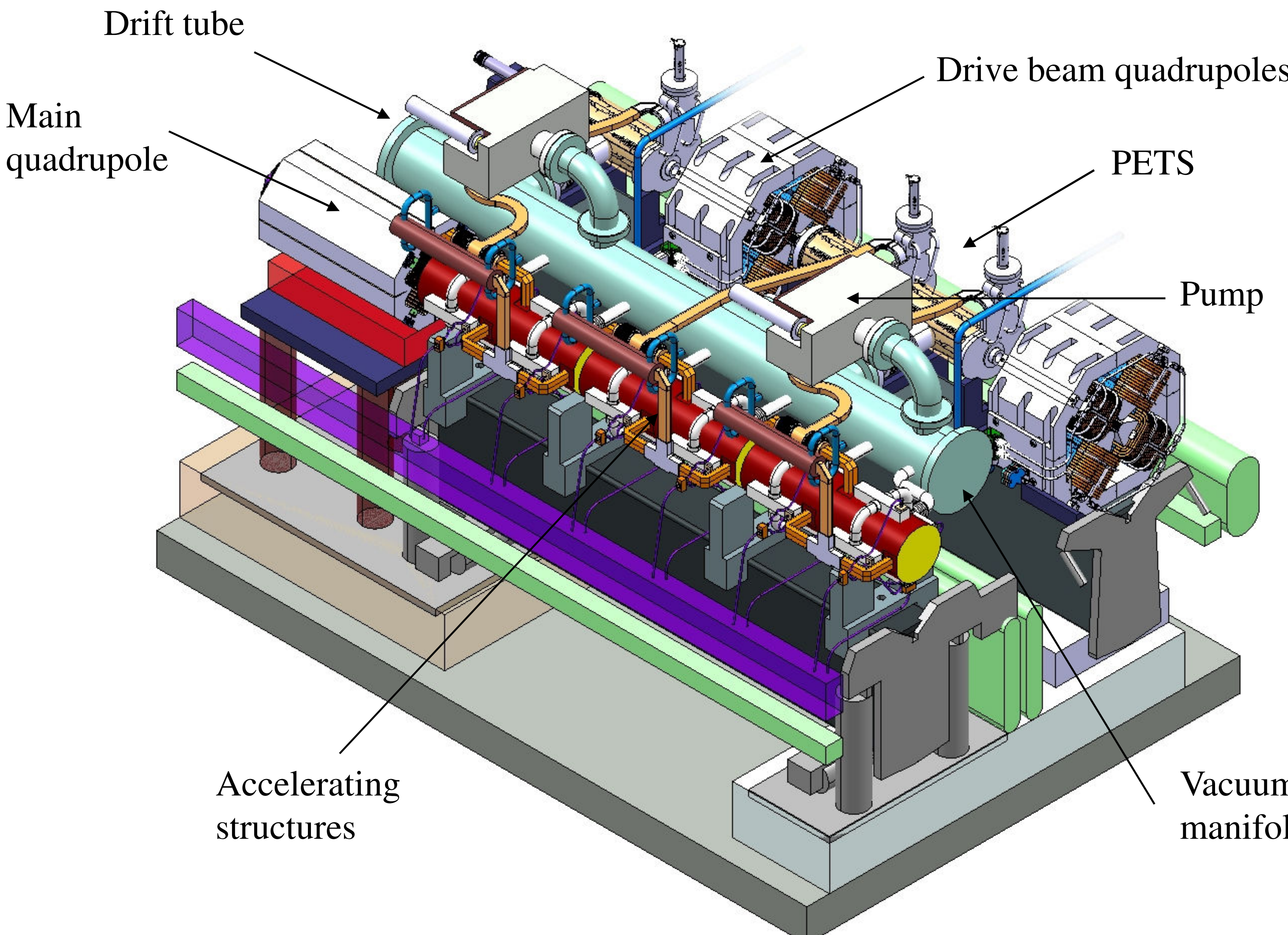
Working Group 4
RF Structures and Sources

Summary

Roark Marsh, LLNL

CLIC module


Drift tube
Main
quadrupole
Drive beam quadrupoles
PETS
Pump
Accelerating
structures
Vacuum
manifold

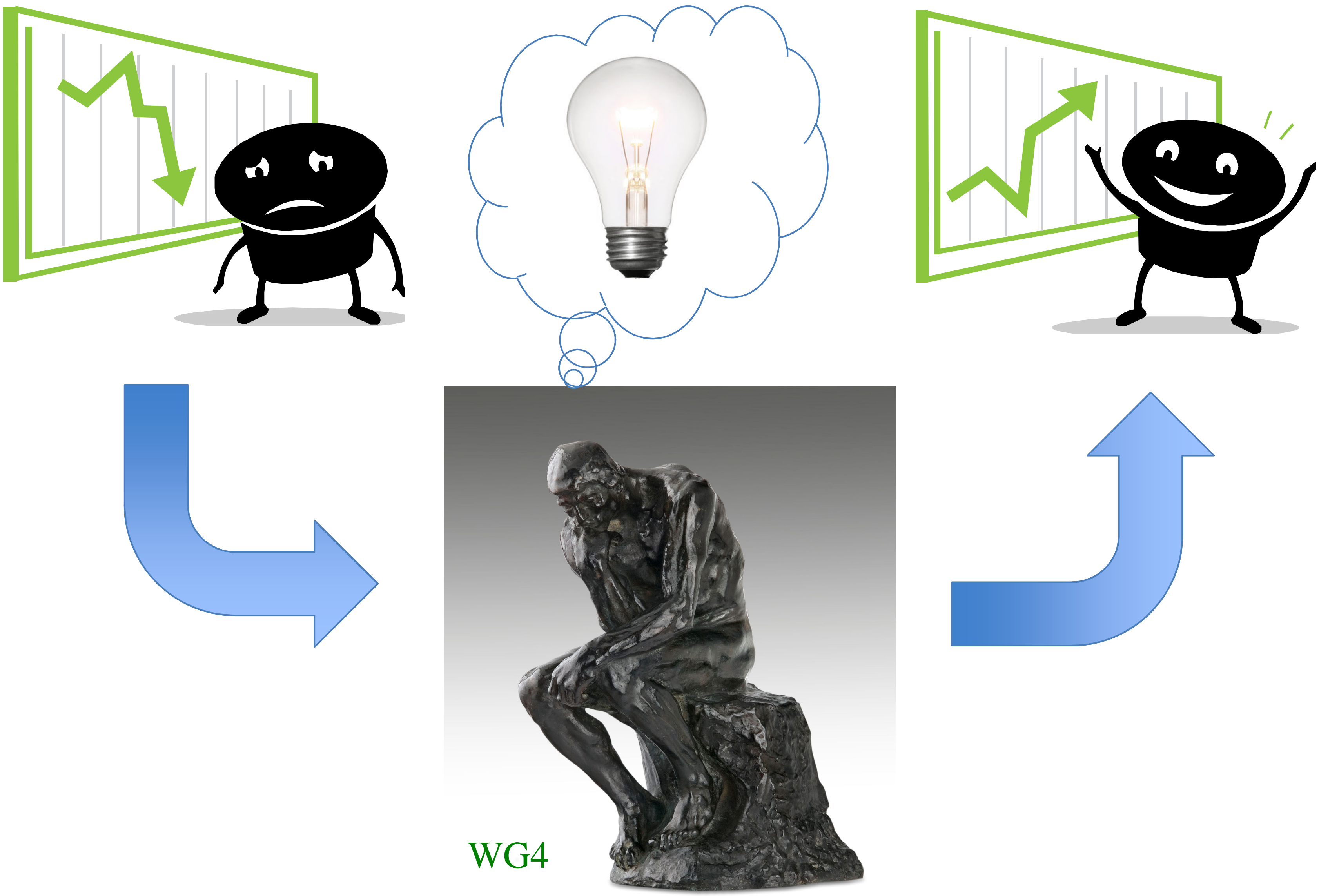
RF Structures

Poor Performance

Good Performance

Opportunity for real Physics Research!
(making CLIC lemonade from High Gradient lemons)

RF Structures



Thank You…

- **Walter Wuensch**
- **Chris Adolphsen**
- Flyura Djurabekova
- Igor Syratchev
- Alessandro Cappelletti
- Roger Jones
- Oleksiy Kononenko
- Arno Candel
- Zenghai Li
- Sergey Kuzikov
- Rolf Wegner
- Micha Dehler
- Juwen Wang
- Germana Riddone
- David Carrillo
- Toshiyasu Higo
- Yasua Higashi
- Tatiana Pieloni
- Alexei Kanareykin
- Karl-Martin Schirm
- Roger Ruber
- Valery Dolgashev
- Lisa Laurent
- Helga Timko
- Jim Norem
- Jan Kovermann
- Markus Aicheler
- Giovani Rumolo
- Cedric Garion
- Riccardo Zennaro

Themes

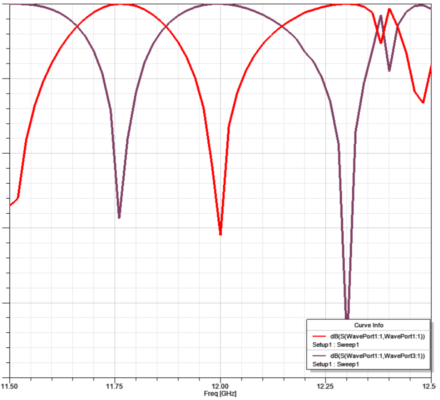
- Theory and Design
- Production and Development
- Test Stands and Results
- Modeling and Simulations
- Vacuum Specifications

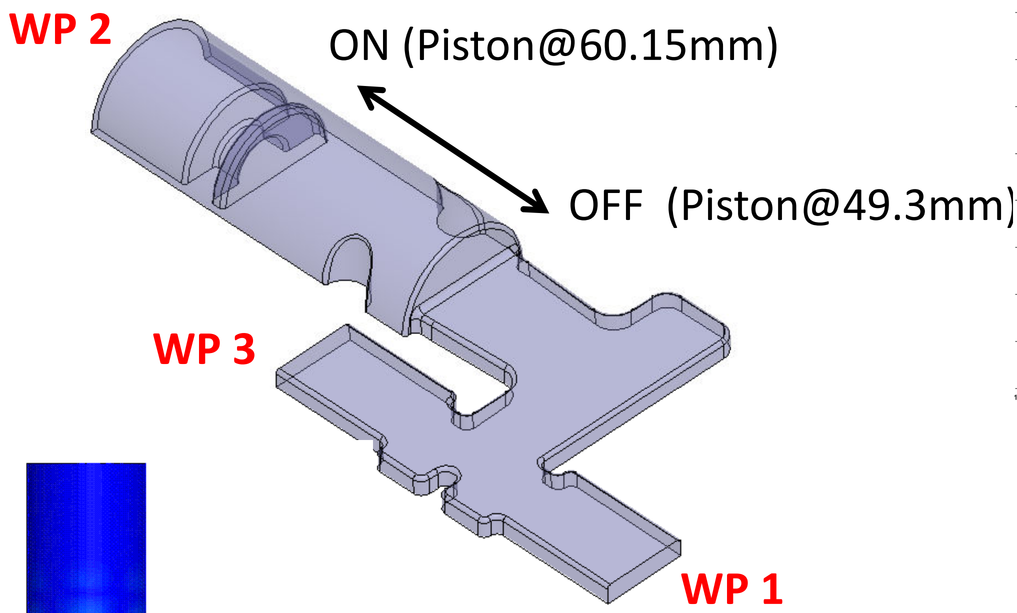
Themes

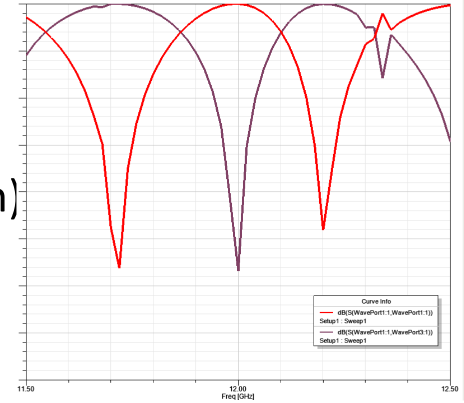
- **Theory and Design**
- Production and Development
- Test Stands and Results
- Modeling and Simulations
- Vacuum Specifications

Alessandro Cappelletti

REFLECTOR: DESIGN #2

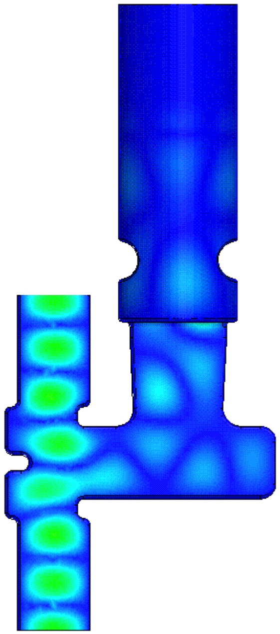






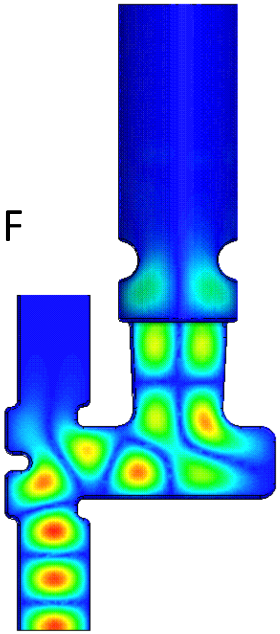
ON

11.9942 [GHz]	WavePort1:1 -46.1
	WavePort2:1 -48.8
	WavePort2:2 -85.2
	WavePort2:3 -39.1
	WavePort2:4 -55.5
	WavePort3:1 -0.000712

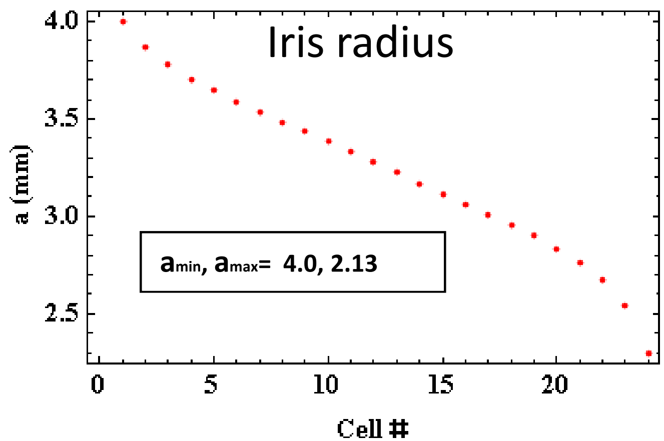


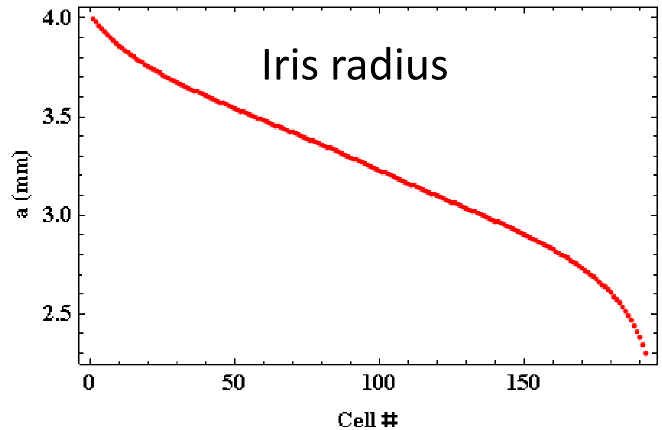
OFF

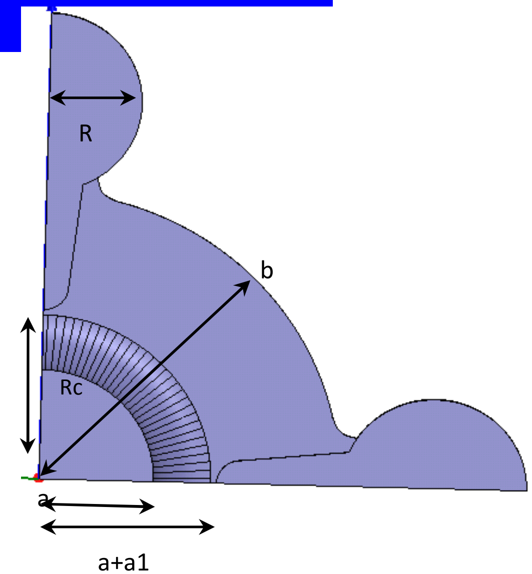
11.9942 [GHz]	WavePort1:1 -0.000528
	WavePort2:1 -43.1
	WavePort2:2 -74.7
	WavePort2:3 -58.6
	WavePort2:4 -41.6
	WavePort3:1 -60.6

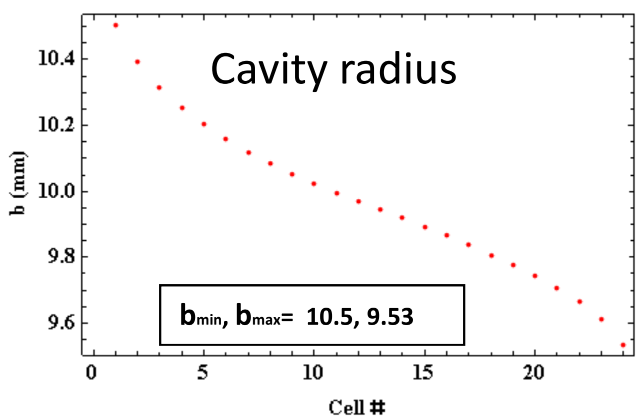


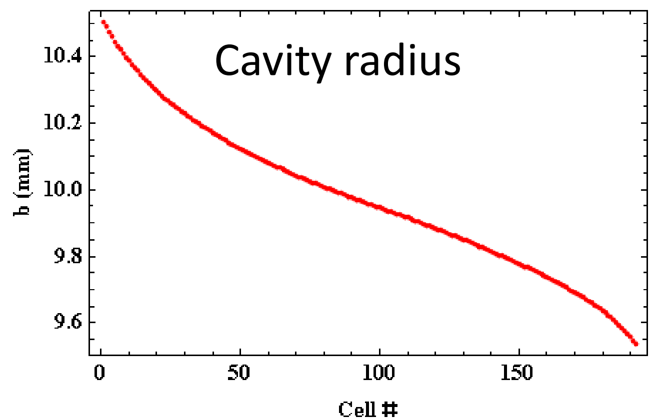
4. Structure Geometry: Cell Parameters

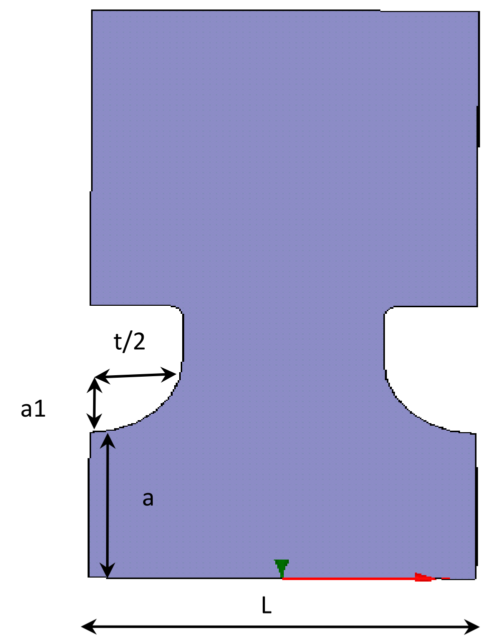








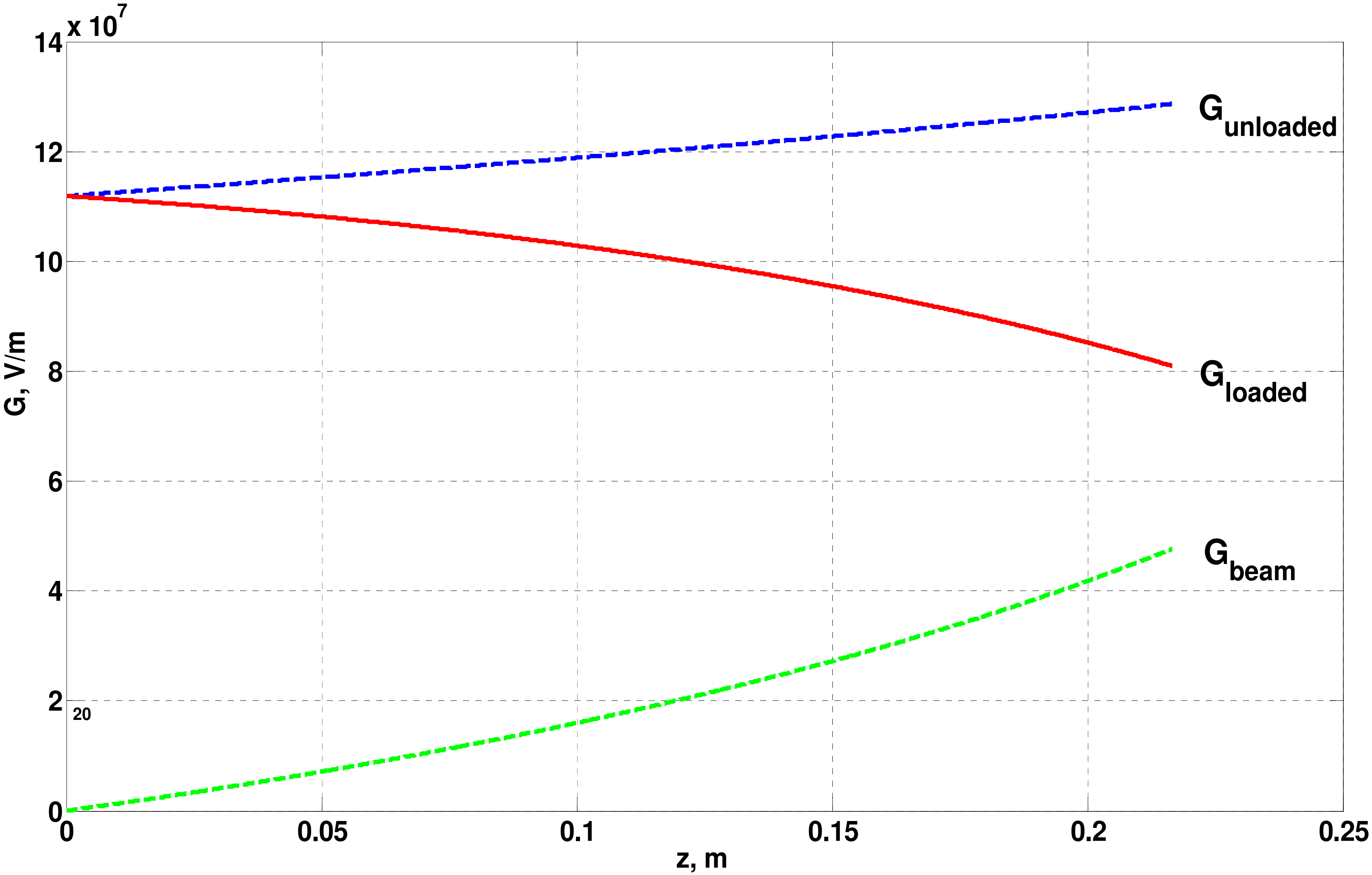




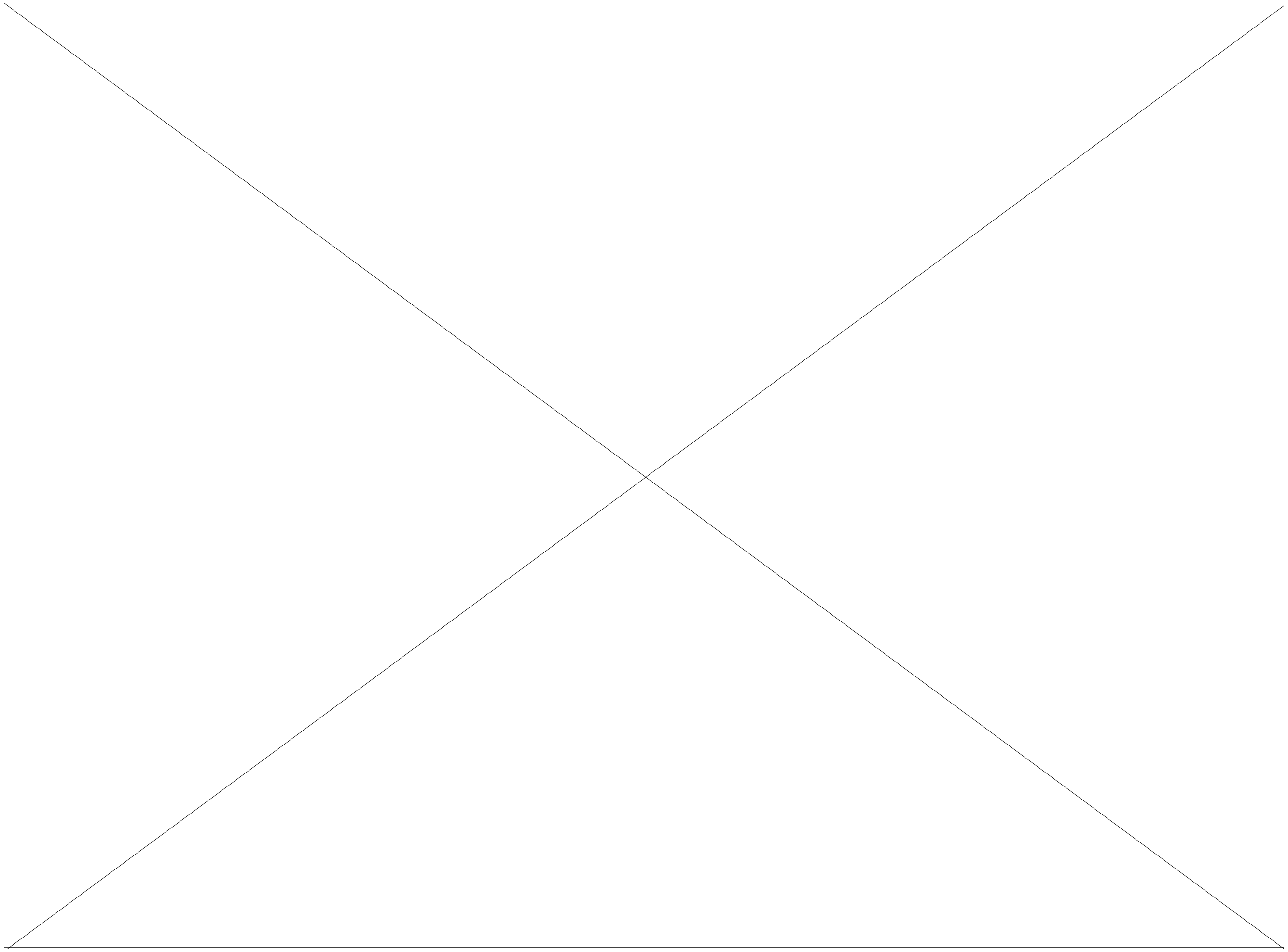
Sparse Sampled HPT
(High Power Test)

Fully Interleaved
8-structures

Beam loading: steady-state



Beam loading simulation



Arno Candel

Parallel Finite Element EM code suite **ACE3P**

SLAC has developed the conformal, higher-order, C++/MPI-based parallel EM code suite ACE3P for high-fidelity modeling of large, complex accelerator structures.

