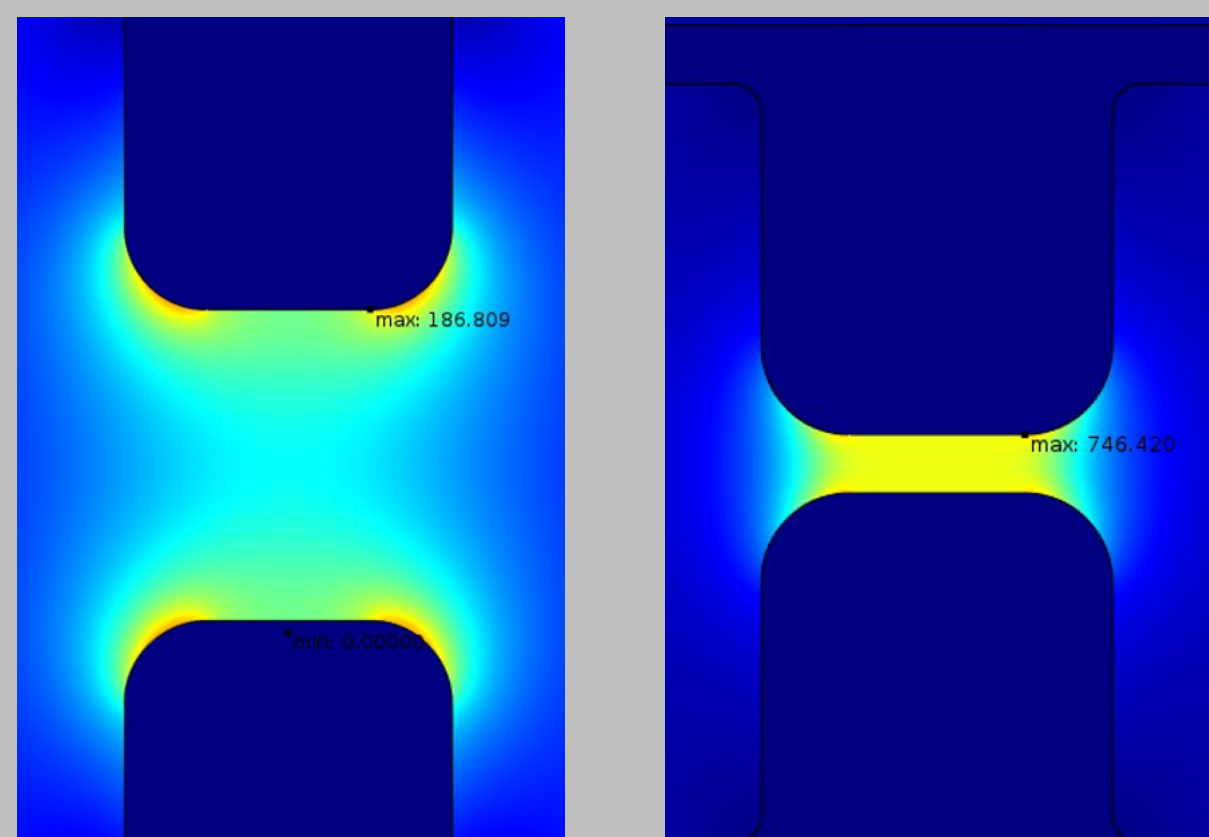
Technology Summary

- Hermetically sealed vacuum spark gap switches
- Trigger ring at the midplane
- Goal: operating at 100 kV, 20 kA with high (>1000) lifetime



2D Electrostatic COMSOL Simulation Results

- Electrode imperfections appear to be less impactful at shorter gap spacings.
- Larger gap spacing lead to higher self-break voltages but at lower electric fields.



