Report from Nextef

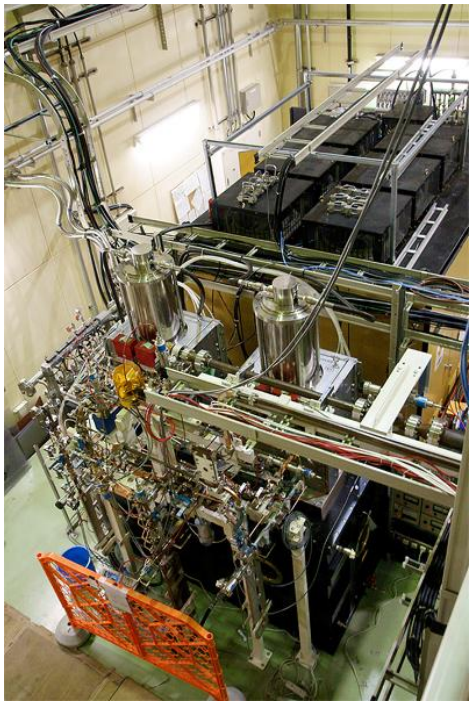
IWLC10, Genève, Oct. 20

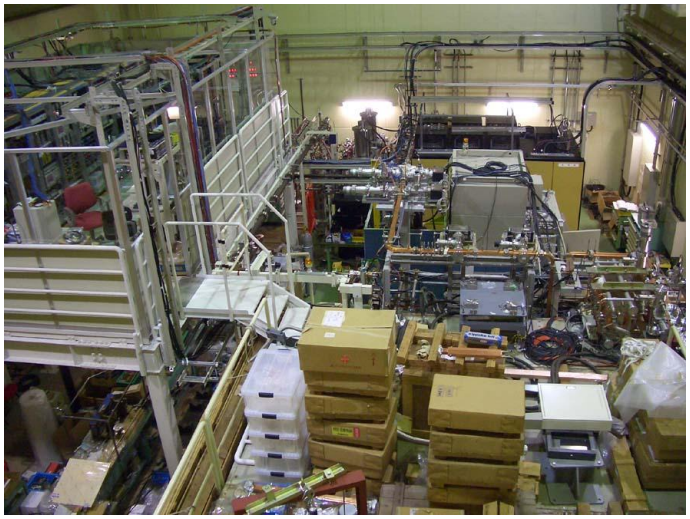
T. Higo (KEK)

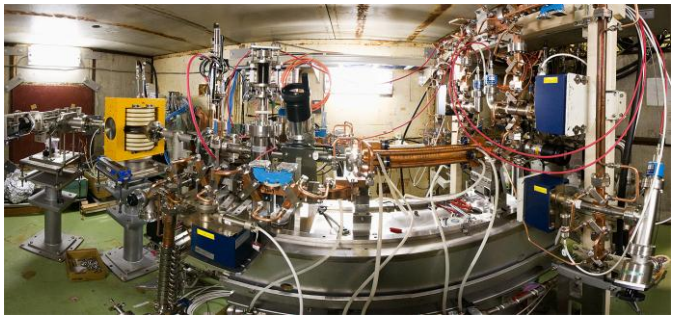
Contents

- Nextef
- TD18 results and related issues
- Near future experimental plans
- Nextef expansion status
- Other associated activities

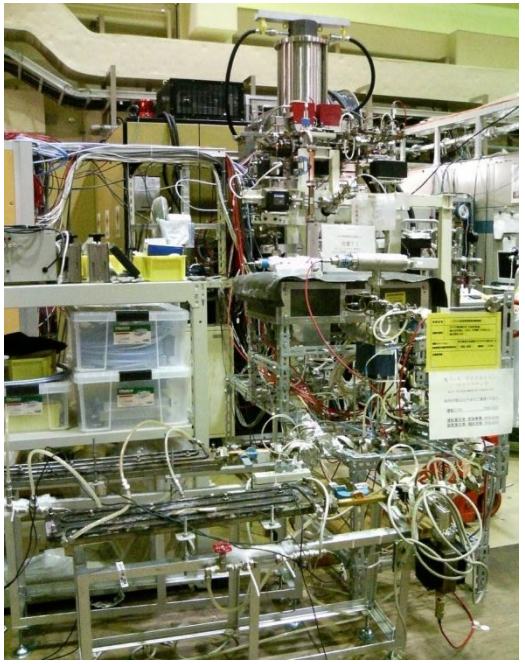
Nextef has been keeping the same configuration since 2007





