Nextef results & status

International Workshop on Breakdown Science and High Gradient Technology

KEK, Japan

18 April 2012

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- Normal conducting X-band studies at KEK
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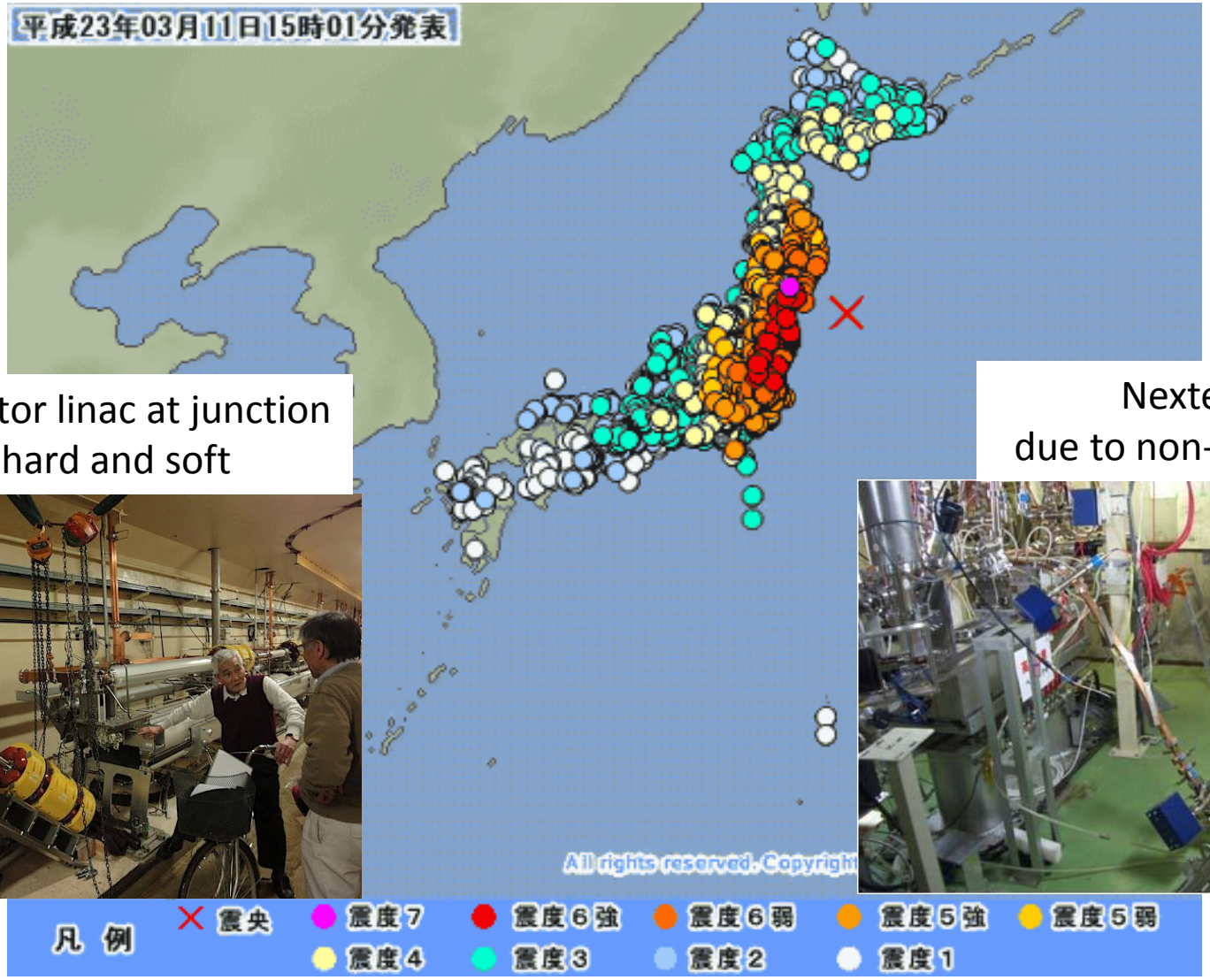
- CLIC pulse operation
- Effort to identify trigger source leading to suppress breakdowns

Status of Japan under recovery

- One year has passed since 11 March, 2011
  - Still frequent earthquakes, but frequency decreasing
- East Japan under recovery
  - From Tsunami disaster
    - Establish to be safe against Tsunami
  - Reforming the north-east area
    - Assignment as a special area for science
- Japan under recovery and reform
  - Fukushima nuclear plants
    - National trend toward reducing nuclear plants
    - Government approval of restarting operation

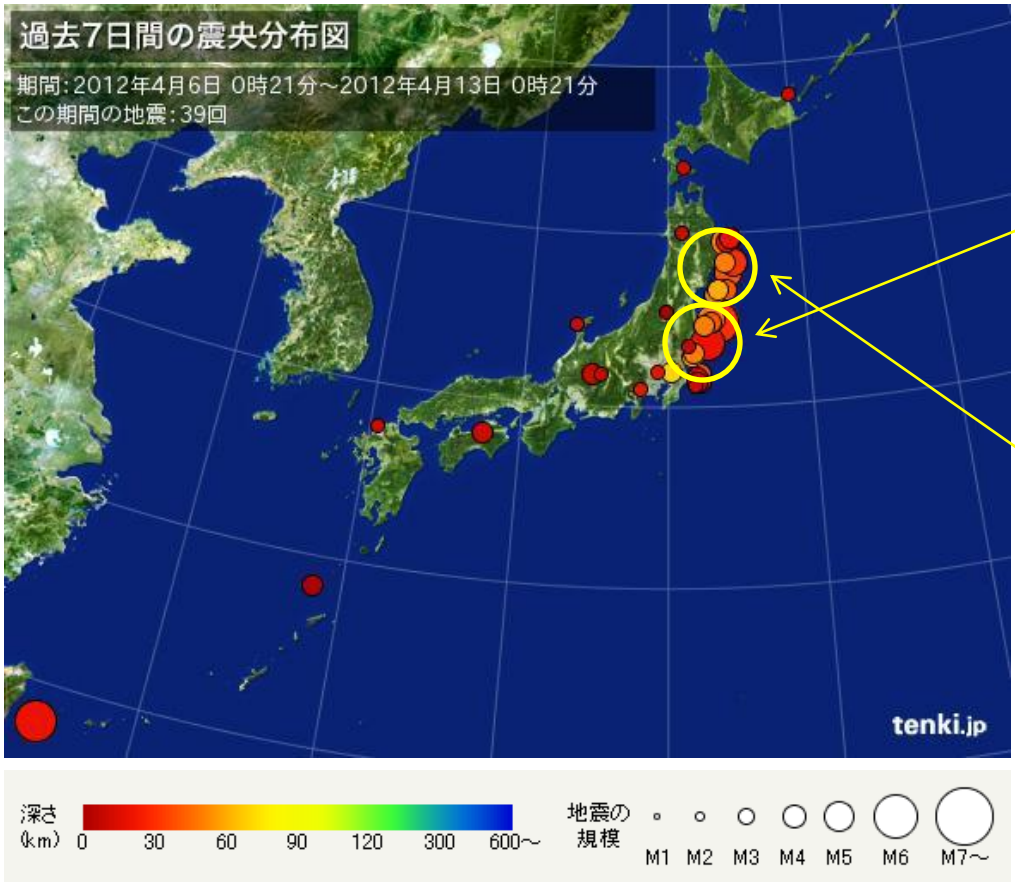
Seismic intensity = 6- at Tsukuba on 11 March, 2011



KEK Injector linac at junction between hard and soft

Nextef collapse due to non-fixed load

Recent earthquakes in Japan in a week (April 6—13)



We still suffer from frequent earthquakes with seismic intensity of 2~3.

One of the candidate site of ILC in Japan is located in north-east Japan, no big one in several hundred years.