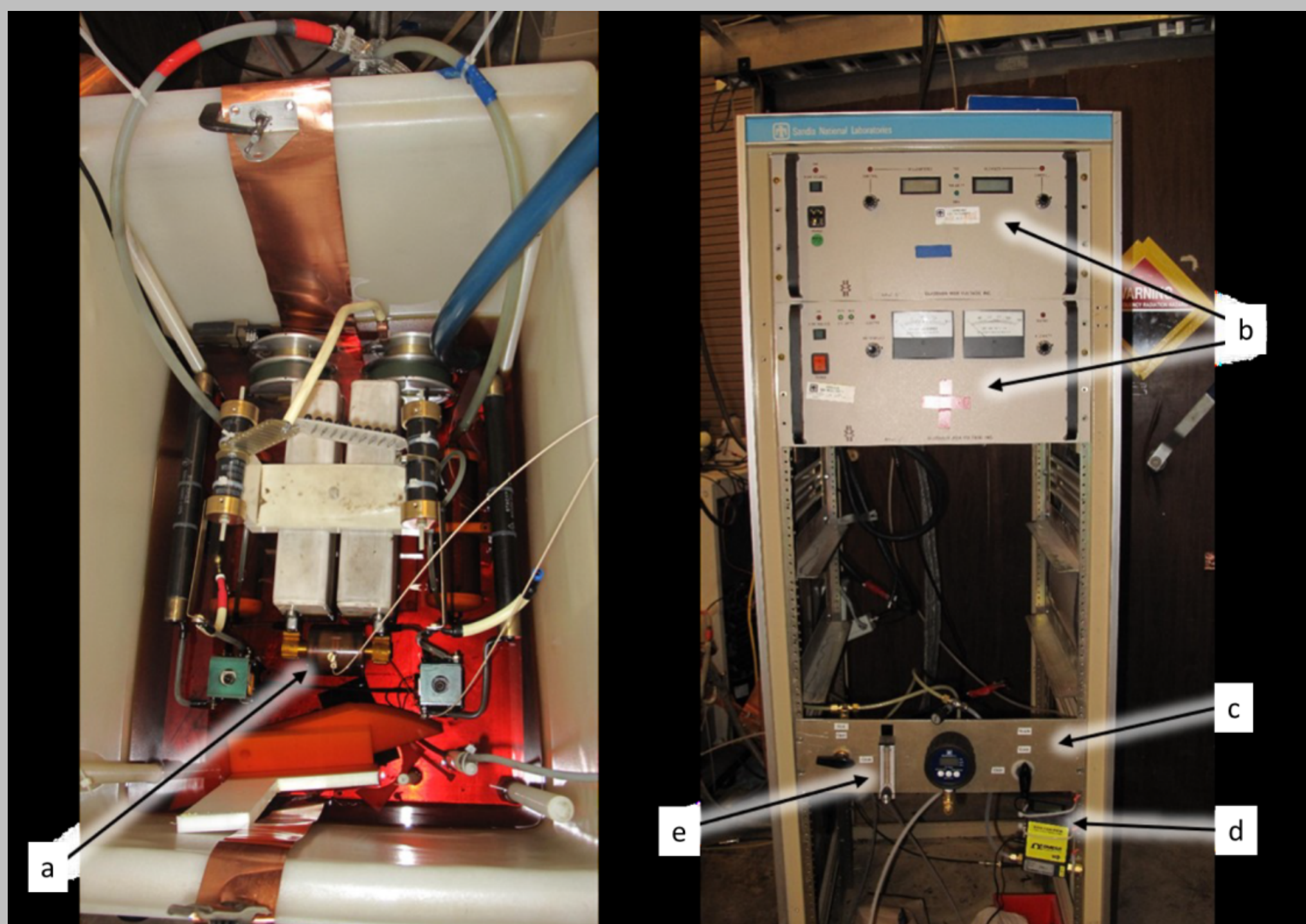
Simulation Type	Gap Spacing (in)	Max E (kV/cm)	E_av (kV/cm)	Enhancement
No Defect	0.1	426	394	1.08
Defect	0.1	747	394	1.90
No Defect	0.2	240	197	1.22
Defect	0.2	425	197	2.16

