INSTITUTE of RADIOPHYSICS and ELECTRONICS NAS of UKRAINE

Part 3

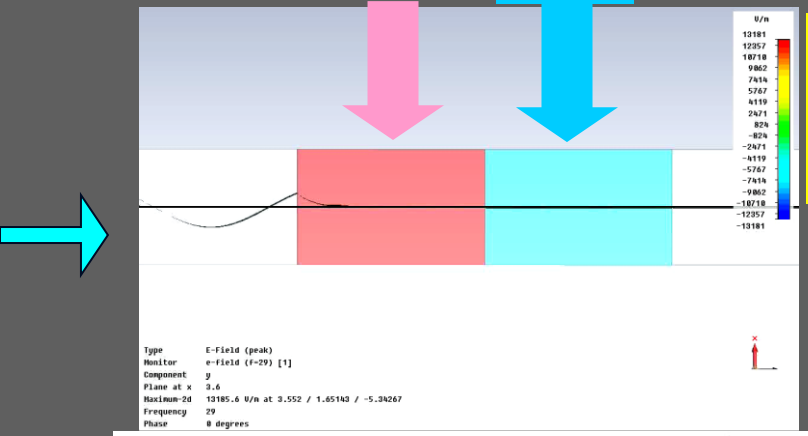
Radiospectroscopy Department

2016

Forming the backward wave in the left handed medium

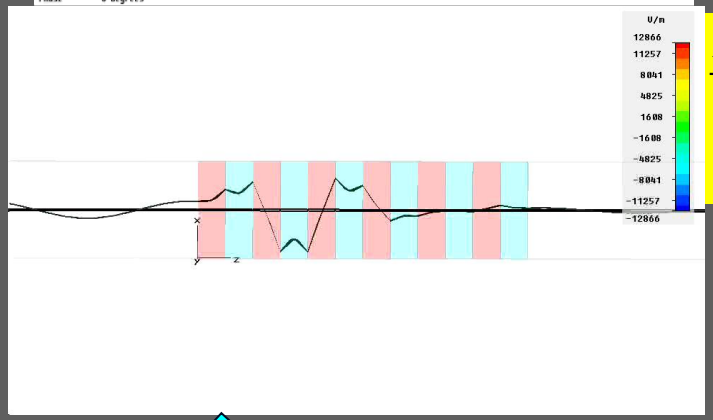
1D medium with various $\frac{\lambda}{d}$

