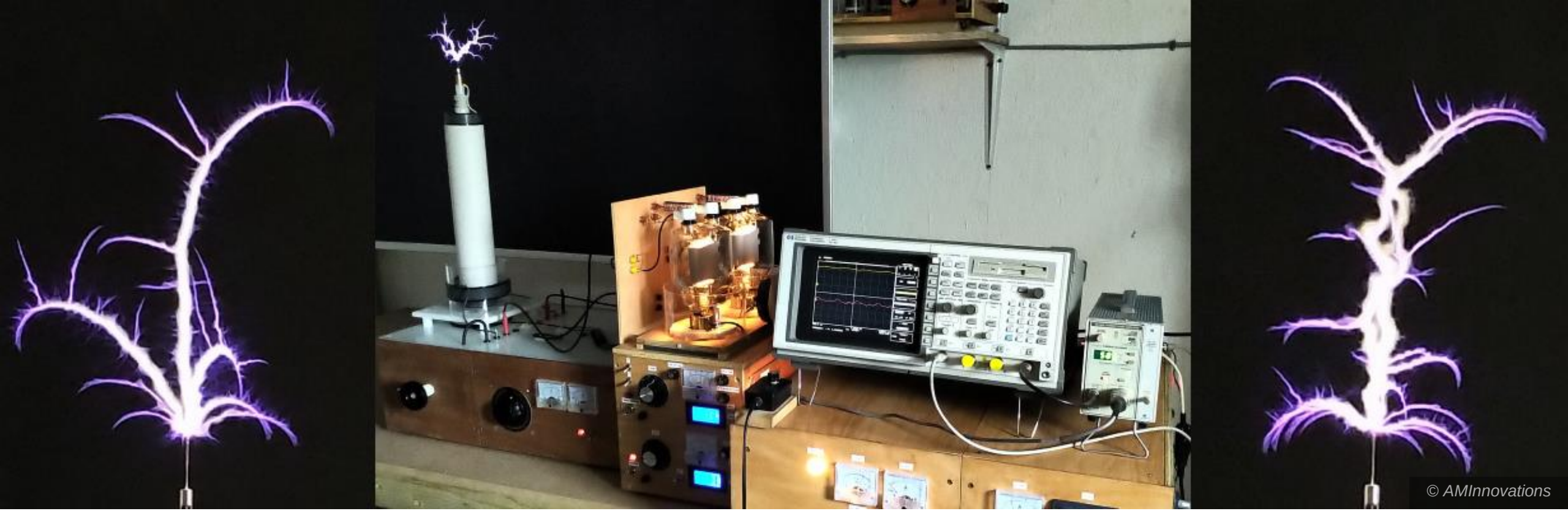


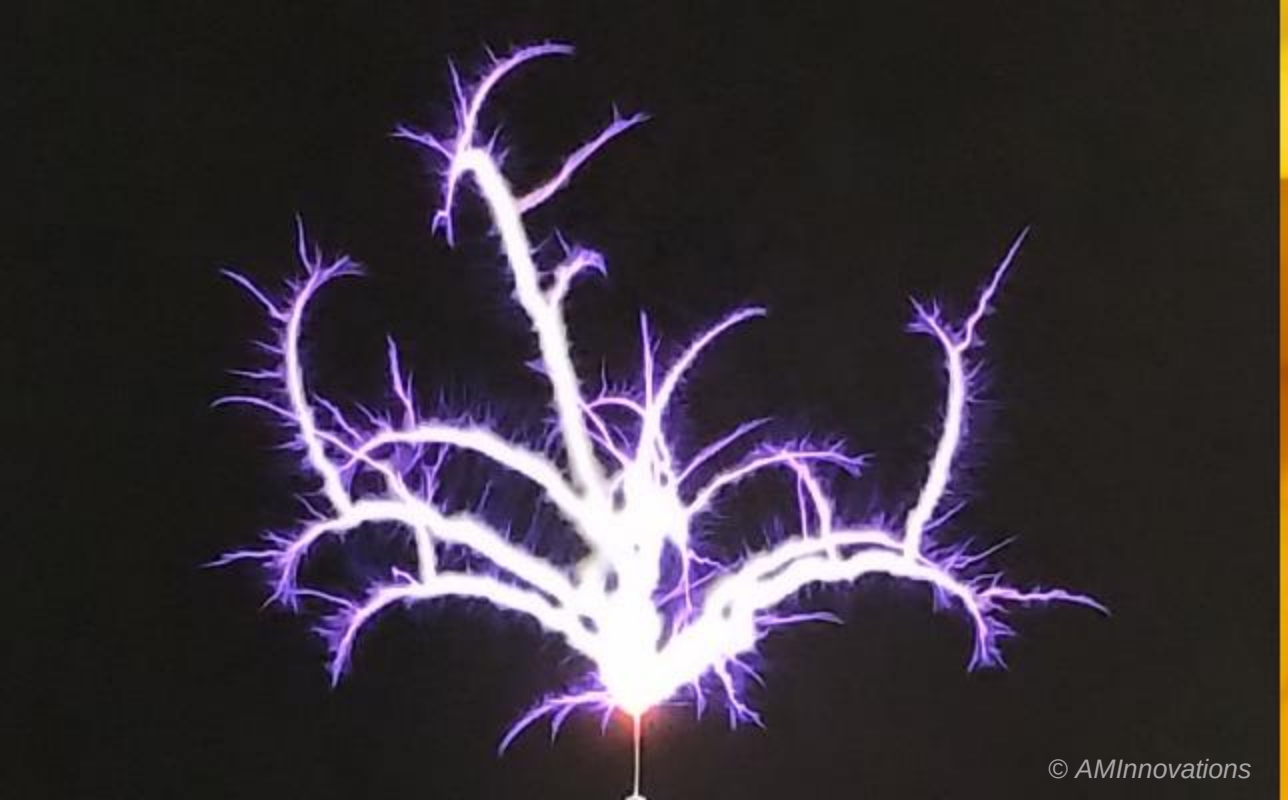
The Golden Ratio Discharge

Part 1 – The Fractal Fern

ESTC 2023 – Adrian Marsh Ph.D.

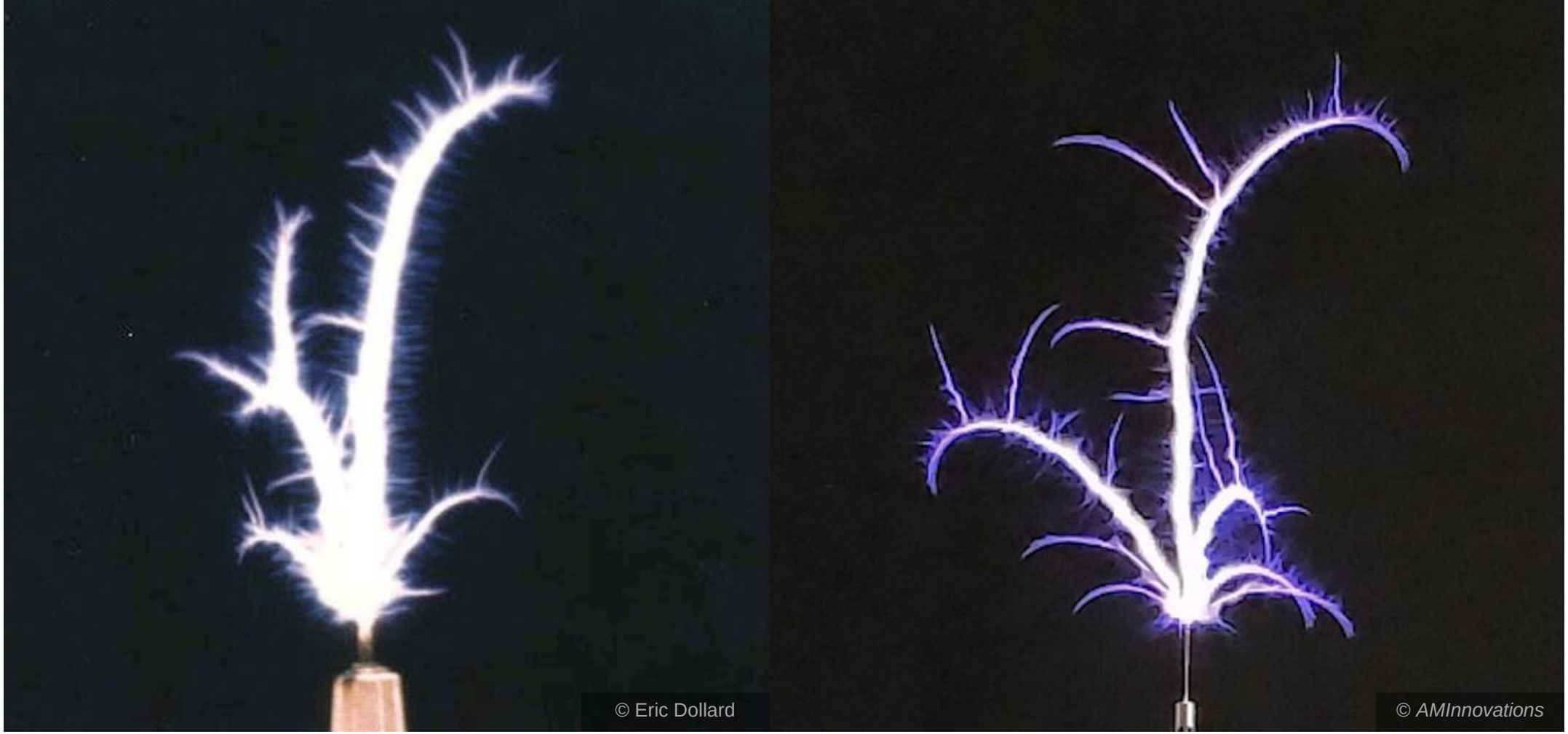
This Presentation is Dedicated to the Late Robert Marsh 1945-2023

His Support, Encouragement, and Engineering Skills contributed so much to the research, apparatus, and content of this presentation and many others …



> *Throughout space there is energy. Is this energy static or kinetic!*
>
> *If static our hopes are in vain; if kinetic - and this we know it is for certain - then it is a mere question of time when men will succeed in attaching their machinery to the very wheelwork of nature.*

- Nikola Tesla 1892, Inventor, Engineer and Futurist



- Discovered by Eric Dollard in 1978 as part of the Integratron experiments, (left image).
- Featured on the front cover of Peter Lindemann's "The Free Energy Secrets of Cold Electricity", 2001.
- Rediscovered by Adrian Marsh in 2021 as part of the "Wheelwork of Nature" experiments, (right image).

The Golden Ratio – φ

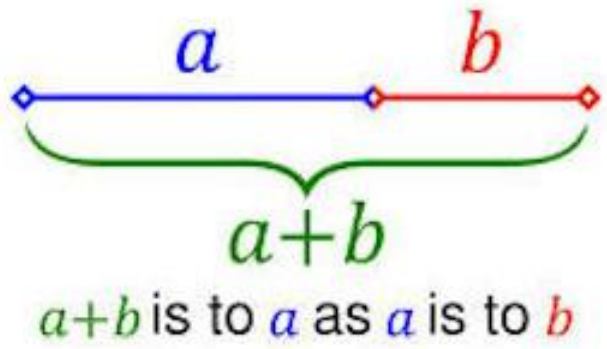
- Denoted by the Greek letter *phi* – φ
- Algebraically where the ratio of two quantities is equal to the ratio of their sum to the larger of the two quantities.
- Satisfies a quadratic equation and is an irrational number.
- Appears in many patterns in nature often in the form of the Golden Spiral.
- Used by artists and architects across history to create aesthetically pleasing and harmonious structures.
- Esoterically is part of “Sacred Geometry”, and known as the “Divine Proportion”.
- Represents a key part of the underlying hidden principles and processes inherent in the Wheelwork of Nature.

The Golden Ratio – Algebraic

- The ratio of the two quantities *a* to *b* is equal to the ratio of *a+b* to *a*.
- φ is the algebraic solution to the quadratic equation shown.
- φ is an irrational number, that is a number that cannot be expressed as the ratio a/b where a and b are integers.
- φ is not a transcendental number like the natural logarithm *e.*
- The quadratic equation yields two solutions:

$$\frac{1+\sqrt{5}}{2} = 1.618033\ldots \text{ and } \frac{1-\sqrt{5}}{2} = -0.618033\ldots.$$

- The positive root and the negative root share many qualities of the golden ratio, and are two reflections of the same vibration.
- The golden rectangle with φ as its aspect ratio is a basic building block in golden ratio geometry.



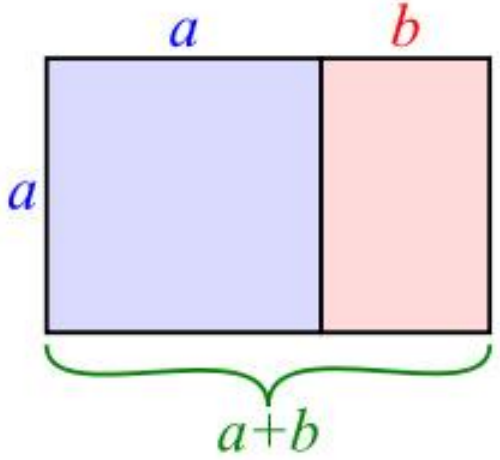
$a+b$ is to a as a is to b

Expressed algebraically:

$$\frac{a+b}{a} = \frac{a}{b} = \varphi$$

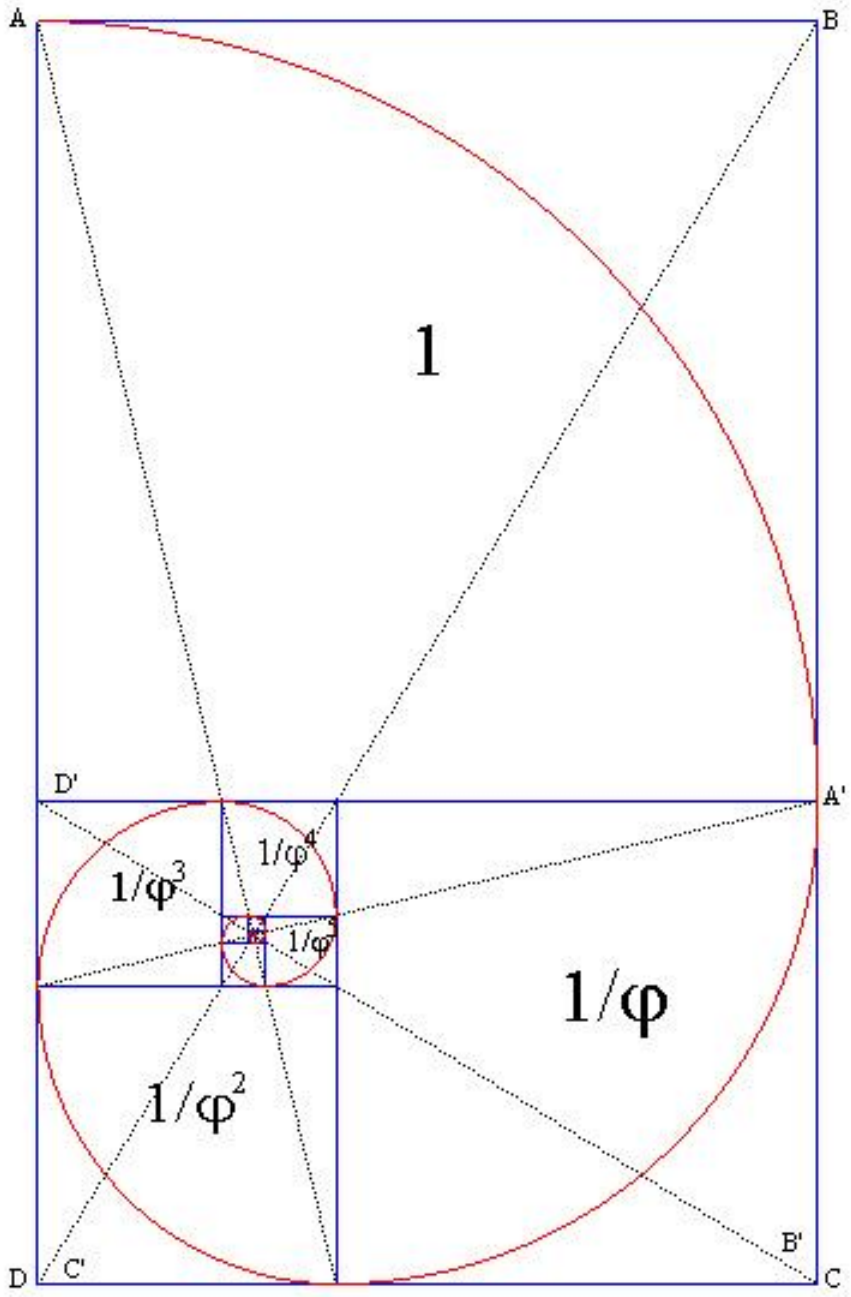
$$\varphi^2 = \varphi + 1$$

$$\varphi = \frac{1+\sqrt{5}}{2} = 1.6180339887\ldots.$$



The Golden Spiral

- The golden rectangle forms the starting point, ABCD is the largest rectangle with width AB = 1 and height BC = φ
- The rectangle is repeated reducing in scale to form the golden spiral from consecutive quarters of circles inscribed in each square. The centre *O* is the asymptotic point of the spiral.
- The golden spiral has the property of “eadem mutata resurgo” – a Latin phrase that translates to “Although changed, I arise the same”, and is invariant with centre *O*, ratio φ , and angle $\pi / 2$.
- The golden spiral closely approximates a true logarithmic spiral which is a transcendental curve.
- The Fibonacci spiral starting from the Fibonacci rectangle approximates the golden spiral, but does not have the property of “eadem mutata resurgo”.
- The “eadem mutata resurgo” property of the golden spiral combined with its prevalence in nature, suggests that it may be a fundamental principle in the Wheelwork of Nature.



The Golden Ratio – Esoteric

- Referred to in the legend of Atlantis *c.* 100,000 BCE.
- Used by the ancient Egyptian civilisation *c.* 2500 BC.
- Used by the ancient Greek civilisation *c.* 1200 BC.
- The centre *O* combined with the property of “eadem mutate resurgo” was referred to as the “Eye of God”, and is both the source and sink of the aetheric “Vortex” of creation.
- A principle of the “law of economy”, which governs the most optimal flow of energy, the path of least resistance, and of maximum inclusive harmony in life.
- It is suggested that the “law of entropy” does not apply to the golden ratio, and even more, that entropy can be reversed in natural manifestations of the golden spiral.
- Known as the “Divine Proportion” and analogous to “God’s relationship to creation”.
- The basis of “Sacred Geometry” and related to Numerology.

If you only knew the magnificence of the 3, 6 and 9, then you would have a key to the universe.

If you want to find the secrets of the universe, think in terms of energy, frequency and vibration.

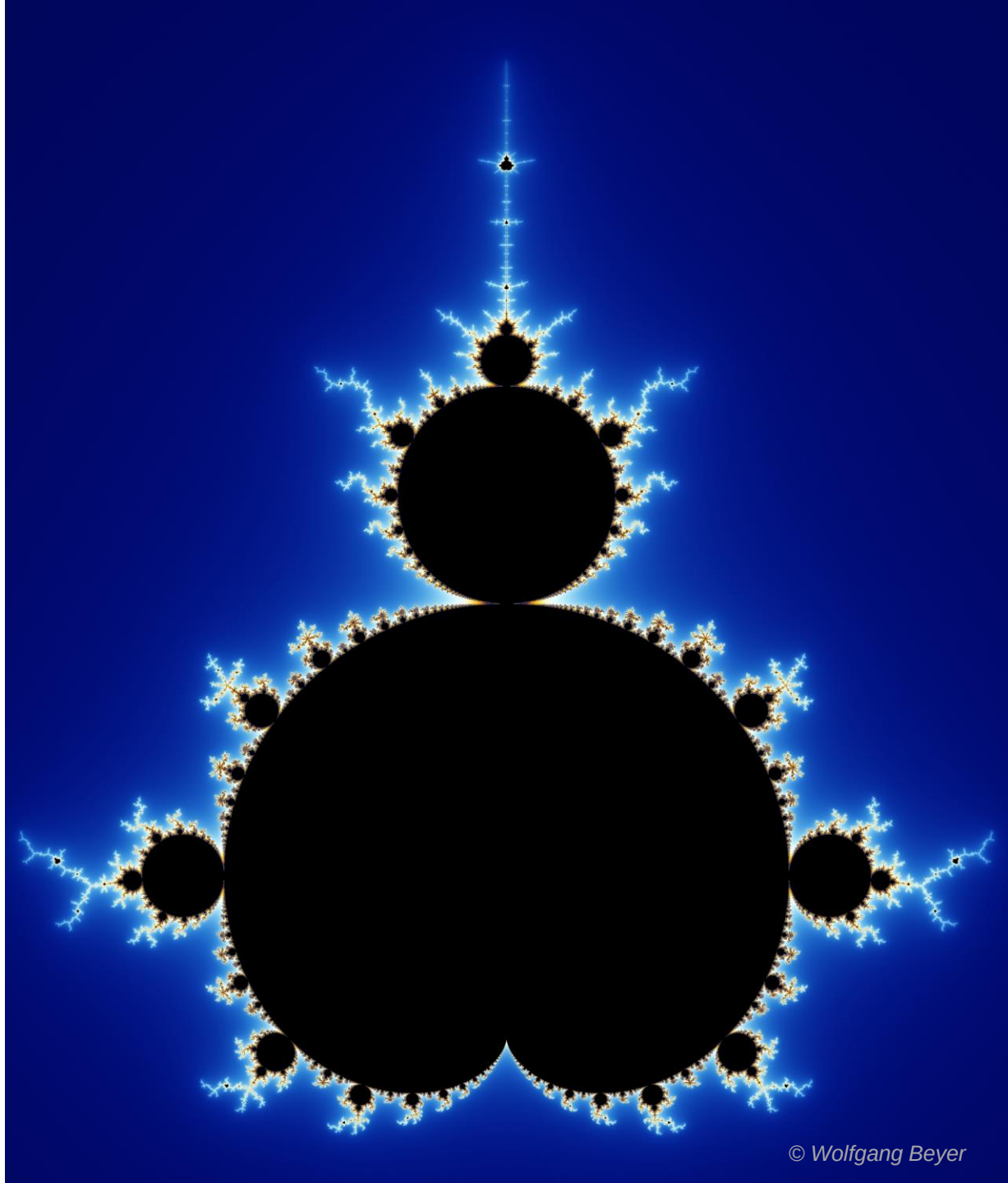
- Nikola Tesla 1931, Inventor, Engineer and Futurist

Fractals

- A geometric shape containing detailed structure at arbitrarily small scales.
- Self-similar and self-repeating at any structural scale, to produce expanding or unfolding symmetry.
- The Mandelbrot set is the set of complex numbers *c* for the non-diverging function:

$$f_c(z) = z^2 + c$$

- When visualised graphically the complex number set yields a repeating fractal pattern.
- Studied for centuries, but formally defined and name as a fractal in 1975 by Benoît Mandelbrot.
- Fractal self-similar, self-repeating features appear in nature e.g. Lightning bolts, and hence form a part of the Wheelwork of Nature.



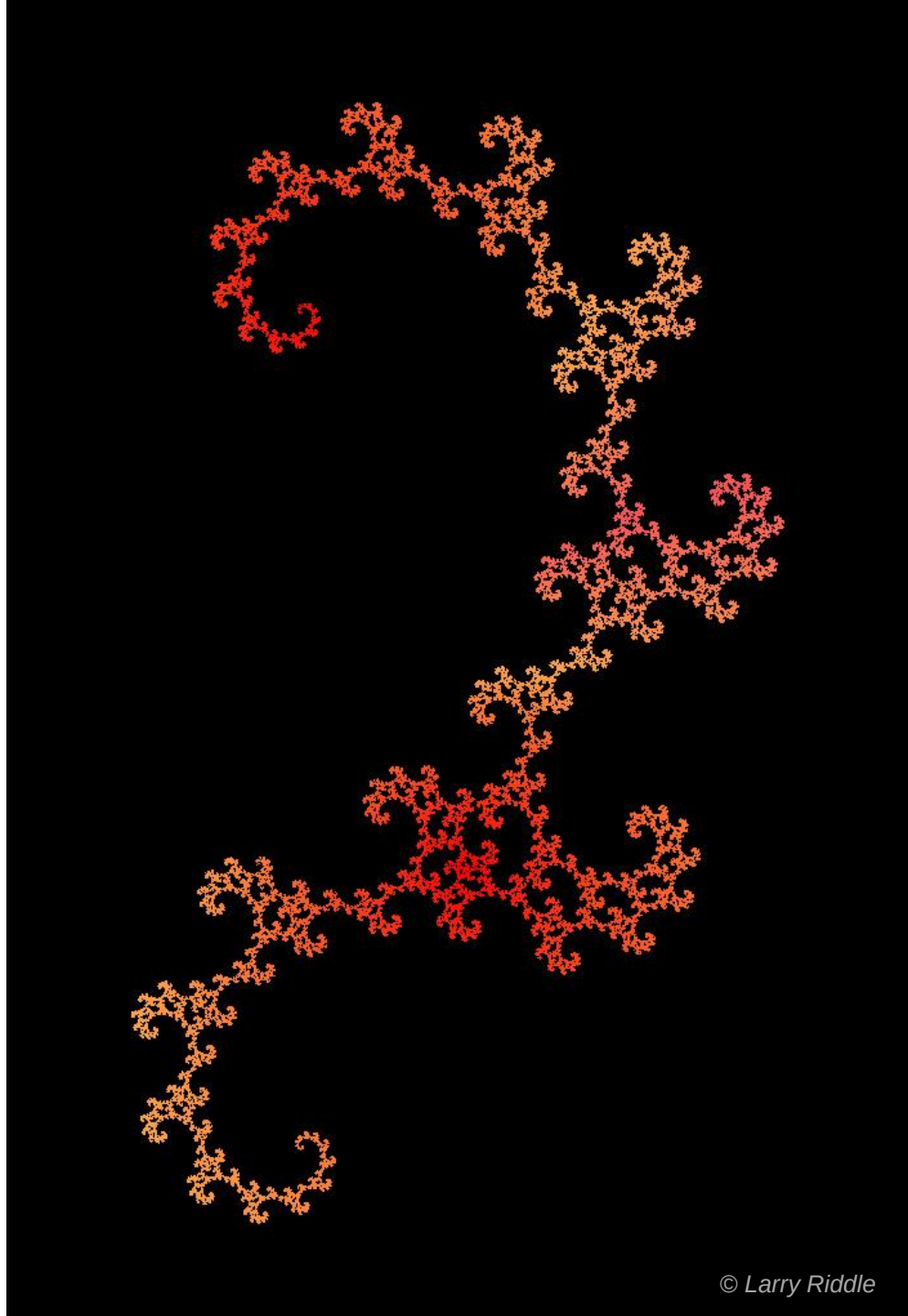
The Fractal Fern - Self-similar and self-repeating at any scale, to produce expanding or unfolding symmetry.

Fractals and the Golden Ratio

- Fractals can be based on any rate of expansion.
- A Fractal created on a Golden Ratio expansion produces a geometrically optimised, non-overlapping, self-similar, self-repeating pattern.
- The Golden Dragon is a combination of two fractal number sequences which expand according to the Golden Ratio.
- Two non-overlapping copies scaled by factor ***r*** and ***r²*** yields the Golden Ratio Dragon and satisfies:

$$r^{\varphi} + r^{2\varphi} = \frac{1}{\varphi} + \frac{1}{\varphi^2} = \frac{\varphi + 1}{\varphi^2} = 1$$

- The Golden Dragon is reflected in the Wheelwork of Nature in the form of specific instances of the Golden Ratio discharge.
- The Golden Dragon also satisfies the property of “eadem mutata resurgo” - “Although changed, I arise the same”



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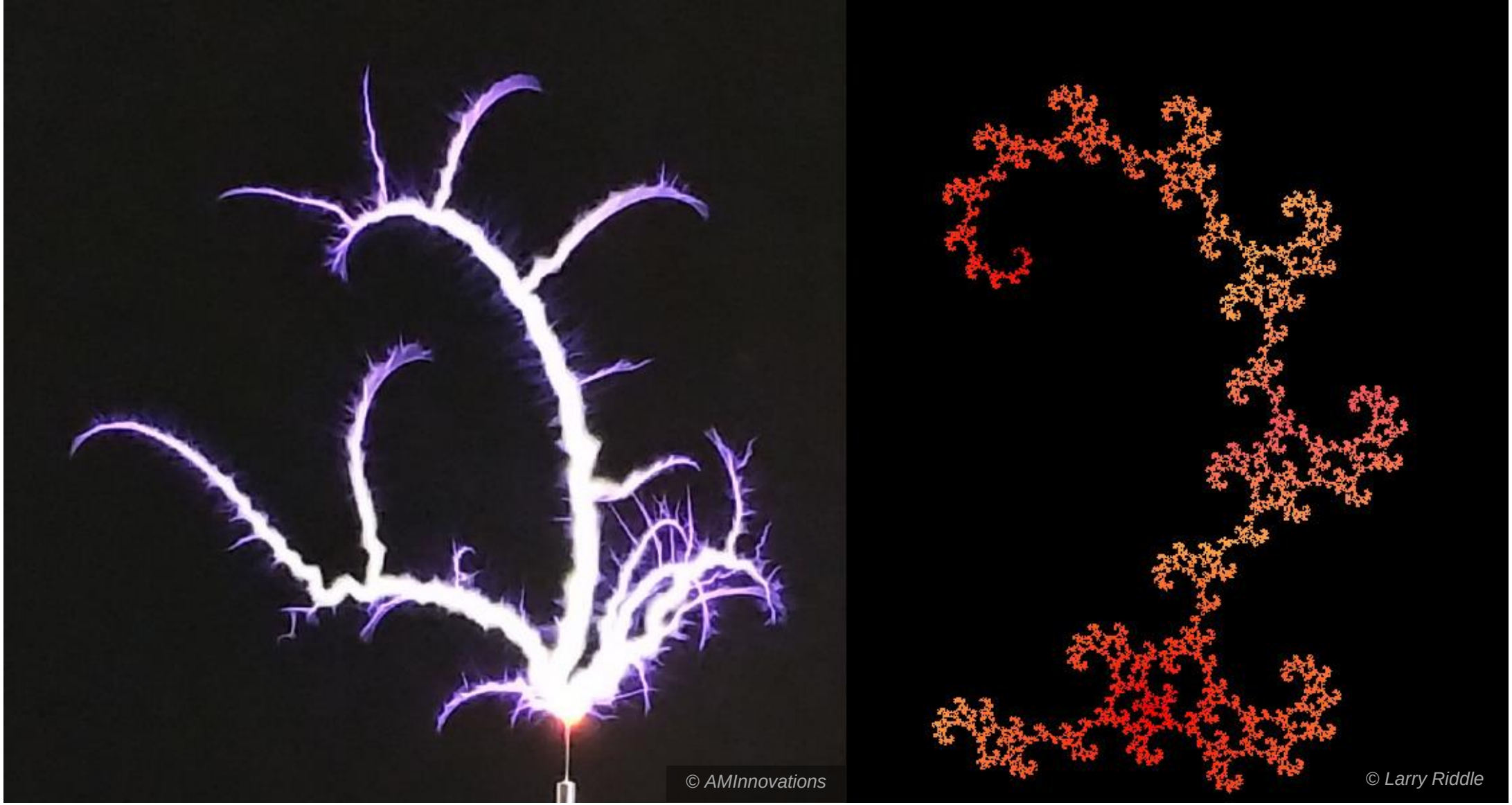
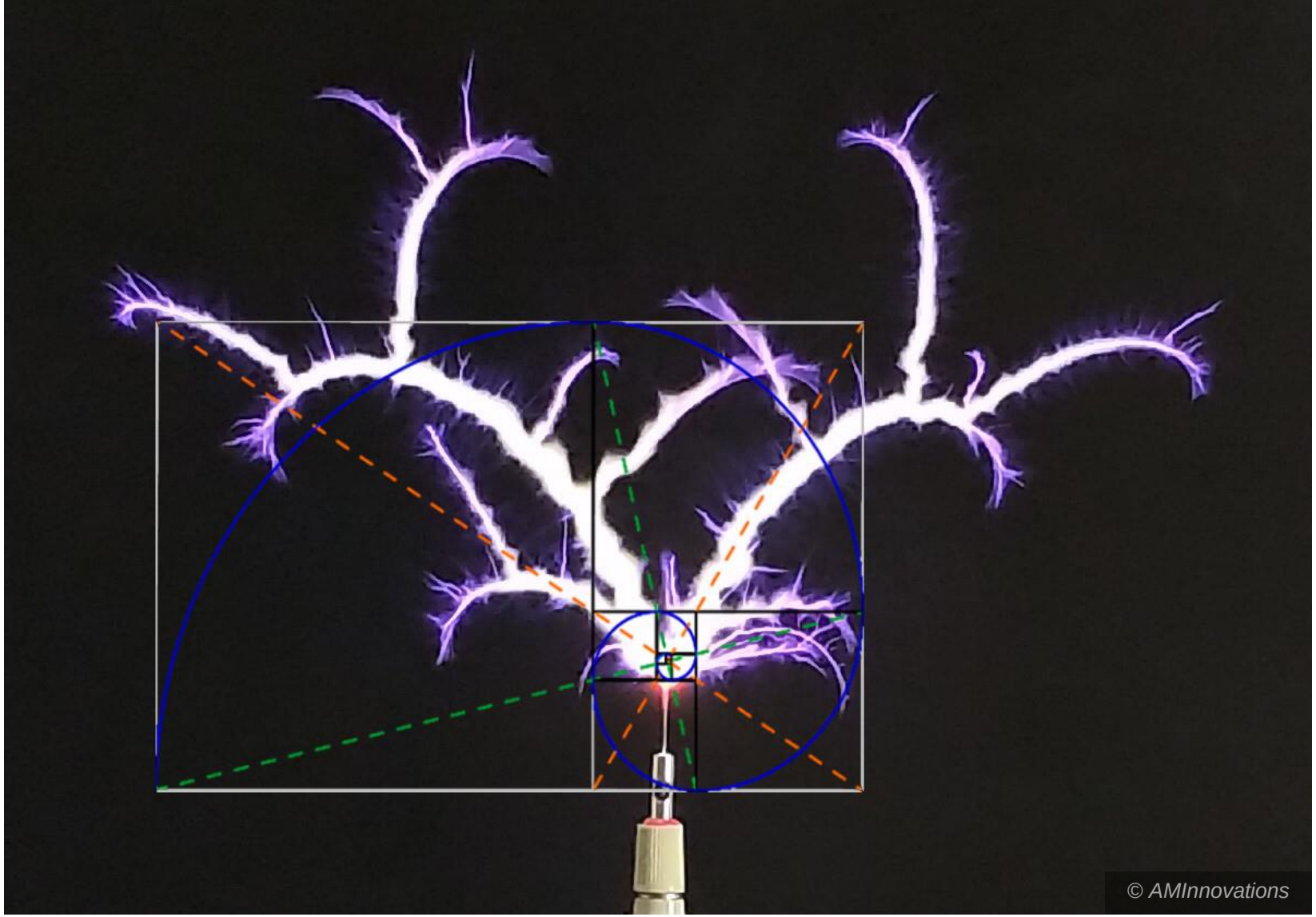
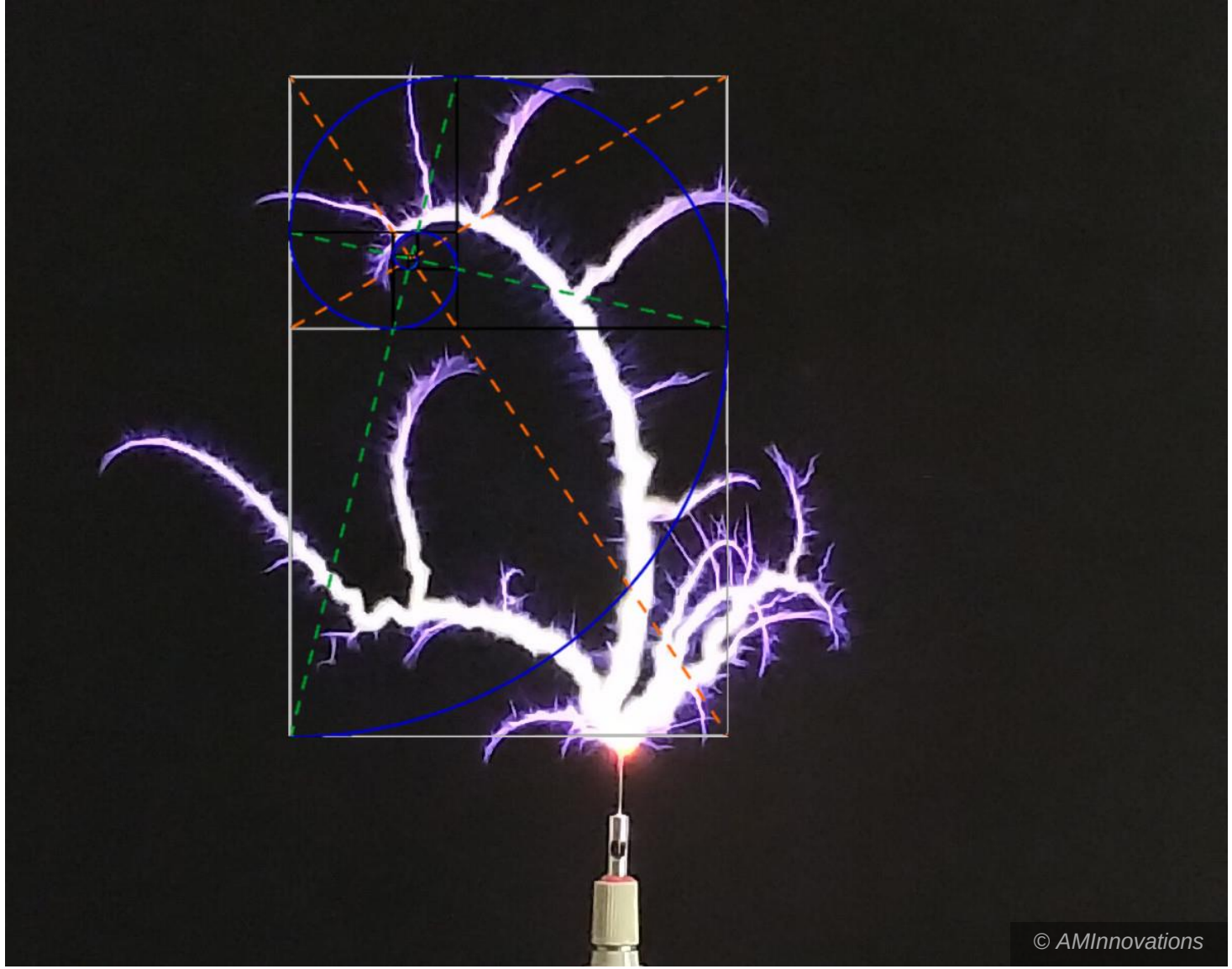


