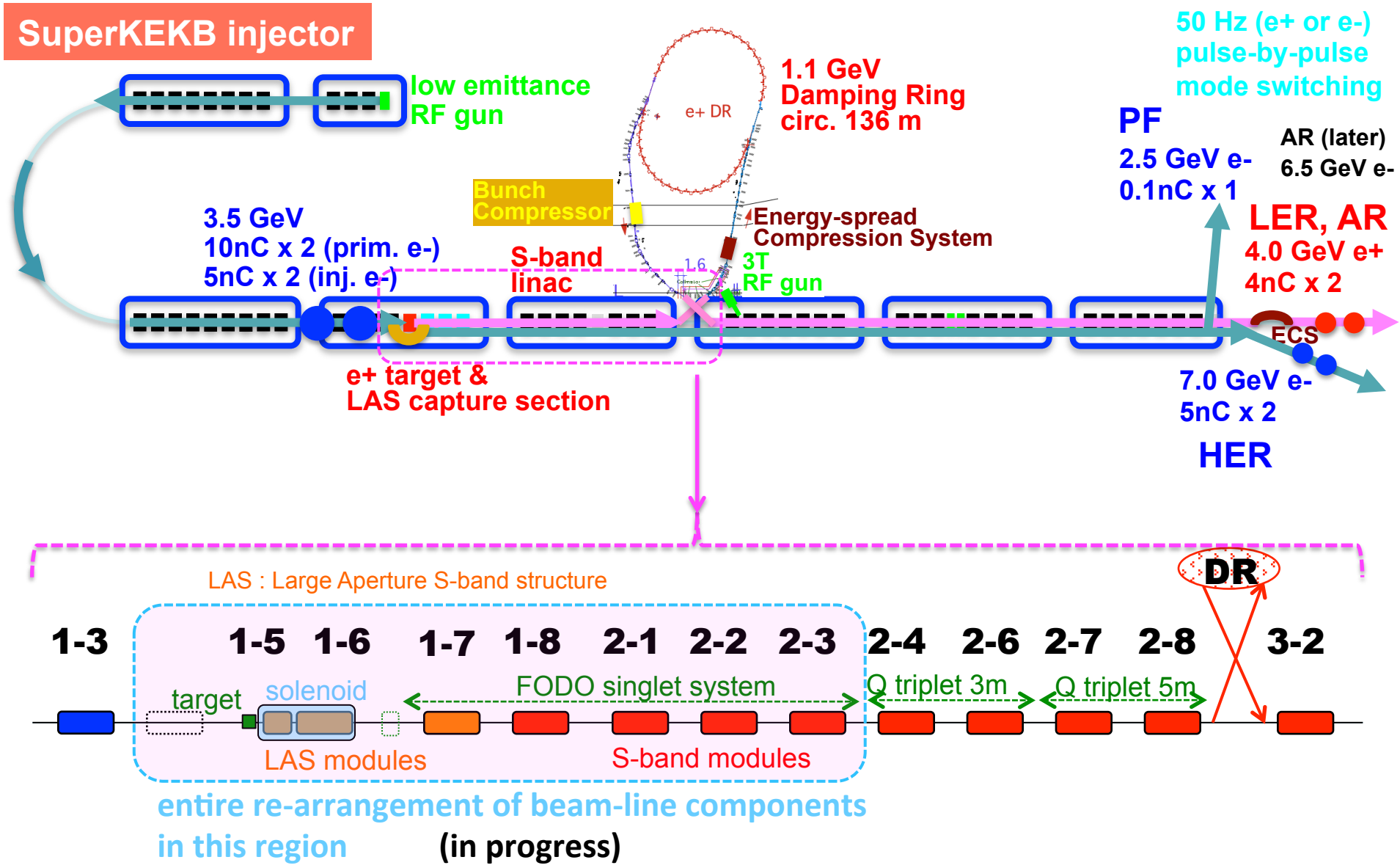
