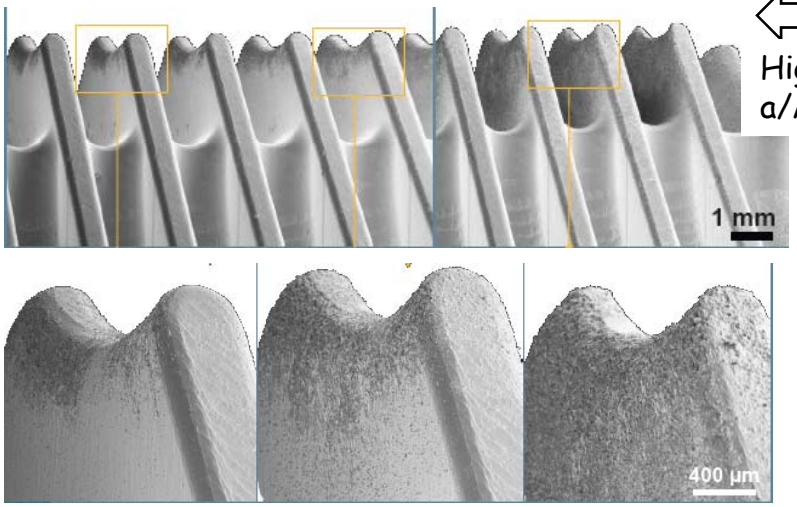
Feeding Power into Structures - Innovation

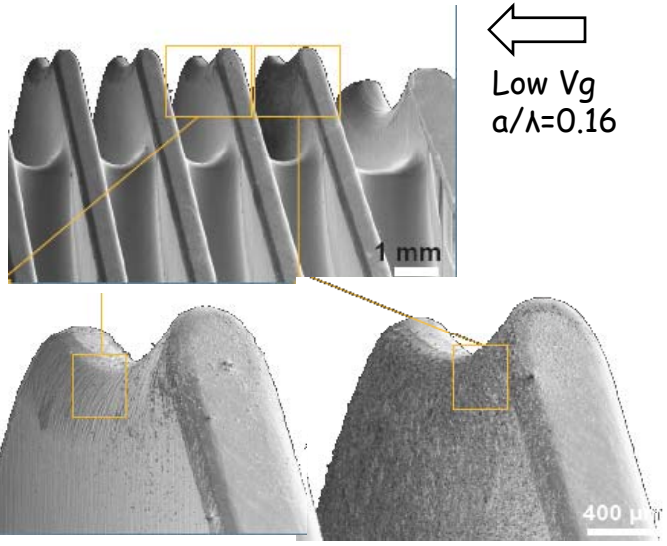
Igor SYRATCHEV (*CERN*)

The first cell puzzle…

HDS 60 (cells) copper was processed from both sides



High Vg
a/λ=0.19



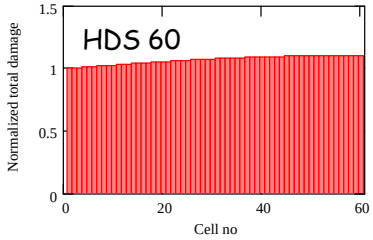
Low Vg
a/λ=0.16

G. Arnau Izquierdo TS/MME

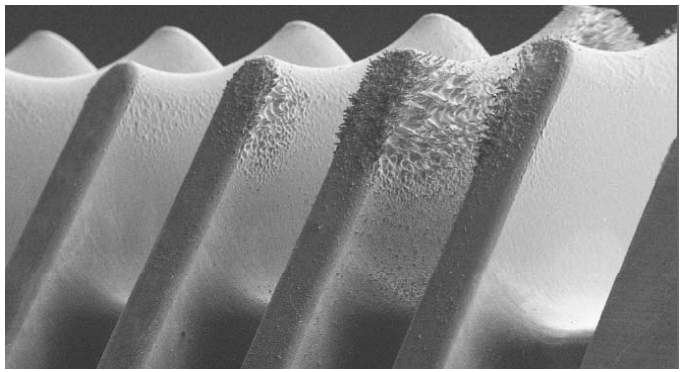
Very often we do observe, that after accelerating structure processing the most of the surface modifications take place in a few first cells. Also the number of cells involved is correlated with the group velocity, the less the Vg the fewer cells modified.