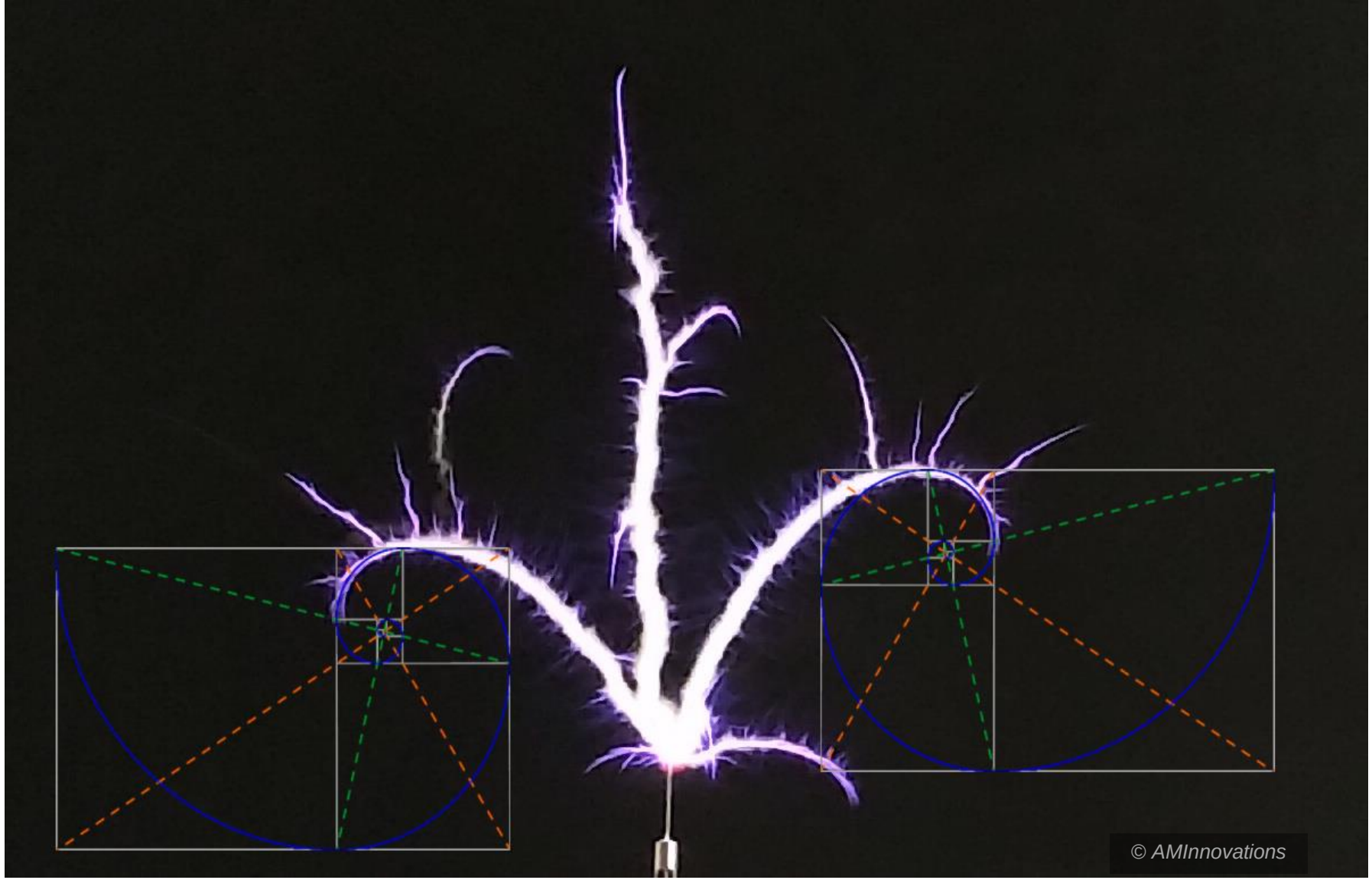
The Golden Dragon Discharge – Combined Fractal and Golden Ratio Expansion



The Golden Ratio fit to the Discharge Source – Primary Tendrils



The Golden Ratio fit to the Discharge Sink – Primary Tendril.



The Golden Ratio fit to Tendril Spiral Geometry

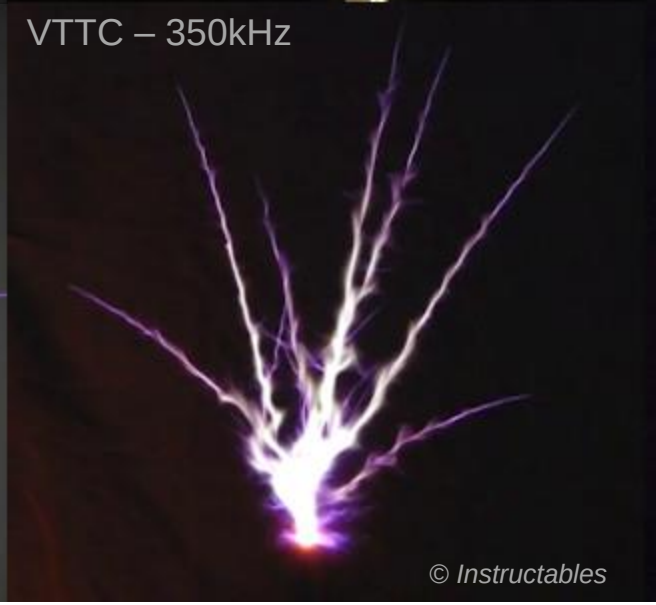
The Golden Dragon (Golden Ratio + Fractal) fit to Primary Tendril and Spiral

Electrical Discharges

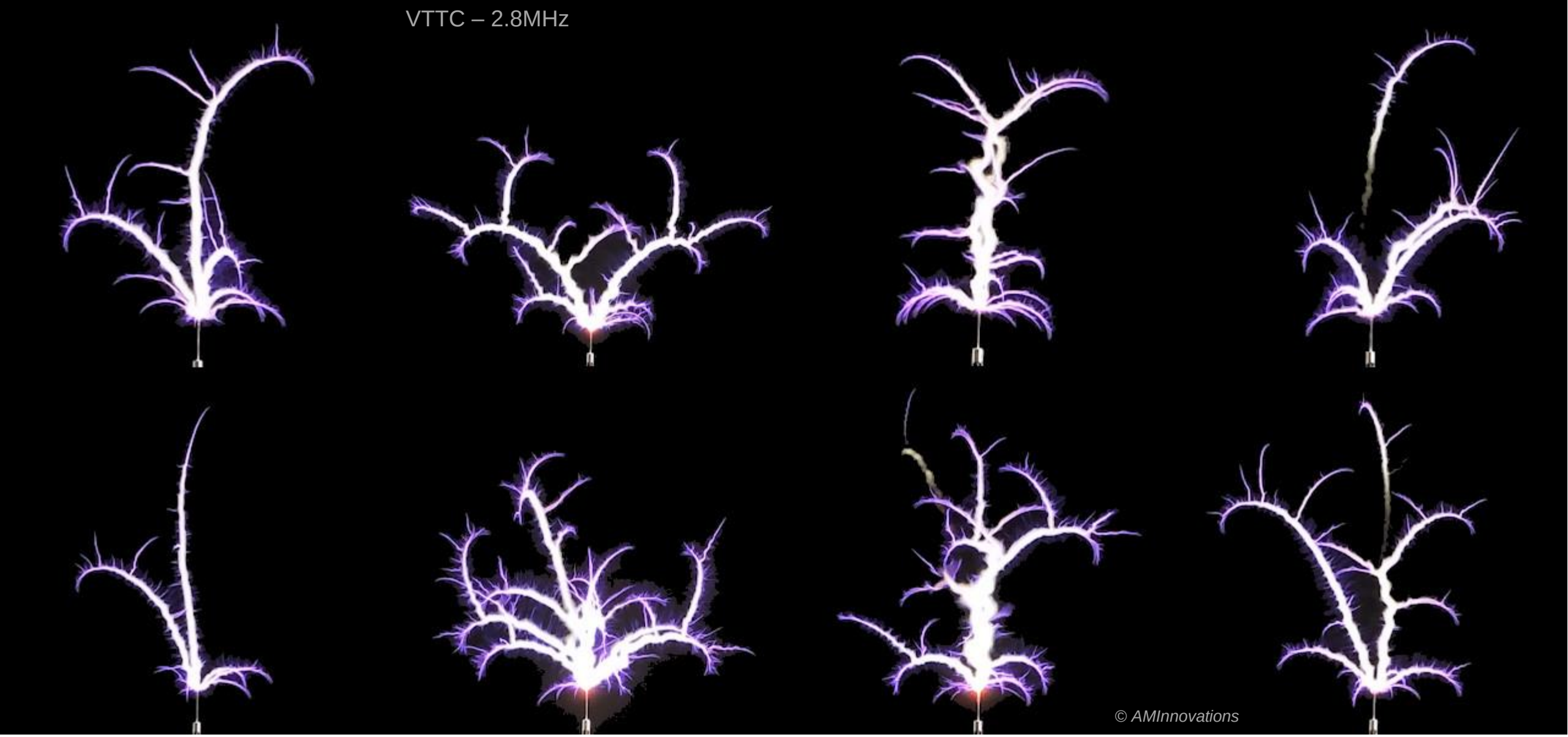
- Results from an accumulated charge imbalance between two regions e.g. electrostatic lightning discharge between a cloud and the ground.
- A high electric field creates an ionised electrically conductive region in an insulating medium e.g. air in a spark gap or inert gas in a discharge tube.
- Dielectric breakdown is accompanied by a rapid discharge via an electric current, emitting both light and sound.
- Ionisation of the dielectric medium involves complex dynamics between the magnetic and dielectric induction fields.
- An esoteric alternative – a rip in the web of life revealing a brief glimpse of the one light of creation – a symbol of the spirit!

Tesla Coil Discharges

- Tesla coil invented by Nikola Tesla *c.1891.*
- Known as Tesla Magnifying Transformer (TMT).
- Resonant air cored transformer.
- High-voltage, high-frequency electricity.
- Can produce huge voltage magnification
- Generators include spark gap, linear amplifiers, vacuum tube oscillators, impulse thyratrons, solid-state power-amps etc.
- Complex linear and non-linear electro-dynamics between the magnetic and dielectric induction fields.
- Discharge form strongly dependent on frequency band, coil geometry and materials, type of generator, drive waveform and modulation, and environment.



VTTC – 2.8MHz



What causes the Golden Ratio Discharge ?

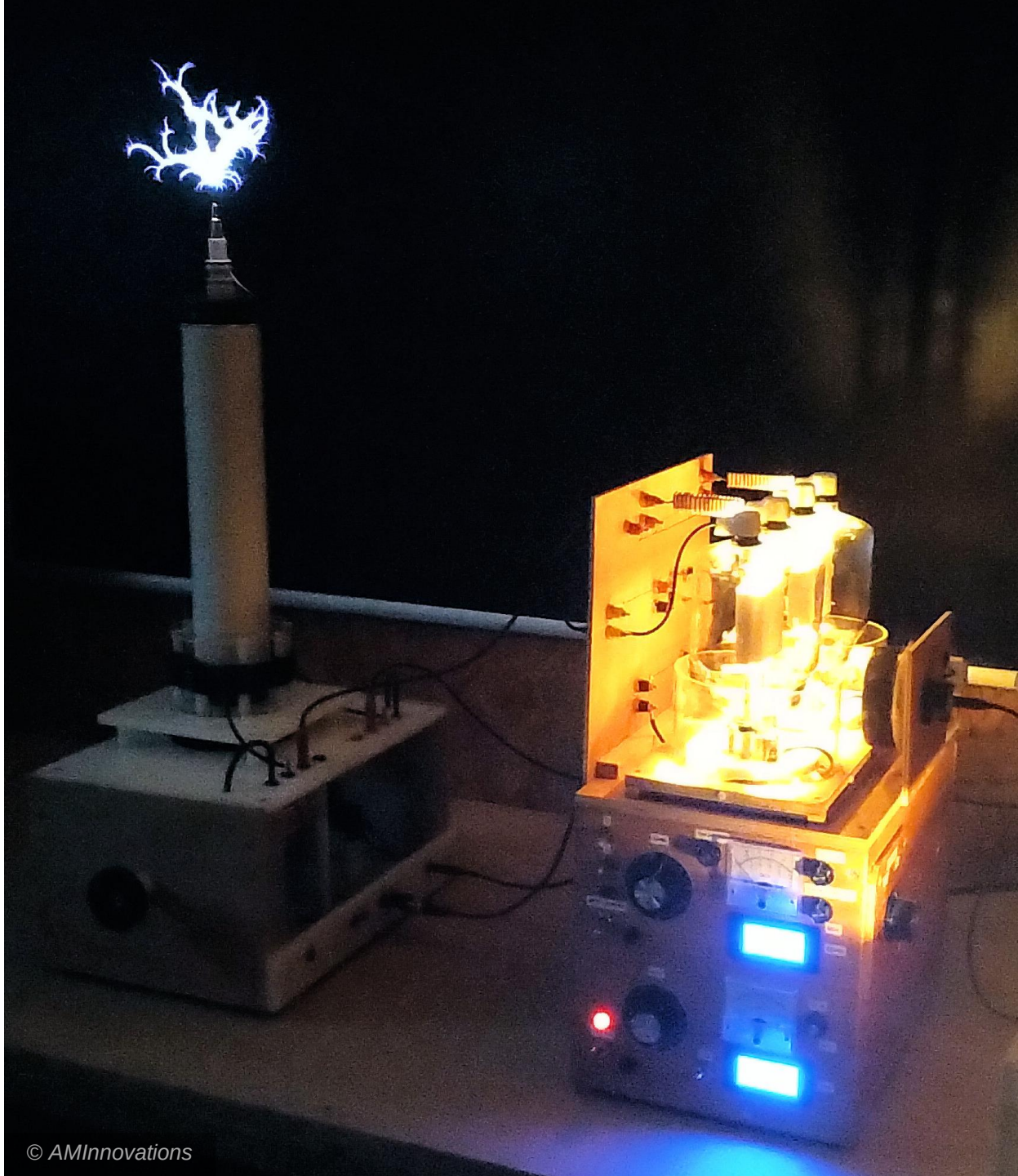
- The Tesla coil: design, form, geometry, materials - incorporating Golden Ratio features ?
- The Generator: type, power, frequency, waveform, envelope, duty-cycle, modulation, linear/non-linear, switching, harmonics ?
- The Air: temperature, humidity, chemical composition, pressure ?
- The unique and dynamic relationship between the Magnetic and Dielectric Induction Fields ?
- Underlying natural principles in the Wheelwork of Nature ?

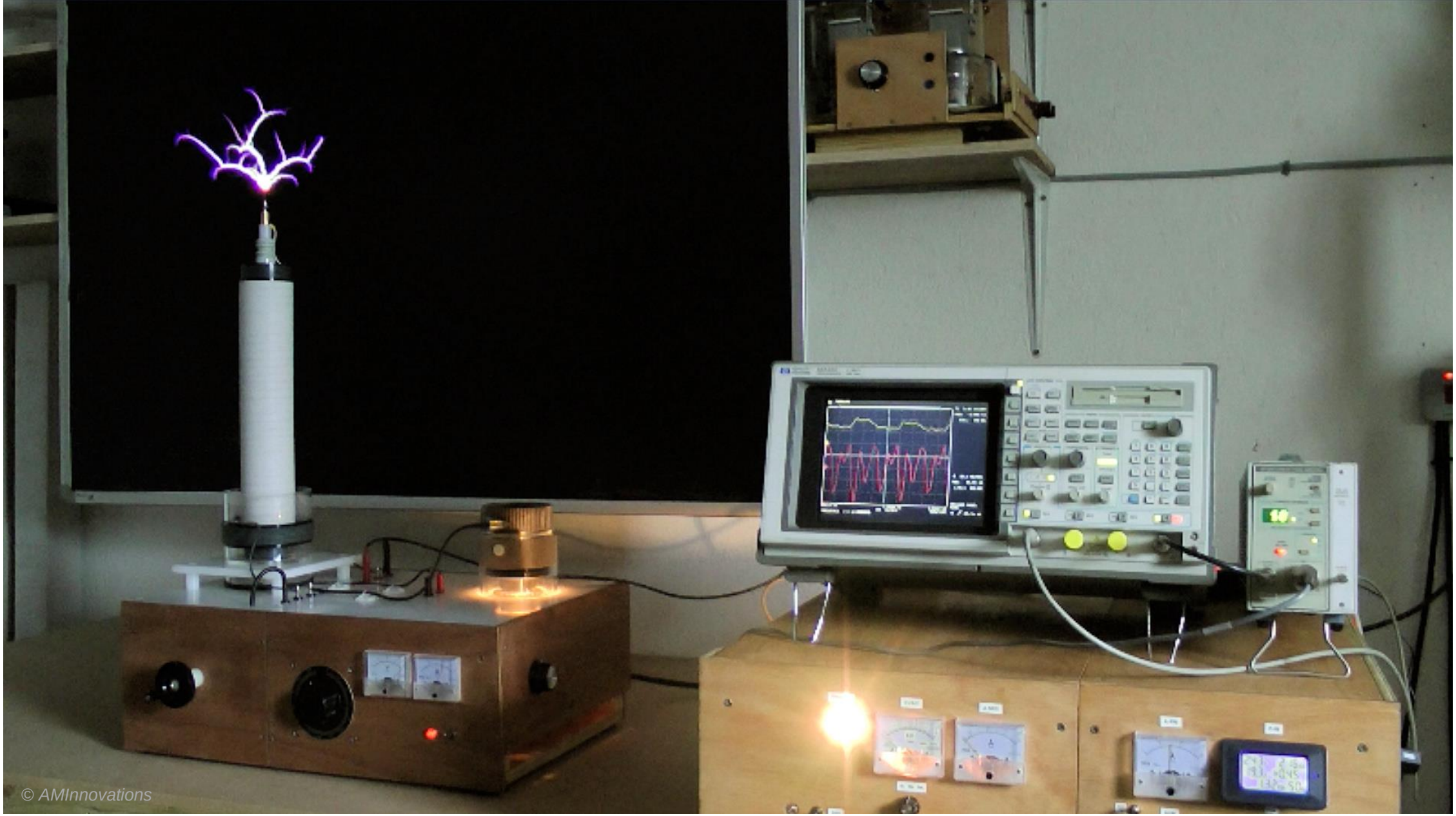
A Combination of Some of the Above ?

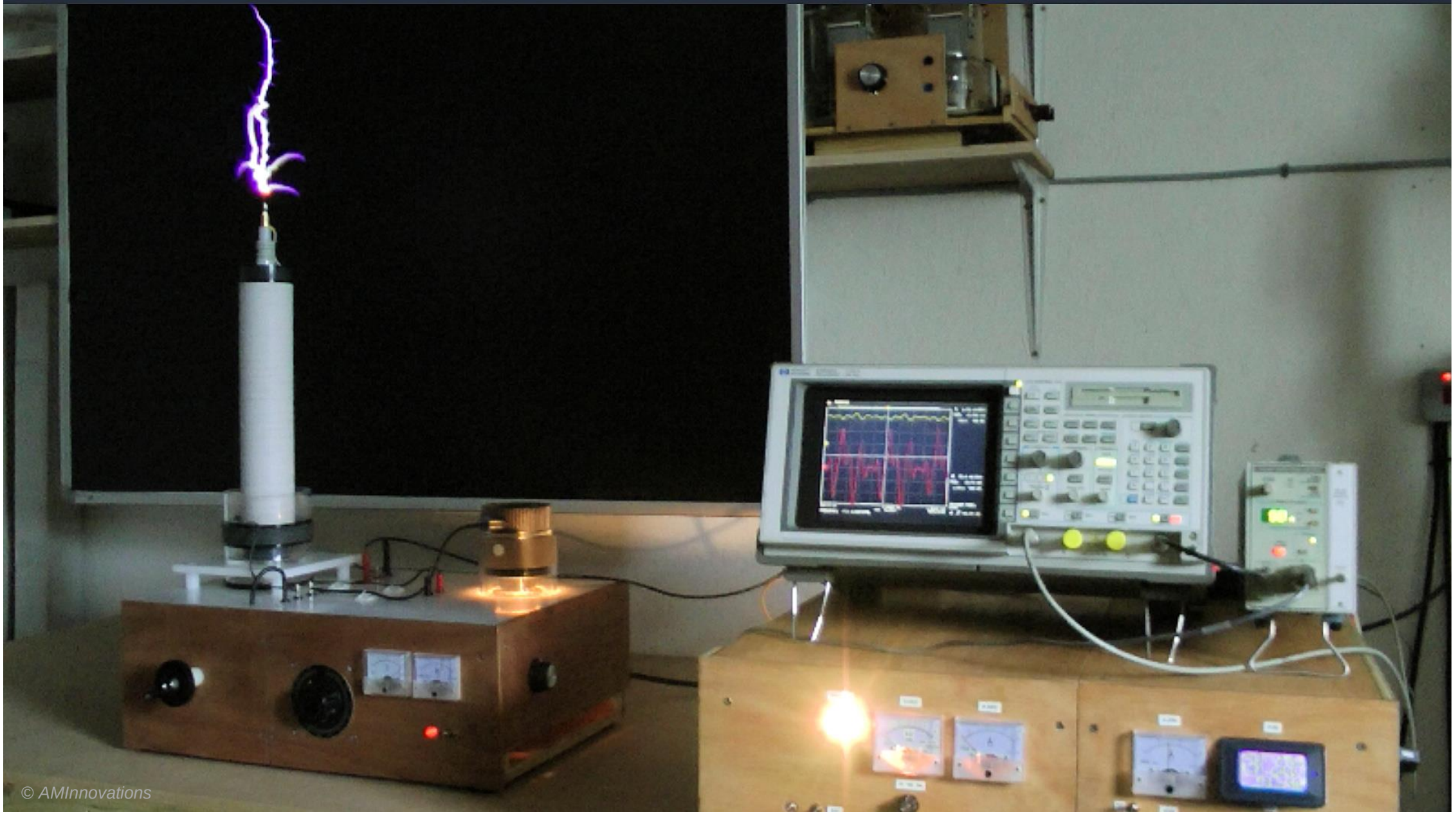
Something Else/Other Factors - As yet Unknown ? …….

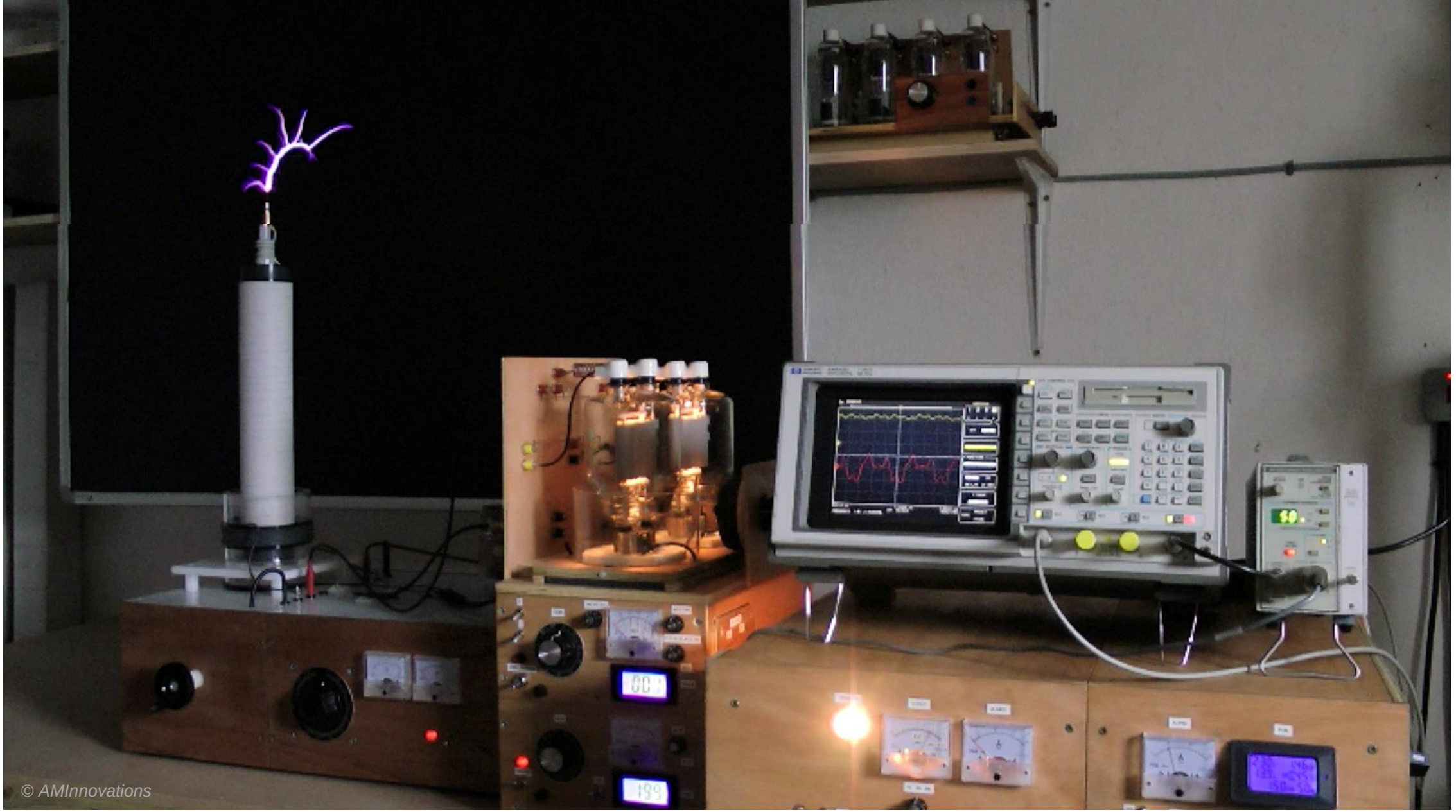
The Wheelwork of Nature

- Experimental series aimed at revealing fundamental principles underlying electrical phenomena e.g. the golden ratio discharge, galaxy in a bulb, radiant energy etc.
- Intended to use only basic, readily available materials, components, and Tesla coil designs.
- The golden ratio discharge apparatus uses Tesla coil design with no designed Golden Ratio proportions or geometry.
- A vacuum tube generator in the form of an Armstrong oscillator was selected for high power combined with tunability and simplicity.
- The HT supply was designed based on two series MOTs with a level shifter, using again basic components for simplicity.
- No special components, design, or proprietary apparatus or knowledge.









Wheelwork of Nature Experiments – Tesla Coils

- Five standard geometry Tesla coils at different frequencies with no Golden Ratio features by design: 3494kc, 2068kc, 1013kc, 570kc, 357kc:
  - Tall and narrow high aspect ratio 5:1 for high voltage magnification.
  - Wire grade and insulation thickness determines winding pitch and number of turns.
  - Primary standard 12awg multi-turn suitable for VTTC designs.

Secondary Coil	Wire Specifications					Design Resonant Frequency	
	Guage & Type	Conductor Dia. (mm)	Turn Spacing (mm)	Wire Length (m)	No. Turns	Free f_{ss} (kc)	λ/4 Tuned (kc)
Original, 1	$1mm^2$ silicone clad	1.10	1.35	37.0	155	3494	2025
2	awg20 silicone clad	0.81	0.64	62.6	262	2068	1199
3	0.71mm magnet	0.71	0.00	127.8	535	1013	587
4	0.4mm magnet	0.40	0.00	226.8	950	570	331
5	0.25mm magnet	0.25	0.00	363.0	1520	357	207

Coil Dimensions: Height and Width of 380mm x 76mm, with an aspect ratio of 5:1, and wound onto a 3" diameter pvc plastic former, height 420mm.

Wheelwork of Nature Experiments – Generators

- Disruptive spark gap generators (SGTC):
  - Very difficult to drive a TC at high power in the Mc frequency range, better suited to 10kW @ < 500 kc.
  - Lightning-like discharge, no Golden Ratio Discharge observed.
- Solid-state generators and Linear Amplifiers (SSTC and DRSSTC):
  - Difficult to drive a TC at high power in the Mc frequency range, better suited to 2kW @ < 3Mc.
  - Mix of lightning-like discharges, plasma flares, and sword-like streamers, no Golden Ratio Discharge yet observed.
- Impulse Thyratron generators (IPTC):
  - Can drive a TC at very high frequencies and very high power e.g. 100kW @ < 25Mc.
  - Large current-rich plasma flares, and high-energy long streamers, possible Golden Ratio Discharge.
- Vacuum Tube Generators and Tube Linear Amplifers (VTTC):
  - Can drive TCs at high frequencies and higher power e.g. 10kW @ < 10Mc.
  - Golden Ratio Discharge observed when the output is modulated, switched, or a low-duty cycle.

Wheelwork of Nature Experiments – VTTC Generators

- Push-Pull or Double-Ended Tube Generator:
  - Highest efficiency configuration, Eric Dollard has achieved > 90%.
  - Maximum power transfer to the TC, driven from both half-cycles of the waveform.
  - Minimum radiated (lost) energy when used with a half-wave TC (Double pole centre driven).
  - Requires a tube or solid-state driver or pre-amplifier stage, and a modulator or staccato controller.
  - More complex construction, more components, complex to setup and tune.
- Vacuum Tube Linear Amplifier:
  - Modest efficiency from grounded grid configuration, typically up to 60% with decent matching
  - Relatively quick and easy to setup with commercially available equipment.
  - Requires a high-power antenna tuner or magnetic coupled swing-link unit etc. to match the 50Ω system impedance to the series resonant mode of the TC.
  - Requires an exciter stage with amplitude modulator, or a staccato controller, for low duty cycle.
  - Restricted bands of operation of the TC according to the radio amateur bands.

Wheelwork of Nature Experiments – VTTC Oscillators

- Class-C Armstrong Oscillator:
  - Moderate efficiency for Class-C operation, up to 55-65% with careful tuning.
  - Can operate at very high powers, and up to 10kW with appropriate tubes.
  - Single GU5B Power triode, P_A ~ 3.5kW @ 3Mc – Golden Ratio Discharge observed.
  - Dual Parallel 833C Power triodes, P_A ~ 2.1kW @ 3Mc – Golden Ratio Discharge observed.
  - Dual 883C or 3-500Z Power triodes full Golden Ratio Discharge can be observed P_A > 250W.
  - Auto-tracking of parallel resonant mode via “tickler” or pickup coil close to TC.
  - Parallel resonant mode adjusted via a parallel vacuum variable capacitor in the TC primary.
  - High tube output impedance matches to the dominant parallel resonant mode of the TC.
  - Grid leakage bias adjustment during operation via variable grid leakage rheostat.
  - Fine output impedance matching during operation via grid-bias current variable rheostat.
  - No additional matching unit or exciter required when the generator series drives the primary coil.
  - Very low component count, and low complexity generator, and with low-duty cycle with an AC tank.