$\varepsilon < 0$ $\mu < 0$



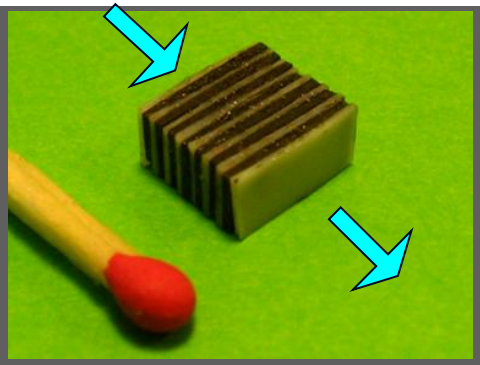
$\frac{\lambda}{d} \le 1$

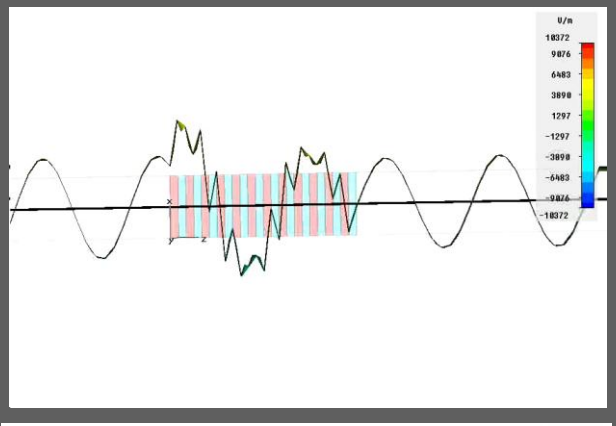
$n = 2$



$\frac{\lambda}{d} \approx 6$

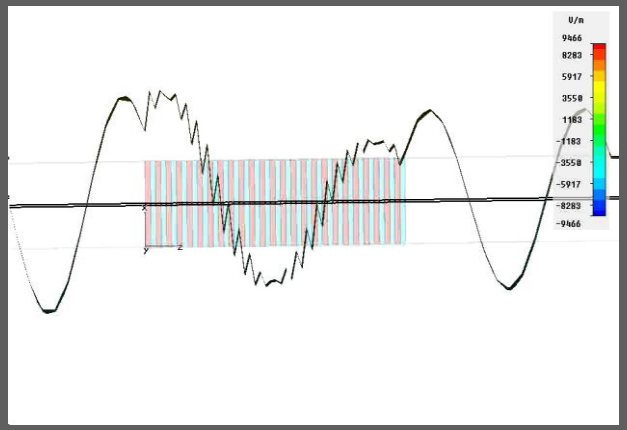
$n = 12$





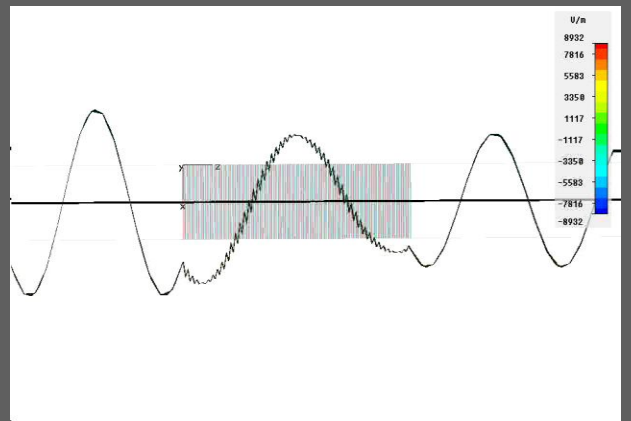
$\frac{\lambda}{d} \approx 13$

$n = 24$



$\frac{\lambda}{d} \approx 27$

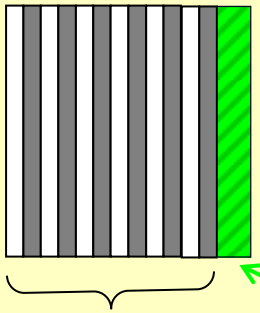
$n = 50$



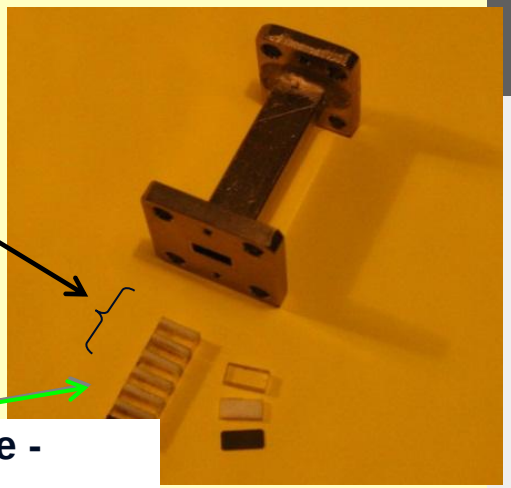
$\frac{\lambda}{d} \approx 54$

$n = 100$

Left Handed Media – Perovskite-Manganite structure

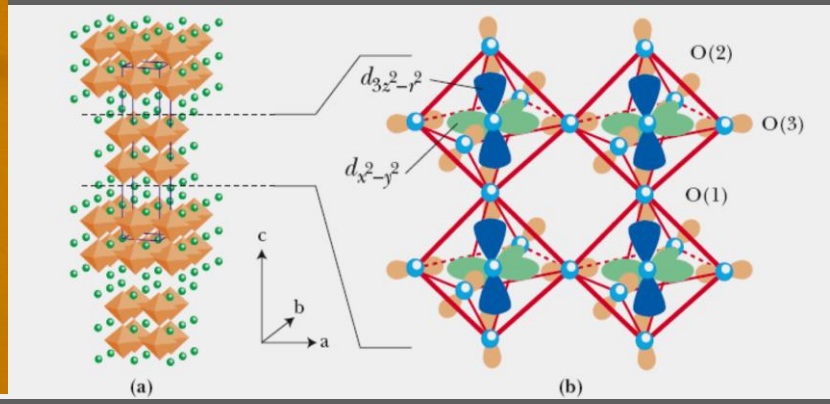


PC

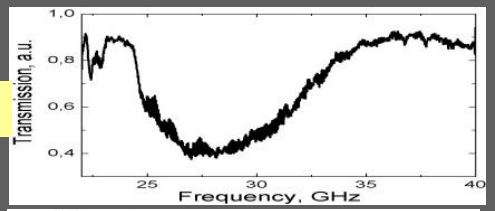


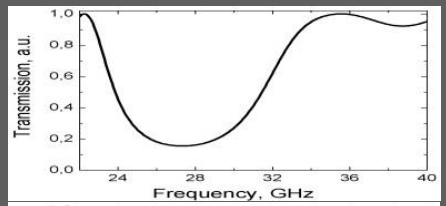
PC (quartz/ teflon)