ACE3P: Parallel Finite Element EM Code Suite

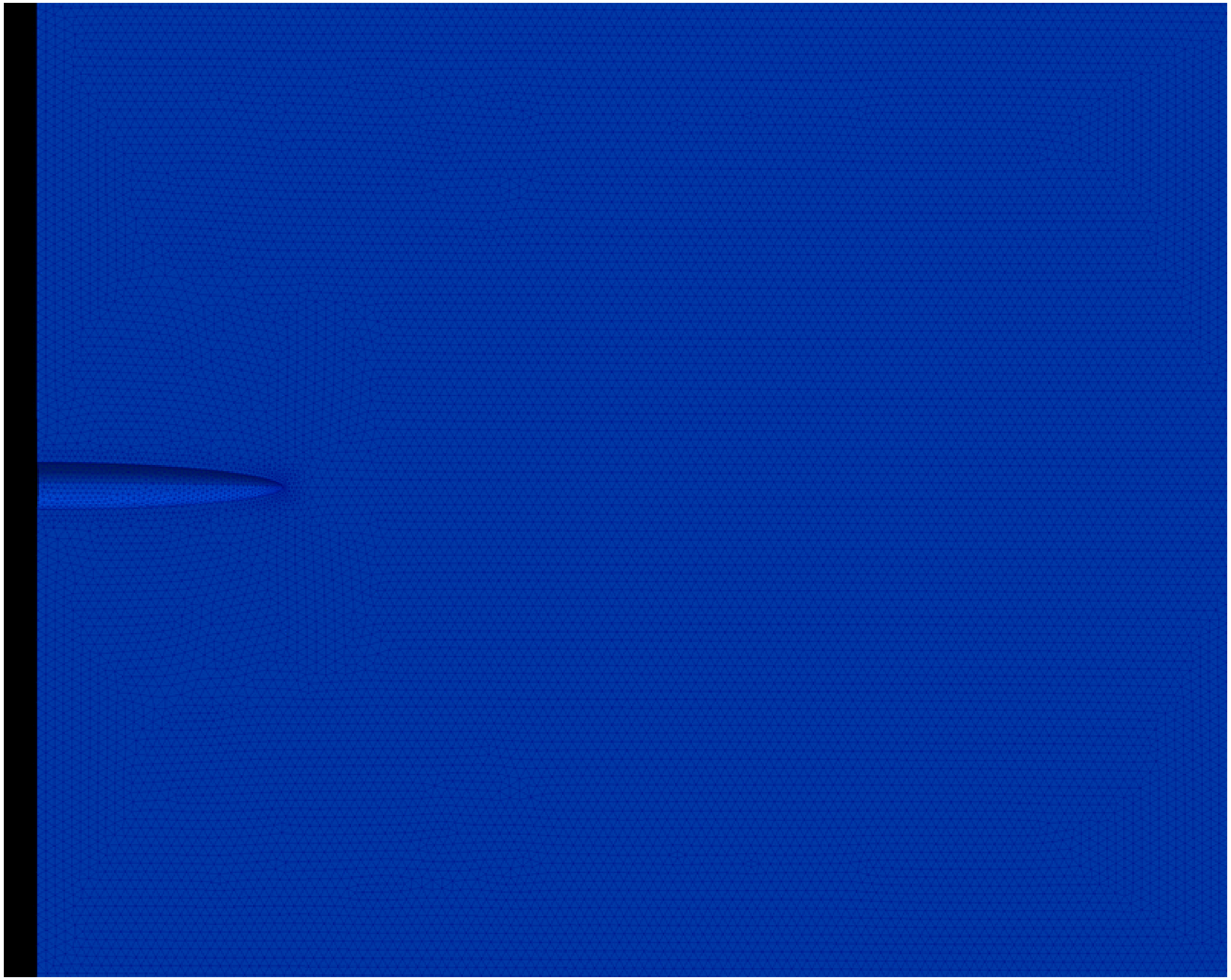
(Advanced Computational Electromagnetics, 3D, Parallel)

	ACE3P Modules	**– Accelerator Physics Application**
***Frequency Domain*:**	Omega3P	– Eigensolver (nonlinear, damping)
	S3P	– S-Parameter
***Time Domain*:**	T3P	– Transients & Wakefields
	Pic3P	– EM Particle-In-Cell (self-consistent)
***Particle Tracking*:**	Track3P	– Dark Current and Multipacting
	Gun3P	– Space-Charge Beam Optics
***Multi-Physics*:**	TEM3P	– EM-Thermal-Mechanical

***Visualization*:** ParaView – Meshes, Fields and Particles

Funded by SciDAC1 (2001-2006) and continuing under SciDAC2 (in black)
Under development for ComPASS (2007-2011) (in blue)

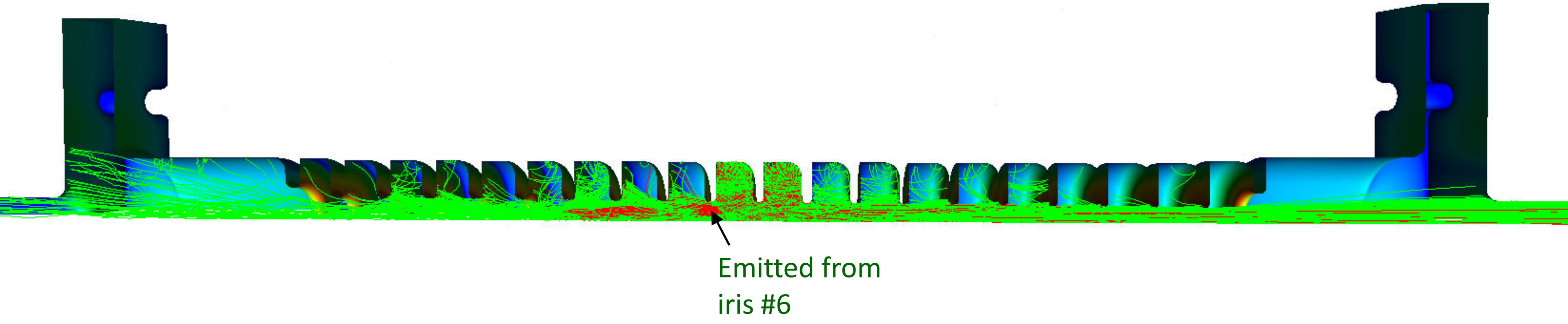
Pic3P: Self-consistent field emission



Pic3P simulation of field emission, including space-charge effects.
Parameters indicated on previous slide.
Particles colored by momentum, only space-charge fields shown.

Zenghai Li

Dark Current Emitter Simulation

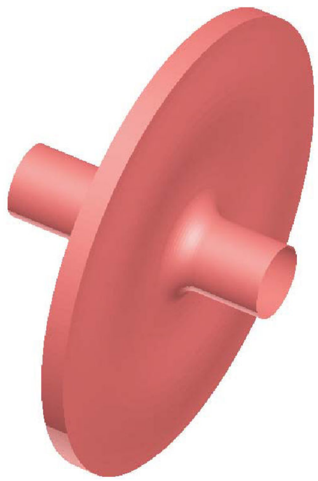


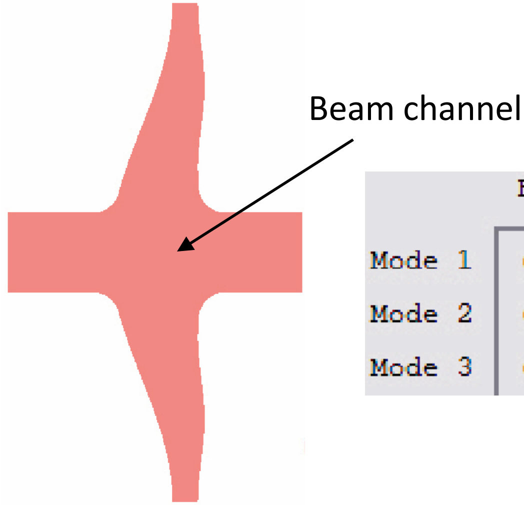
- Intercepted electrons - dark current heating on surface
  - Deposit energy into the wall results in surface heating
- Captured electrons: energy spectrum
  - Emitter (disk) location - energy
  - Emitter density on disk – amplitude
- Heating on dark current emitter
  - Due to emission current
  - Due to RF field enhancement on emitter

Sergey Kuzikov

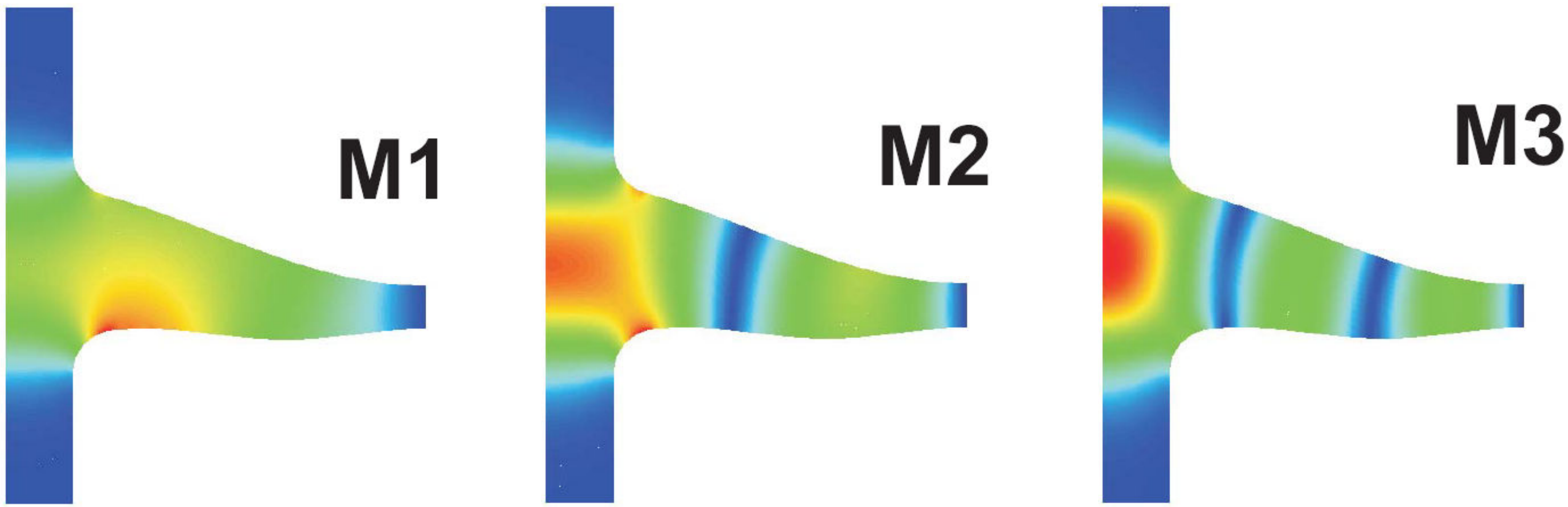
Three-mode axisymmetric cavity with modes at 3, 6, and 9 GHz

The first design issue is to obtain an equidistant mode spectrum. This has been solved by specific cavity shape (each mode is tuned by its own sine-like wall profile.





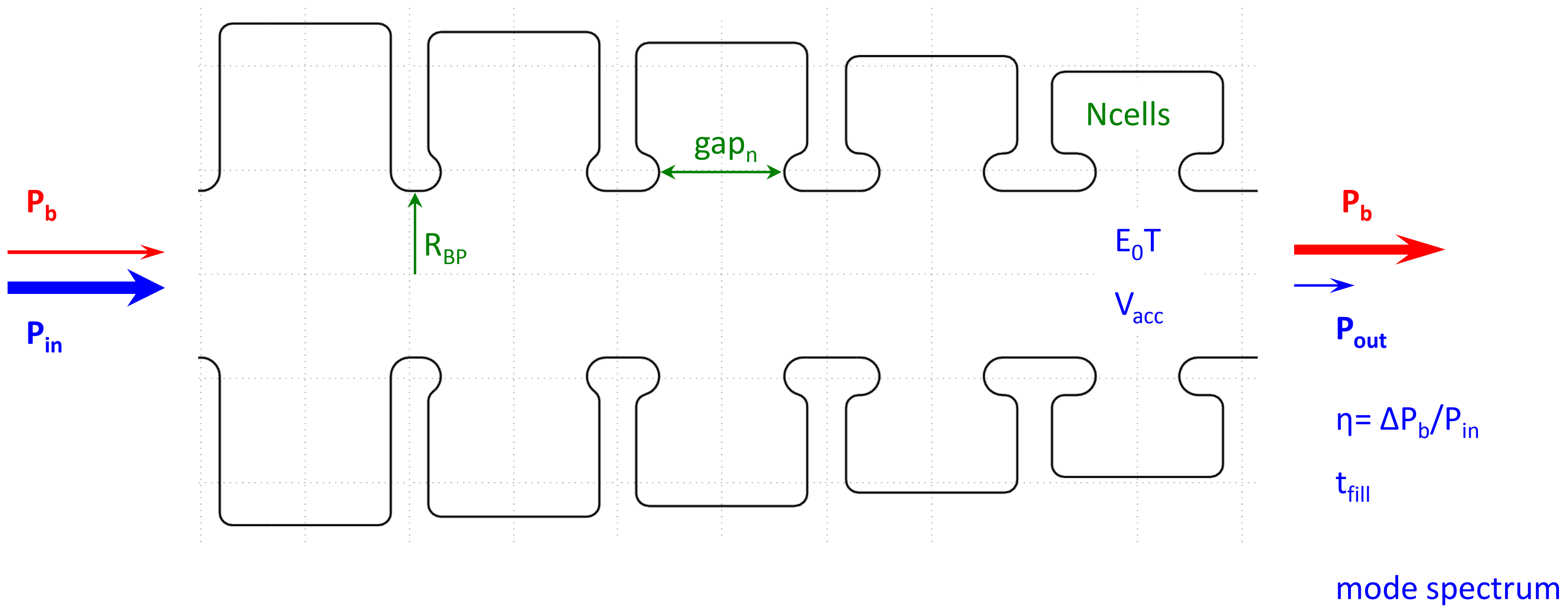
	Frequency (GHz)	Q
Mode 1	(3.00045e+000, 2.65761e-004)	5.64502e+003
Mode 2	(6.00359e+000, 3.52313e-004)	8.52024e+003
Mode 3	(8.99912e+000, 3.98611e-004)	1.12881e+004



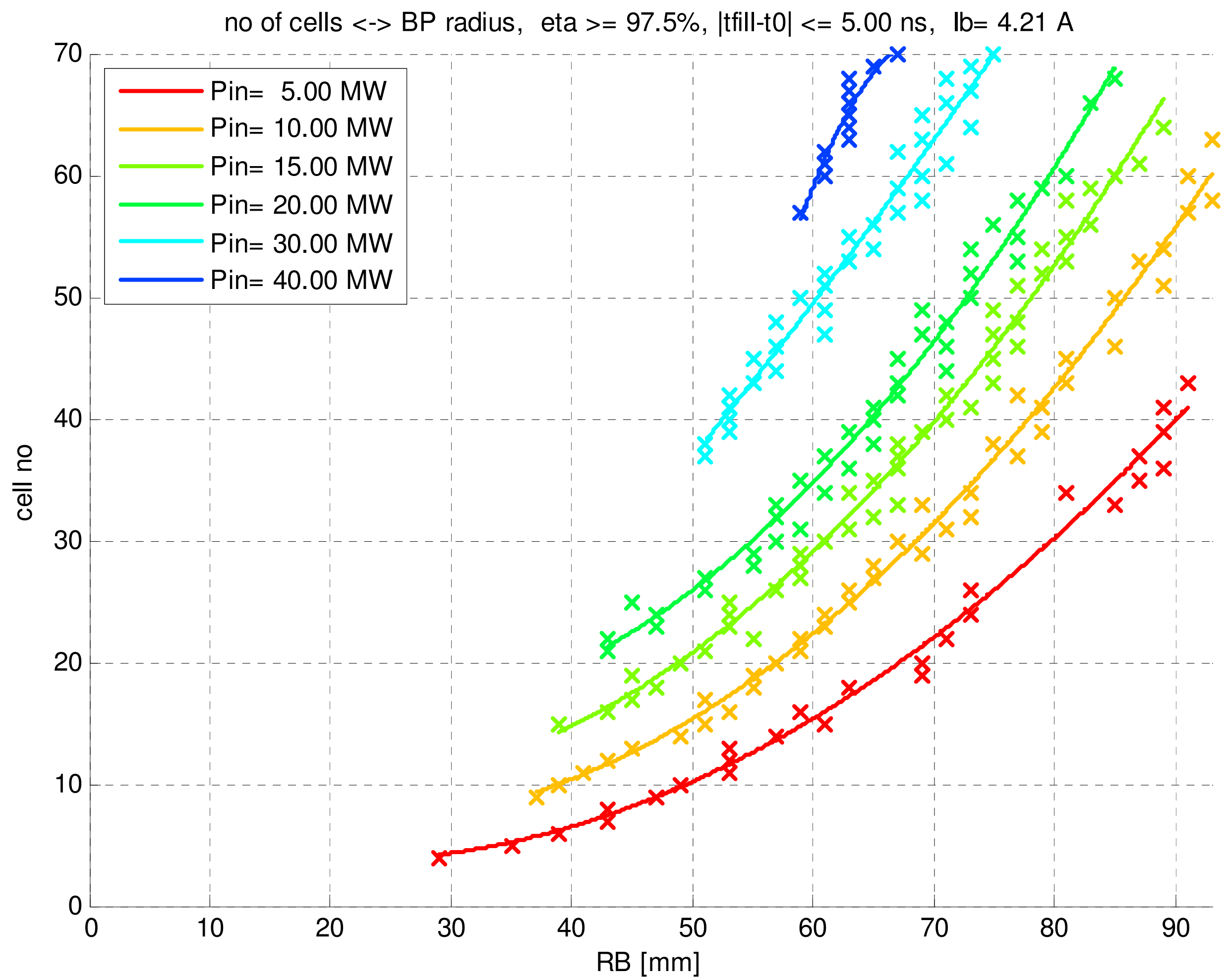
E-fields of eigenmodes

design of TWS DBA

constant aperture



optimisations

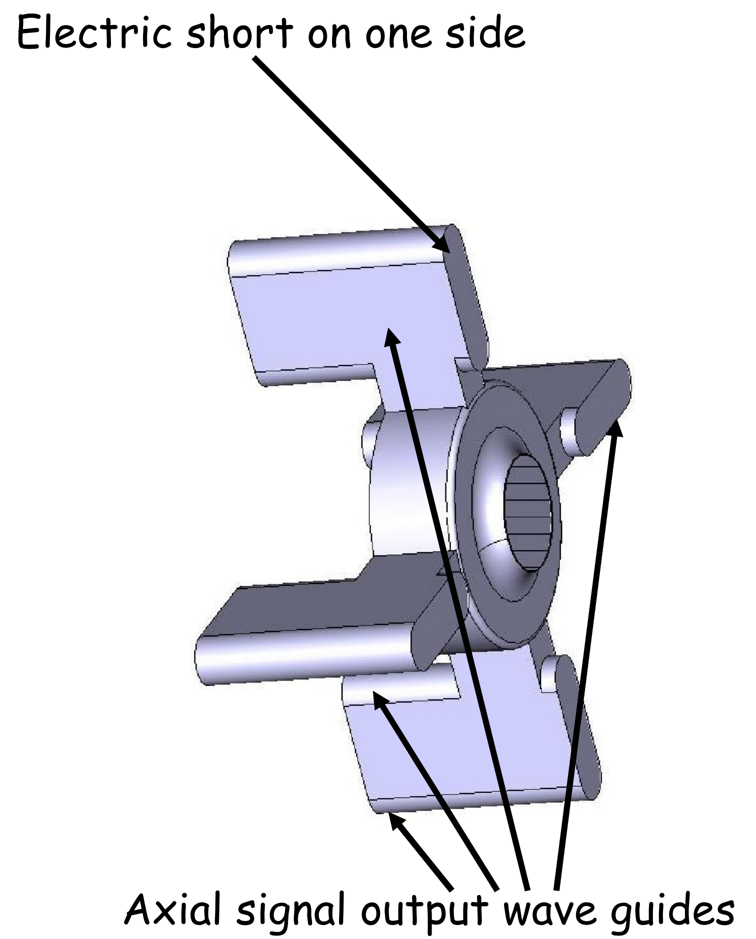


$\eta_{RF} \geq 97.5\ \%$

$|t_{fill} - 245\ \text{ns}| \leq 5\ \text{ns}$

HOM coupler inspired from NLC DDS

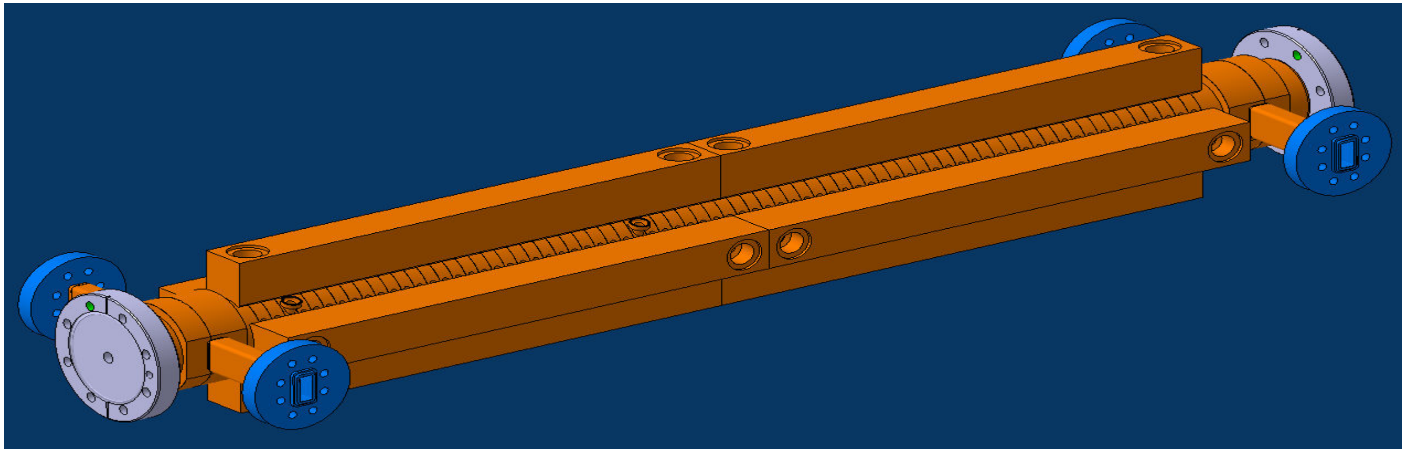
- TE type coupling minimizes spurious signals from fundamental mode and longitudinal wakes
- Need only small coupling (Qext<1000) for sufficient signal
- Only minor loss in fundamental performance – 10% in Q, <2% in R/Q
- Output wave guides with coaxial transition connecting to measurement electronics



Micha Dehler

Summary

- Design for joint CERN/PSI/FERMI X band structure
- Special challenge transverse wake fields
  - 5π/6 design: open aperture, while efficient in terms of RF power
  - Wake field monitors
    - Separate decoupled signals for up and downstream part
    - Additional information from time domain envelopes of output signals
    - Forward feature: Resolution determined by internal structure alignment
    - Reverse feature: Noise floor in signal measures internal structure alignment
- In collaboration with SLAC to do validate circuit simulations using SLAC codes S3P/Tau3P
- In the process of fabricating structure (finished with RF/mechanical design, preparing for machining disks)
- Looking forward to tests with real beam ….