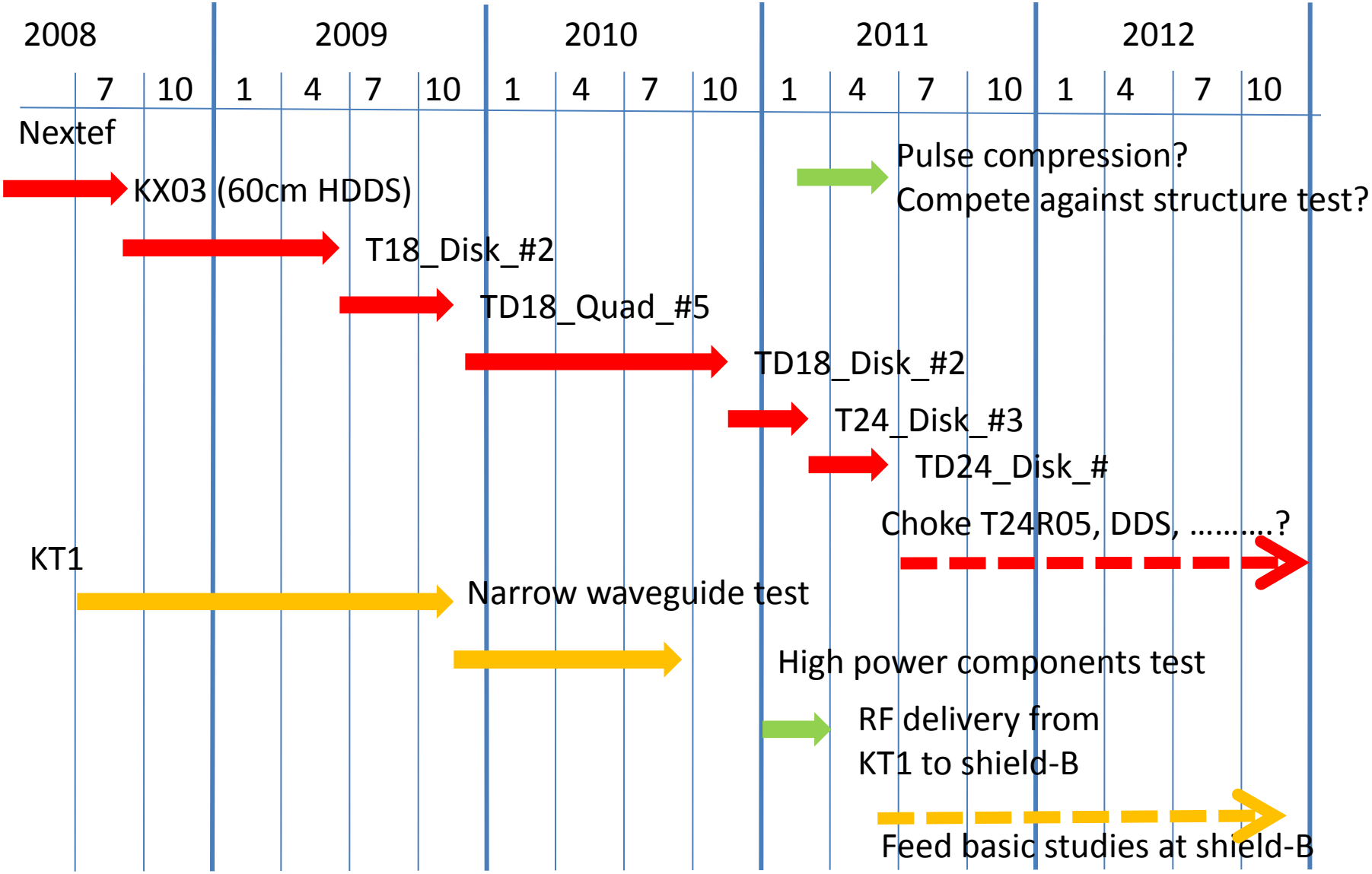


Nextef
2 klystron setup



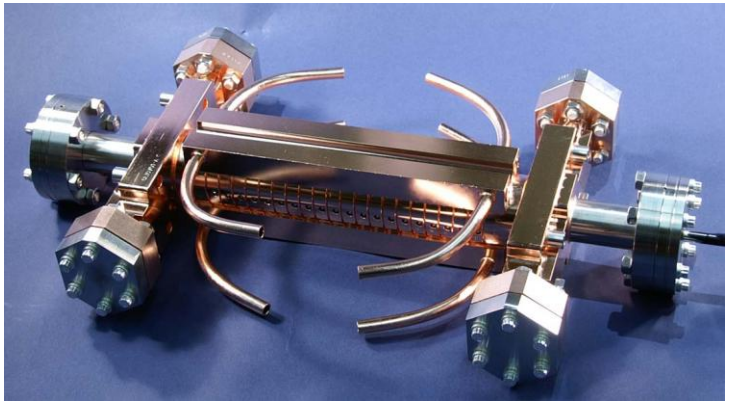
KT1
1 klystron setup

Studies at Nextef & KT1

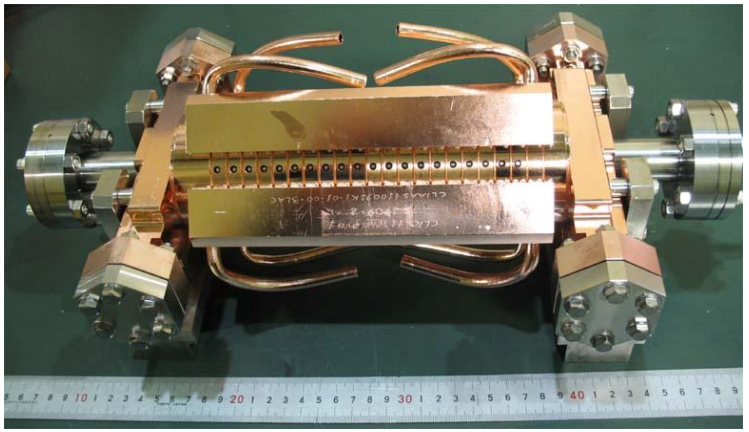


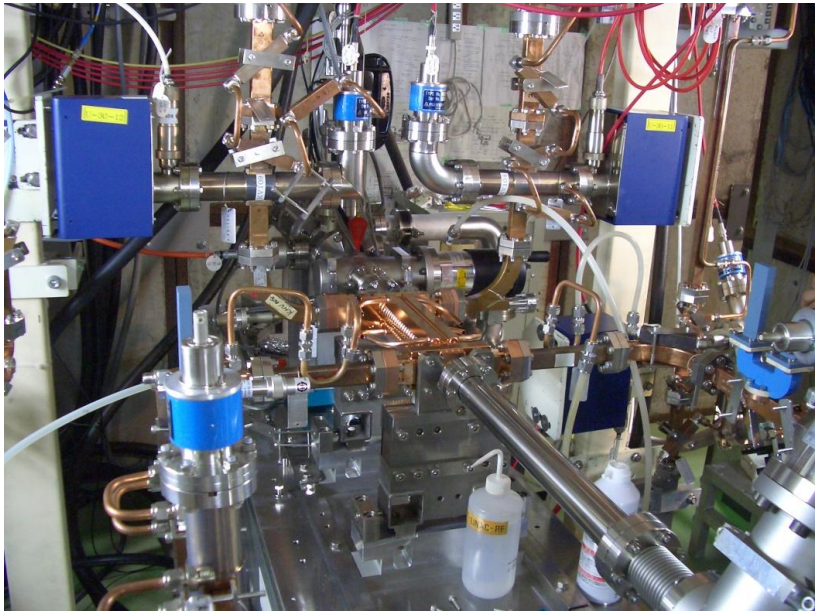
Structure test for CLIC study

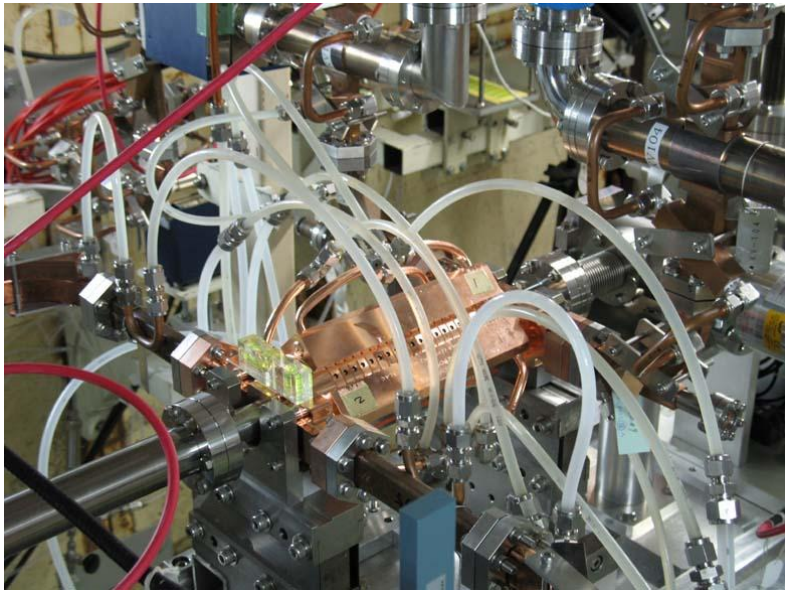
T18_Disk_#2



TD18_Disk_#2





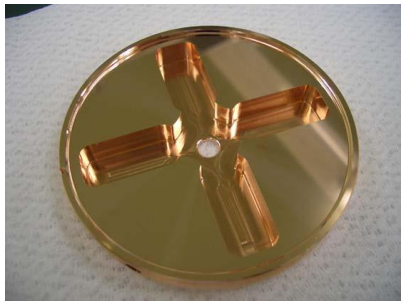


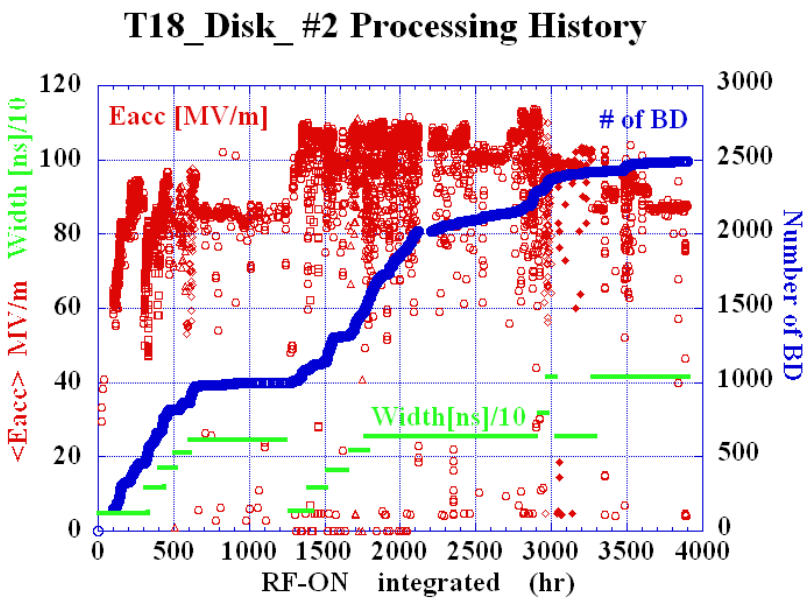
T18_Disk_#2
Undamped disk-based

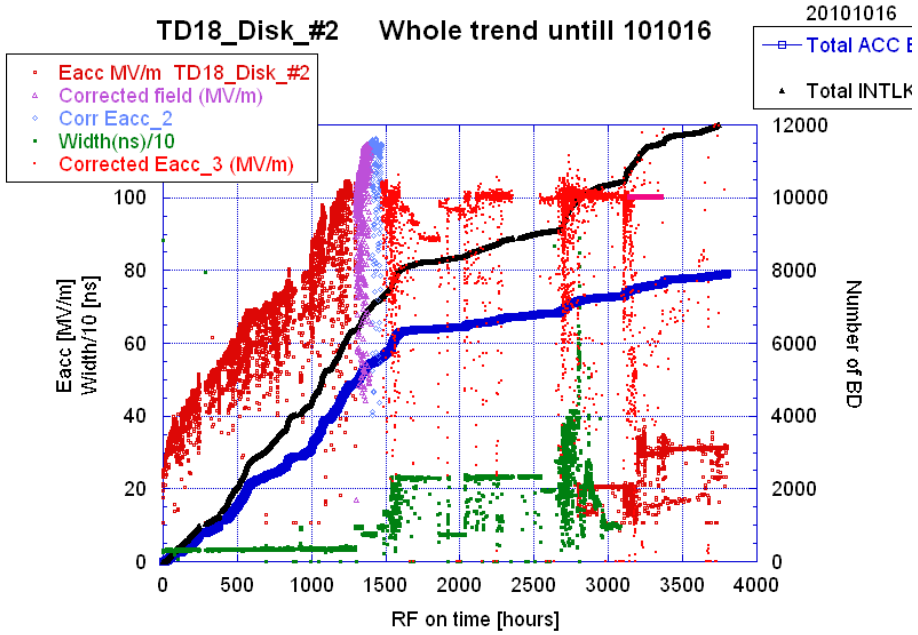
Strategy

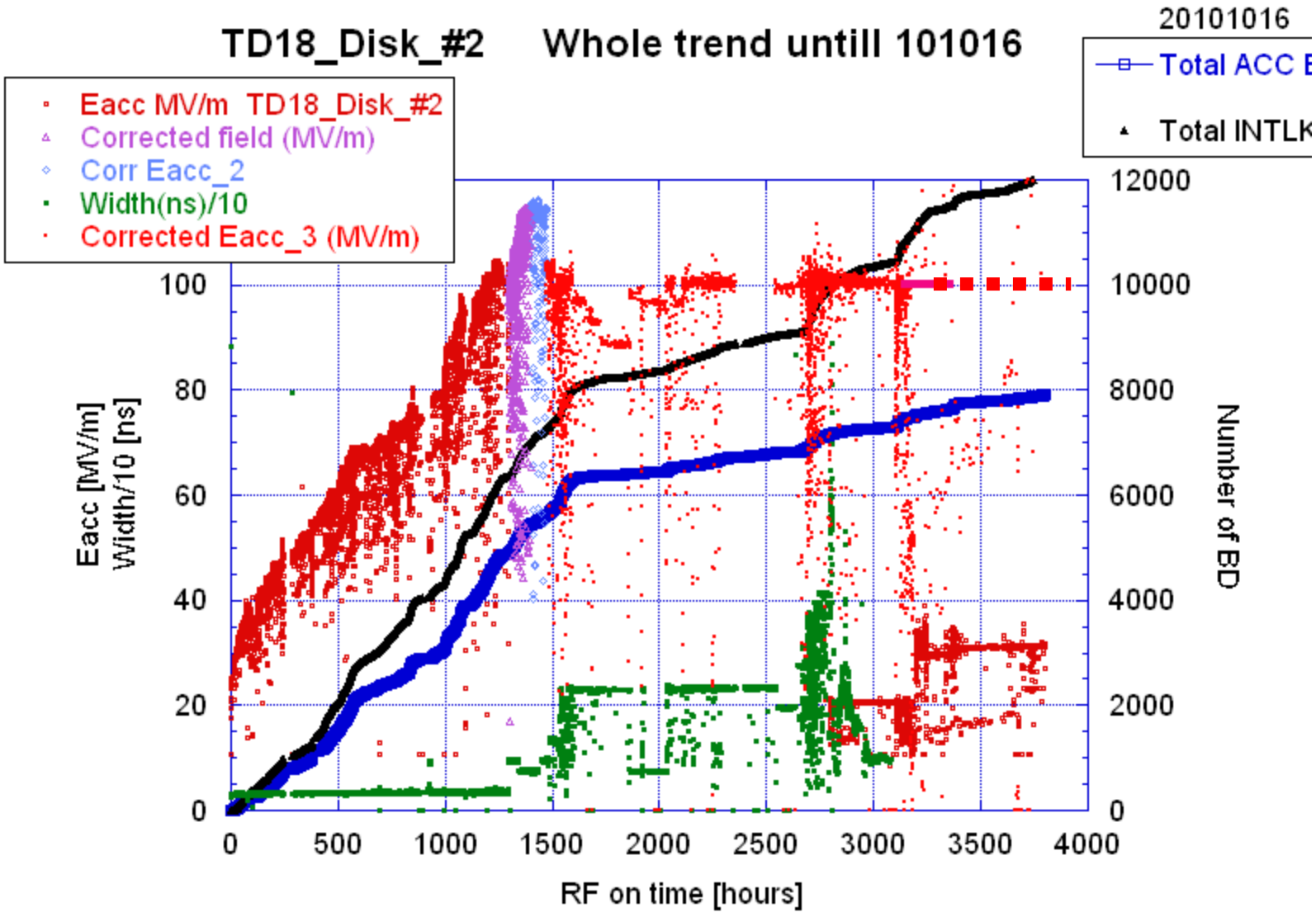
Disk-based
CLIC electric design
KEK mecha design +fab
SLAC assembly
Test at SLAC and KEK

TD18_Disk_#2
Damped disk-based





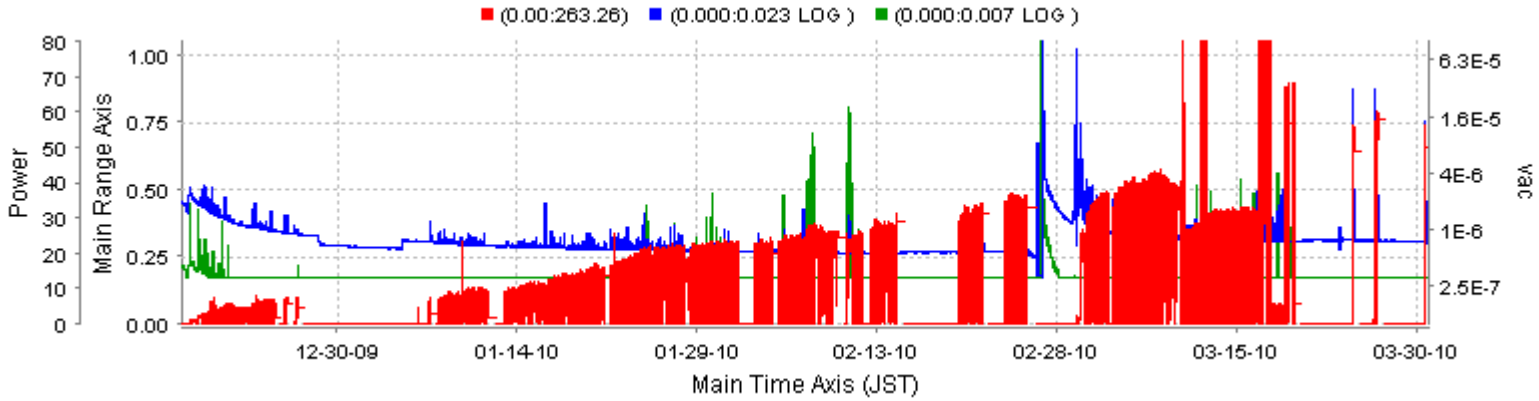



TD18_Disk_#2 Whole trend untill 101016
20101016
Total ACC E
Total INTLK
Eacc MV/m TD18_Disk_#2
Corrected field (MV/m)
Corr Eacc_2
Width(ns)/10
Corrected Eacc_3 (MV/m)
Eacc [MV/m]
Width/10 [ns]
Number of BD
RF on time [hours]
0
20
40
60
80
100
0
2000
4000
6000
8000
10000
12000
0
500
1000
1500
2000
2500
3000
3500
4000