Wheelwork of Nature Experiments – Self Oscillation

Generator allows the Tesla Coil to freely oscillate …

According to the natural characteristics of the TC design …

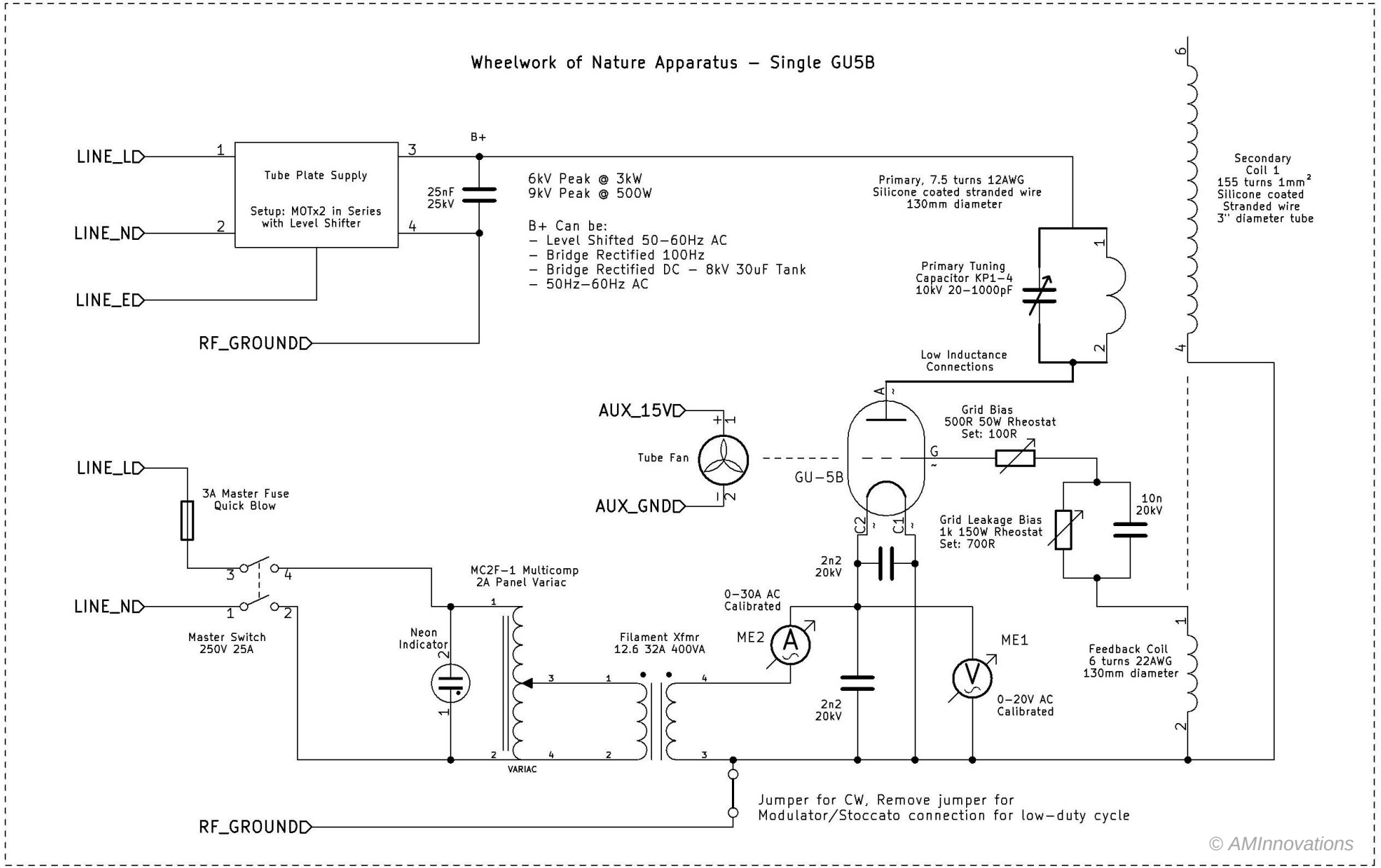
Self-Oscillation maintains the optimum resonant tuning …

TC expression can be exactly what it wants to be!

> *… then it is a mere question of time when men will succeed in attaching their machinery to the very wheelwork of nature.*
>
> *- Nikola Tesla, 1892*

GU-5B Vacuum Tube

- GU-5B (ГУ-5Б) Single Power Triode up to 110Mc.
- Direct heated carbonized thoriated tungsten filament.
- Filament heater 12.6V @ 25A.
- Specified Anode voltage 5kV @ < 30Mc.
- Specified Anode dissipation 2.5kW.
- Specified Output power, at least 3.5kW < 30Mc.
- Empirical Peak Anode voltage at low-duty cycle up to as high as 9kV without flashover.
- Empirical Peak Anode dissipation at low-duty cycle up to as high as 3kW @ 250°C (Anode temp force cooled).
- Makes a very robust, versatile, and compact single tube Class-C Armstrong oscillator for a Tesla coil.
- Output impedance of single tube is well suited to drive the parallel mode in series-fed primary setup.


Wheelwork of Nature Apparatus – Single GU5B
LINE_LD
LINE_ND
LINE_ED
RF_GROUND
Tube Plate Supply
Setup: MOTx2 in Series with Level Shifter
B+
25nF 25kV
6kV Peak @ 3kW
9kV Peak @ 500W
B+ Can be:
– Level Shifted 50–60Hz AC
– Bridge Rectified 100Hz
– Bridge Rectified DC – 8kV 30uF Tank
– 50Hz–60Hz AC
Primary, 7.5 turns 12AWG Silicone coated stranded wire 130mm diameter
Secondary Coil 1 155 turns 1mm² Silicone coated Stranded wire 3" diameter tube
Primary Tuning Capacitor KP1–4 10kV 20–1000pF
Low Inductance Connections
AUX_15V
AUX_GND
Tube Fan
GU–5B
Grid Bias 500R 50W Rheostat Set: 100R
Grid Leakage Bias 1k 150W Rheostat Set: 700R
10n 20kV
2n2 20kV
2n2 20kV
3A Master Fuse Quick Blow
Master Switch 250V 25A
MC2F–1 Multicomp 2A Panel Variac
VARIAC
Neon Indicator
Filament Xfmr 12.6 32A 400VA
0–30A AC Calibrated
ME2
ME1
0–20V AC Calibrated
Feedback Coil 6 turns 22AWG 130mm diameter
Jumper for CW, Remove jumper for Modulator/Stoccato connection for low–duty cycle
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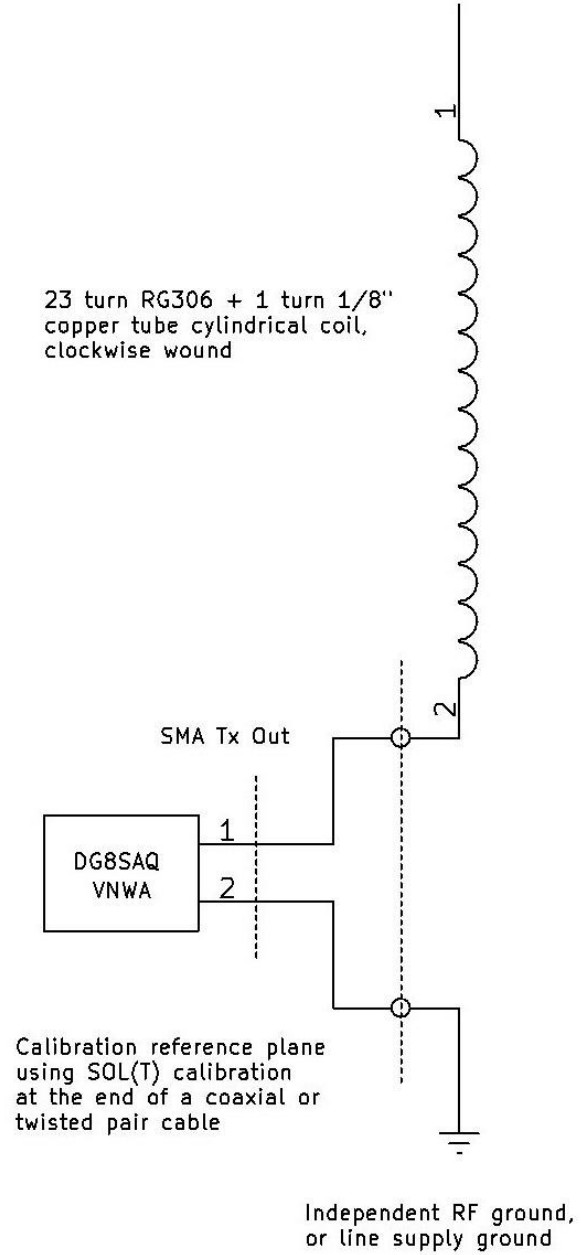
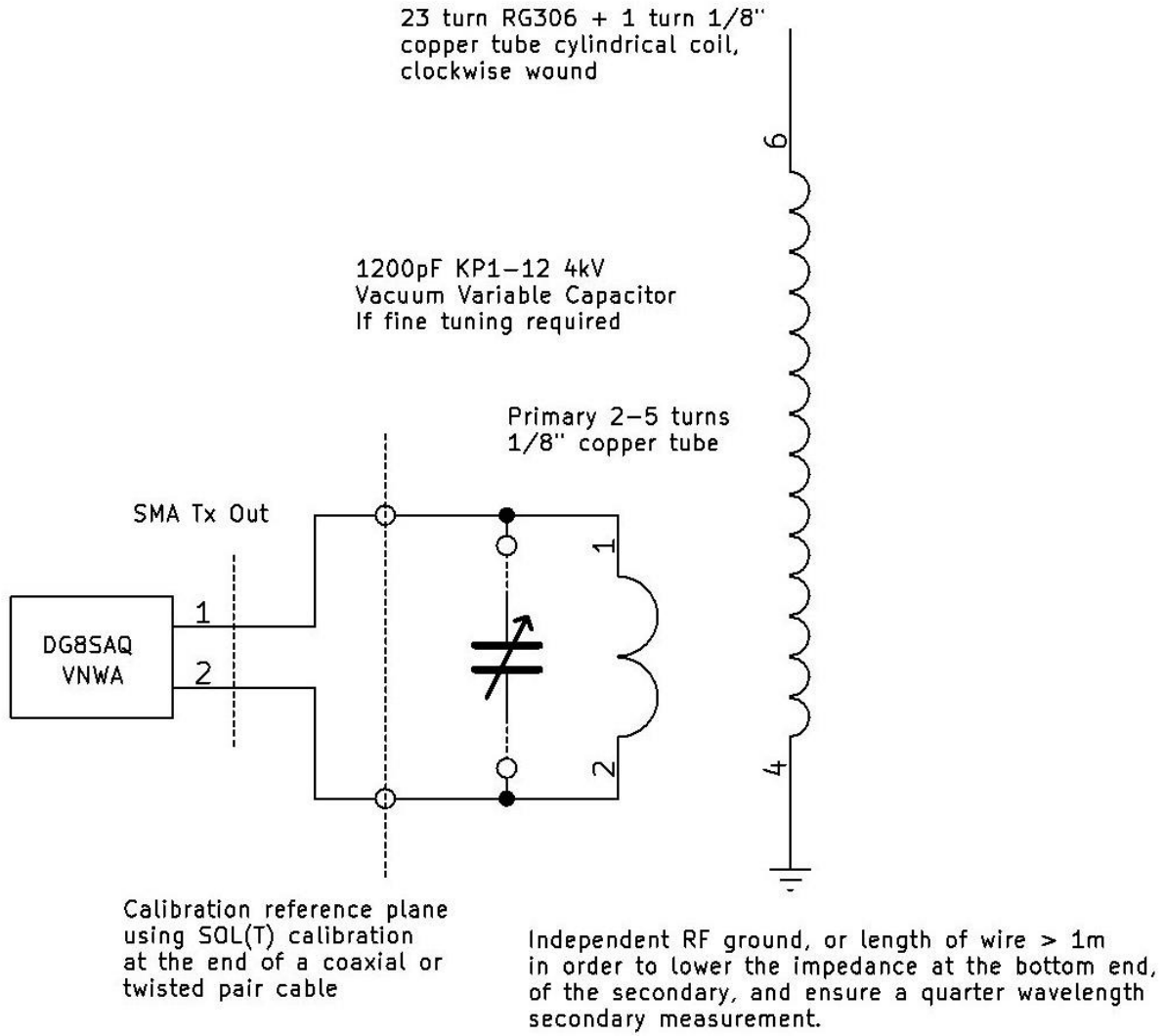
TC Impedance - Series-fed

- Suitable for direct impedance measurement of a single coil, or connected coils, with minimal distortion of the free resonance. e.g. a Tesla secondary and/or extra coil,
- This arrangement is effectively like an antenna placed directly in series with the positive terminal of the generator.
- The negative terminal of the generator is connected down to an independent RF ground, or the line supply ground.
- A Z_{11} single port VNA measurement represents a good measure of the coil characteristics.
- SOLT calibration used to set the reference plane as close to the secondary coil terminal and ground terminal as possible.
- The free resonance of the coil is easily effected by the presence of other coils e.g. a primary or extra coil.
- The free resonance of the high-Q secondary coil is minimally disturbed by connection to the VNA by this method.

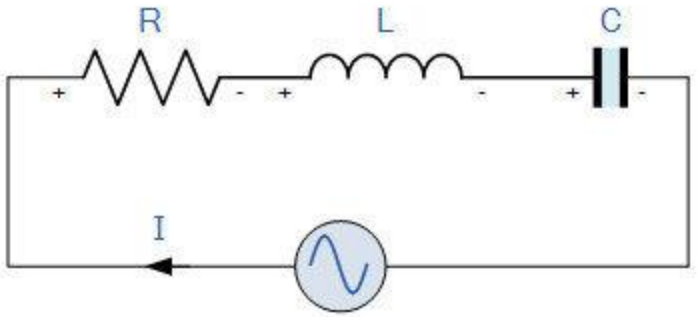


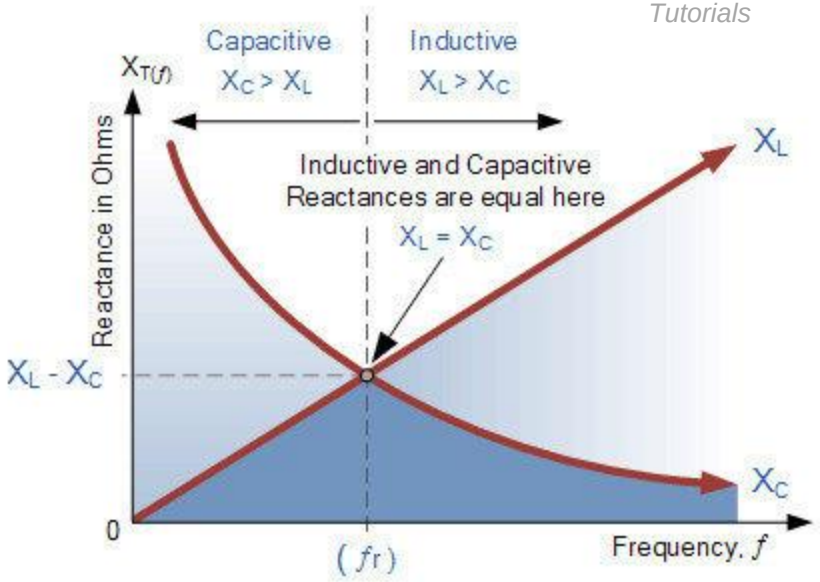
TC Impedance - Primary-fed

- A Tesla coil is operated by electrically driving the primary from a suitable generator.
- A primary-fed measurement looks at the impedance of the complete TC, TMT, and whatever is connected as loads etc.
- A Z_{11} single port measurement will characterise the frequency response of the complete system from the perspective of the generator.
- The Z_{11} measurement is useful for matching the impedance of the generator, and identifying key operating points of interest.
- A Z_{21} two port measurement will characterise the transfer response, from the generator through to the load, of the complete system.
- Tuning of the complete system can be adjusted and measured dynamically.

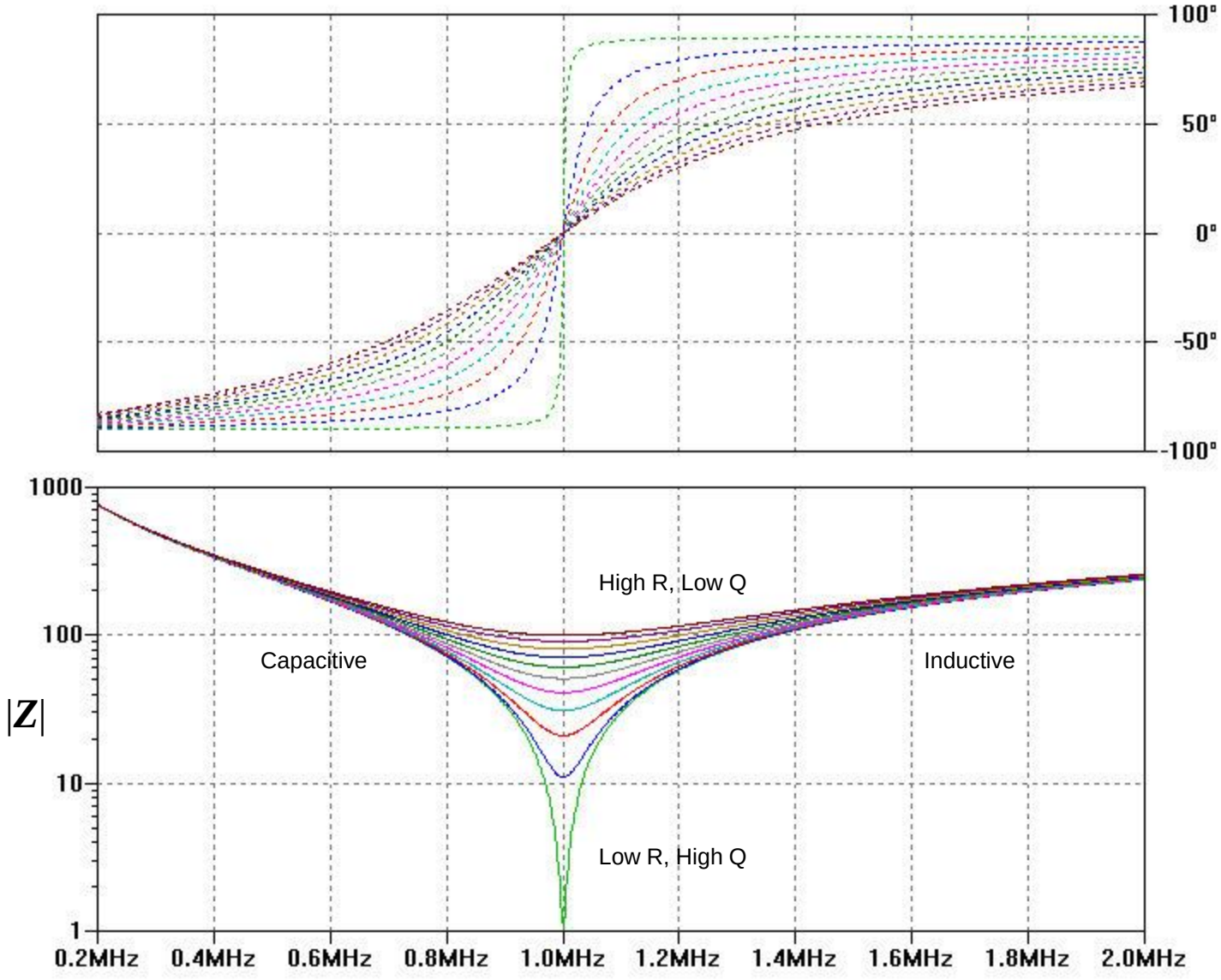


Series Resonance

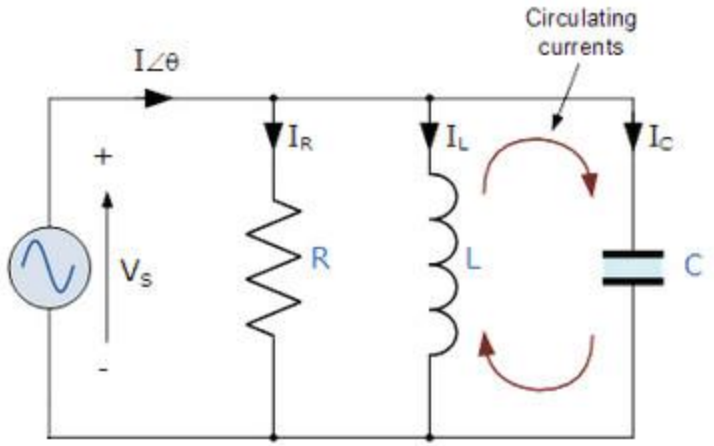




Series Resonance Component Impedance



Parallel Resonance



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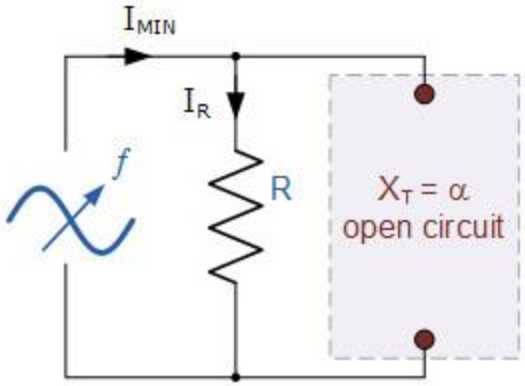
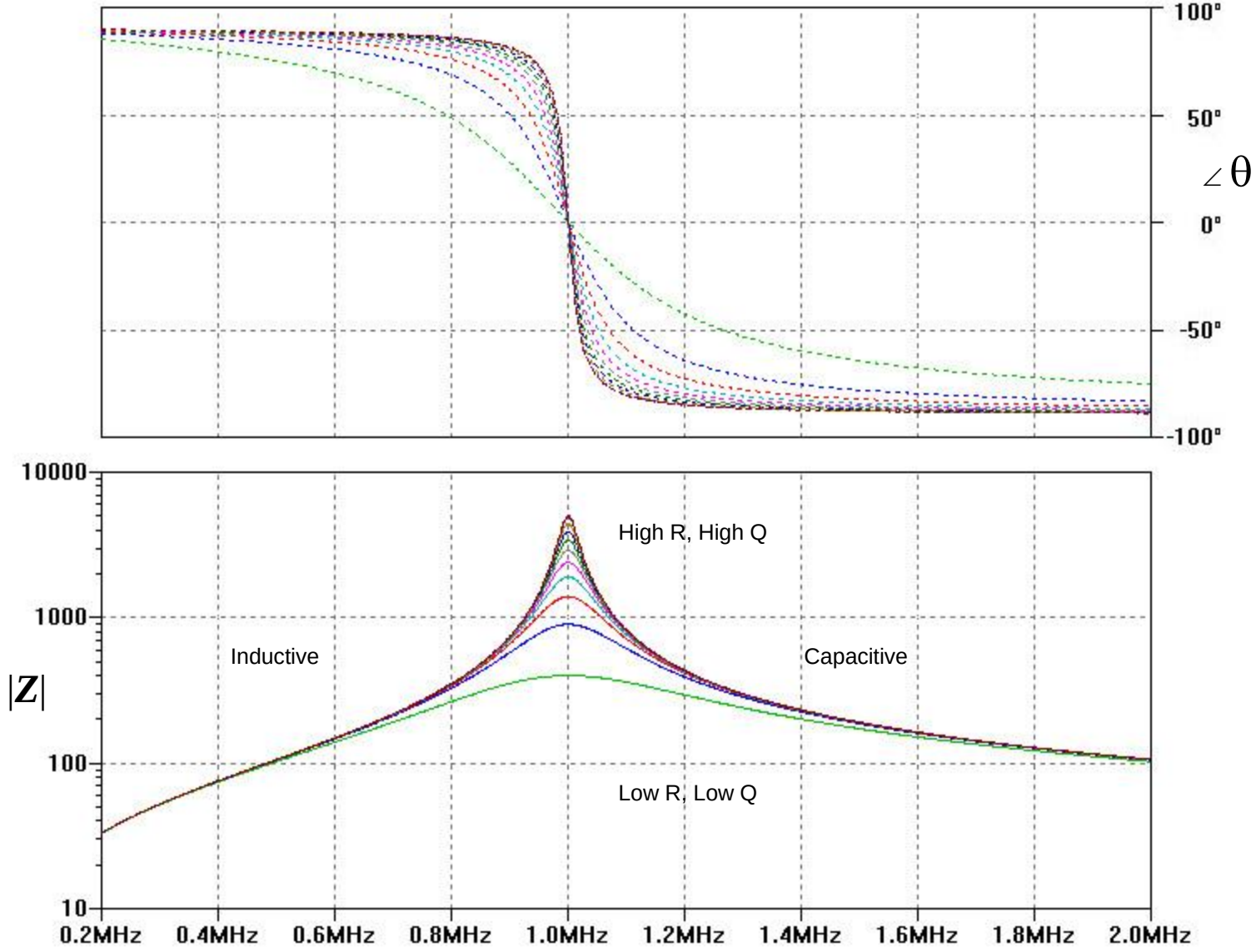
At resonance the reactive current is zero



Parallel Resonance Component Impedance



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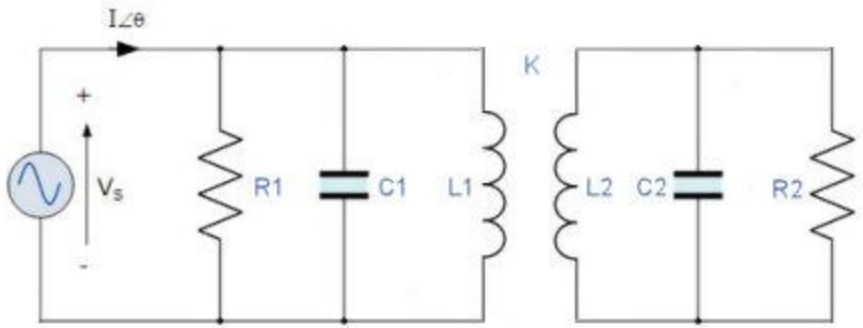
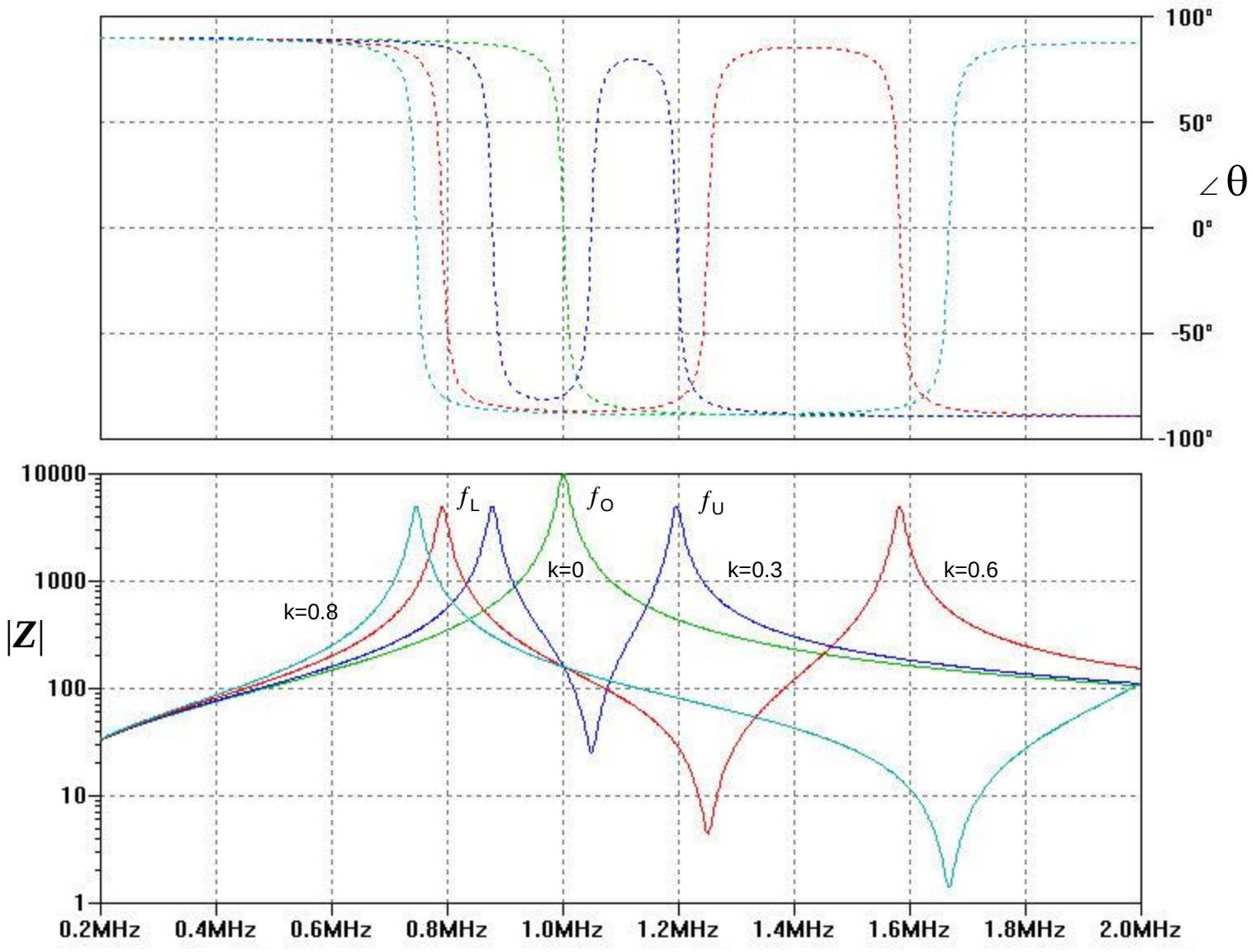
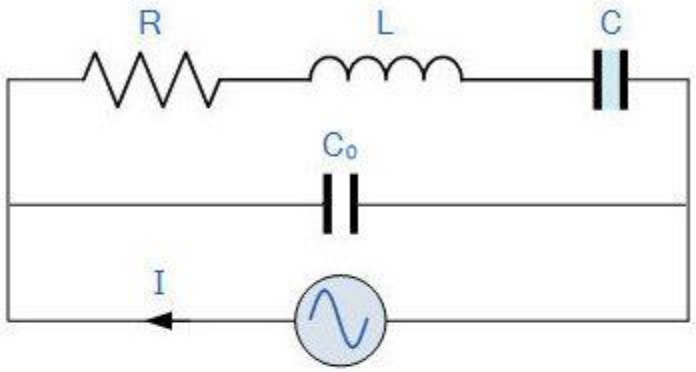
Coupled Resonant Circuits



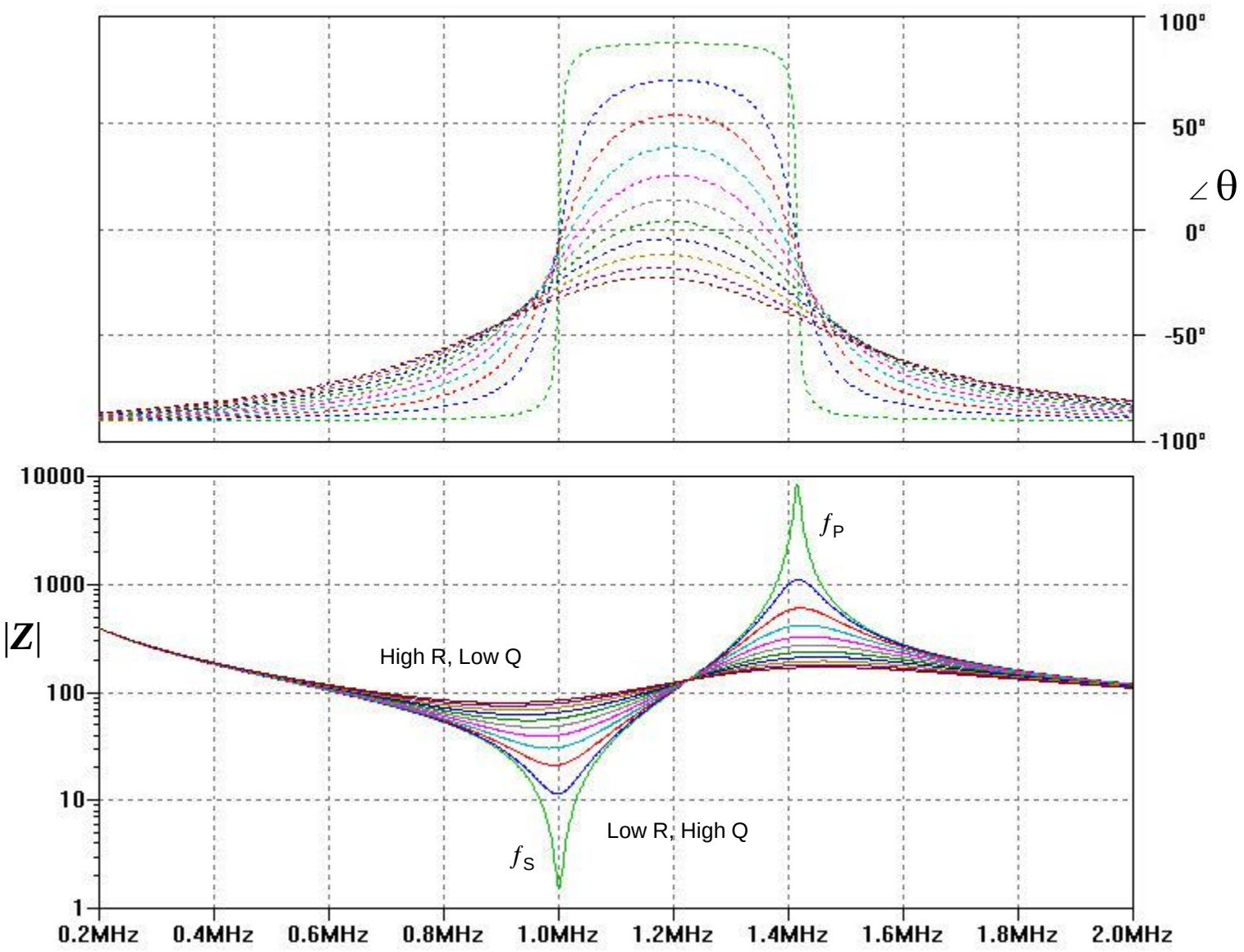
- Coupled resonant circuits interact.
- When both fundamentals f_O are close frequency splitting or “beating” occurs.
- $f_O \rightarrow f_U$ and f_L, (upper and lower).
- Non-coupled the two circuits may have the same resonant frequency.
- As magnetic coupling coefficient *k* increases, f_U and f_L move further apart.
- Tesla coils have coupled primary and secondary coils, typically *k* ~ 0.1 - 0.3

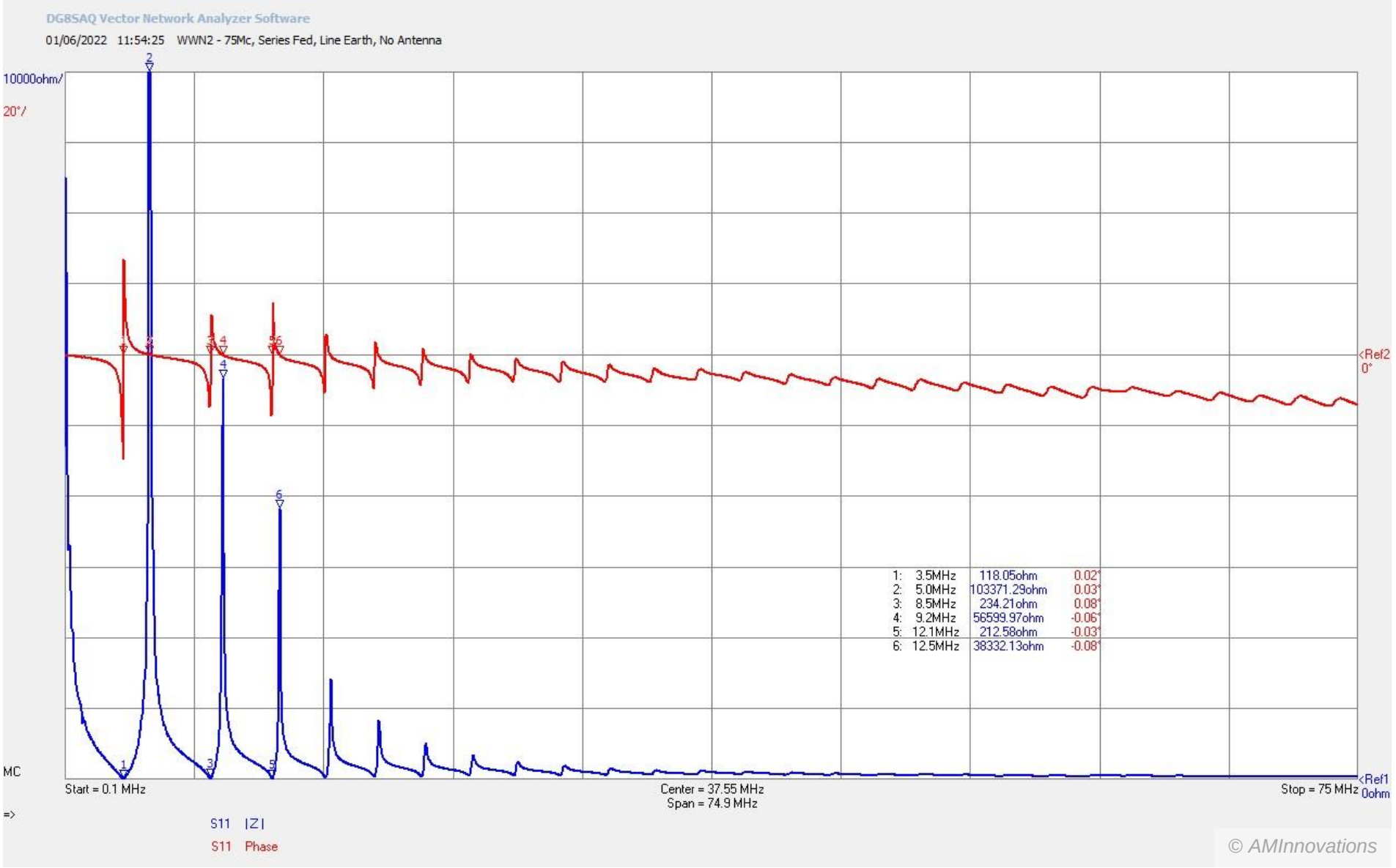


Multiple Resonant Modes

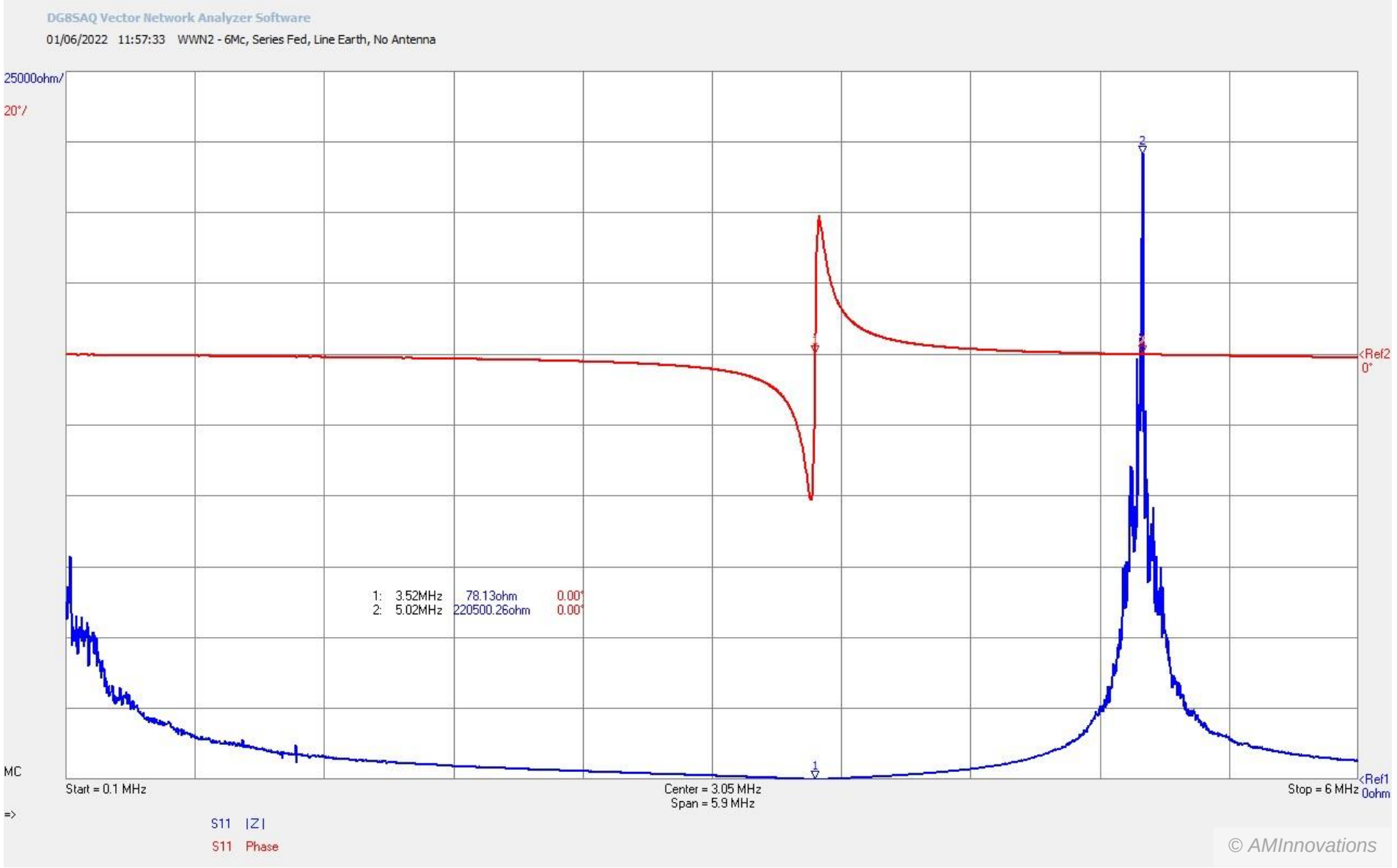


- Crystals and piezo-electric materials exhibit multiple resonant modes, both a series f_S, and parallel f_P, resonance.
- The equivalent circuit has both parallel and series resonant circuits.
- A Tesla coil secondary is a complex distributed resonator and can also exhibit f_S and f_P resonant modes.
- The combination of multiple resonant modes and frequency splitting in a TMT system represents a significant tuning and generator matching challenge.

