Bridging the gaps between microwave modelling and materials measurements *and between women and engineering*

Malgorzata Celuch
QWED Sp. z o.o., Poland

IEEE MTT-S Chapter Chairs Meeting in Region 8
European Microwave Week, Milan, 26 September 2022

to my Father,
MSc in engineering with PhD in economics,
Sybirak - survivor of Soviet deportation to Siberia

with an appeal for a stronger response
to Russia's invasion of Ukraine
to prevent Siberia happening to my children

Outline

1. My path to engineering

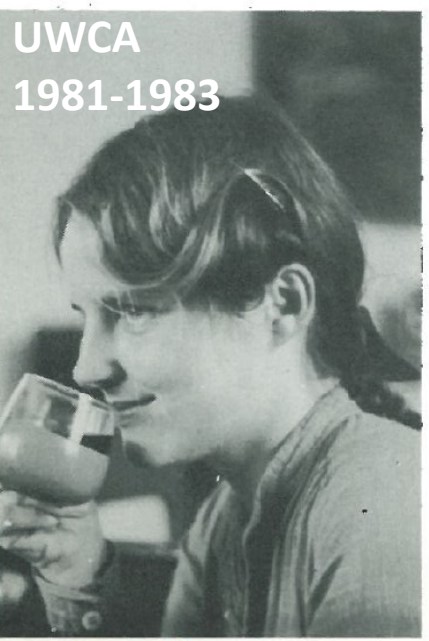
2. From research on Electromagnetic Modelling to its exploitation by QWED

3. QWED expanding into Material Measurements

4. Exploring the synergies between EM Modelling and Material Measurements

5. Being a woman in this field

I wanted to do geography (with focus on marine science)



MALGORZATA CELUCH

Polish (100/) — 10/5/64
Maths, Further Maths, Geography, Physics, English, Polish, Russian.
EMU EMC
Spanish, Volleyball, Weaving, Bandy, Badminton . . . AHMAS(?) . . .

Quiet, quiet, quiet . . . and soon proved to be a chief Maths tutor, a real revolutionary (. . . "but Deon . . . Poland has got a desert!) . . . and . . . a master of ceremonies at midnight parties.
"The only true law is that which leads to freedom. There is no other."
Scientific exploration of the Bristol Channel followed by the exploration of humanity: apart from the change to Extra-Mural this included more of the intellectual conversations in Mendelsohn House.
Polish hospitality helped keep dorm 12 a home.
From depression to the highest happiness. . . . No, Gosia was not lacking her own problems, but she used them as a backing for understanding the others.
Don't believe your eyes-all they show is limitation.

. . . Look with your heart.

https://www.atlanticcollege.org/

https://www.bbc.com/news/uk-wales-56015904
announcing Belgian (2018) and Spanish (2021) Princesses to study at UWCA

revisiting UWCA 2005

UWCA Reunion 2013

So how it came about…

“Telecommunication includes exploring the interior of Earth with radiowaves”

a guide to Polish univerisities, 1983

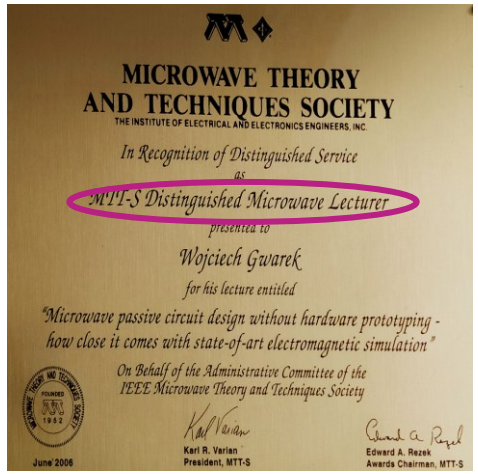
Origins of QWED Computer Modelling

since 1980s…

IEEE- awarded research of Prof. Wojciech Gwarek

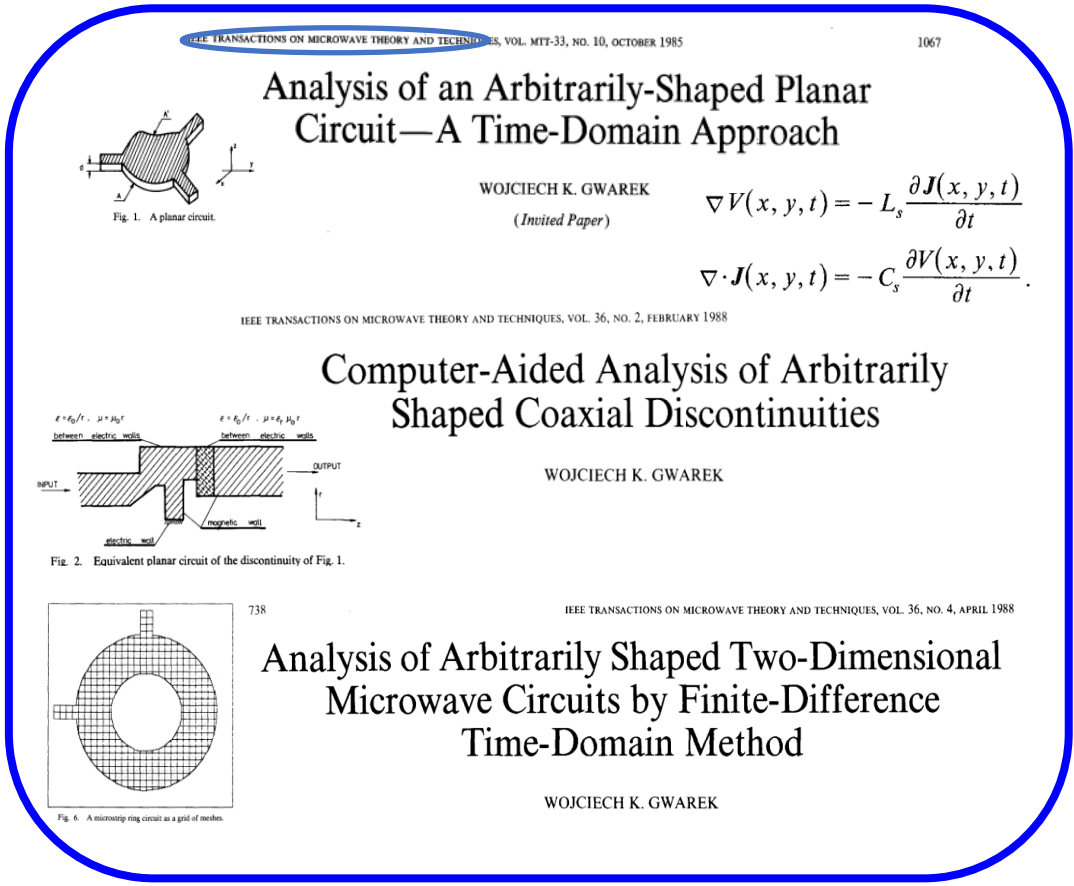
on 2D FDTD modelling (with novel conformal meshing)

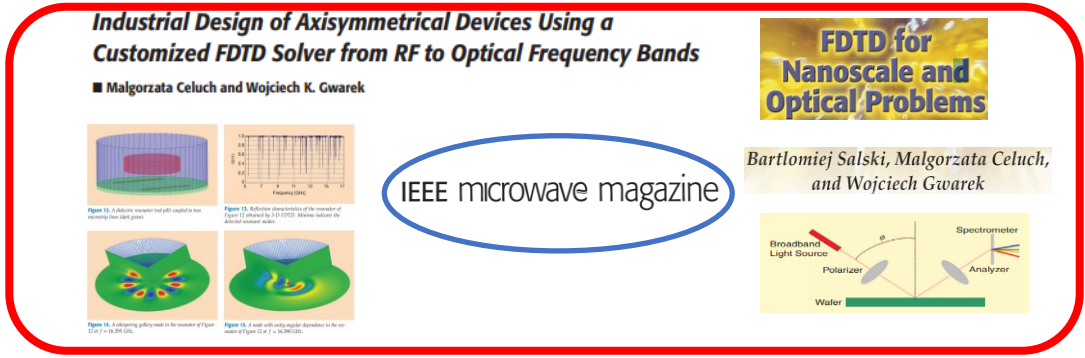
Fellow, Pioneeer Award, DML



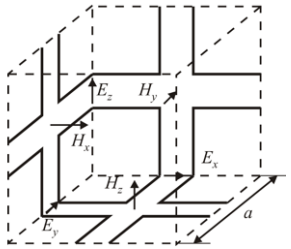
… by early 2000s:

QWED commercialises & continues the development licences for QuickWave-3D by QWED used worldwide industrial applications from RF to optical bands

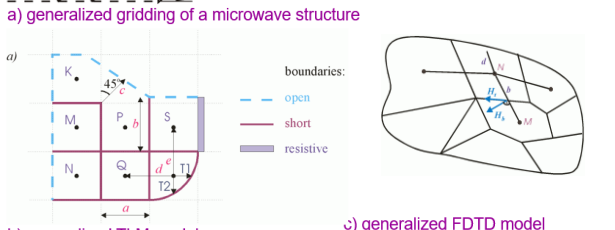


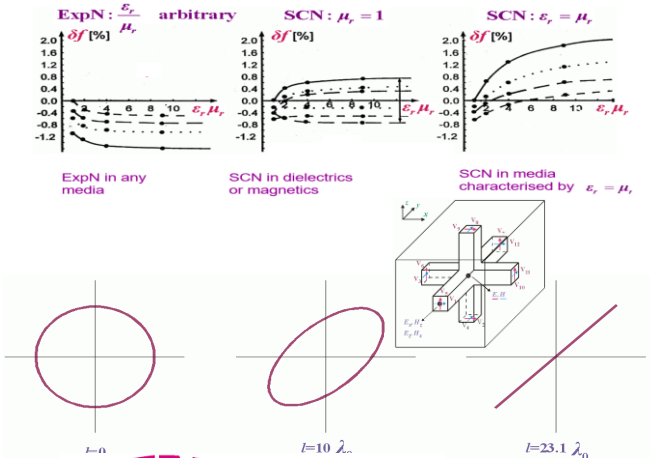


FDTD versus TLM
Theorem of Formal Equivalence



nodes: FDTD discretisation of Maxwell eqs.
connecting lines & stubs: TLM discretisation of Huygens principle



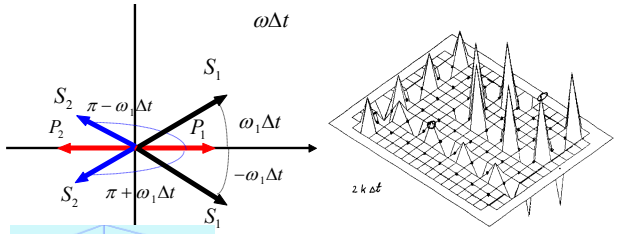


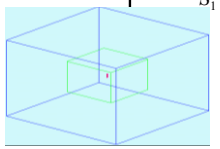
around 1990s:

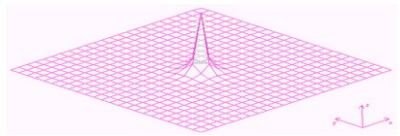
Generalised dispersion relations
Theory of P- and S-eigenmodes

$$P(\omega\Delta t)\ S(\omega\Delta t, \beta_x a, \beta_y a, \beta_z a) = 0$$

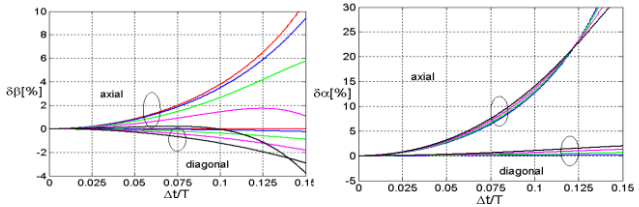
$$\omega_{ph}^2[-\omega_{ph}^2\mu\varepsilon + \beta_{xph}^2 + \beta_{yph}^2 + \beta_{zph}^2]^2 = 0$$



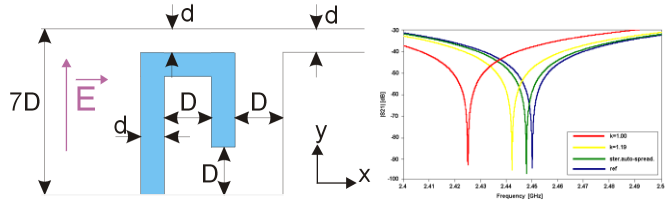




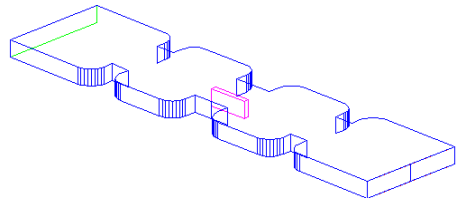
Dispersion in lossy media

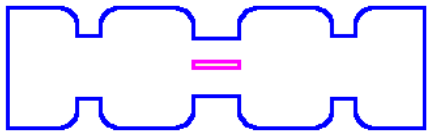


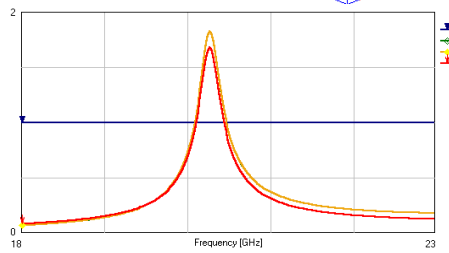
Field singularities

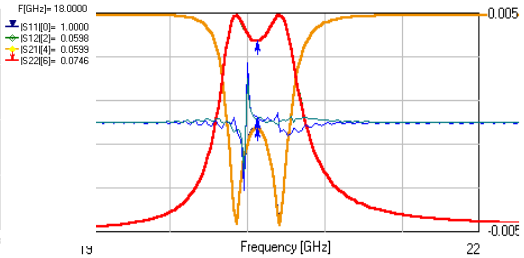


Generalised extraction of S-parameters in multi-modal transmission lines (incl. evanescent modes)

