The First Experimental Results on Single-Mode Accelerating Structure
Theory and interpretation of experimental results

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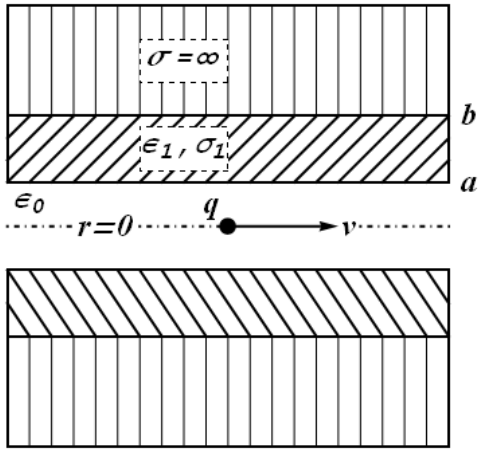
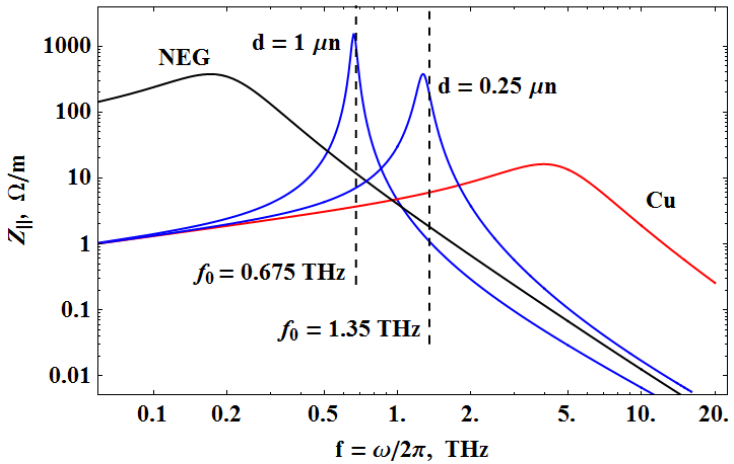
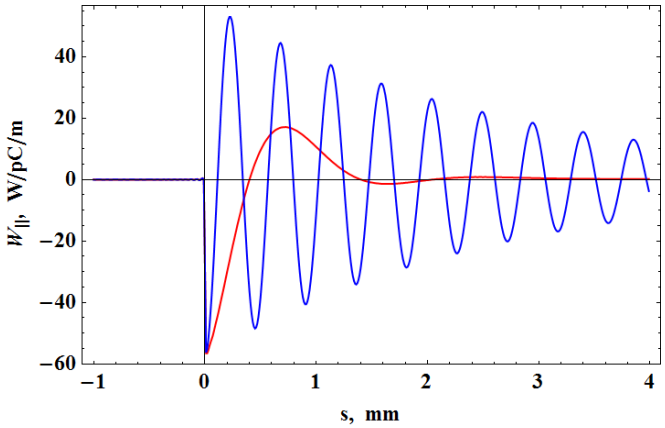
Center for the **A**dvancement of **N**atural
Discoveries using **L**ight **E**mission

TWO-LAYER Circular Wavequide

IMPEDANCE







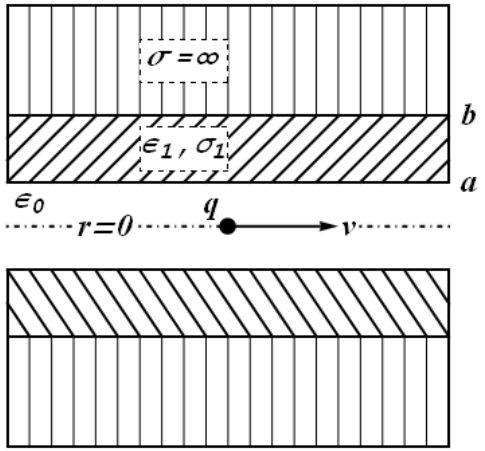
$$Z_{||}^{0}(\omega) = R\left[1 + jQ\left(\frac{\omega_0}{\omega} - \frac{\omega}{\omega_0}\right)\right]^{-1}$$

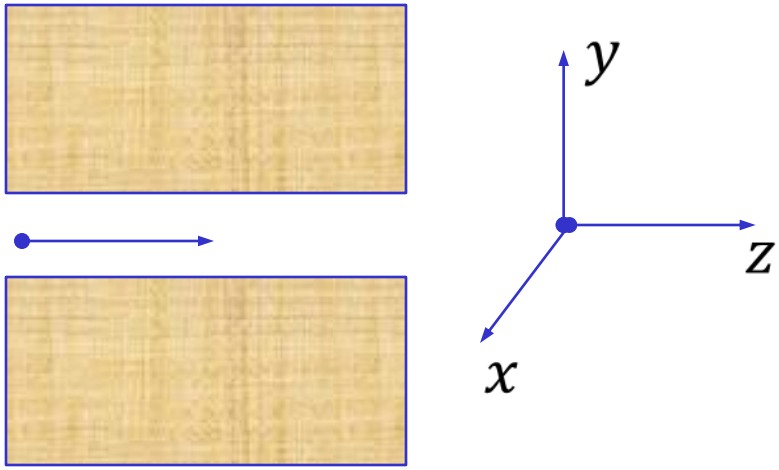
$$W_{||}^{0}(s) = -\frac{Z_0 c}{\pi a^2} e^{-\alpha s}\left[\cos(k_\alpha s) - \frac{\alpha}{k_\alpha}\sin(k_\alpha s)\right]$$