Themes

- Theory and Design
- **Production and Development**
- Test Stands and Results
- Modeling and Simulations
- Vacuum Specifications

Juwen Wang

Work Done Since the Collaboration

1. Eleven structures have been made and five high power tested
   - 1 x T28_vg2.9 (T26) Structure

     Used T53VG3MC components and completed by the end of May, 2008

     High power tested in the NLCTA since June 2008.
   - 4 x T18_VG2.4_DISC Structures #1, #2, #3, #4

     Two with SLAC flanges, high power tested successfully at NLCTA

     One with KEK flanges has also been successfully tested at KEK
   - 2 x TD18_VG2.4_DISC Structures #1, #2

     Fabrication completed (one with SLAC flanges, one with KEK flanges)
   - C10 Structures: 2 x C10_VG 1.35 #1, #2 and 2 x C10_VG 0.7 #1, #2

     Fabrication completed, one (VG1.35) of four structures preliminary tested

2. Five CERN made test structures high power tested

   SLAC Provided RF feed and related components for tank versions
   - HDX11 Cu Structure and Mo Structure

     Electrical polishing and reassembly and Microwave evaluation
   - T18_VG2.6_QUAD

     Cooling tube flanges brazed at a hydrogen furnace with 25/75 Au/Cu alloy

     Four quadrant assemblies vacuum baked at 650°
   - T18_VG2.6_DISK Assembled in the tank at SLAC
   - T24_VG2.4_DISK Assembled in the tank at SLAC

Juwen Wang

Cleaning of Accelerator Parts

NATIONAL ACCELERATOR LABORATORY

For accelerator structure parts with single diamond tuning surfaces:

1. Vapor degrease in 1,1,1 trichloroethane or equivalent degreaser for 5 minutes.
2. Alkaline soak clean in Enbond Q527 for 5 minutes at 180ºF.
3. Cold tap water rinse for 2 minutes.
4. Immense in 50% hydrochloric acid at room temperature for 1 minutes.
5. Cold tap water rinse for 1 minute.
6. Immense in the following solution for maximum of 5 seconds depending on the surface finish required:

Phosphoric Acid, 75%	21 gallons
Nitric Acid, 42º Baume	7 gallons
Acetic Acid, Glacial	2 gallons
Hydrochloric Acid	12.6 fluid ounces
Temperature	Room

7. Cold tap water rinse for minimum of 2 minutes until the film on part disappears.
8. Ultrasonic in DI Water for 1 minute.
9. Ultrasonic in new, clean alcohol for 1 minute.
10. Final Rinse to be done in new, clean alcohol.
11. Hold in clean alcohol in stainless steel containers.
12. Dry in a clean room using filtered N2.

For accelerator structure parts with regular machining surfaces:

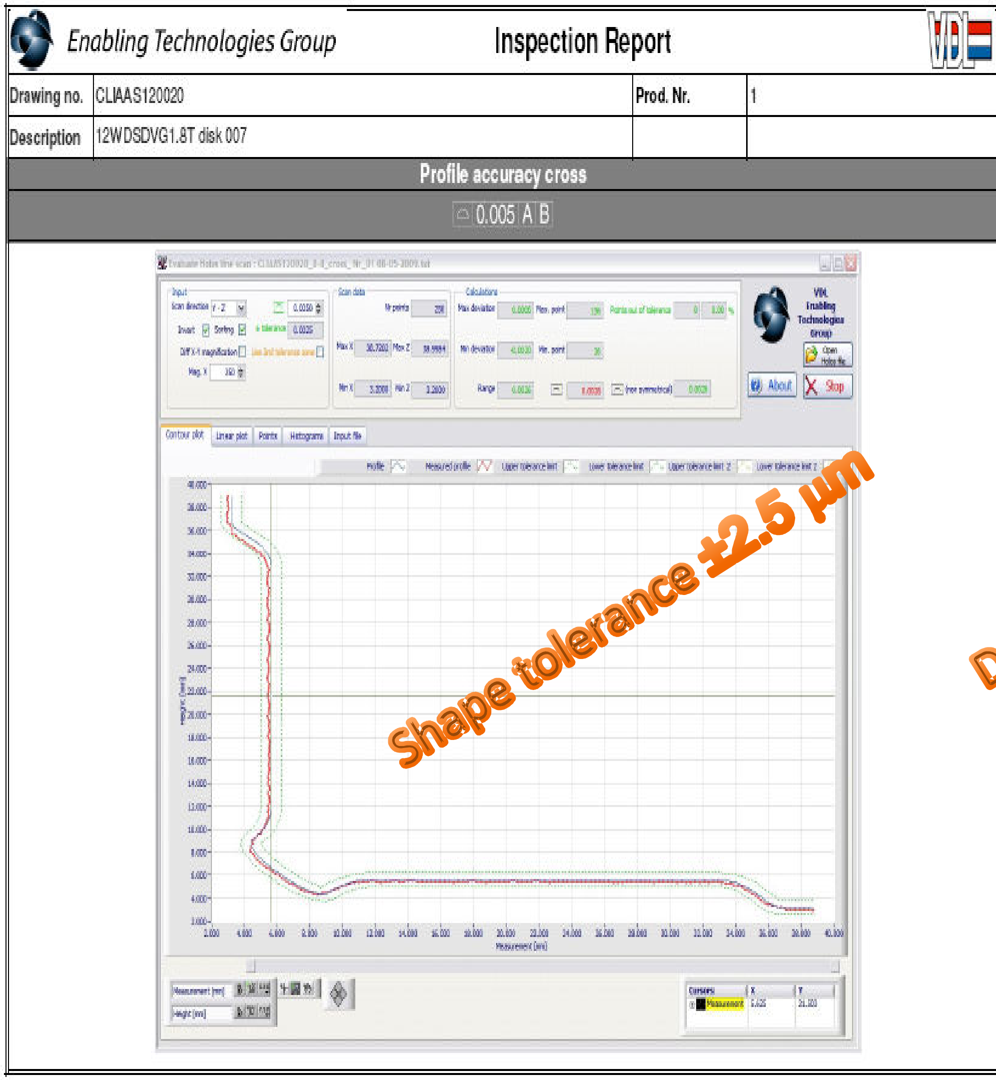
6. Immense in the following solution for maximum of 30-60 seconds depending on the surface finish required:

Ongoing Program for Structures

1. C10 Structures: 2 x C10_VG 1.35 #1, #2 and 2 x C10_VG 0.7 #1, #2
   - All four assemblies are completed
   - One VG1.35 in preliminary high power test with problem in RF feed
   - More testing after resolving the problems in circular waveguide junction
2. TD18_VG2.4_DISK #2, #3
   - Microwave tuning both structures completed
   - Vacuum baking underway
   - Shipping #3 with KEK flanges to KEK
   - Assembly of the structure with SLAC flanges in preparation
   - High power test in October
3. Plan to retest TD18_VG2.4_QUAD
   - Chemical cleaning done
   - Planning to have hydrogen firing and Vacuum baking
   - Reassembly and microwave check in March.

Germana Riddone

Manufacturing at VDL


Enabling Technologies Group — Inspection Report

Drawing no.	CLIAAS120020	Prod. Nr.	1
Description	12WDSDVG1.8T disk 007		

Profile accuracy cross

0.005 A B

Page 4 of 5

Shape tolerance ±2.5 µm

Enabling Technologies Group — Inspection Report

Drawing no.	CLIAAS120020	Prod. Nr.	1
Description	12WDSDVG1.8T disk 007		

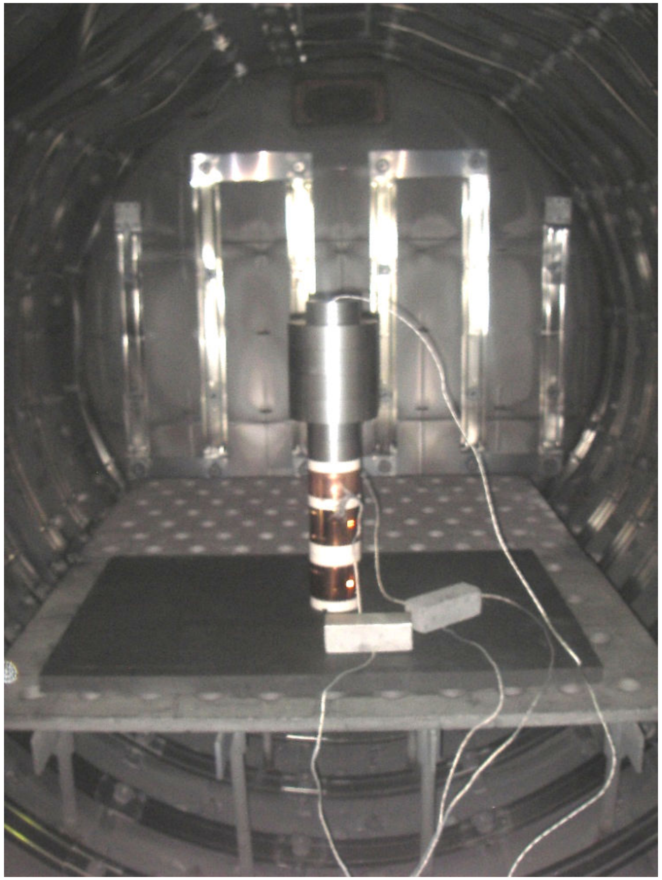
Dimensions

Measurand	Description	Nominal	Upper	Lower	Actual	Deviation	Pass	Fail	Remark
1	Ref A 0.002	0.0000	0.0020	[illegible]	[illegible]	0.0015	√		
2	Outer diameter Ref B	80.0000	0.0050	[illegible]	[illegible]	0.0004	√		
3	0.002	0.0000	[illegible]	[illegible]	0.0005	0.0005	√		
4	0.005 A	0.0000	[illegible]	0.0000	[illegible]	0.0001	√		
5	Width of cross Z+	[illegible]	[illegible]	[illegible]	[illegible]	0.0002	√		
6	Width of cross Z-	[illegible]	0.0025	[illegible]	11.2514	0.0014	√		
7	Width of cross Y-	11.2500	[illegible]	[illegible]	11.2501	0.0001	√		
8	[illegible]	11.2500	[illegible]	-0.0025	11.2501	0.0001	√		
9	[illegible]	[illegible]	[illegible]	-0.0025	8.3171	-0.0004	√		
10	[illegible] A 0.002	[illegible]	0.0020	0.0000	0.0006	0.0006	√		
11	[illegible] ite Ref A [illegible]	0.0000	0.0050	0.0000	0.0036	0.0036	√		
11	Cross 0.005 A	6.8368	0.0025	-0.0025	6.8364	-0.0004	√		
12	Bottom plane cross 0.002	0.0000	0.0020	0.0000	0.0011	0.0011	√		
13	Depth of recess for solder foil	0.0300	0.0100	0.0000	0.0382	0.0082	√		
14	Diameter undulation	5.8478	0.0025	-0.0025	5.8469	-0.0009	√		
15	0.002	0.0000	0.0020	0.0000	0.0004	0.0004	√		
17	0.003 B	0.0000	0.0030	0.0000	0.0012	0.0012	√		
9	Measurand t	1.4807	0.0025	-0.0025	1.4801	-0.0006	√		
18	Undulation 0.005 A B	[illegible]	0.0050	0.0000	0.0038	0.0029	√		
19	Cross 0.005 A B	[illegible]	[illegible]	0.0000	0.0026	0.0015	√		

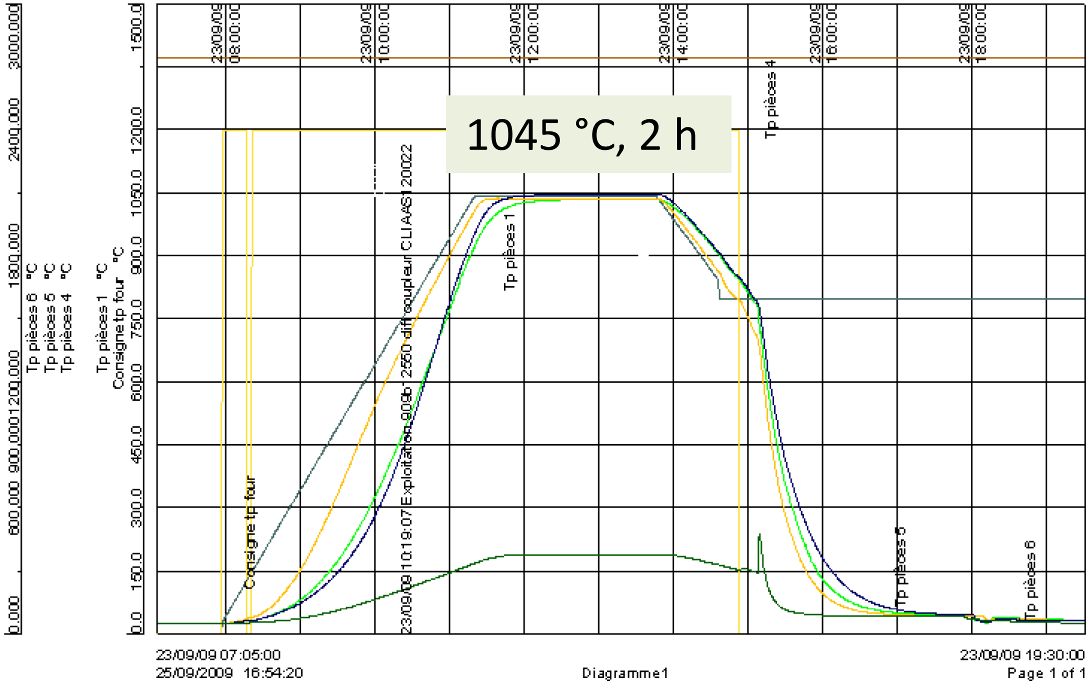
All dimensional checks are conform

Damped disk at 12 GHz

Diffusion bonding



H$_2$ pure bonding
~ 4 bar

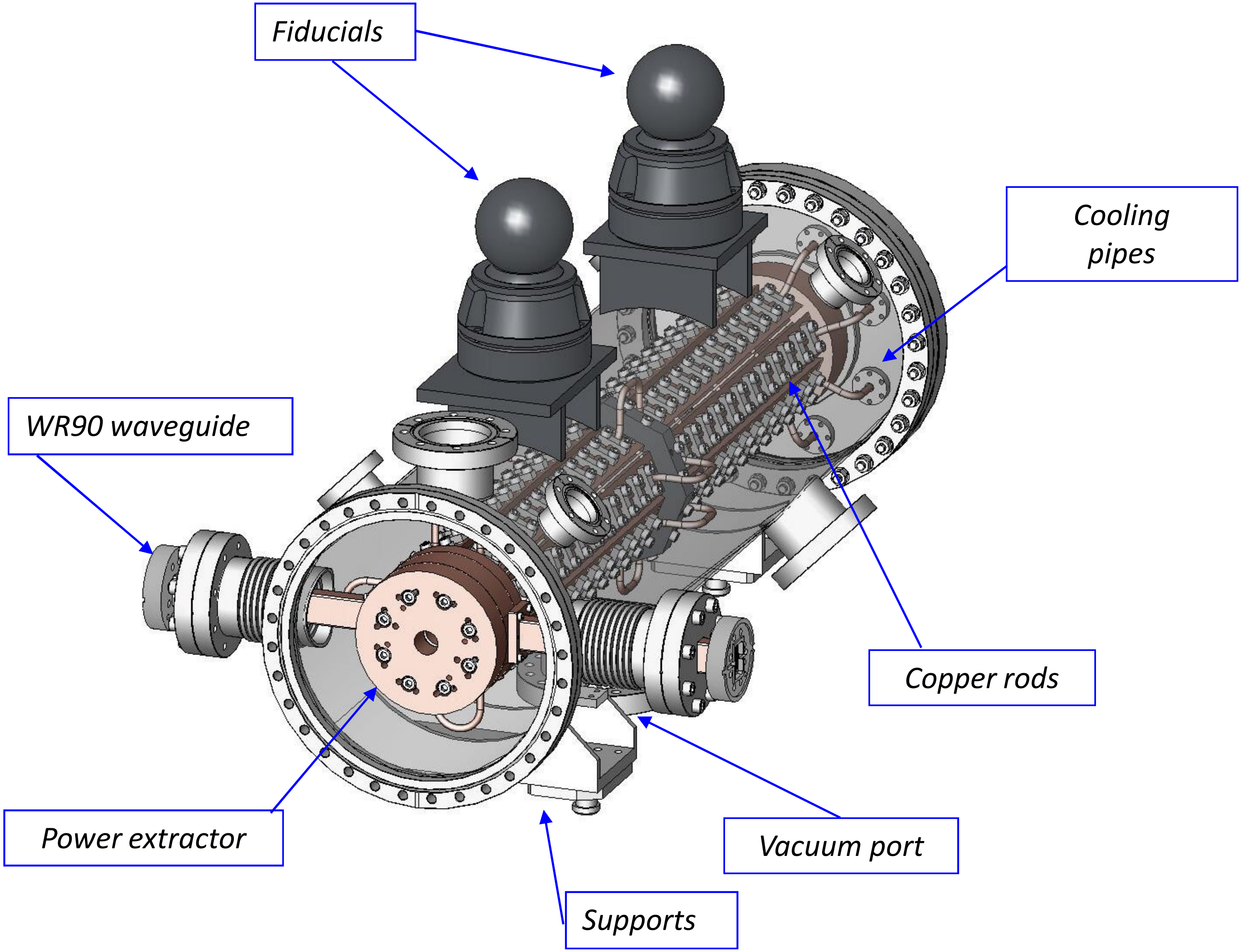


Diffusion bonding cycle

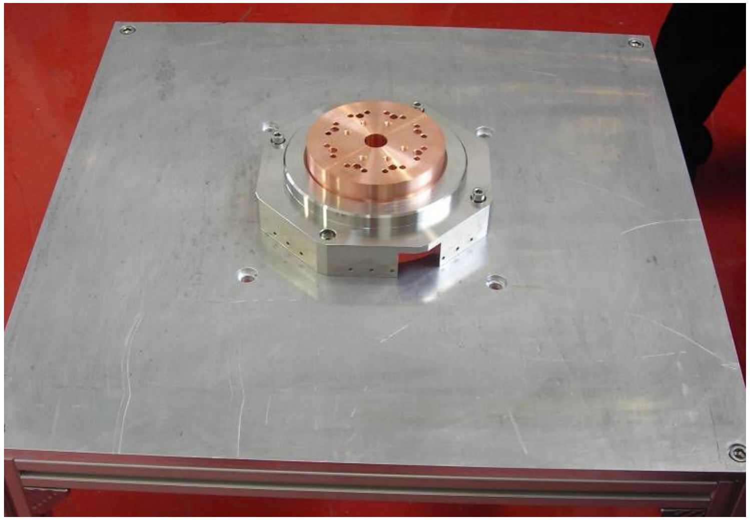
Comparison SLAC/CERN

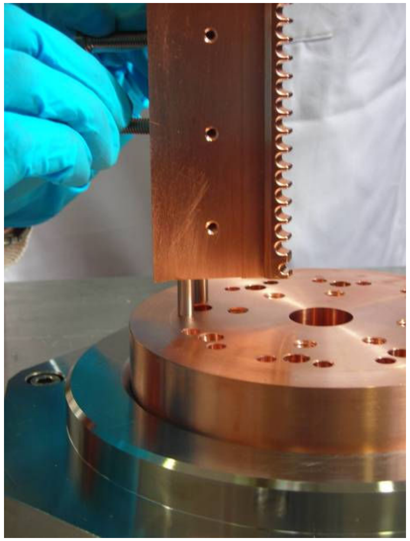
SLAC/KEK BASELINE procedure	CERN SLAC/KEK based procedure	Comparison
Cleaning (SLAC procedure) [light etch]	Cleaning (SLAC procedure) [light etch]	Same procedure
H2 brazing of couplers (1040 ˚C, Au/Cu)	Diffusion bonding of couplers (H2, 1040 ˚C)	Different mechanical design → for CERN couplers bonding can be applied (in addition CERN has little experience with Au/Cu brazing)
Diffusion bonding of disk stack (H2, 1020 ˚C)	Diffusion bonding of disk stack and couplers (H2, 1020 ˚C)	Same cycle
H2 brazing of couplers to disk stack (1020 ˚C, Au/Cu)		This step is not needed for CERN as the couplers are bonded to the disks during the bonding of the disk stack
Vacuum baking [double-can system] (>10 days at 650 ˚C)	Vacuum baking [double-can system] (>10 days at 650 ˚C)	Same cycle

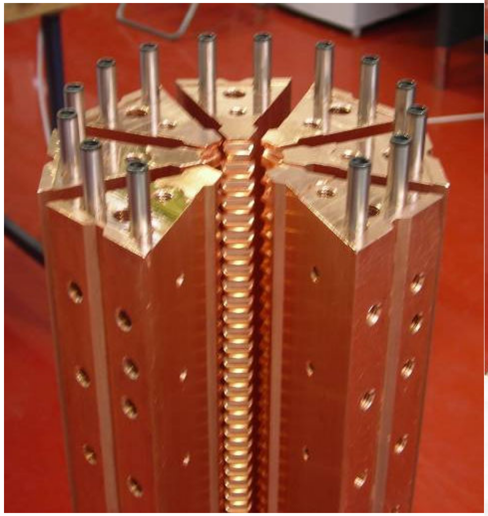
General layout

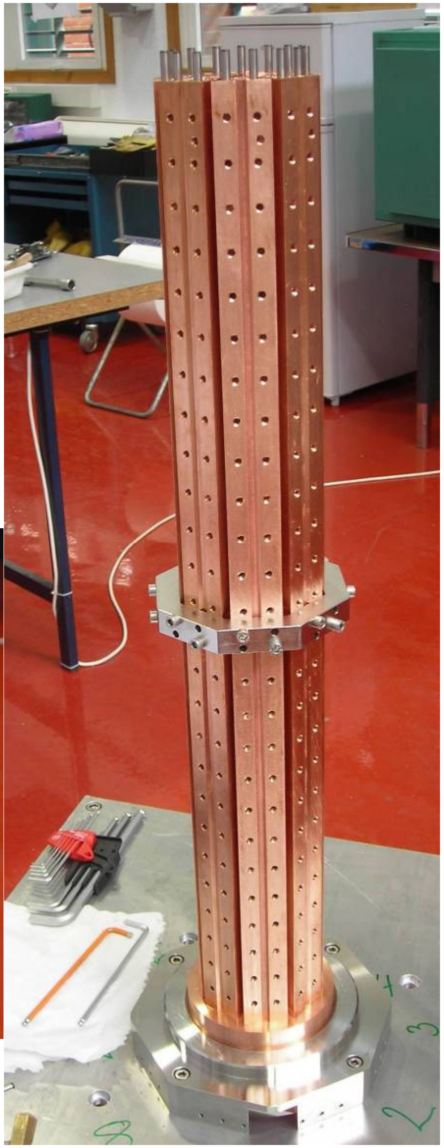


RF structure assembly

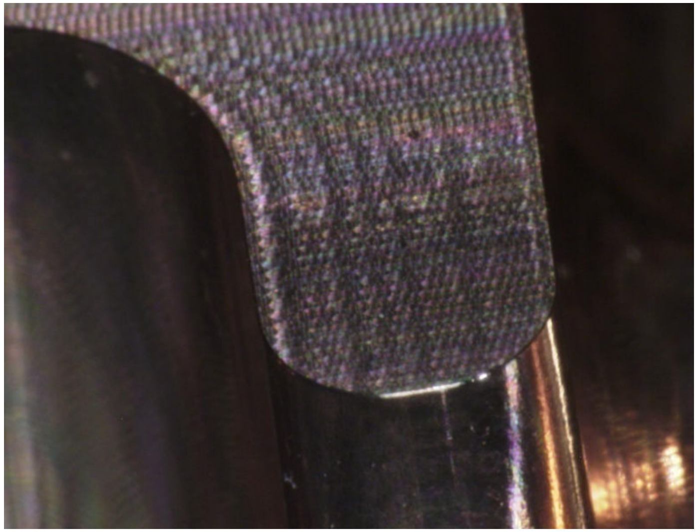


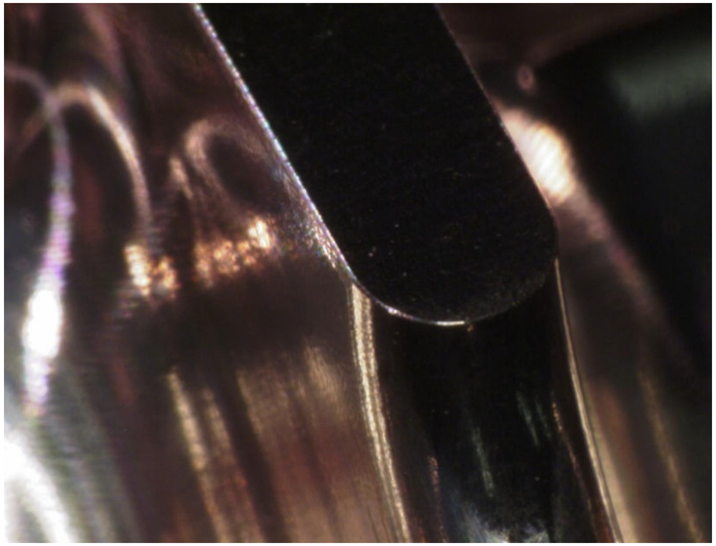






KEK's version: 50 micron chamfer





Made of CuZr without heat treatment.