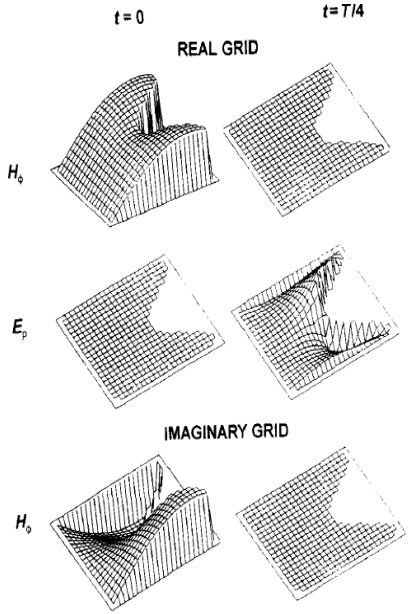




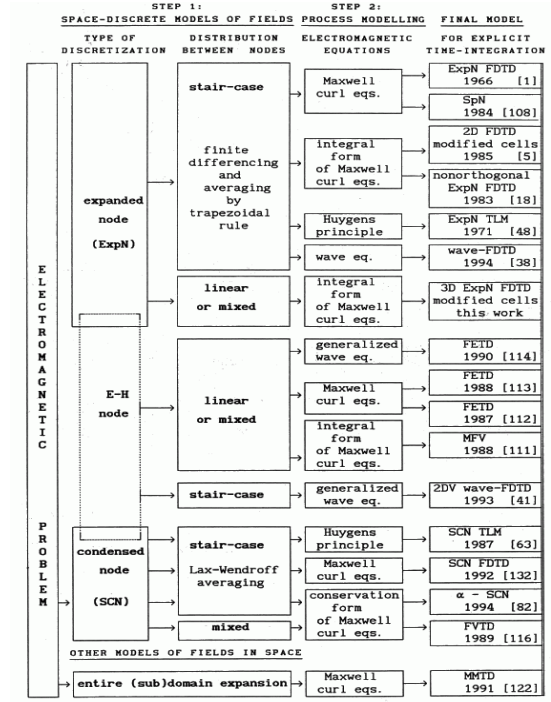




Periodic & vector 2D FDTD and TLM in real & complex form



Classification of time-domain methods



1990s at European Microwave Conferences

Cannes,1994

HIGHER-ORDER MODELLING OF MEDIA INTERFACES
FOR ENHANCED FDTD ANALYSIS OF MICROWAVE CIRCUITS

M.Celuch - Marcysiak, Wojciech K. Gwarek

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Nowowiejska 15/19, 00-665 Warsaw, Poland.
tel.: (22)253929, fax: (22)255248, e-mail: gwarek@ire.pw.edu.pl

PRINCIPLE OF HIGHER-ORDER APPROXIMATIONS FOR MEDIA INTERFACES

Regular Cartesian gridding of microwave circuits leads to the simplest FDTD code with the smallest requirements of computer resources per cell per iteration. However when applied to inhomogeneous problems, it generates cells intersected by media interfaces as shown in Fig.1. We shall consider three models of such cells for an FDTD electromagnetic simulation:

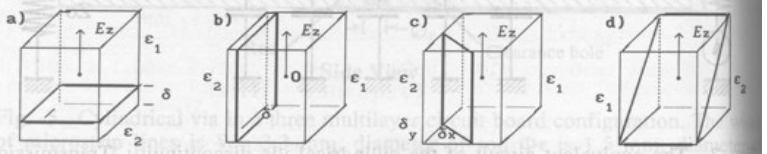

Fig.1.: Media interfaces intersecting elementary FDTD cells.

Jerusalem, 1997

MULTILEVEL IMPROVEMENTS TO CONFORMAL FDTD
FOR S-PARAMETER EXTRACTION WITHIN IRREGULARLY SHAPED
TRANSMISSION LINES

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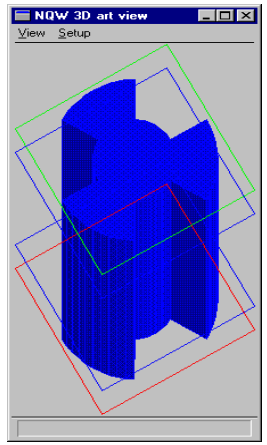
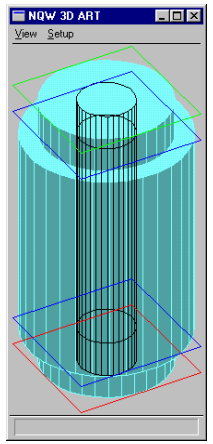
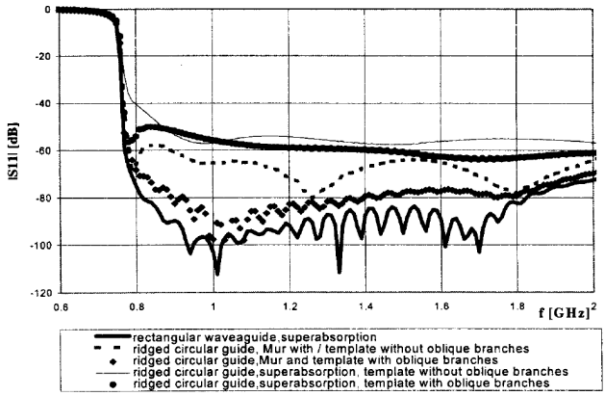
tel.: (48 22) 660 76 31, fax: (48 22) 25 52 48, e-mail: gosiac@ire.pw.edu.pl







QWED started 1997

celebrating 25 years

Founders: A.Wieckowski, M.Sypniewski, M.Celuch, W.Gwarek

Prof. Jerzy Buzek awarding QWED team in 1998
Prime Minister of Poland 1997-2002
President of the European Parliament 2009-2012

Dr. Malgorzata Celuch
President since 2017, VP 1997-2017
- 35 y experience in mathematical, 25 y in management
- Awards for excellence from e.g. Prime Minister of Poland, Rector of WarsawUnivTech

Janusz Rudnicki, MS,
VP for IT
- 22 years of experience in simulation software development

Dr. Marzena Olszewska-Placha,
VP for R&D
- 15 y of experience in simulation-based MHz to THZ design and consultancy
- 4 y experience in research management

Dr. Andrzej Więckowski
Senior in CAD
- 48 years of experience in computer-aided electronic engineering and engineering software development

Prof. Wojciech Gwarek,
President 1997-2017
- 22 years of experience in simulation software development

Dr. Maciej Sypniewski
Senior in CAE
- 35 years of experience in engineering software development and GHz measurements

10
people employed

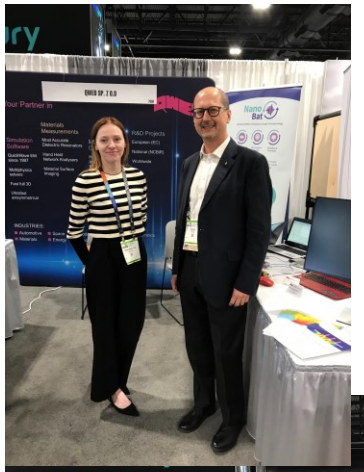
7
consultants cooperating

50%
female

since 1998 annually at IEEE IMS

Anaheim, CA, 1999

San Francisco, CA, 2006



Denver, 2022

International…

Microwave-08, Jaipur, India

…also in EU-policy-making

2008 Paris, France

Consolidating Research and Innovation for European SMEs Conference
Paris, France
September 15-16, 2008

Dr. M. Celuch was an invited speaker in the high level Conference jointly organised by the European Commission and OSEO ***"Consolidating Research and Innovation for European SMEs: How to do more and better"***, which took place at the French Ministry for Economy, Industry and Employment, place on September 15-16, on the occasion of the French Presidency of the European Union. Video recordings of the Conference are available at **http://www.ue-recherche-et-pme.oseo.fr/**. Dr. Celuch participated in Debate: ***How to adapt support for SMEs within an enhanced networking approach***.

The European Commission also organised, in parallel with and in complement to the main conference, a ***dedicated EC press programme*** for journalists present at the Conference. QWED was proud to be ***one of fifteen European research success stories*** selected for presentation.

…and Multidisciplinary Actions

EMB-1998, Linkoping, Sweden

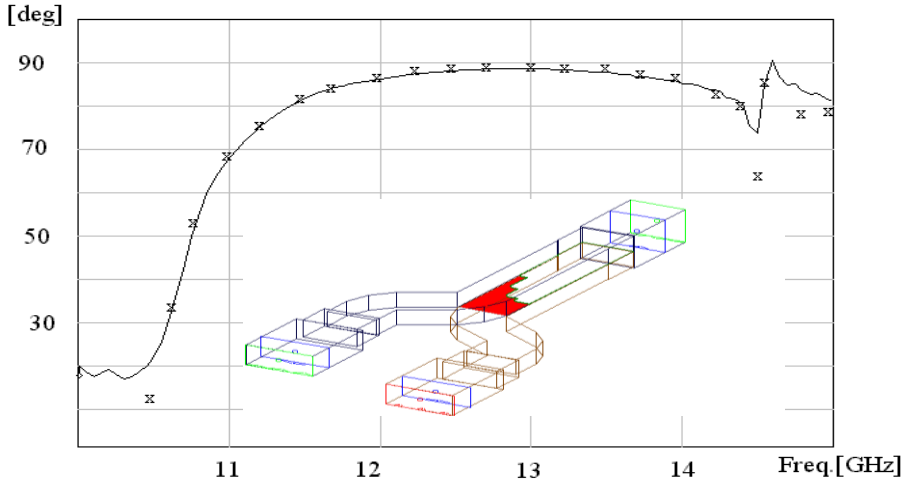
IEEE IMS 2014, Tampa, FL

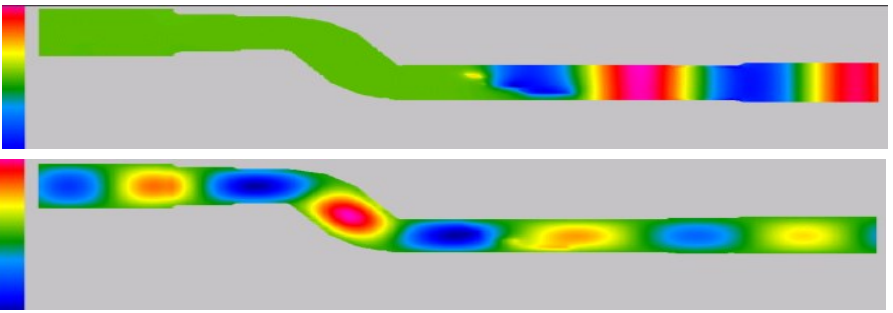
QuickWave original applications in cosmic reseach & satellite telecommunication

Septum polariser by SES

design & measurements: Saab Ericsson Space
modelling: QWED, 1997

below: differential phase-shift



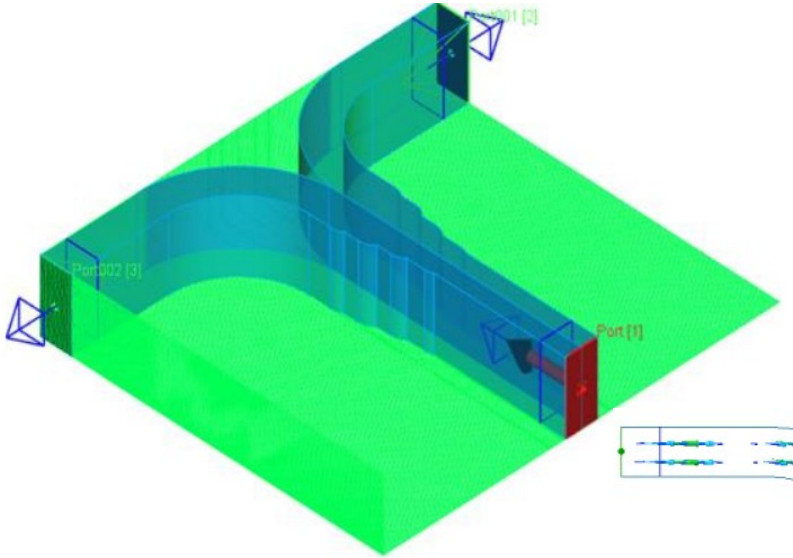


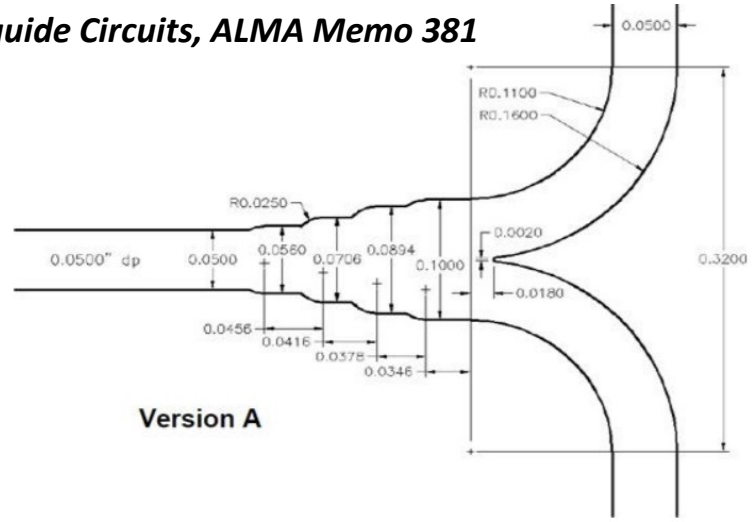
propagation of two polarisations

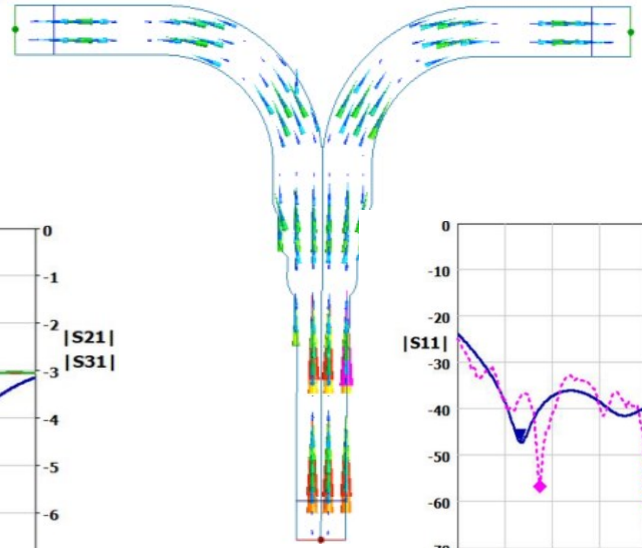
at centre frequency

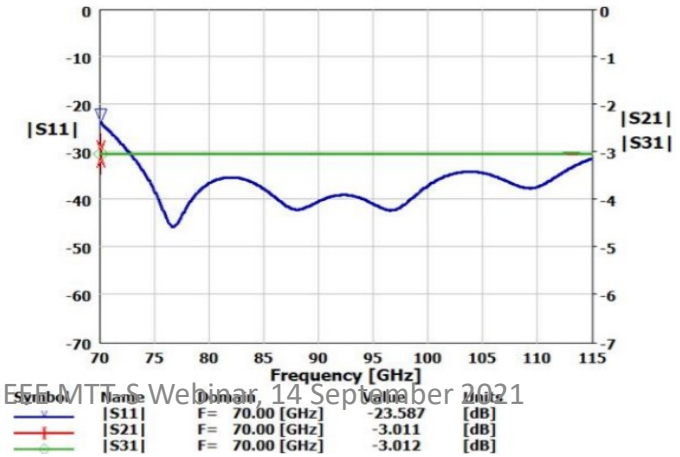
E-plane Y-junction by NRAO

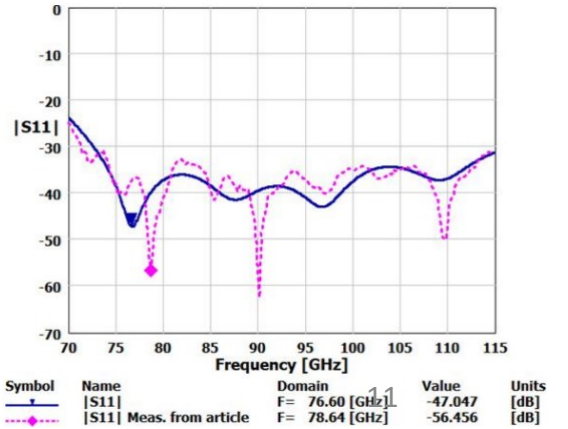
after A. R. Kerr, Elements for E-Plane Split-Block Waveguide Circuits, ALMA Memo 381