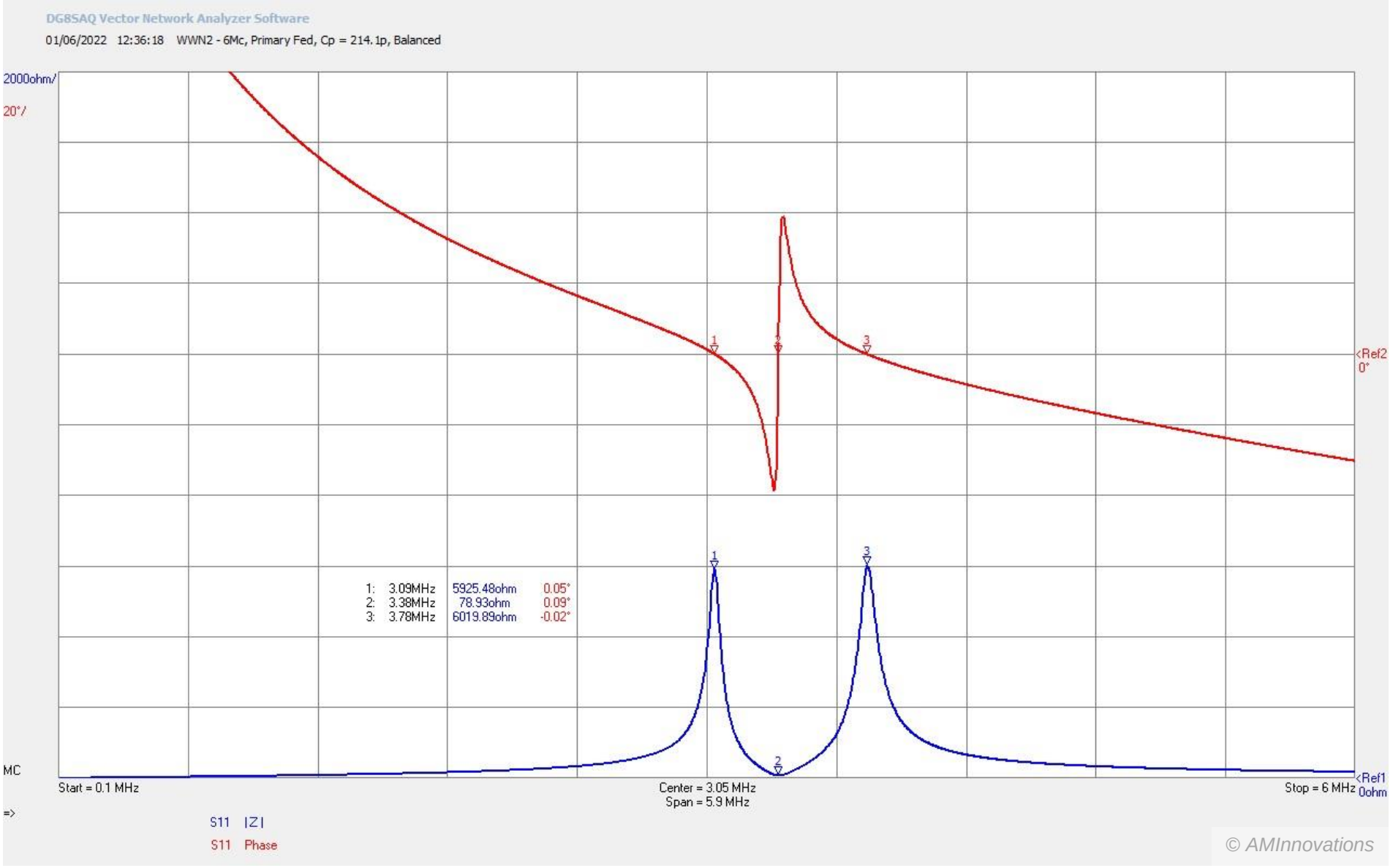




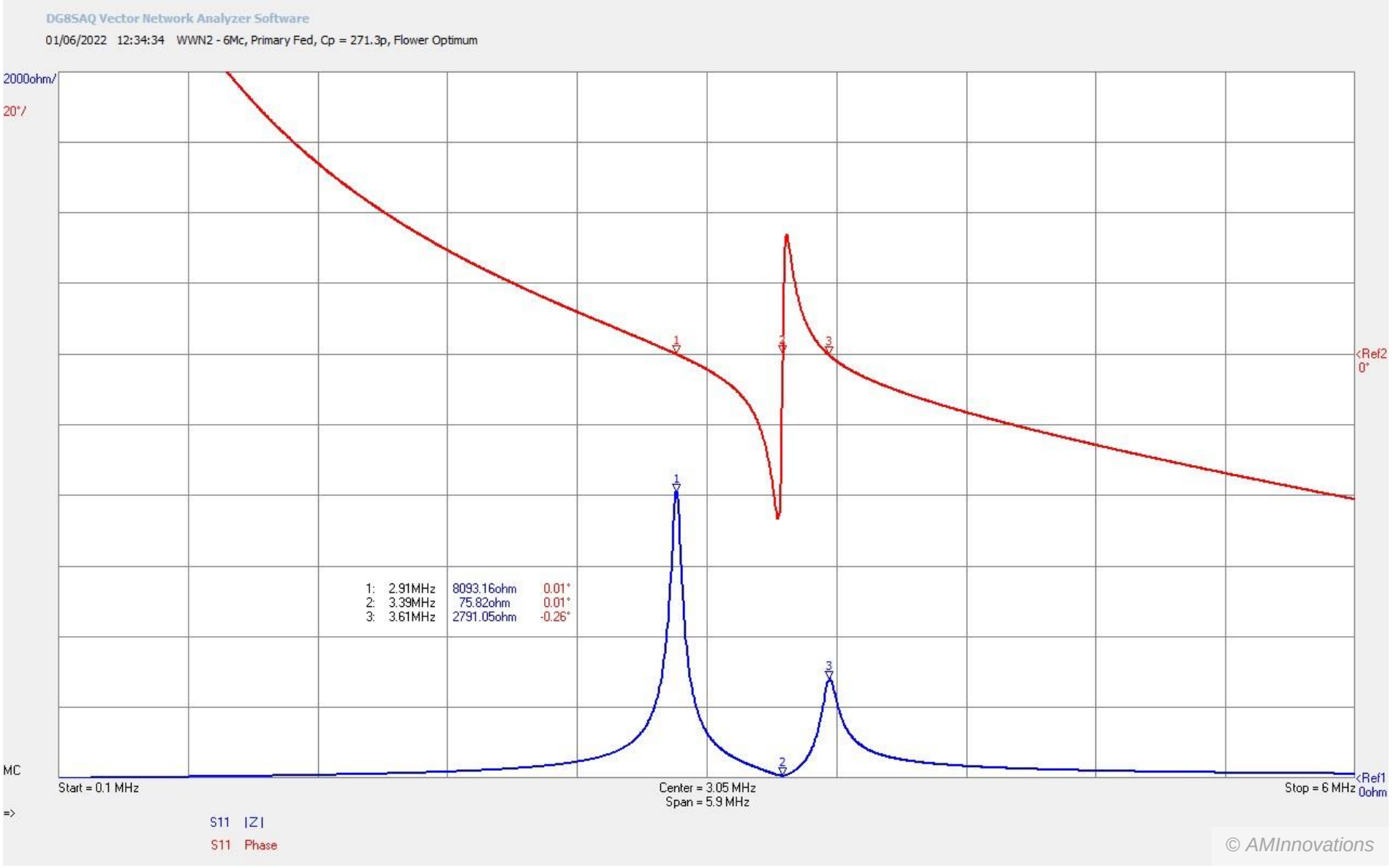
Input Impedance Z_{11} - Series-Fed Secondary Coil 1 Only, Wideband 75Mc Scan



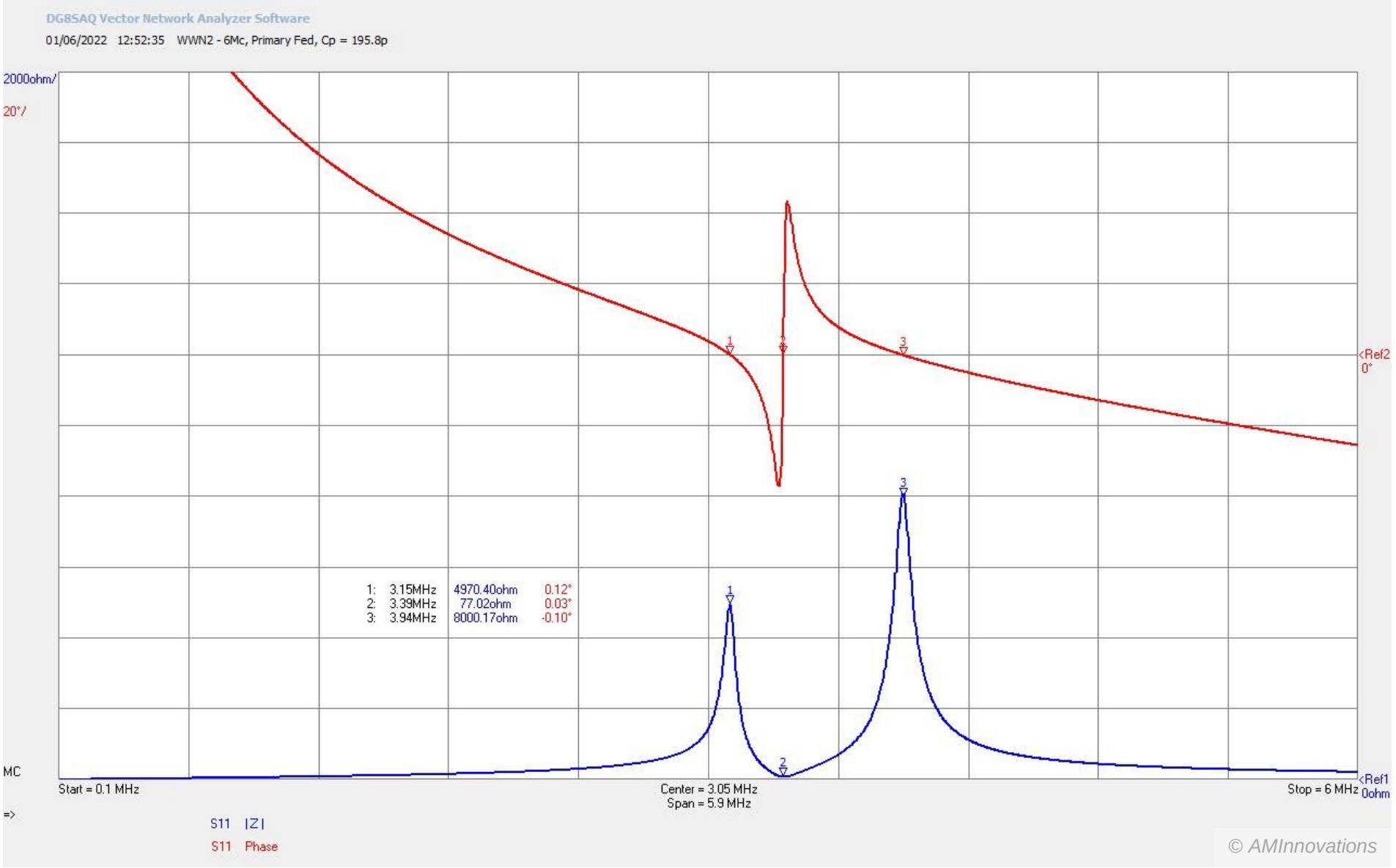
Input Impedance Z_{11} - Series-Fed Coil 1 Only, Fundamental Series and Parallel Resonant Modes



Input Impedance Z_{11} – Primary-fed Coil 1, Cp = 214.1pF, Balanced Parallel Modes



Input Impedance Z_{11} – Primary-fed Coil 1, Cp = 271.3pF, Lower Parallel Mode



Input Impedance Z_{11} – Primary-fed Coil 1, Cp = 195.8pF, Upper Parallel Mode

Coil Tuning Results

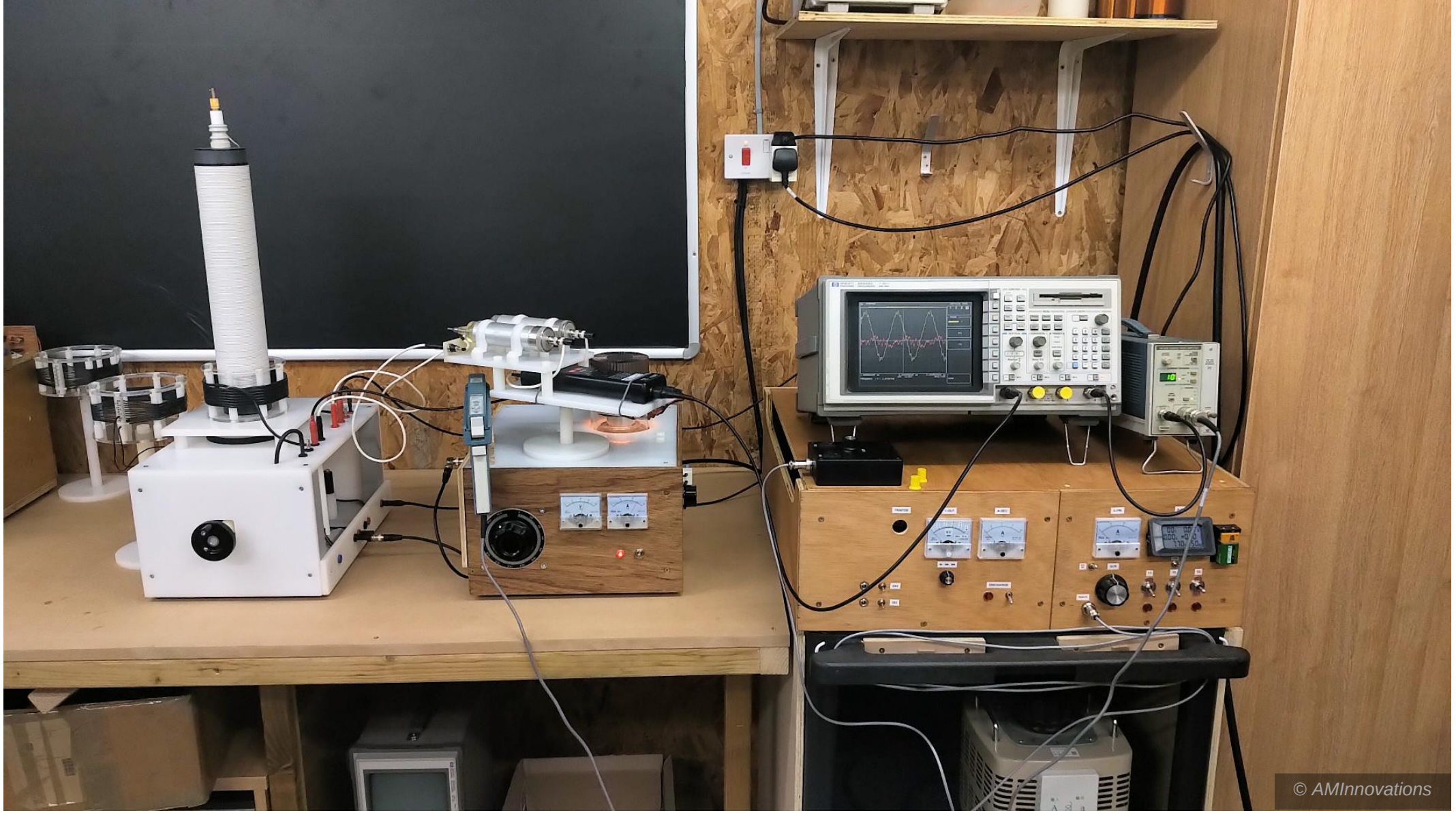
- Vacuum Tube Class-C Armstrong Oscillator with auto-feedback from grid leakage bias:
  - Frequency tracking to match the lower or upper parallel resonant modes.
  - Variable vacuum capacitor in primary adjust and fine-tunes oscillator characteristics.

Secondary Coil	Design Frequency	VNWA Measured and Generator Driven				
	Free f_{ss} (kc)	Series-Fed f_{ss} (kc) *1	Lower Parallel f_L (Mc) *2	Upper Parallel f_U (Mc) *2	Primary C_P (pF) *3	Resistance @ fss
Original, 1	3494	3410	2.40 - 2.85	3.21 - 3.45	197	28.5
2	2068	2030	1.44 - 1.80	2.15 - 2.34	528	20.0
3	1013	1100	0.79 - 0.91	1.16 - 1.38	1634	8.7
4	570	640	No Oscillation	0.75 - 0.87	4951	6.2
5	357	410	No Oscillation	0.49 - 0.73	11676	5.2

*1. Series-fed measurement of the free resonant frequency of the secondary coil only, and without the primary coil or primary tuning capacitor C_P.

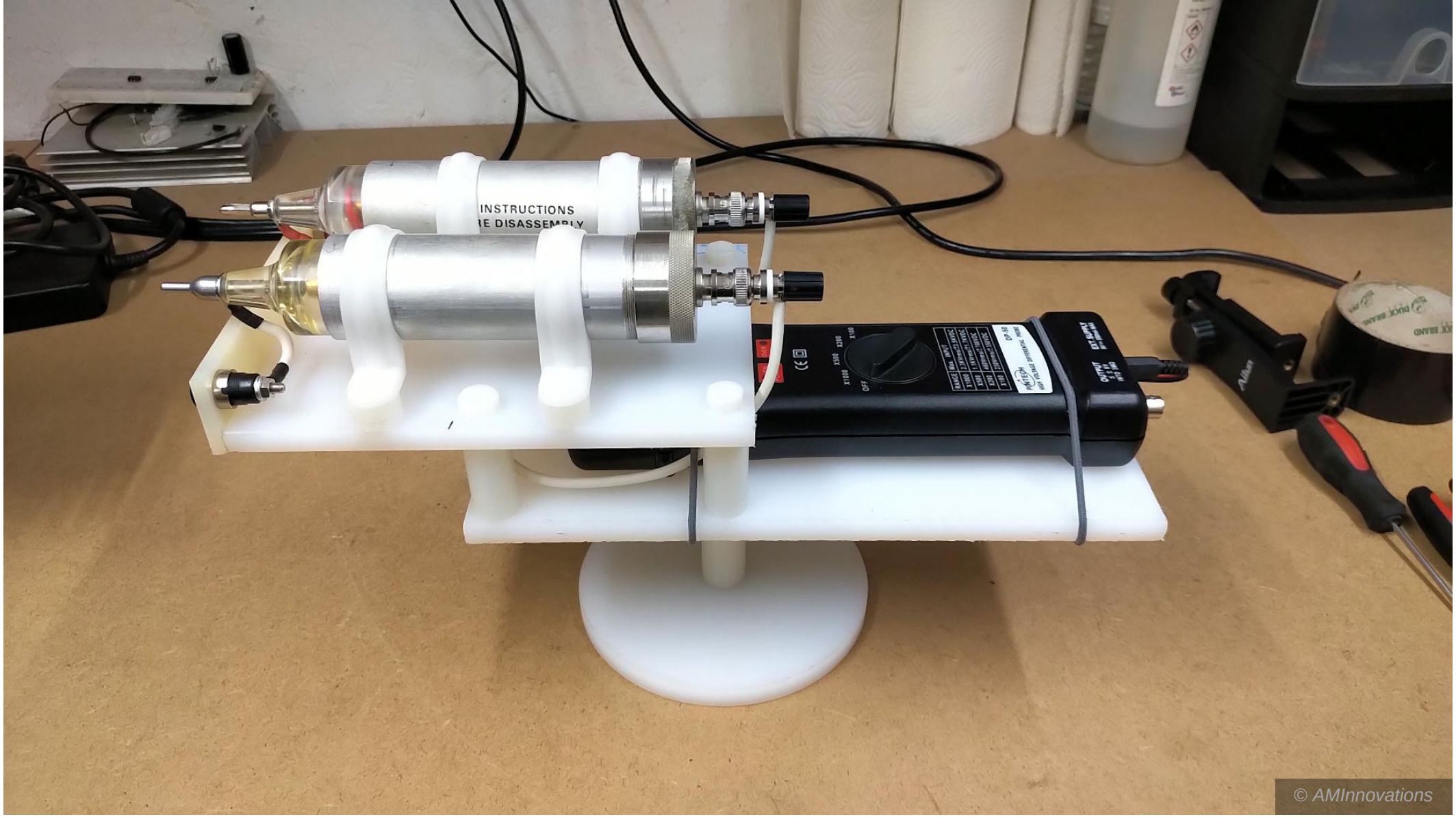
*2. The lower and upper parallel mode ranges f_L and f_U are tuned using a KP1-4 vacuum variable capacitor as the primary circuit tuning capacitor, and where required combined with an additional fixed parallel capacitance. The combination of these two primary circuit capacitors forms C_P.

*3. The primary tuning capacitance required to balance the lower and upper parallel modes f_L and f_U, (equal magnitude of impedance at zero phase angle).

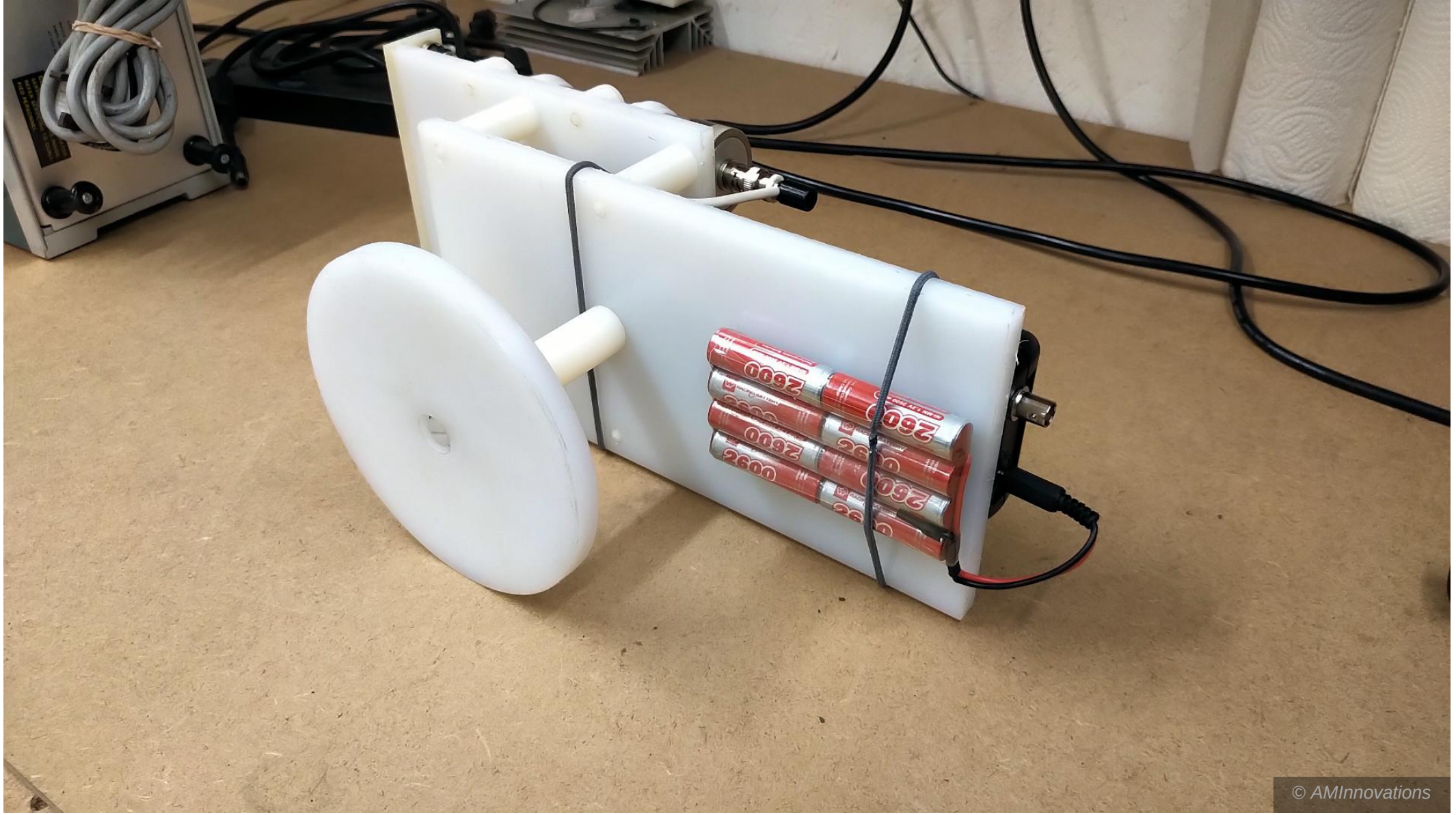


Experimental Apparatus and Measurement Equipment Setup

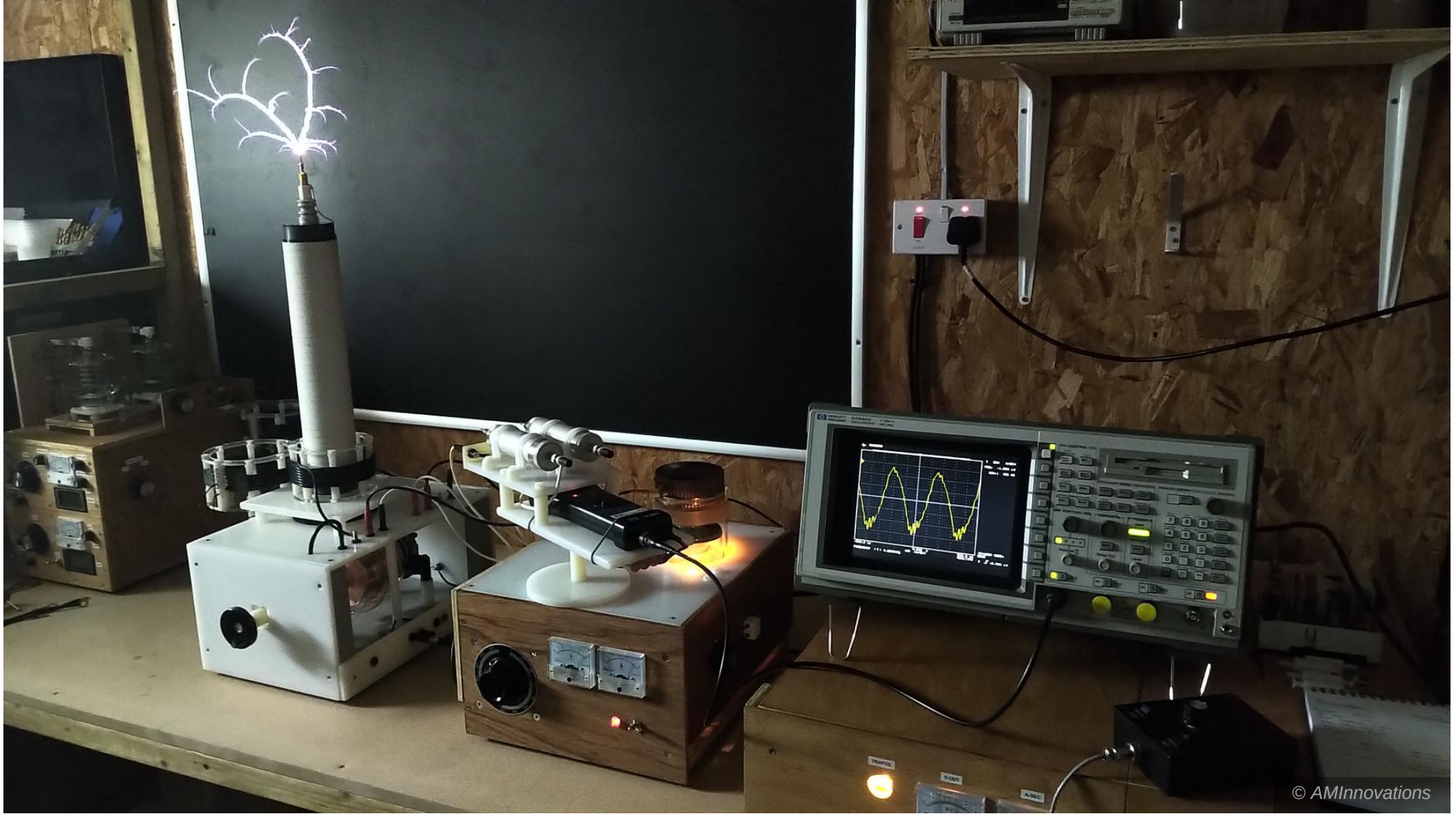
Extra High Voltage Differential Probe 80kV pk-pk, and Tektronix A6303 100A Current Probe



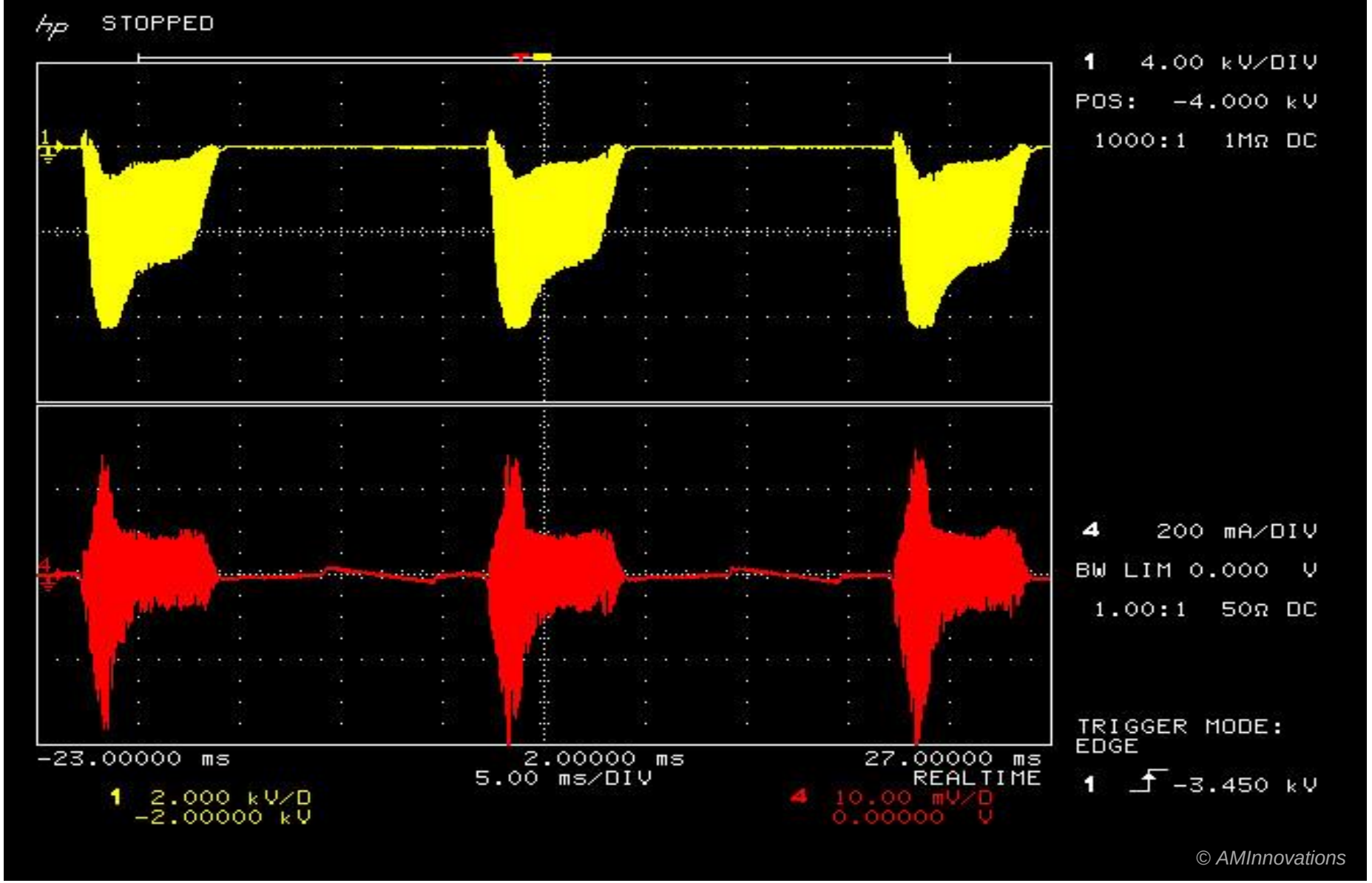
Custom Extra High Voltage Differential Probe - 2 x Tektronix P6015A, and Pintech DP-50