50 micron rounding: shape with angles and bumps.

Reference planes were formed by milling in a few micron level without re-chucking for shaping cells.

Assembly was done within ten micron level.

Surface Treatment for Quadrants

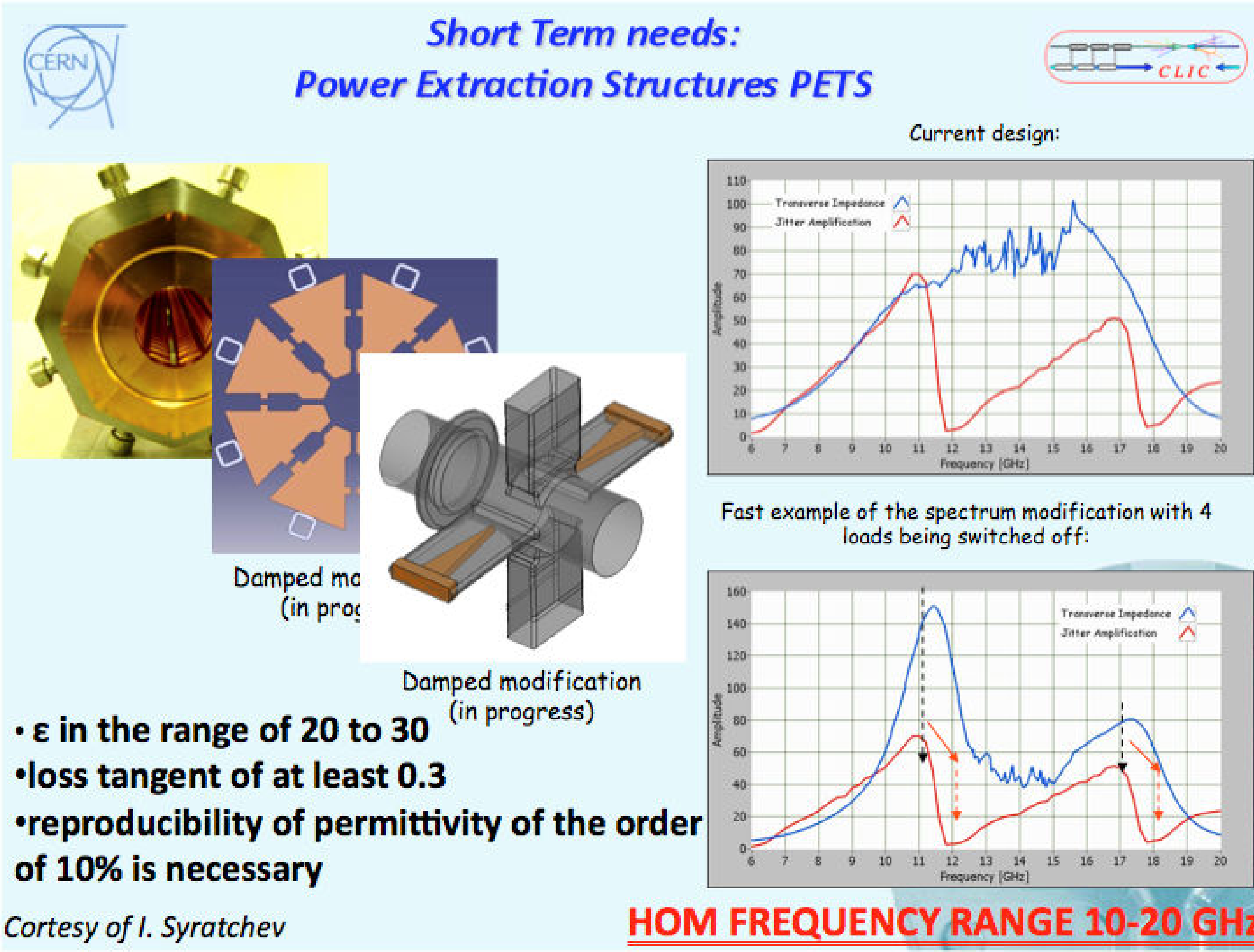
- Pre-machining (remain 100 μm)
- 650 degC annealing
- Final machining (same surface roughness to disk)
- Chemical Etching (~5 μm)
- HPWR (remove burs, particle)
- Degreasing (remove particle and fine oxide layer)
- 150~200 degC baking in vacuum
- Assembly in the ILC grade clean room

Summary

1. One order more precise machining (roughness, dimension) technologies glowed up compare to NLC/GLC generation, So Quadrants is very attractive

2. 5000~7000 disks, 25~30 structures fabricated for NLC/GLC

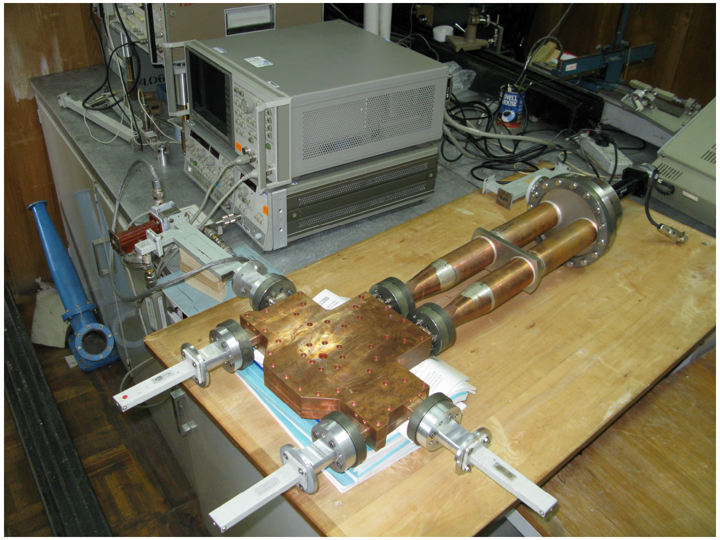
3. In order to understand fabrication technologies for high gradient quadrants structures, may be needed 2~3 years


CERN
Short Term needs:
Power Extraction Structures PETS
CLIC
Current design:
Transverse Impedance
Jitter Amplification
Amplitude
Frequency [GHz]
Damped mo
(in prog
Damped modification
(in progress)
Fast example of the spectrum modification with 4 loads being switched off:
Transverse Impedance
Jitter Amplification
Amplitude
Frequency [GHz]
• ε in the range of 20 to 30
•loss tangent of at least 0.3
•reproducibility of permittivity of the order of 10% is necessary
Cortesy of I. Syratchev
HOM FREQUENCY RANGE 10-20 GHz

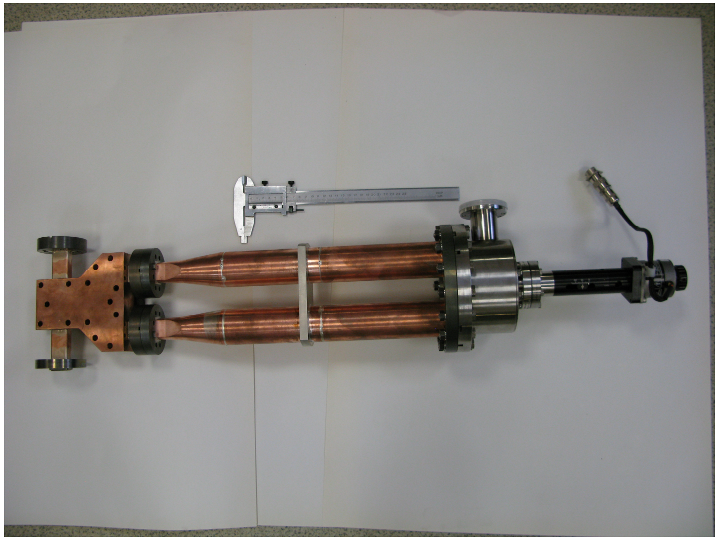
Contracts with Gycom Ltd.:

1. 30 GHz transmission line and RF components
2. 30 GHz SLED II PC
3. Length compensators for transmission lines
4. Pumping ports at big waveguide diameter
5. Vacuum valve
6. Attenuators and phase shifters at 30 GHz and 12 GHz
7. 12 GHz BMC

Total: 10 contracts for last 3 years



12 GHz attenuator

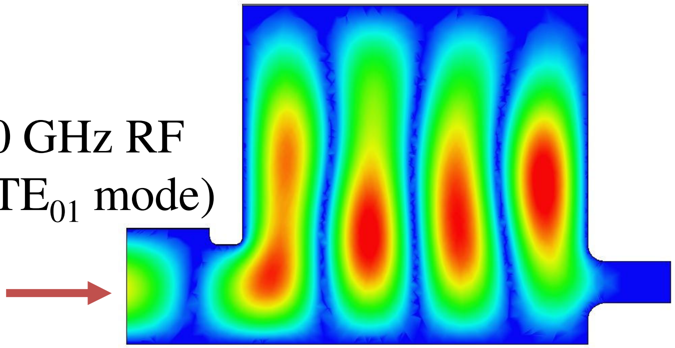


12 GHz phase shifter

Sergey Kuzikov

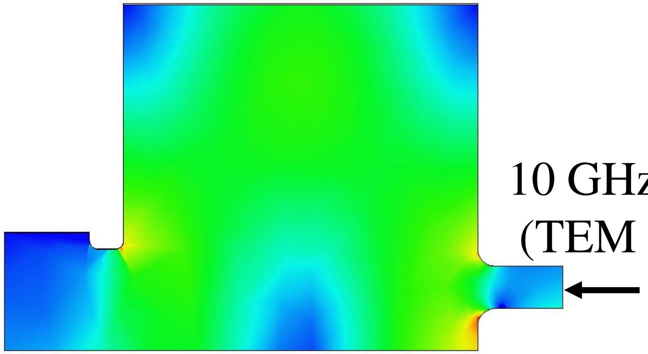
Fast active RF switch (phase shifter) based on induced multipactor

30 GHz RF
(TE_{01} mode)



High-Q 30 GHz cavity (operating RF)

10 GHz RF
(TEM mode)

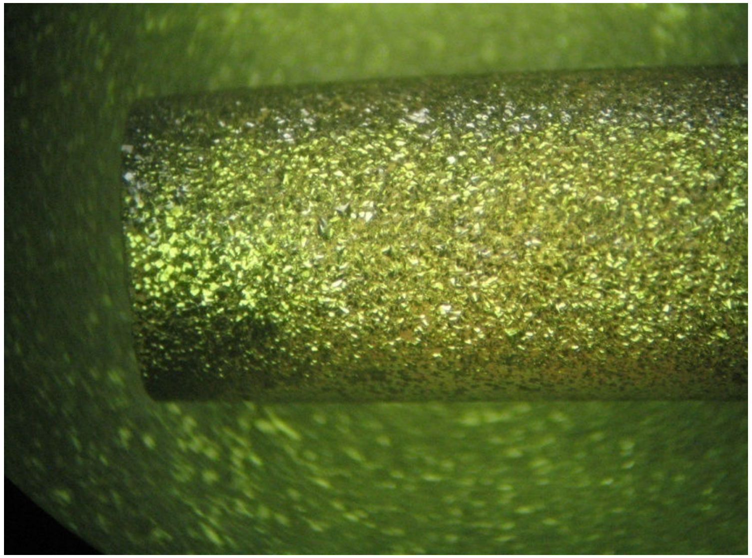


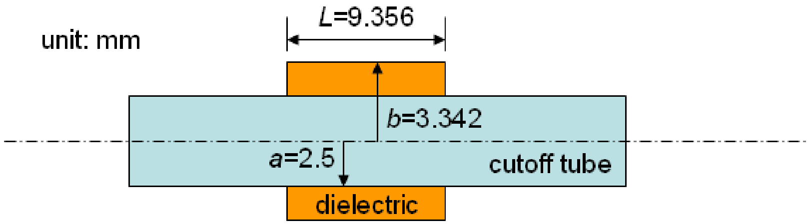
The same cavity at 10 GHz, low-Q (switching RF)

10 GHz radiation of kW power level initiates multipactor,
30 GHz operating radiation of multi-megawatt power level is scattered and absorbed by the prepared multipactor.
Swiching time is 10-20 ns.

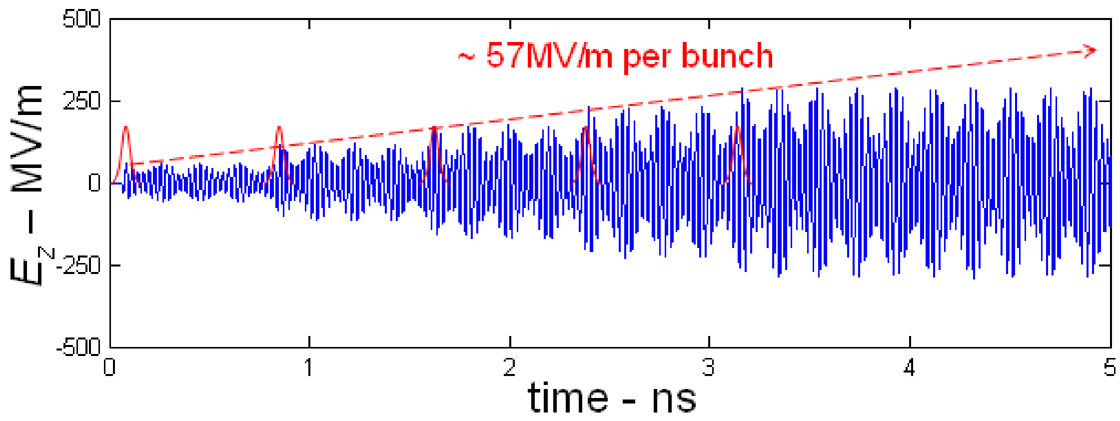
Alexei Kanareykin

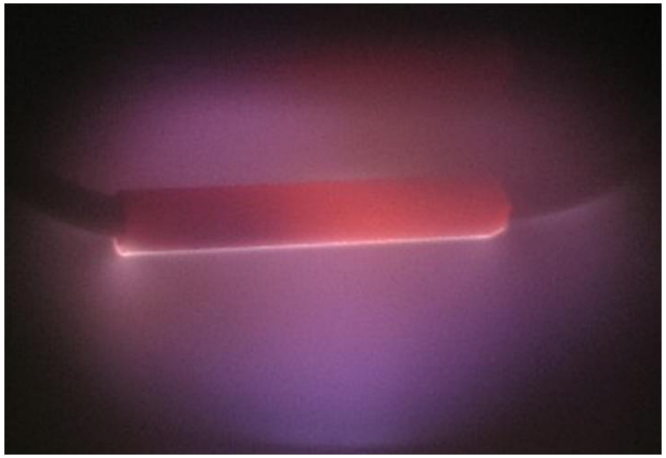
35 GHz Diamond Based DLA Structure





CVD diamond tube fabrication





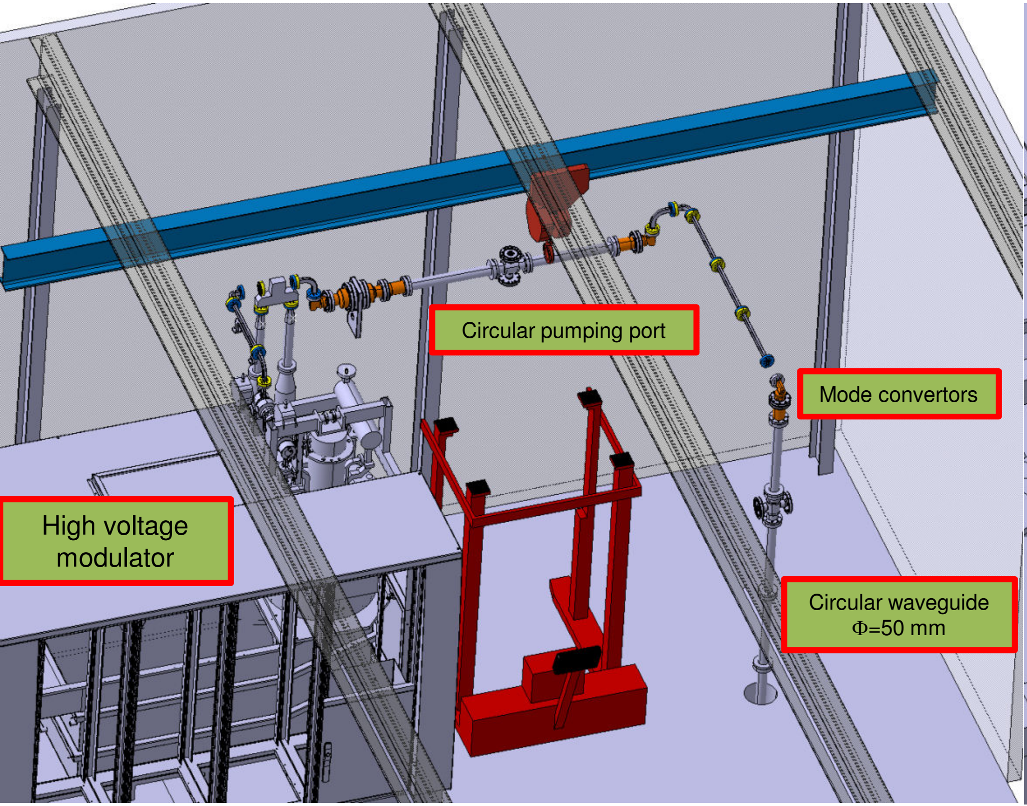
Themes

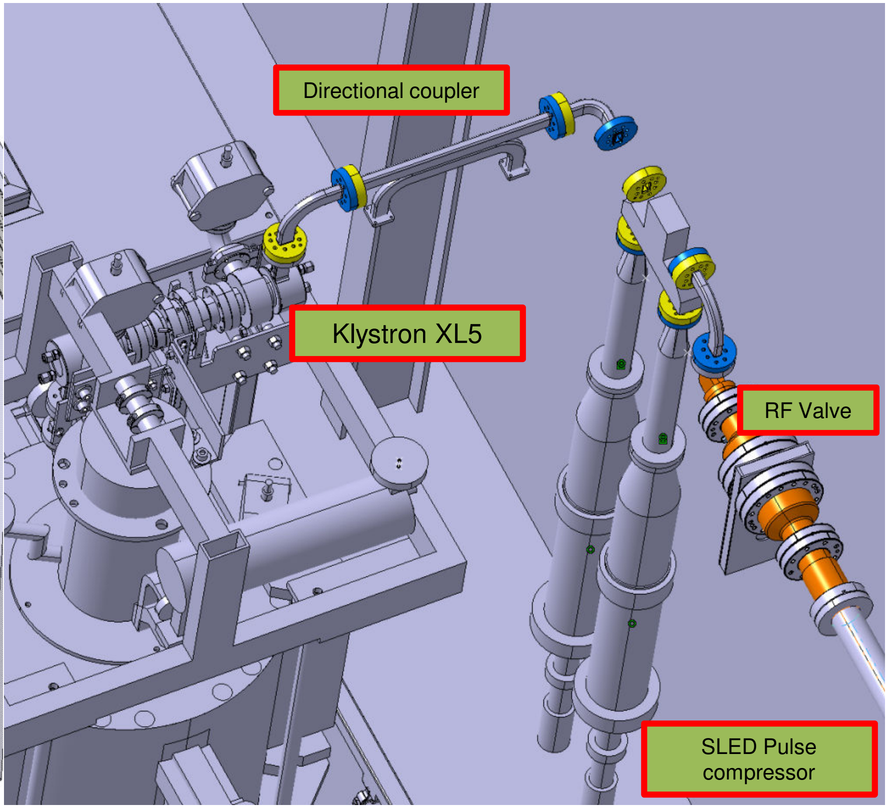
- Theory and Design
- Production and Development
- **Test Stands and Results**
- Modeling and Simulations
- Vacuum Specifications