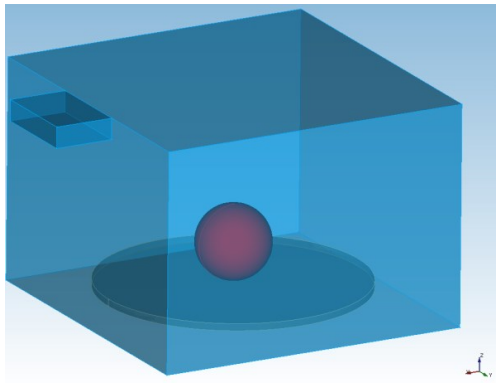


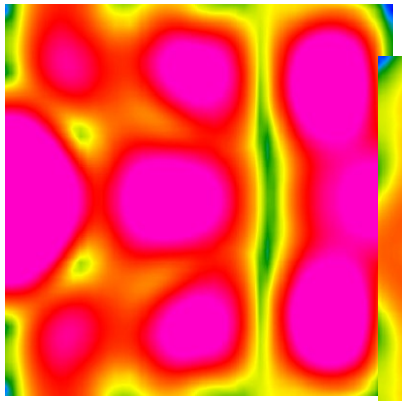




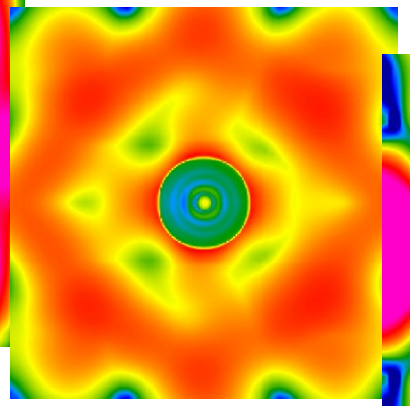
QuickWave modelling EM field interaction with tissues (for food processing & medical applicators)

Separation of incident and diffracted fields (*option implemented per request of P.O.Risman, Malardalen Univesity*)

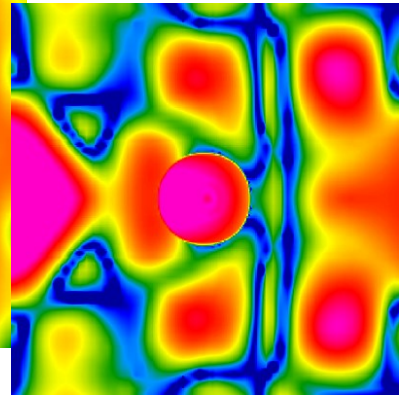




E-field in an empty cavity

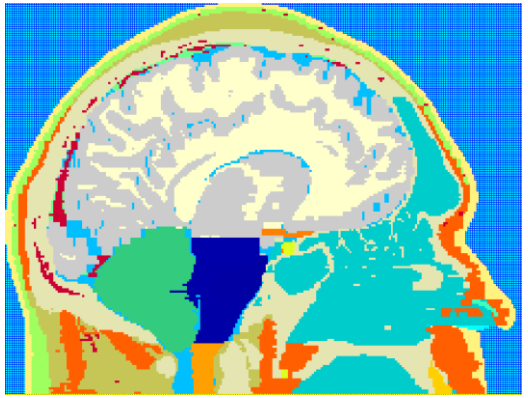


E-field in a loaded cavity

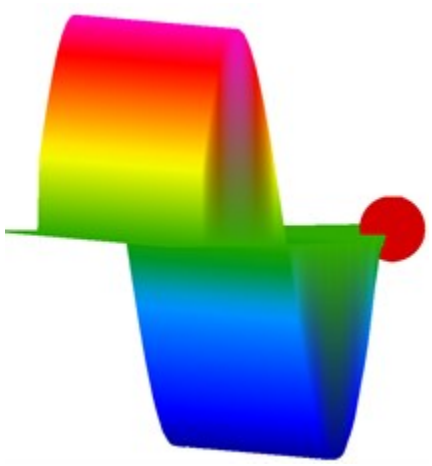


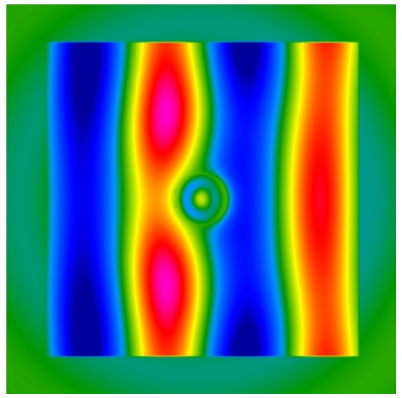
Scattered near-fied in cavity

Detection of inhomogenities in tissues

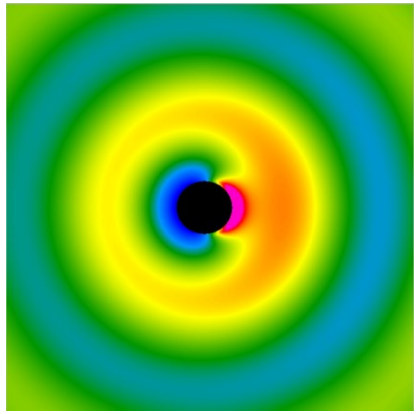


AustinMan model* converted to **QuickWave EM** software for Mälardalen University, Sweden

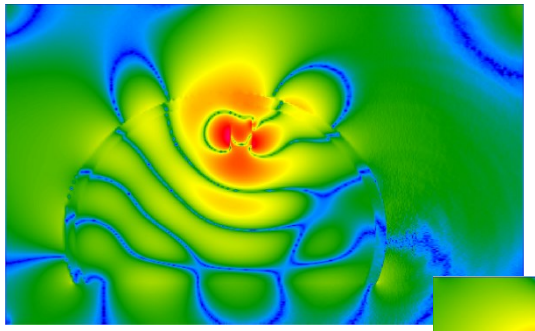


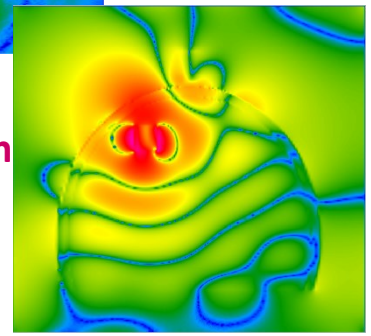


Total field
Focusing by the load
„exploding egg effect”



Diffracted field reveals cause of focusing: circumferential resonance





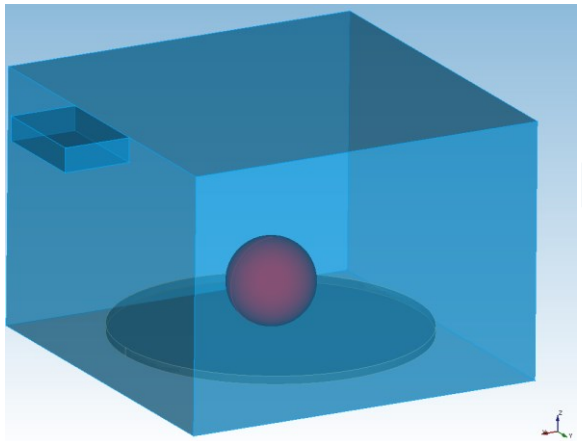
- ✓ **Tumours & haemorrhages detection**
- ✓ **Optimisation of multiantenna tomographic systems**

* https://sites.utexas.edu/austinmanaustinwomanmodels/

Ilustration & cross-verification of QuickWave Multiphysics Regimes in Elsevier Book

Simple microwave heating benchmarks & microwave heating phenomena studies*

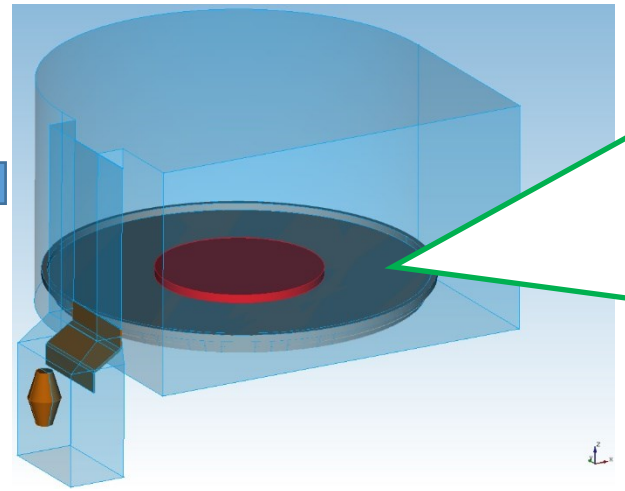
Design & analysis of real-life microwave oven cavities, incl. complicated cavity shapes and advanced feeding system*



- heat transfer & load dynamics
- Load rotation & arbitrary movement during heating
- Source parameters tuning – regime for solid state sources
- Temperature dependence of material parameters

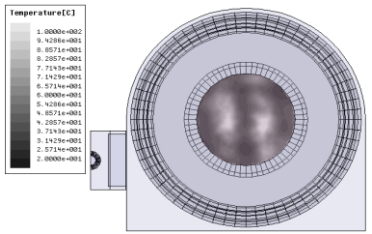
Freezing to file the state of the simulation

De-freezing on arbitrary computer & at convenient time

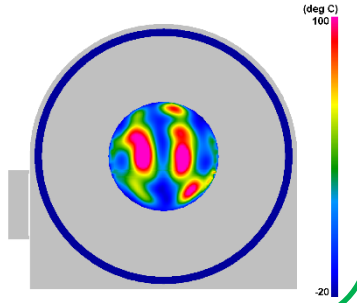


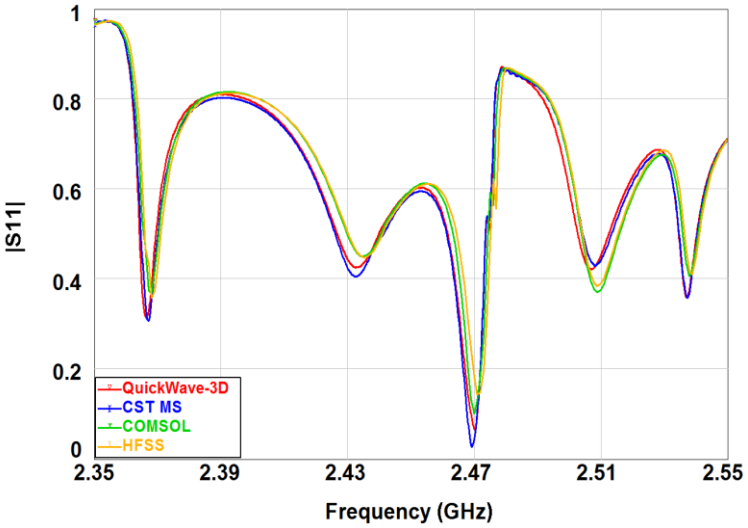
Courtesy of Whirlpool Inc. – Whirlpool MAX oven

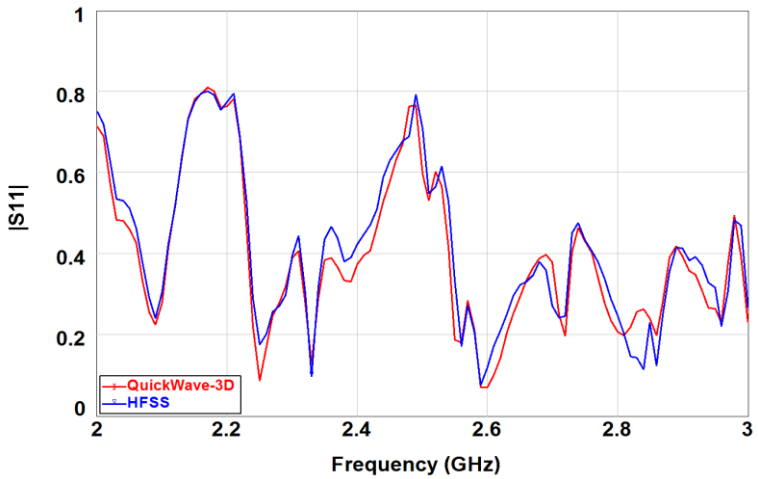
HFSS v11



QuickWave 3D & BHM







With QuickWave EM computation as fast as **1 min 18s** on a **low-cost video card** – supporting **all** graphic cards **with OpenCL**

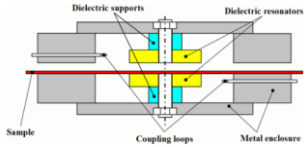
* M.Celuch, P.Kopyt & M. Olszewska-Placha in eds. M. Lorence, P. S. Pesheck, U. Erle, *Development of packaging and products for use in microwave ovens*, 2nd Ed. Elsevier 2020.