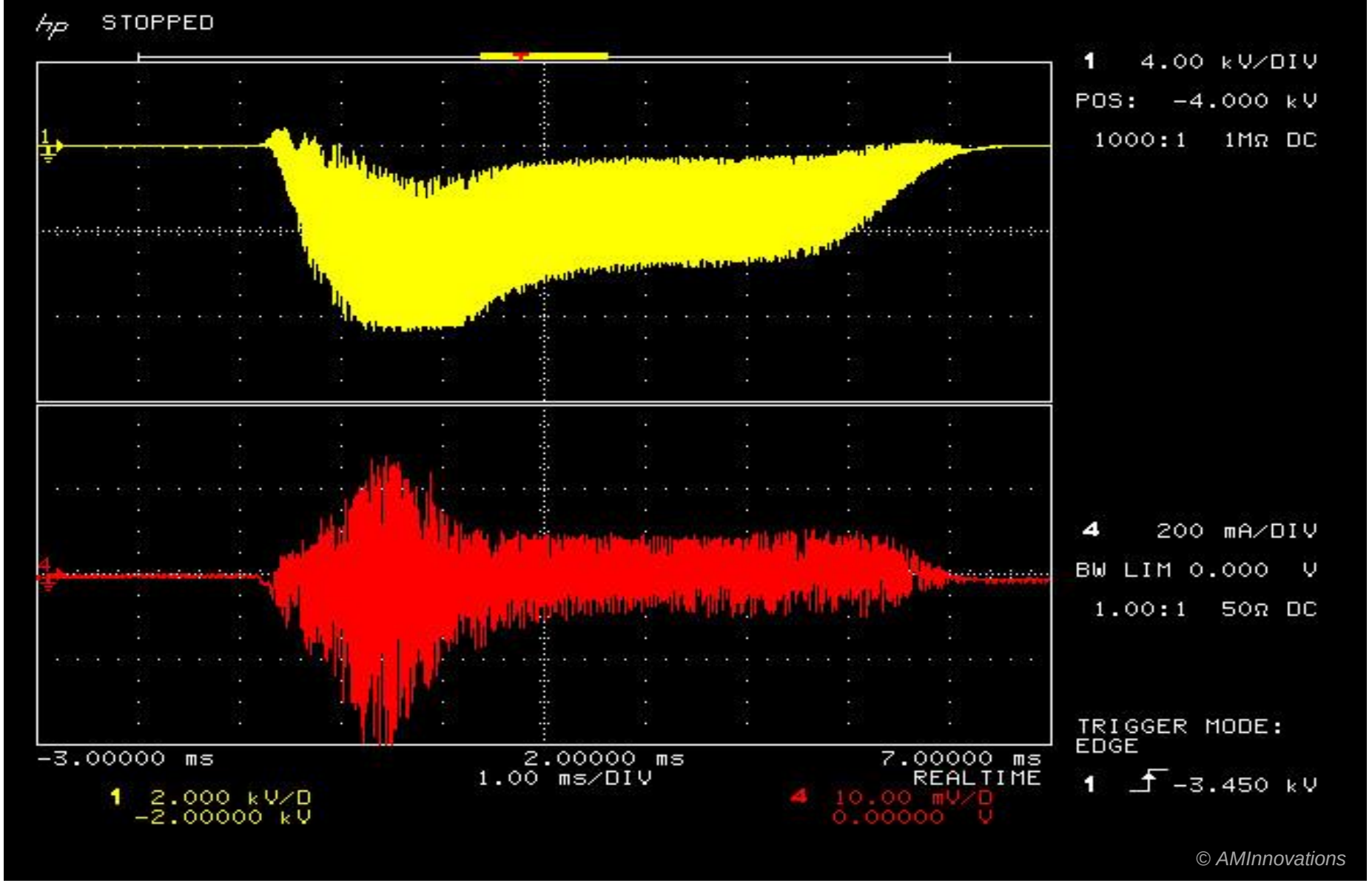
Custom Differential Probe powered by batteries - Electrical isolation between the experiment and measurement



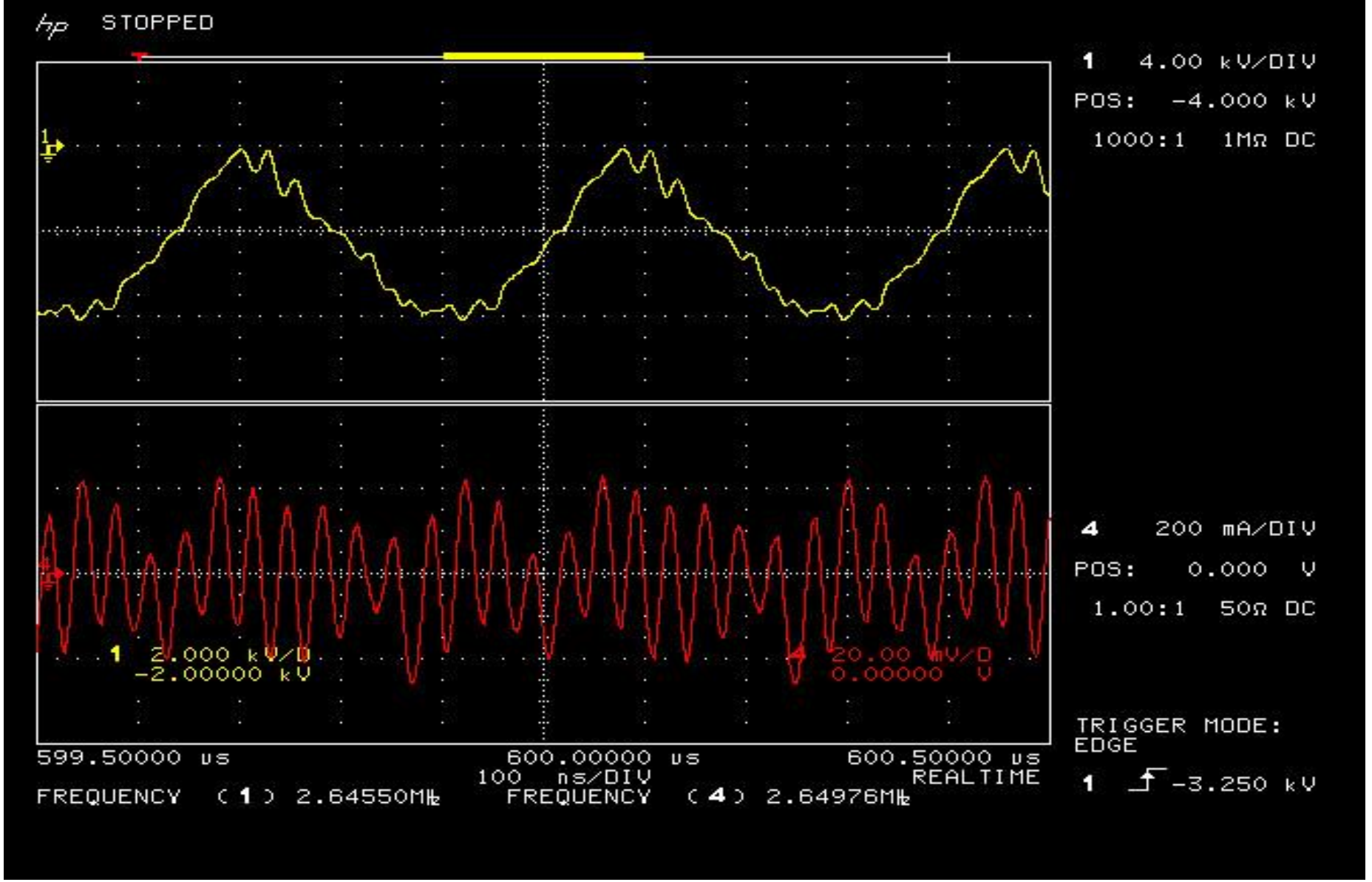
Apparatus during operation showing the Golden Ratio Discharge



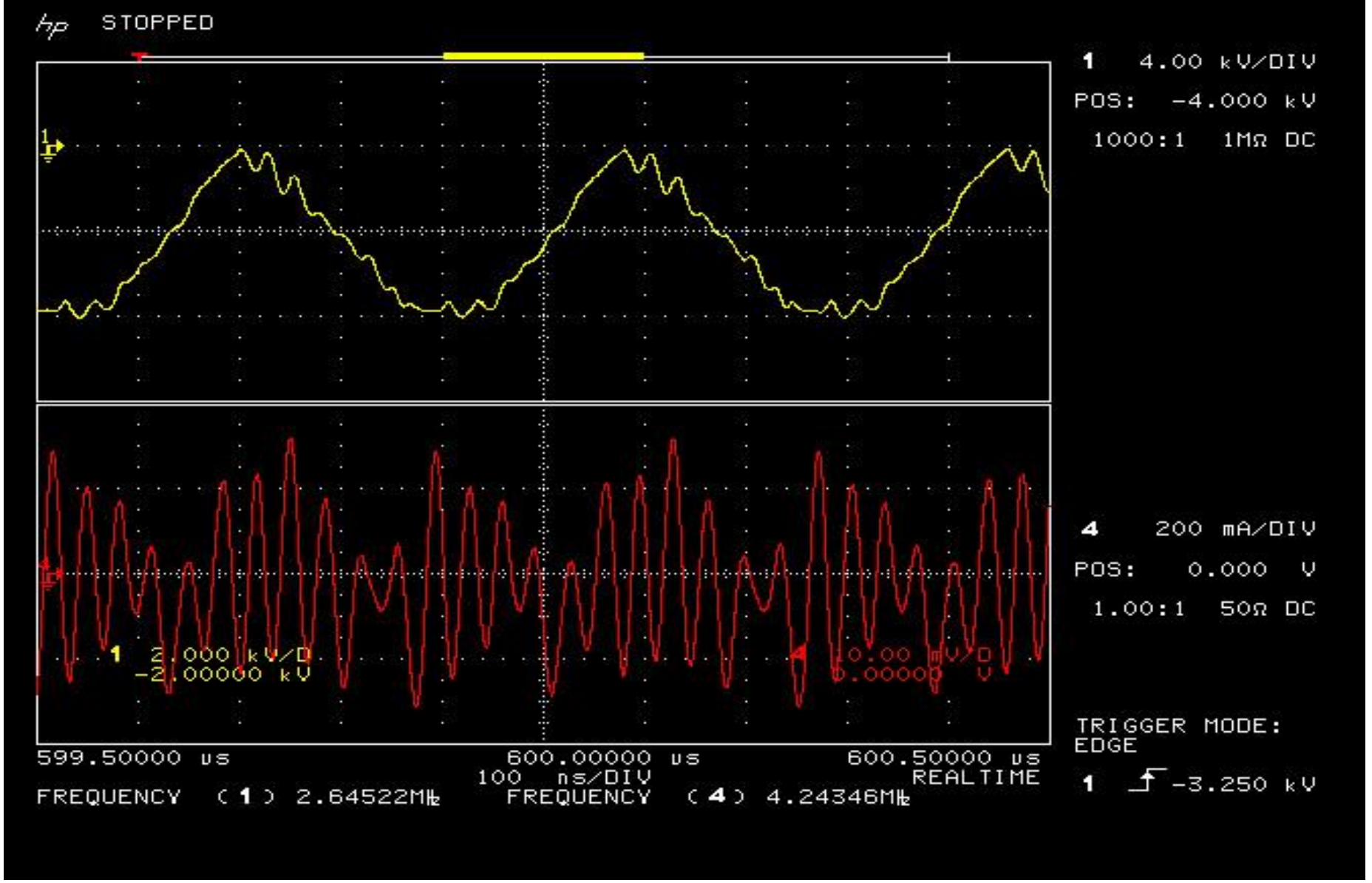
Primary Coil Input Burst Waveform 9kV pk-pk (yellow), 700mA pk-pk (red), 6ms Burst, 20ms Period, Half-wave 50Hz



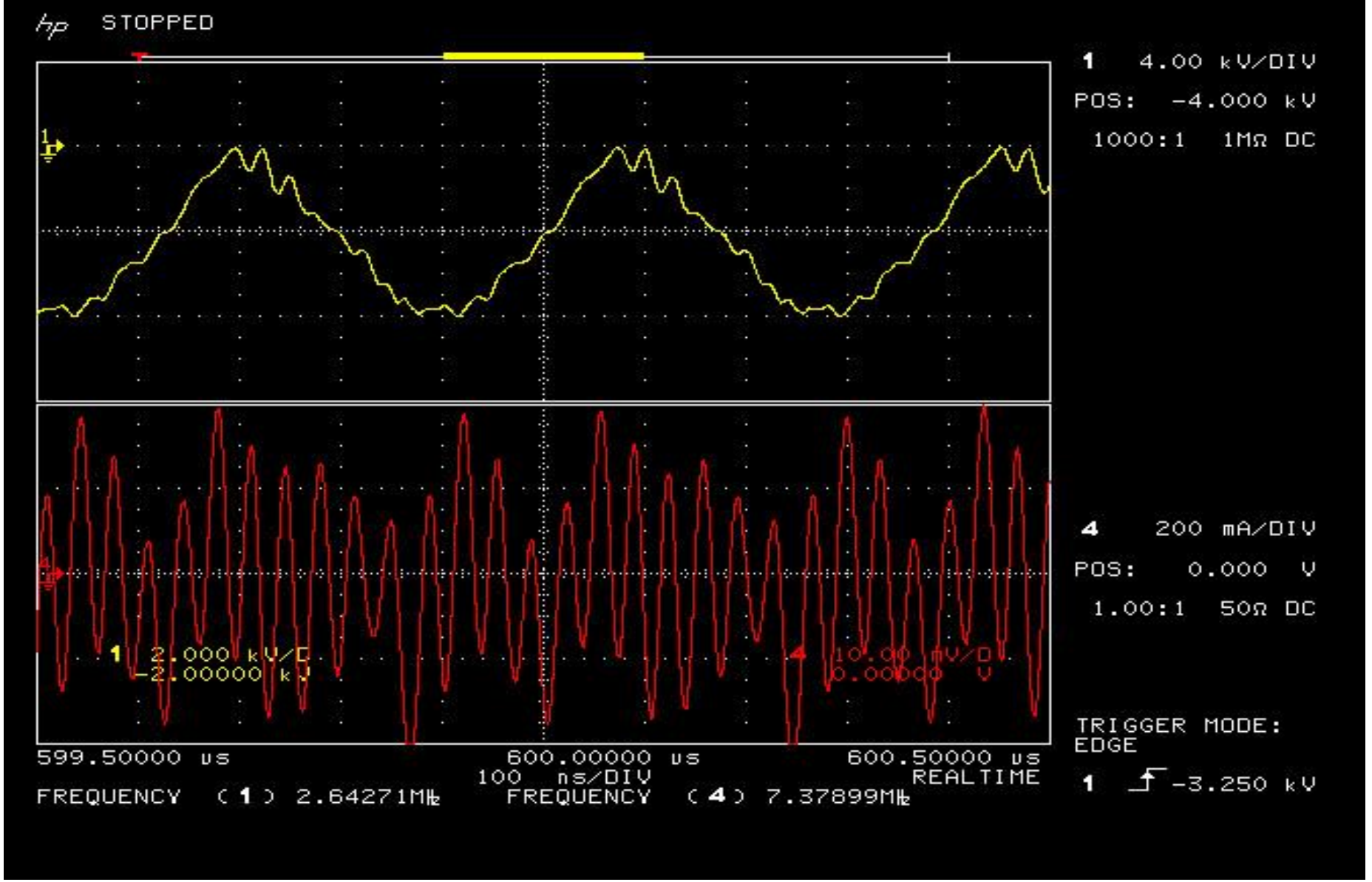
Primary Coil Single Burst Waveform – 9kV pk-pk (yellow), 700mA pk-pk (red), 6ms Burst, Under-sampled



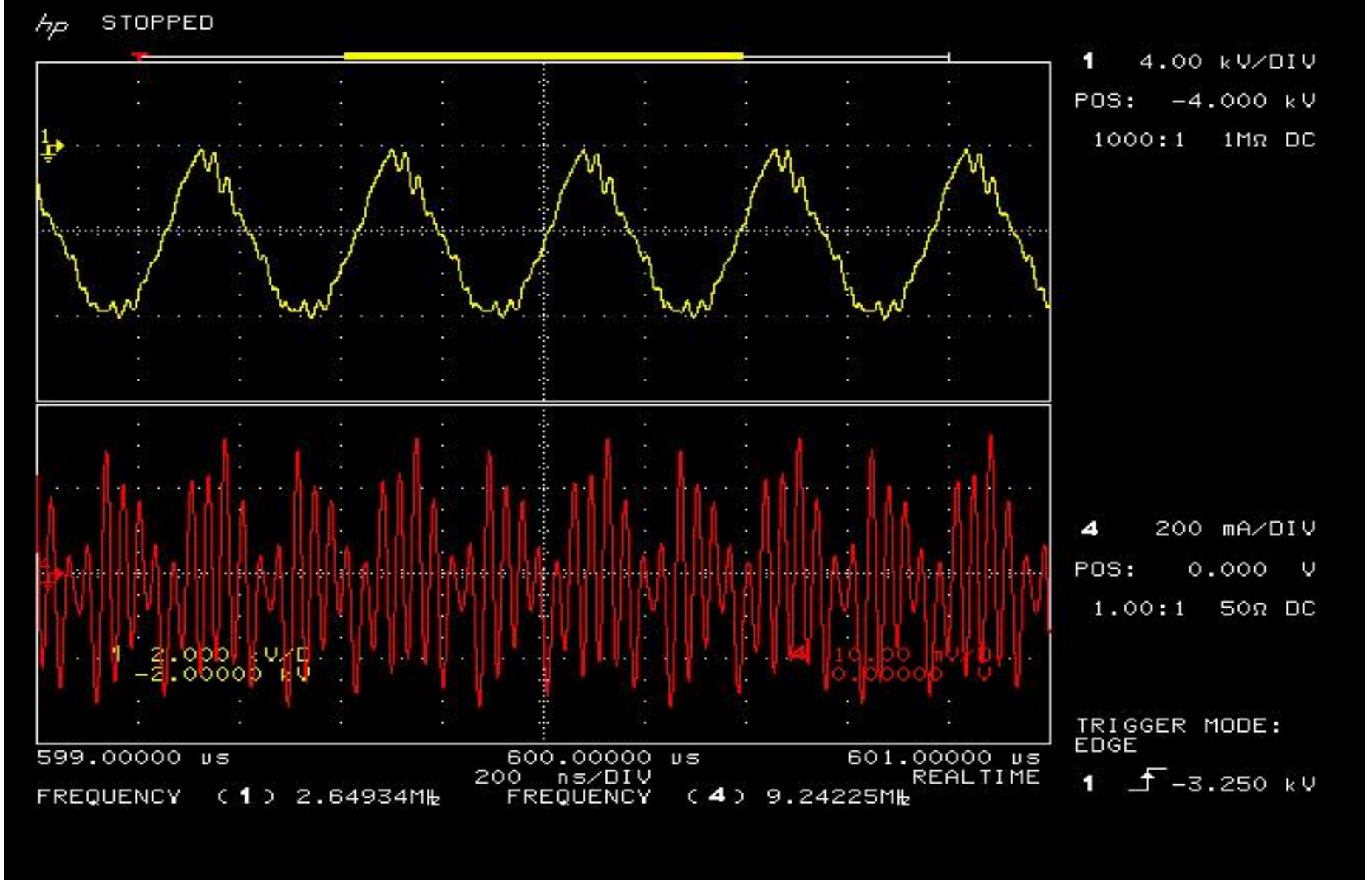
Secondary Coil Free Oscillation – 8kV pk-pk (yellow) 2.64Mc, 500mA pk-pk (red) 2.64Mc



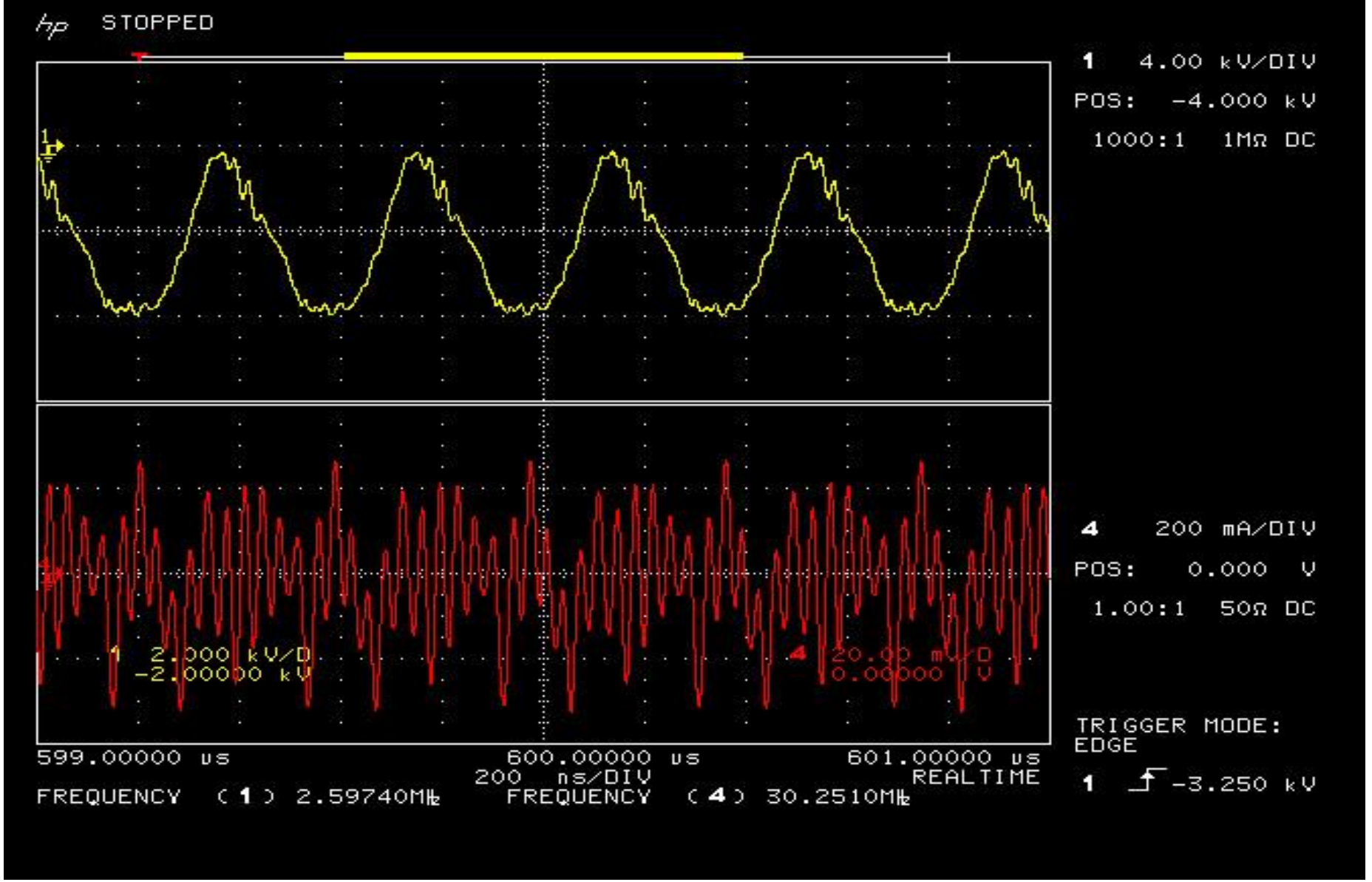
Secondary Coil Free Oscillation – 8kV pk-pk (yellow) 2.64Mc, 600mA pk-pk (red) 4.24Mc



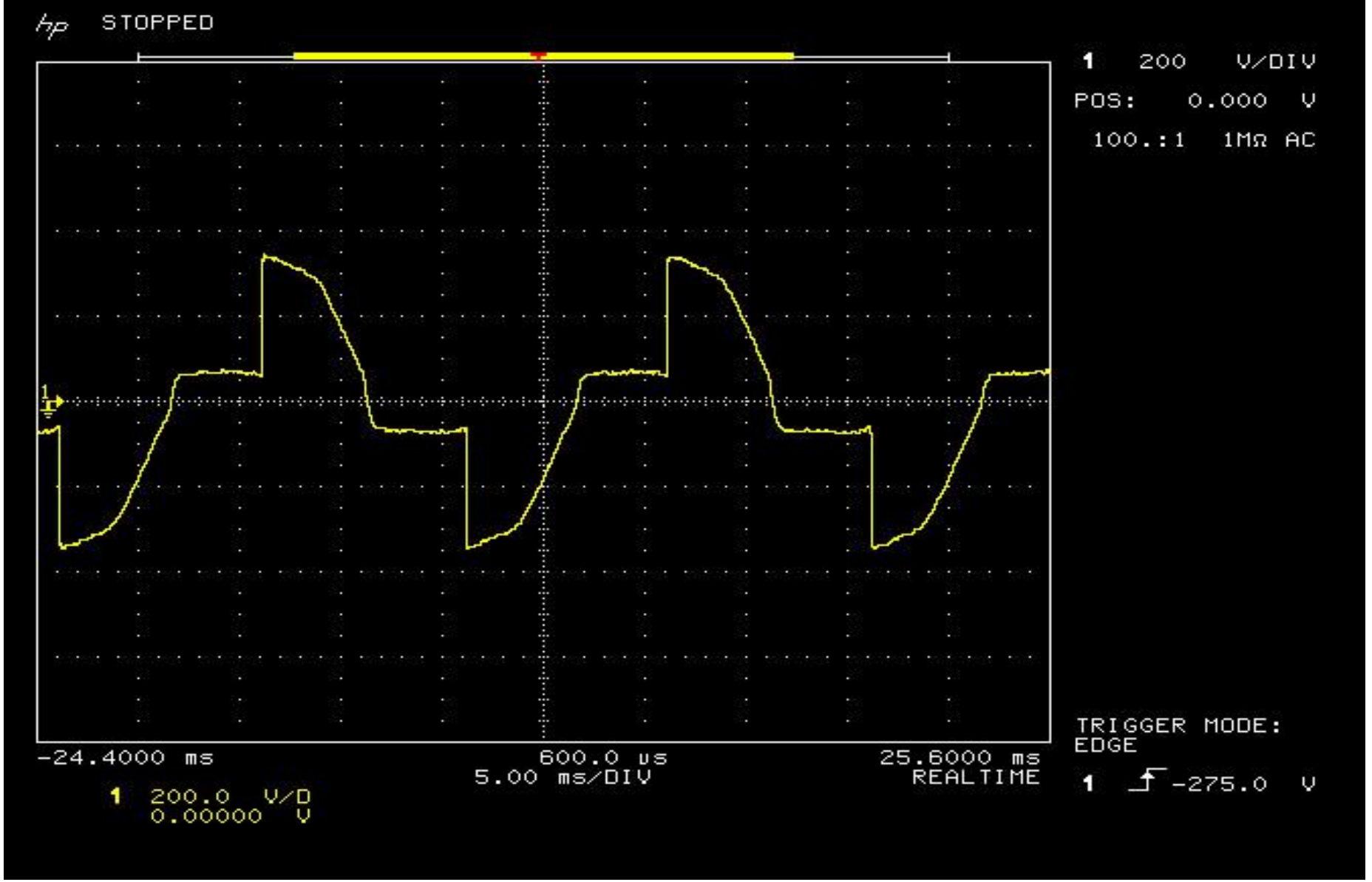
Secondary Coil Free Oscillation – 8kV pk-pk (yellow) 2.64Mc, 800mA pk-pk (red) 7.37Mc



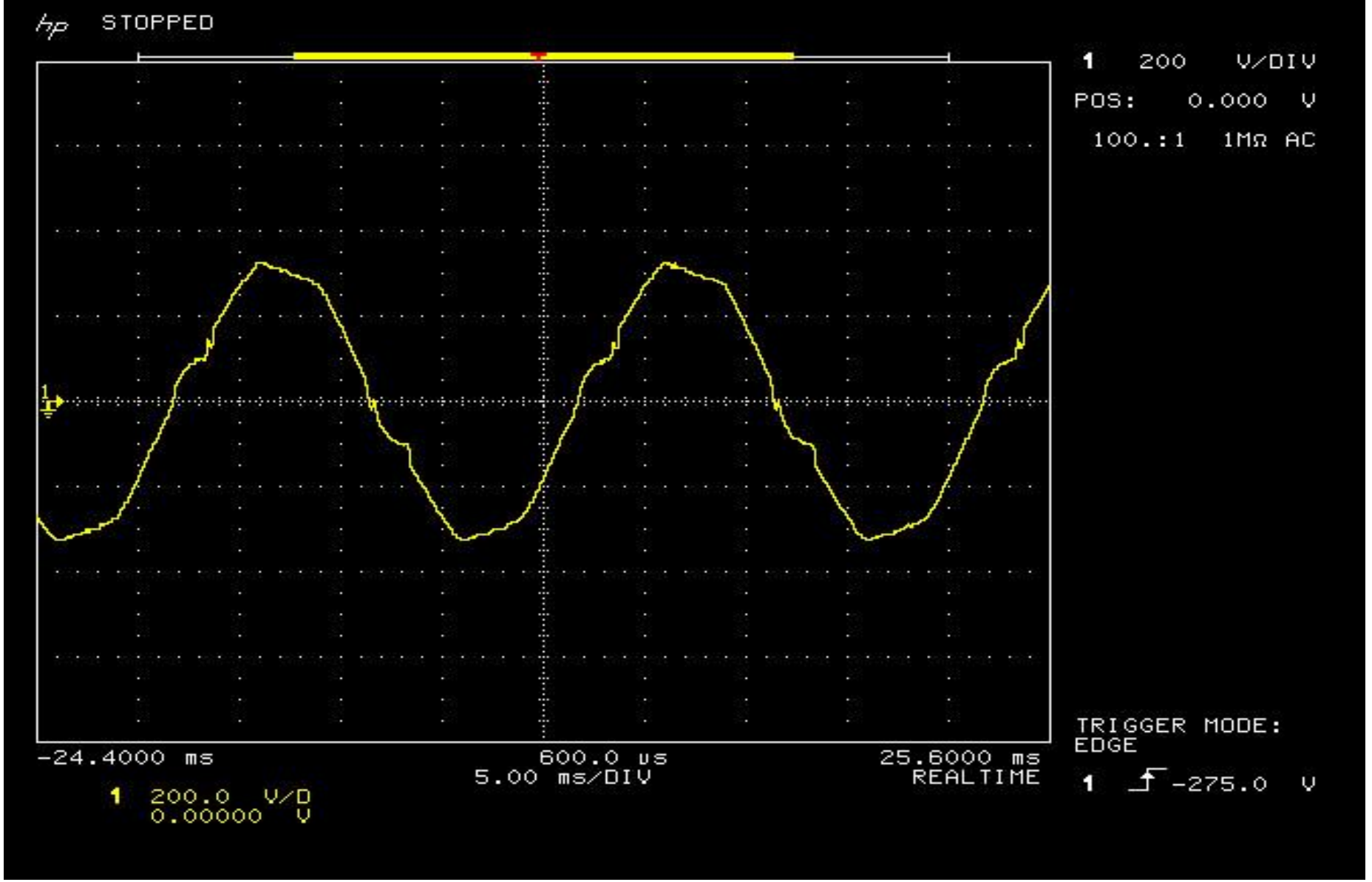
Secondary Coil Free Oscillation – 8kV pk-pk (yellow) 2.64Mc, 600mA pk-pk (red) 9.24Mc



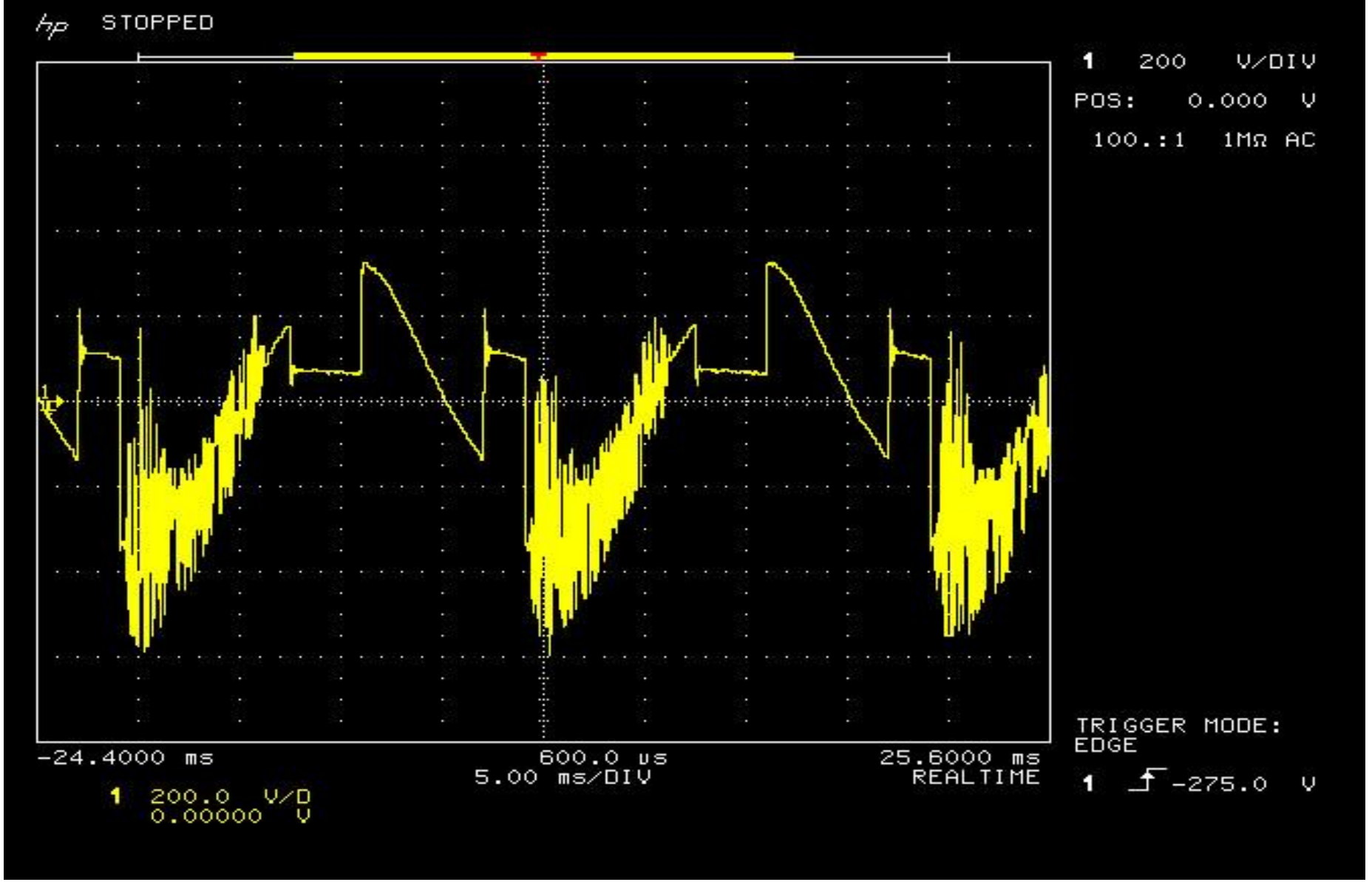
Secondary Coil Free Oscillation – 8kV pk-pk (yellow) 2.64Mc, 600mA pk-pk (red) 30.25Mc