Comparison of Commercial Spark Gap Switches

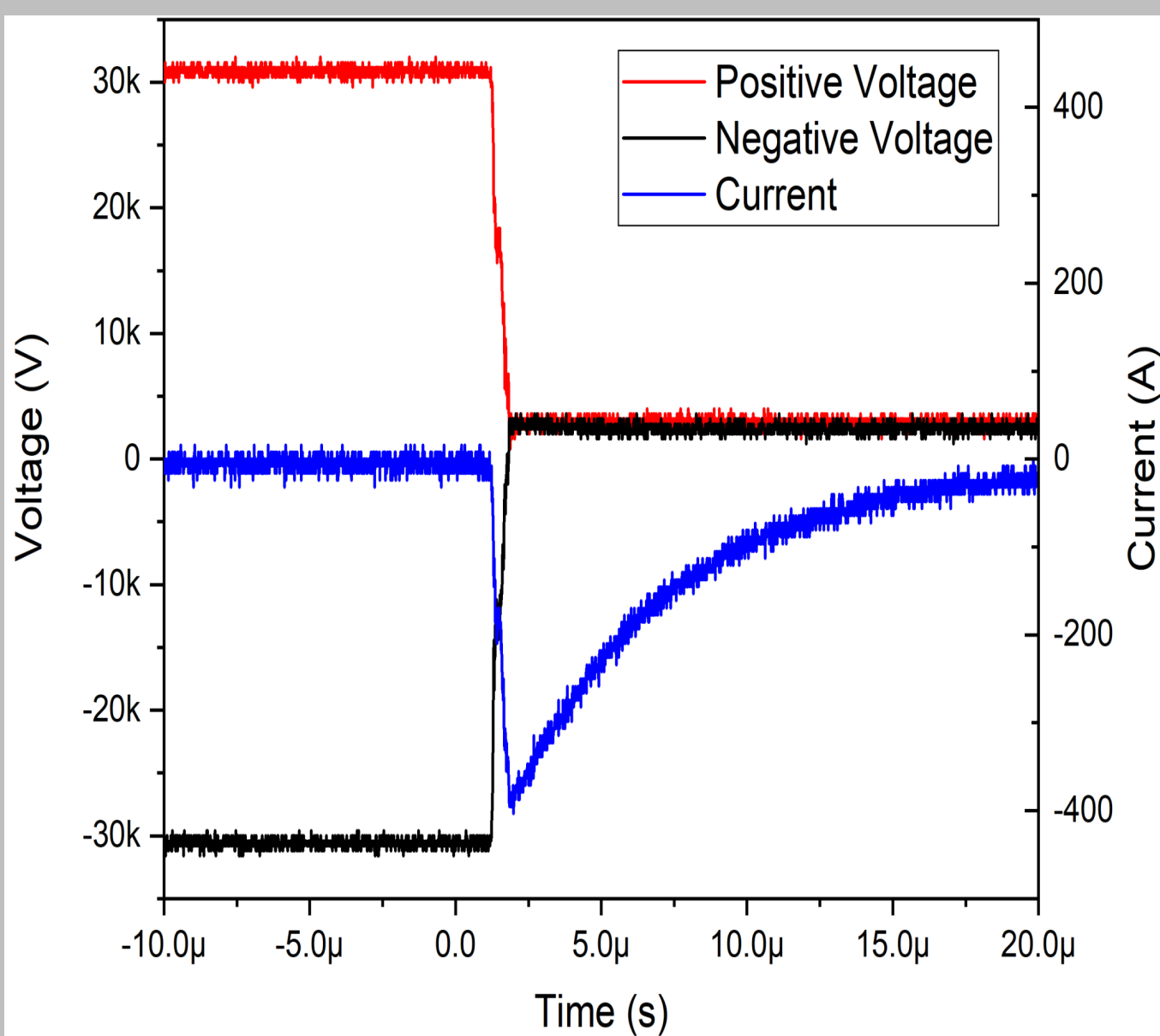
Switch	Volume (cm ³)	Max Volt. (kV)	Min Volt. (kV)	Max Current (kA)	Lifetime
SNL Vacuum	83	70	2	10	1
SNL Gas	158	100	10	40	2500
Flash	740	50	5	100	10000
L3 T-670	740	100	18	100	10000
Flare	740	150	10	100	10000
Excilites GP-74B	880	100	40	100	10000
L3 402	1168	100	25	100	10000
Excilites GPV-6313	872	80	0.3	60	1
L3 T-508	7410	120	30	150	2000

Testing of Compact Sealed Spark gaps

- Spark gap switches were tested with bipolar +/- 50 kV across them, and discharged with 100 A – 10 kA peak current