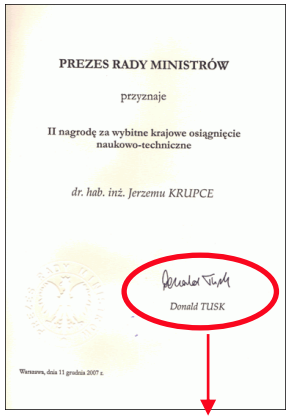
Origins of QWED Material Measurements

since 1980s…

awarded research of Prof. Jerzy Krupka (IEEE Fellow)

on dielectric resonators (best known: Split-Post Dielectric Resonator)




PREZES RADY MINISTRÓW

przyznaje

II nagrodę za wybitne krajowe osiągnięcie naukowo-techniczne

dr. hab. inż. Jerzemu KRUPCE

Donald TUSK

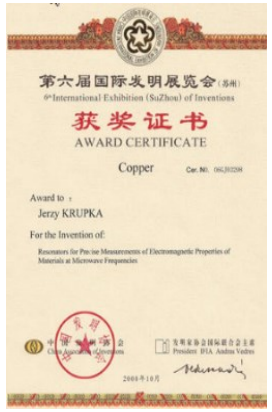
by Donald Tusk
Prime Minister of Poland 2007-2014
President of the European Council 2014-2019


DIPLOMA

Eureka!

THE BELGIAN AND INTERNATIONAL TRADE FAIR FOR TECHNOLOGICAL INNOVATION

Médaille d'or


第六届国际发明展览会

6th International Exhibition (SuZhou) of Inventions

获奖证书

AWARD CERTIFICATE

Copper

Award to :

Jerzy KRUPKA

For the Invention of:


Agilent Both
IEEE IMS 2006, San Francisco, CA


MMA-2010, Warsaw PL
co-organised by QWED & Warsaw Univ.Tech.

… by early 2000s:

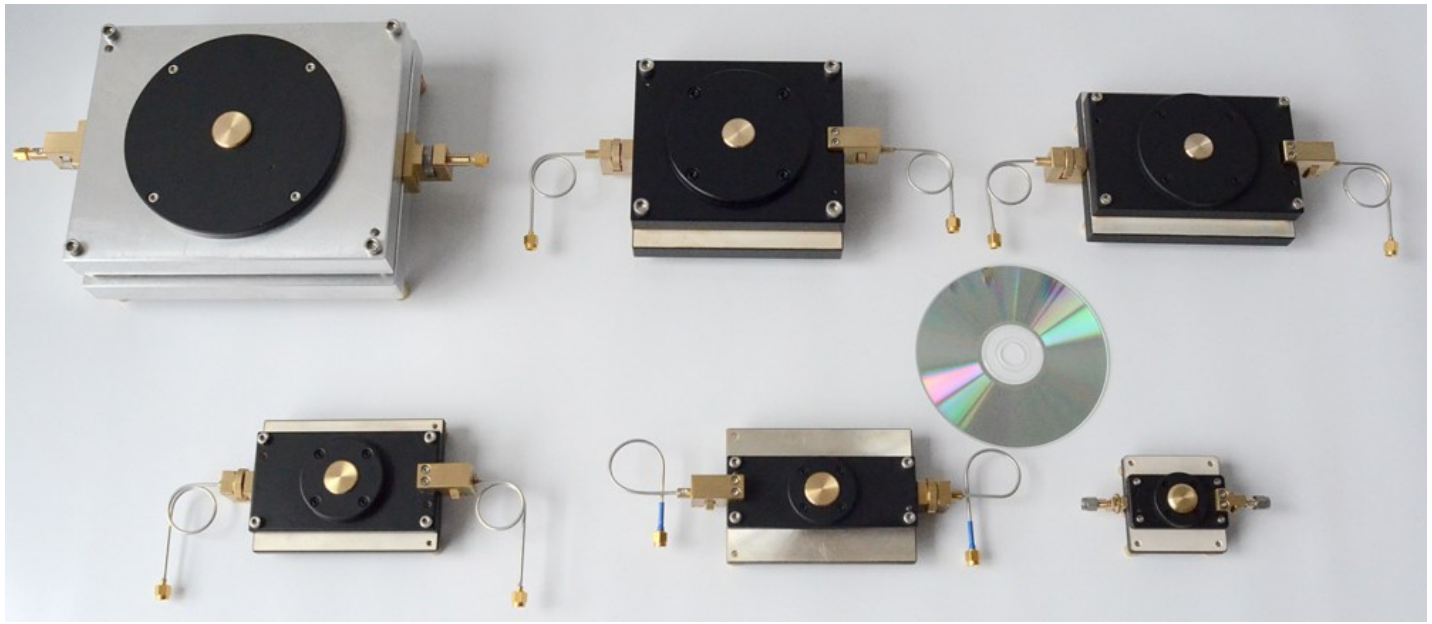
QWED commercialises the SPDRs

endorsement by Agilent / Keysight

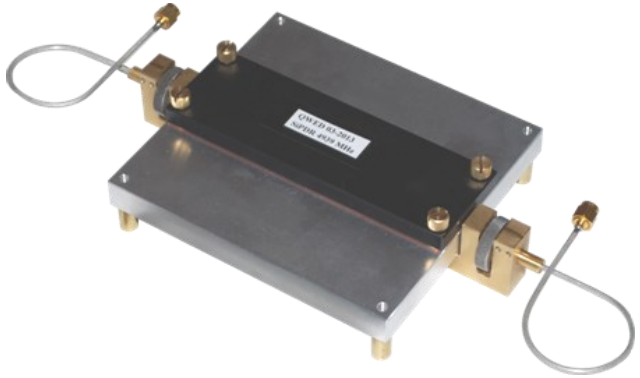
publication of standard IEC 61189-2-721:2015

Popular Dielectric Resonators by QWED

SPDRs for laminar dielectric materials
typical units: 1.1 GHz -15 GHz

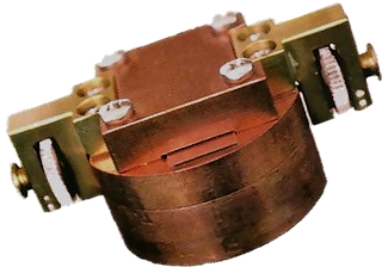


5 GHz SiPDR for resistive sheets

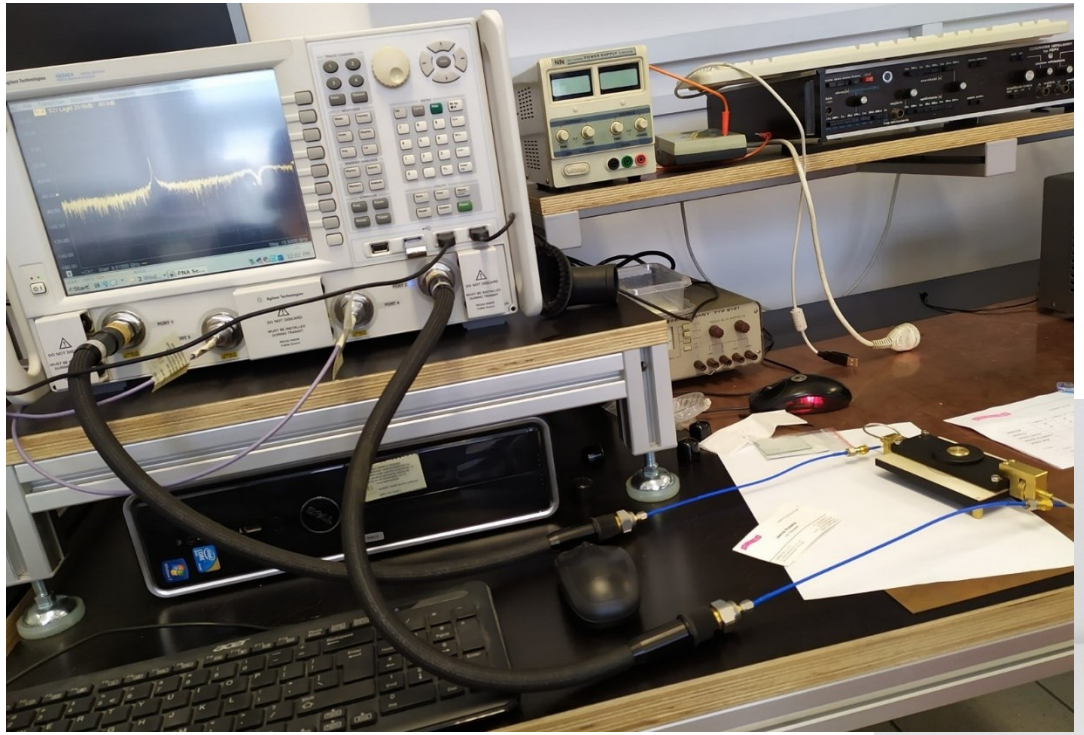


TE01δ cavities, typically 1 – 10 GHz
for bulk low-loss dielectrics

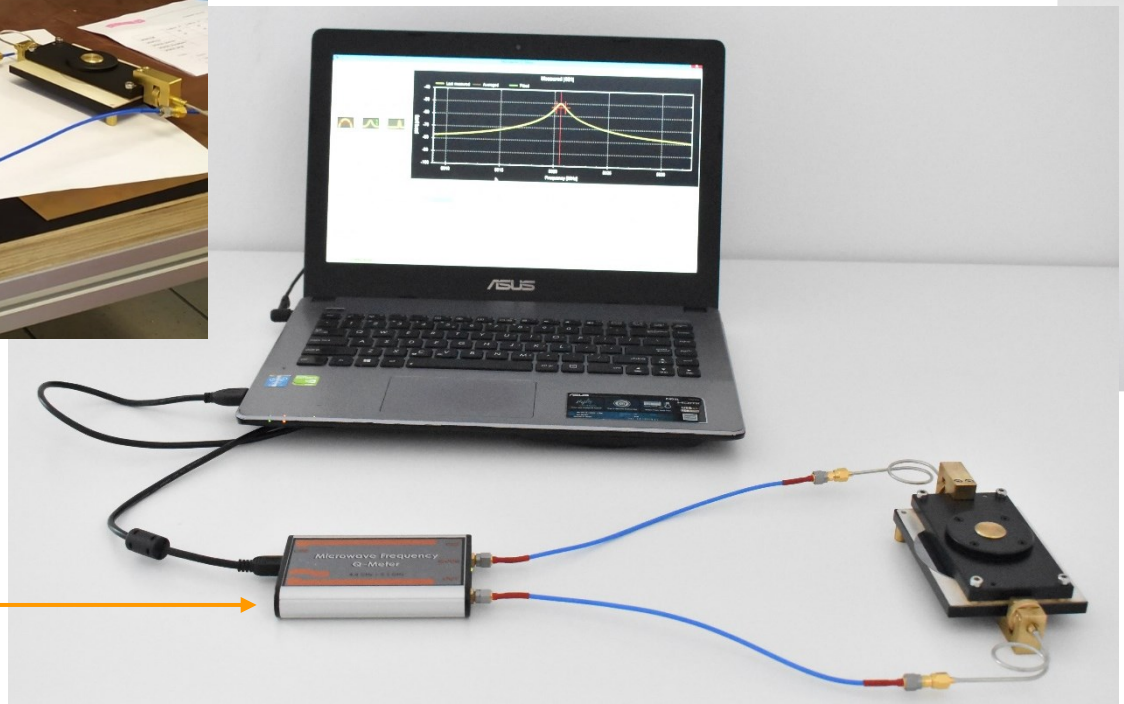
modified SiPDR for graphene



Resonators Operating in Different Setups

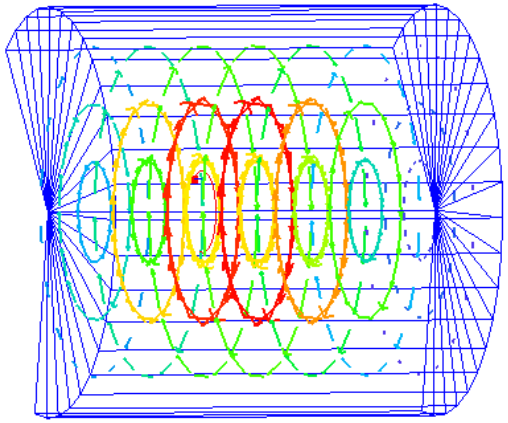


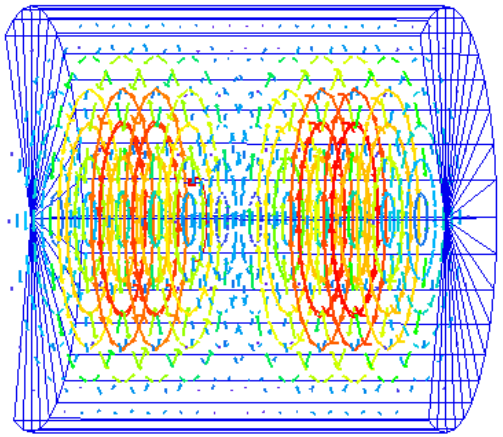
also for home-office!