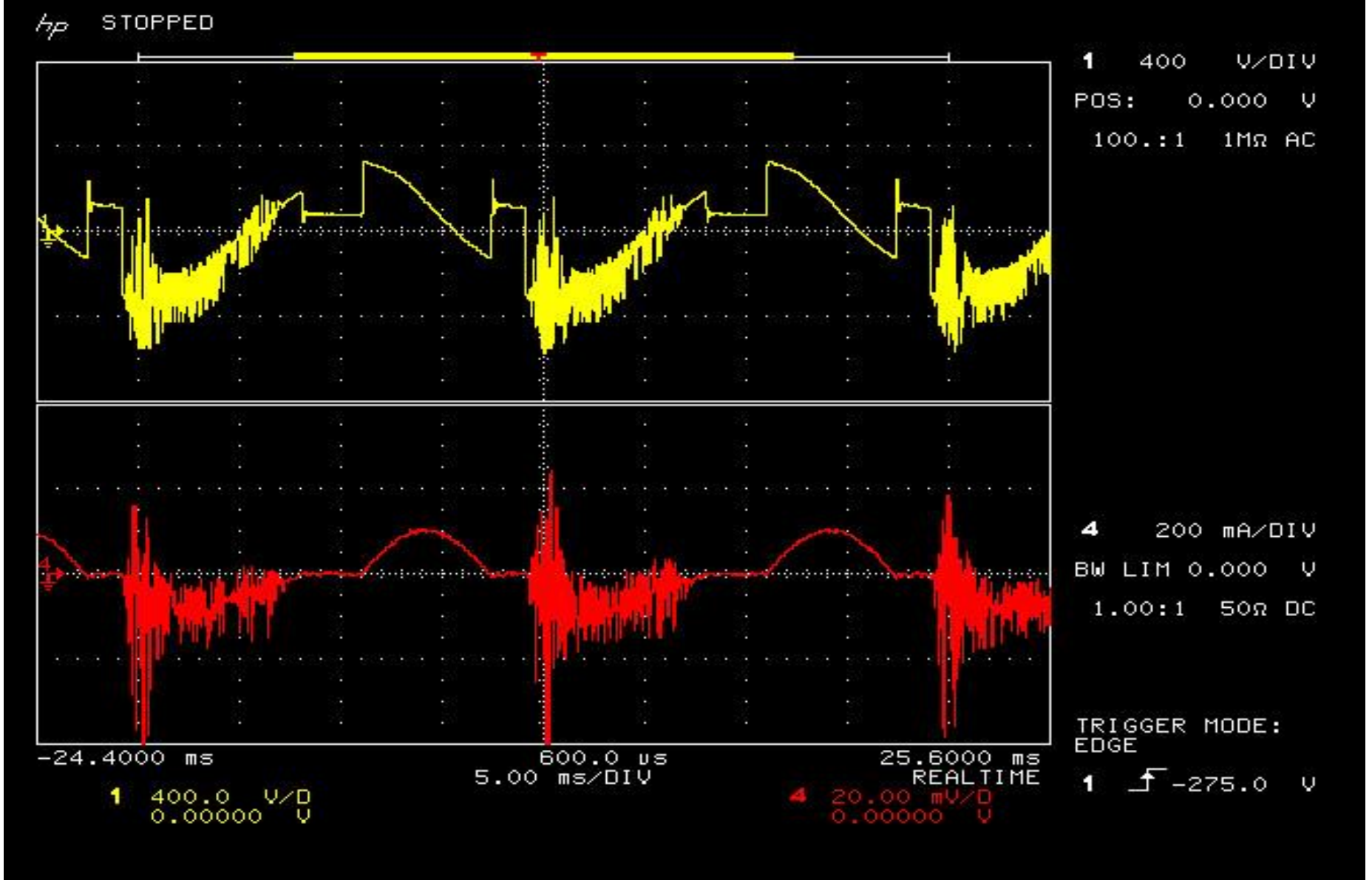
HV Transformer Primary - SCR 50%



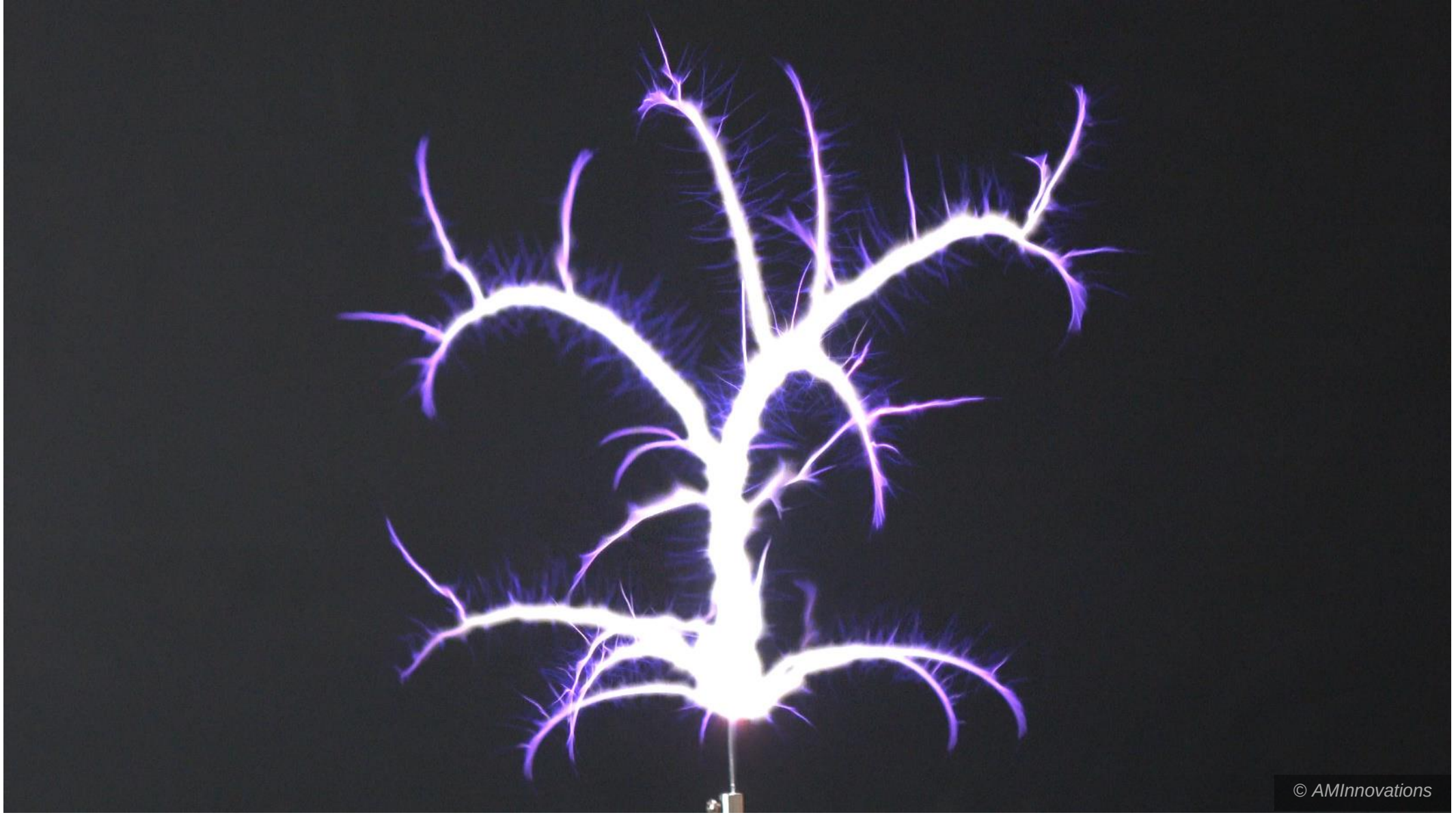
HV Transformer Primary - SCR 100%



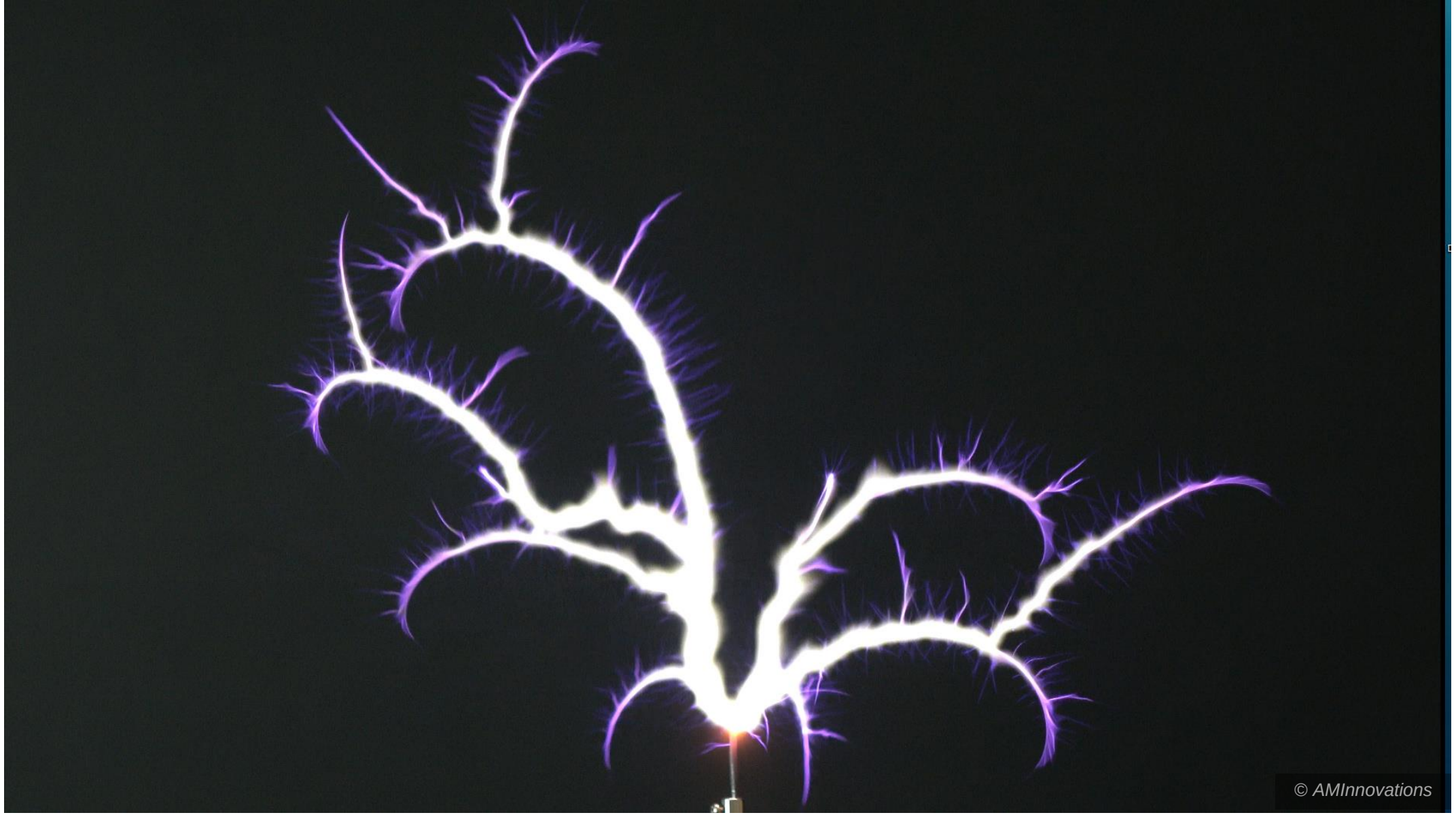
HV Transformer Primary Combined with Primary Coil Input Burst - SCR 60%



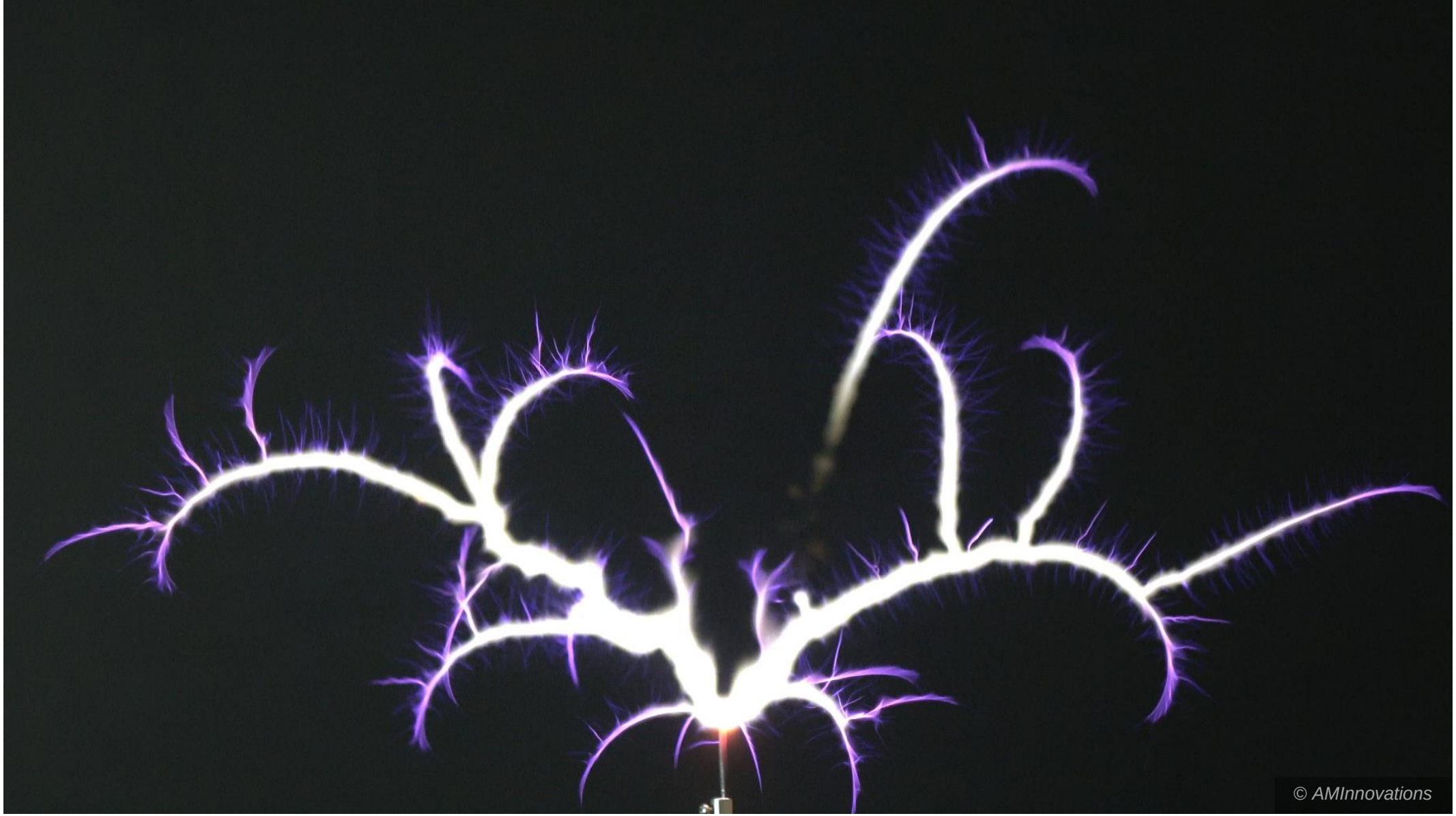
HV Transformer Primary Combined with Primary Coil Input Burst (Voltage and Current) - SCR 60%



4K Images taken by the Sony RX10M2 - Micro-filaments (blue hedge) that appear to result from parasitic oscillation



4K Image – Primary, Secondary, and Tertiary tendrils

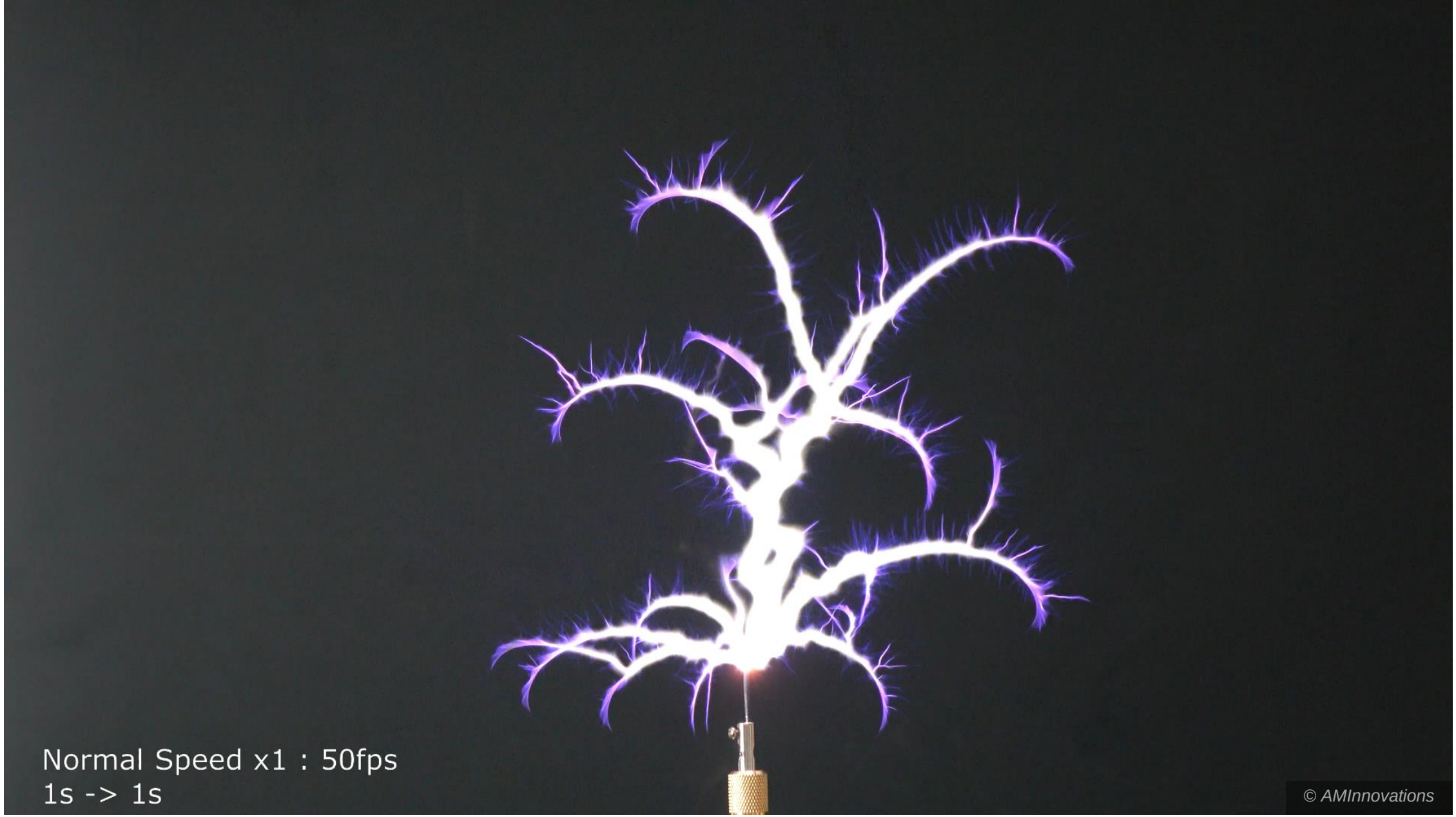


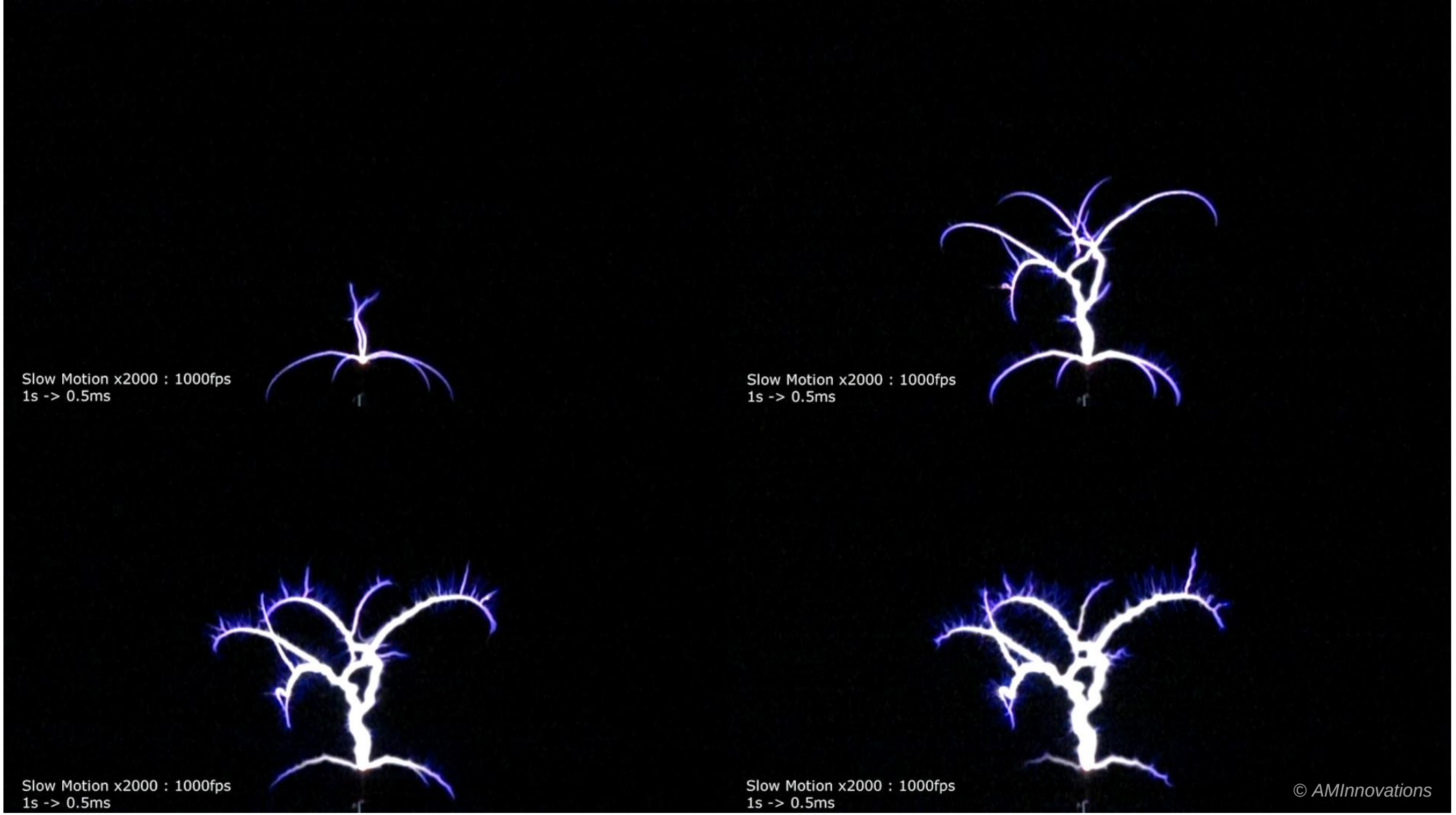
4K Image – An exhausting tendril

4K Image – Primary and Secondary Tendrils in the focal plane of the camera

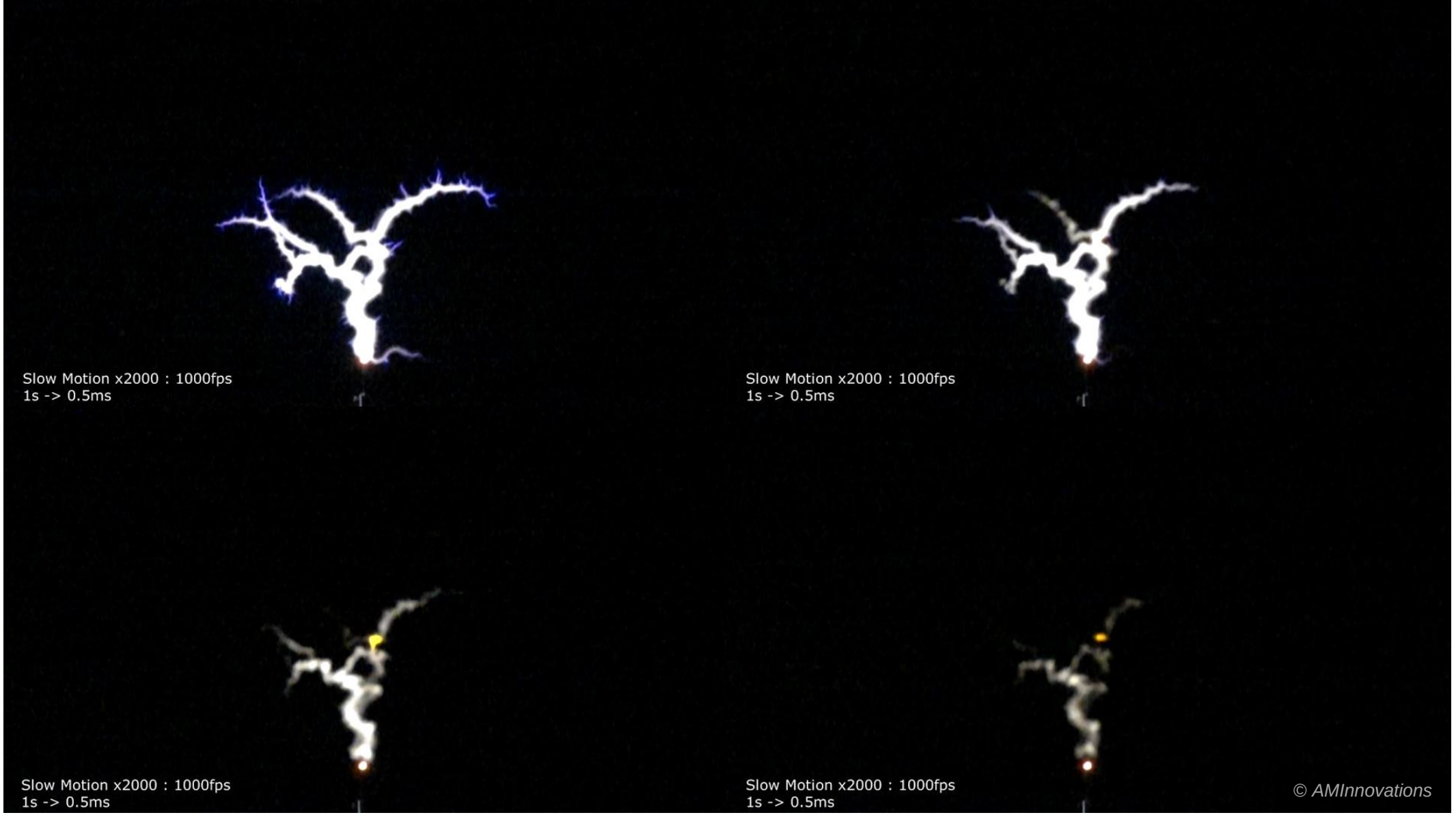
Slow Motion Photography

- Increase the photography frame-rate using a high-speed camera.
- Observe discharge formation and extinguish.
- Ideally slow motion photography over 1000fps -> 10000 fps.
- 1000fps economically possible with the Sony RX10M2 and above.
  - 1000fps is a frame every 1ms, resolution is reduced from HD video to 1322x968.
  - Playing at 25fps video is slow motion x40, 1s -> 25ms.
  - Video play-rate at 10% provides x400 slow motion, 1s -> 2.5ms.
  - Video play-rate at 2% provides x2000 slow motion, 1s -> 0.5ms (500us).
- Discharge formation and extinguish lasts for ~ 10ms or 10 frames at 1000fps.
- The modulation rate is at 50Hz line frequency, a period of 20ms, half-cycle 10ms.
- A faster camera up to 10000fps and above would make 1 frame every 100us.
- A 10000fps camera can easily cost $50k+ … suitable for discharge and lightning photography.





Slow motion from Sony RX10M2 1000fps – Growth of discharge over 4 frames (4ms)



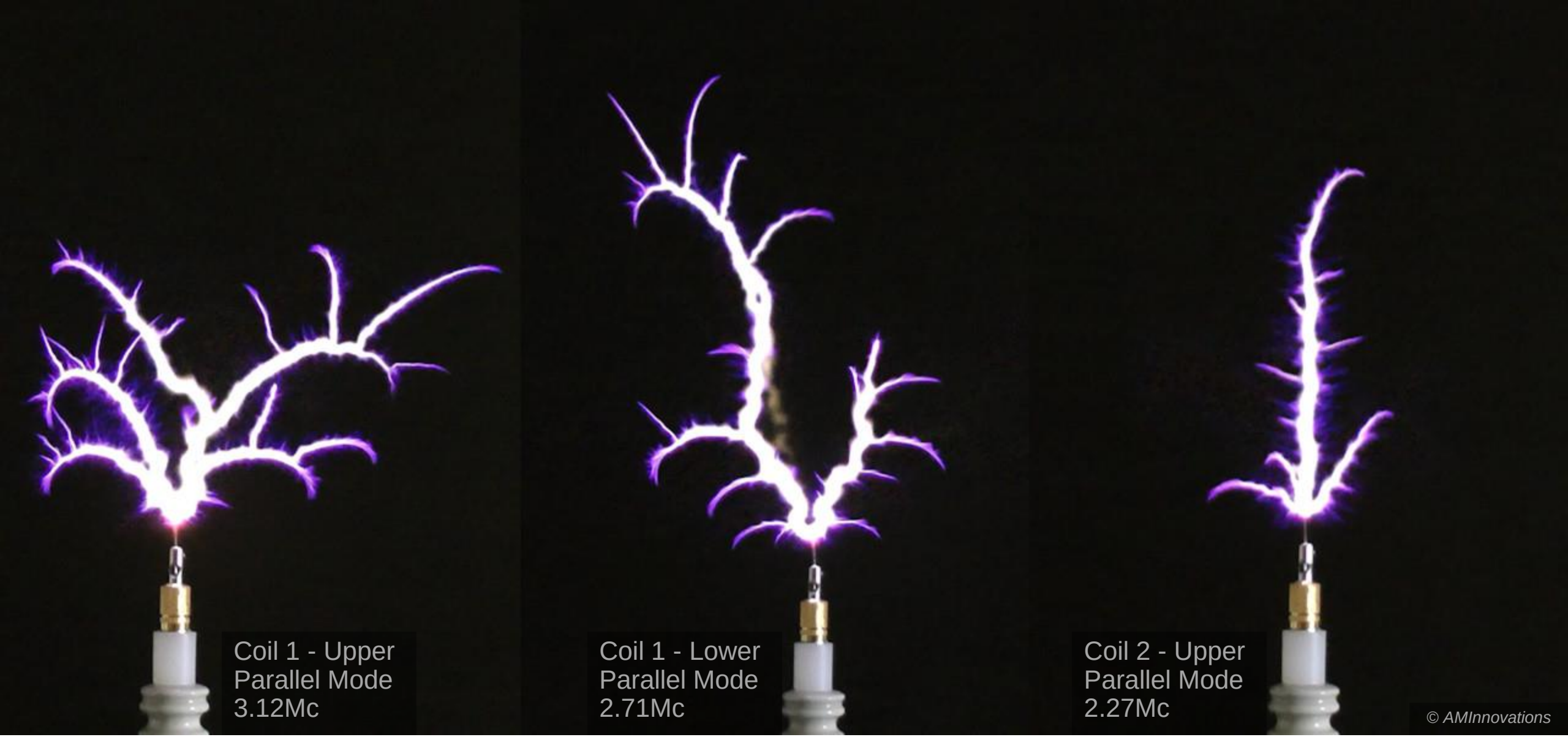
Slow motion from Sony RX10M2 1000fps – Extinguish of discharge over 4 frames (4ms)

Slow motion from Sony RX10M2 1000fps – Growth of discharge over 4 frames (4ms)

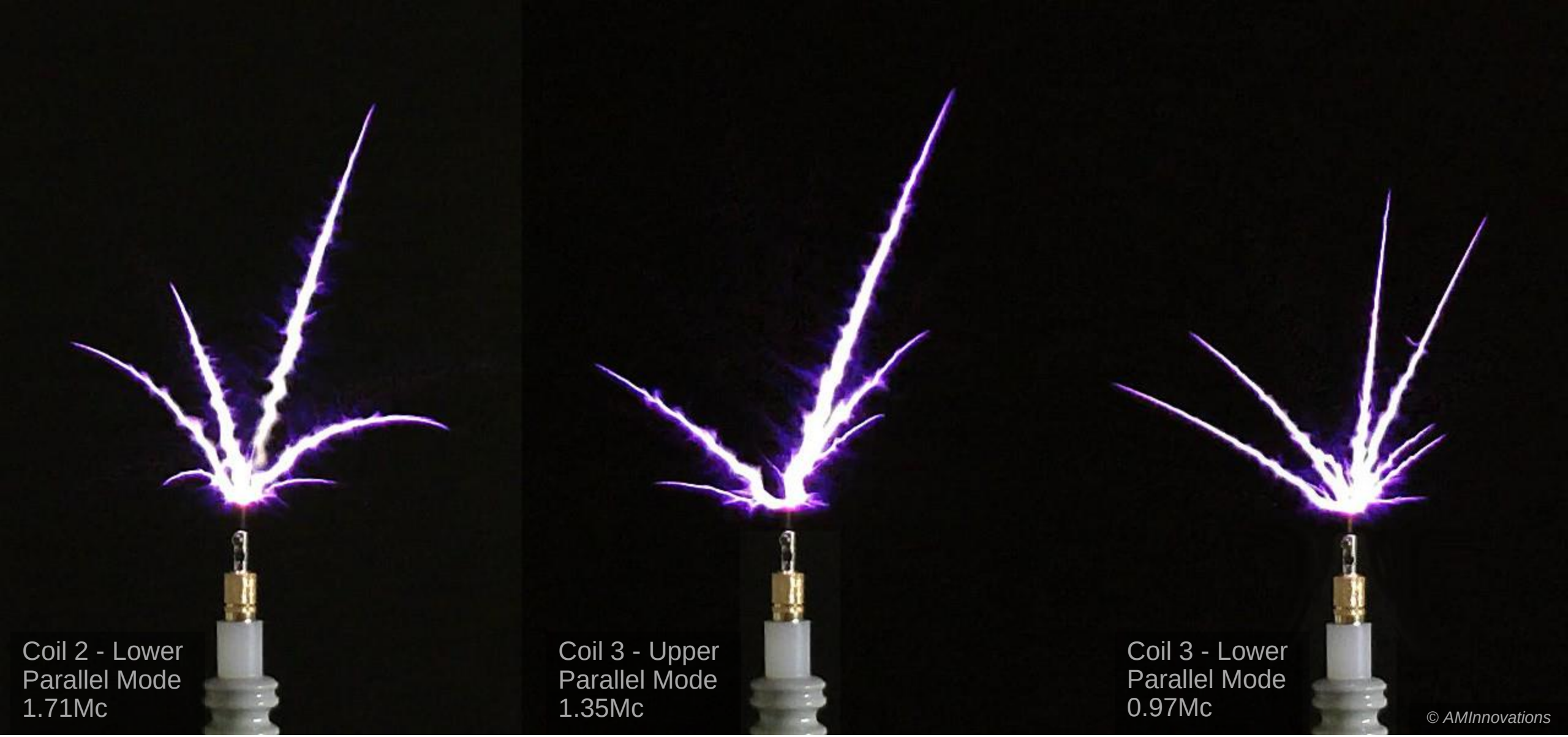
Slow motion from Sony RX10M2 1000fps – Extinguish of discharge over 4 frames (4ms)

Vibrational Characteristics

- Discharge form is strongly dependent on frequency or rather vibration.
- With increasing fundamental resonant frequency, up to 5Mc the GRD is tighter, and more ball-like.
- Dual 833C Power Armstrong oscillator suitable for higher frequencies up to 30Mc.
- At a lower transition frequency 1.6-1.8Mc the GRD transforms to straight “swords” discharges.
- A standard Vacuum Tube Tesla Coil driven at <~1.6Mc will show straight “swords”.
- As the frequency reduces <~ 1Mc the swords become straighter, longer, and more closely spaced.
- Swords above ~1Mc show the beginnings of small secondary tendrils.
- Swords below ~1Mc rarely show secondary tendrils.