As one of the conventional explanation one could expect the statistical distribution of the events in a chain model. However with adopted processing strategy (trip rate ~10^{-3}) the event probability and normalized to that damage distribution is calculated to be very flat.

R. Corsini – 14 Nov 2006



HDS 11 titanium



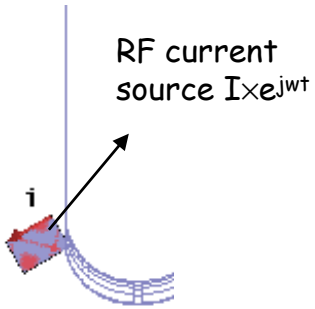
- The breakdown initiation
- The RF pulse dependence
- The damage mechanism
- and …

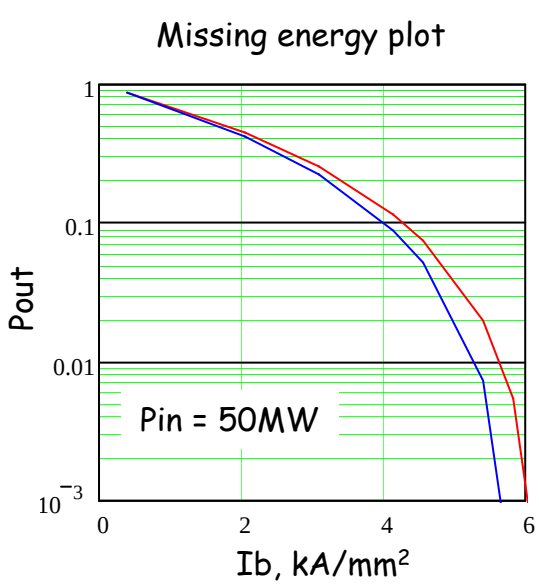
will not be addressed

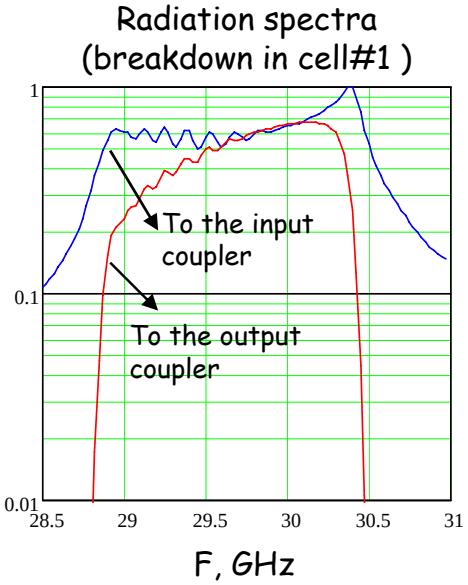
What do we certainly know, the breakdown ignition is a very fast process: 0.1 -10 ns. If so, one can propose the main difference between the "first" and "second" cell is accessible bandwidth.
And the lower group velocity the more the difference.
The first cell, if breakdown occurs is loaded by the input coupler/waveguide and is very specific in terms of bandwidth.
Other words, the first cell can accept "more" energy during breakdown initiation then consequent ones.
Worse to mention that we do not know the exact transient behavior of the breakdown and the structure bandwidth could play important role.