Vacuum level and low power feature

VAC-@OUT-WG ACC-IN power

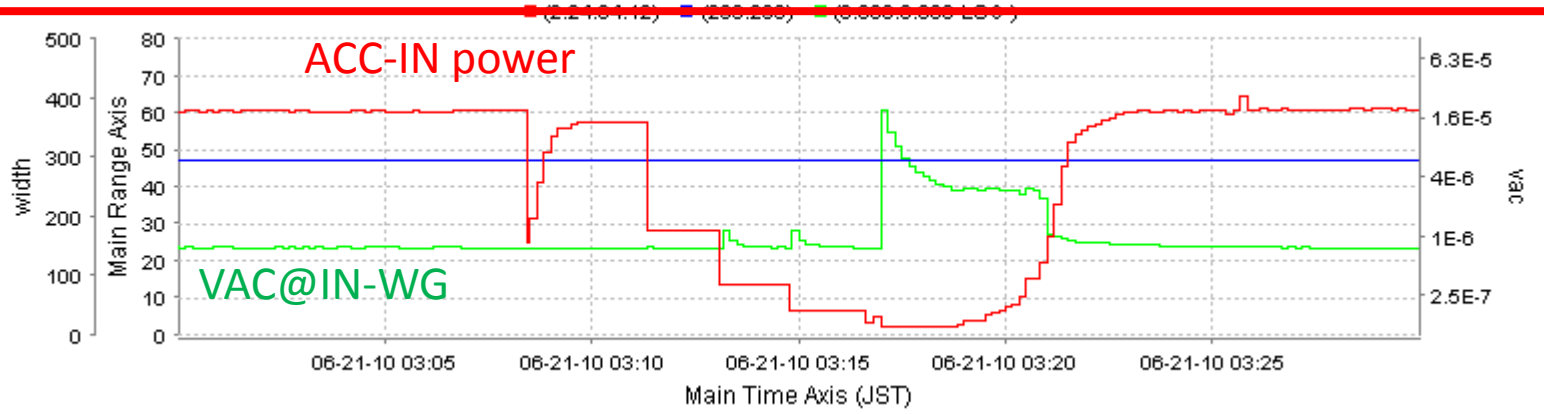
VAC@IN-WG

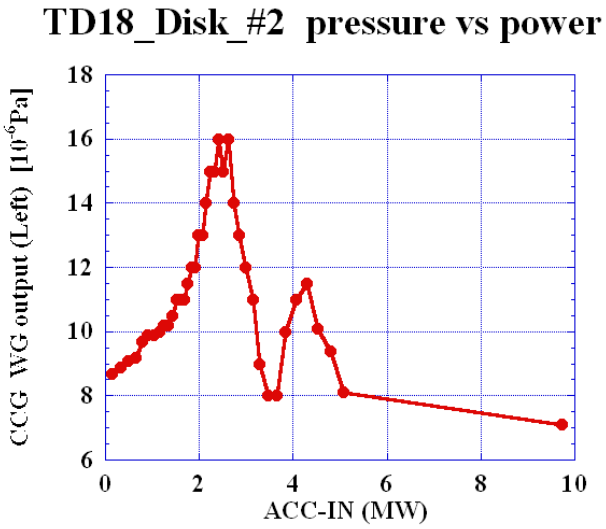


Vacuum level was not so good, ~1x10^-6Pa at worst position.
Now preparing an action to improve from the next structure.

Pressure increase at low power level

Even after running at top power, the vacuum gets worse when it decreases power.

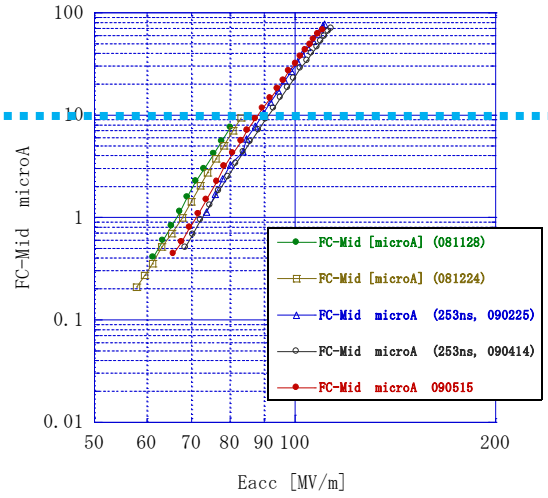




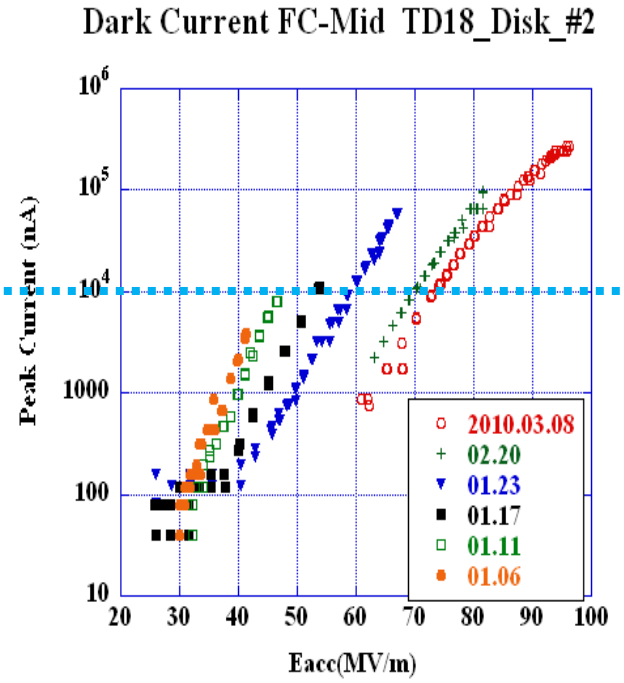
Even a few hour stop of RF pulses makes the vacuum level worse in the next startup process, because the recovery usually passes through this region.