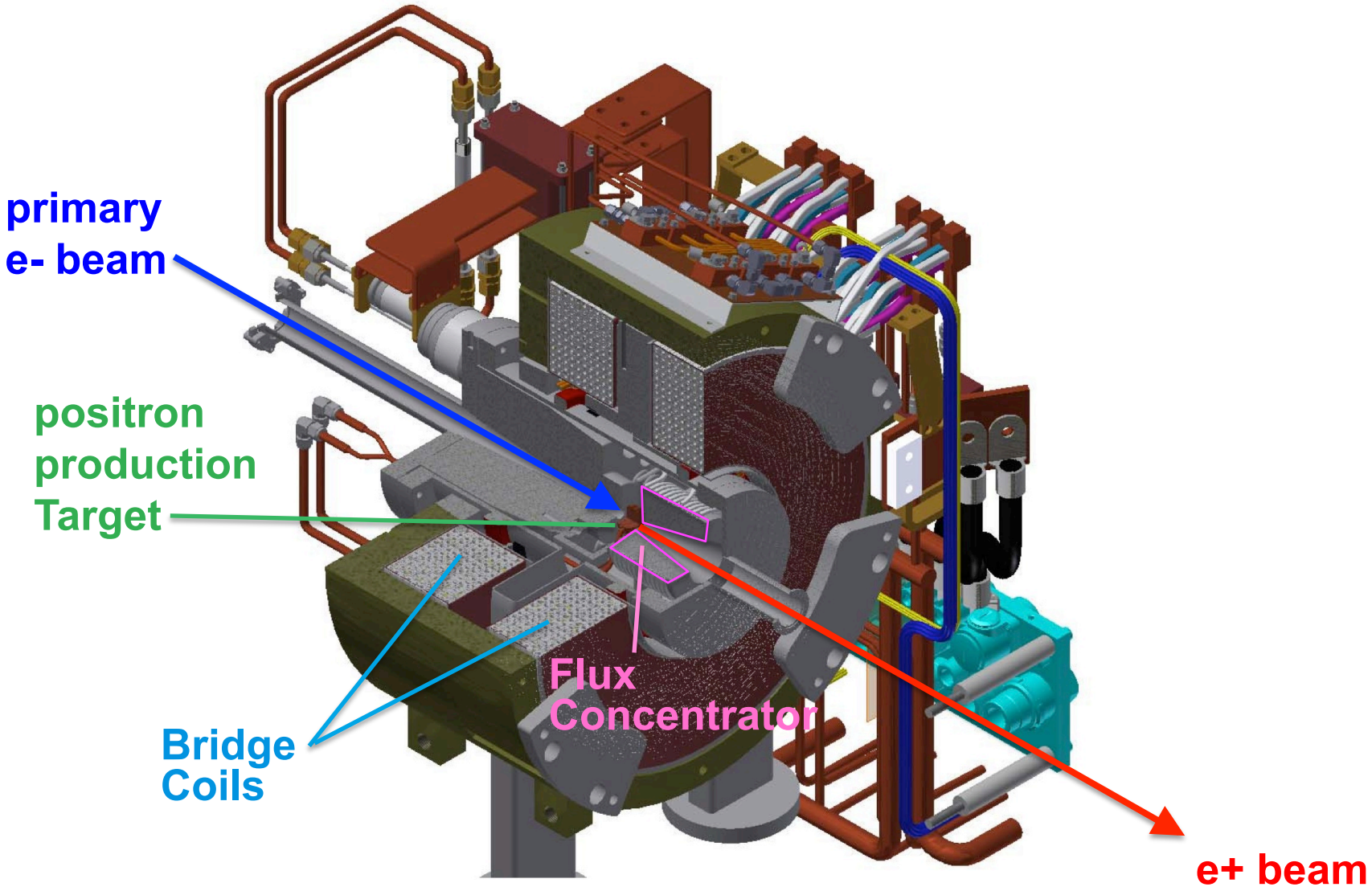
Positron Source Upgrade