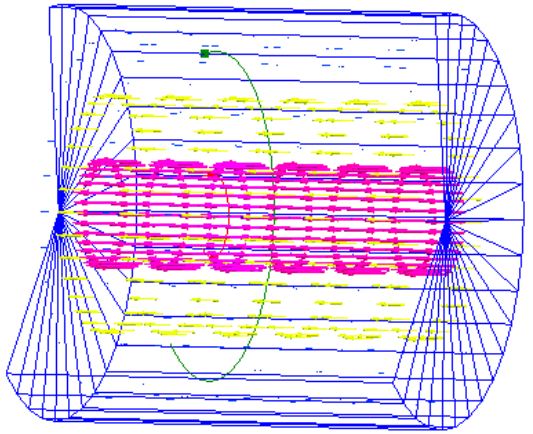


QWED Microwave Frequency Q-Meter untis for 5 GHz and 10 GHz

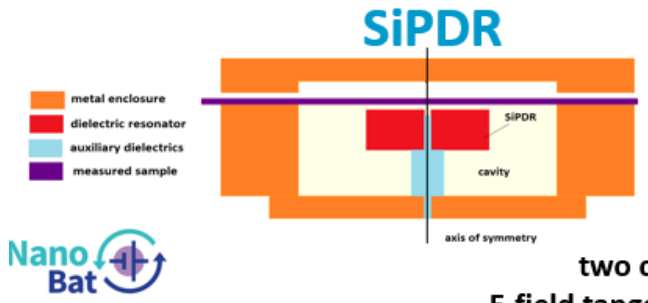
QuickWave Modelling for Enhanced Design & Calibration of Resonators

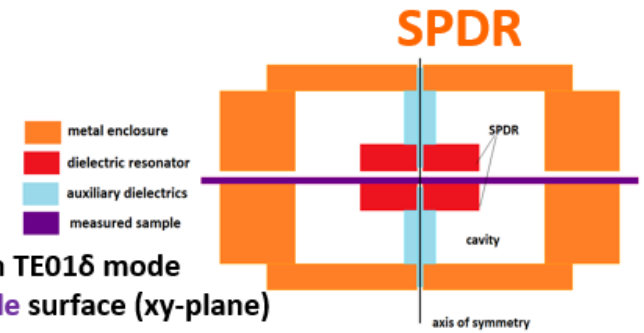


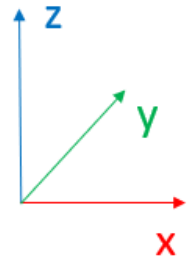




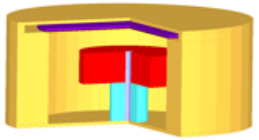
Tutorial examples on
NanoBat Open Platform
https://qwed.eu/nanobat.html

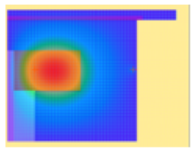






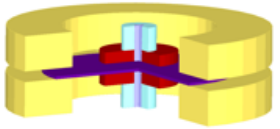
two configurations used with TE01δ mode
E-field tangential (parallel) to sample surface (xy-plane)

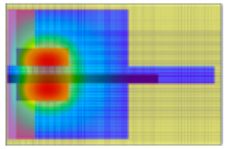




E-field distribution in the half cross-section

sample between the **single post dielectric** and the **ground plane**

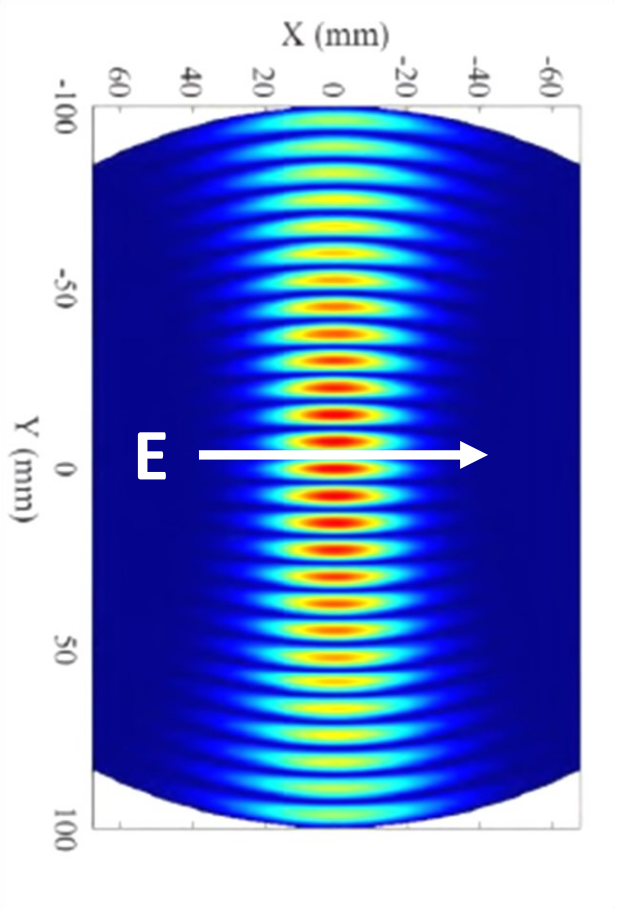


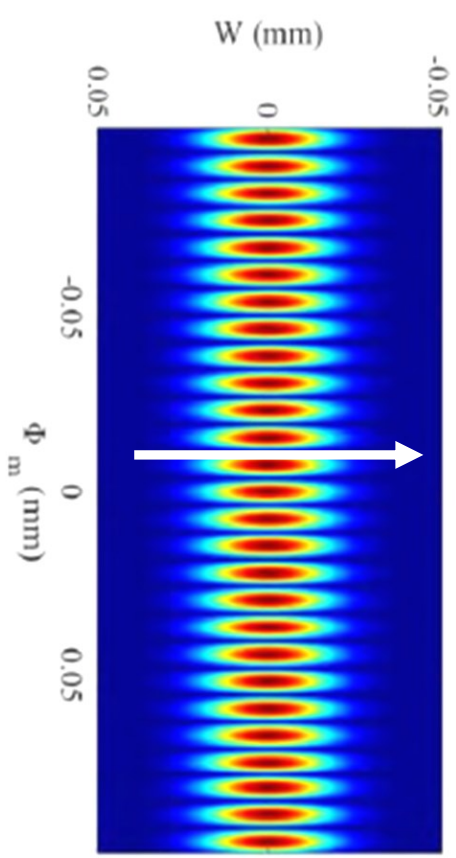


E-field distribution in the half cross-sectior

sample half-way between the **two dielectric posts** (in the "split" of the "post")

New: Fabry-Perot Open Resonator 20 – 110 GHz



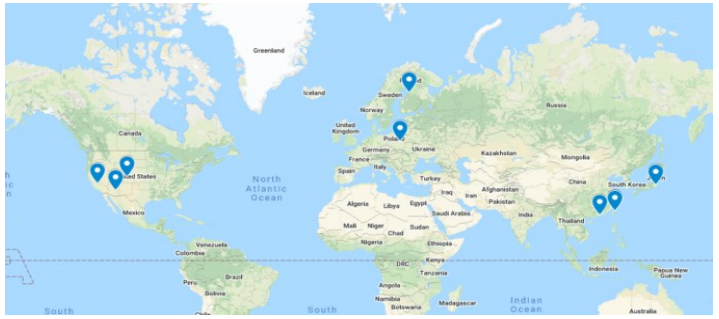


continuing the successful collaboration with Warsaw Univ. Tech. (Profs. J.Krupka, B.Salski, P.Kopyt)
available for hands-on experience in QWED EuMW exhibition **booth A16**

iNEMI 5G Round Robin Overview

Our project: iNEMI

- 3M
- AGC-Nelco
- Ajinomoto USA
- AT&S
- Centro Ricerche FIAT-FCA
- Dell
- Dupont
- EMD Electronics (Co-Chair)
- Flex
- Georgia Tech
- Showa Denko Materials
- IBIDEN Co Ltd
- IBM
- Intel
- Isola
- ITRI (Co-Chair)
- Keysight (Co-Chair)
- MacDermid-Alpha
- Mosaic Microsystems
- NIST
- Nokia
- Panasonic
- QWED
- Shengyi Technology Company
- Sheldahl
- Unimicron Technology Corp
- Zestron



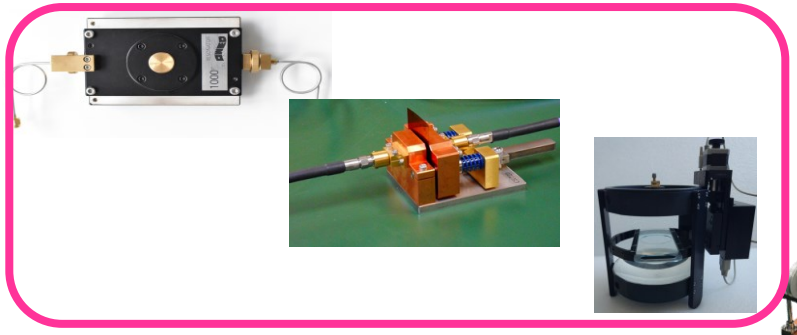
Sample Material Requirements
- Stable, Low loss
- Low moisture absorption / temperature dependency
- Isotropic
- Good mechanical & handling properties

1st Project Stage
- Precision Teflon
- Cyclo Olefin Polymer

2nd Project Stage
- Rexolite
- Fused Silica

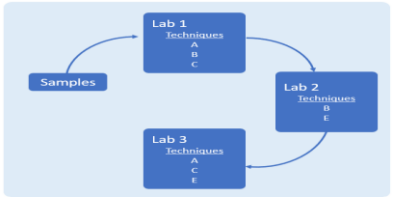
Industrial
- Automotive

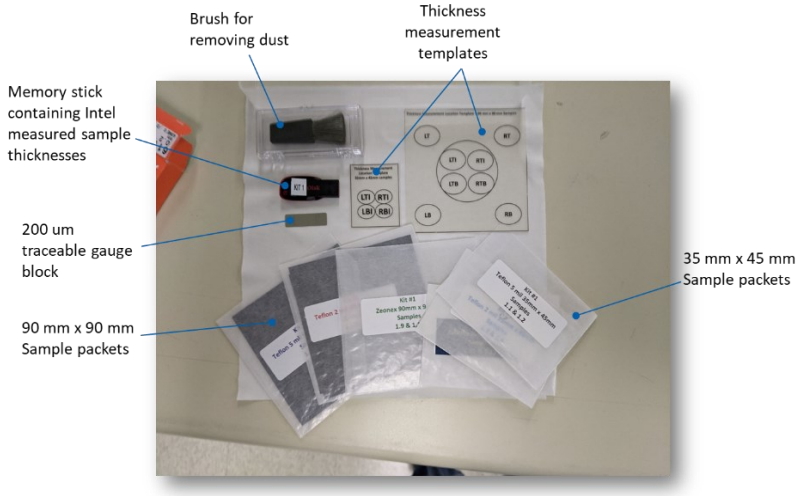
Techniques Included
- Split Post Dielectric Resonator
- Split Cavity Resonator
- Fabry-Perot
- Balanced Circular Disk Resonator



→ Frequency Span : 10GHz – 100GHz with overlaps

10 Laboratory Round Robin





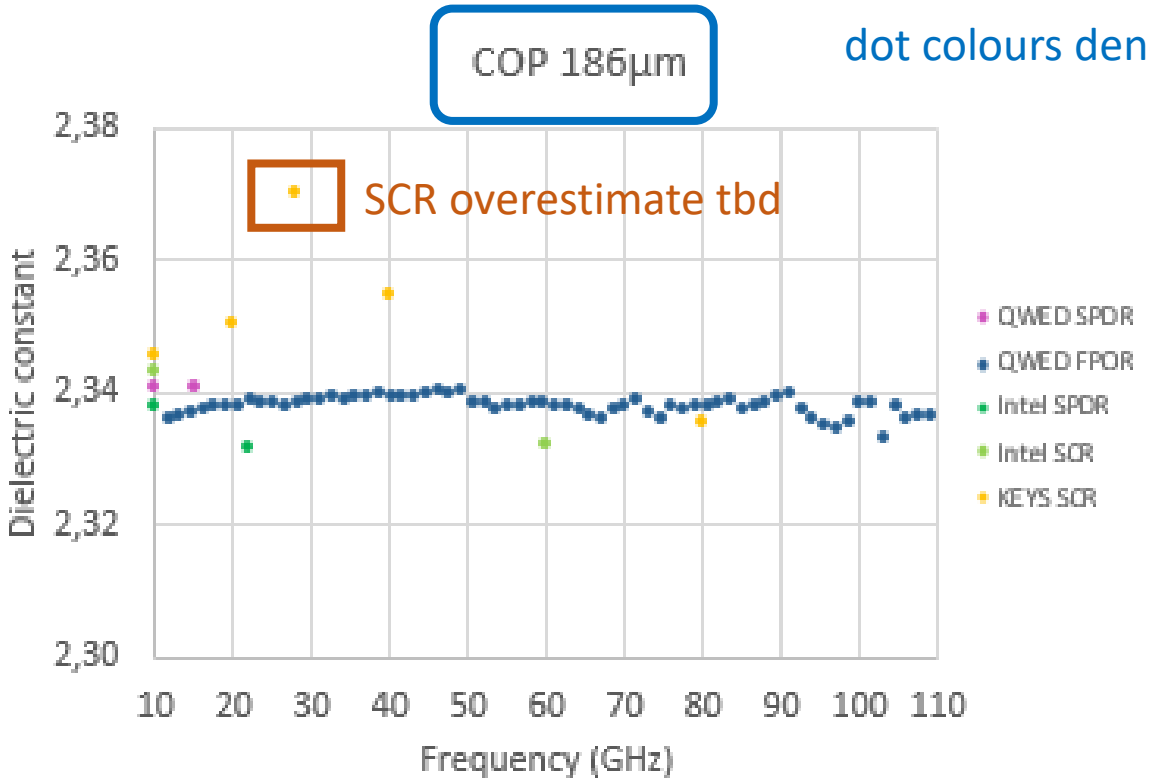
10 Sample Kits Created
- Sample sizes 35 mm x 45 mm, 90 mm x 90 mm
- circulated between 10 labs