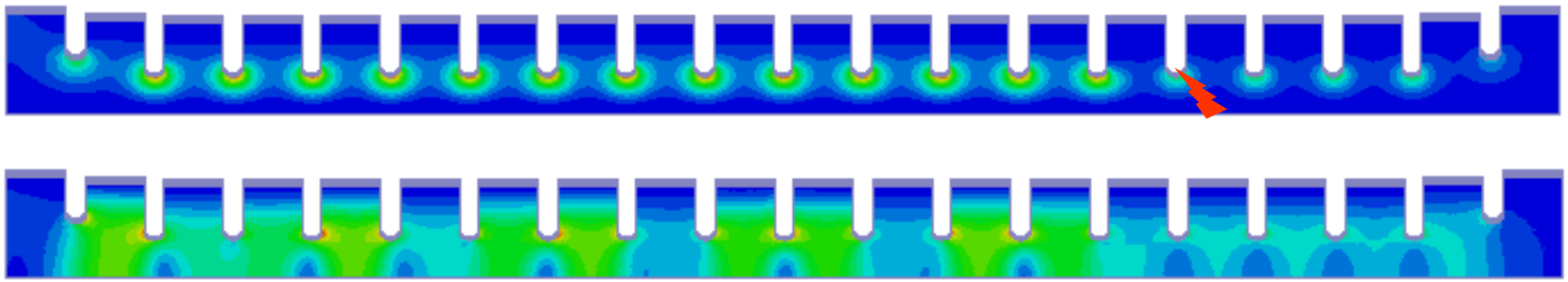
Breakdown 'naive' modeling in HFSS

Structure: 2pi/3 aperture 3.5 mm (Vg=4.5%)

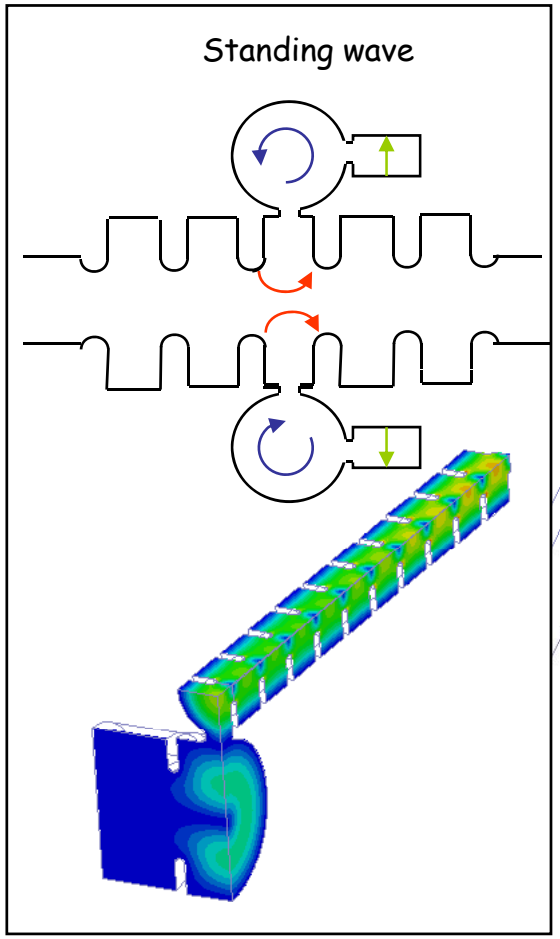


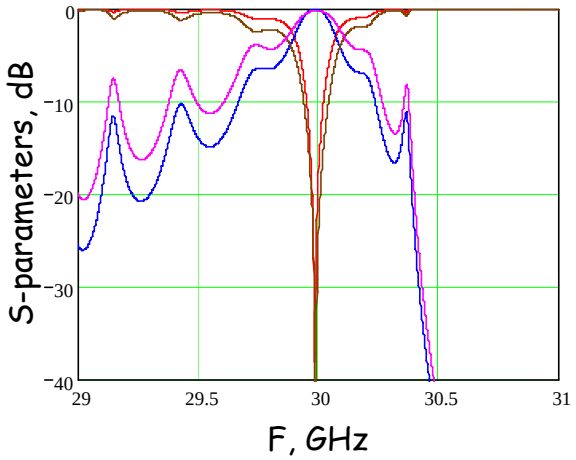


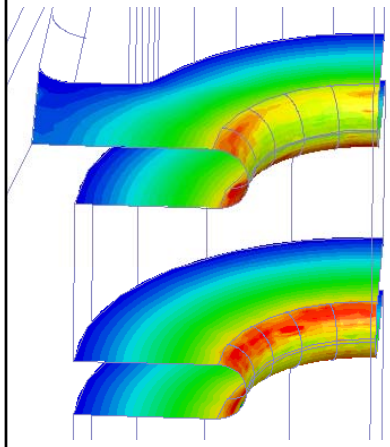




Configuration #1 (breakdown resonant fuse) :
Resonant cavity with reduced electric surface field (HO1) is located between structure and waveguide.



