# Excitation of TM010 Pass-band Modes in CW Cold Test of 1.3GHz Cavities at DESY European



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The CW test of the 9 cell TESLA-type cavity in liquid helium bath at 2 K gives the cavity performance data for the cavity acceptance. The excitation of parasitic modes of the operating pass band is an error source for the cavity gradient and guality factor determination. The relation of this effect to the field emission as well as to other test parameters has been investigated.

#### Errors in Qo and Eacc from parasitic 7/9-Pi mode.

•The calculated Qo and Eacc of the Pi mode are higher than in fact because the power meter does not separate modes. •High amplitude of 7/9Pi mode unlocks the driver and reduces Pi - mode.



### **Statistics**

•The excitation of the parasitic modes in the operating pass band has been observed in 88 CW cold tests out of 182 and in 42 cavities under test out of 66 since 2006.

•2/9Pi, 6/9Pi and Pi modes excite frequently other modes

- •Main trouble is the appearance of 7/9Pi mode:
- The generation by the Pi accelerating mode.
- This mode builds up in almost all the best cavities with high Q.

- High amplitude of the 7/9 Pi mode unlocks the drive frequency of Pi mode.







2/9, 3/9, 4/9Pi modes excite other modes at low field. Instability takes place with increasing power.



## Radiation measured outside of the cryostat

•6/9Pi mode builds up 2/9. 3/9 and 4/9Pi modes with the strong radiation. Instability takes place with increasing power.



•The radiation detector is at the top of the cryostat and does not show the radiation for most of the tests with 7/9-Pi mode generation.



•TLD thermoluminescent detectors are placed inside of the cryostat at the cavity tank. •Radiation changes by generation of 7/9Pi mode. •Low energy < 50 kV X-ray.



## The losses influence on 7/9Pi mode



•The ramp of 7/9Pi- parasitic mode excitation is increased with higher QLoad changing by the input antenna coupling. •The exponential function of the parasitic mode excitation exp(t/T) is different from the cavity response 1- exp(-t/T) on the outside excitation.

• The exponential function exp(t/T) describes a positive feed-back system.

Good agreement to KEK theory :

[S.Noguchi, Parasitic Mode Excitation, TTC Meeting Orcay 2009].



#### Summary

Drive mode Pi excites parasitic mode 7/9Pi:

•Errors in Qo and Eacc measurement.

•The excitation is stable, has large amplitude and sometimes destroys the lock of the Pi mode.

•The power transmission to the 7/9Pi mode does not make any additional losses.

•Good agreement to Noguchi theory:

- -The ramp of 7/9Pi-mode excitation is increased with higher QLoad and E field;
- -The exponential function of the parasitic mode
- excitation is formed by positive feed back. -Field emission exists.

Drive modes other than Pi:

•Most of parasitic modes are unstable and have low fields. •Excitation is accompanied by a strong field emission.



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