$$\varsigma = d\sigma_1 Z_0 / \sqrt{3} \sim 1 \qquad \omega_0 = c\sqrt{2/a_1 d_1}$$

Wake Function

TWO-LAYER FLAT STRUCTURE



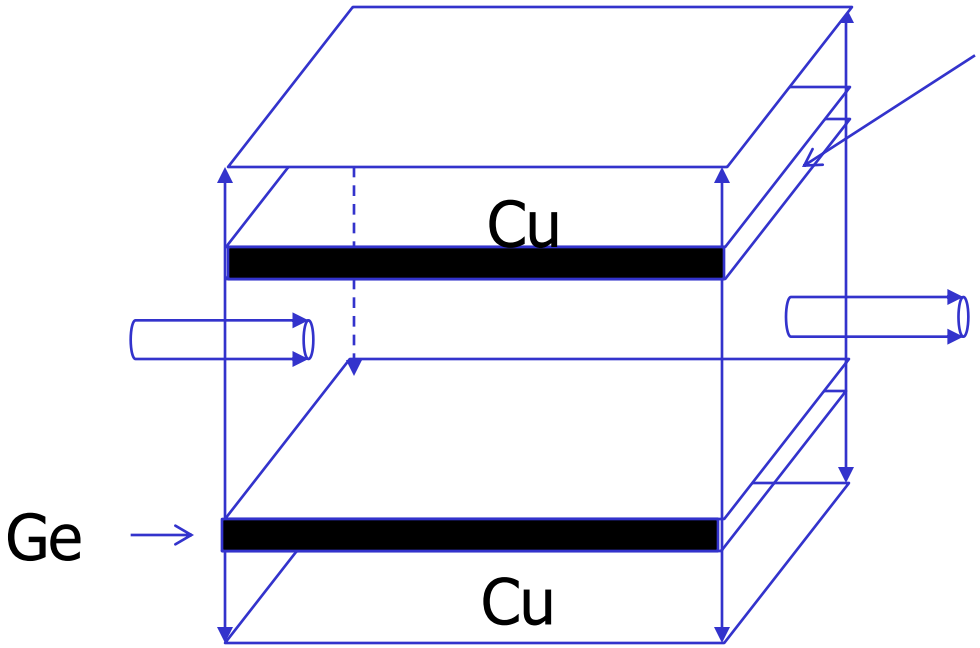


$$E_z(q,k) = \frac{Z_0}{16\pi^2} \frac{k\left(K^2 - q^2\right) Sh(2dK)}{\left(KCh(Kd)Ch(qa) - qSh(Kd)Sh(qa)\right)\left(q(q^2 + k^2 - K^2)Ch(Kd)Ch(qa) + kK^2 Sh(Kd)Sh(ka)\right)}$$

$$d \to \infty \qquad E_z(q,k) = \frac{Z_0}{16\pi^2} \frac{k\left(K^2 - q^2\right)}{\left(KCh(qa) - qSh(qa)\right)\left(q(q^2 + k^2 - K^2)Ch(qa) + kK^2 Sh(ka)\right)}$$