Golden Ratio Discharge at Reducing Frequencies: 3.12Mc, 2.71Mc, 2.27Mc



Golden Ratio Discharge to Swords at Reducing Frequencies: 1.71Mc, 1.35Mc, 0.97Mc

Experimental Variations that reveal the GRD – Same Coil Apparatus

- GU5B, 833C, 3-500ZG, 4-400A Vacuum tube generators.
- A line cycle modulated generator using power control from an SCR (switched) or a Variac (sinusoidal).
- A bridge rectified full-wave, half-wave, or level shifted/multiplied line cycle modulated generator.
- A cathode keyed vacuum tube generator with HV DC supply (non line modulated). Without cathode keying this generator arrangement will show a tree discharge/plasma flame/burning bush.
- Cathode keying can include Triac, Mosfet/IGBT, Vacuum Tube, Mercury Wetted Relays.
- Capacitive top-loading on the TC with associated tuning.
- A Vacuum Tube generator driven at the series mode with cathode keying does reveal the GRD but is difficult to sustain and optimise.

Experimental Variations NOT revealing the GRD – Same Coil Apparatus

- Spark Gap generators applied to any of the designed coil 1-5.
- CW high-frequency inverter generator with high frequency modulation ~20kc.
- Lower frequency driven solid-state generators, including with frequency feedback.
- Lower frequency Tesla Coils - tend to reveal swords, trees, flames etc. Fractal discharges possible but without Golden Ratio expansion.
- Tesla coils with no waveform modulation, cathode keying, or non-linear switching.
- Heavily filtered or bandwidth limited generators such as HF linear amplifiers, designed to drive a coil or antenna at a fixed and specific generators.
- Tesla coils with very high or very low magnetic coupling to the primary.

Key Experimental Requirements for the Golden Ratio Discharge

1. A Tesla transformer design with sufficient voltage magnification to observe clearly the discharge form, and sufficient power to develop white hot discharges.
2. A freely oscillating TC apparatus with feedback to the generator, tuned to the high output impedance upper or lower parallel modes, appears to reveal the most stable form of the GRD.
3. A higher TC operational frequency > ~1.6-1.8Mc : The Golden Proportion is 1.618...
4. A generator with either waveform modulation or cathode keying.
5. A low modulation or keying frequency typically < 500c/s.
6. A low duty-cycle primary coil waveform, with possible mono-polar properties.

The Golden Ratio Discharge – Observational Conjectures

1. The discharge follows expansions (Golden Ratio and Fractal) readily found within the natural world and within the Wheelwork of Nature.
2. The discharge consists of both spatial and temporal order, which originates from underlying as yet unknown principles within the Wheelwork of Nature.
3. The tiny orthogonal filaments along the major tendrils are related to the principle of displacement of electric power, an underlying principle in the Wheelwork of Nature.
4. The physical discharge phenomena most likely results from the relationship between the dielectric and magnetic fields of induction within the common medium. A relationship defined by underlying as yet unknown qualities of vibration.
5. The scalar quantity of frequency, found as the key dependent parameter so far, is actually only a small piece of an underlying vibration, which is in and of itself, made up of a range of different qualities.

Golden Ratio Discharges – Origin Conjectures

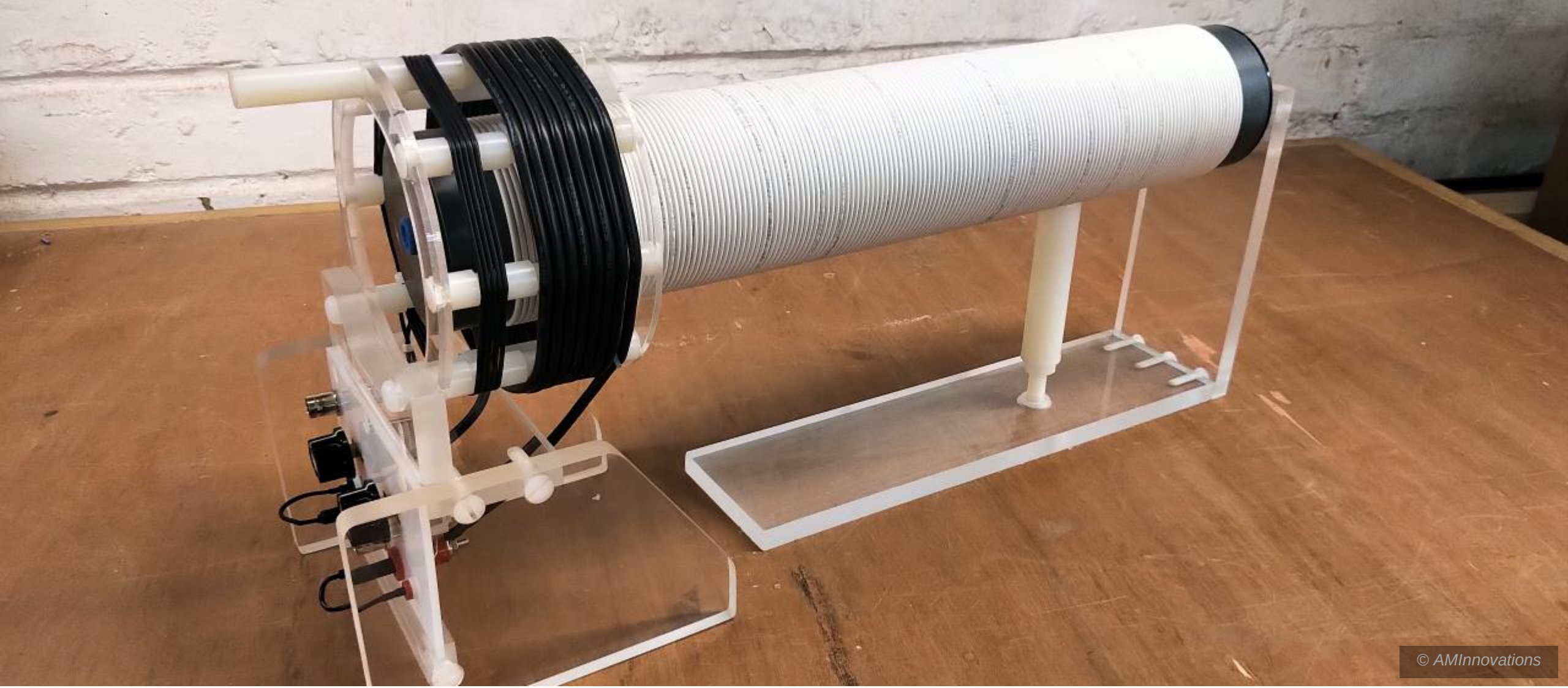
1. The observed spatial and temporal order of the discharge revealed in this experiment suggests a guiding set of fundamental principles that may extend beyond simply the Wheel-work (mechanics) of Nature – Intelligence ?
2. Vibration (quality), Resonance (synchronicity), and Tuning (awareness) are key to understanding how to attach our apparatus to the wheelwork of nature, and hence become part of a synchronicity that may extend across many levels and layers of existence – Aetheric Spectrum / Web of Life ?

> *… then it is a mere question of time when men will succeed in attaching their machinery to the very wheelwork of nature.*
>
> *- Nikola Tesla, 1892*

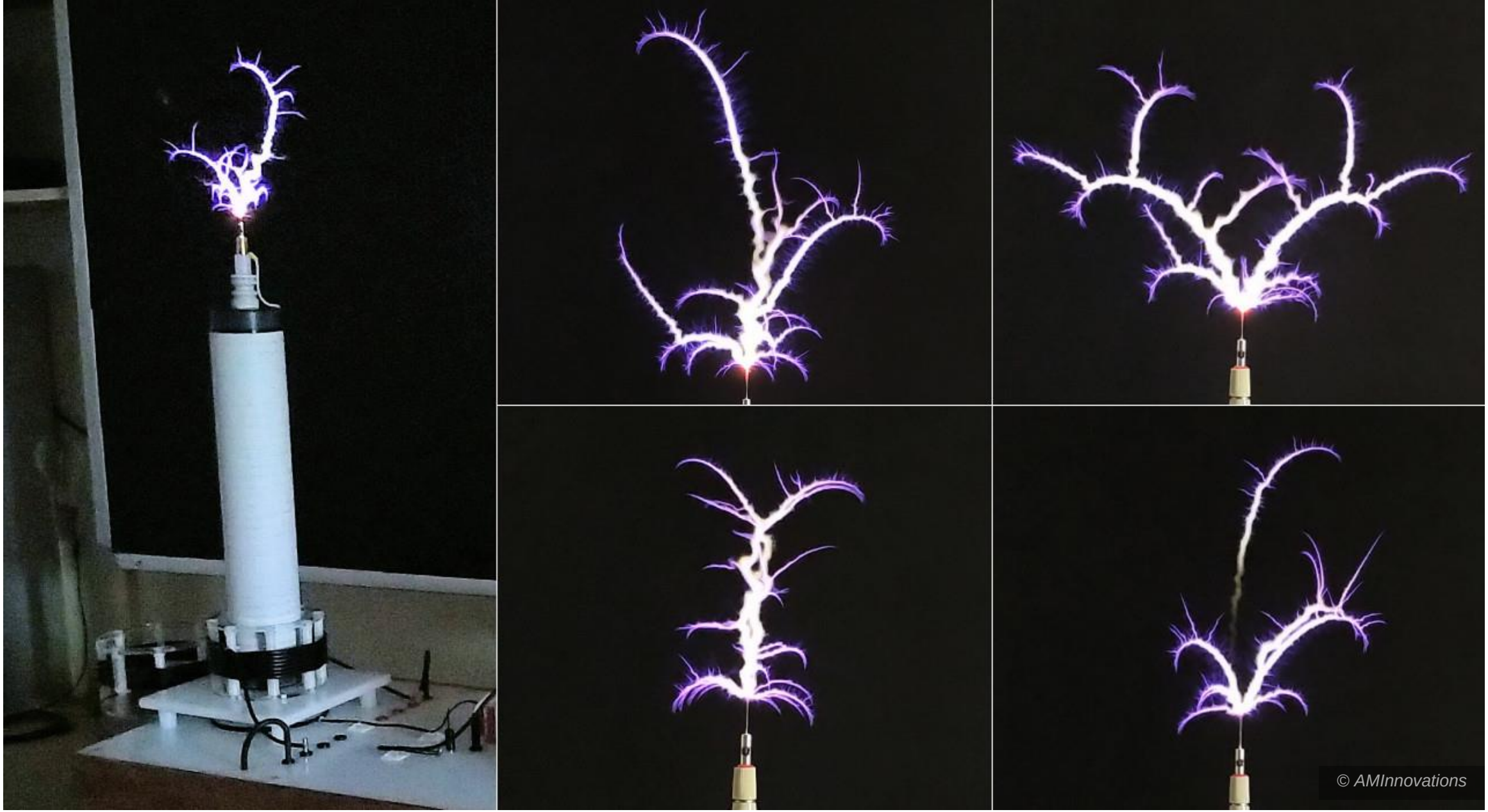
The Golden Ratio / Fractal Discharge experiment appears to support Tesla's profound statement, and has the potential to reveal deeper knowledge within the natural order.

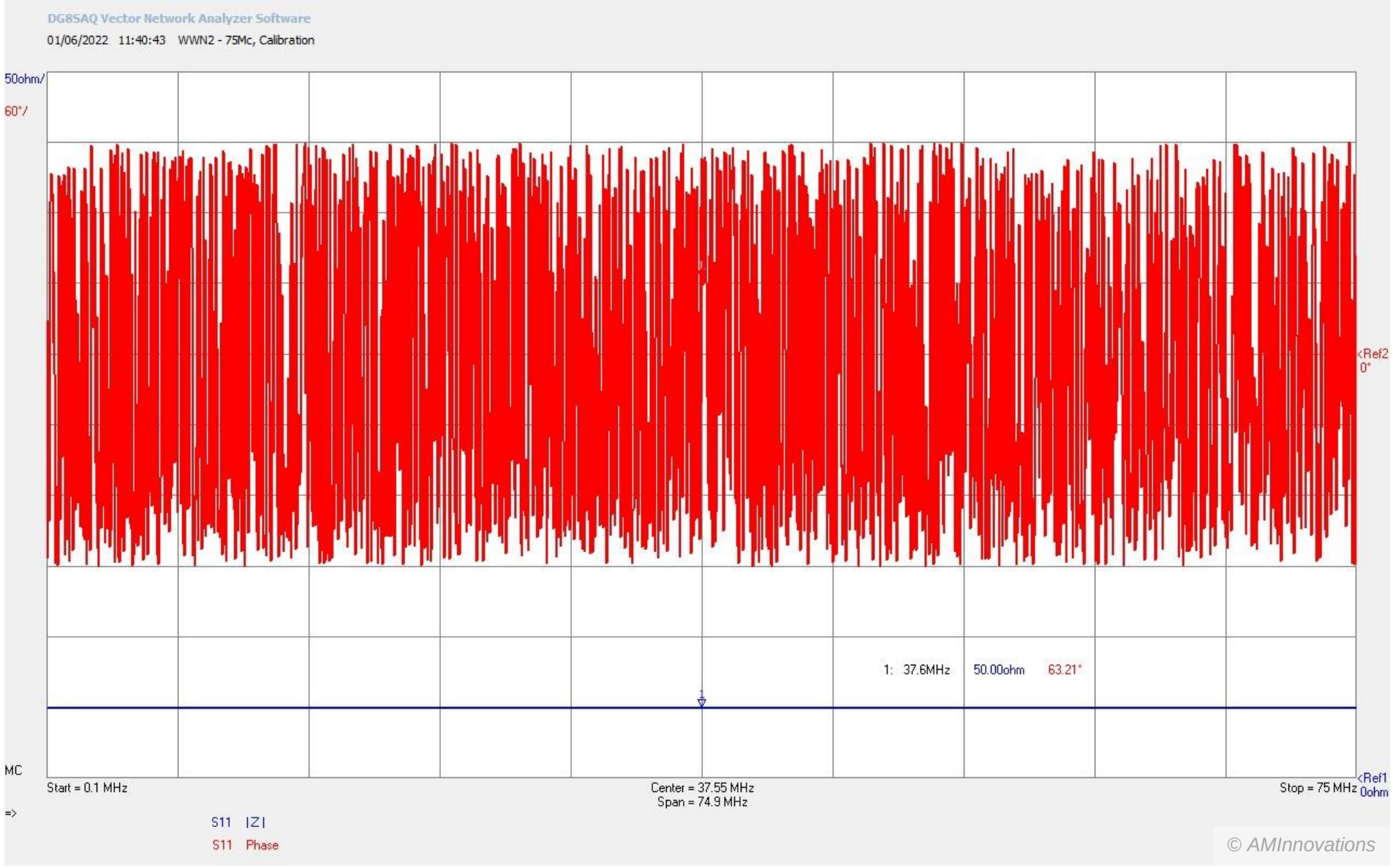
Appendix 1 - The Wheelwork of Nature
Cylindrical Tesla Coil Analysis

- Secondary designed to resonate at ~ 3.5Mc in the 80m amateur band, 3.5-3.8Mc (UK).
- Secondary 155 turns 1mm^2 silicone coated wire, (2.45mm outer, 1.1mm dia. conductor).
- 5:1 Aspect ratio, tightly wound for maximum dielectric induction field magnification.
- Primary 7.5 turns 12AWG silicone coated micro-stranded cable.
- Primary tuned by KP1-12 20pF – 1200pF 4kV vacuum variable capacitor.
- Adjustable frequency drive in lower and upper parallel modes f_U and f_L, from ~ 2.5Mc – 3.7Mc.
- Magnetic coupling between primary and secondary variable by coil spacing.

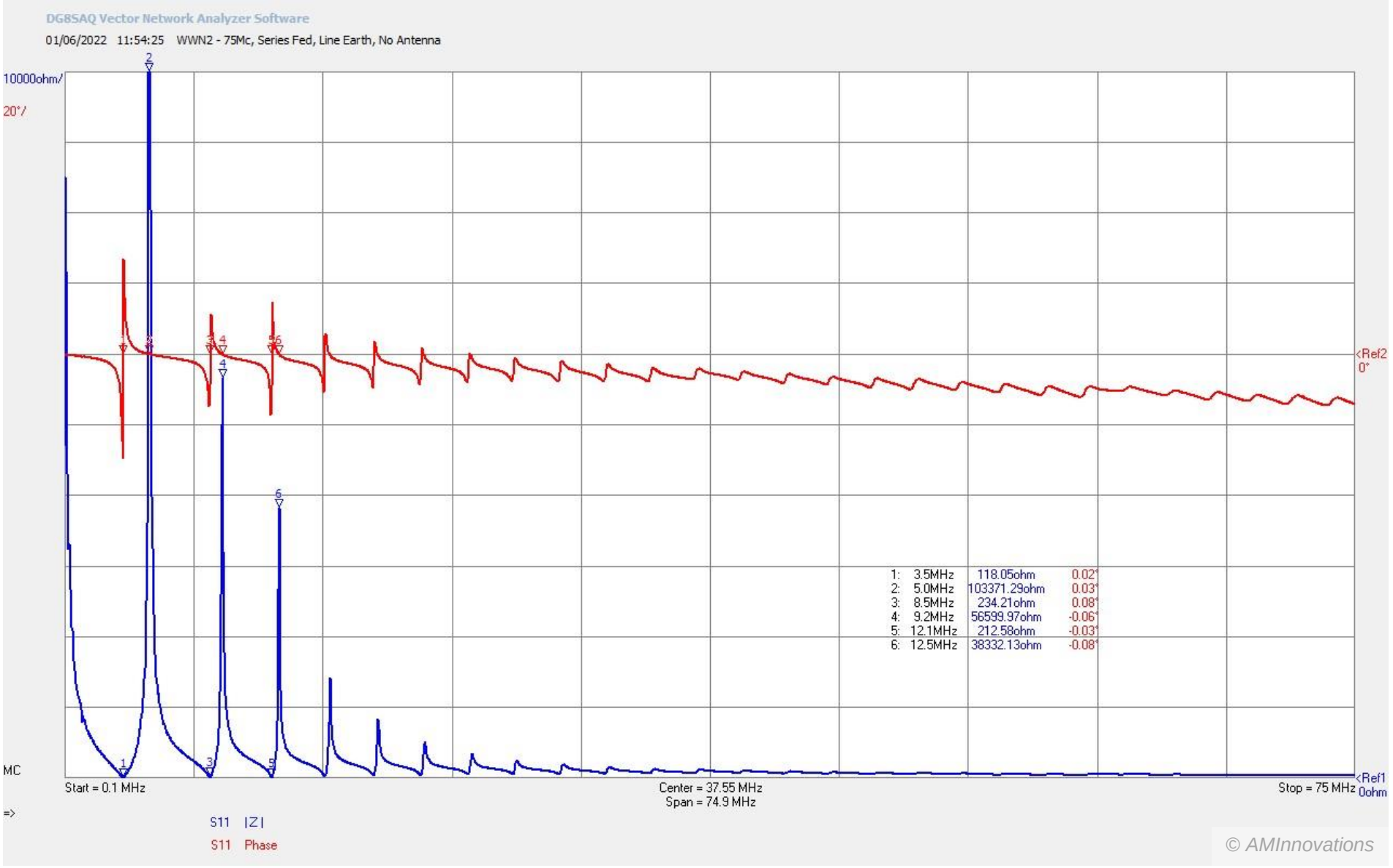


The Wheelwork of Nature – Fractal “Fern” Discharges – Standard Cylindrical Tesla Coil

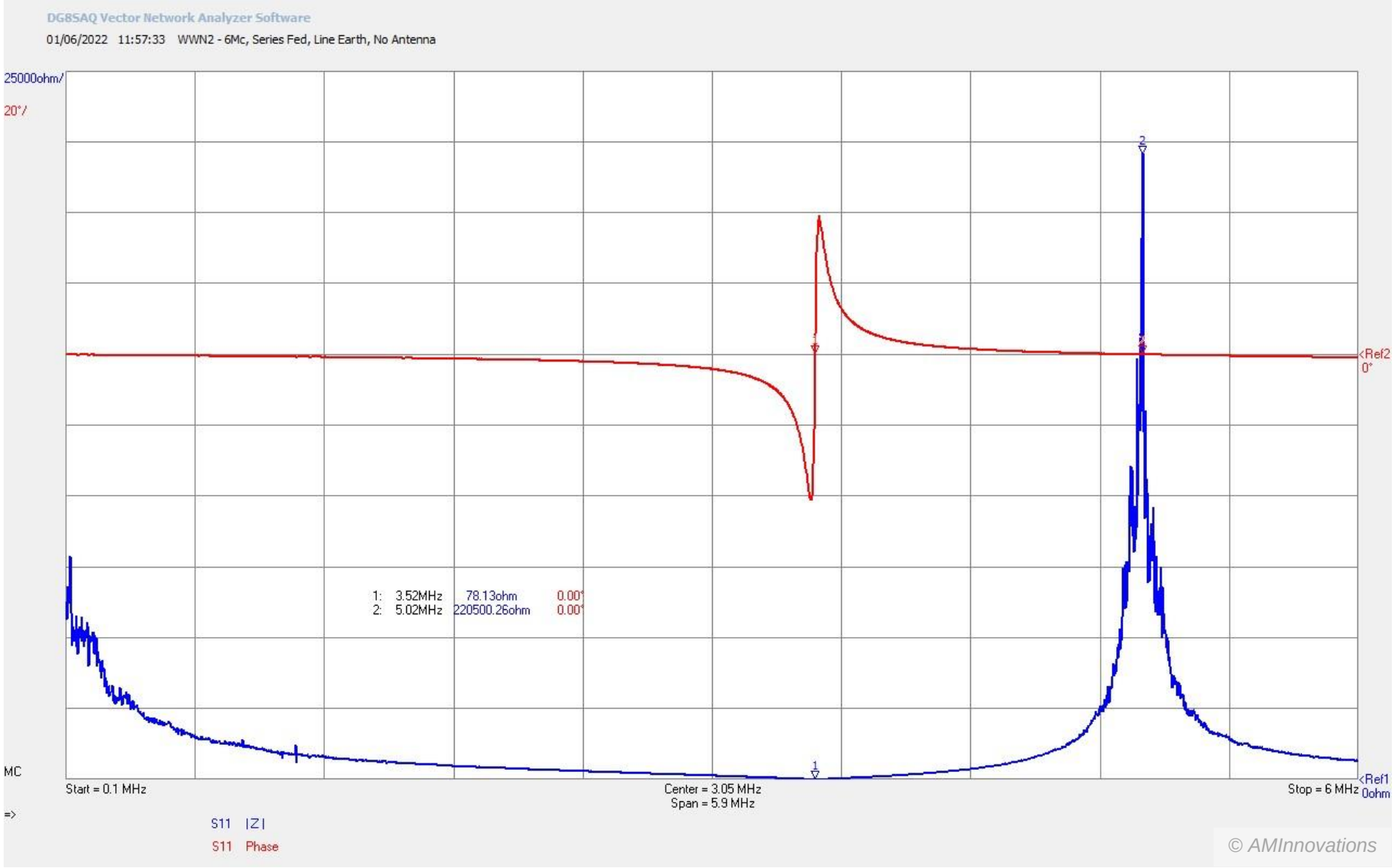




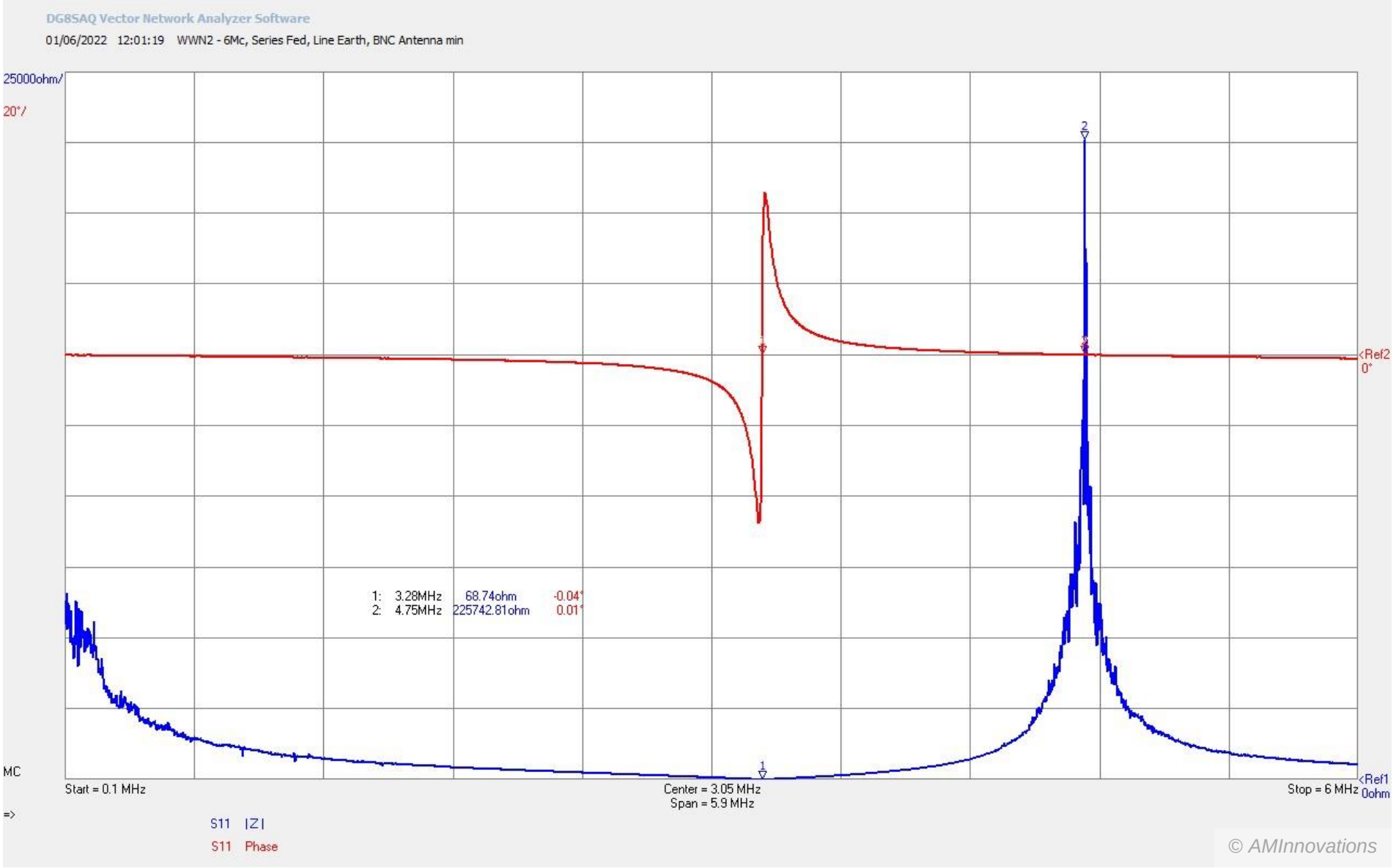
Calibration DG8SAQ VNWA : 15cm BNC cable, 0.1-5 MHz, 50Ω termination



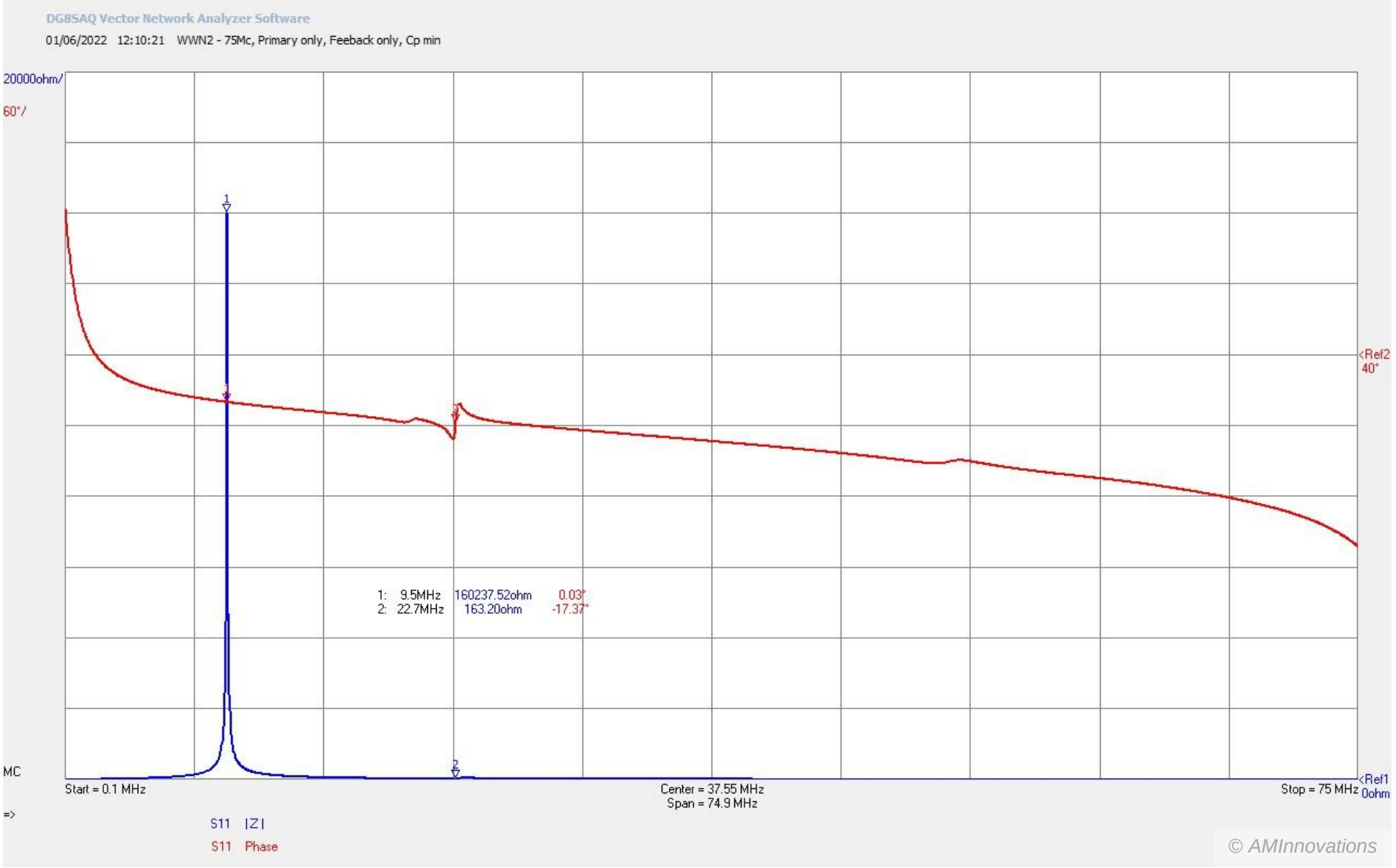
Series-Fed Secondary Coil Only – Wideband 75Mc Scan



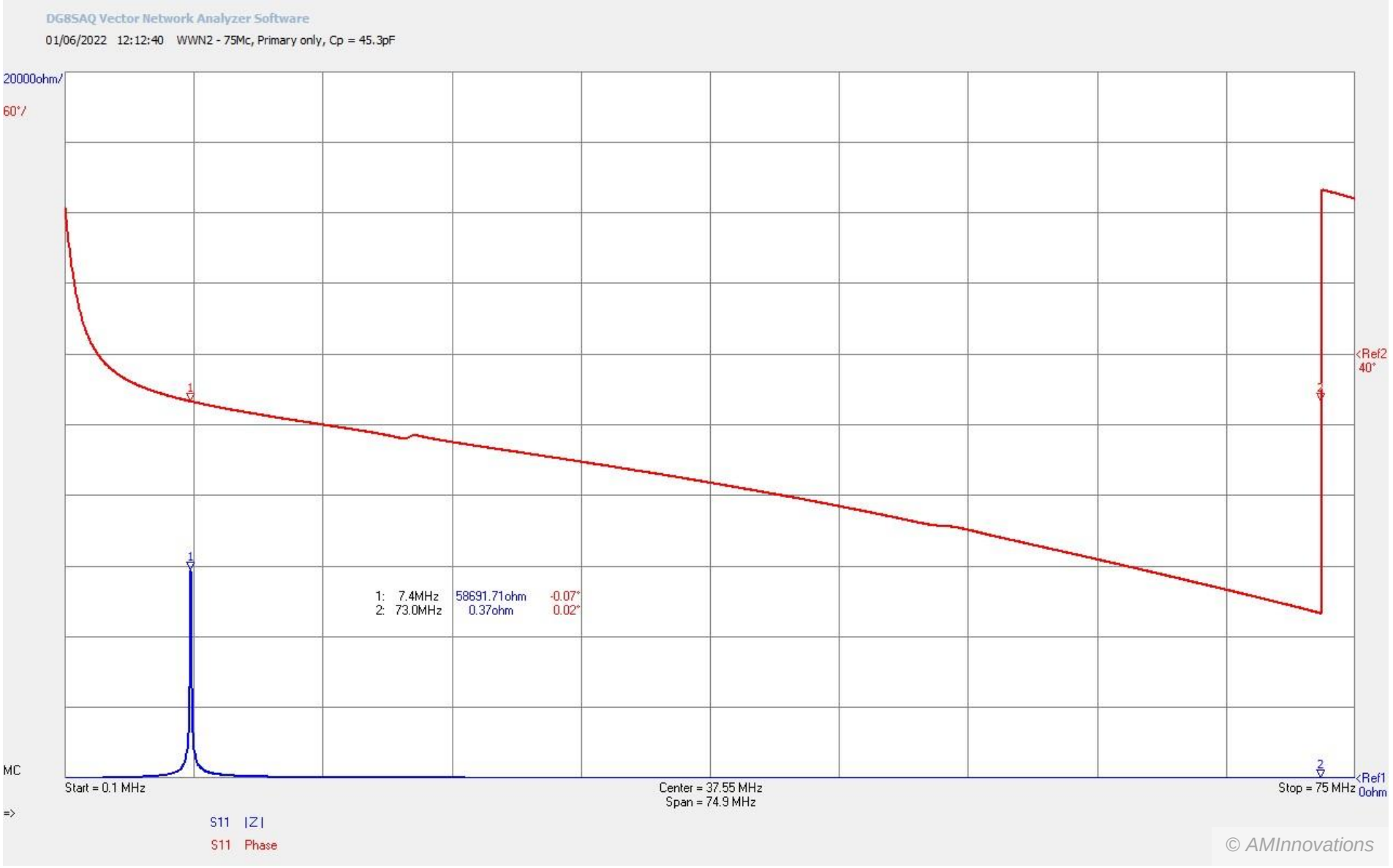
Series-Fed Secondary Coil Only – Fundamental Series and Parallel Resonant Modes