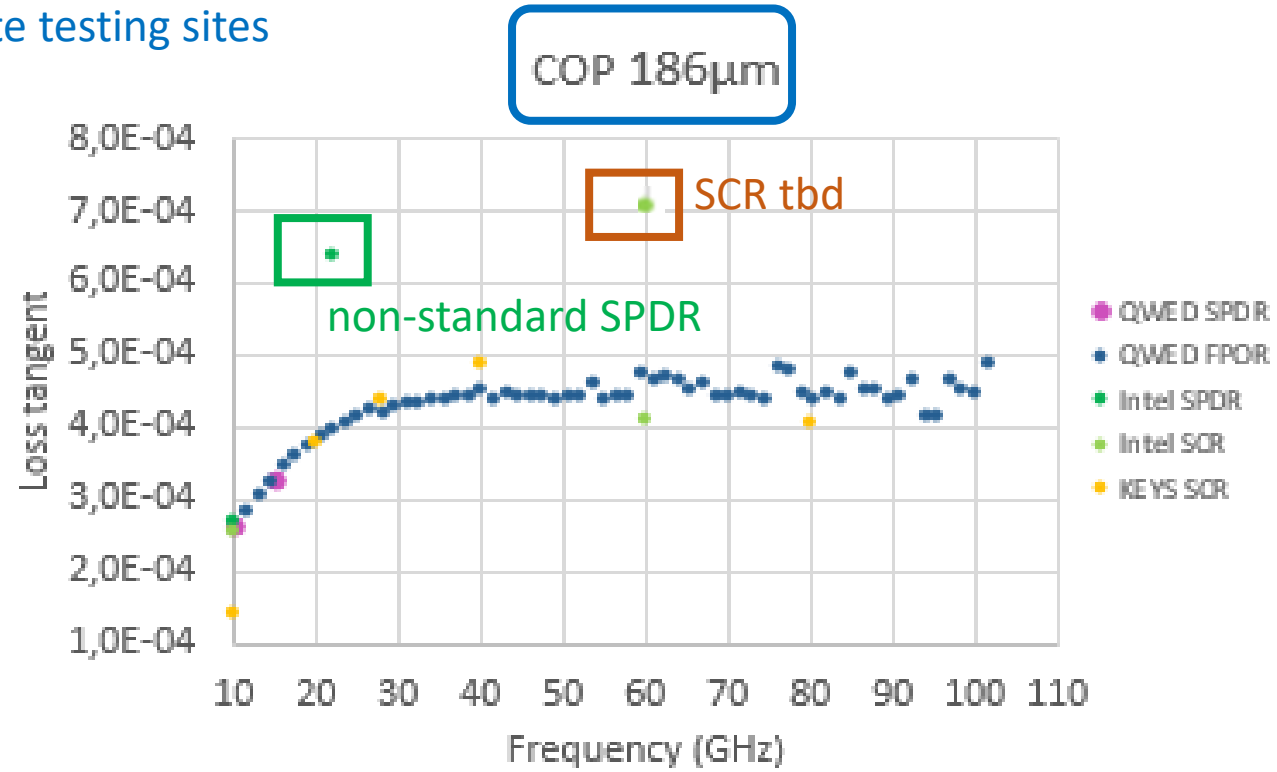
Characterisation Results - Consistency

3 labs, 3 techniques, 14 laboratory setups

Intel - SCR at 10 / 60 GHz and SPDR at 10/ 20 GHz,
Keysight - SCR at 10 / 20 / 28 / 40 / 80 GHz
QWED - SPDR at 10/ 15 GHz and FPOR over 10-110GHz.

dot colours denote testing sites





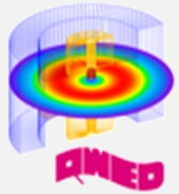
Dk spread < 1% (within ± 0.5% from average)
(< 2% incl. outliers)

> 40GHz 2x increase in Df compared to 10GHz

Current Work: Bridging Computer Modelling with Material Measurements

Commercial since 1997
QuickWave Simulation Software
~1000 licences implemented

THE EUROPEAN ICT PRIZE WINNER



Applicator design
& model for
parameter extraction

Modelling (EM, MW, multiphysics,...)
- waves in free space is "easy" Maxwellian
- wave interaction with matter is "complicated"...

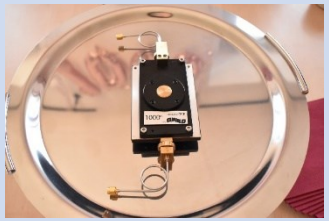
INNOVATION

Material measurements

Accurate material
parameters
(constitutive
relations)

Commercial resonator test-fixtures since 2001

1000th unit sold in 2020



Open Platform Examples & Tools

QW-Modeller for QuickWave
Free general purpose 3D CAD modeller for QuickWave.

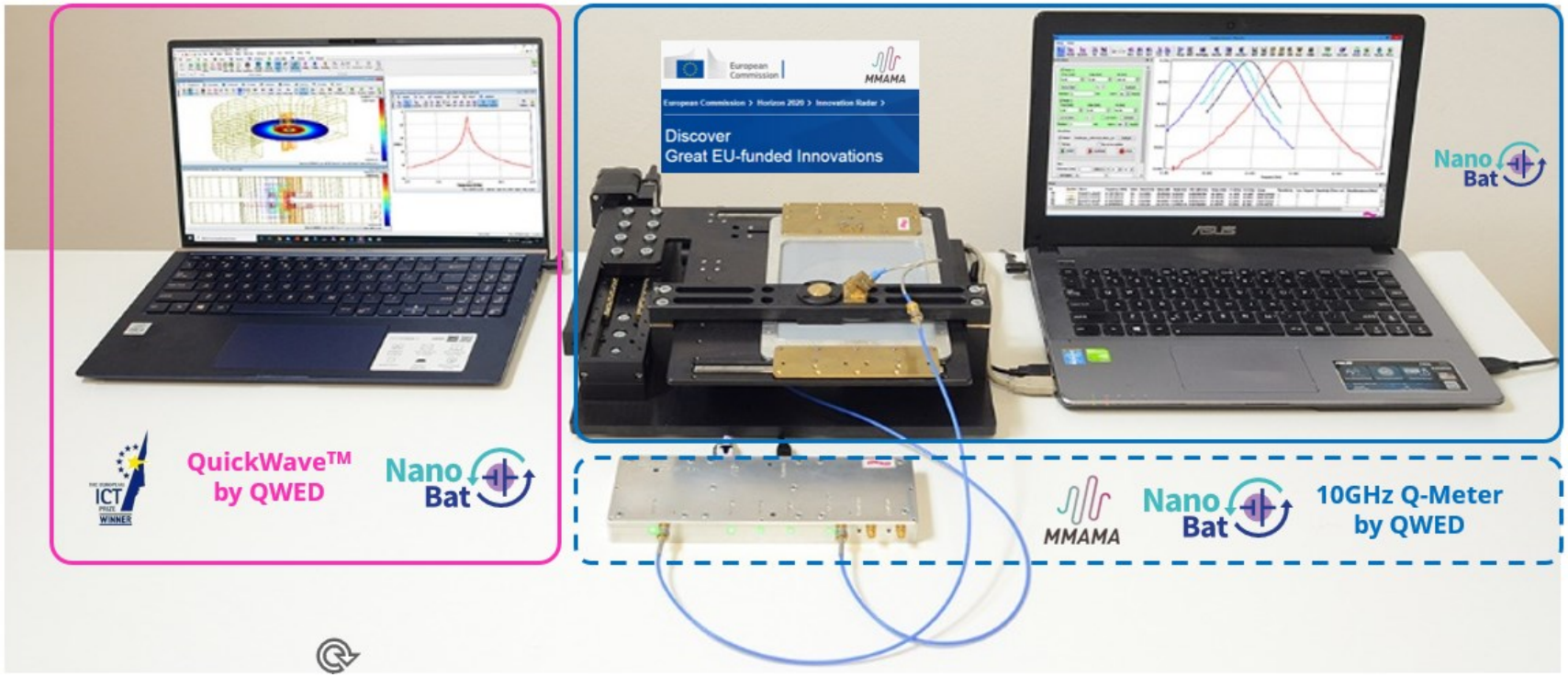
Open Platform Examples:

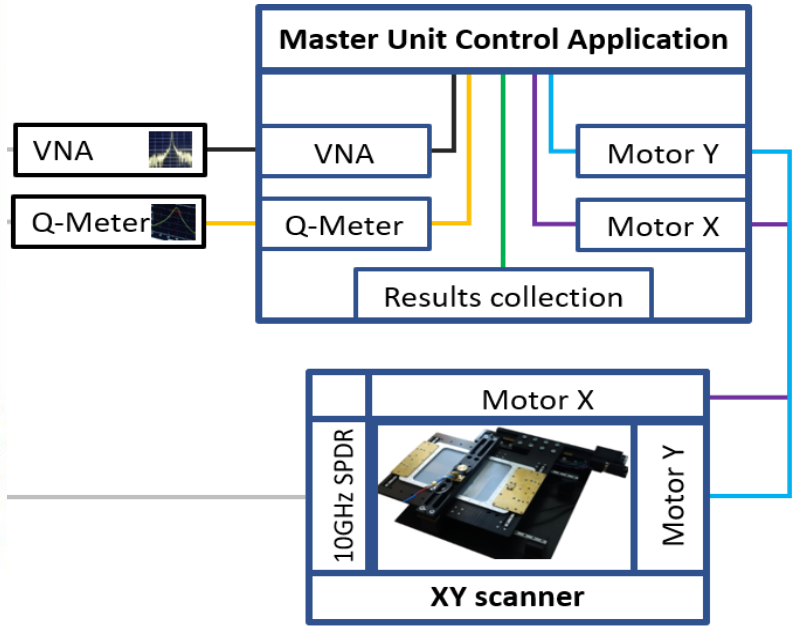
SMM tip presented at Numerical Electromagnetic

European Standard:
IEC 61189-2-721:2015
CEN-CENELEC Workshop 2021

2D Imaging of Low-Loss Dielectric Materials

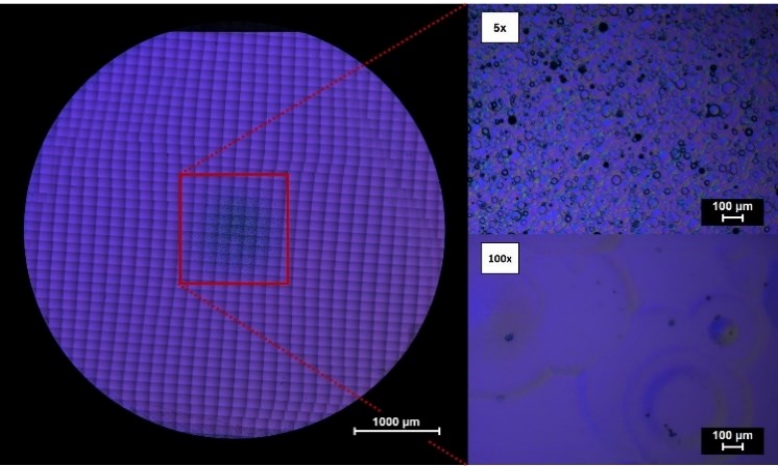
2D scanner designed with a modified 10 GHz SPDR





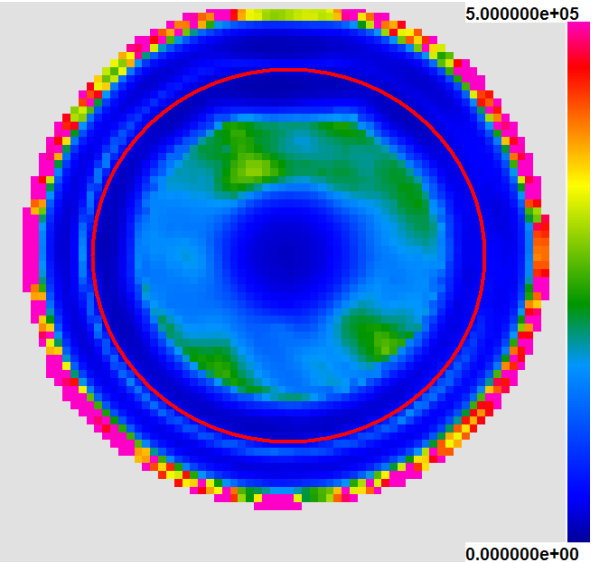
Finalist of the European Innovation Radar Prize 2021

2D SPDR Imaging of HR- GaN for Light & Power Electronics Devices



Optical microscopy image at L-IMiF reveals morphology inhomogeneity in the central area:

- in qualitative terms only,
- attributed to non-uniformity of the growth,
- only the central part appears unuseful for making devices.

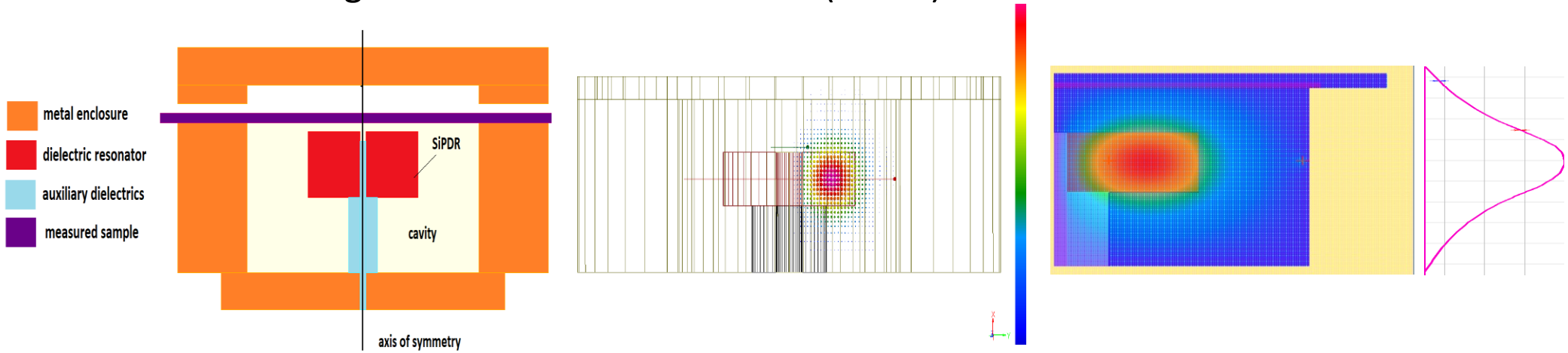


SPDR image:

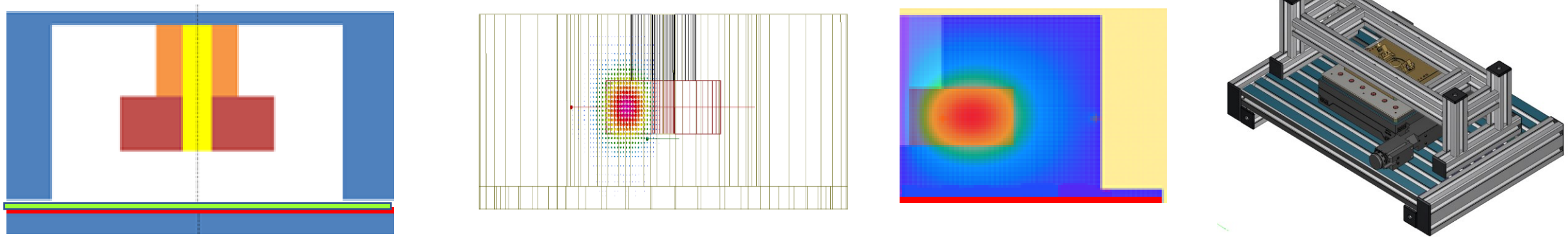
- shows this whole GaN template unuseful,
- quantitative evaluation:
  - edge ring inherent to so-called edge effect,
  - ca. $2 \cdot 10^4$ Ωcm in the centre (dark blue),
  - ca. $5 \cdot 10^4$ Ωcm along the inner ring (light blue),
  - up to $1.2 – 3 \cdot 10^5$ Ωcm across outer SUT's area (blue-green),
  - edge effect along the circumference.