H. Henke, O. Napoly, EPAC-1990, p 1046

$$K = \sqrt{q^2 + k^2(1 - \varepsilon_1) - jkZ_0\sigma},\ k{=}\omega/c$$



$$\varepsilon_{Ge} = 16$$

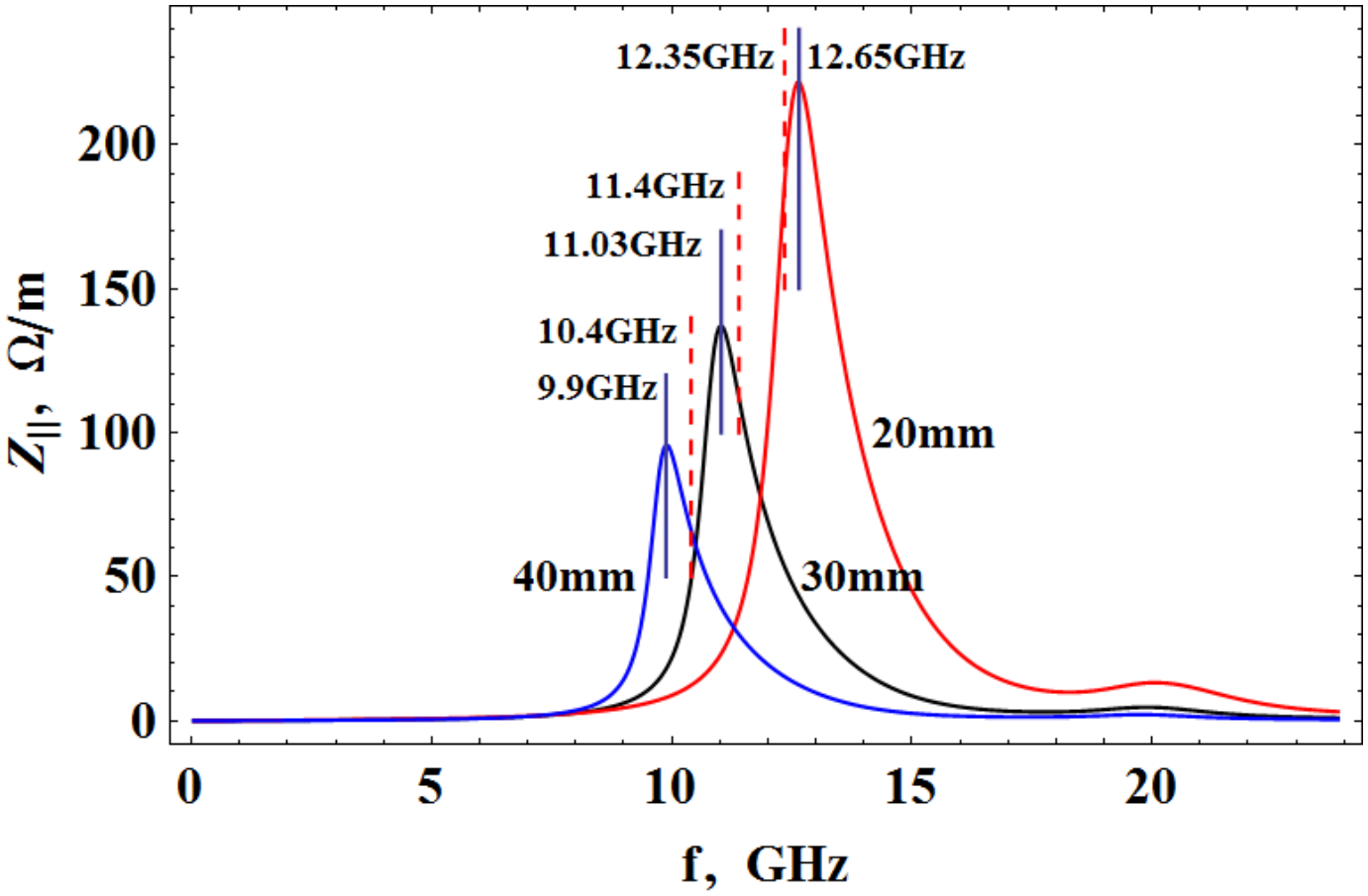
$$\sigma_{Ge} = 2\ \Omega^{-1}m^{-1}$$

$$\varepsilon_{Cu} = 1$$