KEKB injector linac
Takuya Kamitani

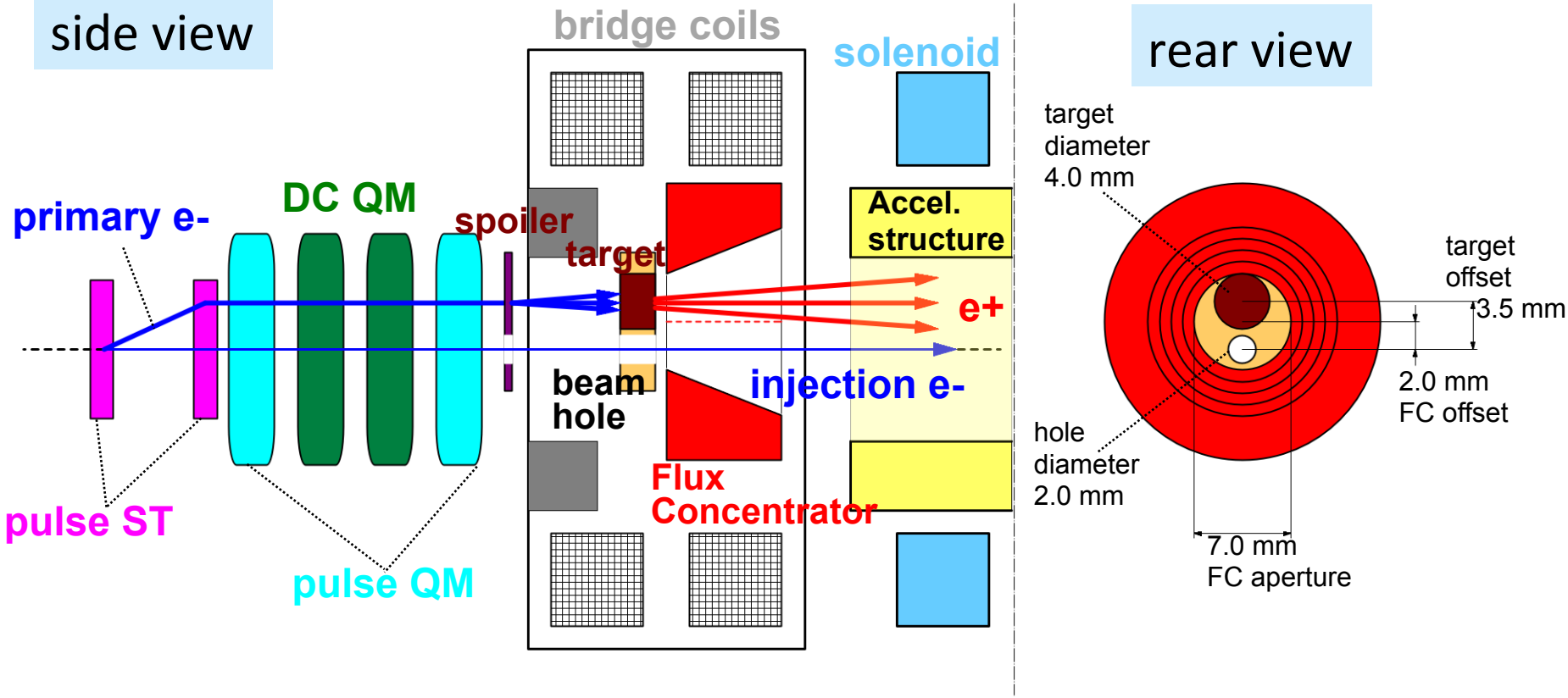
SuperKEKB Injector



SuperKEKB positron source



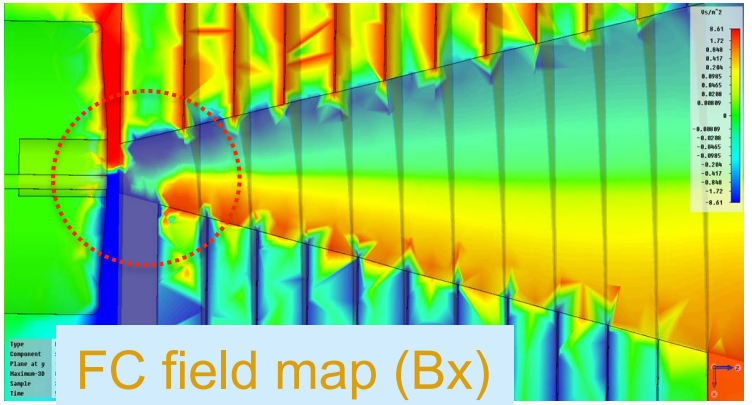
target offset & beam hole