2D Imaging of Conductive Films – iSiPDR Scanner Design

Commercial 5GHz Single-Post Dielectric Resonator (SiPDR): schematics and E-field distribution



New 10GHz inverted SiPDR (iSiPDR) incorporated into 2D scanner



mpre so[phistocated design & calibration:

active sheet facing the **DR head** → distance depends on the thickness of sample **substrate**

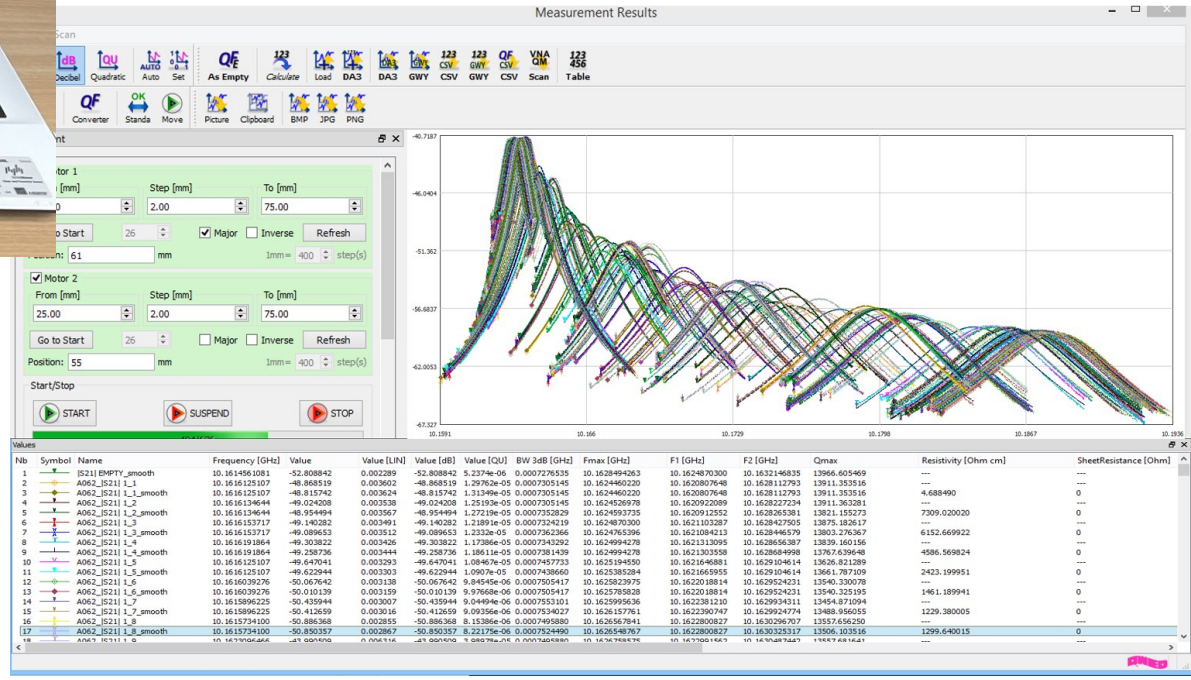
2D Imaging of Conductive Films – 10 GHz iSiPDR Scanning Setup

2D SiPDR scanner

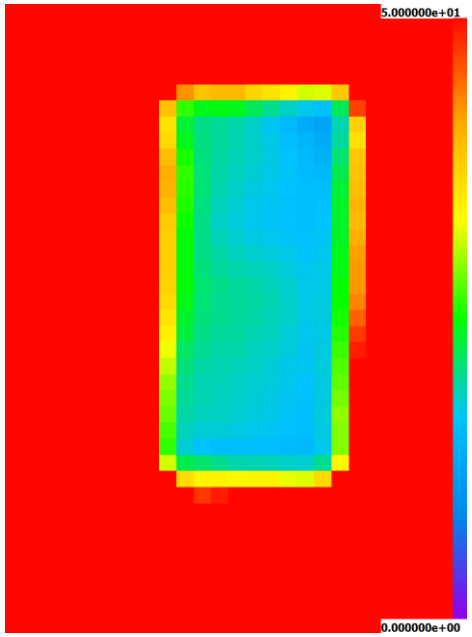
Keysight FieldFox

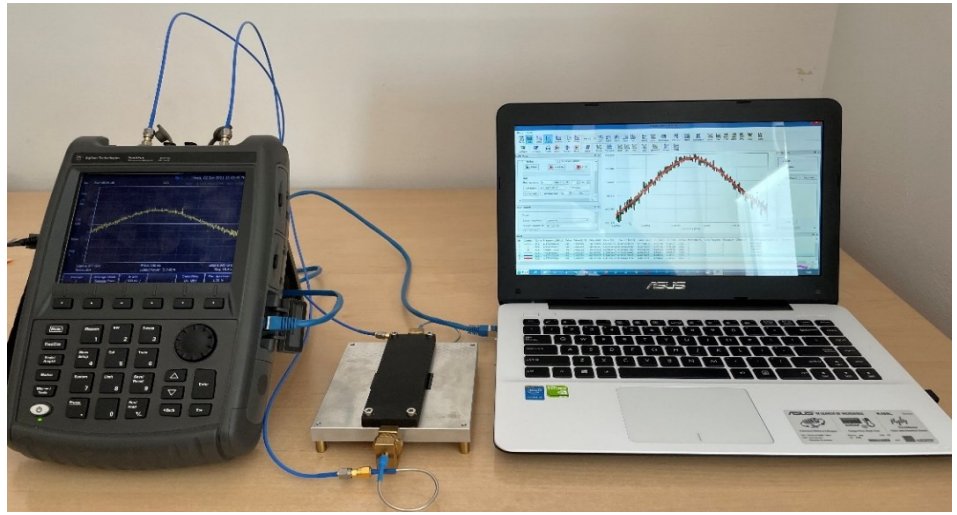
Control App

a family of |S21| curves obtained in one scan



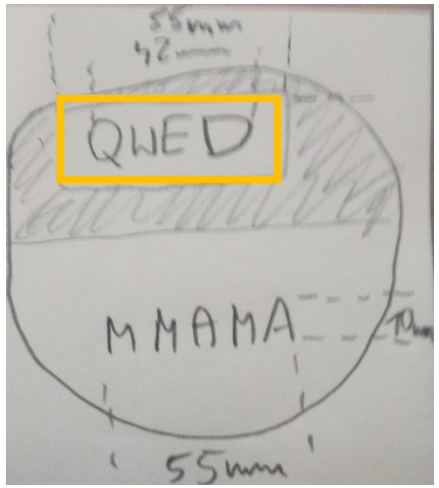
2D Imaging of Conductive Films – Application to Graphene Anodes

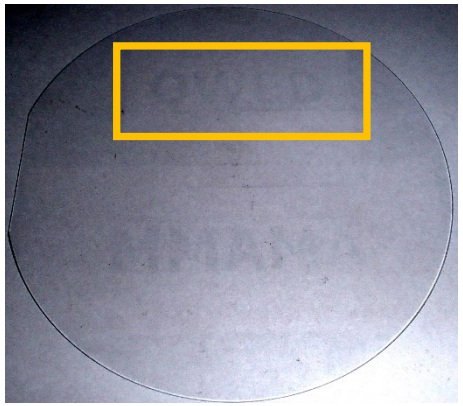


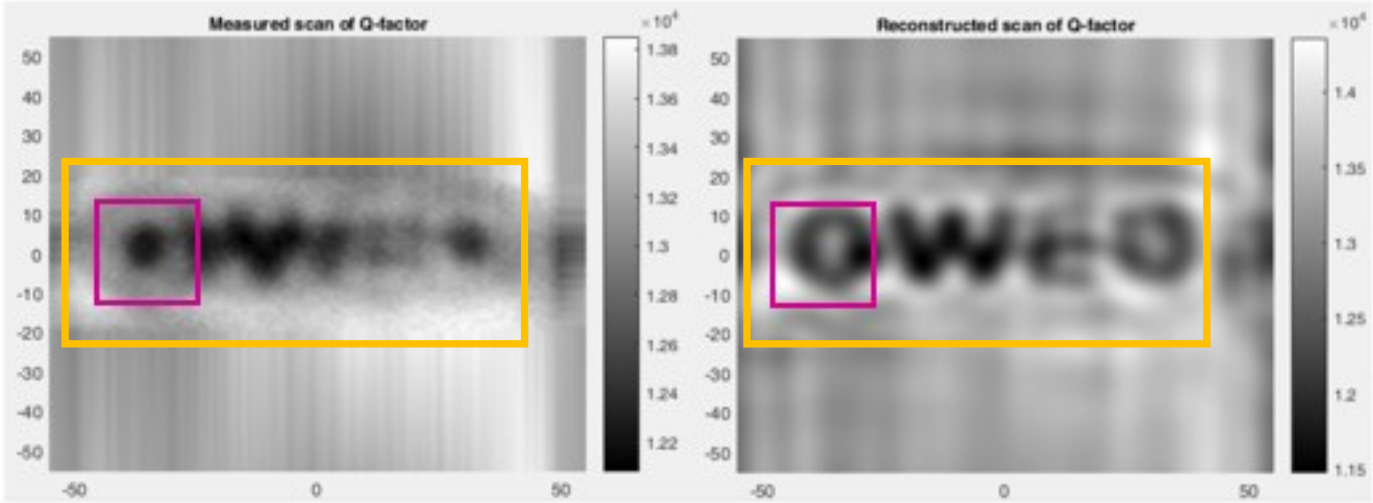


- Scanning area: 50 mm x 75 mm (25 mm margin around SUT)
- Uniform scanning step: 2 mm
- 1014 measurement points
- Avr thickness of the deposited graphene anode layer: 0.130 mm ± 0.02 mm
- Non-uniformities in R_s map due to sample thickness variation
- R_s extracted for average thickness value
- An absolute value of R_s can vary within uncertainty of ±15%
- Avr R_s of 19.3 Ω/sq. in exact agreement with point-wise 5GHz SiPDR device.

Modelling-Based Resolution Enhancement of Surface Images





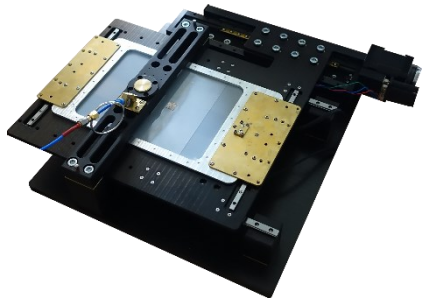


raw image of sample resistivity (measured Q-Factor)

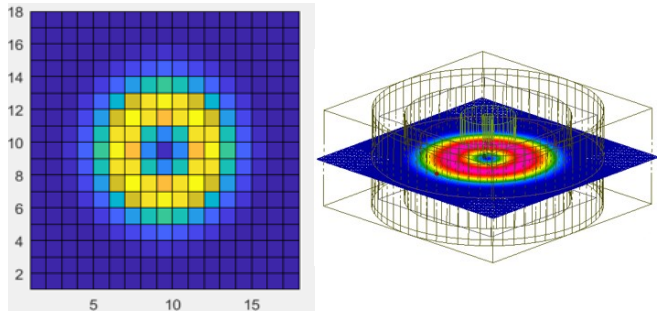
image further deconvolved using SPDR field pattern pre-simulated in QuickWave

MMAMA MATERIA NOVA M-ERA.NET

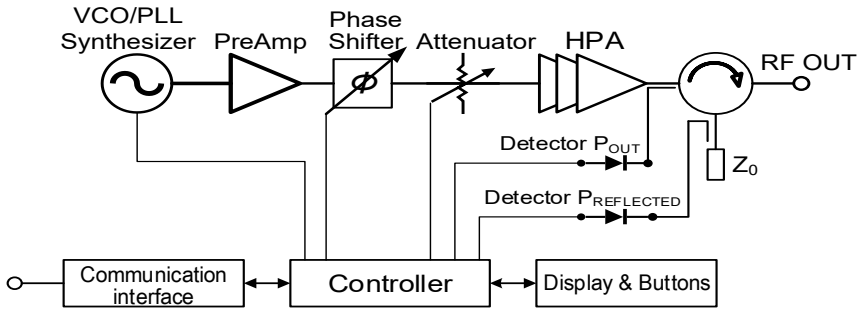
Patterned PEDOT:PSS sample courtesy MateriaNova, Belgium