Comparison of dark current

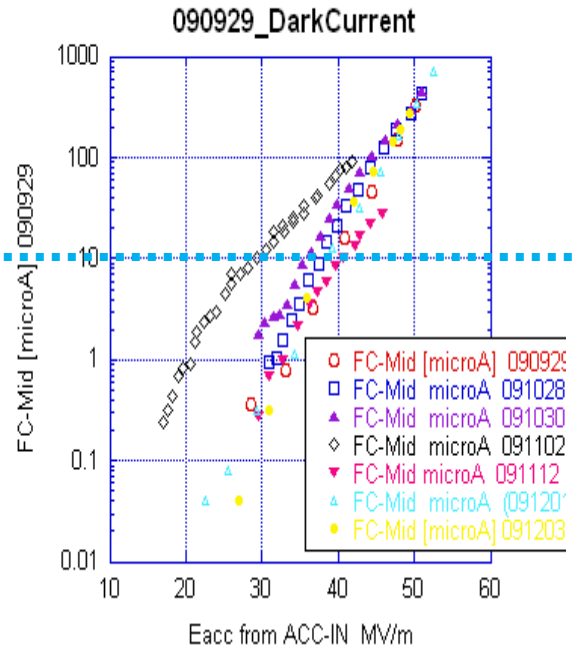
T18_Disk



TD18_Disk



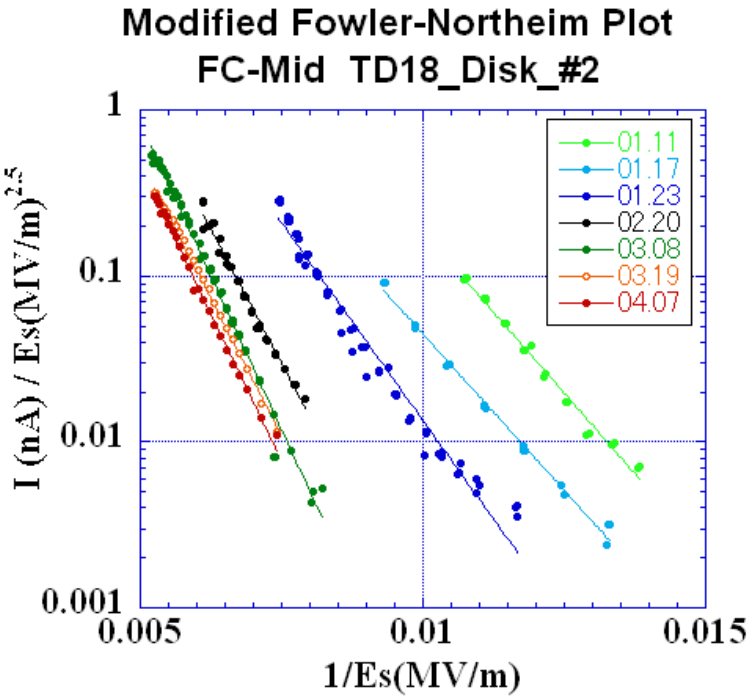
TD18_Quad

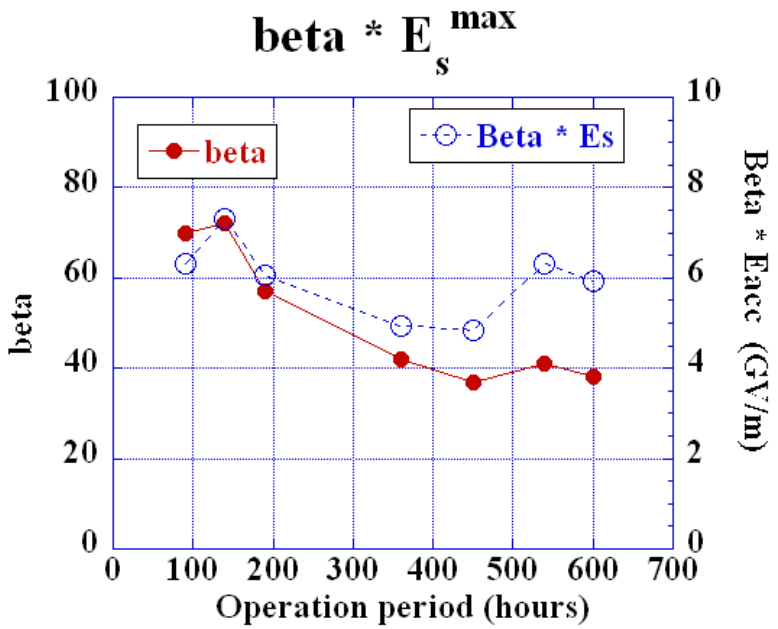


Eacc for peak dark current of 10 μA

90MV/m 70MV/m 40MV/m

Evolution of dark current till early April in TD18_Disk

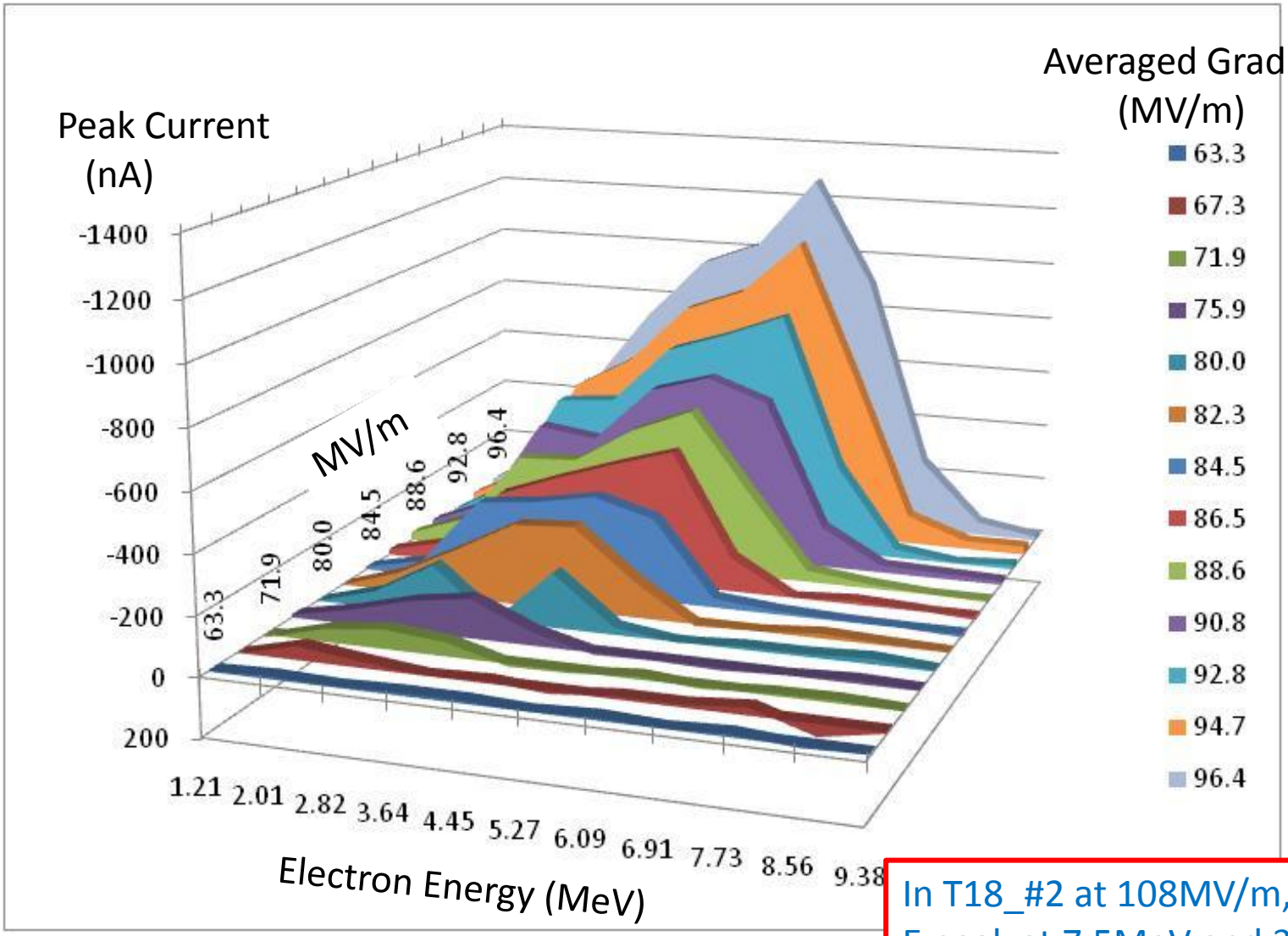




Dark current reduced by three order of magnitude.
It followed roughly modified F-N formula.
β reduced from 70 to 40.
$\beta * E_s^{max} \sim 5\sim7$ GV/m

TD18 Dark Current Energy Spectrum

252ns RF, 50pps; 56MW==100MV/m



In T18_#2 at 108MV/m,
E peak at 7.5MeV and 3.5MeV.
This is similar to TD18 shown here.

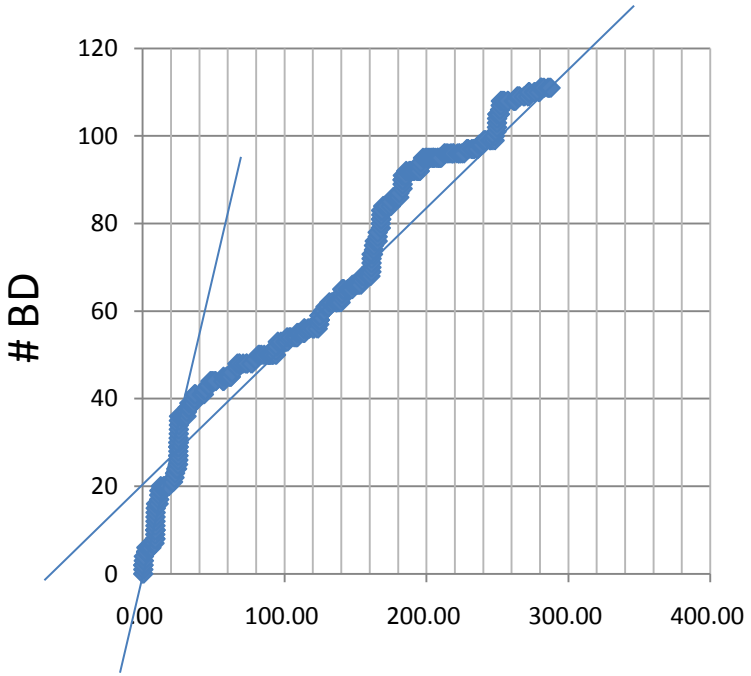
BDR evaluations

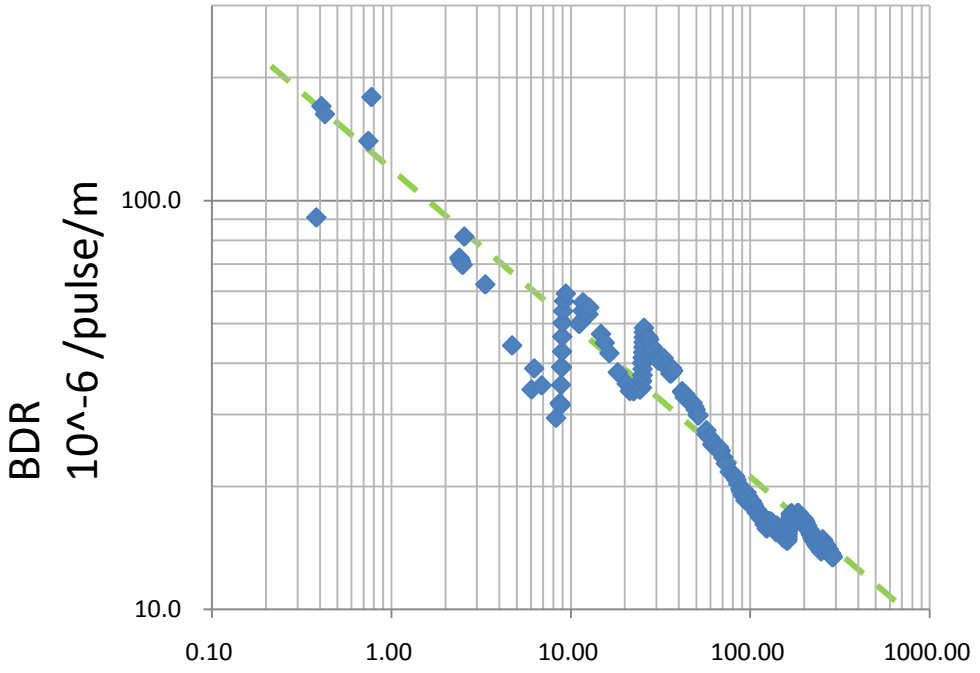
- Summarize all the taken data
- Longer pulse characteristics
- Double pulse with equal height

- To taste with TD18_#2 in this week
  - Switching among different pulse heights
  - Following pulses without stopping at breakdown

BDR of TD18_#2 at 252 ns

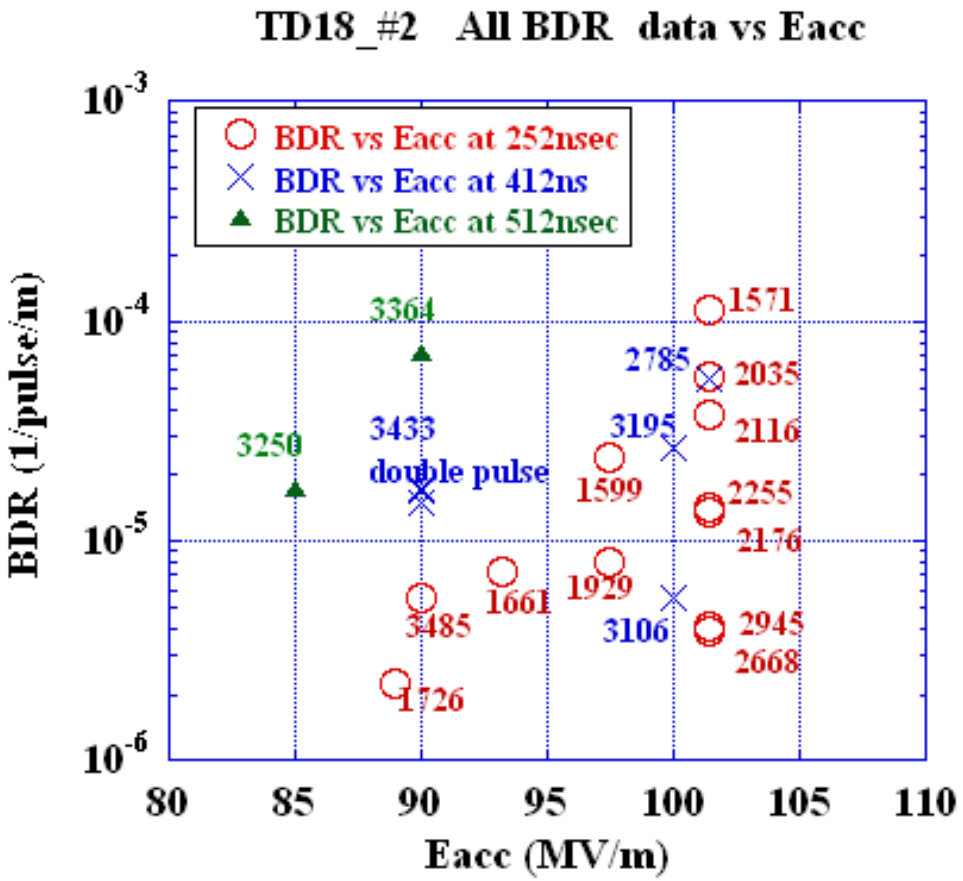
TD18_Disk_#2 BDR~ 1.3 x 10^{-5} /pulse/m]
during Run 51&52 (60MW, 252ns)
as of the total RF-ON period of 2255 hours





Still decreasing in a logarithmic time scale BDR ~ t^-0.38

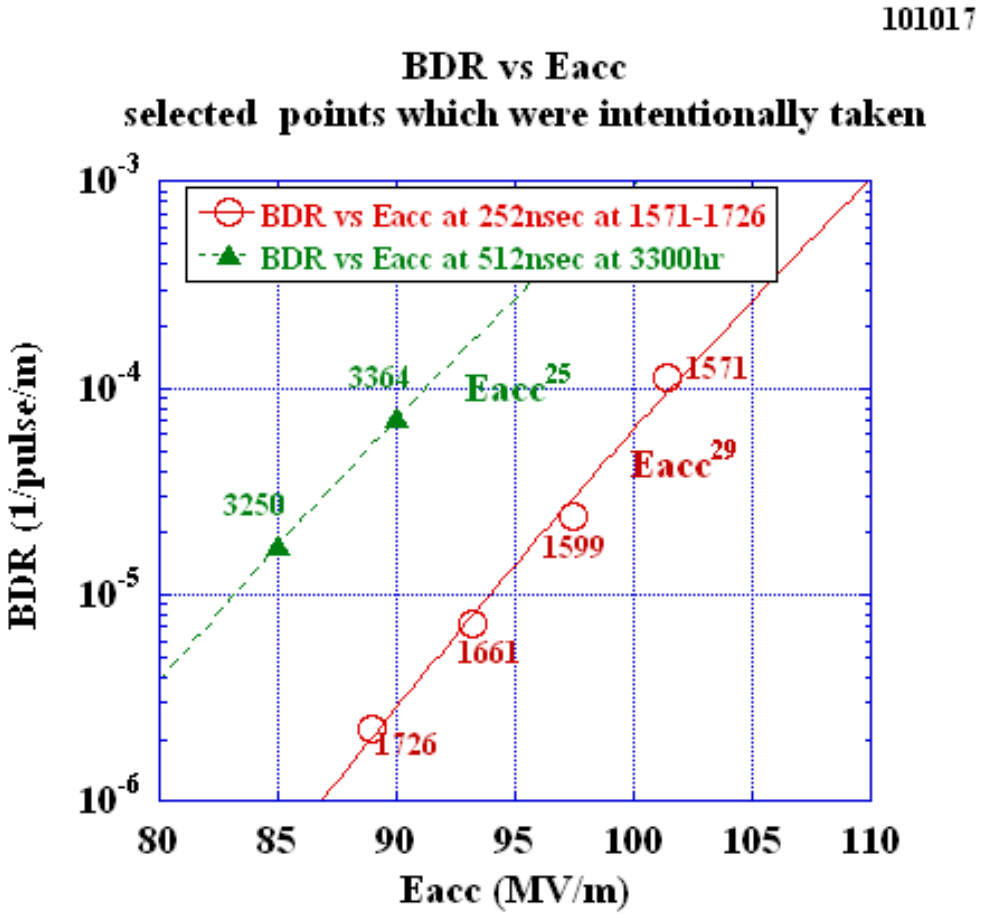
TD18_#2 all BDR vs Eacc



It seems difficult to get a smooth curve as function of Eacc by collecting all data points scattered in time and in operation parameter space.

