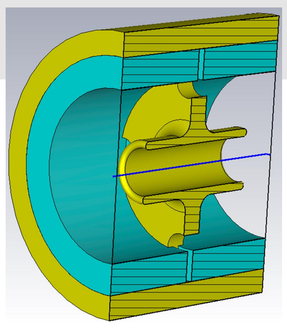
# FUNDAMENTAL PROPERTIES OF A NOVEL, METAL-DIELECTRIC, TUBULAR STRUCTURE WITH MAGNETIC RF COMPENSATION

A.V. Smirnov*[1], E. Savin[2]
[1]*RadiaBeam Systems, LLC, Santa Monica, CA 90404, USA;*
[2]*National Research Nuclear University "MEPhI", Moscow*. 115409, Russia)

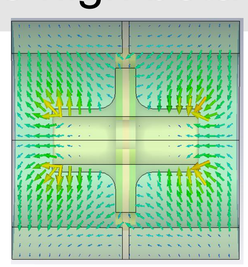
ABSTRACT

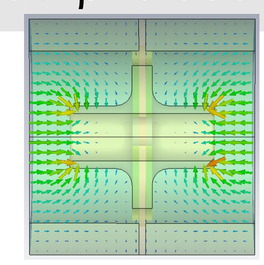
A number of electron beam vacuum devices such as small radiofrequency (RF) linear accelerators (linacs) and microwave traveling wave tubes (TWTs) utilize slow wave structures which are usually rather complicated in production and may require multi-step brazing and time consuming tuning. Fabrication of these devices becomes challenging at centimeter wavelengths, at large number of cells, and when a series or mass production of such structures is required. A hybrid, metal-dielectric, periodic structure for low gradient, low beam current applications is introduced here as a modification of Andreev's disk-and-washer (DaW) structure. Compensated type of coupling between even and odd TE01 modes in the novel structure results in negative group velocity with absolute values as high as 0.1c–0.2c demonstrated in simulations. Sensitivity to material imperfections and electrodynamic parameters of the disk-and-ring (DaR) structure are considered numerically using a single cell model.