Karl-Martin Schirm

CERN X-band Test-Stand

Progress and Perspective

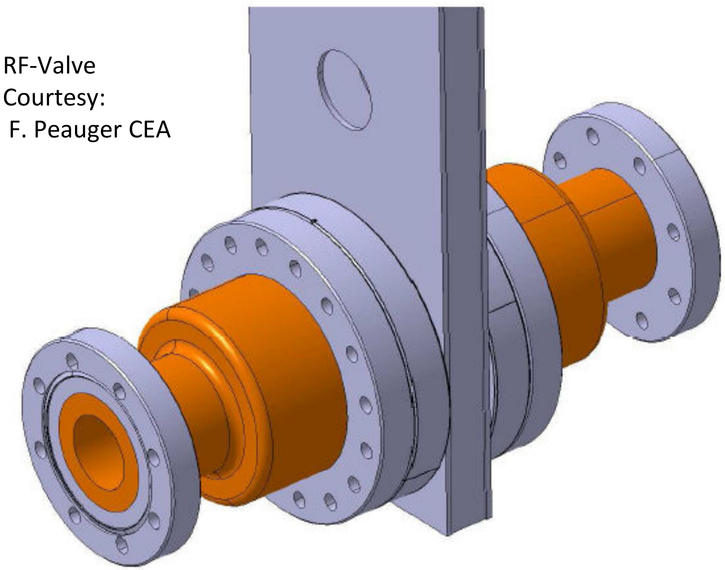


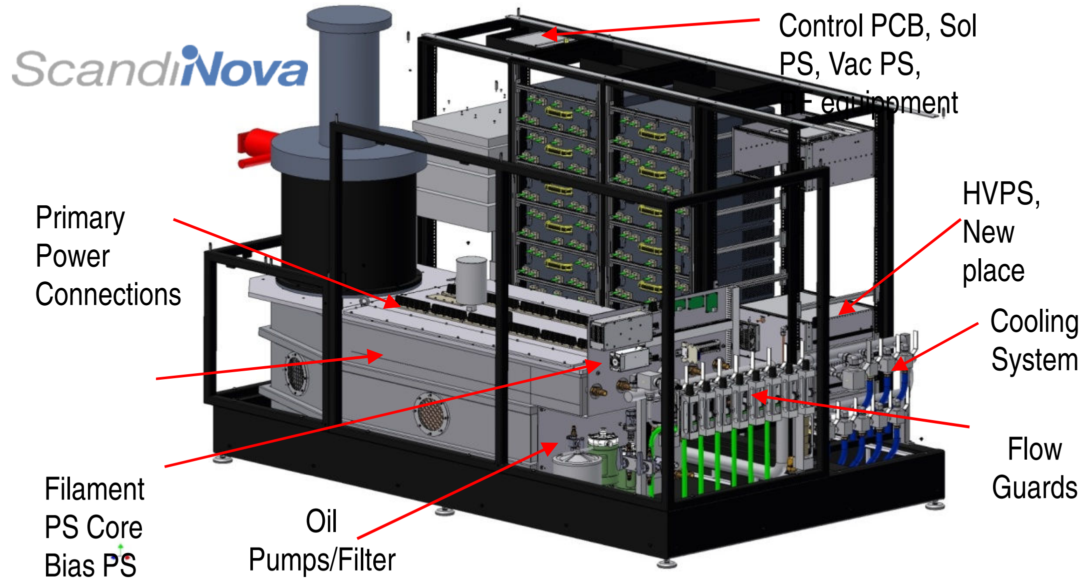


CERN - CEA – PSI – SLAC

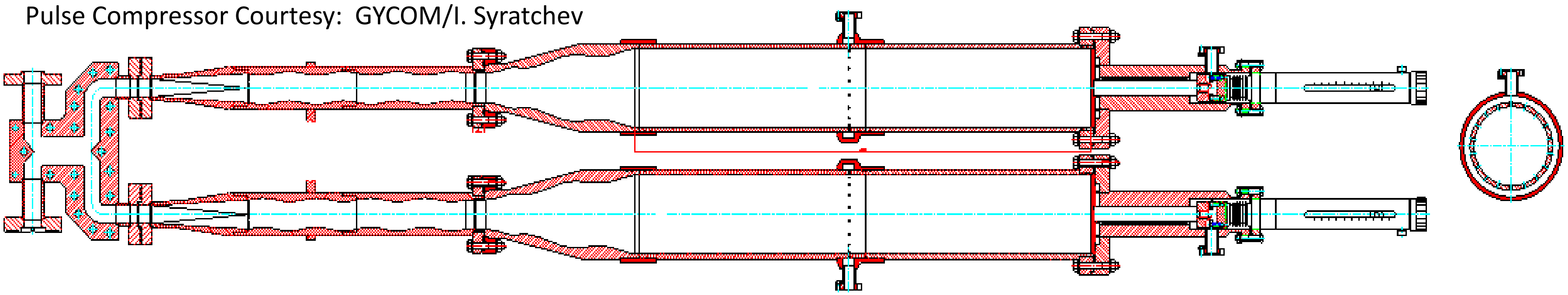
Components

RF-Valve
Courtesy:
F. Peauger CEA





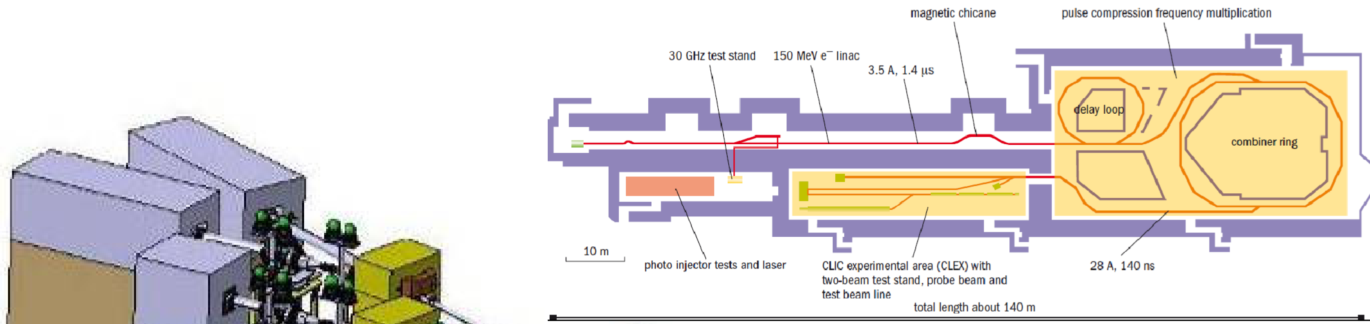
Pulse Compressor Courtesy: GYCOM/I. Syratchev

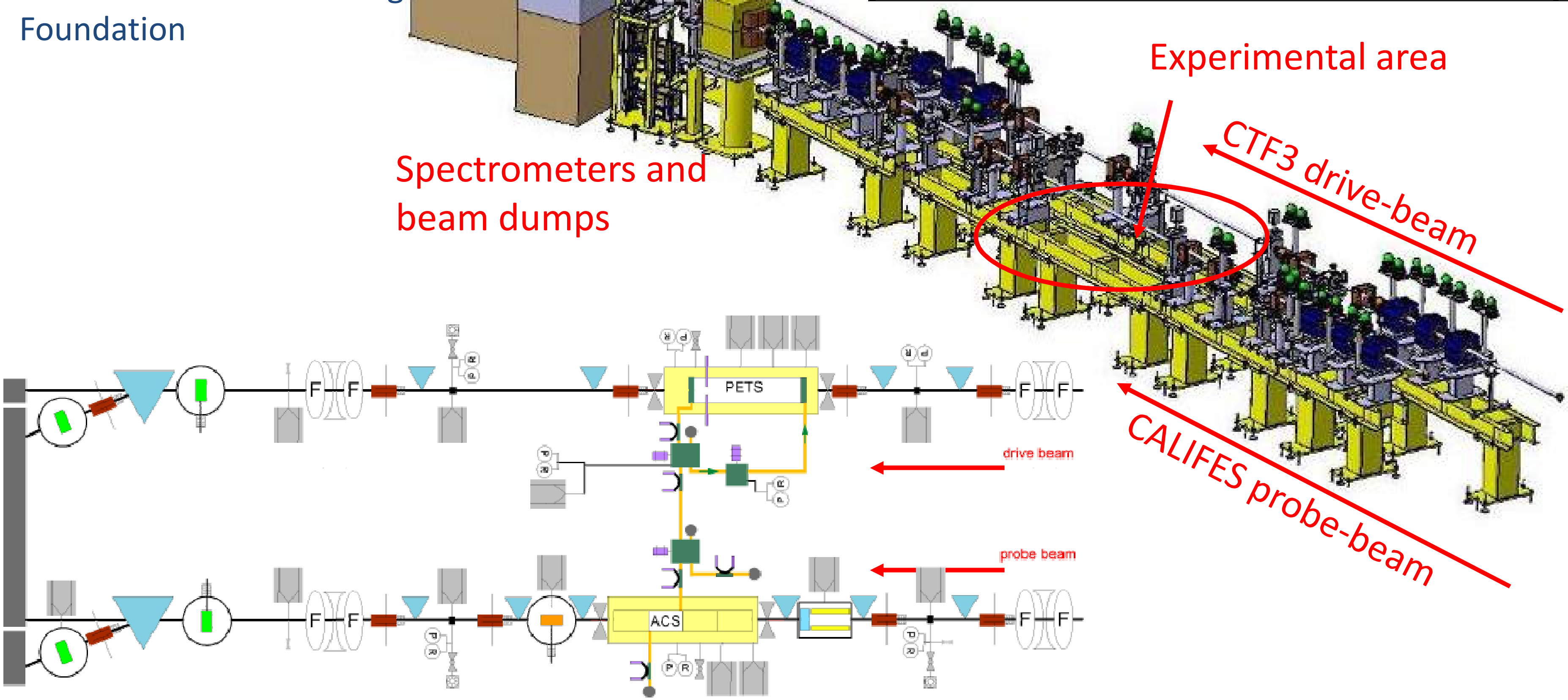


Roger Ruber

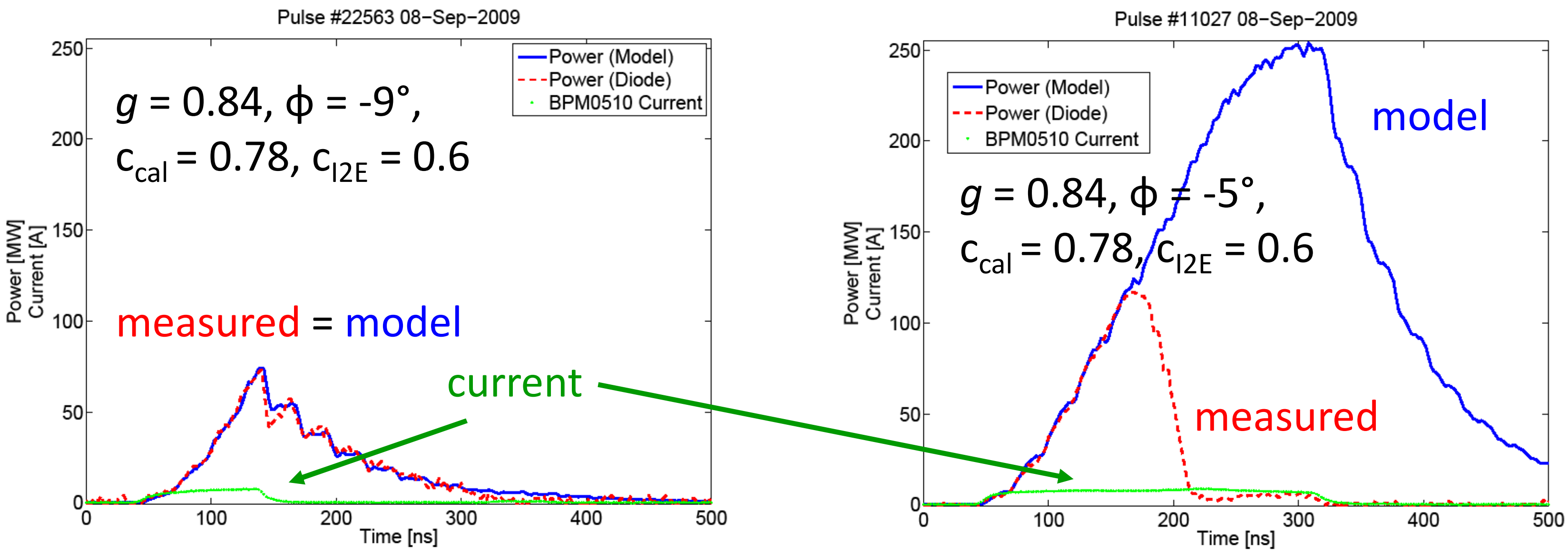
Two-beam Test Stand Layout

Construction supported by the Swedish Research Council and the Knut and Alice Wallenberg Foundation





Power Reconstruction

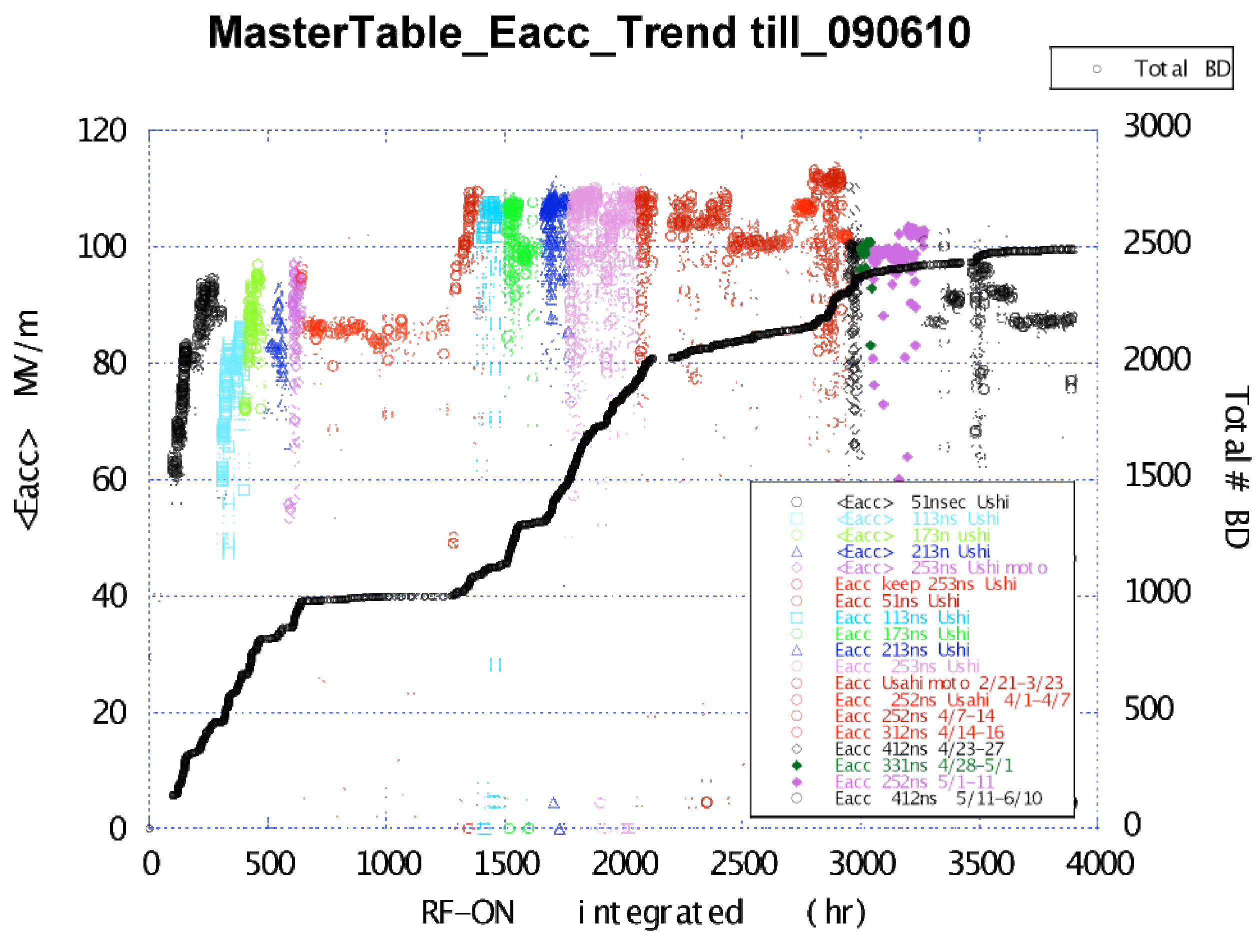


- Parameters constant during normal operation
  → predicts PETS output power
- Accurate parameter fit rising slope
  → gives recirculation loop loss factor and phase shift
- Energy difference (ε) measurement and model indicates ”pulse shortening” → breakdown indicator

Tosiyasu Higo

Whole history of processing of T18_VG2.4_Disk #2

090610



T18_Disk_#2 after high gradient test tentative conclusion

- RF evaluated after high gradient test.
  - Input matching was kept.
  - Output matching changed by Γ=0.05 level.
  - Average frequency increased by 1.1MHz.
  - Field ripple±4.4% near output end.
- Some change in RF performance was observed.
  - Need to compare carefully with SLAC data.

Valery Dolgashev

High Power Tests of Single Cell Standing Wave Structures Tested

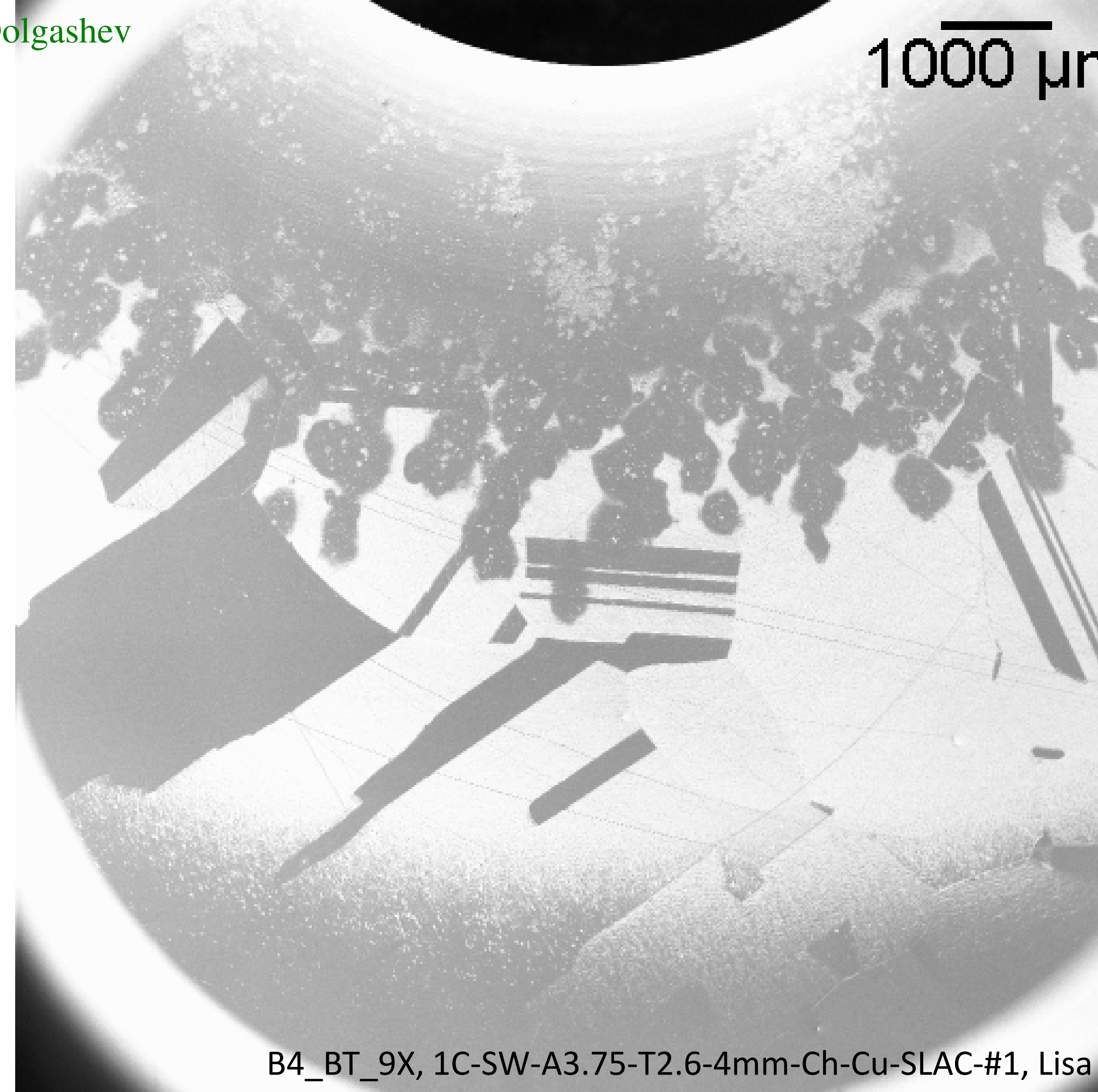
- Low shunt impedance, *a/lambda* = 0.215, *1C-SW-A5.65-T4.6-Cu*, 5 tested
- Low shunt impedance, TiN coated, *1C-SW-A5.65-T4.6-Cu-TiN*, 1 tested
- Three high gradient cells, low shunt impedance, *3C-SW-A5.65-T4.6-Cu,* 2 tested
- High shunt impedance, elliptical iris, *a/lambda* = 0.143, *1C-SW-A3.75-T2.6-Cu*, 1 tested
- High shunt impedance, round iris, *a/lambda* = 0.143, *1C-SW-A3.75-T1.66-Cu*, 1 tested
- Low shunt impedance, choke with 1mm gap, *1C-SW-A5.65-T4.6-Choke-Cu*, 2 tested
- Low shunt impedance, made of CuZr, *1C-SW-A5.65-T4.6-CuZr,* 1 tested
- Low shunt impedance, made of CuCr, *1C-SW-A5.65-T4.6-CuCr,* 1 tested
- Highest shunt impedance copper structure *1C-SW-A2.75-T2.0-Cu-SLAC-#1*, 1 tested
- Photonic-Band Gap, low shunt impedance, *1C-SW-A5.65-T4.6-PBG-Cu,* 1 tested
- Low shunt impedance, made of hard copper *1C-SW-A5.65-T4.6-Clamped-Cu-SLAC#1,* 1 tested
- Low shunt impedance, made of molybdenum *1C-SW-A5.65-T4.6-Mo-Frascati-#1,* 1 tested
- High shunt impedance, choke with 4mm gap, *1C-SW-A3.75-T2.6-4mm-Ch-Cu-SLAC-#1,* 1 tested
- High shunt impedance, elliptical iris, *a/lambda* = 0.143, *1C-SW-A3.75-T2.6-6NCu-KEK-#1*, 1 tested
- Low shunt impedance, made of CuAg, *1C-SW-A5.65-T4.6-CuAg-SLAC-#1,* 1 tested
- High shunt impedance hard CuAg structure *1C-SW-A3.75-T2.6-LowTempBrazed-CuAg-KEK-#1,* 1 tested
- High shunt impedance soft CuAg, *1C-SW-A3.75-T2.6-CuAg-SLAC-#1*, 1 tested

Now 24^{th} test is under way,

Low shunt impedance copper structure joined by electroforming

1C-SW-A5.6-T4.6-Electroformed-Cu-Frascati-#1

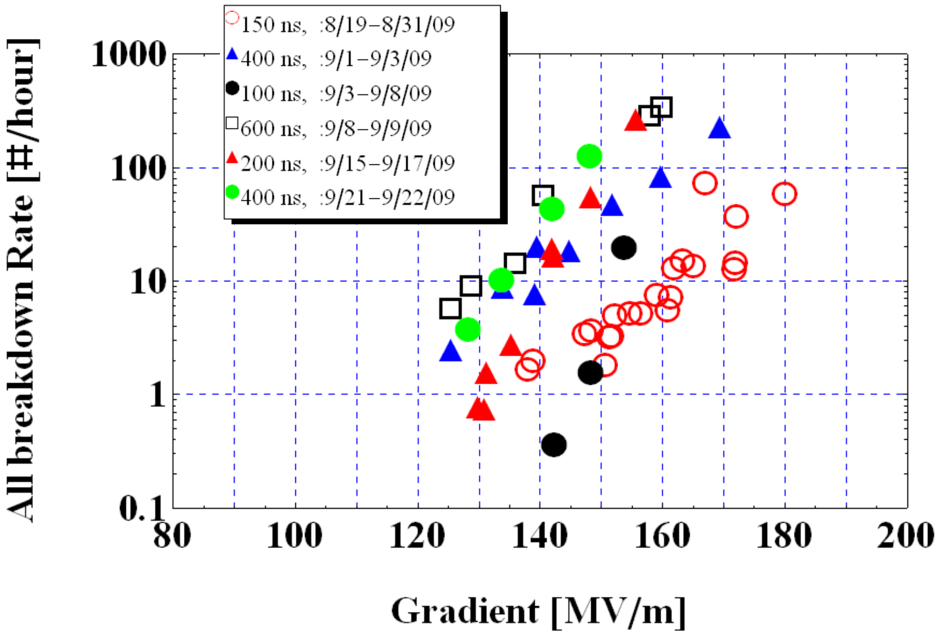
Valery Dolgashev

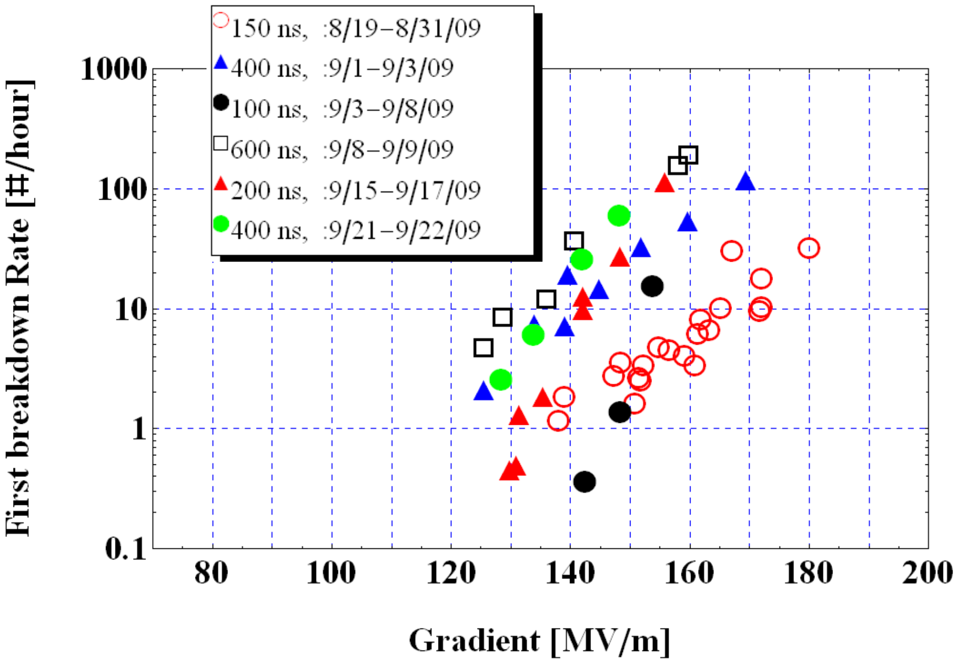


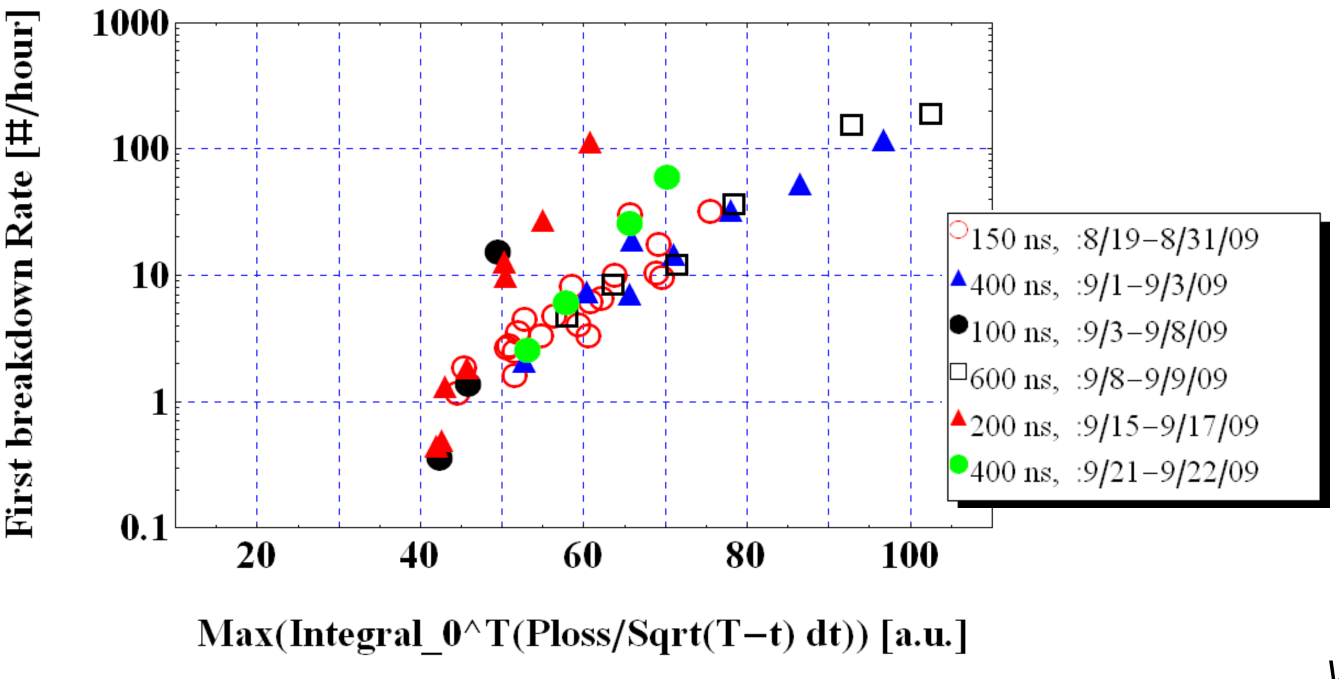
B4_BT_9X, 1C-SW-A3.75-T2.6-4mm-Ch-Cu-SLAC-#1, Lisa Laurent