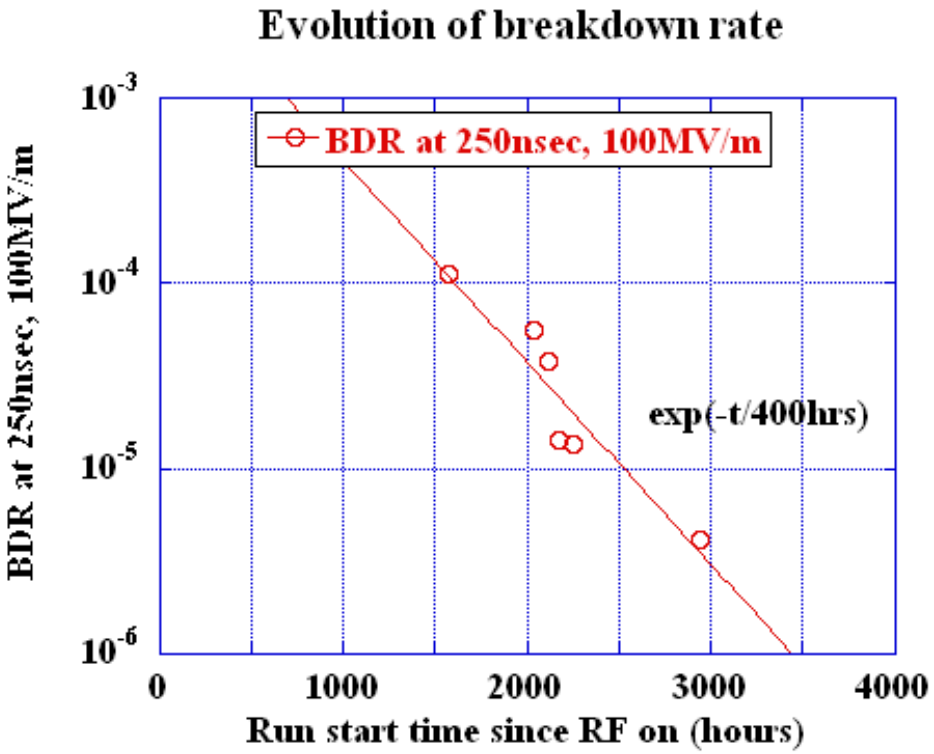
Usually we get a smooth curve by measuring intentionally with focusing to take data of BDR vs Eacc!?

Relevant data points of BDR vs Eacc



Steep rise as Eacc, 10 times per 10 MV/m, less steep than T18

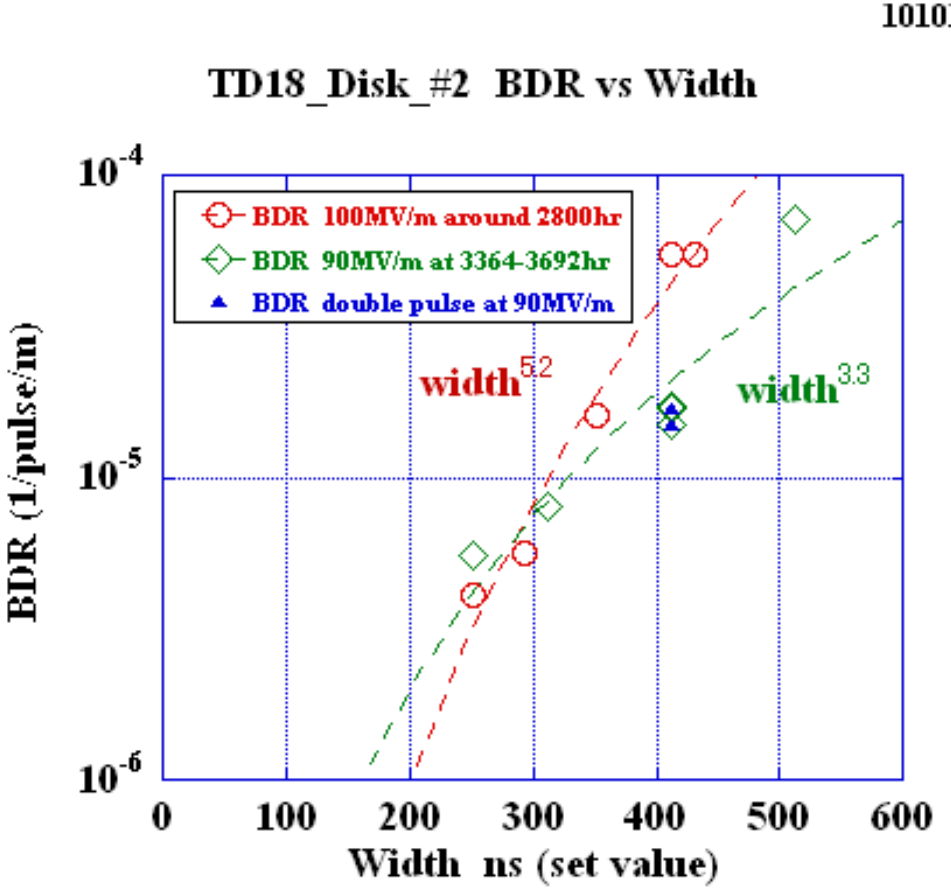
TD18_#2 Evolution of breakdown rate



Keep decreasing, but slow or already saturated?

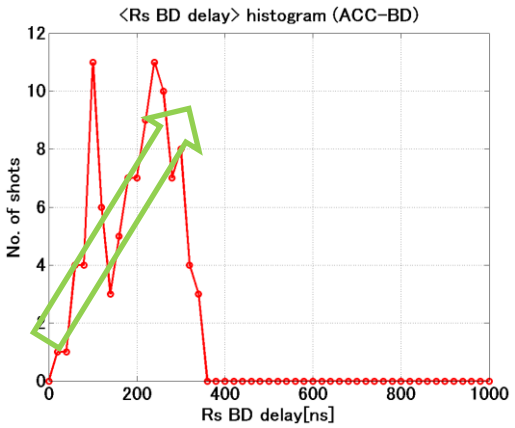
TD18_#2 BDR versus width

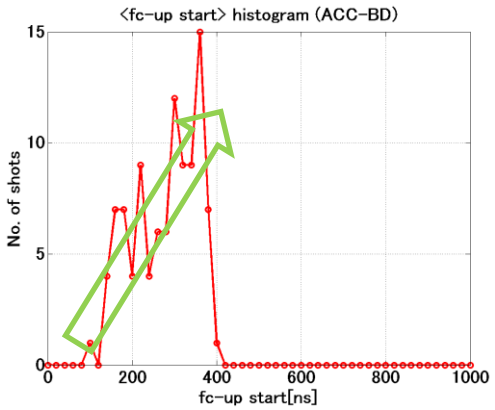
at 100MV/m around 2800hr and at 90MV/m around 3500hr

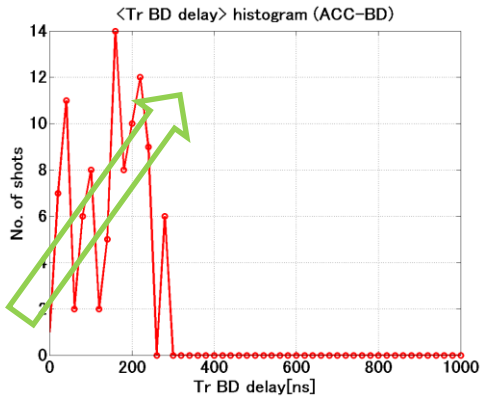


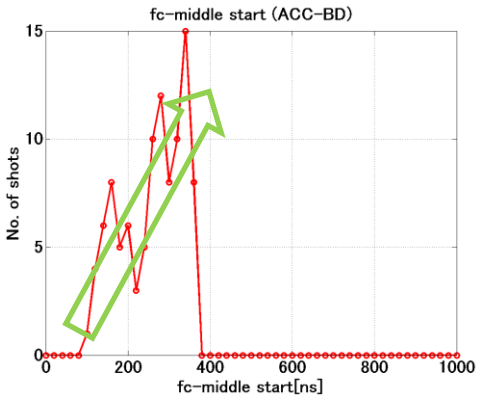
Similar dependence at 90 and 100 if take usual single pulse?

Run 51+52: 252nsec pulse BD start timing







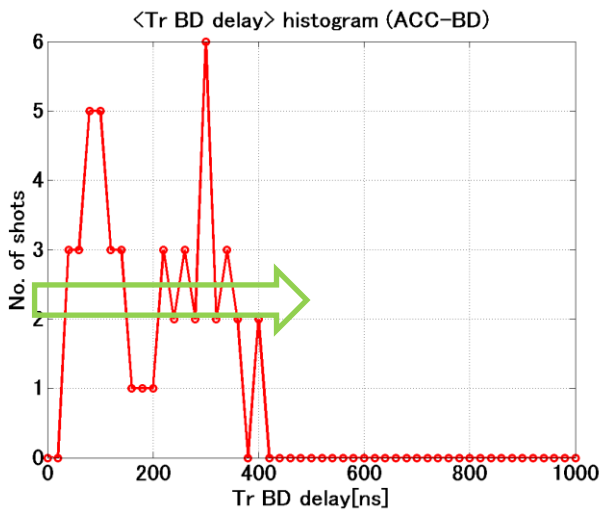


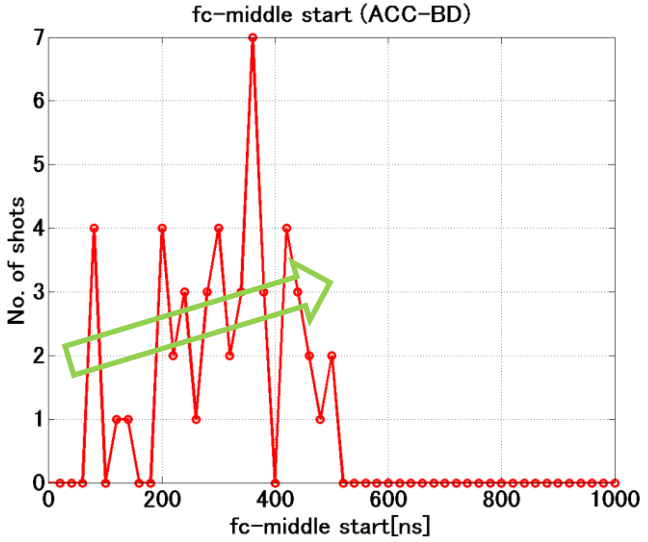
Roughly judging that

fc-mid, Tr-delay = ramping as time

→ triggrt source building up as time?

Run 82: 512ns BD start timing

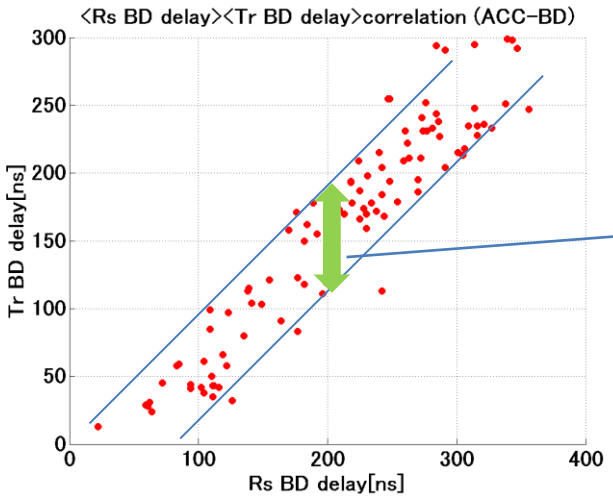




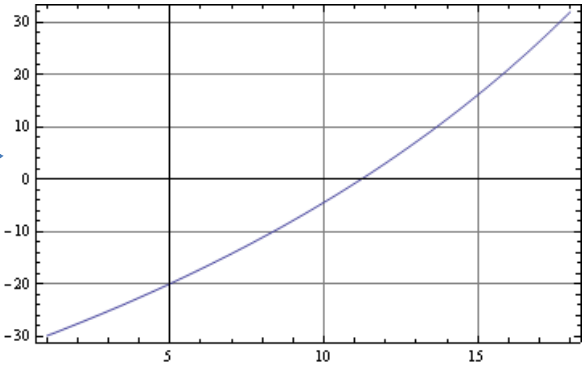
These data does not show such high sensitivity as the previous page.