$$\sigma_{Cu} = 58 \cdot 10^{6}\ \Omega^{-1}m^{-1} \rightarrow \infty$$

Impedances and measured resonance frequencies

$$Z_{||}(k) = \int_{-\infty}^{\infty} E_z(q,k)dq, \; f=kc/2\pi$$



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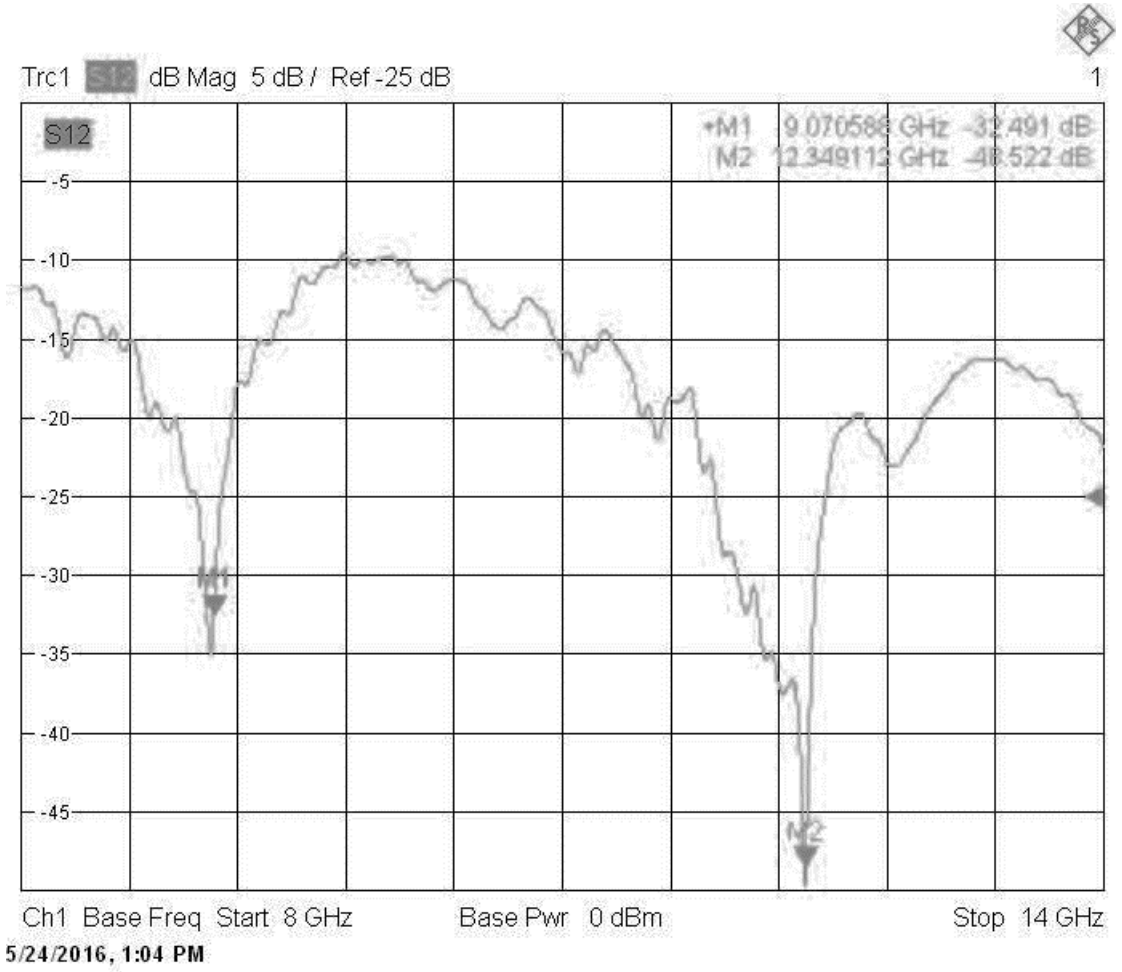
a=20mm