Perovskite - boundary

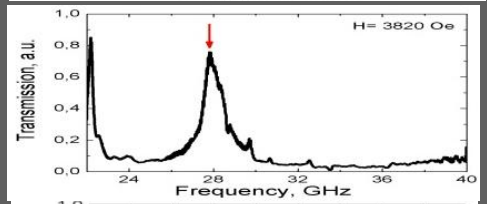


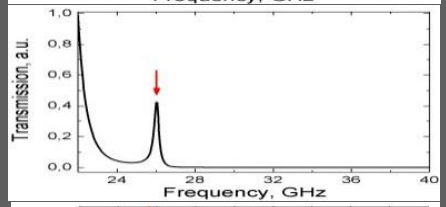
Stop-band of PC



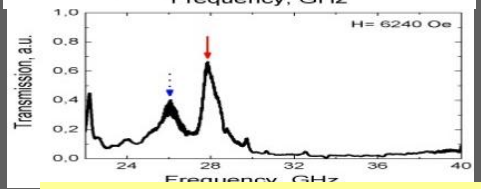


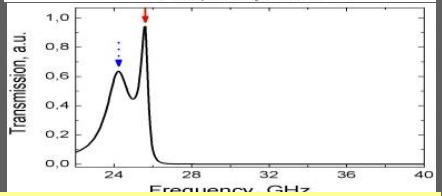
Tamm peak in stop –band





DNG peak + Tamm peak in stop –band



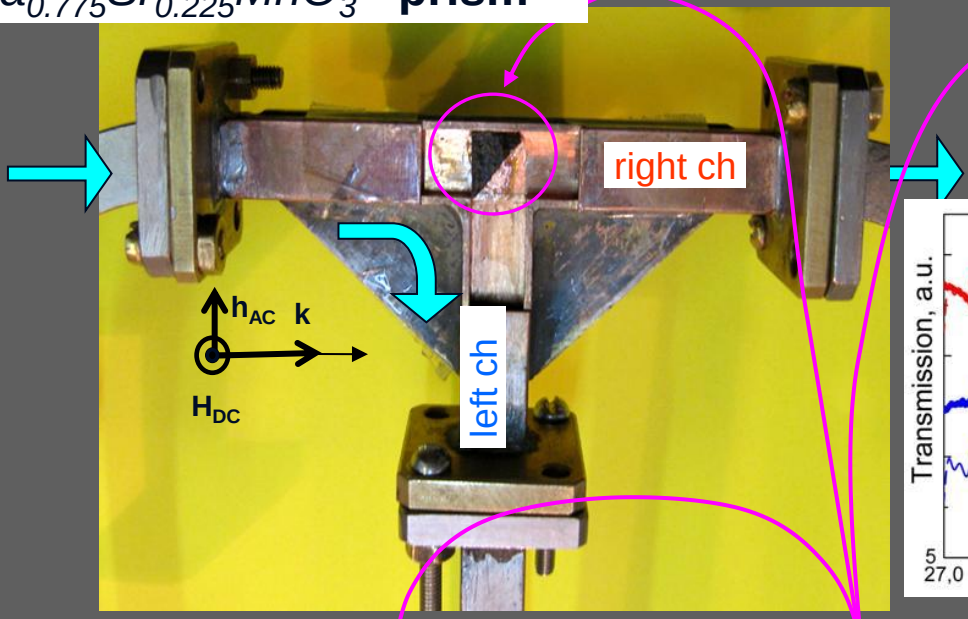


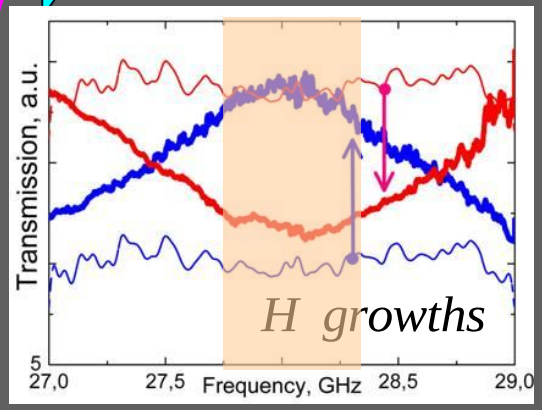
experiment theory

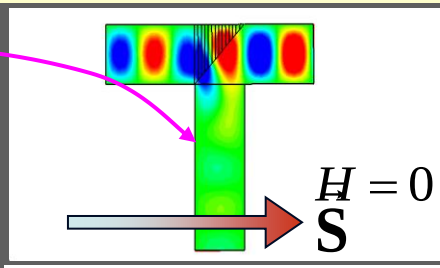
Left Handed Medium prisms. Wave deflecting