Valery Dolgashev

One-C-SW-A3.75-T2.6-CuAg-SLAC-#1



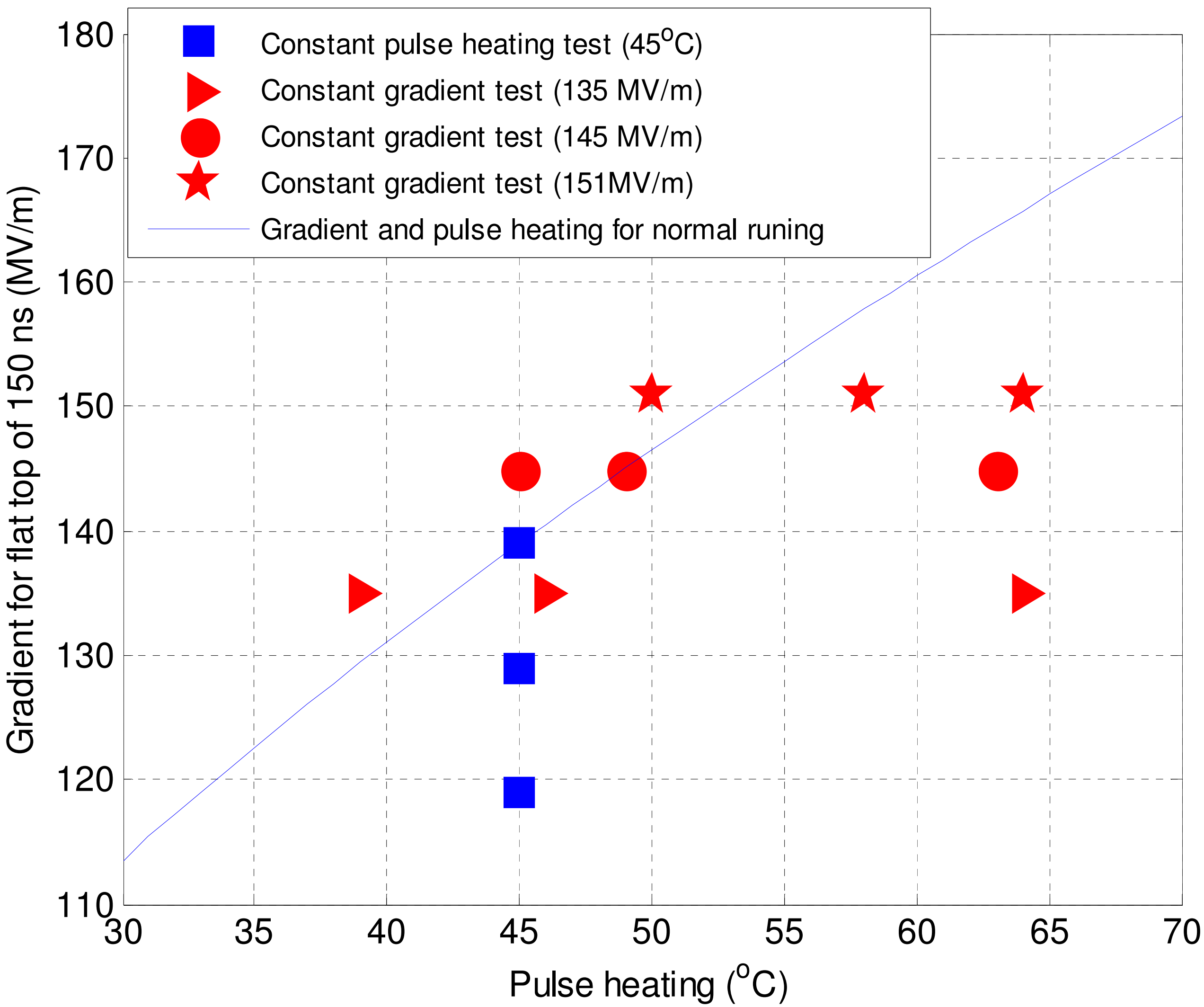




V.A. Dolgashev, 5 October, 2009

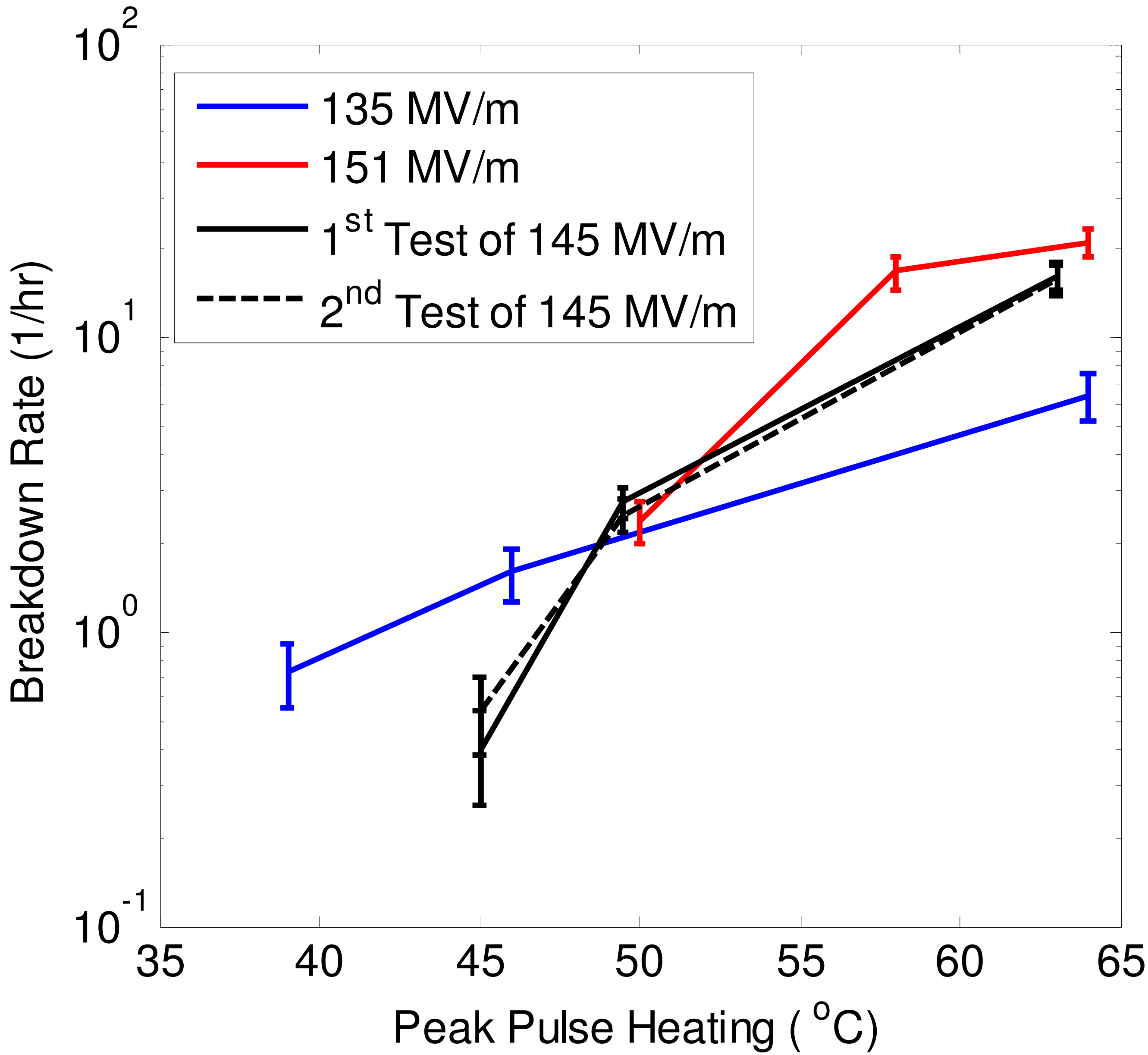
Chris Adolphsen

Measurement Points: Vary Either Pulse Heating or Gradient



Chris Adolphsen

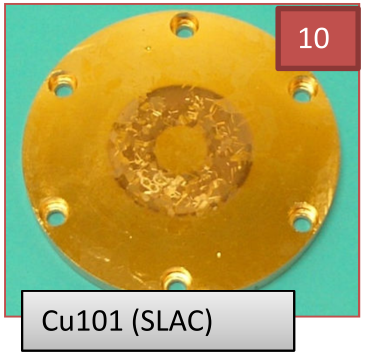
Breakdown Rate for Fixed Gradient

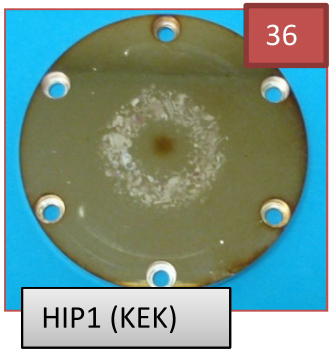


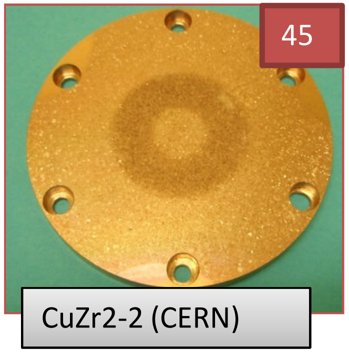
Lisa Laurent

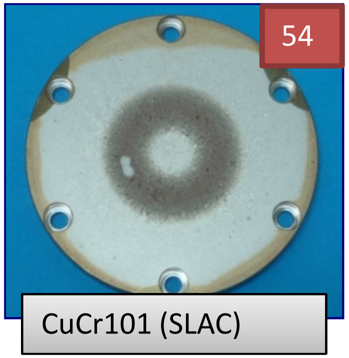
Hardness Test Value

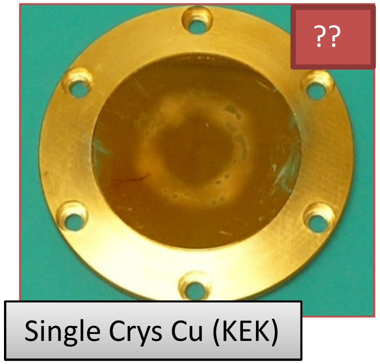
Pulse Heating Samples (CLIC09)

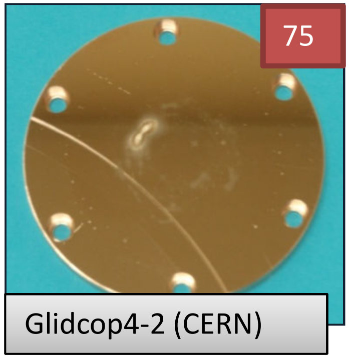


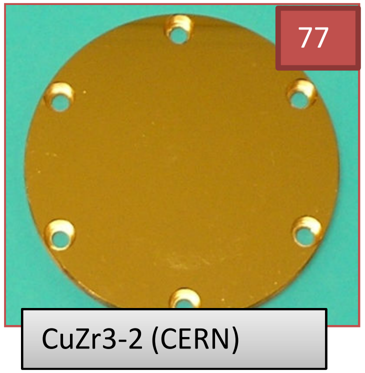


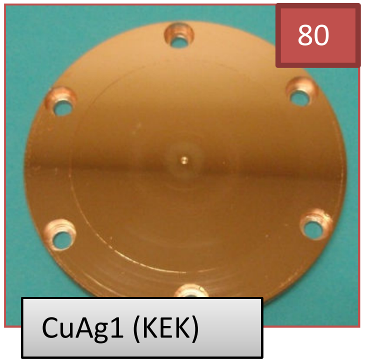


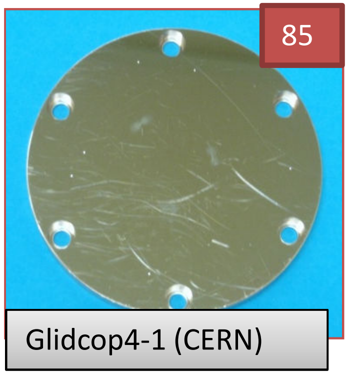






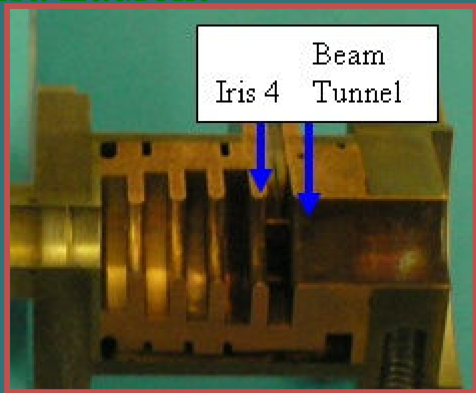




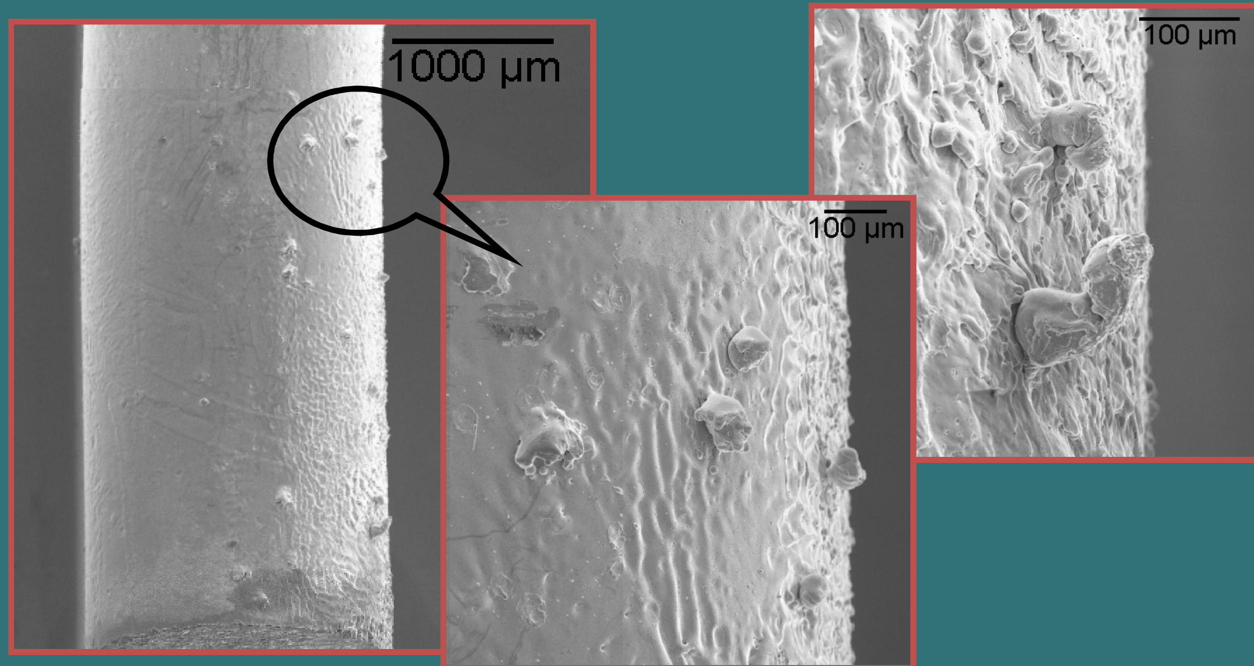


Lisa Laurent

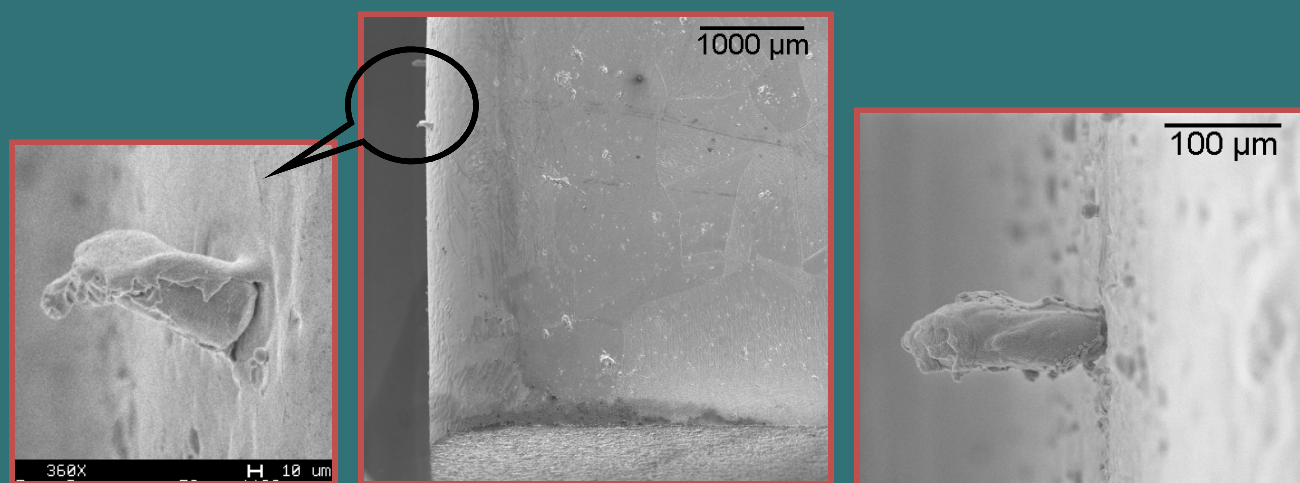
75 MW PPM Klystron: XP1



Iris 4



Beam Tunnel



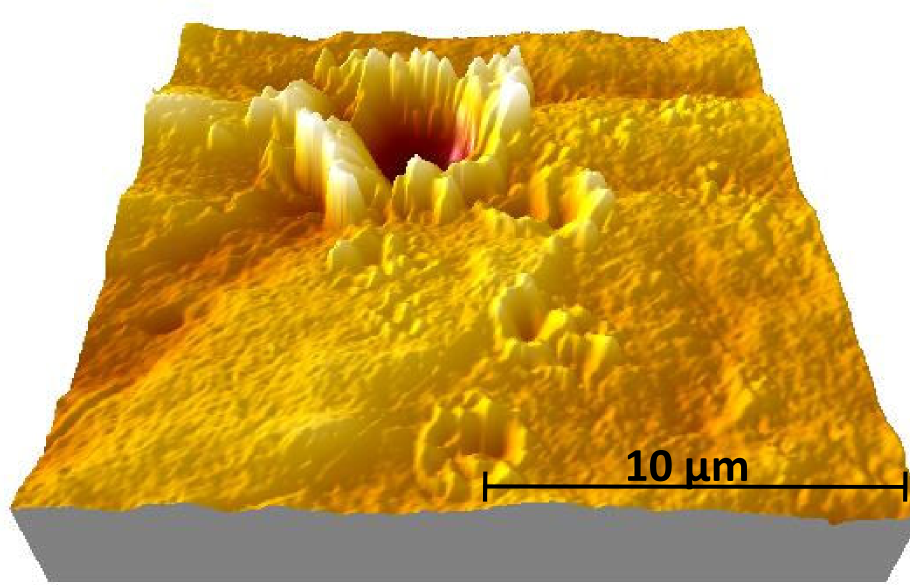
Themes

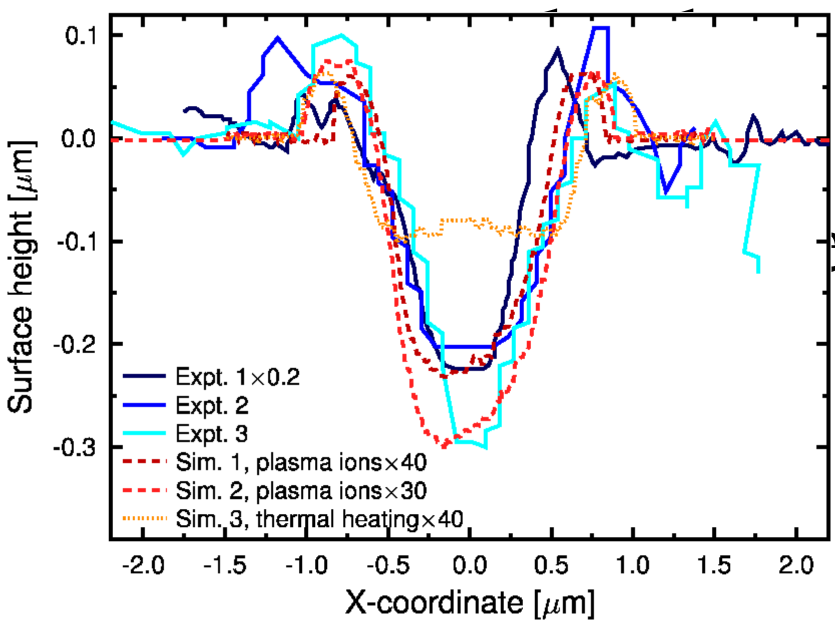
- Theory and Design
- Production and Development
- Test Stands and Results
- **Modeling and Simulations**
- Vacuum Specifications

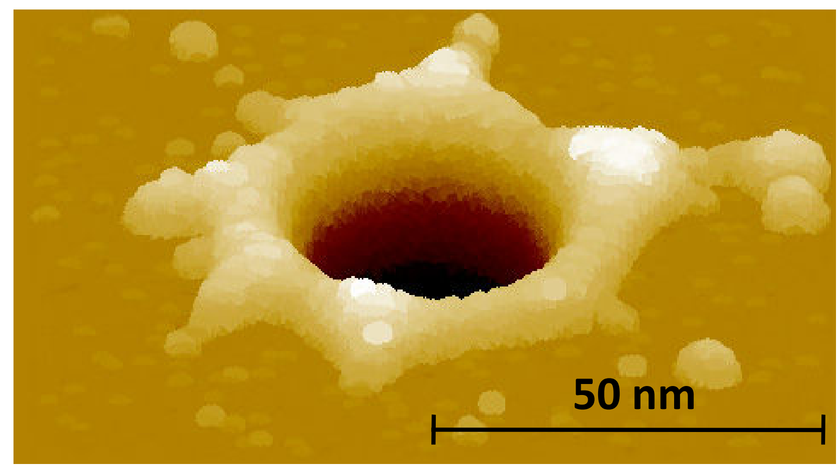
Comparison to experiment

- Self-similarity:

Crater depth to width ratio remains constant over

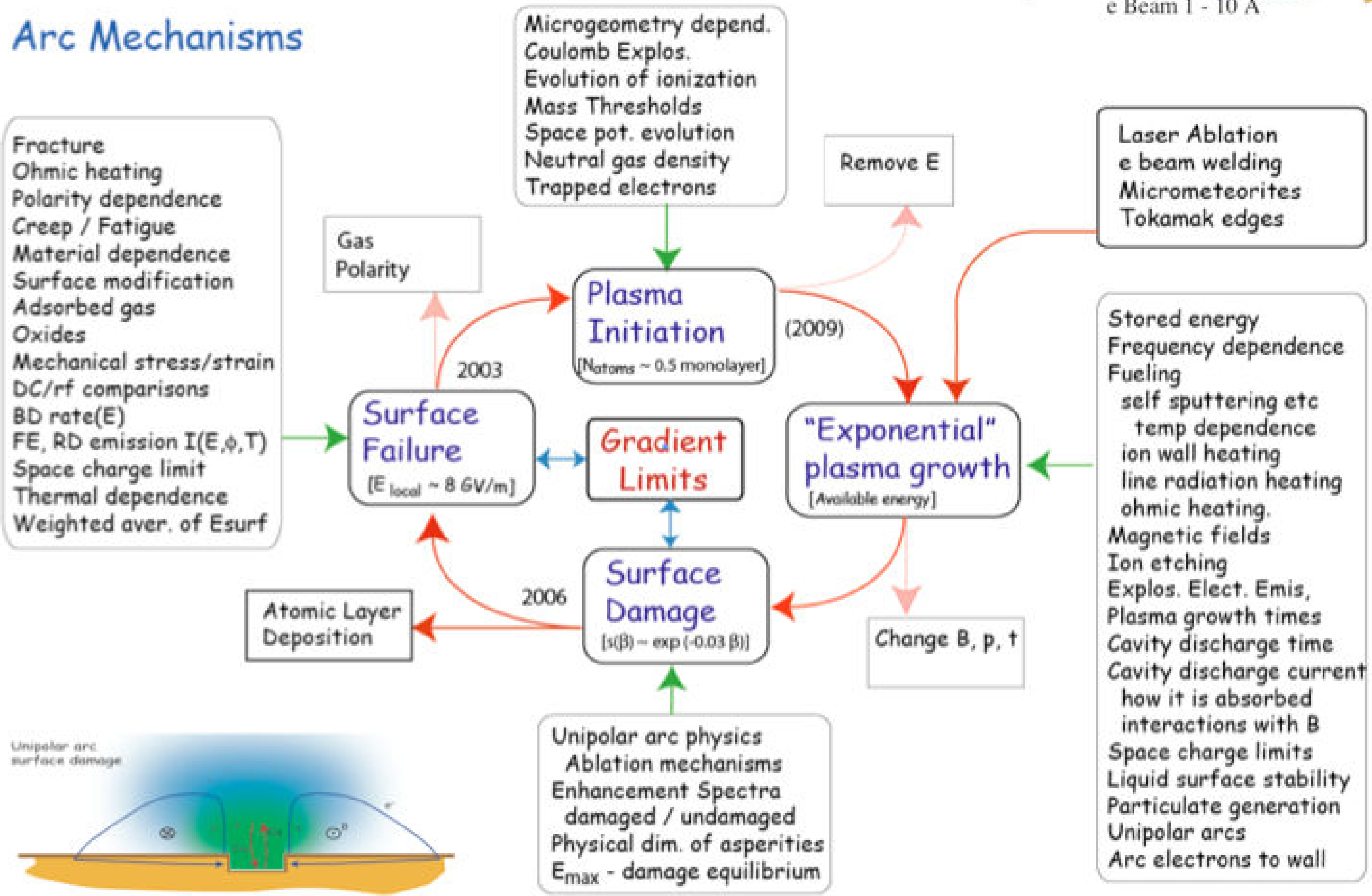






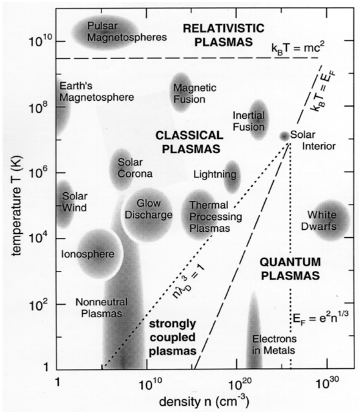
Jim Norem

More details (mere details).



Jan Kovermann

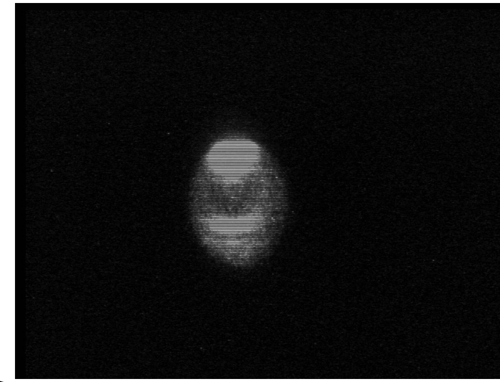
The quantitative ... igh gradients



Plasma parameters → **simulation input**

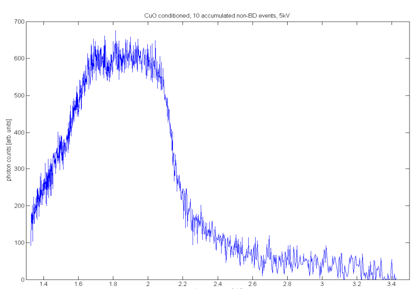
Spectroscopy

- Breakdown source identification

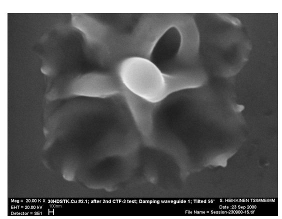


Plasma size/position → **simulation and design input**

BREAKDOWN DIAGNOSTICS



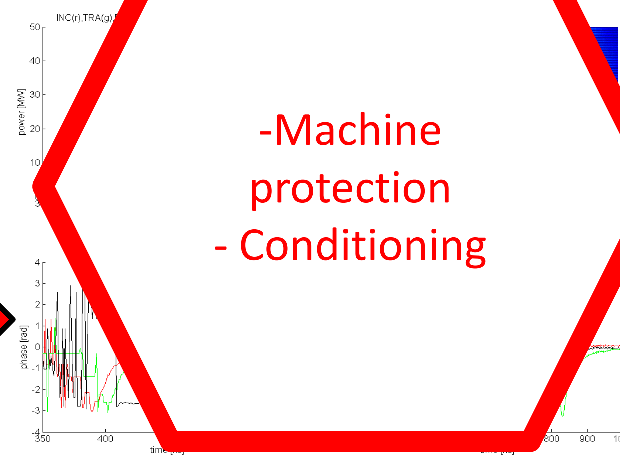
OTR in nominal pulses → **simulation and machine parameter input**



SEM → **simulation and design input**

Missing energy ?

RF measurements, FC, XRAY →



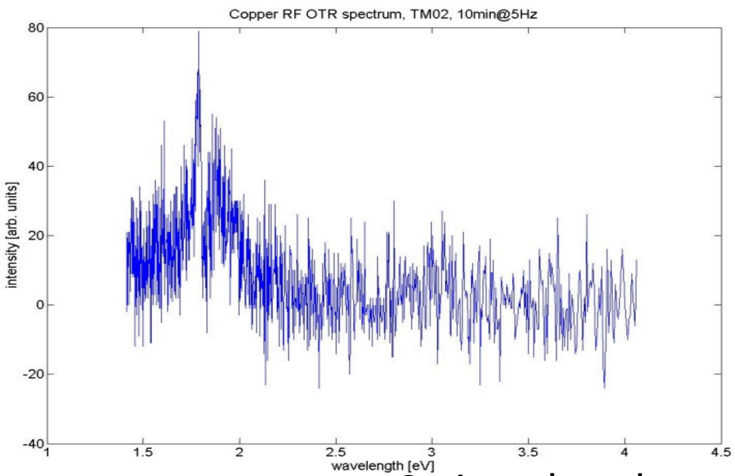
-Machine protection
- Conditioning

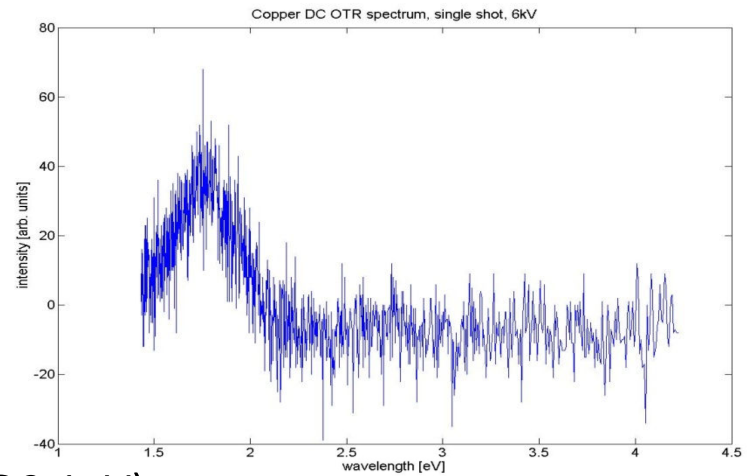
Jan Kovermann

RF and DC diagnostics: some results

RF | DC

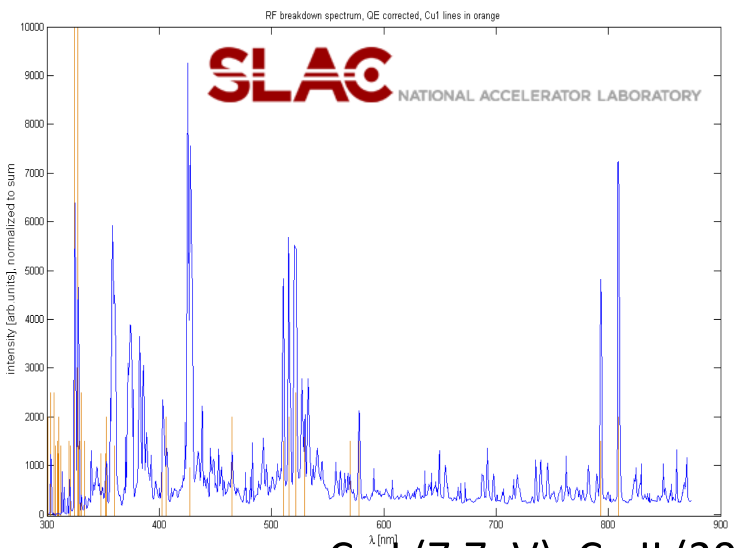
OTR (Cu), ***no BD***

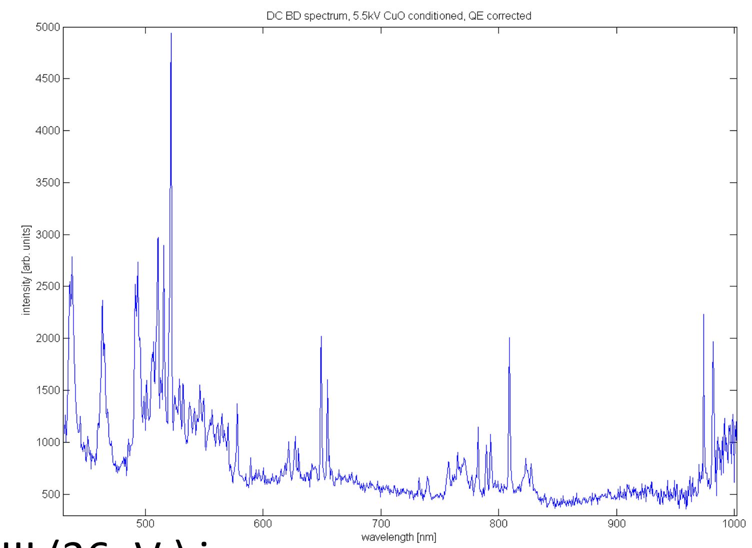




Cu interband transition (@2.1eV) spectrum

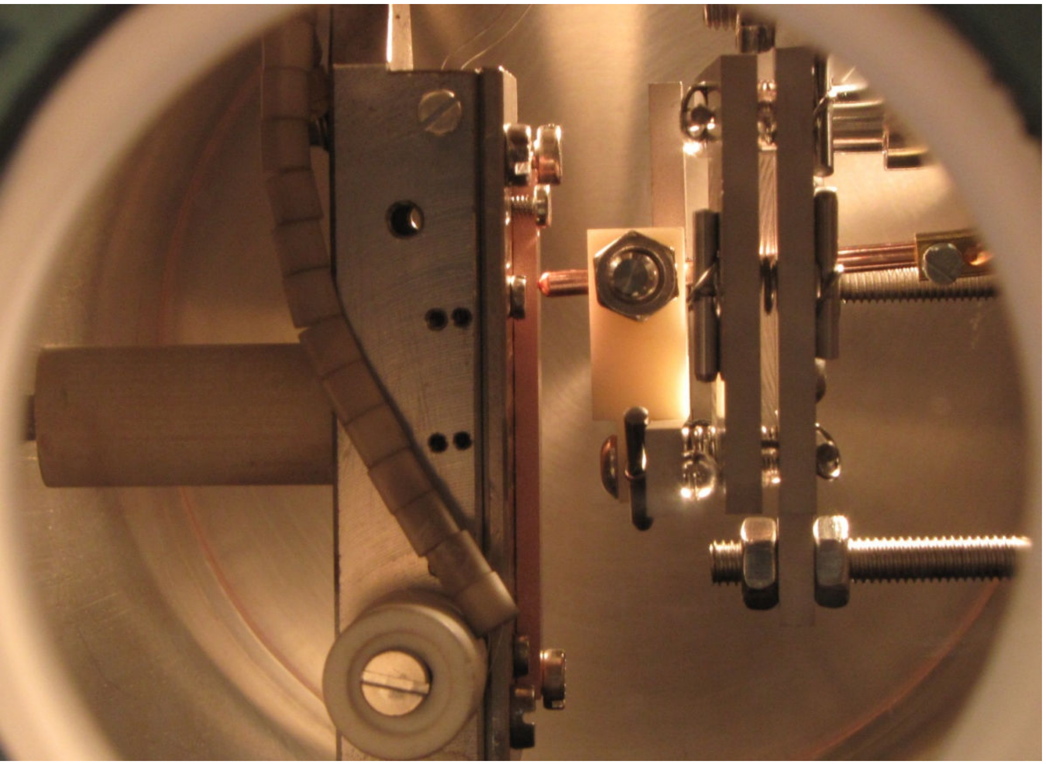
Opt. ***BD*** spectroscopy





Cu I (7.7eV), Cu II (20eV), Cu III (36eV) ions

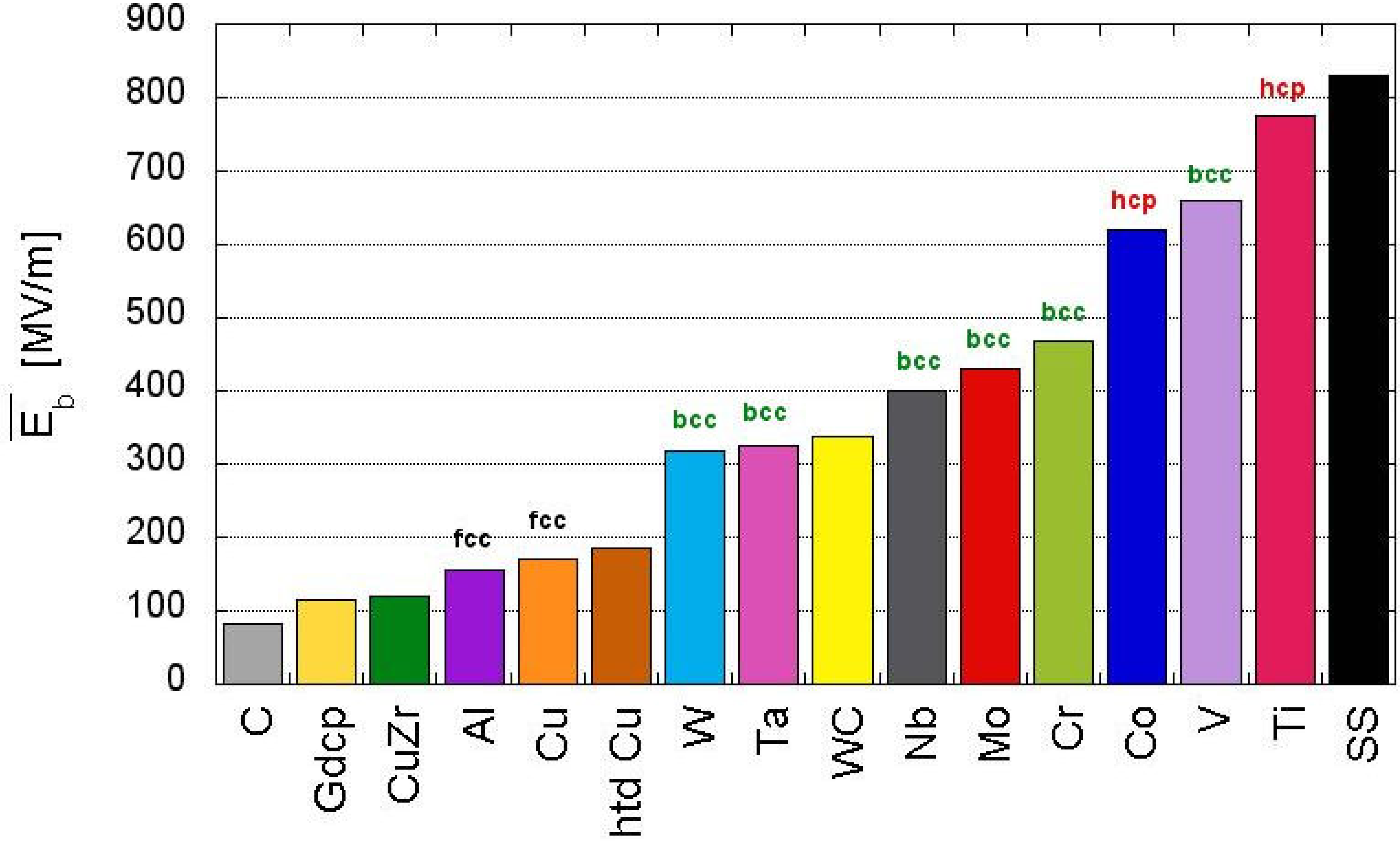
Exploring DC sparks



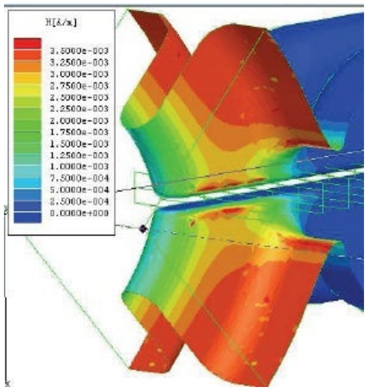
Why DC sparks?

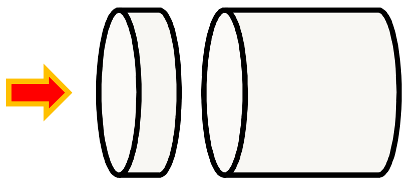
- Allows to study breakdowns on a *fundamental* level
- *Simple and fast* testing of materials, surface treatments etc.

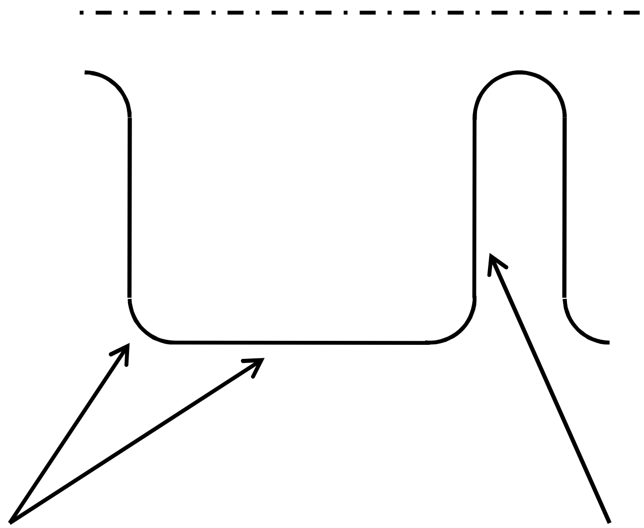
Ranking materials by crystal structure?

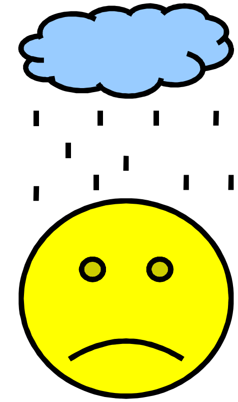


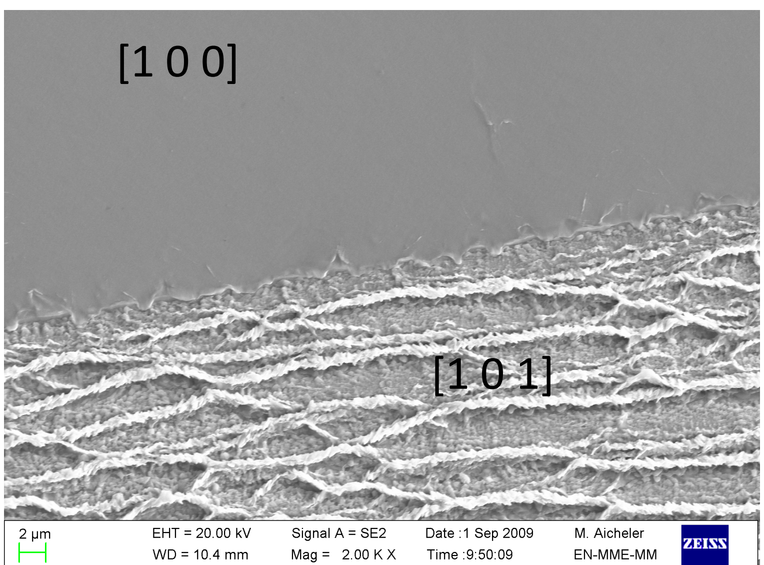
Real structure?