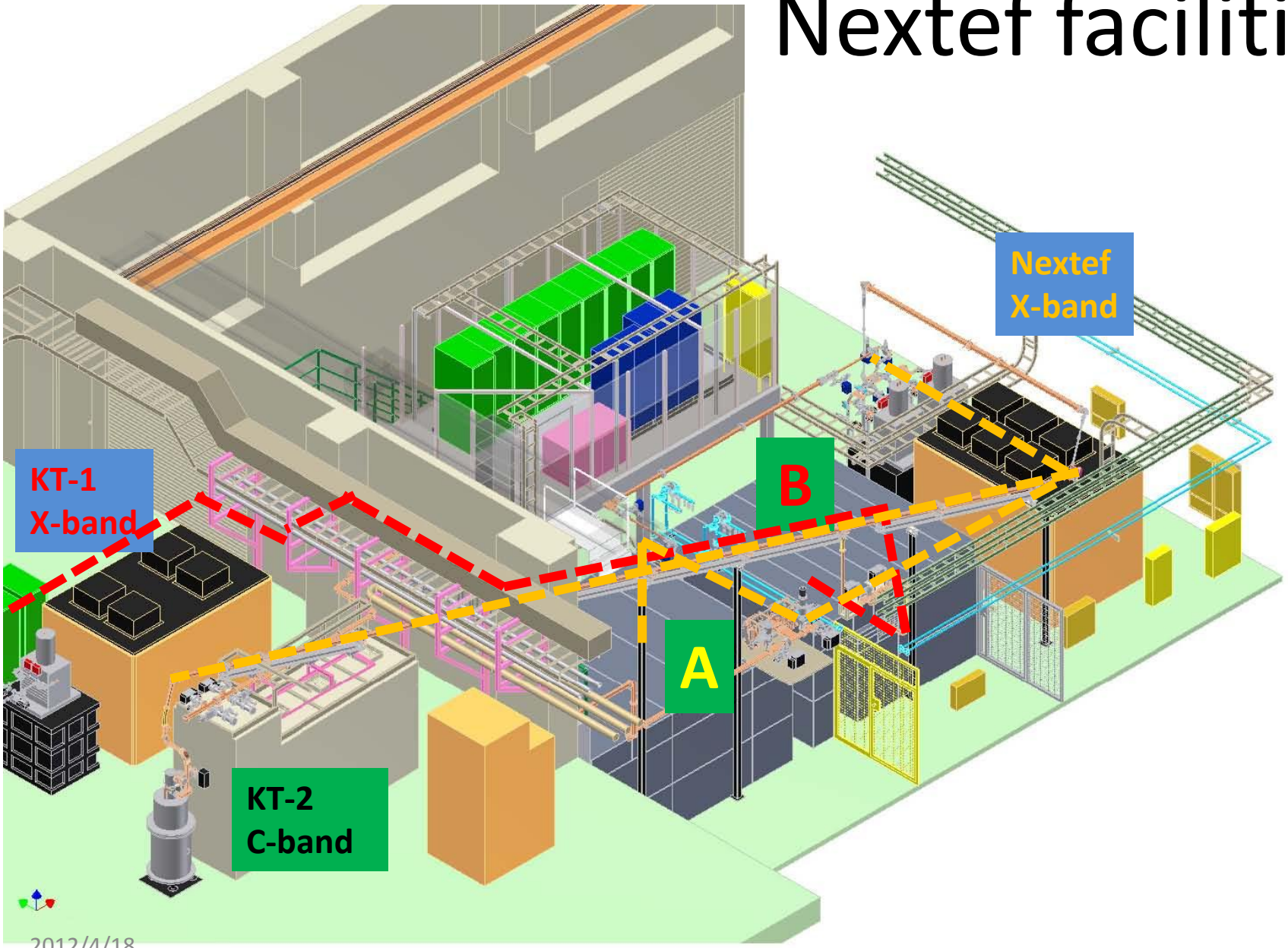
Status of KEK under recovery

- One year has passed since 11 March
- KEK facilities were quickly recovered
  - J-PARC
  - Injector linac
  - ATF, STF, Nextef, ……
- KEK Tsukuba site strategy
  - Recovery budget was approved
  - Recovery with reinforcement against earthquakes
  - Injector linac is being recovered with various improvement, naturally be suited for SuperKEKB

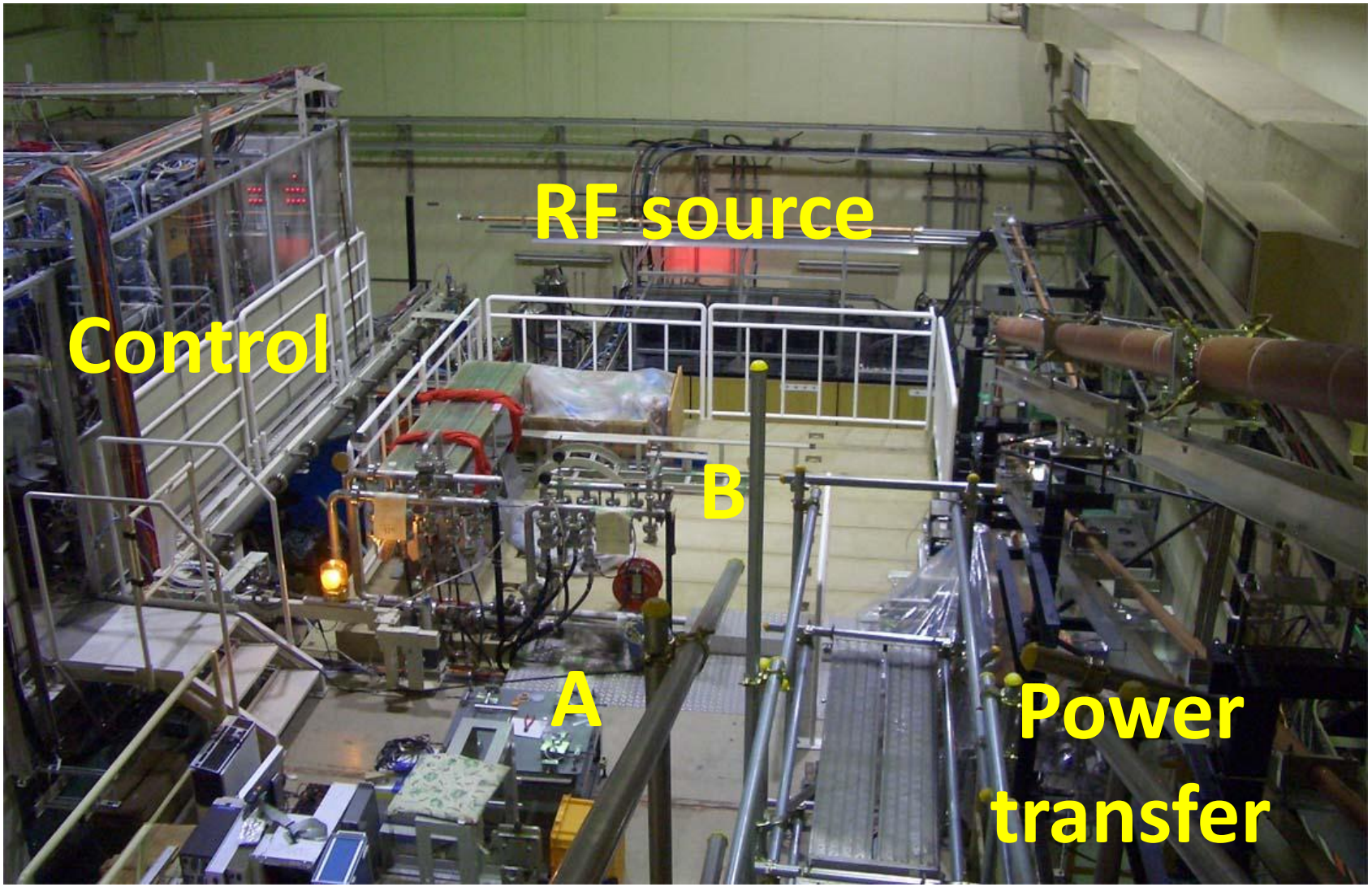
Normal conducting X-band studies at KEK

- X-band as a main project of KEK until ITRP 2004
  - 60cm accelerator structure to confirm operation at 65 MV/m unloaded
- Continue high gradient as a basic research for accelerator
- Join CLIC collaboration
  - 22cm accelerator structure targeting the operation at 100 MV/m unloaded
- Continue and go into a stage
  - To identify the trigger of breakdowns and understand initial processing, operation period, later aging, …..
  - Studies to improve initial conditioning and nominal performance and to suppress deterioration through operation
- The present workshop is one of the step to this end