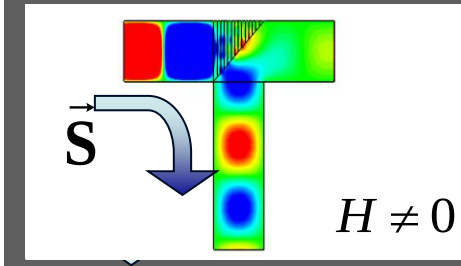
LHM directional coupler

$La_{0.775}Sr_{0.225}MnO_3$ **- prism**

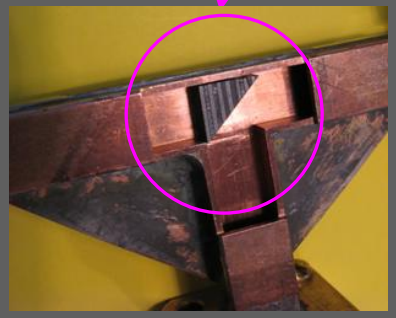


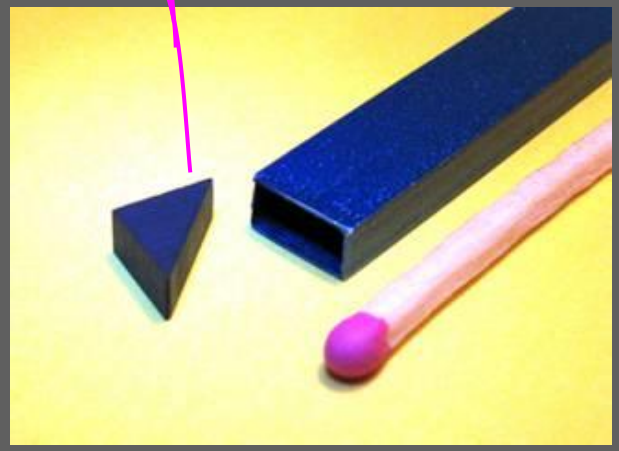




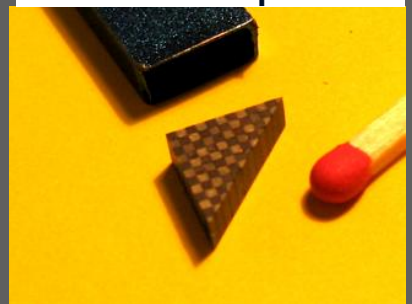


InSb **+ferrite - prism**



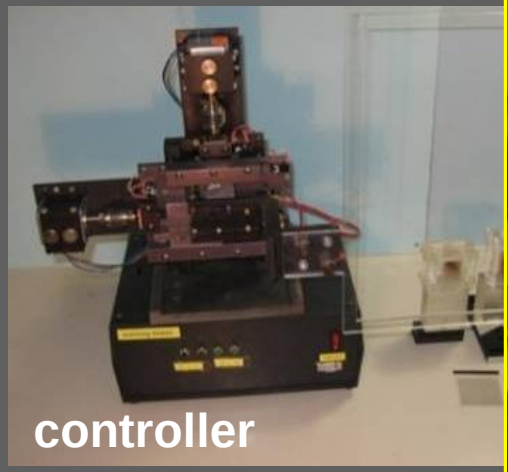


InSb **+ferrite - prisms**

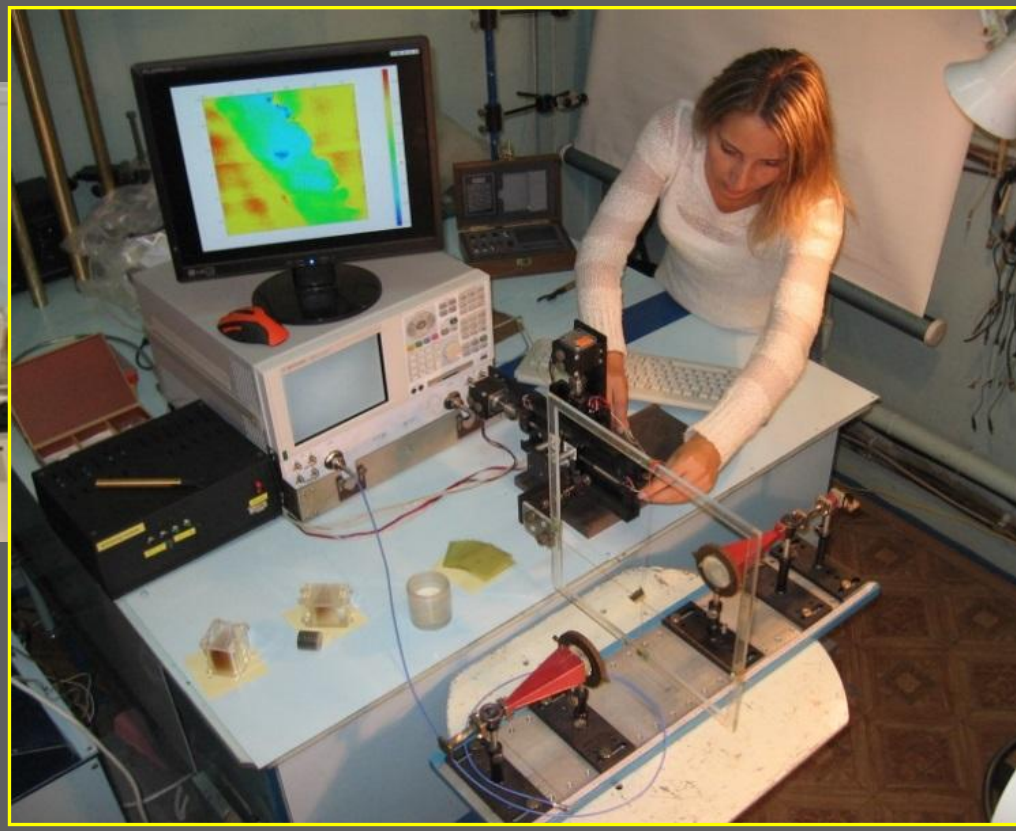


1D-2D scanner
for metamaterials studies