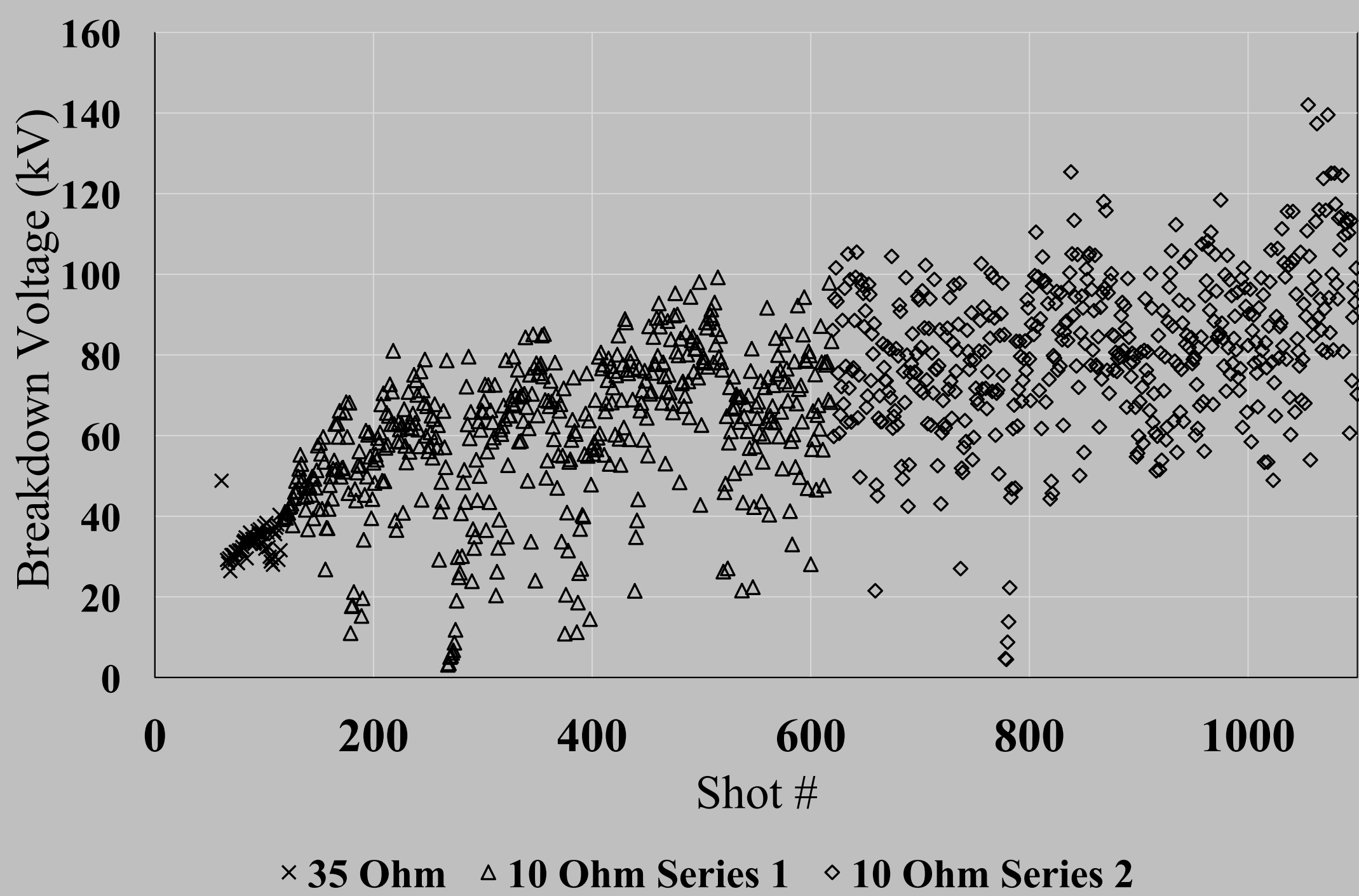
Photograph of the high energy testbed: a) spark gap switch under test, b) power supplies, c) gas control panel, d) digital flow gauge meter, e) flow gauge.



Typical waveform during triggered testing of sealed spark gap switches

Experimentally Observed Conditioning Trend

- Breakdown voltage increased with increasing shot count
- Large variance in breakdown voltage between shots



Conclusions

- Hermetically sealed vacuum spark gap switches for long shelf life
- Self-break voltage of 100 kV obtained
- Lifetime tested with 100 A – 10 kA peak output currents with no degradation in lifetime at 1000 shots
- Issues with variance in breakdown voltage

Future Work

- Investigating different electrode material
- Conduct lifetime testing
- Optimize geometries
- Triggered testing