Nextef facilities



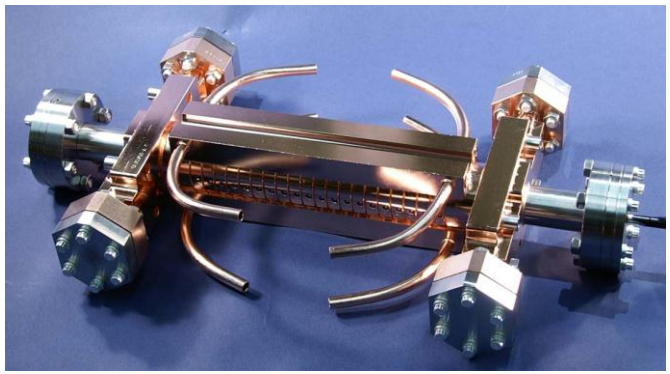
Nextef



Comparison of four CLIC prototype structures

CLIC test structures; a series of fabrication and test

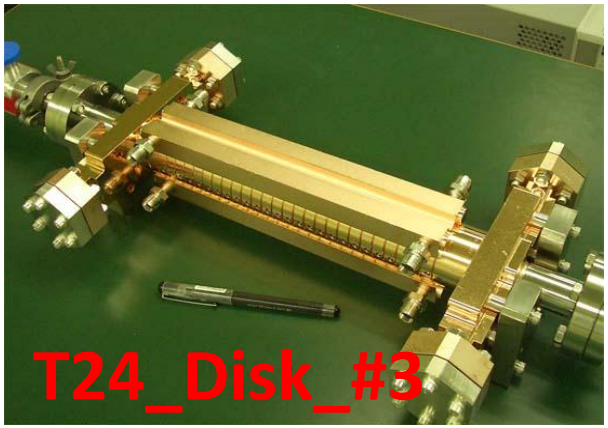
T18 →TD18→T24→TD24



T18_Disk_#2

2009

undamped



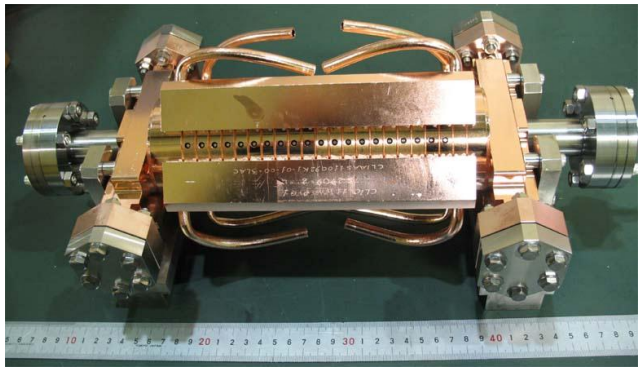
2011

2010

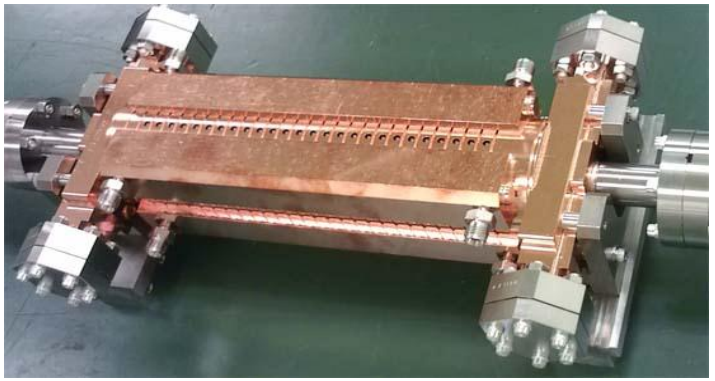
damd

2011~12

damped

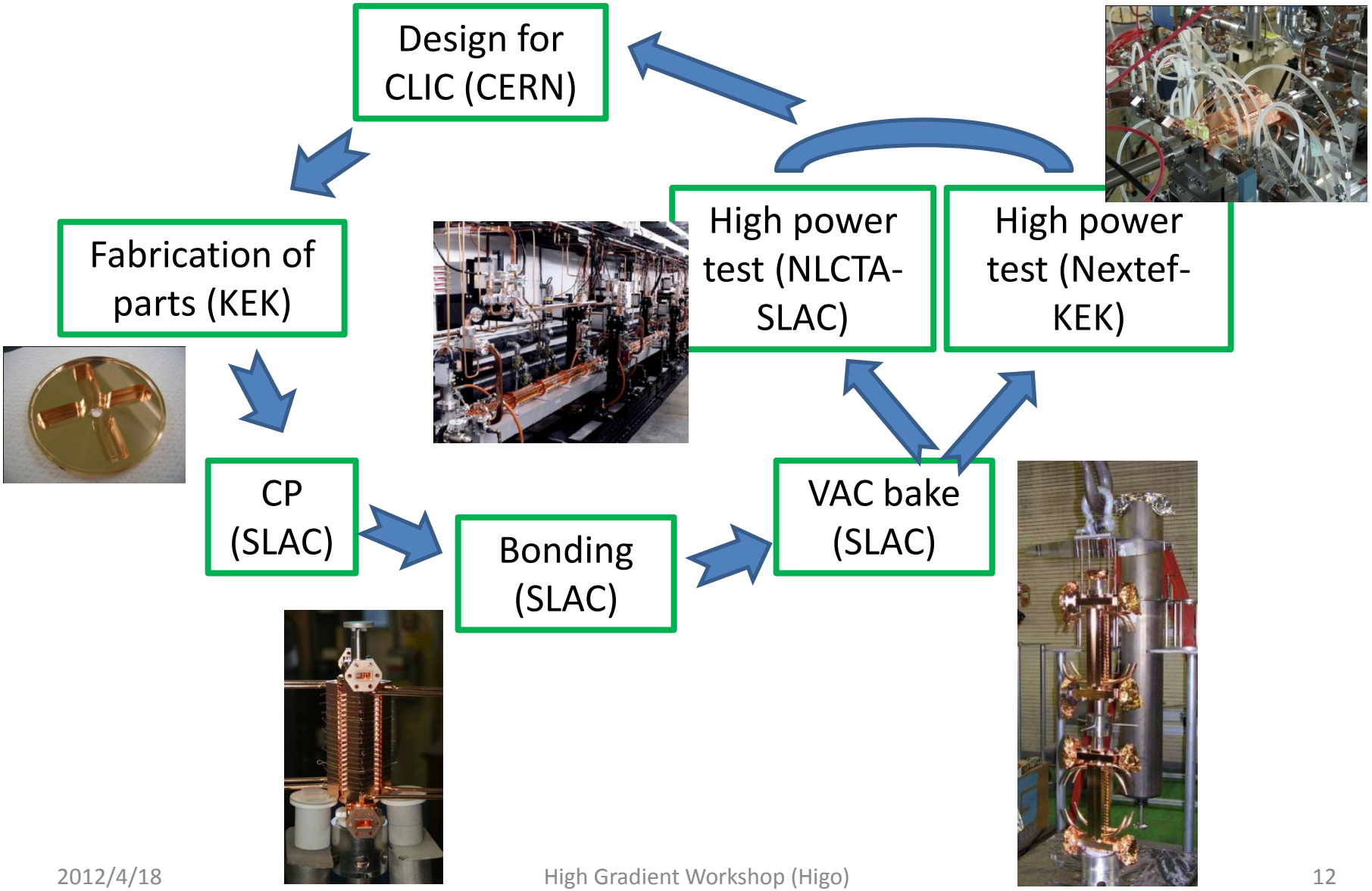


TD18_Disk_#2

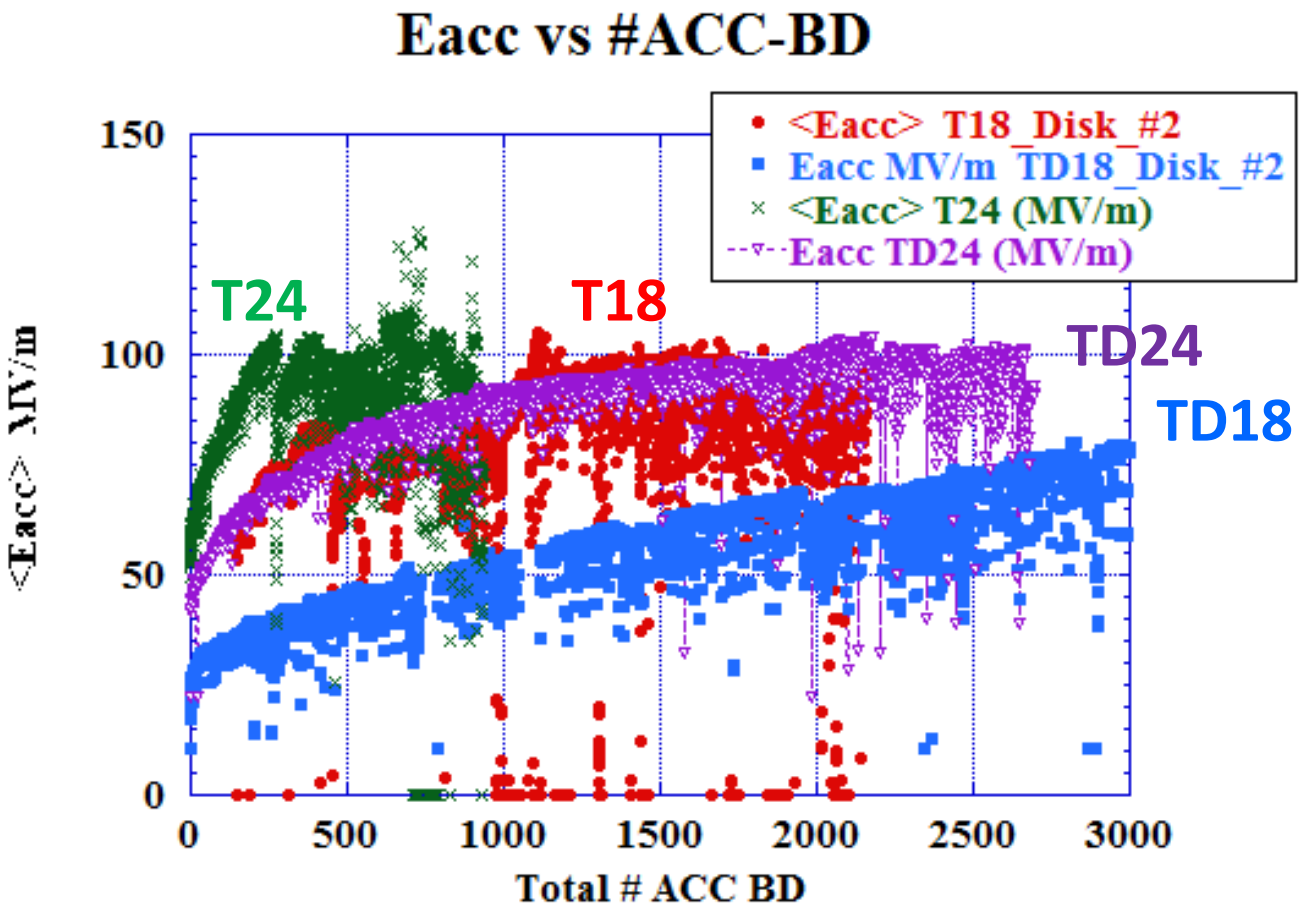


TD24_Disk_#4

SLAC/KEK typical fab/test flow



Difference in processing speed among four structures



More BD's are required for damped!? Why?