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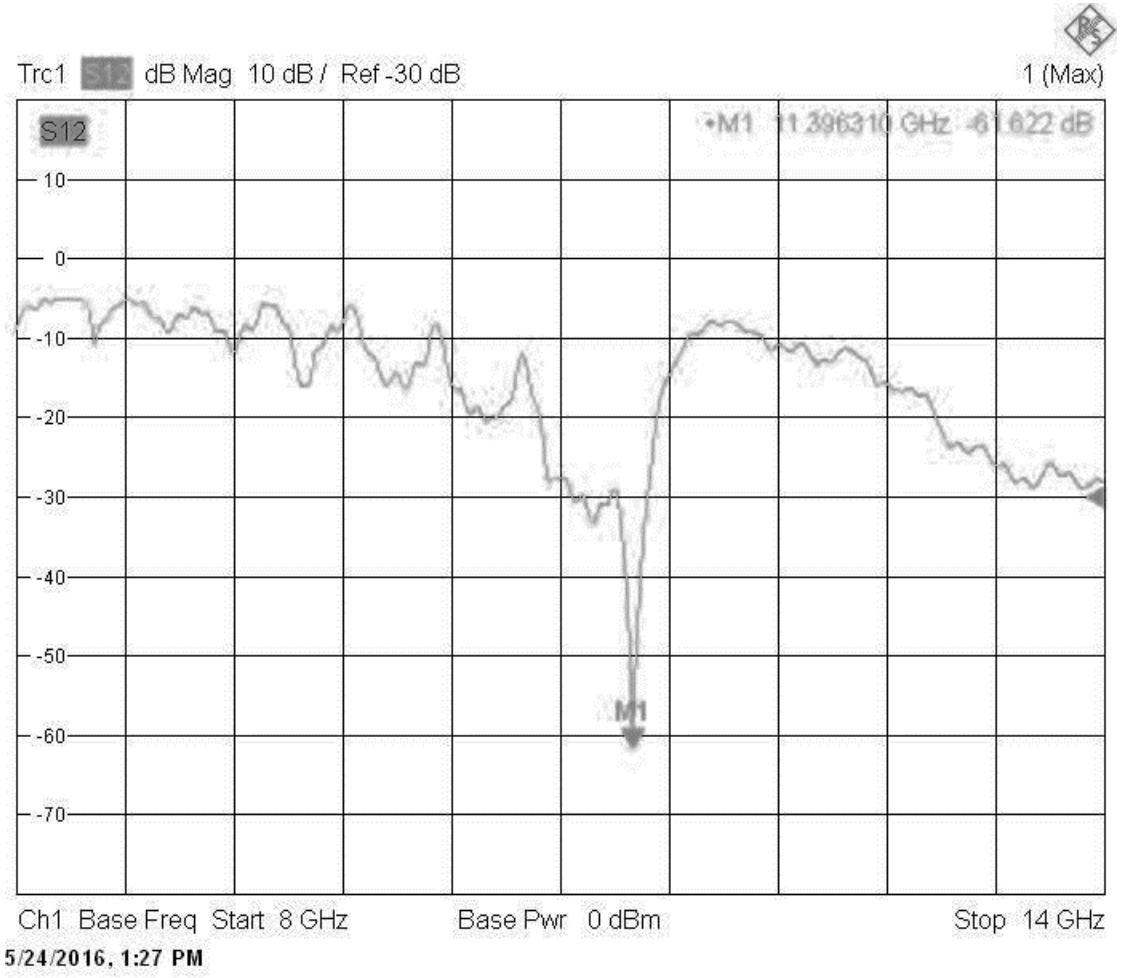
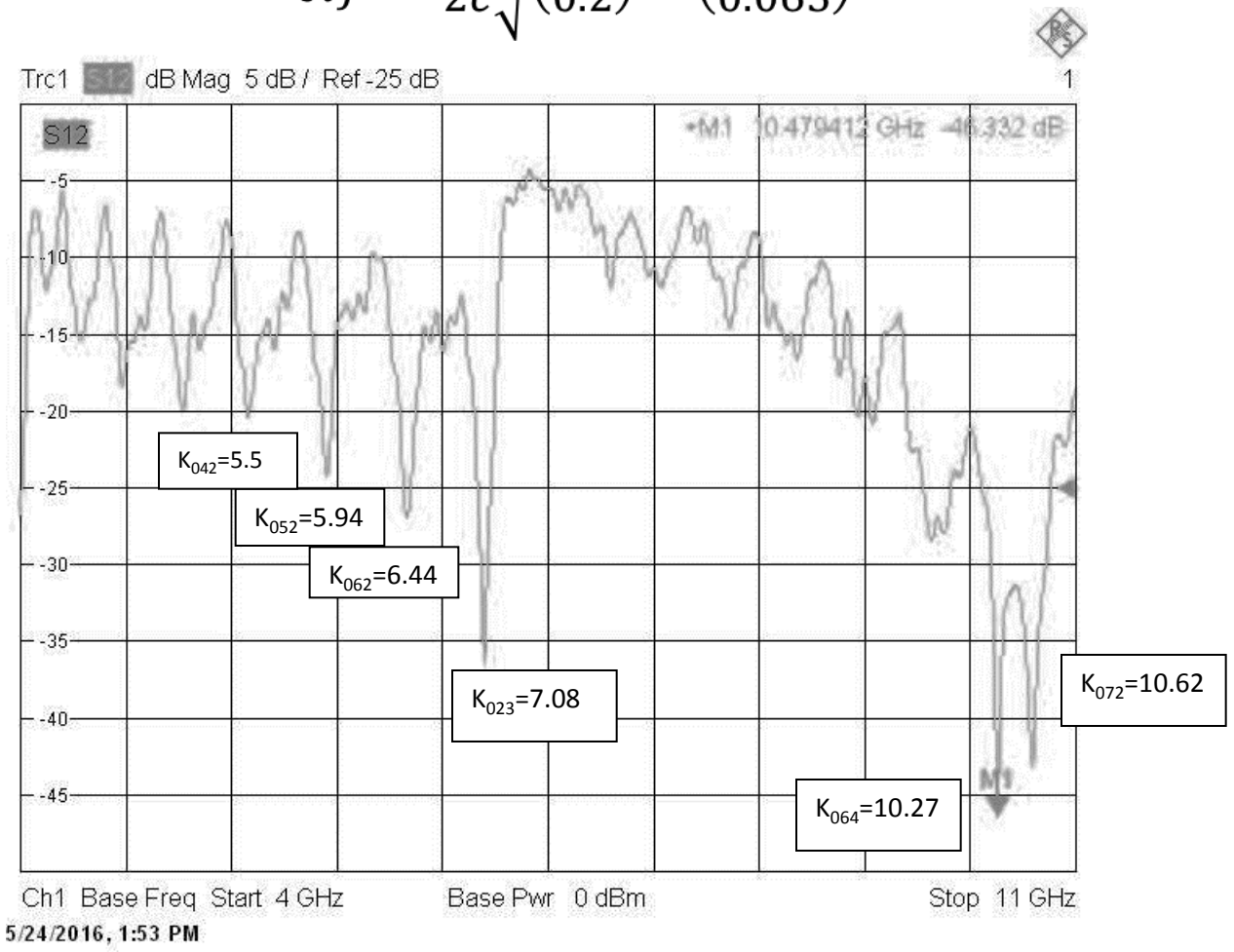
Discoveries using **L**ight **E**mission

a=30mm


Trc1 S12 dB Mag 10 dB / Ref -30 dB
1 (Max)
S12
•M1 11.396310 GHz -61.622 dB
10
0
-10
-20
-30
-40
-50
-60
-70
M1
Ch1 Base Freq Start 8 GHz
Base Pwr 0 dBm
Stop 14 GHz
5/24/2016, 1:27 PM

a=40mm

$$k_{0ij} = \frac{1}{2c}\sqrt{\left(\frac{i}{0.2}\right)^2 + \left(\frac{\mathbf{j}}{0.065}\right)^2}$$