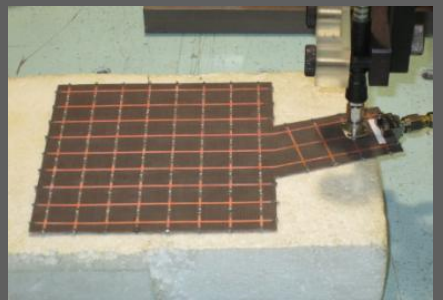
scanning modules



controller



hyperbolic 2D metamaterial



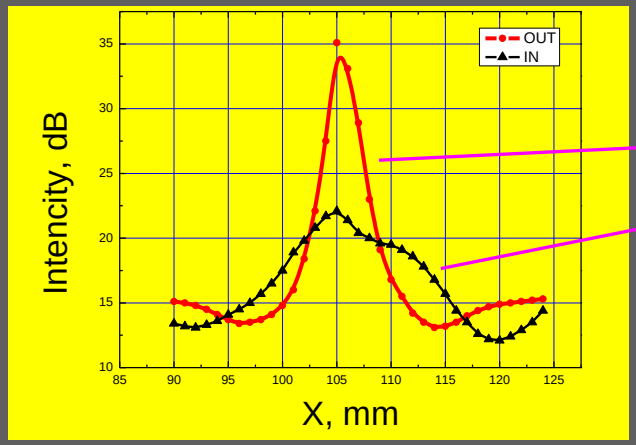
e-mail: tarapov@ire.kharkov.ua

Wire-medium metamaterials for mm waveband

The lenses formed by the array of copper wires

The lenses formed by the array of amorphous metal magnet microwires

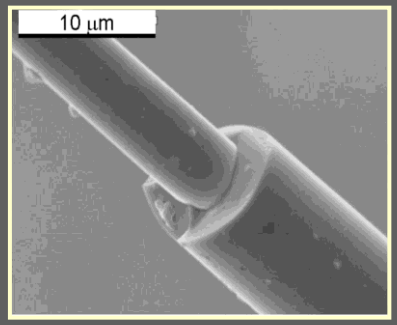
Spatial field distribution near the lens facets