Can it be reduced?

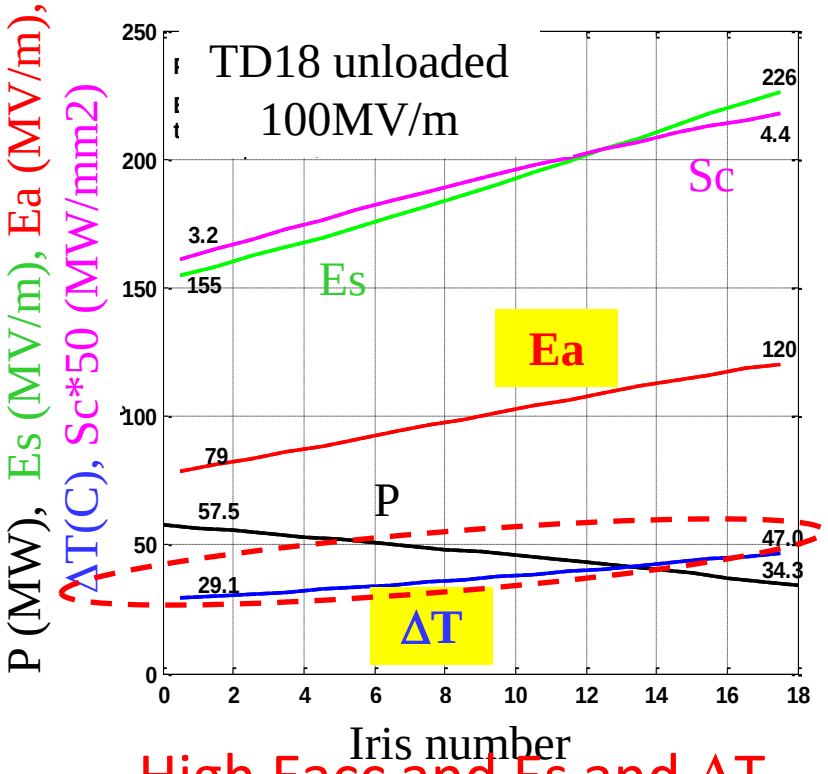
BD's are essentially needed for processing?

Breakdowns are needed or can be avoided?