Distribution is not so heavily rising vs time comparing to the dependence of BDR versus pulse width such as width$^{5\sim6}$.

Where in the structure the breakdown happens?

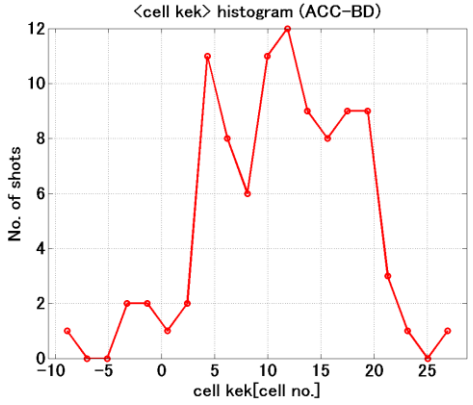


Time difference between Rs and Tr

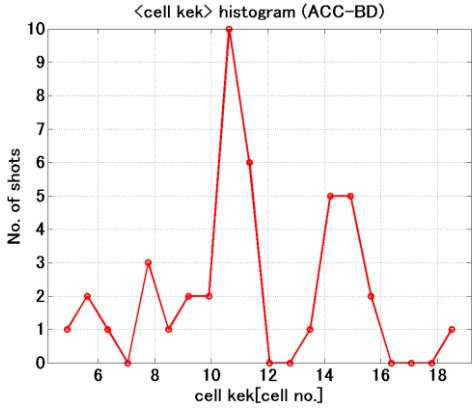


Cell#

51+52 BD position

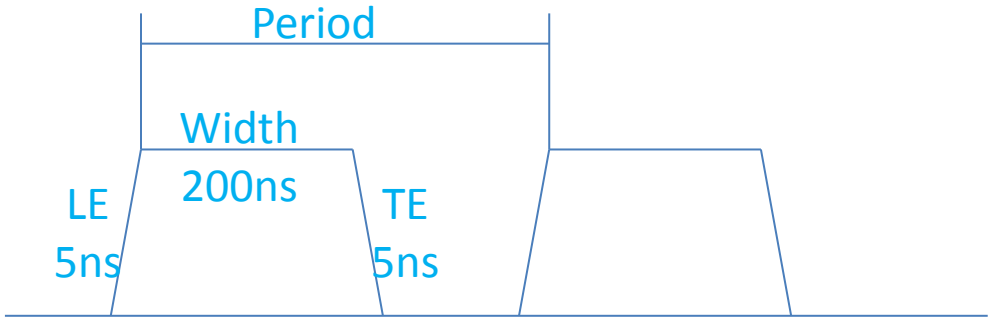


82 BD position

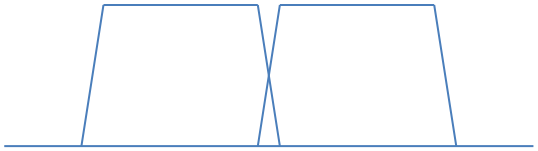


More statistics for us to be confident on distribution. Simply add all cases?

Double pulse operation



200 + 10 + 200



FG set value
Period=210ns
Width=200ns

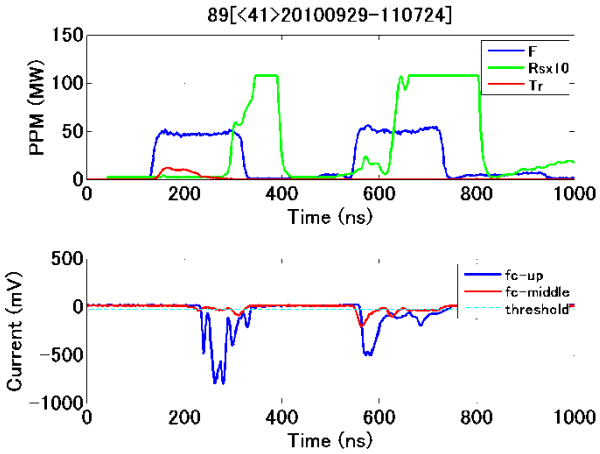
Double (200+10+200)
= Single (410ns eq.)
in Run 71
(30 June – 1 July ---)

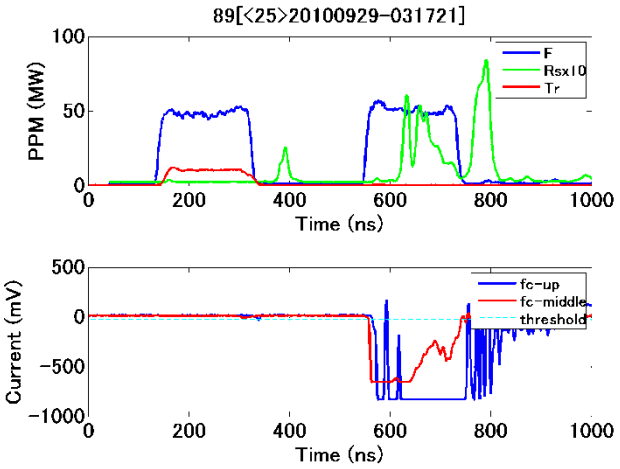
200 + 210 + 200

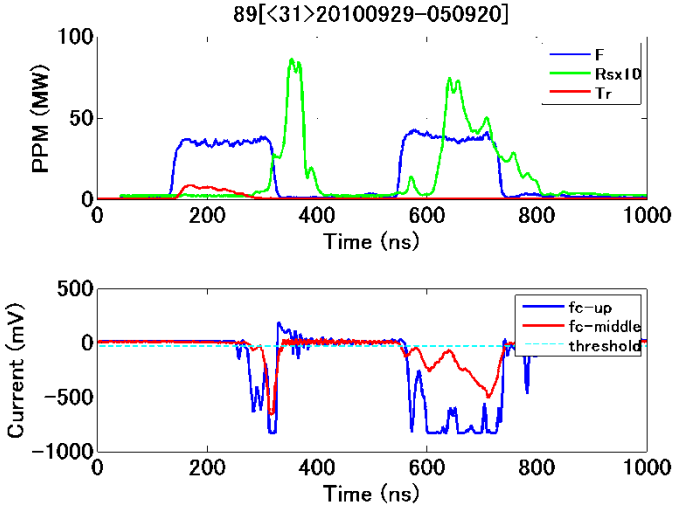
FG set value
Period=410ns
Width=200ns

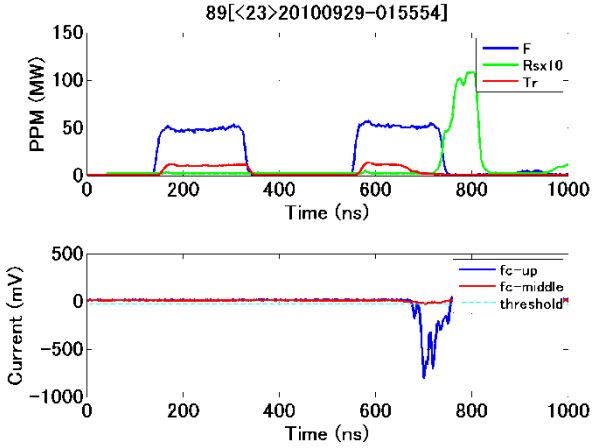
Double (200+210+200)
= Single (2000 or 400ns eq.??)
in Run 72, 73, 74, 89, …

Run 89: Double pulse at 90 MV/m

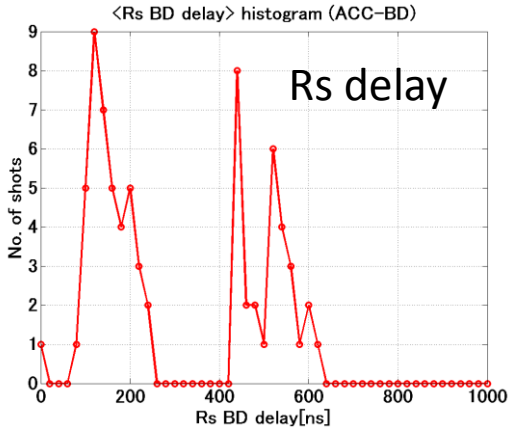


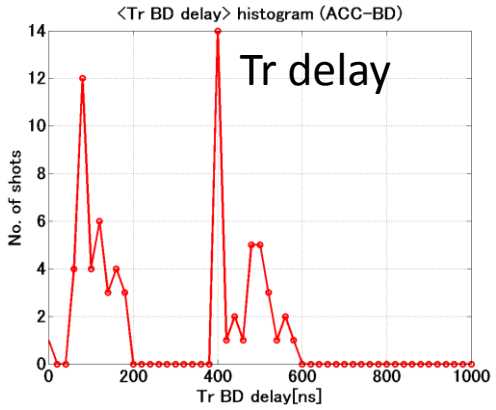


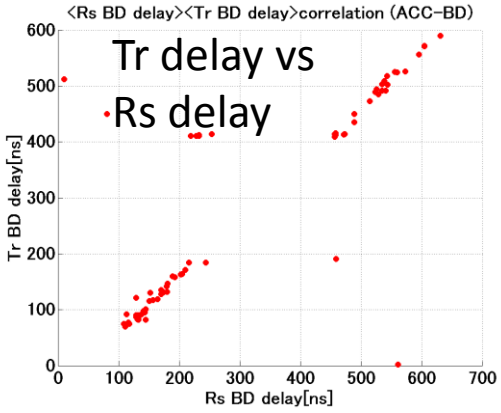


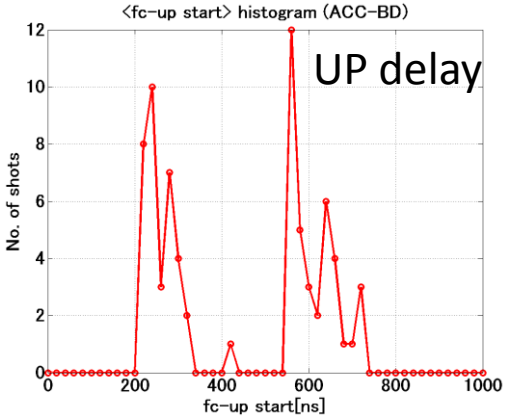


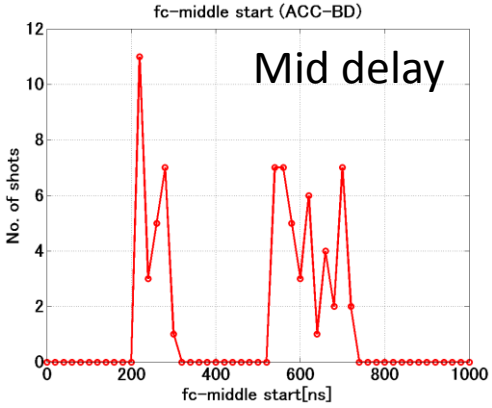
BD trigger timings are equally distributed in the former and latter halves