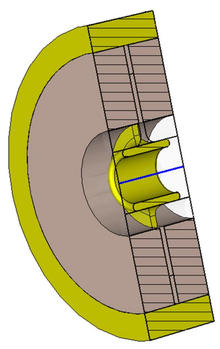
**Disk-and-Ring (DAR) cells**

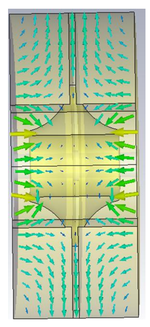


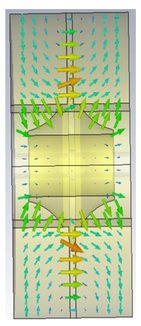
The high beta cell: β=0.936







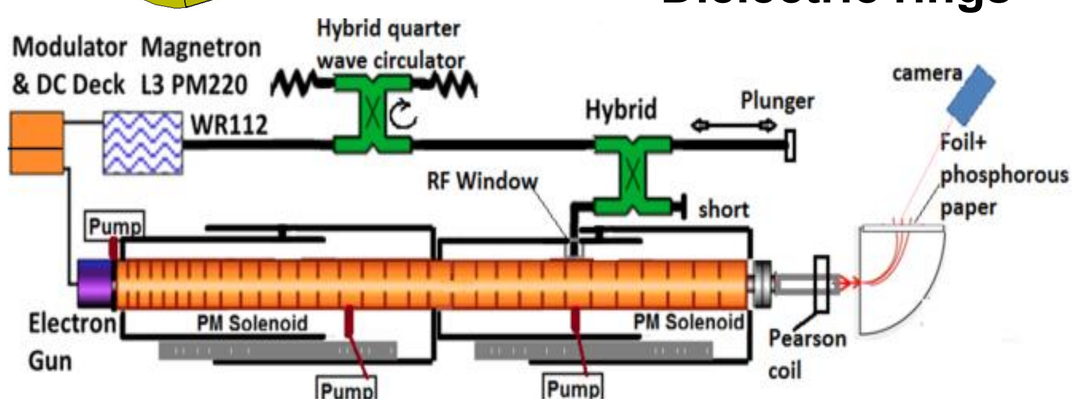


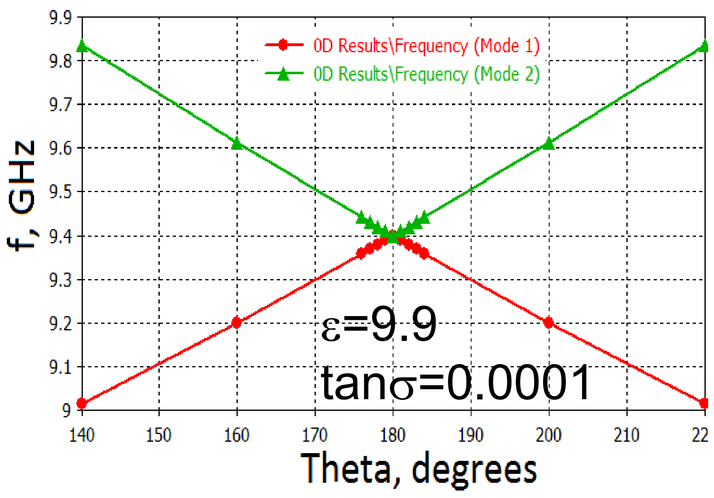


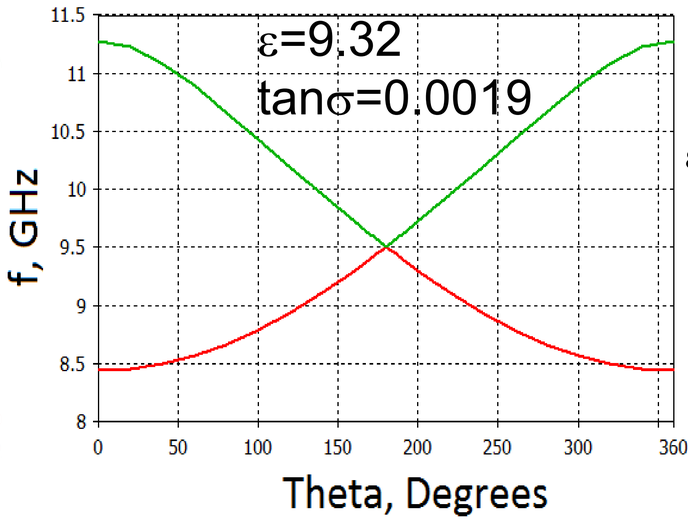
**Compensation at 9.4 GHz**

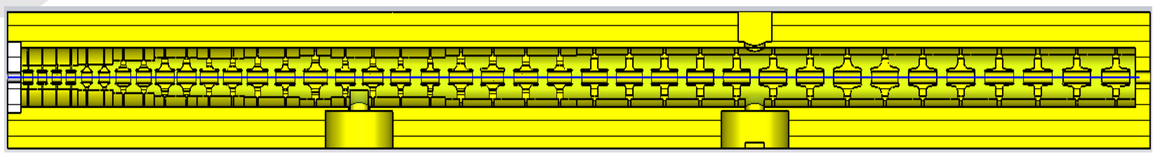
The 1st cell: β=0.338

**ε=9.4-10.5 Dielectric rings**

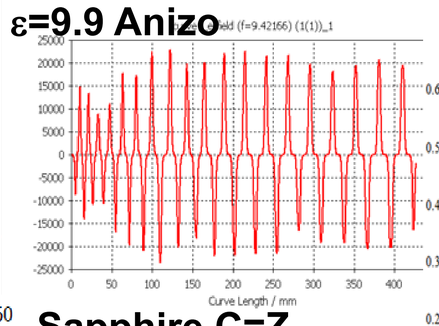


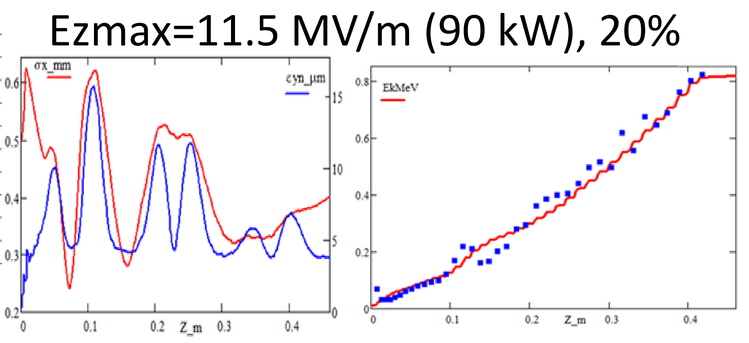



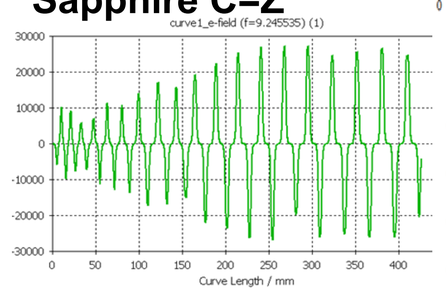
**ε=9.9 Anizo**



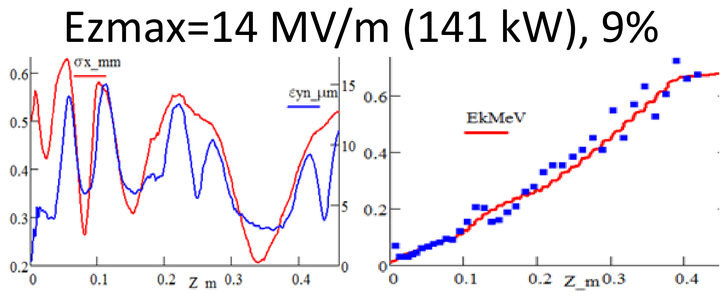

Ezmax=11.5 MV/m (90 kW), 20%