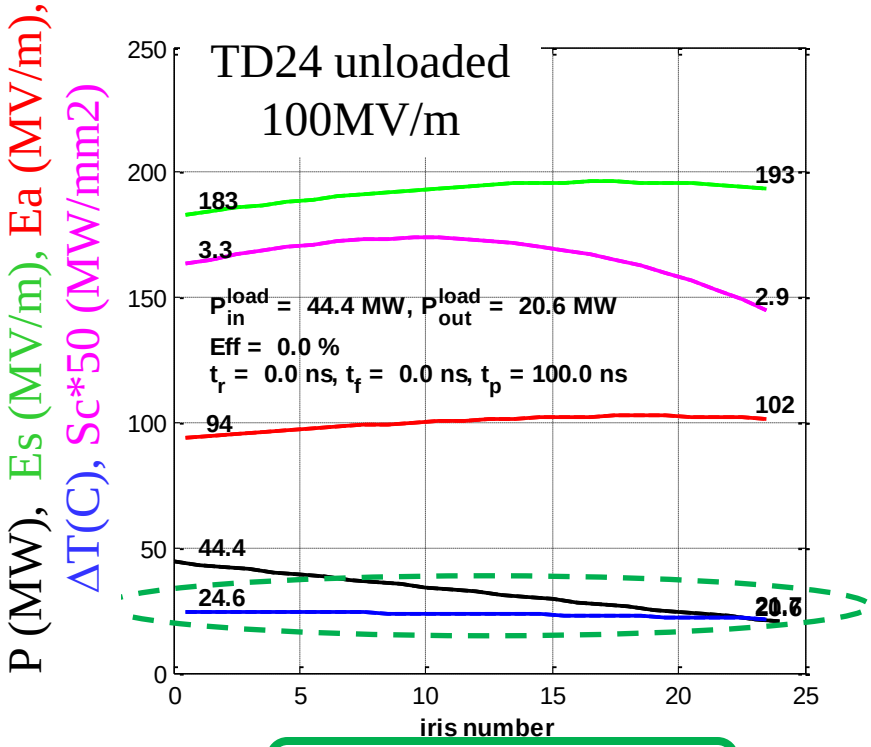
Reduced magnetic field 18 → 24

TD18
Damped

TD24
Damped



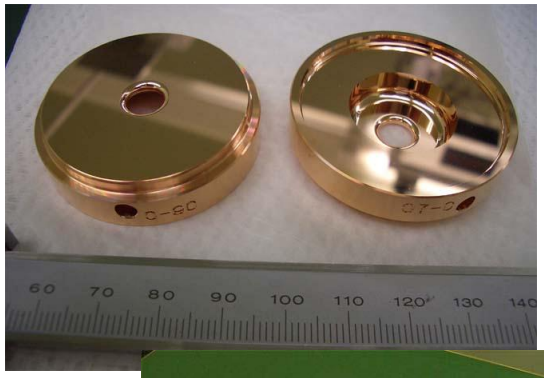
High Eacc and Es and ΔT

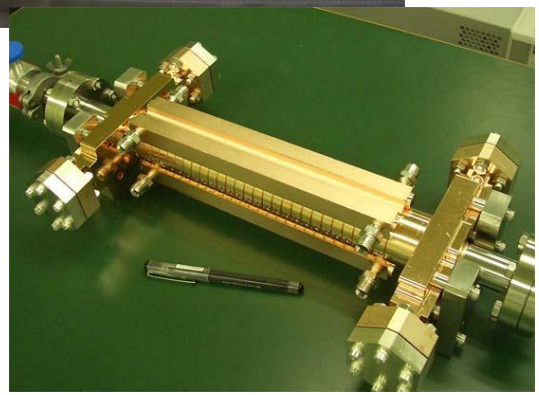


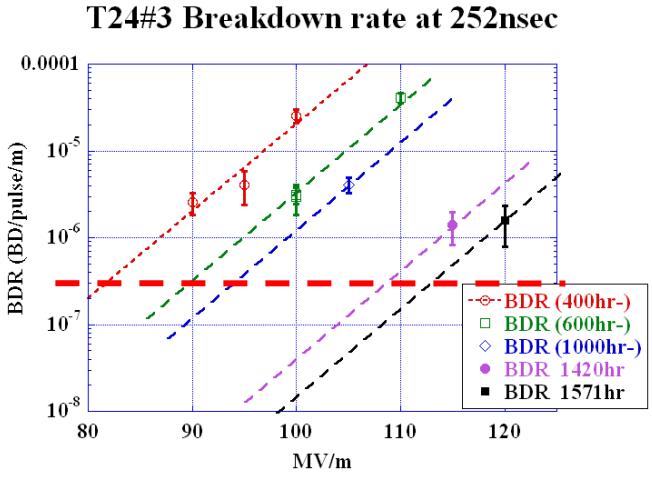
Reduce ΔT

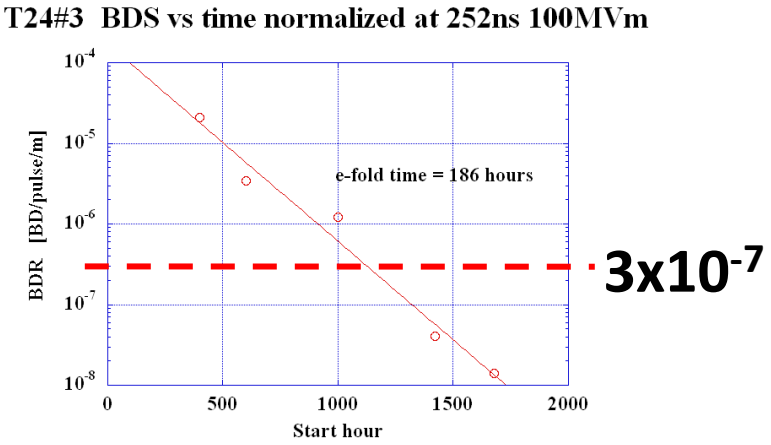
Undamped T24

T24 was found much better than T18





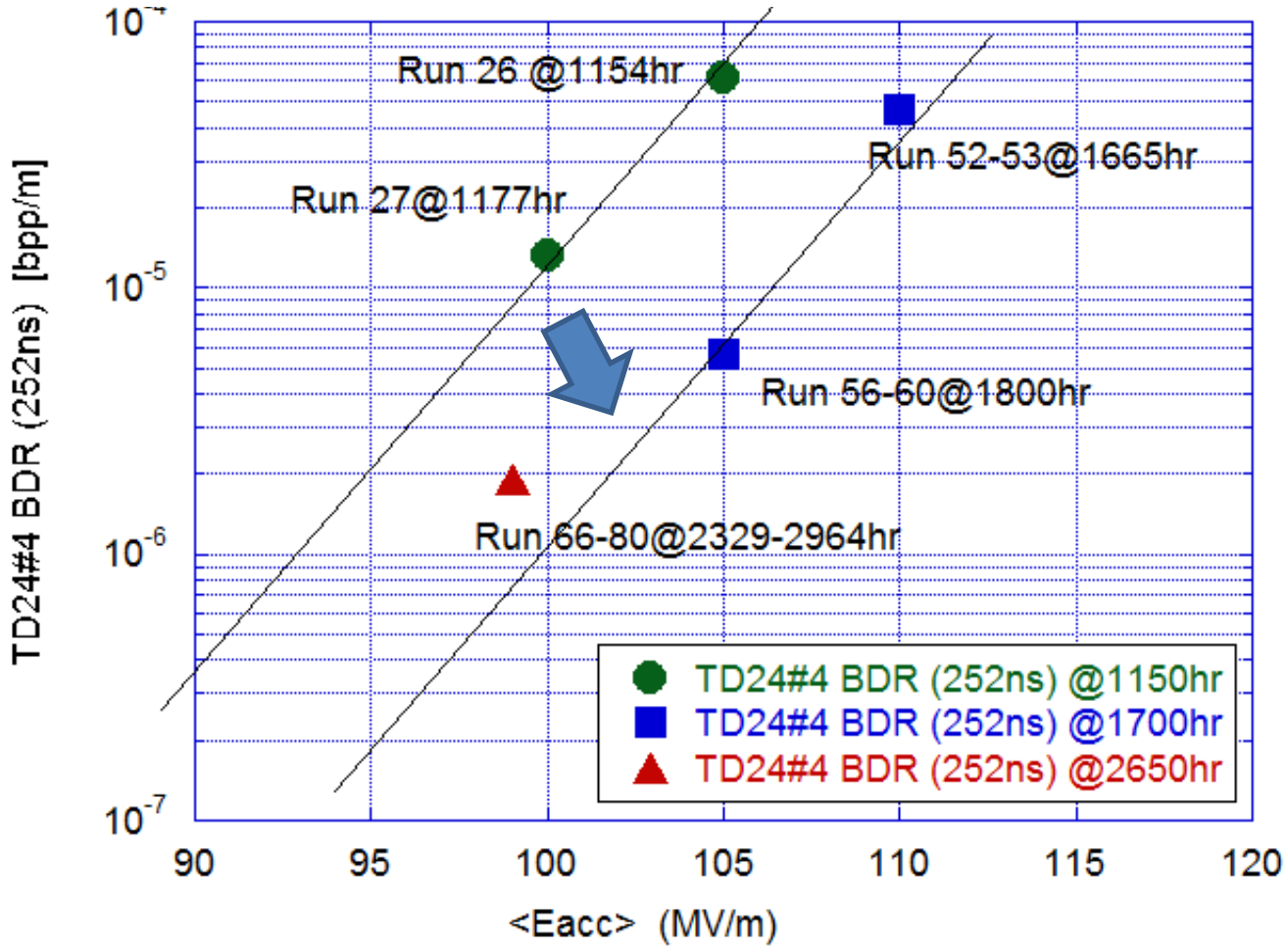




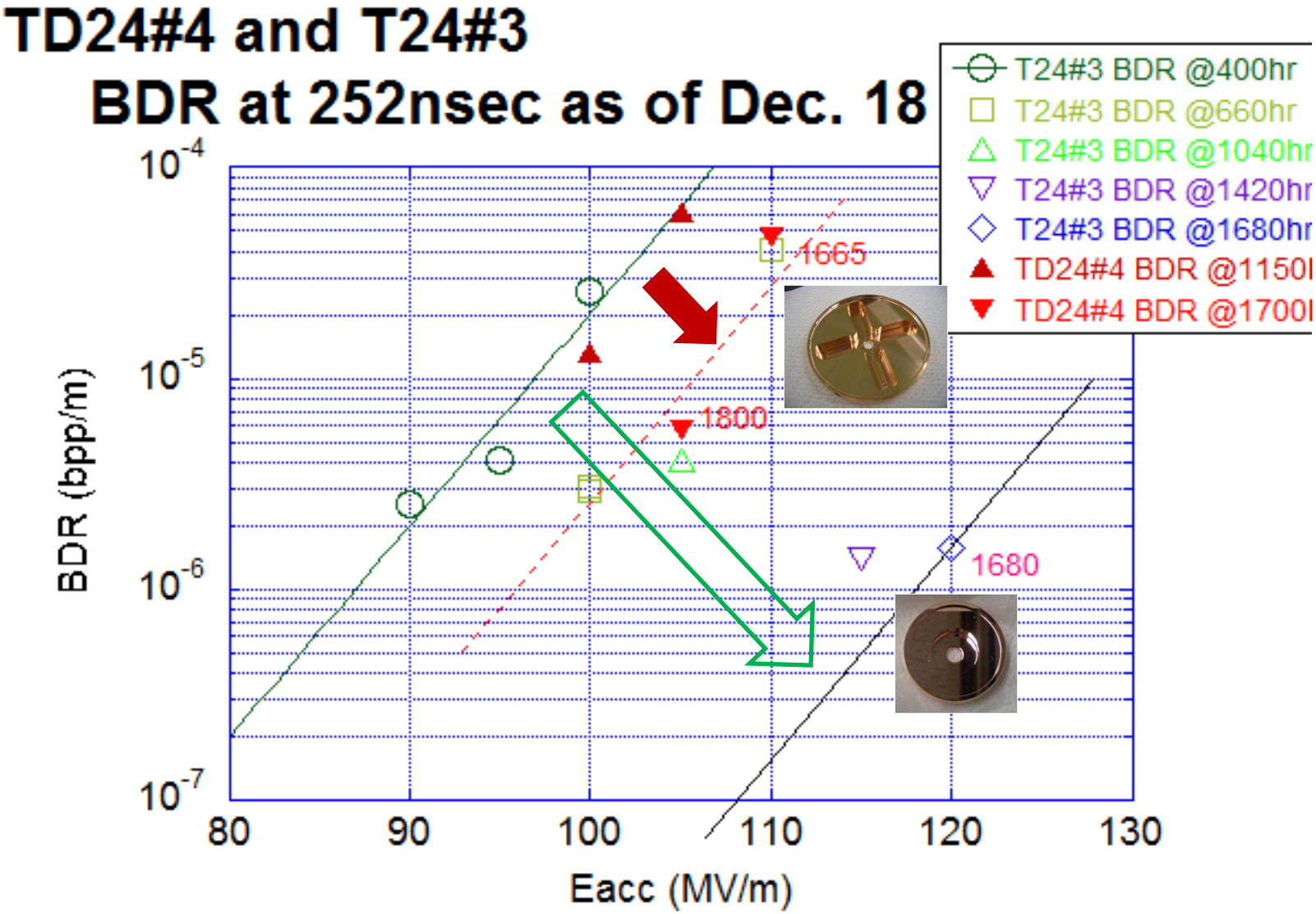
Faster processing