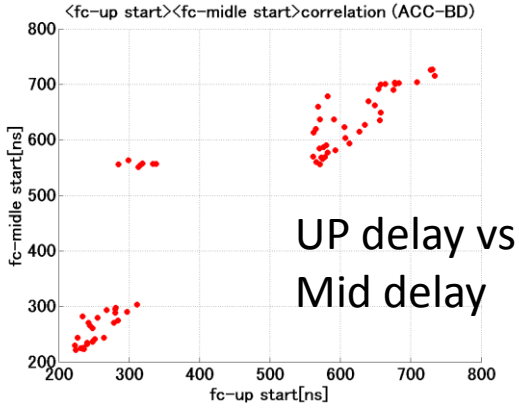




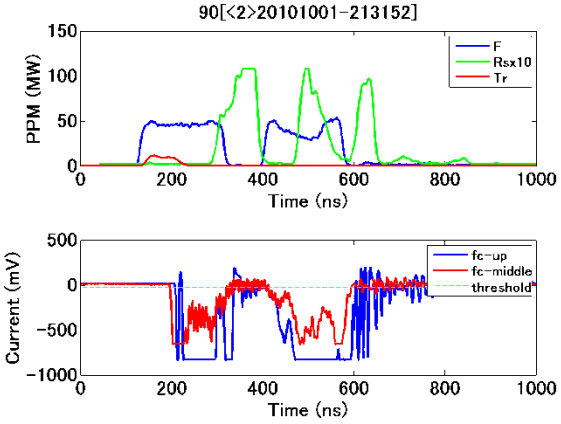


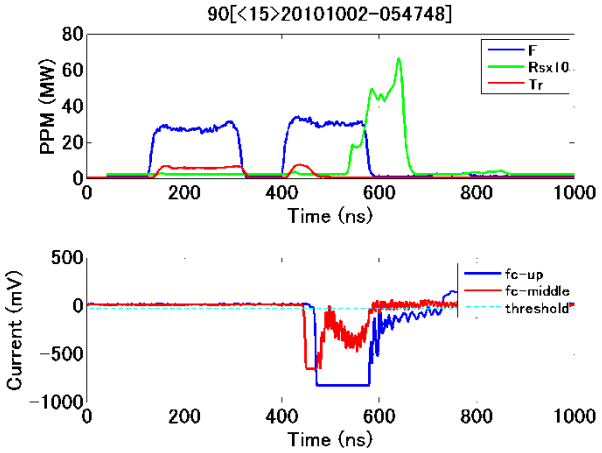


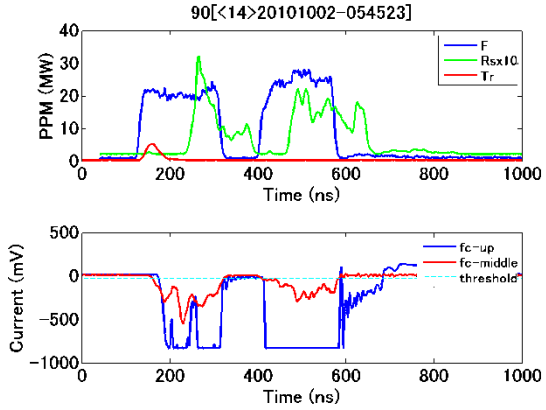


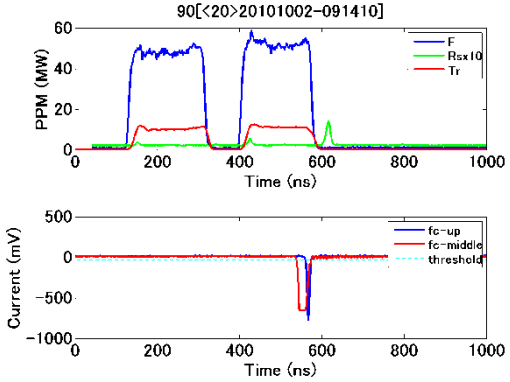


Run 90: Close double pulse at 90 MV/m

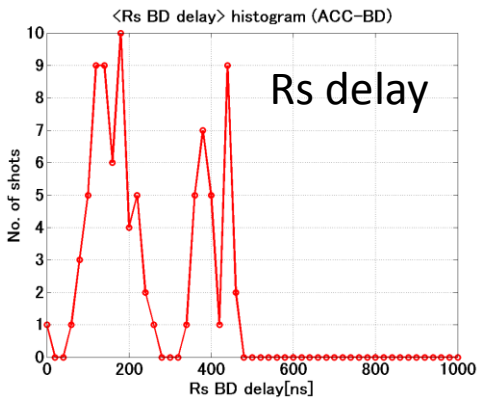


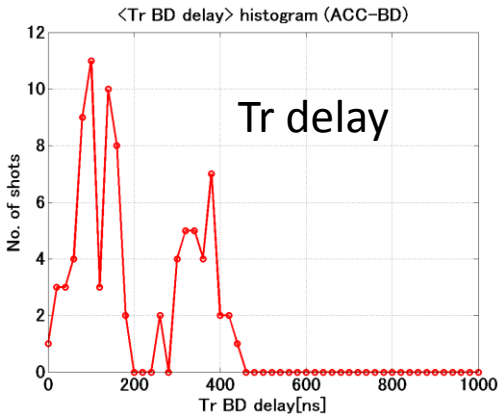


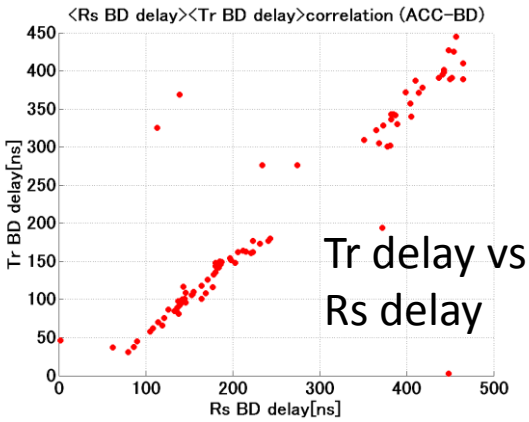


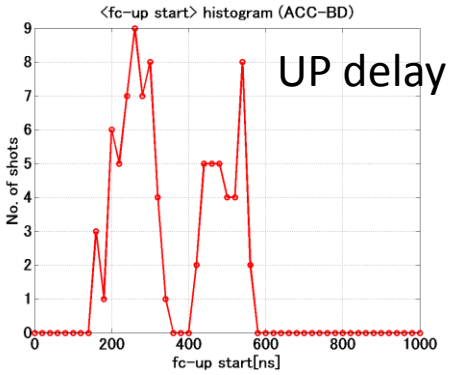


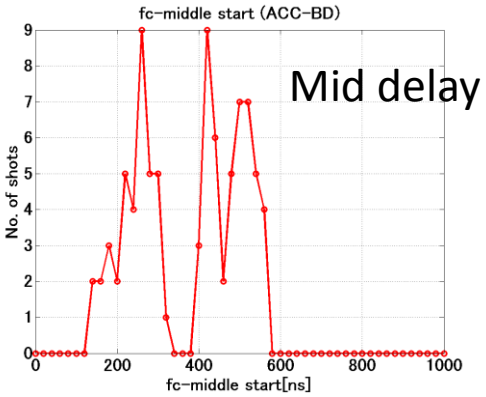
BD trigger timings are equally distributed in the former and latter halves

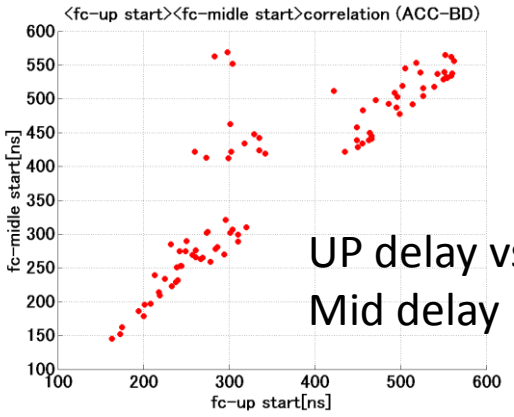




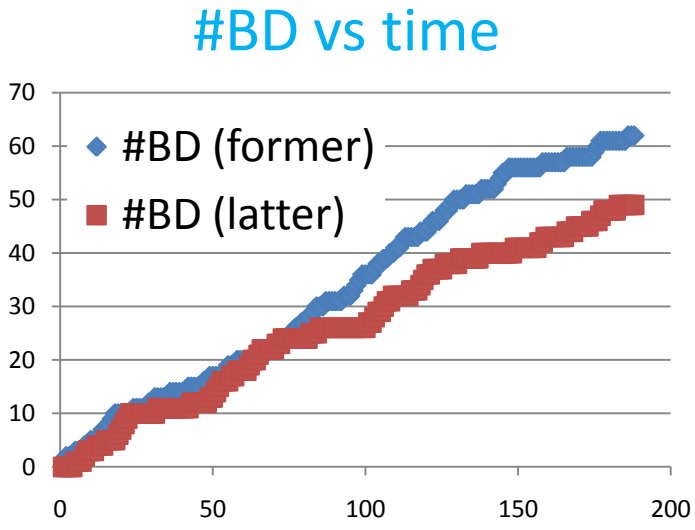


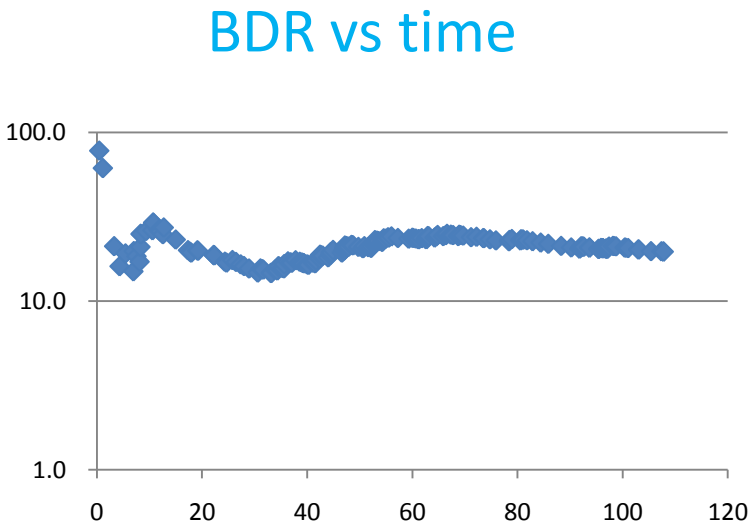






Run 90: 200+50+200 90MV/m double pulse





BD pulse shape confirmed by eye BDR[*10^{-5} BD/pulse/m]

BDR_Former pulse = 31BD/93hrs → 1.0

BDR_latter pulse = 26BD/93hrs → 0.84

BDR_total = 57BD → 1.84

Almost the same BDR for each pulse, former and latter

Structure fabrication related problem?

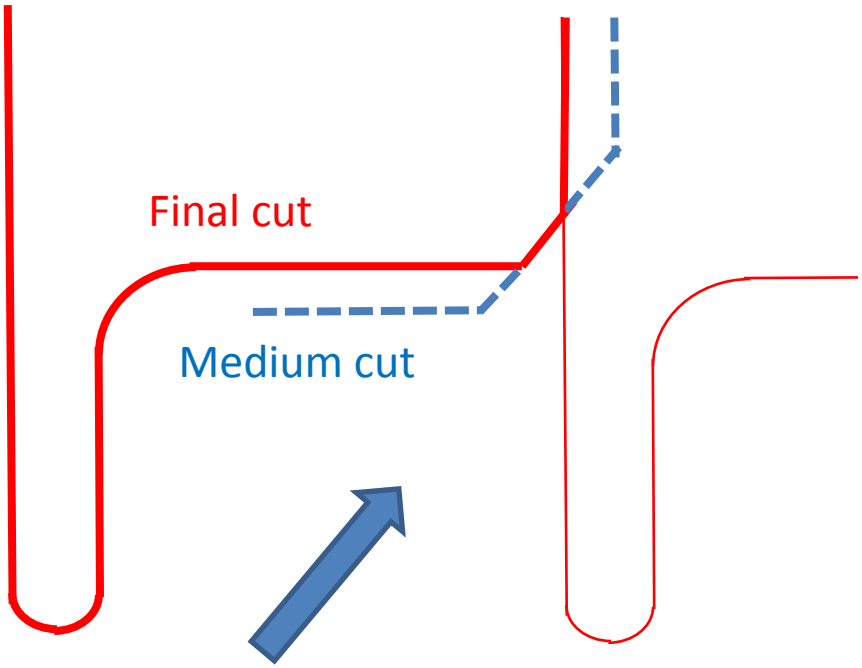
- We see from SEM view of TD18_#3 got by CERN that there may be a gap between cells, especially at the most high magnetic field and periphery.
- It may simply be due to chamfer.