narrow facet of lens

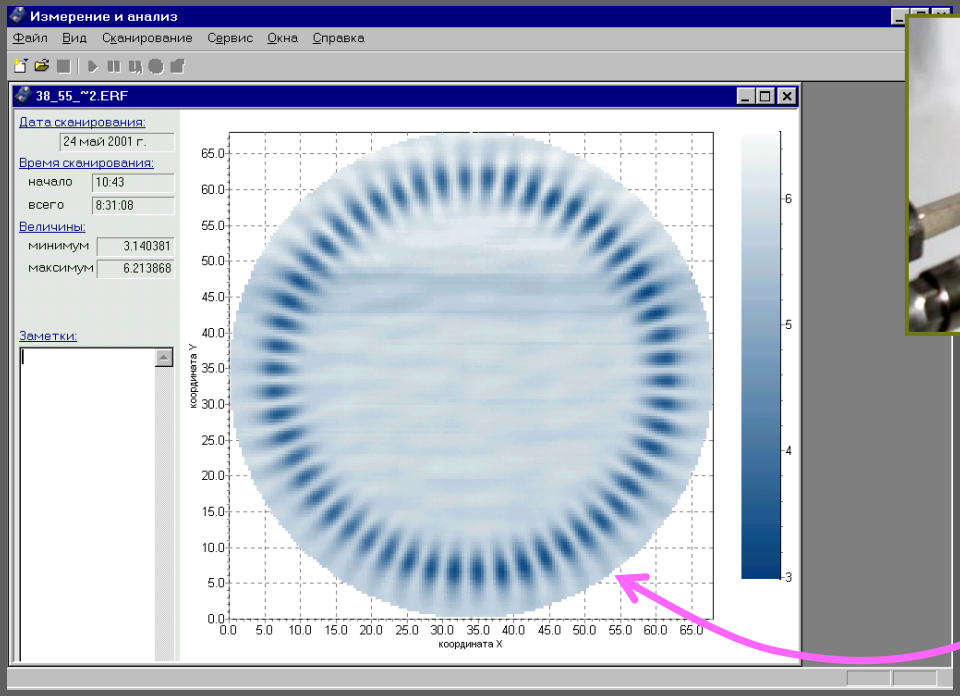
wide facet of lens

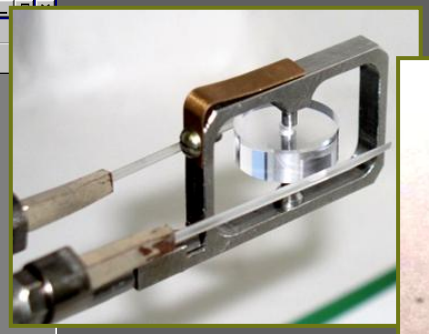
Fe-Ni-Co-B-P microwire



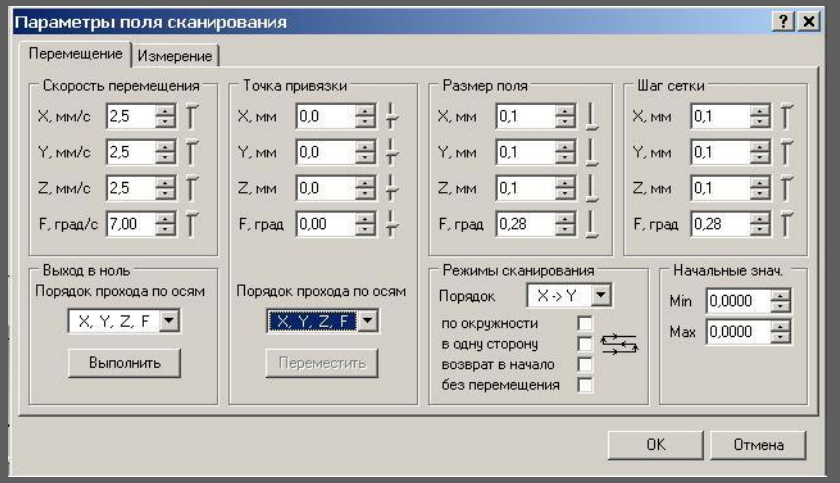
Three dimension (3D) - scanning unit for disk resonators study