Reached low breakdown rate

Damped TD24#4 at 252ns

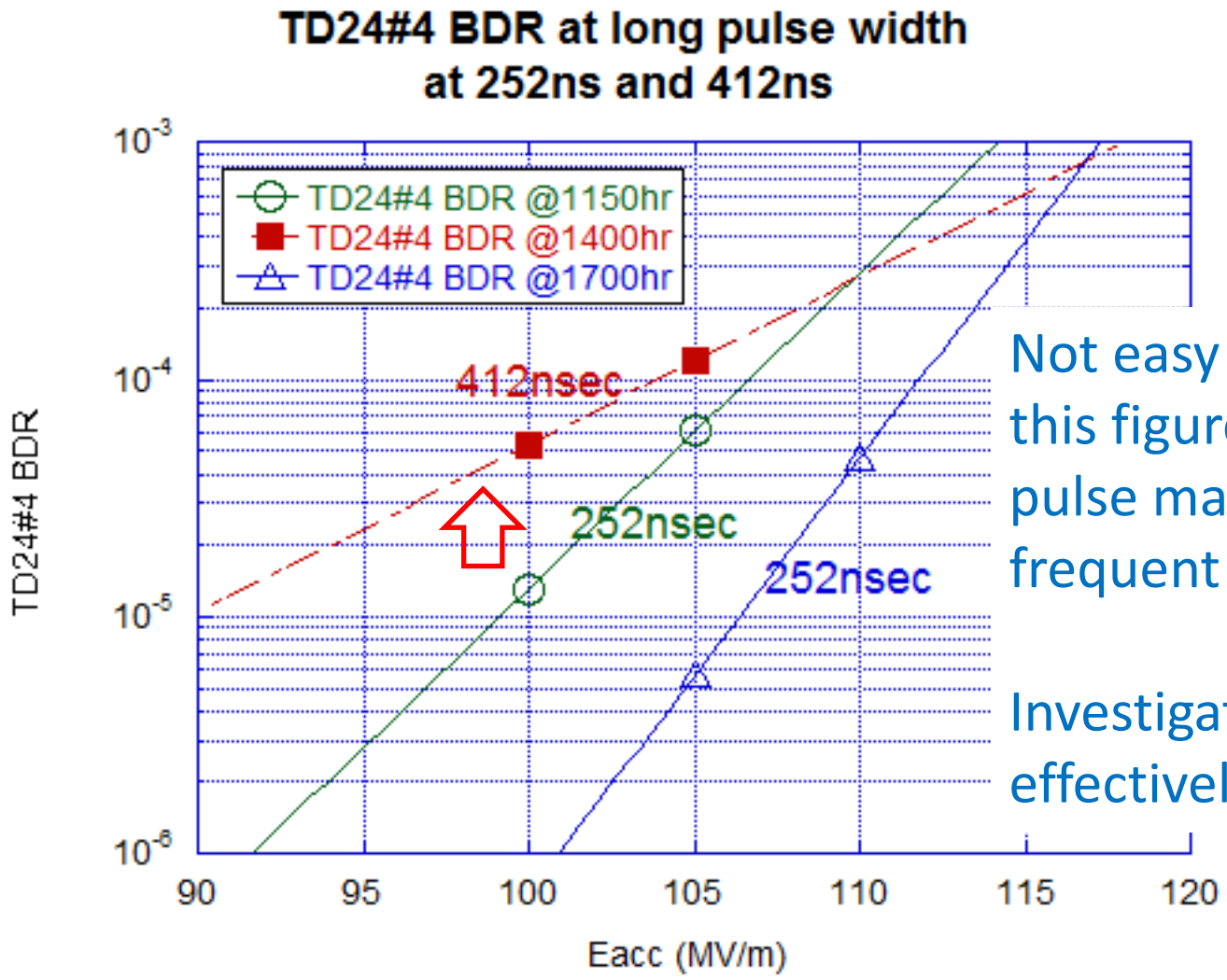


Damped vs undamped



Lines are only for guide for eye and drawn all with the same slope as that of T24 at 40 hr.

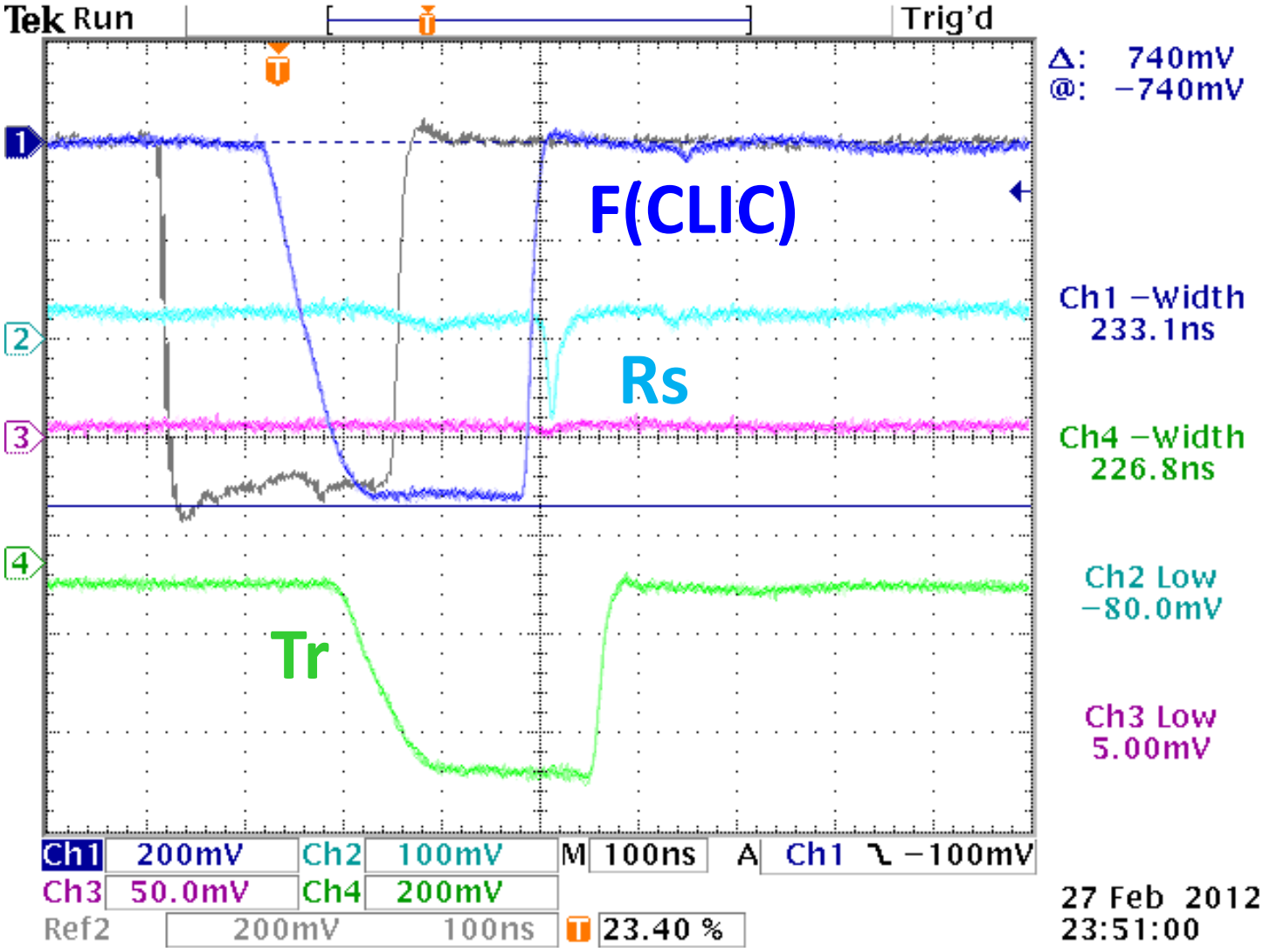
More frequent breakdowns in longer pulse



Not easy to say only from this figure, but longer pulse makes more frequent breakdowns.

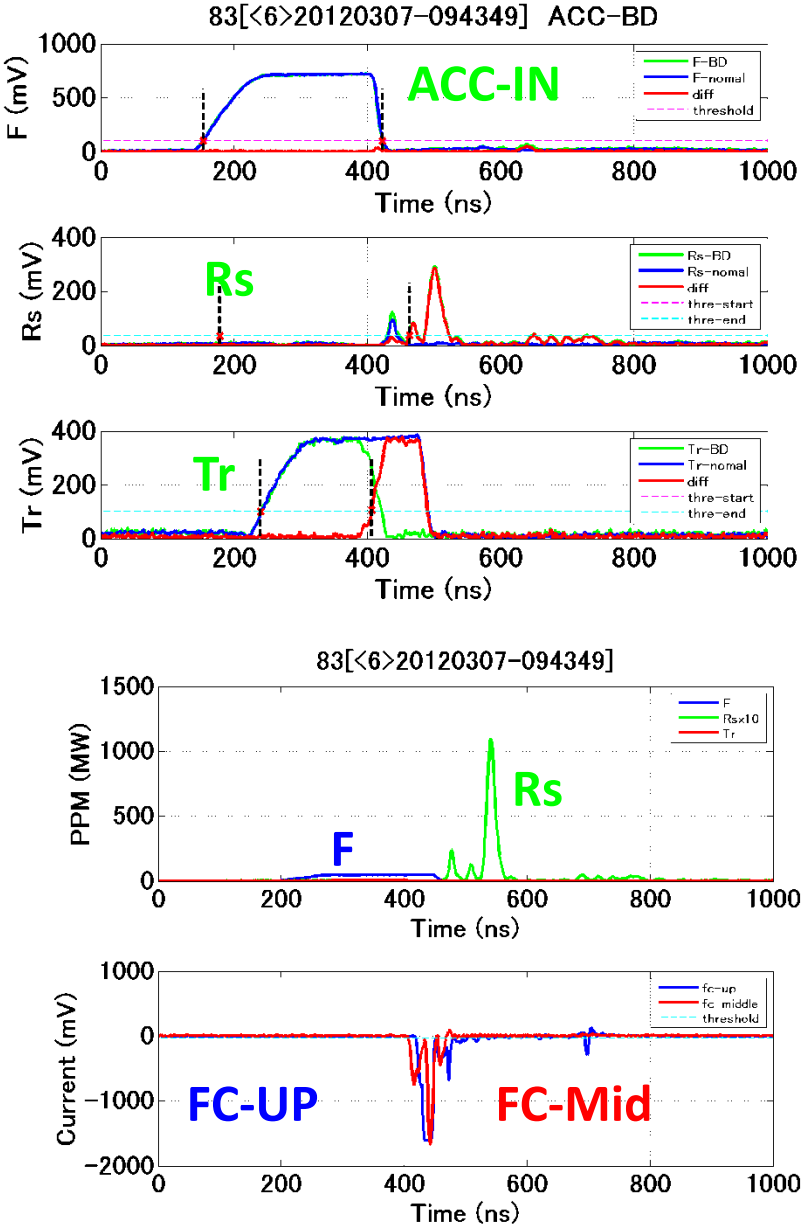
Investigate CLIC pulse: effectively shorter pulse.