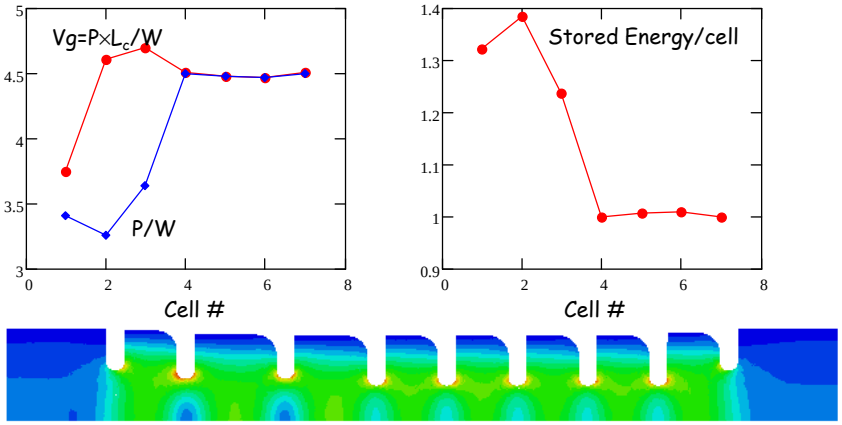




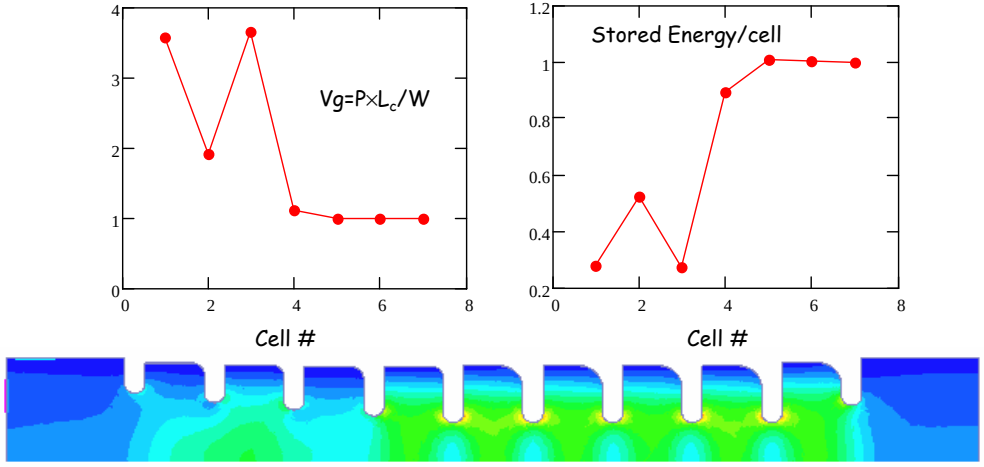
Traveling wave

Configurations #...

Inline taper with increased stored energy

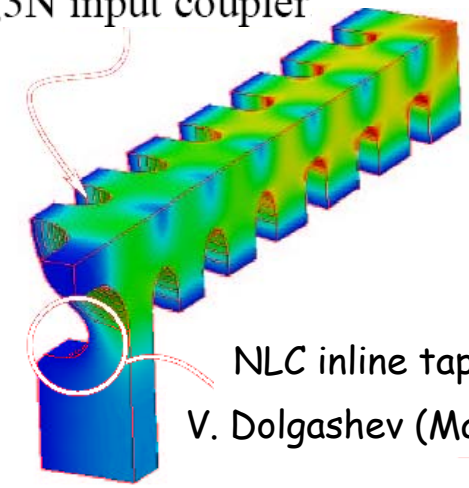


Inline taper with a "speed" bump



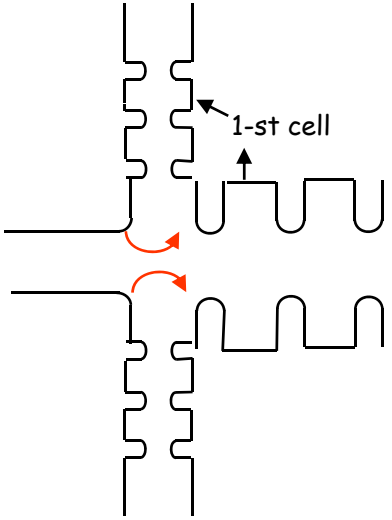
R. Zennaro (June 2007)