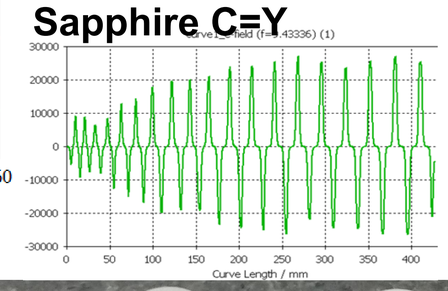

**Sapphire C=Z**

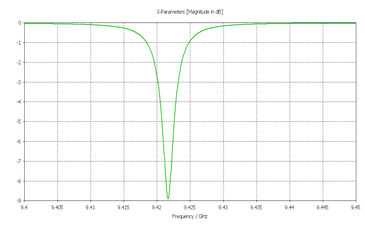


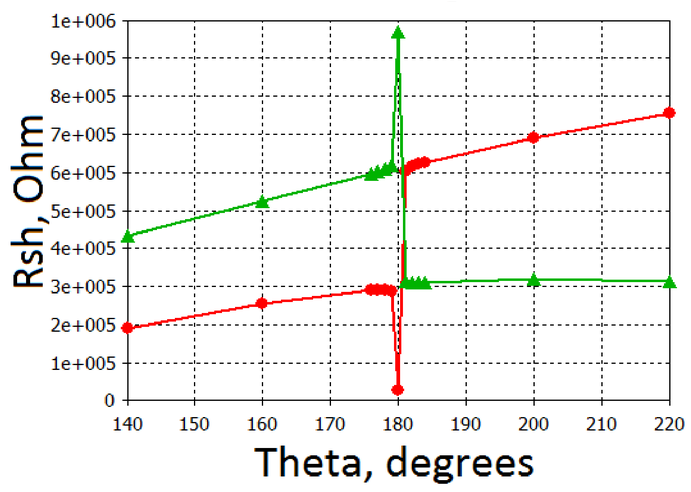

Ezmax=14 MV/m (141 kW), 9%

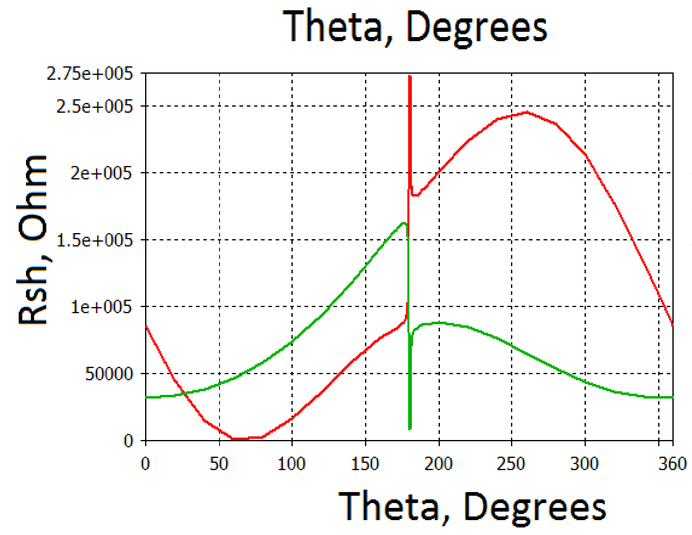


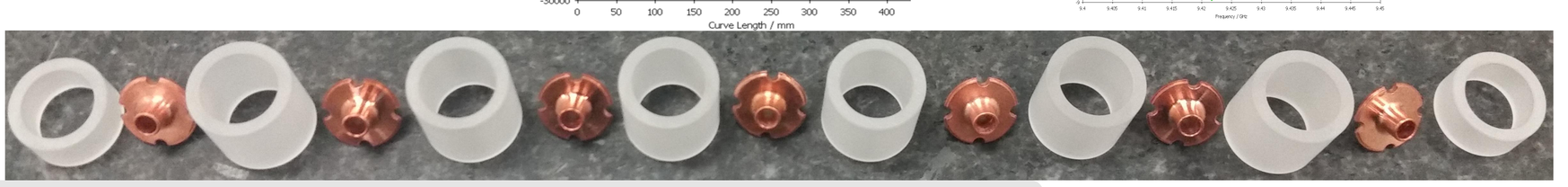

**Sapphire C=Y**



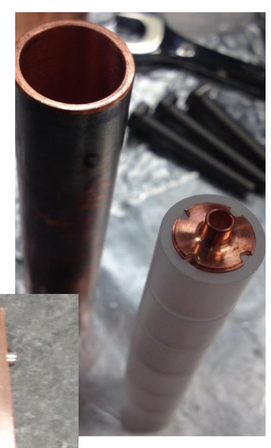


**Cold test assembly**

- Allows combining of compensated and conventional π-mode cells.
- Magnetic focusing can be built-into the disks.
- Eliminates expensive, time consuming, multi-stage copper brazing process.
- Does not require high qualification or expensive advanced technologies like electroforming or high-precision milling with try-and-error replacements of cells (with iterative cold RF tests).
- Does not require expensive and time consuming RF tuning with stubs and cold measurements using VNA.
- High group velocity ~(0.1c-0.2) (negative) at compensation.
- Unlike Andreew's DAW the DAR structure is ~3 times smaller, and does not require supporting rods.
- Admits much larger tolerances.
- Much wider bandwidth ⇒longer resonant SW sections ⇒ >1MeV single structure is possible.



* Corresponding author: asmirnov@radiabeam.com



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Visit us online at www.radiabeamsystems.com
info@radiabeam.com
1713 Stewart Street | Santa Monica, CA | 90404 | USA