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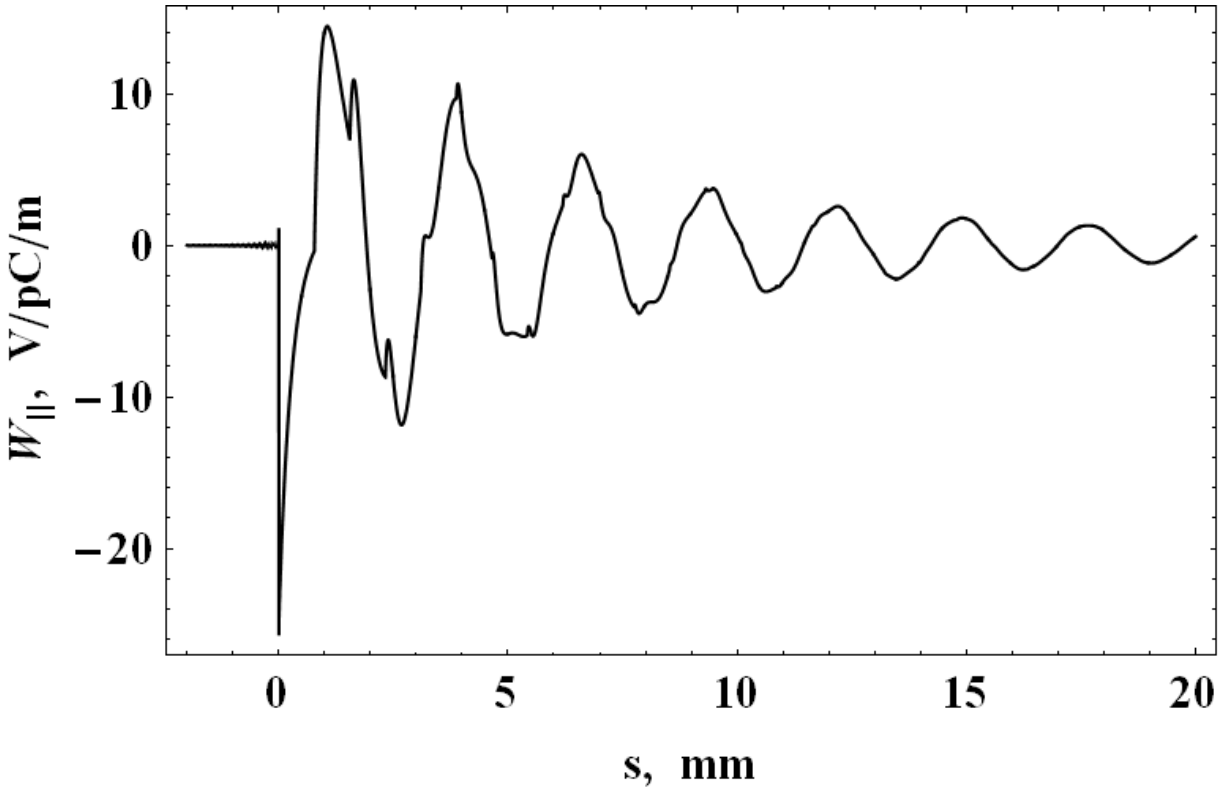
Discoveries using **L**ight **E**mission

Wake potential, a=40mm

$$W_{||} = \int_{-\infty}^{\infty} E_z(q) e^{jks} ds$$



CONCLUSION

The experimental results are interpreted and confirmed by theoretical calculations
It confirms the existence of a proposed Single-Mode Accelerating Structure.

THANK YOU!

Manufacturing of the Single -Mode Accelerating Structure Test Stand

Vahe Danielyan

Vacuum Technologies group
Mechanical Engineering group
Mechanical Workshop

Manufacturing Process

1. *Material Selection*
2. *Design & Technical Drwaings*
3. *Machining*
4. *Measurement*
5. *Assembling*

Material Selection

Copper

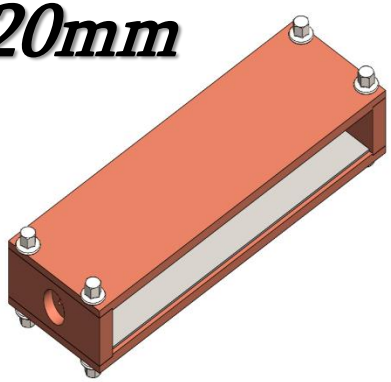
Melting temp.-1083°C
Density -8.940 g/cc
Electrical conductivity- 5.9 × 10^7 S/m
Thermal conductivity - 400 W/(m K)