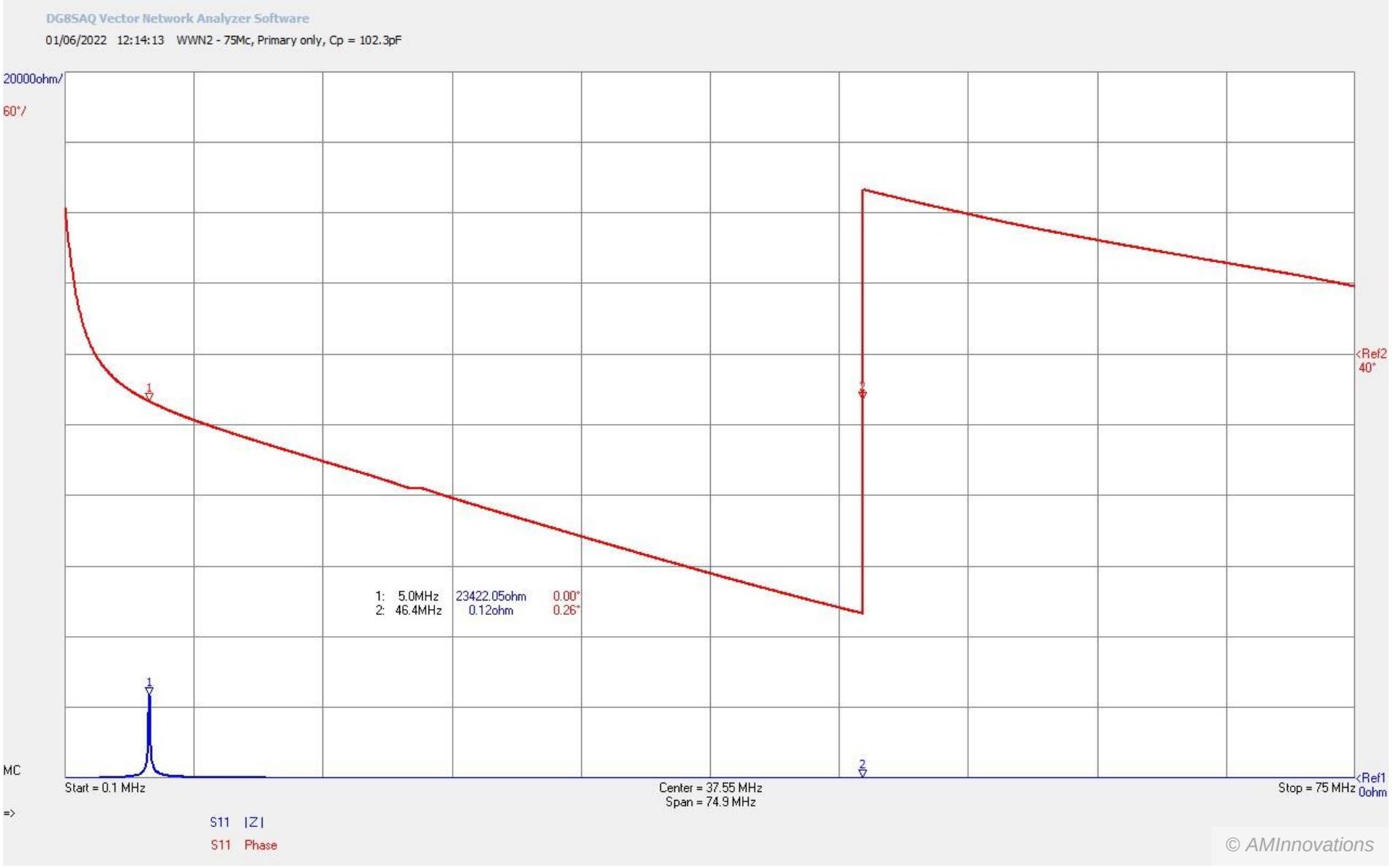
Series-Fed Secondary Coil Only – With Top-end BNC Antenna Minimum Extension



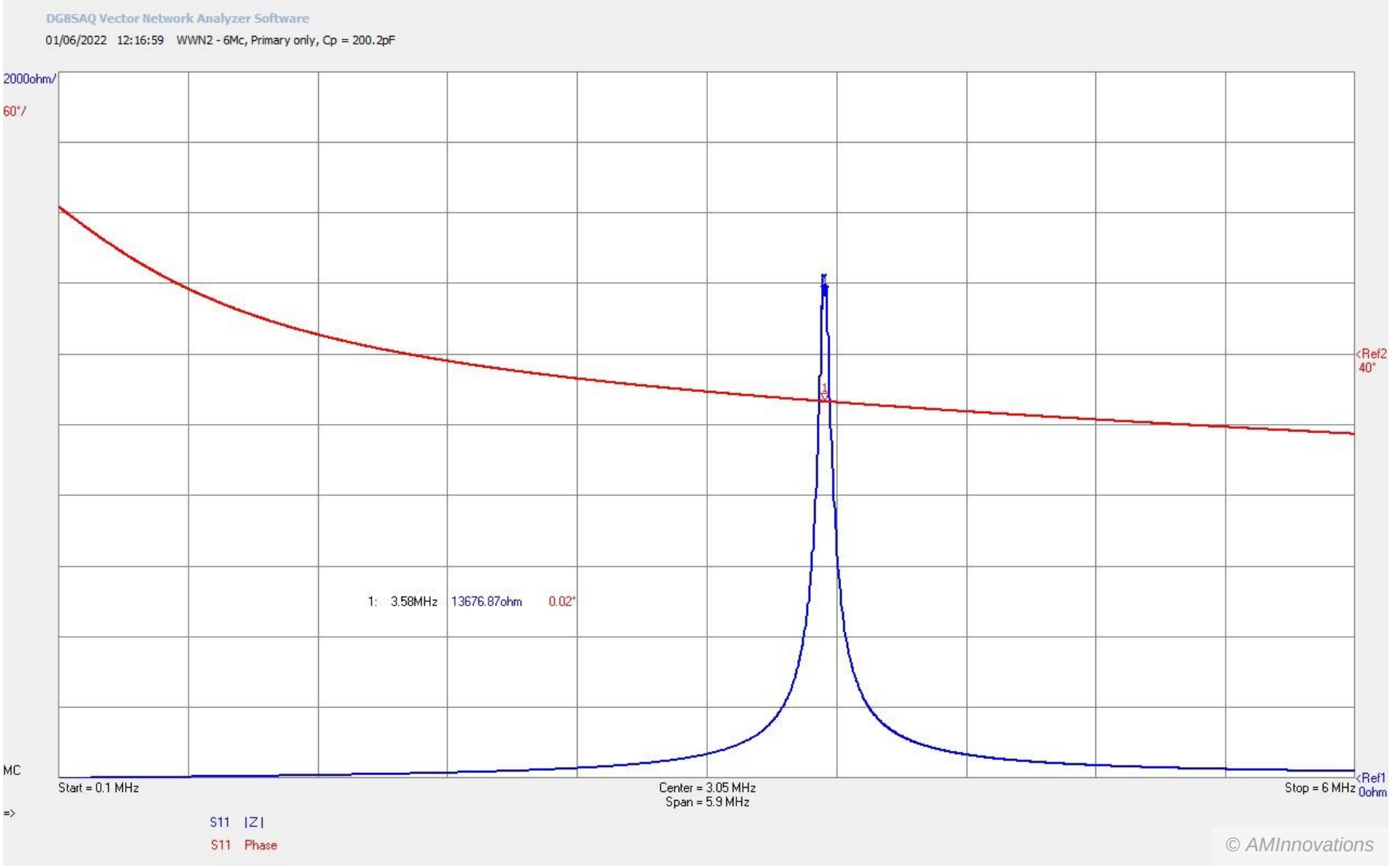
Primary Coil with Feedback Coil Only – Wideband 75Mc Scan, Self Primary Capacitance Only



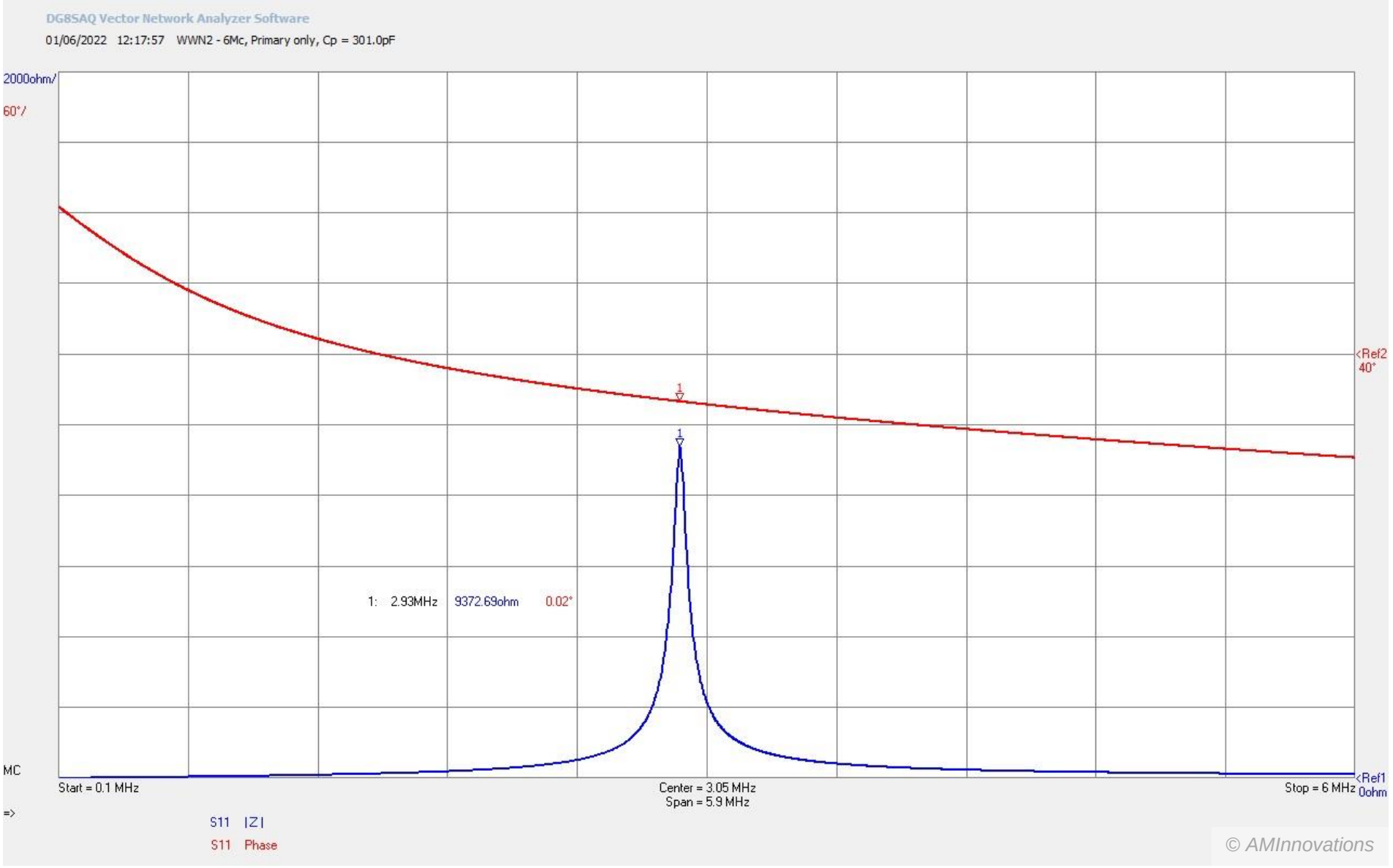
Primary Coil with Feedback Coil Shorted – Primary Capacitance Cp = 45.3pF, Series and Parallel Resonant Modes



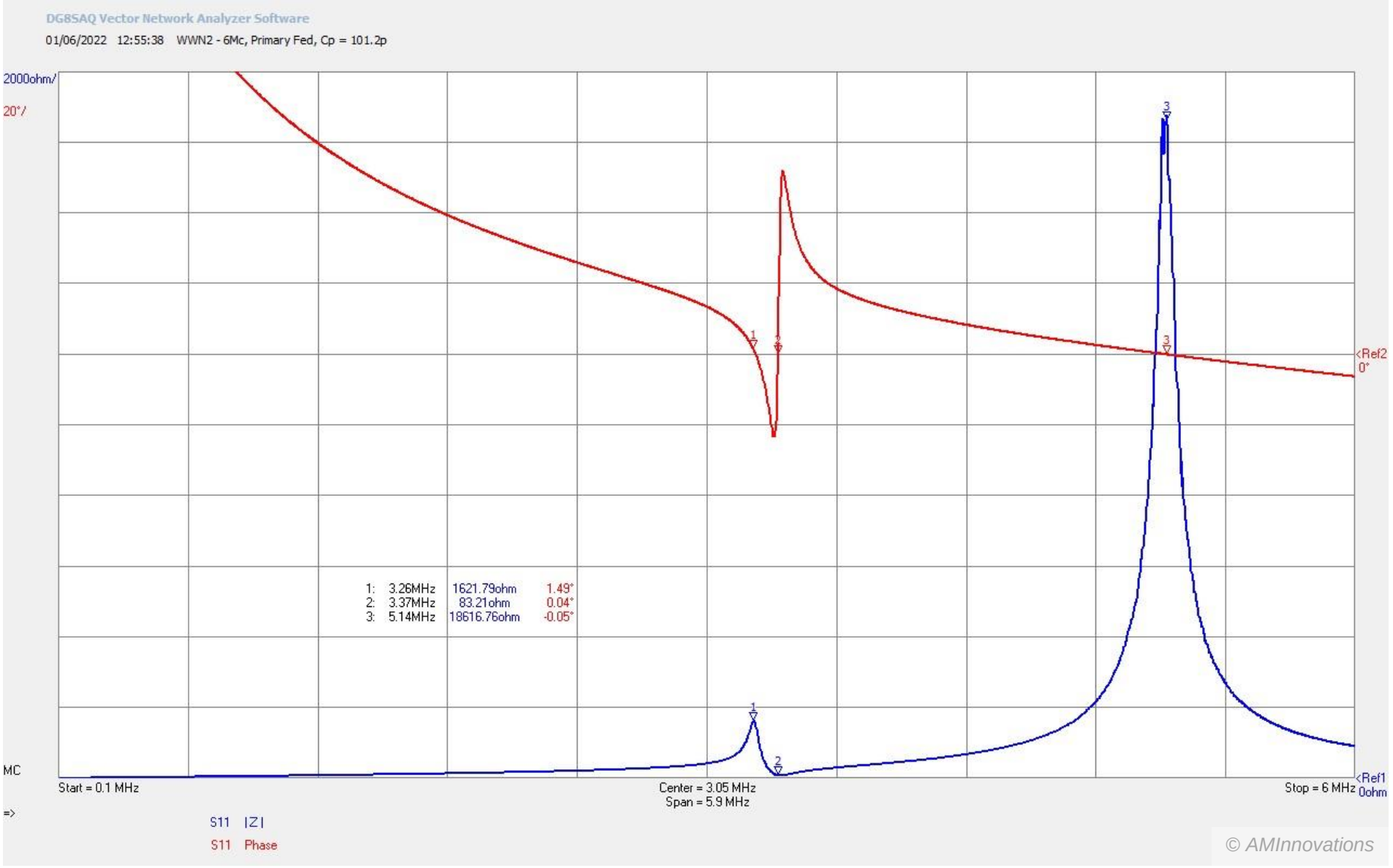
Primary Coil with Feedback Coil Shorted – Primary Capacitance Cp = 102.3pF



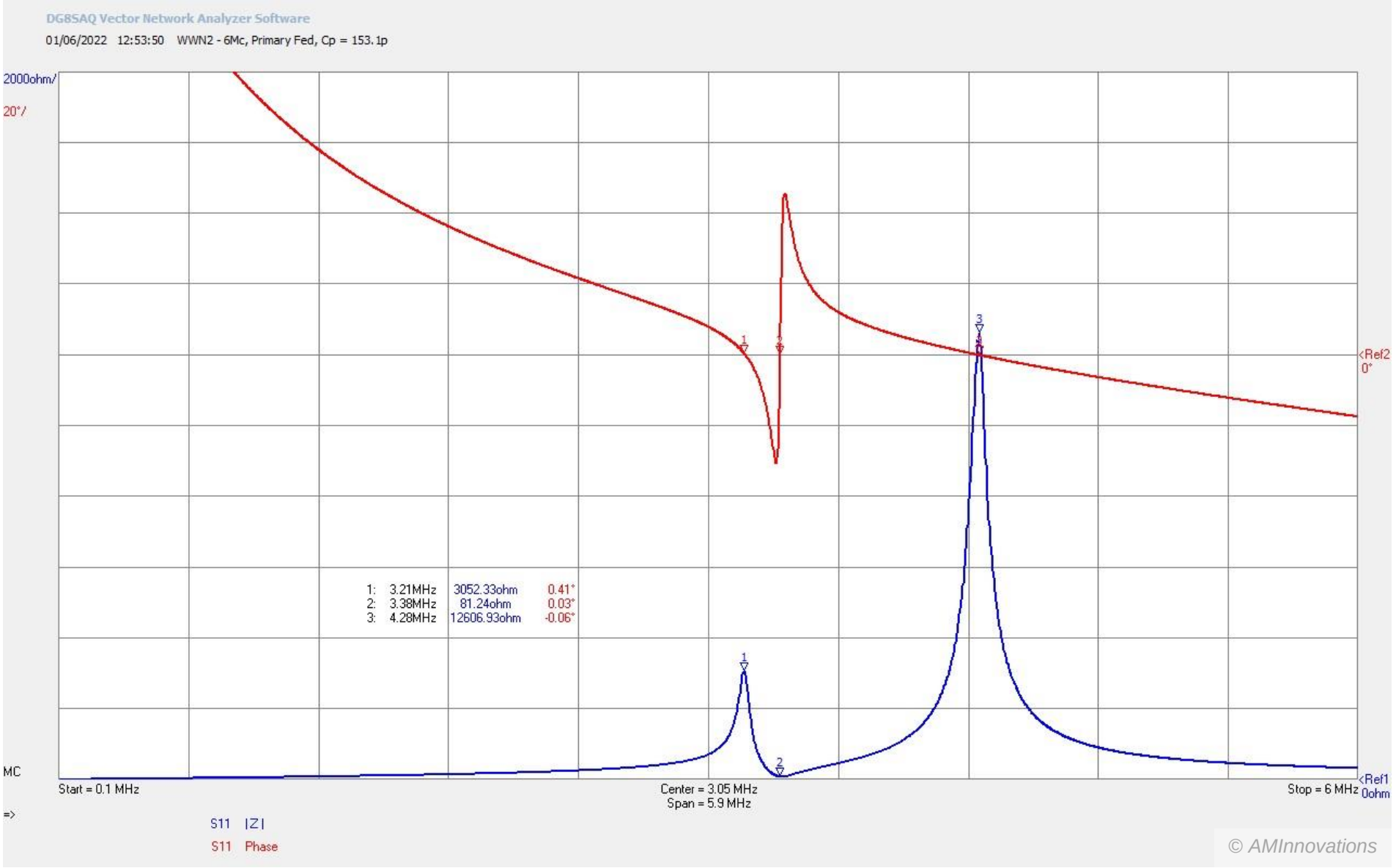
Primary Coil Only – Primary Capacitance Cp = 200.2pF



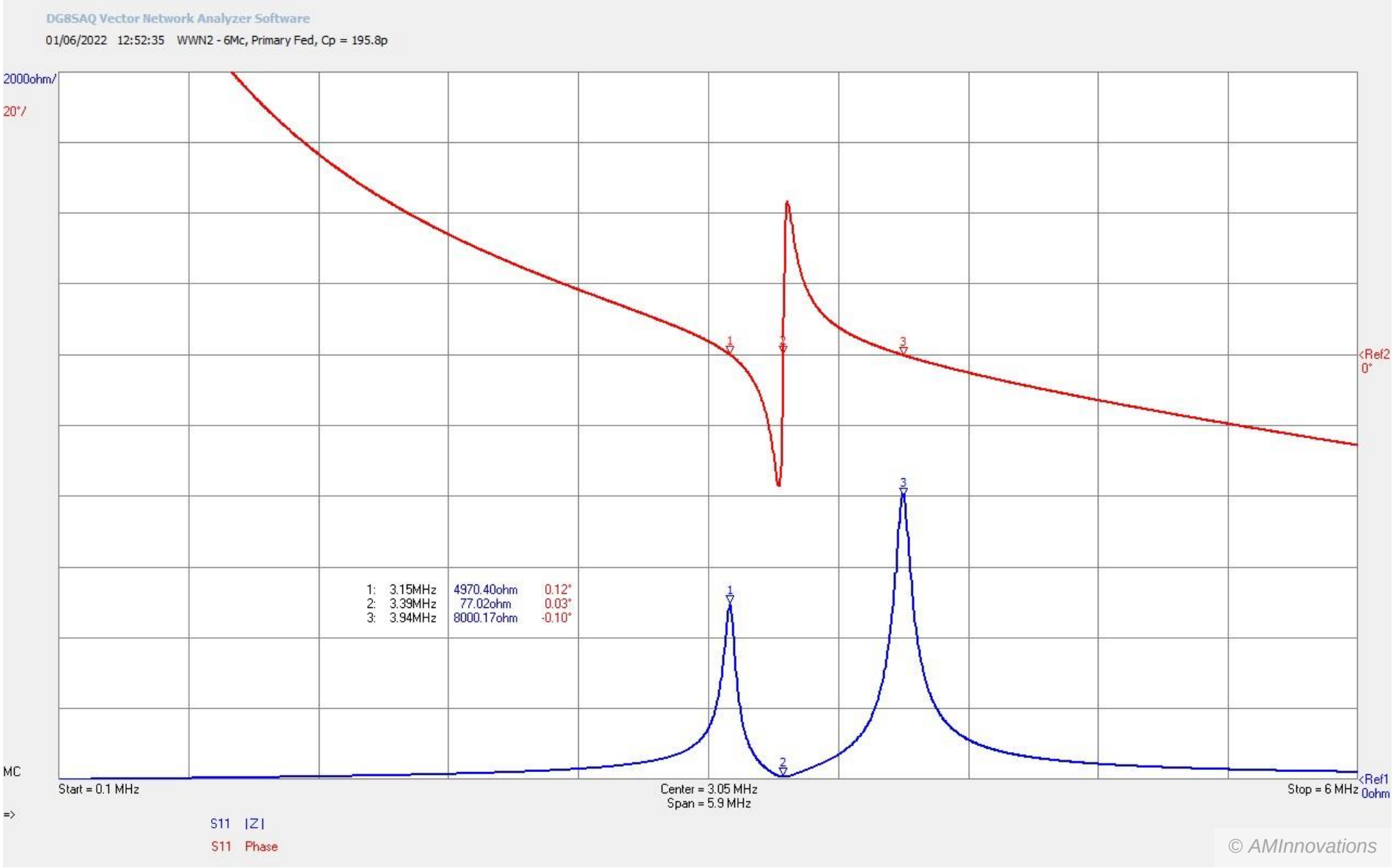
Primary Coil Only – Primary Capacitance Cp = 301.0pF



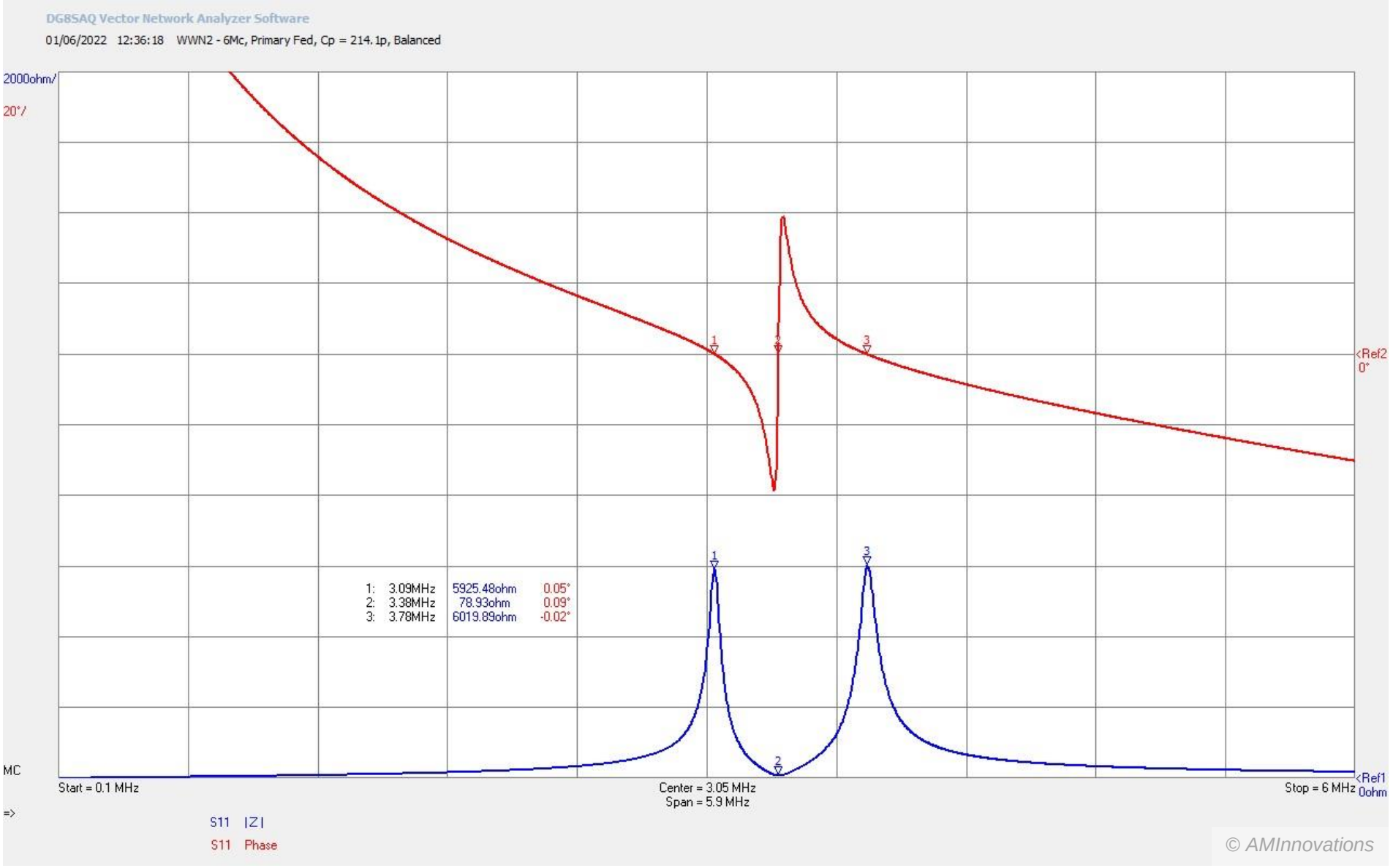
Primary Fed Secondary Coil – Cp = 101.2pF, Series, Upper Parallel, and Lower Parallel Resonant Modes



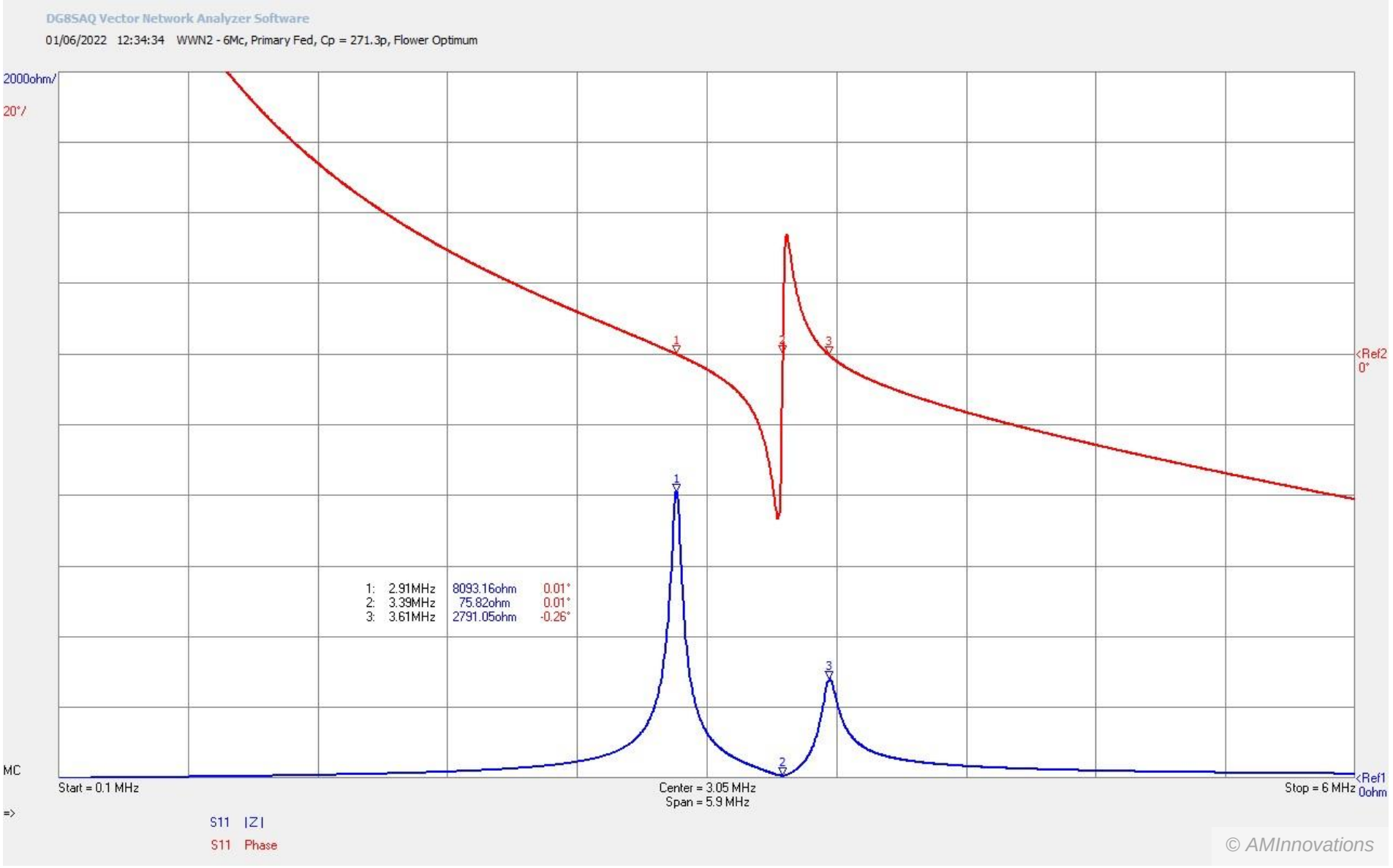
Primary Fed Secondary Coil – Cp = 153.1pF, Series, Upper Parallel, and Lower Parallel Resonant Modes



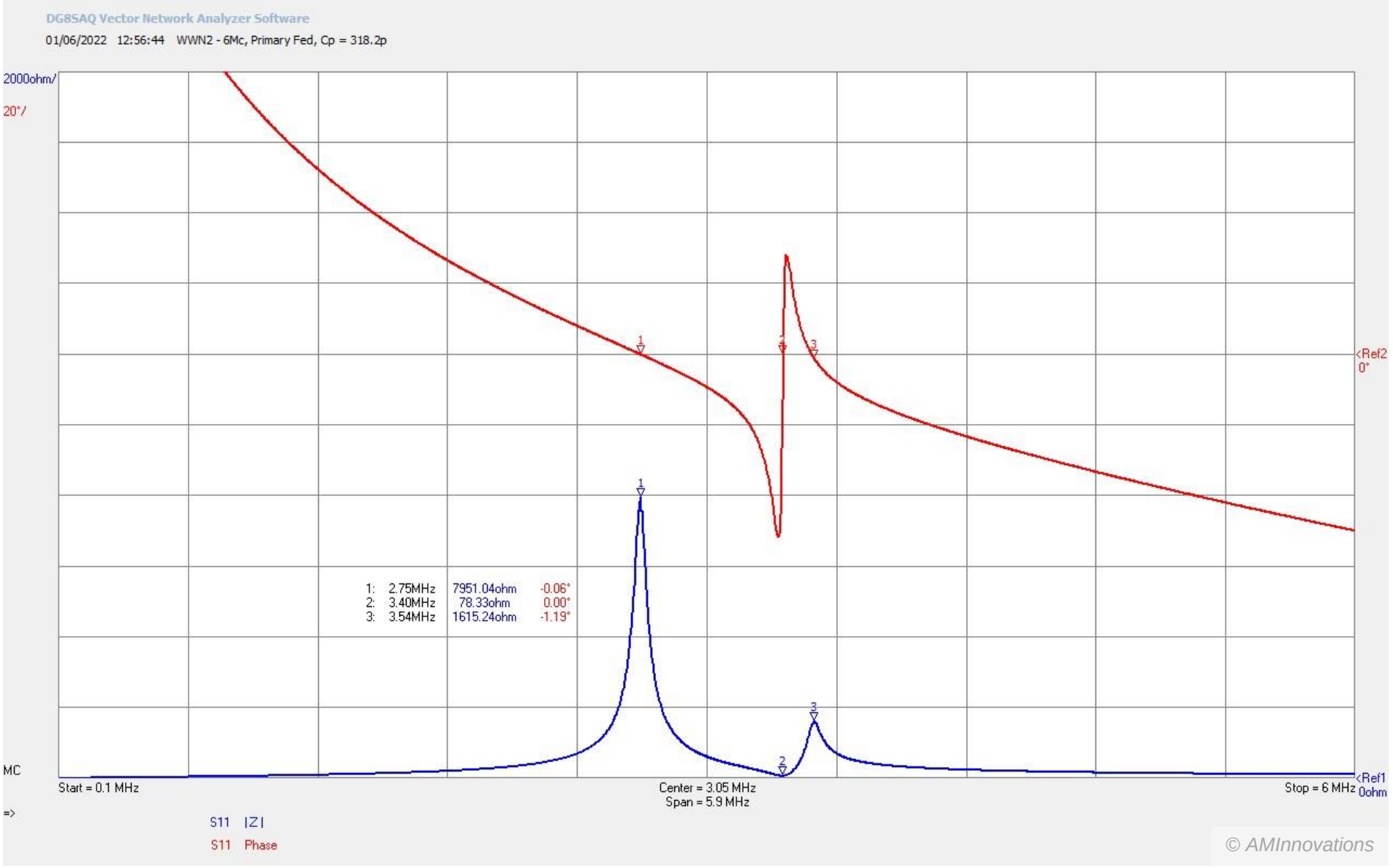
Primary Fed Secondary Coil – Cp = 195.8pF, Empirical Optimum Upper Parallel Mode



Primary Fed Secondary Coil – Cp = 214.1pF, Balanced Parallel Modes



Primary Fed Secondary Coil – Cp = 271.3pF, Empirical Optimum Lower Parallel Mode



Primary Fed Secondary Coil – Cp = 318.2pF