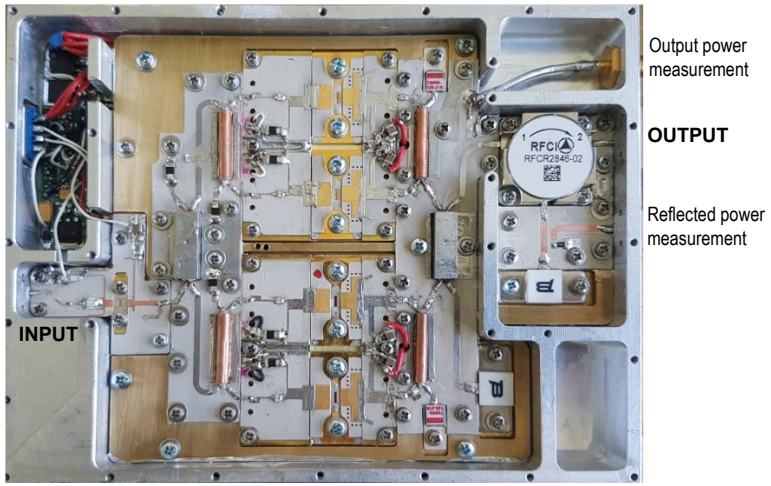


2D SPDR scanner



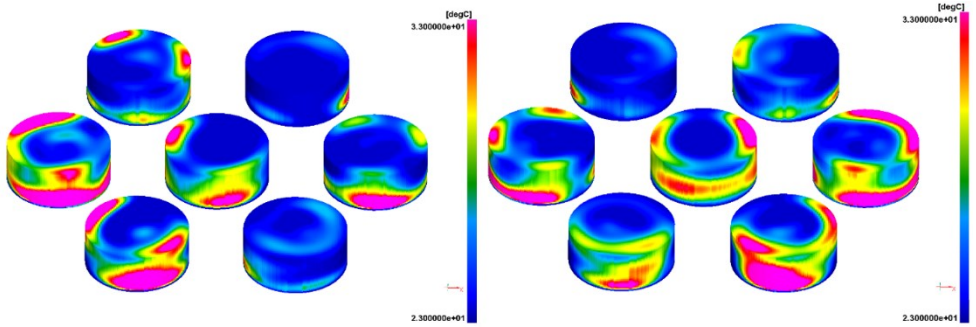
Active - Passive Methodology for Multiphysics Design



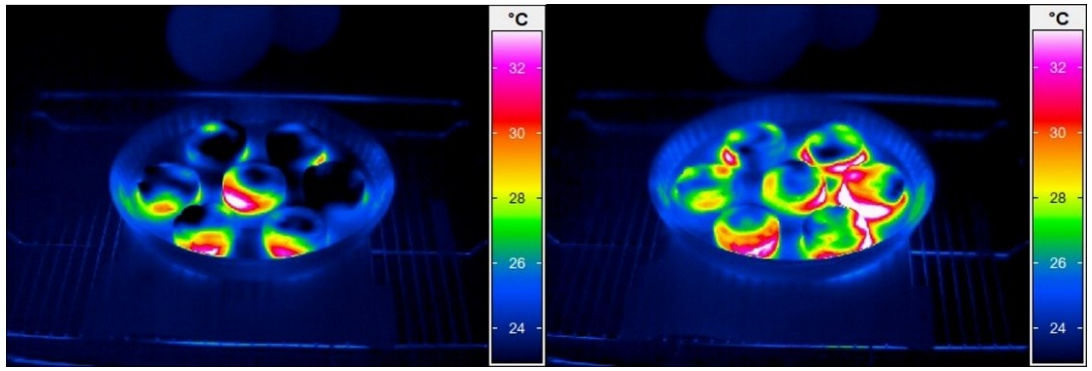


Multifunctional heating source
based on two-stage double-balanced GaN HEMT HPA
(Prof. W.Wojtasiak, Dr. D.Gryglewski Warsaw Univ.Tech.)

Temperature in mashed potato cookies, after 60 s of heating ,
for different relative phase shifts (added 110 degrees) between two sources.
(*Development of packaging and products for use in microwave ovens*, Elsevier, 2020)



QuickWave modelling by QWED



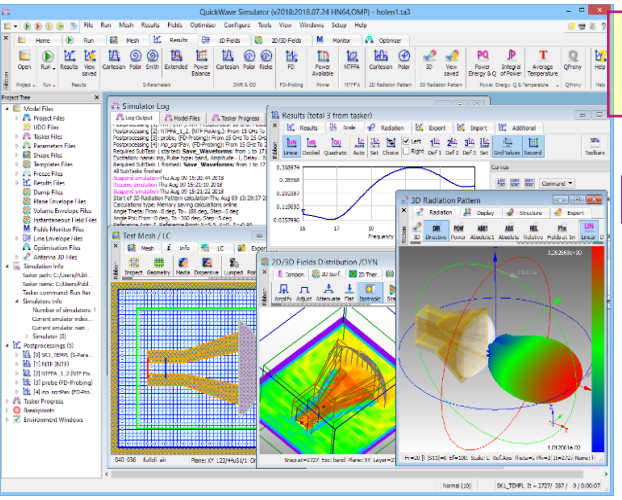
Photos courtesy BSH HAUSGERATE GmbH,
Traunreut, Germany.

B/S/H/

25 years in a Nutshell

presented annually at IEEE IMS Show

R&D projects

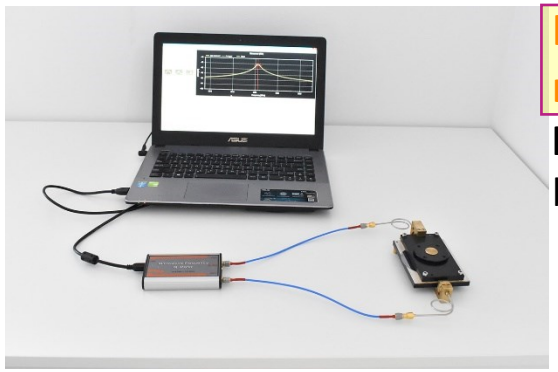


Electromagnetic simulation & design software, 3D & BOR 2D tools

based on 300+ publications by:

prof.W.Gwarek, IEEE Fellow, DML, Pioneer Award

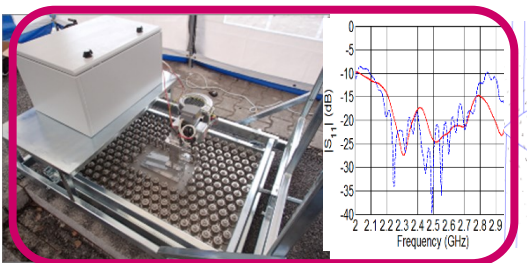
dr.M.Celuch, President of QWED

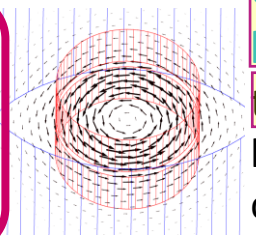


Instruments for precise material measurements

based on 300+ publications

by prof.J.Krupka, IEEE Fellow





Consultancy & design services based on EM expertise & tools

team of 10+engineers, 4 PhDs, 2 Profs

key areas: MW power appliances, customised resonators, antennas &feeds

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FP6 SOCOT – development and validation of an optimal methodology for overlay control in semiconductor industry, for the 32 nm technology node and beyond.

FP6 CHISMACOMB – development, modelling, and applications of chiral materials → EM validation of mixing rules

Eureka E! 2602 MICRODEFROST MODEL – innovative software-based product development tool for simulating and optimising heating and defrosting processes in microwave ovens

FP7 HIRF SE (High Intensity Radiated Field Synthetic Environment) - numerical modelling framework for aeronautic industry

Eureka FOODWASTE – developing new microwave treatment system for high water content waste

ERA-NET MNT NACOPAN – applications and modelling of nano-conductive polymer composites

NGAM2 – designing an industrial device for thermal bonding of bituminous surfaces with the aid of microwave heating

MMAMA (Microwave Microscopy for Advanced and Efficient Materials Analysis and Production) – EM modelling & characterisation for the development of high efficiency solar cells

NanoBat - developing a novel nanotechnology toolbox for quality testing of Li-ion and beyond Lithium batteries with the potential to redefine battery production in Europe and worldwide.

ULTCC6G_EPac – development & application of novel ceramics for 5G & beyond

I4BAGS – modelling & characterisation of ion-implanted battery & graphene-enabled devices

Women in Engineering Activites

Warsaw, 5 October 2020:
First-ever Women in Microwaves session at MIKON
(conference dating back to 1969)

"At MIKON, there have always been women in microwaves, but there has never been a Women in Microwaves (WiM) event." I thought this catchy phrase would open the doors to organizing an inaugural event as part of Microwave and Radar Week (MRW) 2020 [1]. And it did!

Women in Microwaves

Women in Microwaves at MIKON: (Not) for the First Time

■ Malgorzata Celuch

Warsaw, 10 May 2022:
40th Anniversary of the Karta Foundation
in Polin Museum

Women in Science and Engineering Matinee

MIKON-2022 24th International Microwave and Radar Conference

Gdansk, Poland, 12 September 2022, 14:00 – 18:10

SESSION CHAIR:

Dr. Malgorzata Celuch PWED

SESSION ORGANISED BY:

IEEE Women in Engineering WIE

NanoBat

M04: Focused session Women in Science and Engineering Matinee

Room: Heinrich Hertz (room 352)

14:00 *Welcome to the WiSE Afternoon*

Malgorzata Celuch (QWED, Poland)

At MIKON, there have always been women in microwaves, but the first dedicated Women in Microwaves session was only held in 2020. It sparked significant interests and was subsequently featured in the July 2021 issue of the IEEE Microwave Magazine. This year we want to build upon it but also reach out to a broader audience of women active in both engineering and science, and in the management of the two, including some traces of history.

14:20 *RF Design for Ultra-Low Power Wireless Communication Systems*

Jasmin Grosinger (Graz University of Technology & Institute of Microwave and Photonic Engineering, Austria)

In this talk, I will present radio frequency (RF) design solutions for wireless sensor nodes to solve sustainability issues in the Internet of things (IoT), which arise due to the massive deployment of wireless IoT nodes on environmental and economic levels. Engineers can apply these RF design solutions to improve the ultra-low-power operation of IoT nodes, avoid batteries' eco-toxicity, and decrease maintenance costs due to battery replacement. The solutions offer high integration levels based on system-on-chip and system-in-package concepts in low-cost complementary metal-oxide-semiconductor technologies to limit these nodes' costs and carbon footprints.

14:40 *Personal Career Journey and Millimeter Wave Interconnects and Antennas*

Rashaunda Henderson (University of Texas at Dallas, USA)

This talk will describe my career journey highlighting my transition from industry to academia and how my volunteering activities in IEEE MTT-S facilitated my most recent academic role as Professor at UTD. I will then present some results in silicon interconnects and progress related to the design of antennas in package, all in the millimeter wave band.

15:00 *From Academia to Industrial Research - Working Experience*

Agnieszka Konczykowska (ADesign, France)

This talk will present personal working experience, which combines work at University followed by research in telecommunication domain in different large companies. Beside sharing social and human observation, the technical work in a team with the goal of providing high speed integrated circuits and modules for telecom system experiments will be presented. Different competencies and expertise available in this small team, like: semiconductor technology, devices modeling, circuit design, circuit measurements and packaging will be further detailed.

15:20 *WiSE Open Discussion*

Malgorzata Celuch (QWED, Poland)

WiSE Open Discussion

M10: Focused session Women in Science and Engineering Matinee - part II

Room: Heinrich Hertz (room 352)

16:30 *Women in EC Funded Projects - Challenges & Opportunities*

Janine Jost (European Research and Project Office GmbH, Germany)

Globally, the issue of women's visibility in society and their chances to pursue their professional careers have been on the rise with the general acceptance that women's participation in many aspects of our daily and professional lives needs to be increased. This talk will present funding opportunities for young researchers as well as renowned scientists within the scope of the European Commission's funding programmes for research & innovation. A focus will be given to the current programme Horizon Europe. Reflections and evaluations as well as experience with previous programmes FP7 and Horizon 2020 will also be shared. Finally, specific challenges and opportunities for women in innovative EC funded projects will be shown. The presentation should inspire women in science to take advantage of EC funding opportunities to boost their careers and strengthen personal professional networks.

16:50 *Women in Defense Sector*

Paulina M. Epler (Raytheon Technologies Corporation, Poland)

In this talk, I will present personal experiences of working in defense industry in Poland. I will shed light and explore differences between working in Raytheon Technologies Corporation, American aerospace and defense conglomerate, and other defense companies. I will also discuss how Raytheon Technologies empowers women by prioritizing equality, diversity and inclusion in the workplace. Beside sharing my personal observation I will also focus on contracting with American defense companies in accordance with Foreign Acquisition Regulations (FAR).

17:10 *The Research on Nonlinear/EM Co-Design Techniques in Villa Griffone, the Home of Guglielmo Marconi*

Alessandra Costanzo (DEI, University of Bologna, Italy)

In this talk I will review the most significant techniques, in the field of linear and non-linear RF/microwave components, based on the harmonic balancing method developed for more than twenty years in the University of Bologna research labs hosted in Guglielmo Marconi's home. In particular I will consider the nonlinear-electromagnetic co-design of microwave front-ends, able to efficiently combine circuit models of the systems, connected to the antenna,s with the electromagnetic simulation of the antennas and radio channels themselves. SISO and MIMO (Multiple-Input-Multiple Output) systems circuit-level design examples will be considered, with emphasis on WPT and energy harvesting applications.

17:30 *My Journey into Engineering - Thoughts from a PhD Student*

Cerine Mokhtari (CNRS-IEMN - IRCICA - Université de Lille, France)

Becoming an engineer has been my dream since childhood and I could not picture myself doing anything else. I think that the most important thing when chosing a career is to do what we are really passionate about and work hard towards it. As a woman in engineering and science, I hope to see more women following their passion and love for science.

17:50 *Women at QWED and Our Activities in EC H2020 and ERA-NET Projects - Remarks from Session Organisers*

Marzena Olszewska-Placha and Malgorzata Celuch (QWED, Poland)

Women at QWED and our Activities in EC H2020 and ERA-NET Projects - Remarks from Session Organisers

IEEE Women in Engineering WIE

Gdansk, Poland, 12 September 2022

NanoBat

Instead of Conclusions

Cerine Mokhtari (CNRS-IEMN / IRCICA / Université de Lille), thoughts after the WiSE Matinee at MIKON 2022:

"What I didn't say during my speech is that I consider myself lucky as a women and person in general for following the path that I truly wanted and chose. I know that not everyone has this chance. I am grateful for it. Last thing that I would like young women (and men) to always remember is to follow their passion. As much as I want to see more women in Science and Engineering, it is also important to do what makes us happy. Once we found it, hard work will always get us where we want. I hope we will have the chance to meet again. I sincerely appreciated your kindness and your warmth. The Women in Science and Engineering matinee was overall an amazing experience"

My Father used to tell me:

"Whatever you end up doing, do it as well as you can"

THANK YOU FOR YOUR ATTENTION!

PLEASE COME & SEE US
AT BOOTH 1A16