Germanium

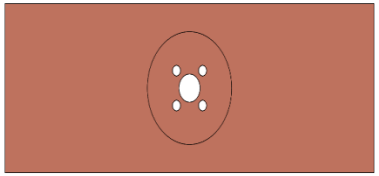
Melting temp.-938°C
Density -5.323g/cc
Electrical conductivity- 2 × 10^3 S/m
Thermal conductivity - 60 W/(m K)

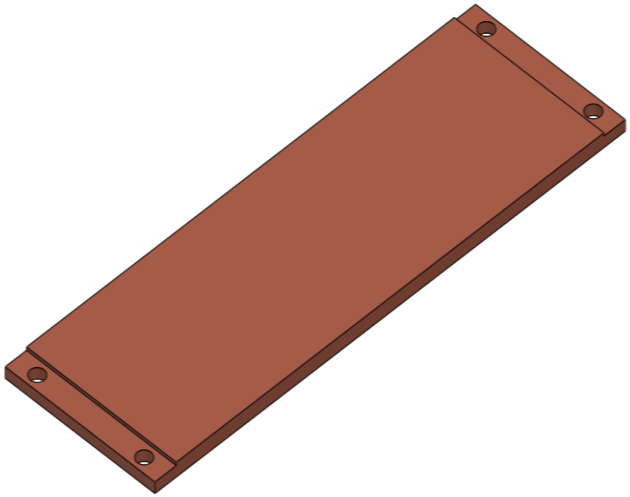
Design

H-20mm

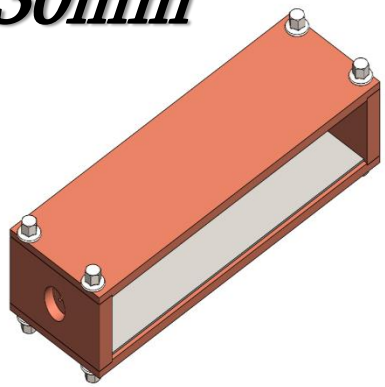


H-24mm

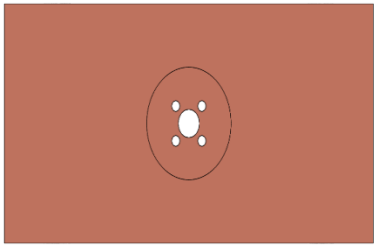


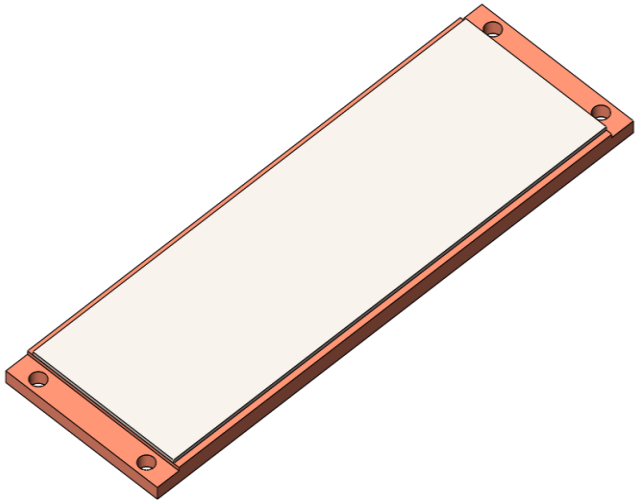


H-30mm

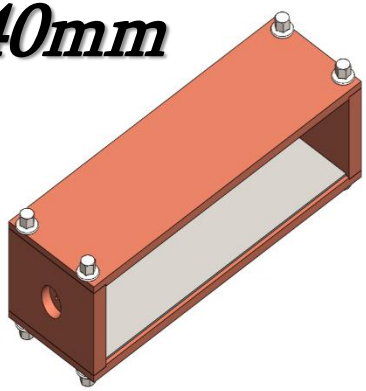


H-34mm

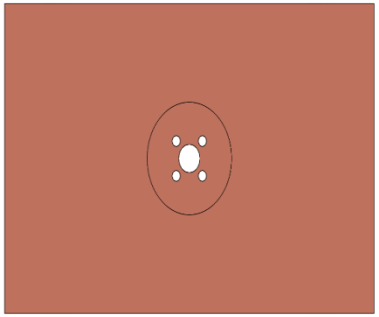