Nominal CLIC pulse

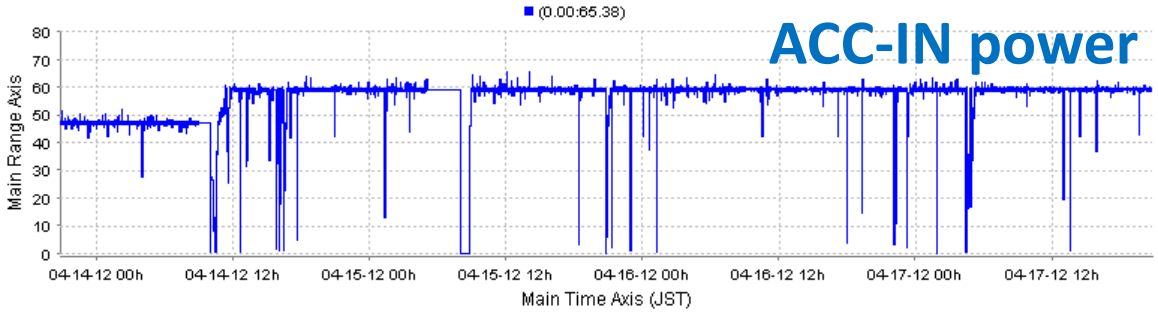


Only 3 breakdowns in 484 hour operation with CLIC pulse at FLT=100MV/m

1.6×10^{-7} bpp/m



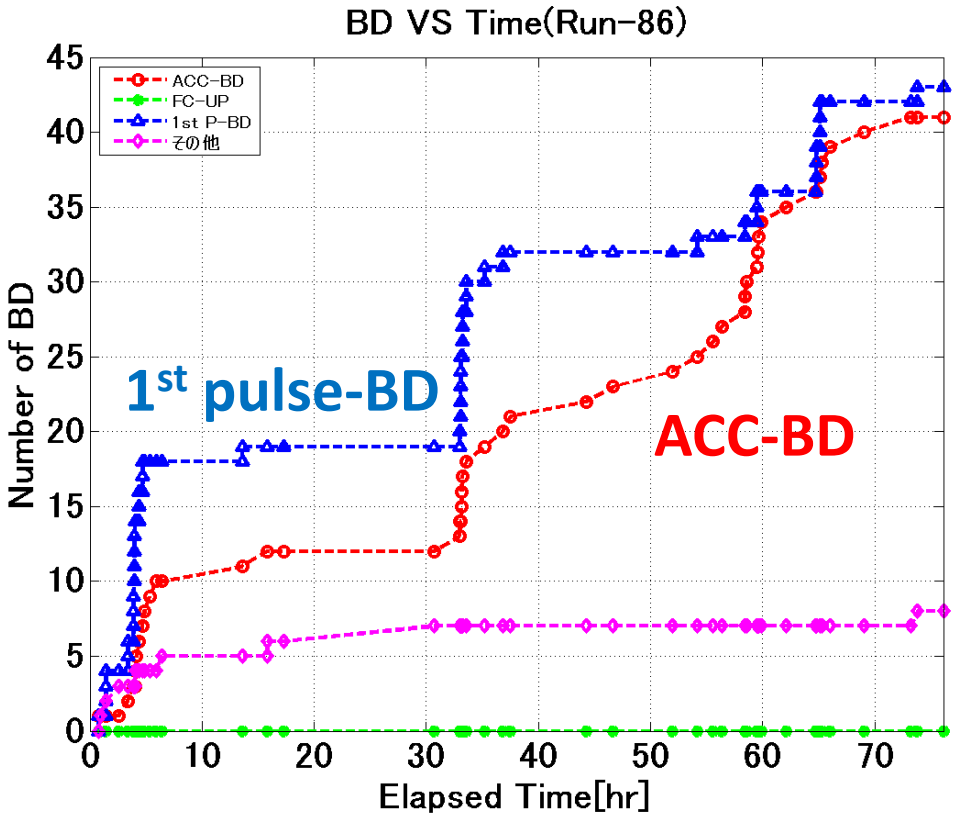
CLIC pulse at 110 MV/m till to date



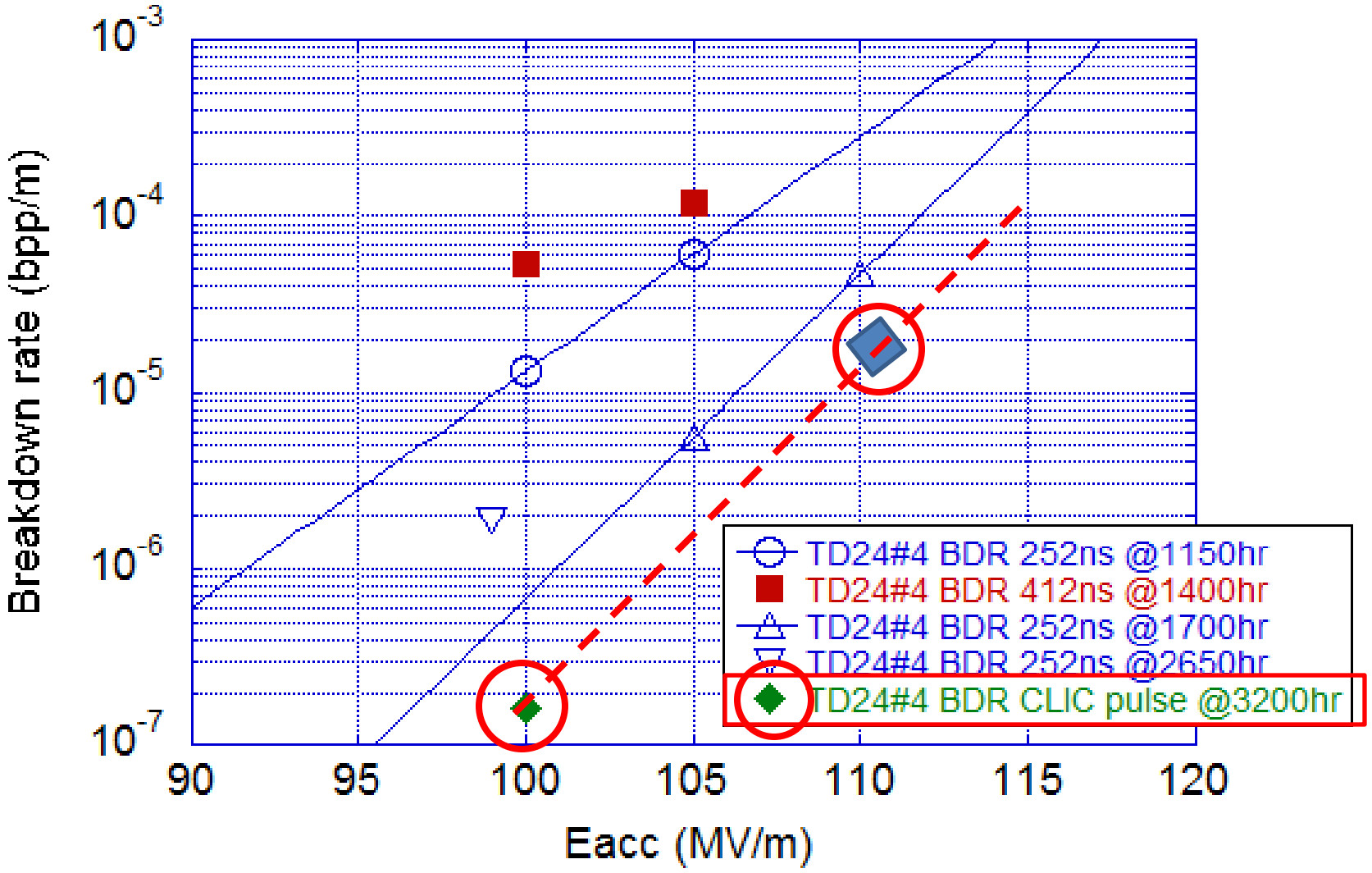
Operated for 77 hours and encountered 41 ACC-BD.

It results in 1.4X10^{-5} bpp/m.

BD's are bunched in time.
BD's are mostly associated with first-pulse BD's.



TD24#4 BDR with CLIC pulse at FLT=100MV/m



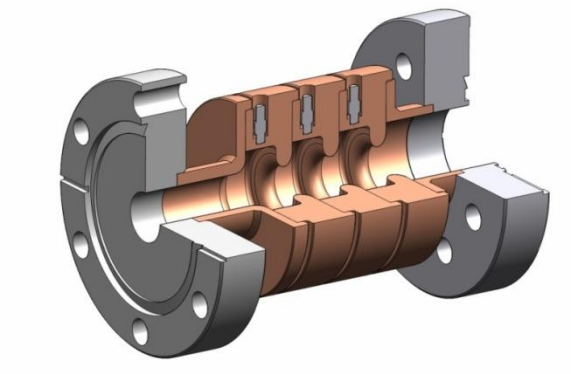
Single-cell studies in preparation or in mind

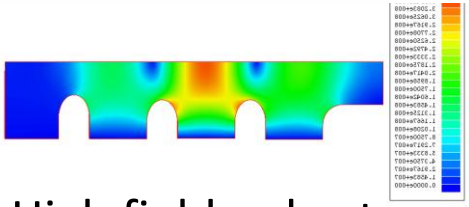
- Explore basic research in a simple geometry
- Center cell is such as the following

1. Standard: KEK made – SLAC test
2. Nominal: Heavily-damped
3. Made of large-grain material
4. Undamped but all-milled
5. All milled quadrant type
6. Choke-mode type