H60vg3N input coupler



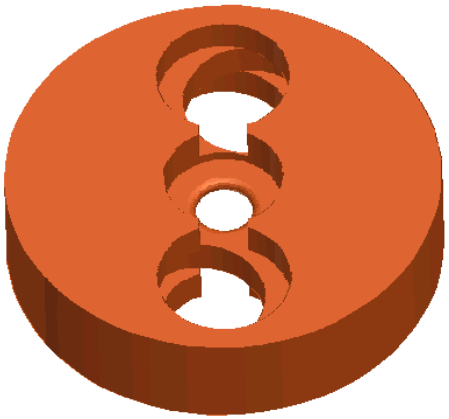
NLC inline taper

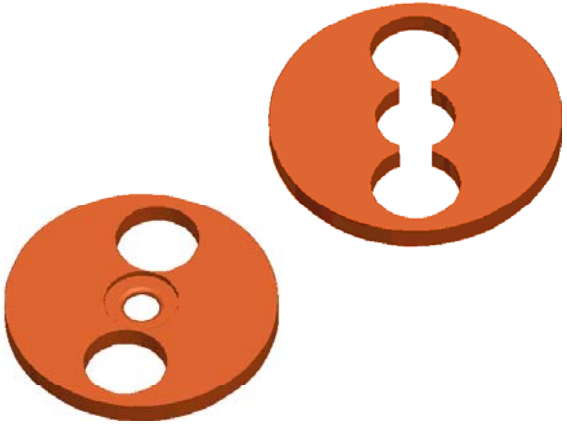
V. Dolgashev (May 2002)



The X-Band Accelerating Structure Design and Test-Program Workshop June 2007, CERN

TWO FREQUENCY STRUCTURE

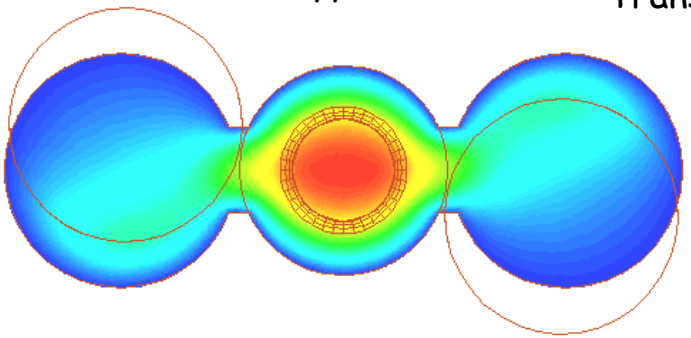


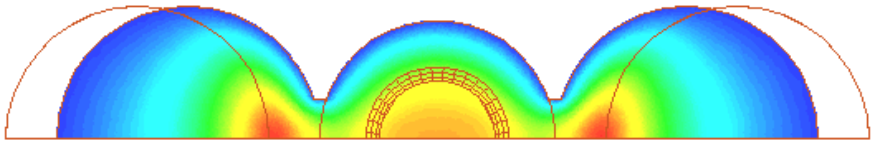


Type 1

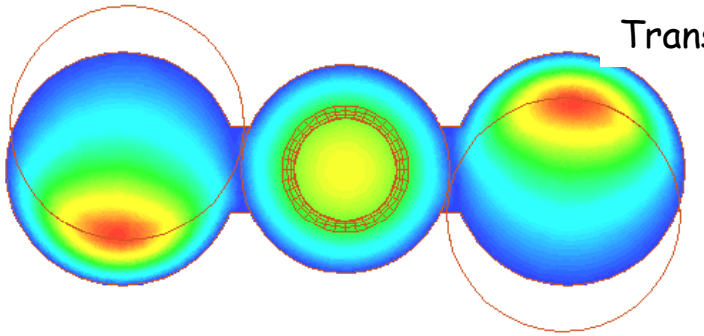
Transversely "0"

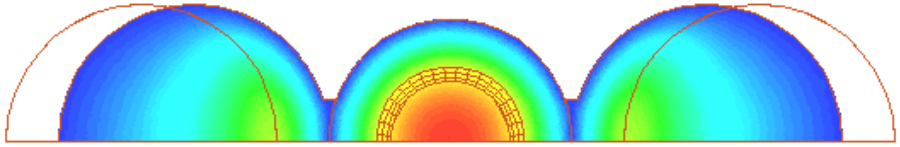
Type 2





Transversely "pi"





Transverse Ez (t) distributions