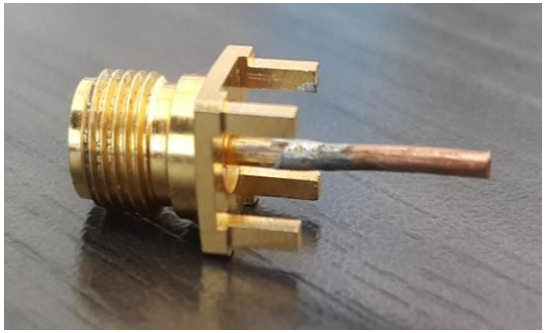


H-40mm



H-44mm

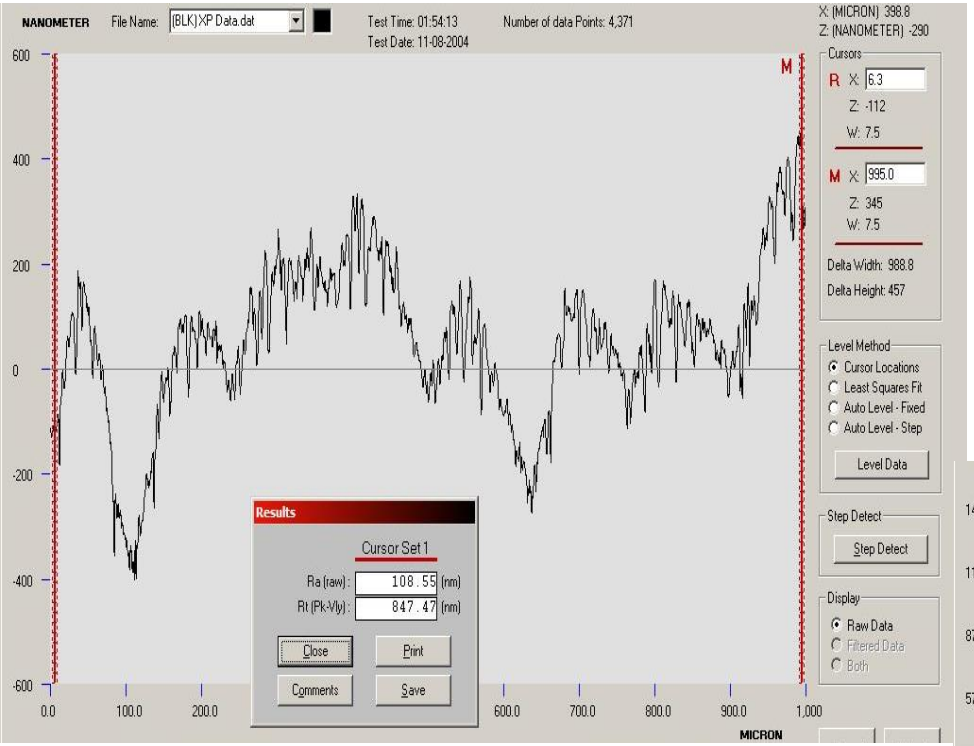


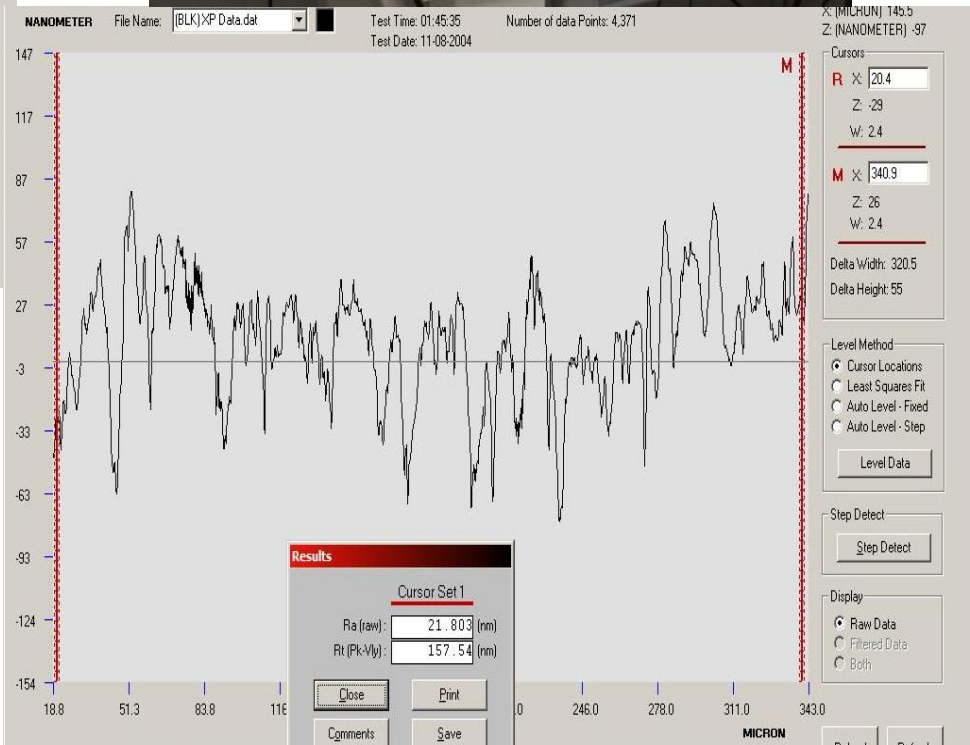


Machining

Measurement

Surface Roughness (Ra)





Scan Length range- *30mm max*
Sample Thickness - *20mm*
Vertical resolution- *100nm*
Vertical range - *1200um max*
Sample view camera- *color camera*
Standard magnification- *100X*
Stylus tip radius - *2.5um*
Stylus force range - *0.05-10mg*

Assembling

THANK YOU FOR ATTENTION