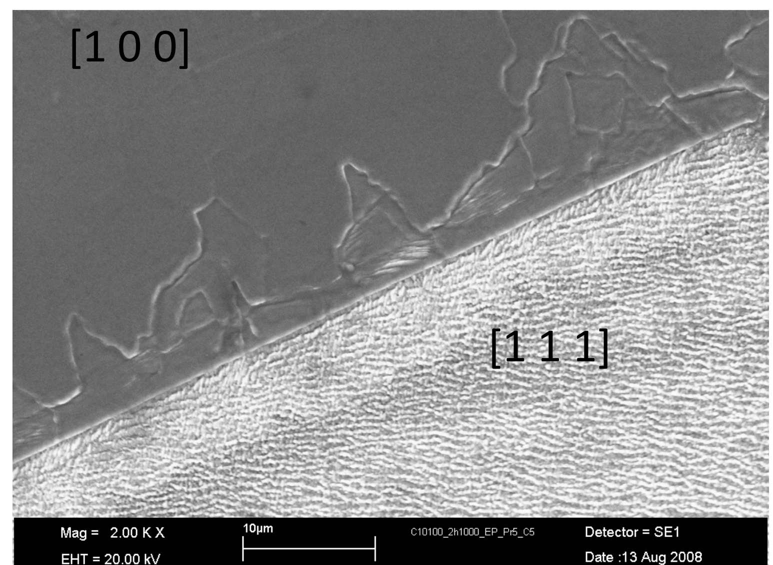












Themes

- Theory and Design
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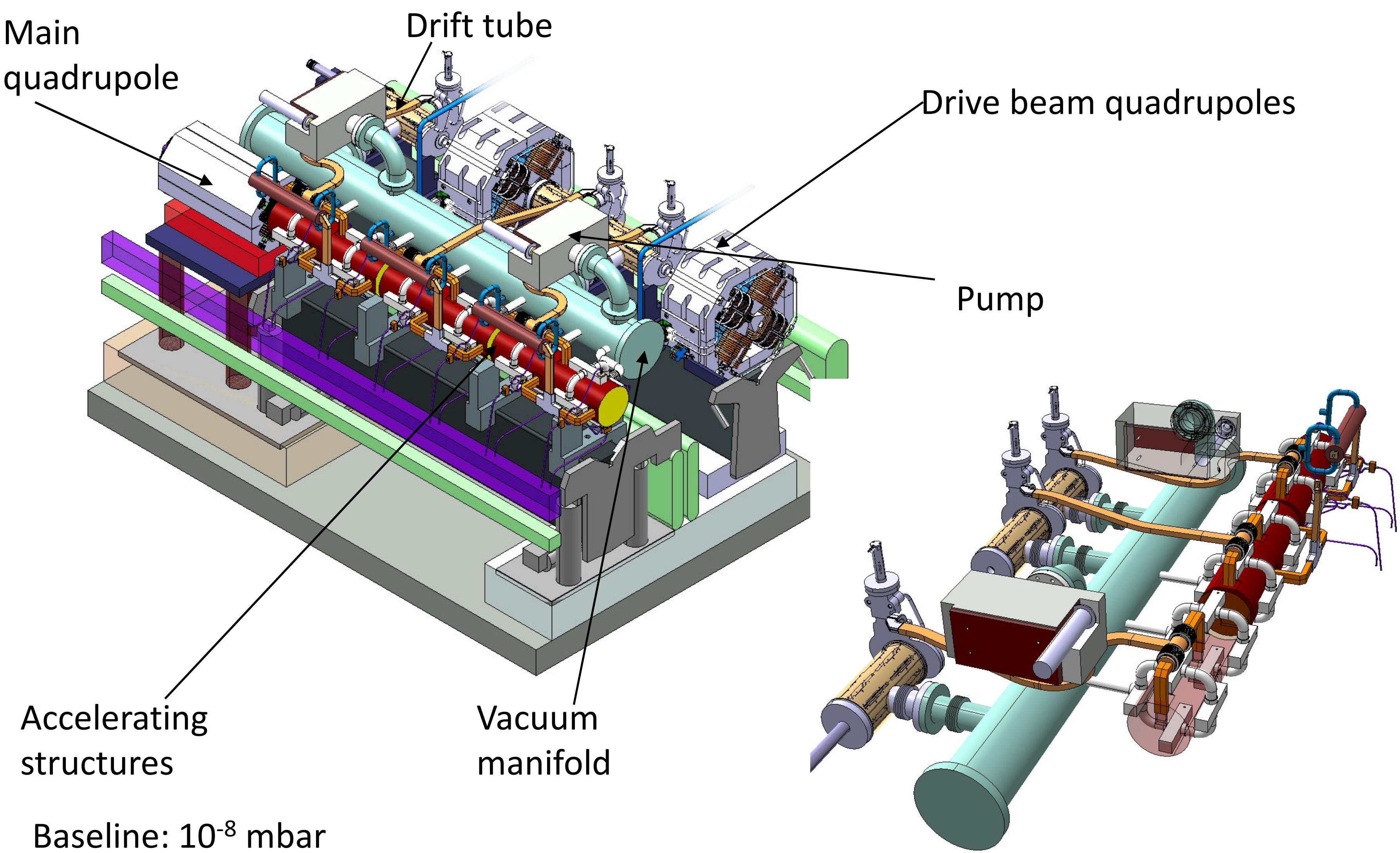
- Modeling and Simulations
- **Vacuum Specifications**

Summary

- The fast ion instability was studied for the CLIC Main Linac using the **FASTION** code (previously developed for the transfer line)
- Including only scattering ionization in the model, the required pressure in the Main Linac is **10 nTorr**
- Extending the model to include field ionization did not change dramatically this picture, as long as full ionization from a peak electric field of 10 GV/m is applied only to the volume swept by the beam
- However, a **more accurate calculation** shows that:
  - Critical electric fields for which the field ionization probability becomes 0.1 (i.e. it takes ten bunches to ionize the full volume) are around 20 GV/m
  - The ionized area is much larger than the beam cross section
  - Field ionization affects a large fraction of the Linac
  - The new model needs to be implemented into FASTION following a simplified conservative recipe. **As a result, the vacuum tolerance could then become much lower than presently specified !!**
- For the study of the fast ion instability in the drive beam decelerator, **implementation of a FASTION module into PLACET** is necessary

Cedric Garion

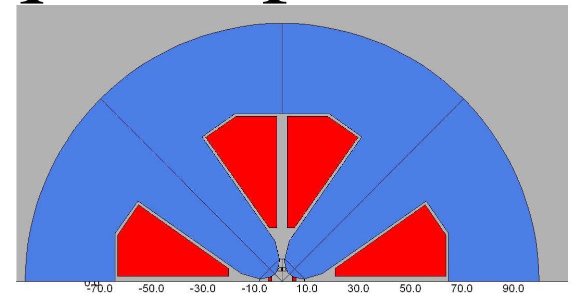
Vacuum system in the CLIC module



Baseline: 10^{-8} mbar

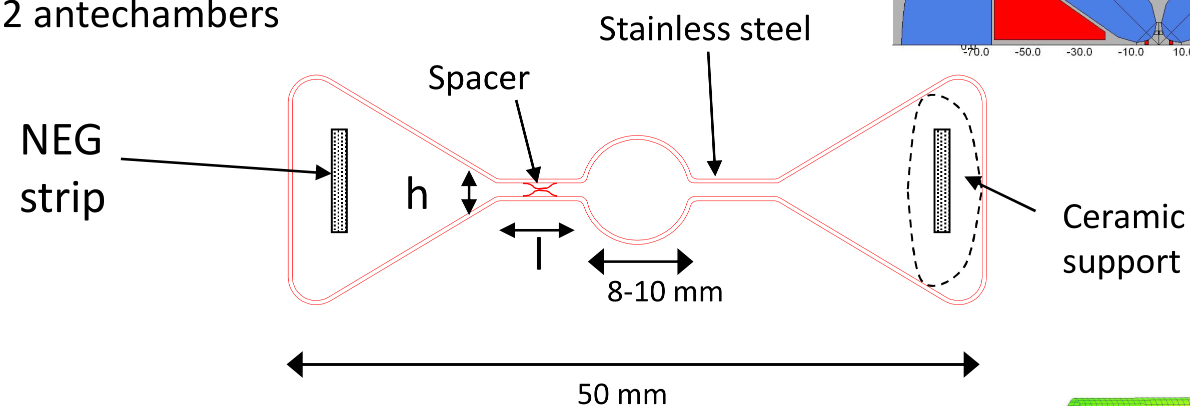
Cedric Garion

Vacuum chambers for the MB quadrupoles



Present design:

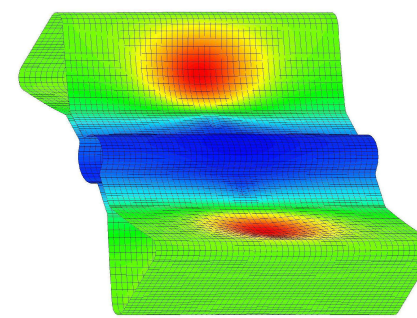
- Stainless steel vacuum chamber, squeezed in the magnet
- NEG strips sited in 2 antechambers
- Copper coated



Effective pumping speed per unit length: $S_{eff} \propto h^2/l$

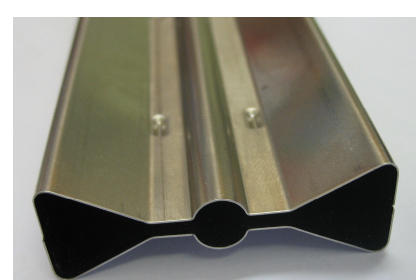
Pressure in the central part is determined by the gap → reduce the sheet thickness → stability becomes an issue (0.3 mm for the prototype)

$q = 10^{-10}$ mbar.l/s.cm^2 → P ~ 4.10^{-9} mbar



Buckling mode

Prototype has been manufactured and is being tested.

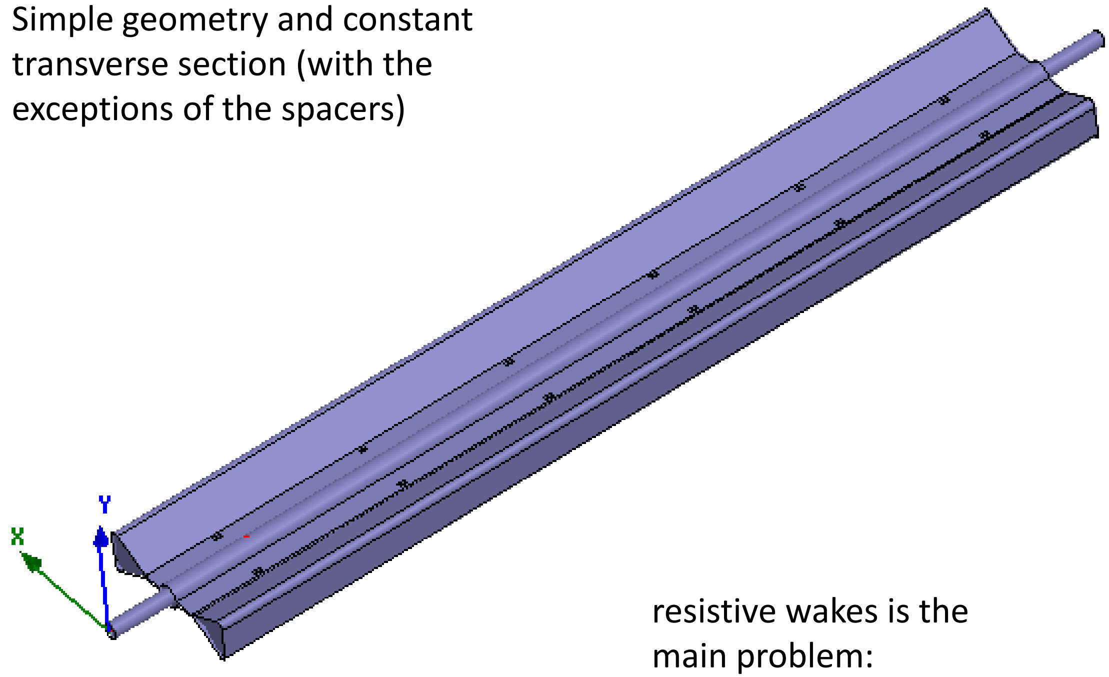


Riccardo Zennaro

Problem: resonator in a beam line; (standing waves excited)

Simple geometry and constant transverse section (with the exceptions of the spacers)

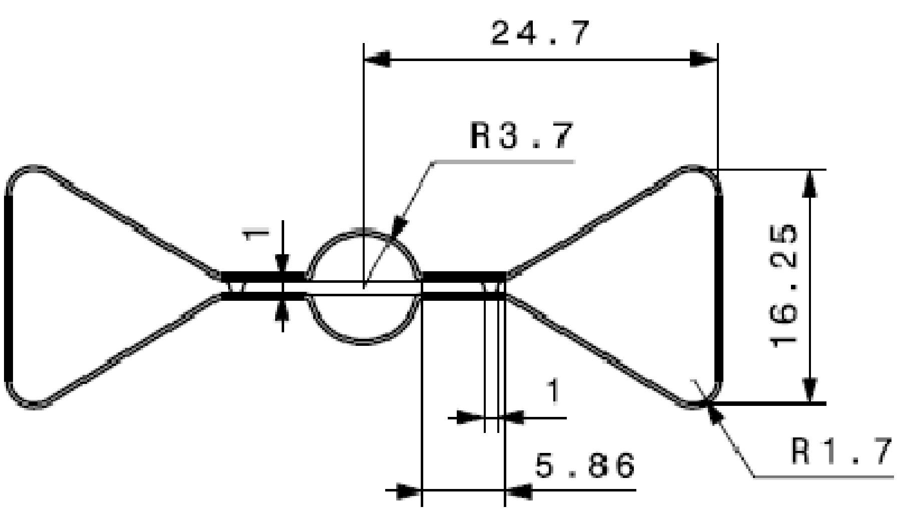
2D problem (HFSS) + longitudinal dependence



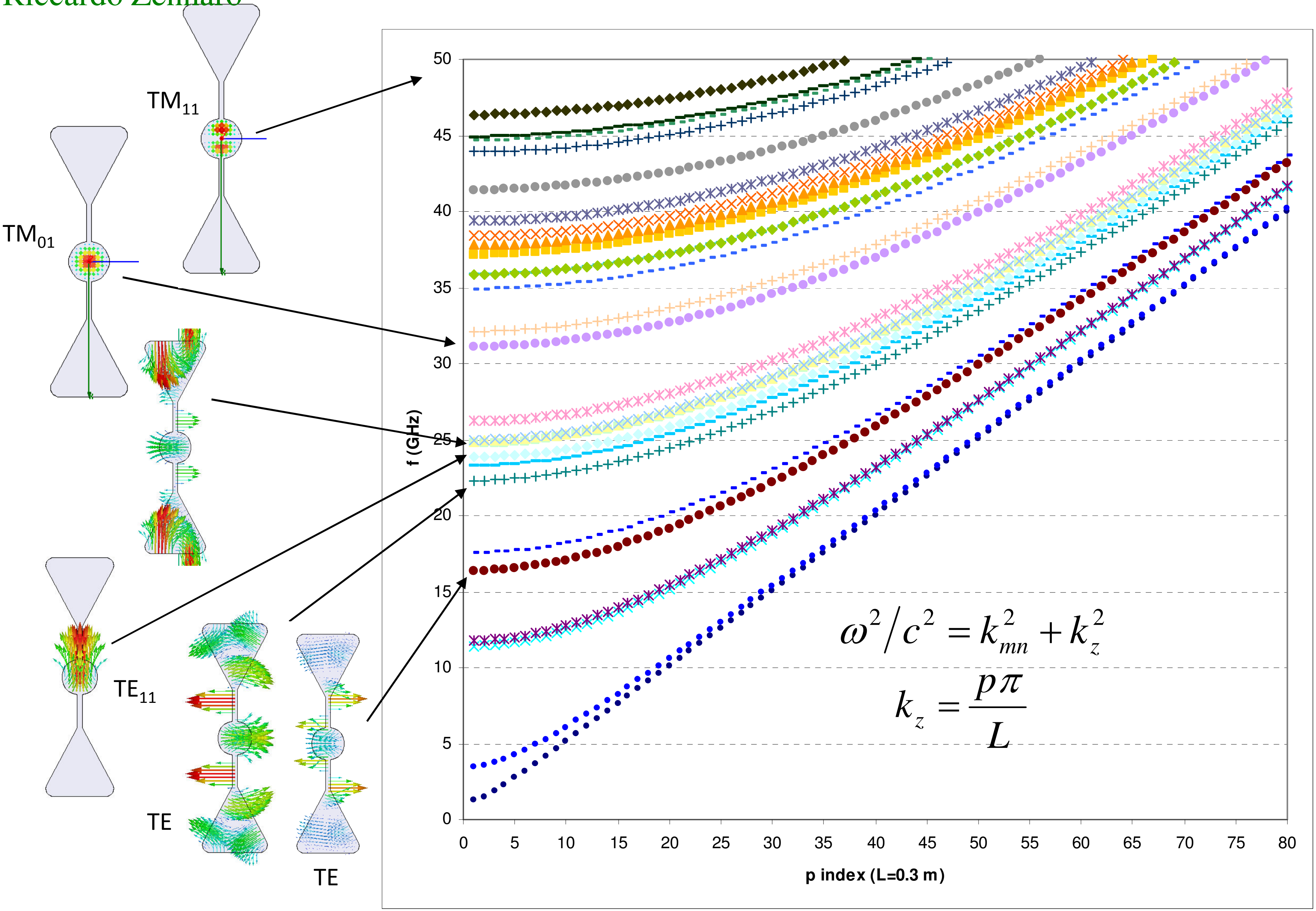
resistive wakes is the main problem:

$$W(s) = -\frac{c}{4\pi^{3/2} a}\sqrt{\frac{Z_0}{\sigma}}\frac{1}{s^{3/2}}$$

Copper layer



Riccardo Zennaro



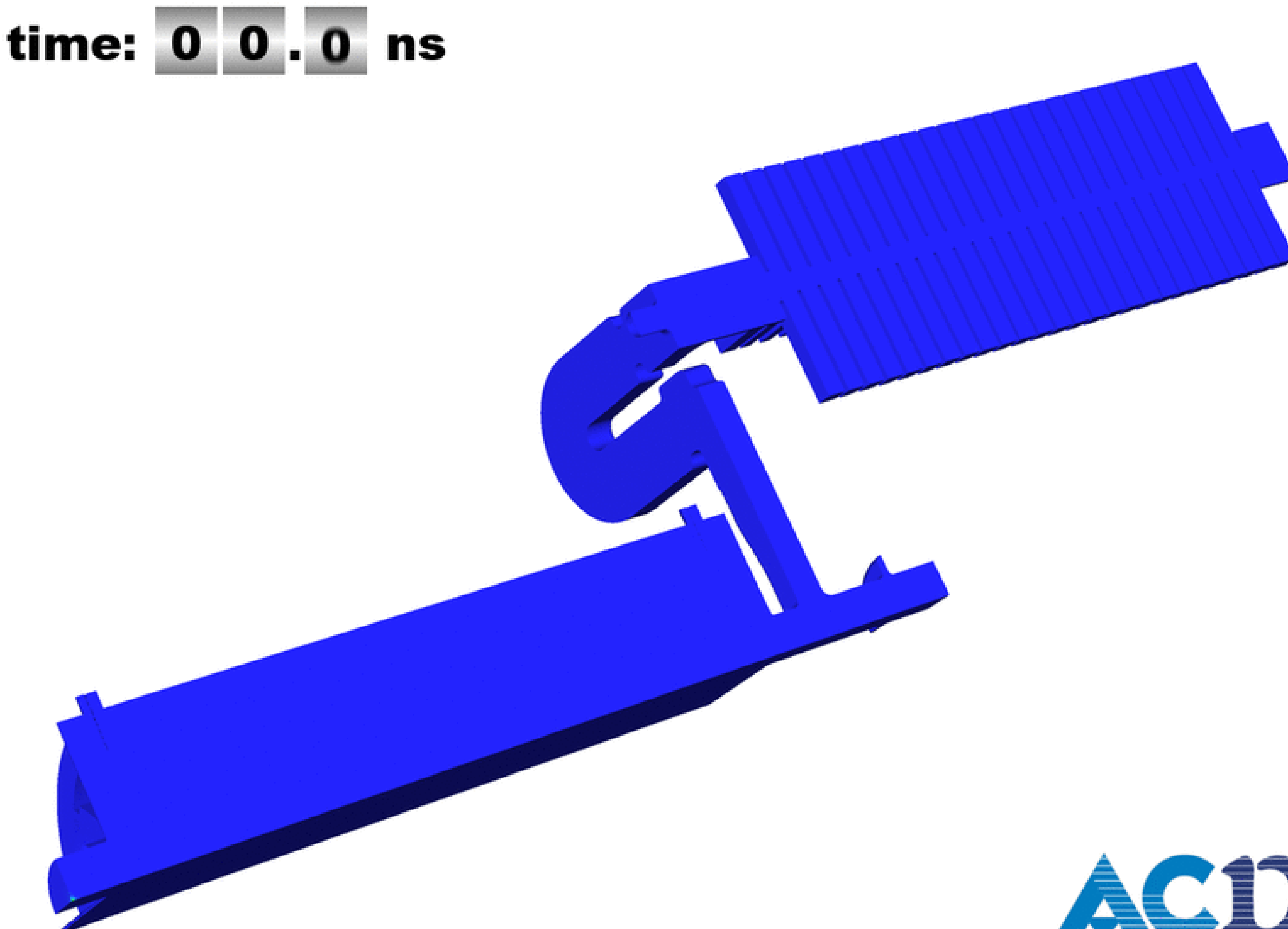
$$\omega^2/c^2 = k_{mn}^2 + k_z^2$$

$$k_z = \frac{p\pi}{L}$$

Outlook

- Working towards a real baseline; setting and meeting rf structure and source specifications
- Theory, design, and testing, with advanced concepts providing alternatives to baseline
- X-band Structure Meeting to be scheduled…

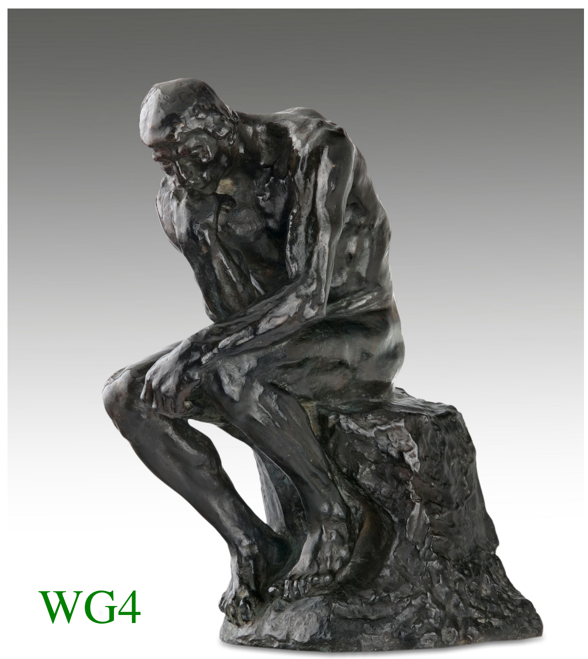
is driven by Novel RF Structures and Sources



ACD ADVANCED COMPUTATIONS

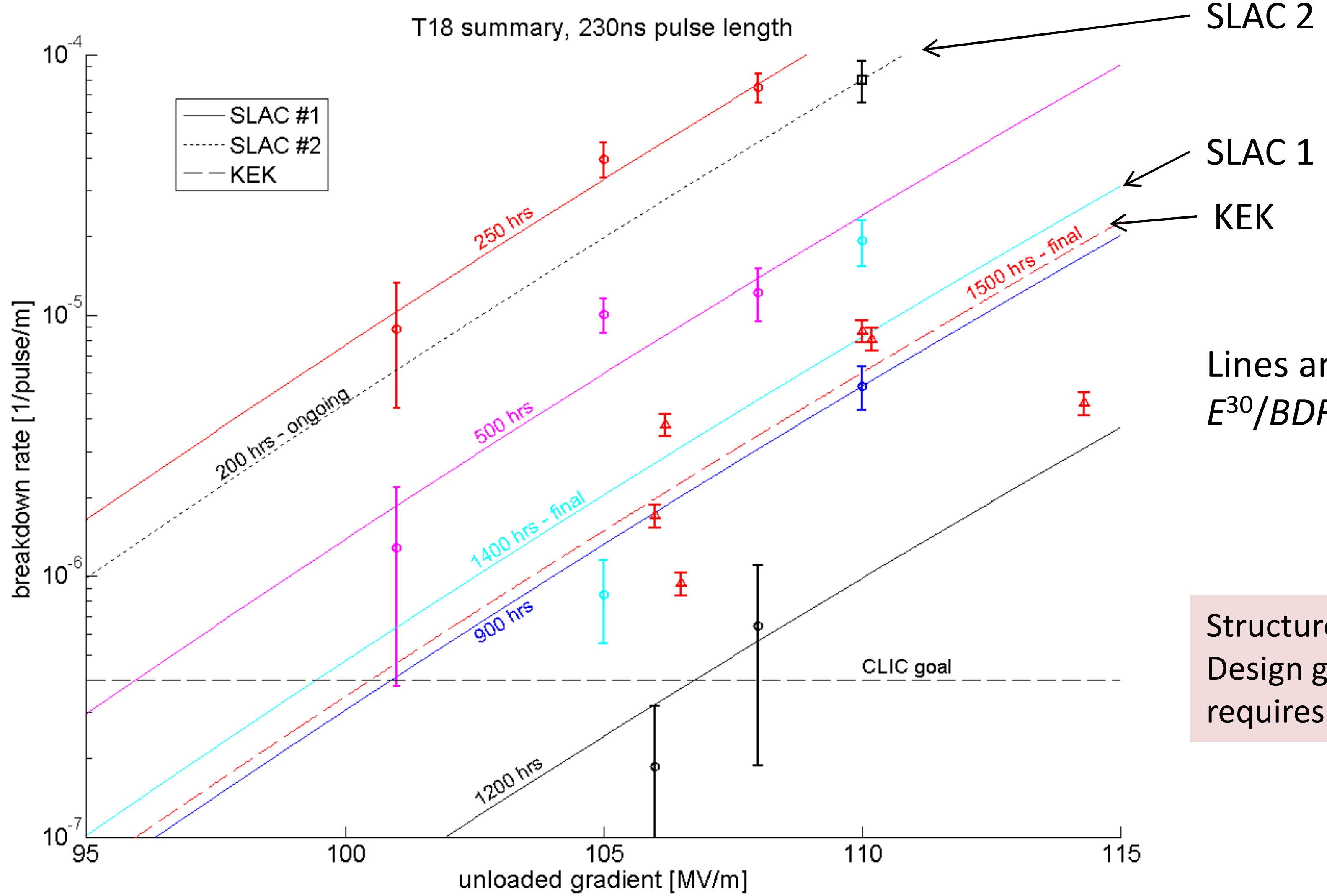
Thank You

- And good luck to everyone for the next year!



Walter Wuensch

CERN/KEK/SLAC T18 structure tests



Lines are $E^{30}/BDR=const$

Structure meets CLIC Design goal, but requires Damping!