- I have still some concern on the flatness, important for robust diffusion bonding.
- Flatness of T18 and TD18 was not good, in many cells it was more than a micron level. We accepted the cells with such big deviation from flat if it becomes better than 0.5 micron when sandwiched by flat surfaces. But this may not be good enough.

- Happy to see the bonding quality check by cutting at CERN.

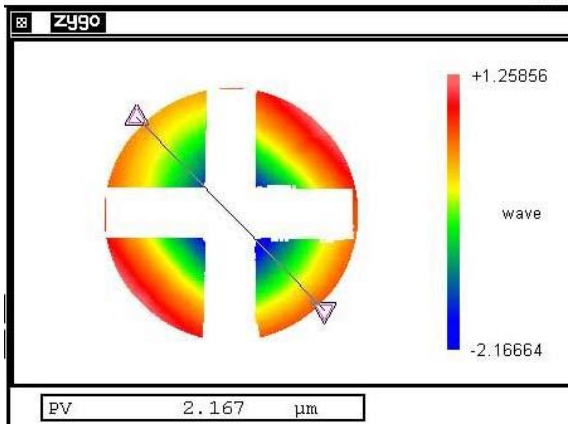
Diffusion bonding area

SEM view of TD18_#3
by M. Aicheler

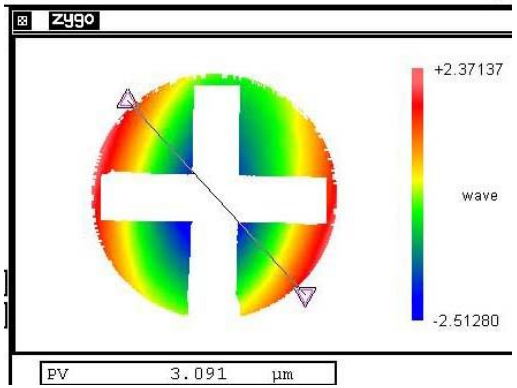


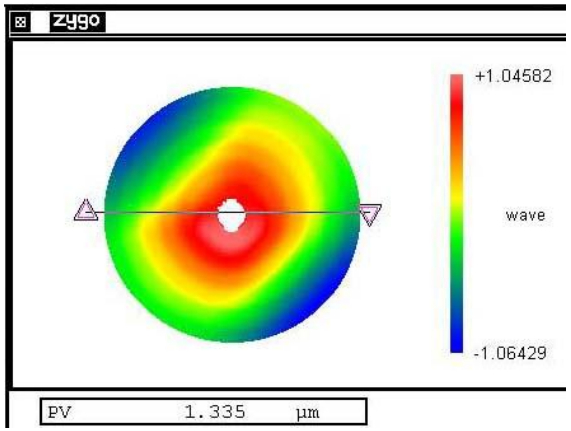
Flatness of cells for TD18_#2

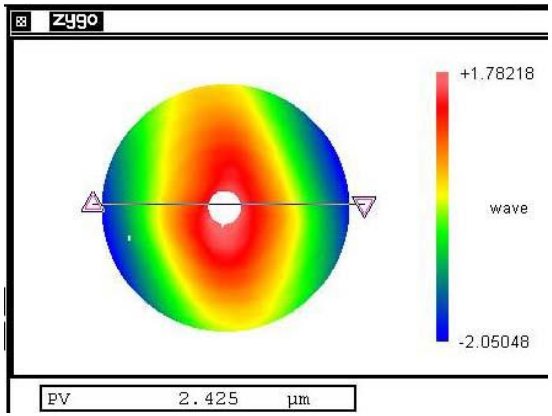
TD18_#2_15b



TD18_#2_09b_2

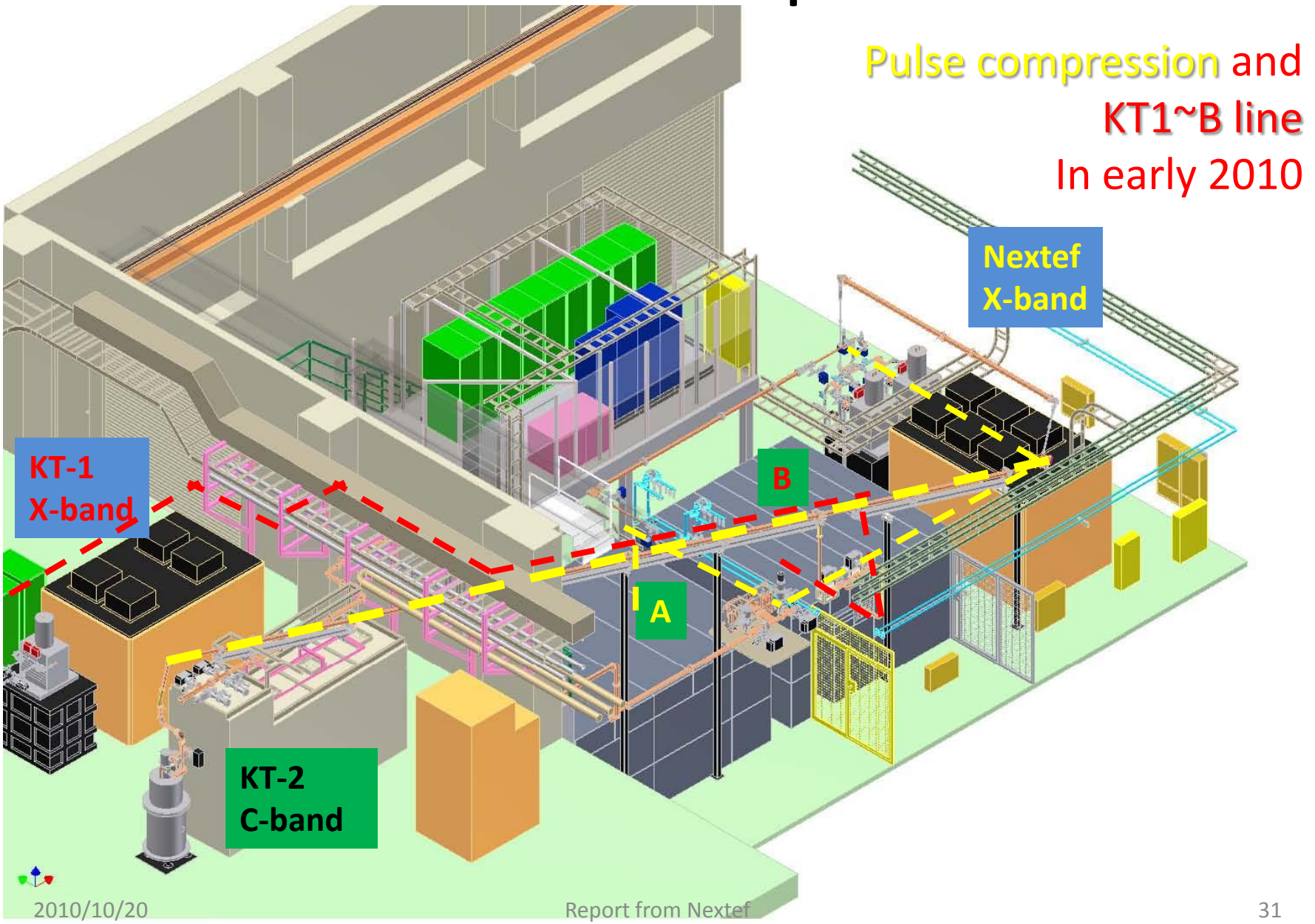






Even ~3 micron flatness was accepted as long as the opposite side was reversely deformed. Mostly potato chip type but one or two cases the conical shape was accepted.

Nextef near future expansion



Fabrication of parts for PC and KT1-B

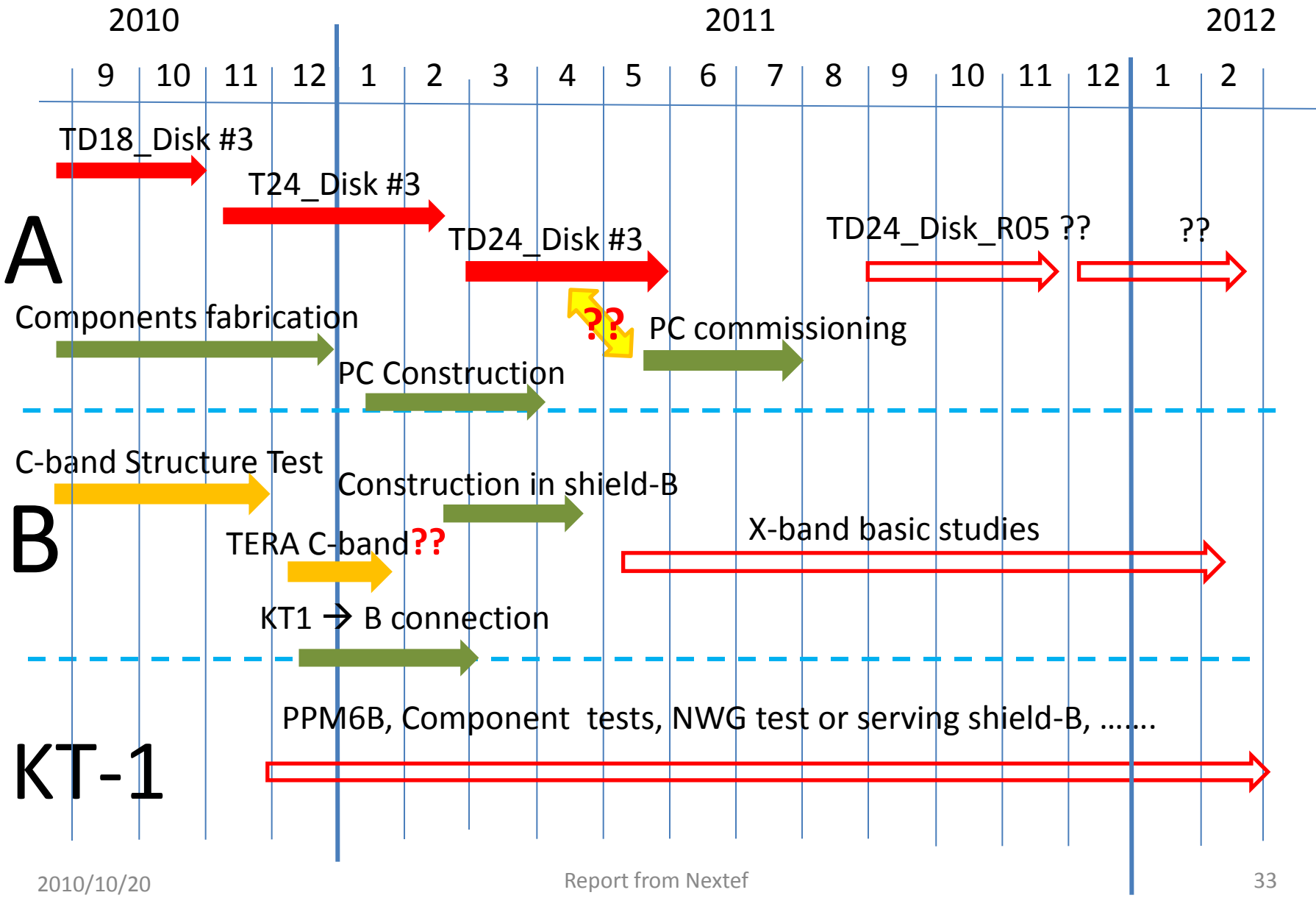
More than 80% fabricated.

A hole was made through a wall between KT1 and shield-B.

Installation of KT1-B in early next year.

Pulse compression setup will follow KT1-B setup.

Nextef neat future plan revised as of IWLC10



Higashi / Dolgashev activities
Fundamental study with SLAC is kept going such as Mo/Cu or SUS/Cu and Moly

We are thinking to start the similar experimental study but more carefully at moderate gradient level as 80-100MV/m.

Our programs as a conclusion from Nextef

- Nextef will run fully dedicated for the feasibility study of CLIC high gradient evaluation
- Nextef will boost peak power and high power stability by introducing pulse compression system
- We try to establish a test area in addition to Nextef for key studies