Scanning of resonant fields spatial distribution for disk resonators



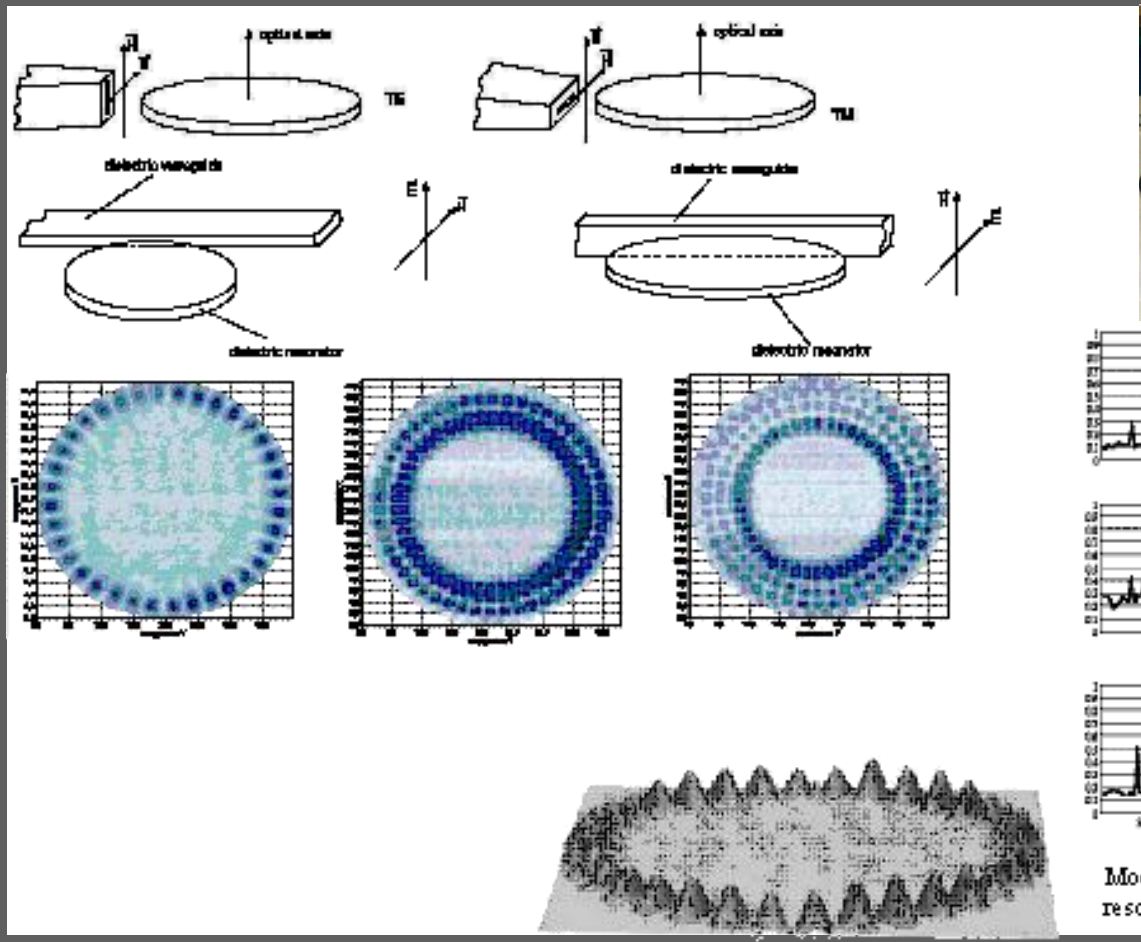


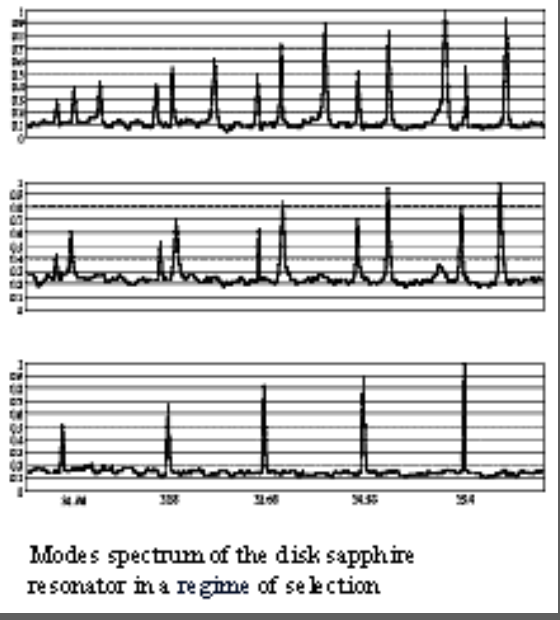
Resonant field spatial distribution for Disk Dielectric Resonator



Interface of scanning program

Whispering gallery dielectric resonators in millimeter wave range



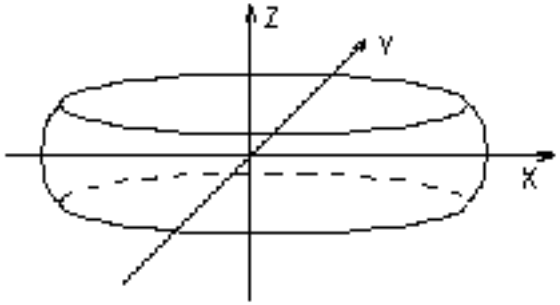


Modes spectrum of the disk sapphire resonator in a regime of selection

Parameters of WGDR:

Diameter	D=5 - 100 mm
Frequency	30 GHz - 146 GHz
Q-factor	10^4-10^5
Material	quartz, sapphire, diamond

Barrel-shaped open resonators



Parameters of BOR:

Equatorial radius	R=10 -150 mm
Meridional radius	r=20-400 mm
Frequency band	30 GHz - 146 GHz
Q-factor	10^3 - 10^4

Resonance frequencies:

$$f = \frac{c - \varepsilon_{kp}}{2\pi a_0} + \frac{c}{2\pi\sqrt{a_0 r_0}}\left(q - \frac{1}{2}\right)$$

$$\varepsilon_{kp} = \frac{\pi(2l-1+4p)}{4} - \frac{4l^2-1}{2\pi(2l-1)+4p}.$$

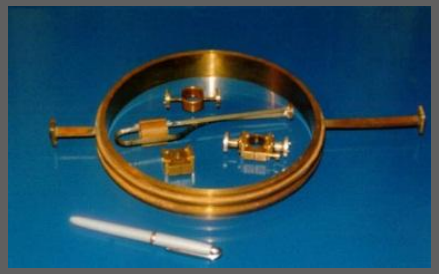
Electrical components of resonant fields

$$E_r = E_0 \frac{1}{k_1 z_c^2} J'_m(k_1 r)\cos(m\varphi)z\exp\left(-\frac{z^2}{2z_c^2}\right);$$

$$E_\varphi = E_0 \frac{m}{r}\frac{1}{k_1^2 z_c^2} J'_m(k_1 r)\sin(m\varphi)z\exp\left(-\frac{z^2}{2z_c^2}\right);$$

$$E_z = E_0 J'_m(k_1 r)\cos(m\varphi)\exp\left(-\frac{z^2}{2z_c^2}\right).$$

$$z_c^2 = \sqrt{a_0(r_0 - a_0)}/k_{m1};\ k_{m1} = 2\pi/\lambda_{m1}.$$



Patterns of resonant fields for some eigen modes of OBR with radius a_0=10 mm
(right - 3D-imaging of amplitude distribution)