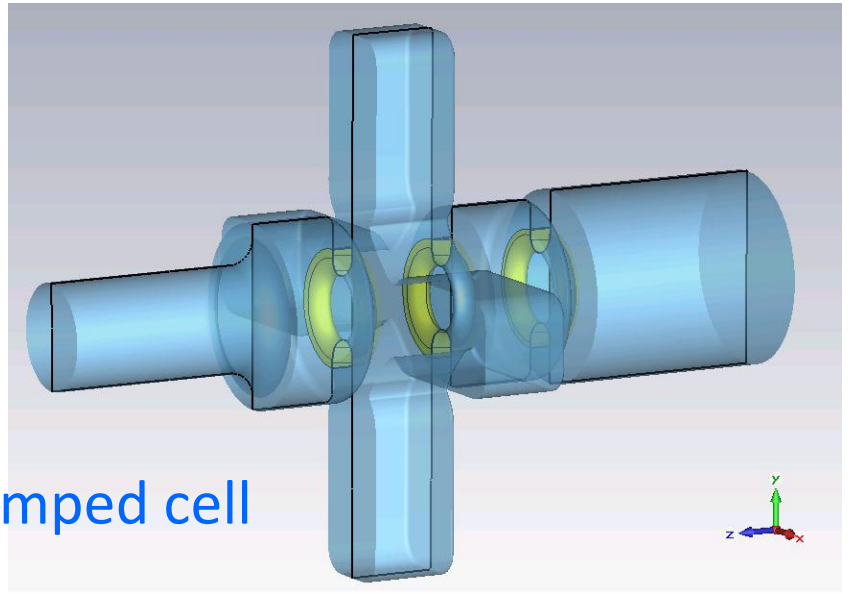
These are under preparation

Basic study setups





High field only at center cell

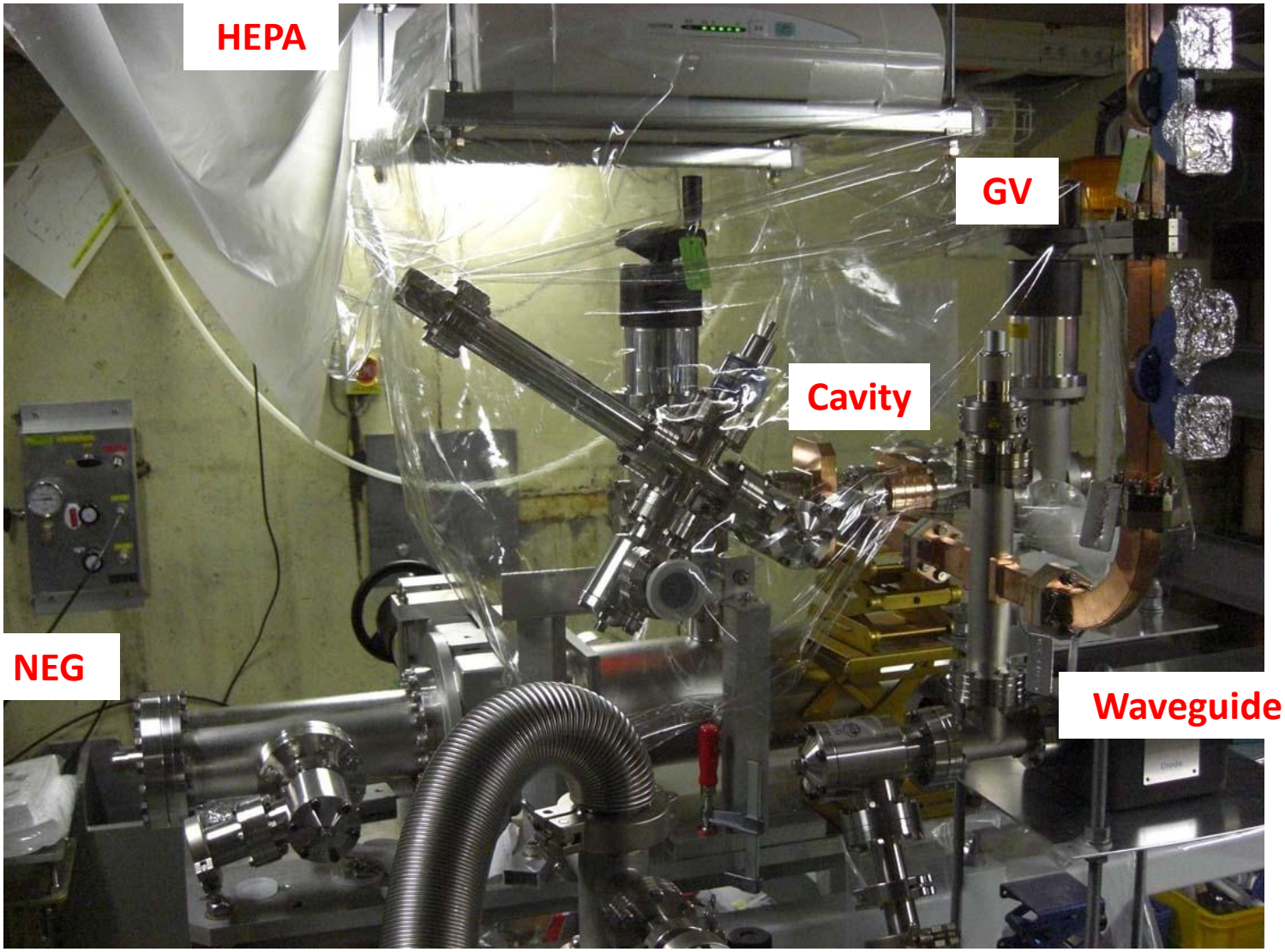


Damped cell

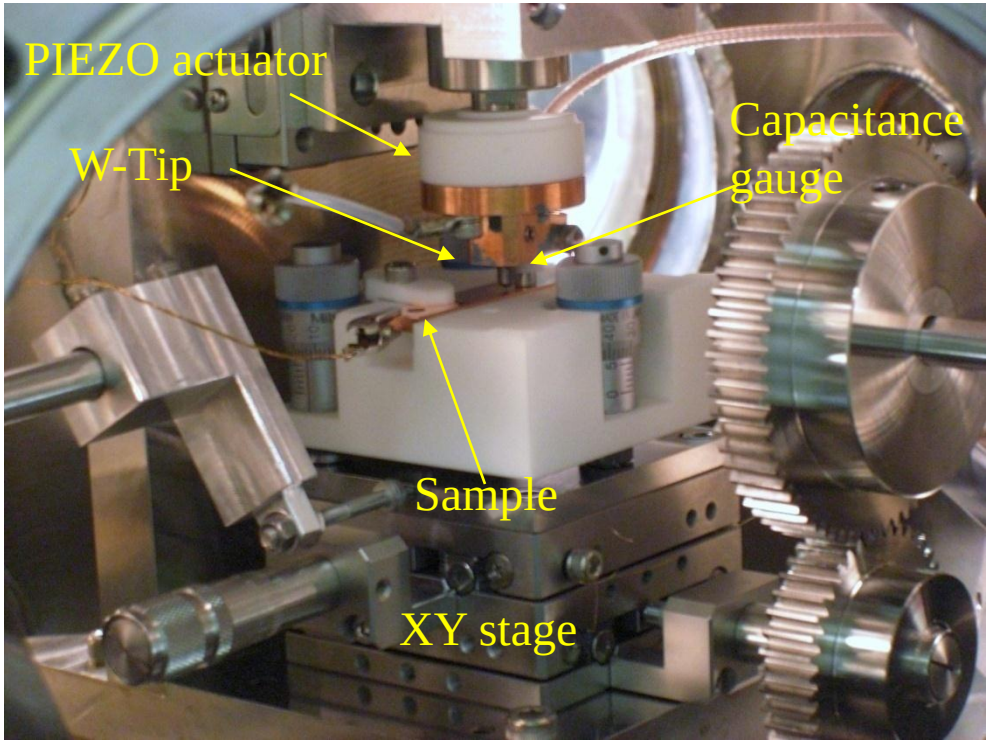
Crystal characteristics

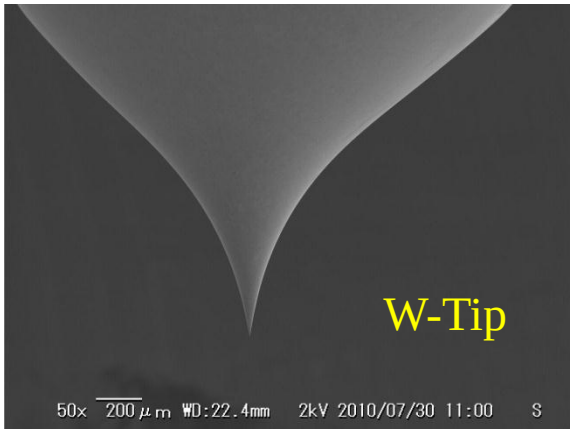
Clean setup

Preparation of setup in shield-B



Scanning field emission microscope being under development at KEK





Field emission and surface of crystal characteristics.

Conclusion

- Four CLIC prototype structures have been tested, each for a few thousand hour scale.
- Improved performance was given with TD24 type.
- CLIC pulse operation met the required BDR for CLIC at FLT=100MV/m.
- Basic research area is under construction, expecting to start test in a month or so.
- All of KEK members suffer from the huge work for SuperKEKB until the commissioning in 2014.
- We want to keep the basic research activity.
- We also want to consider a klystron based compact LC for Higgs.
- We want to expand X-band based applications, but after SuperKEKB.