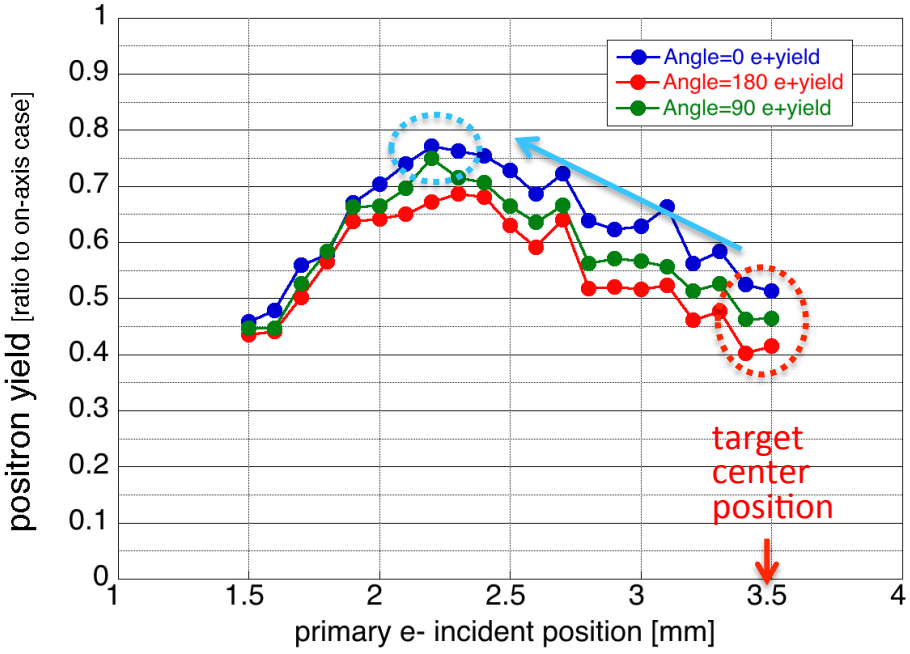


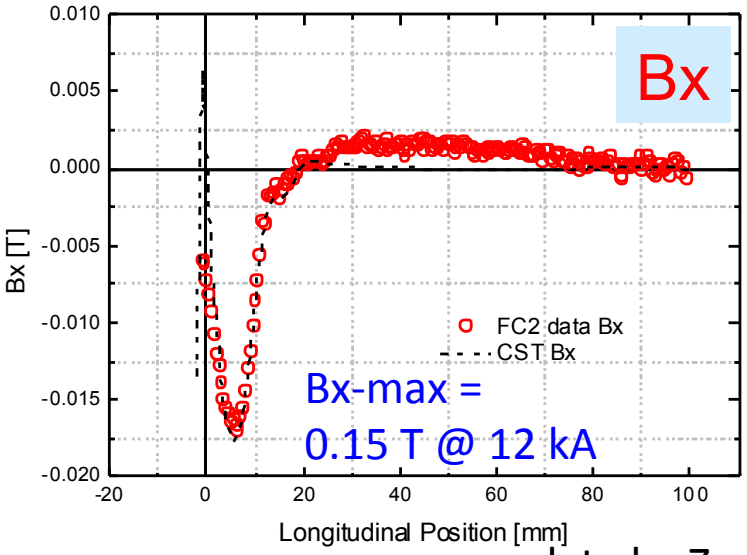
- injection e- beam : on axis to preserve low emittance
- primary e- beam : 2.7 mm off axis
  (target offset 3.5 mm, FC offset 2.0mm)

e+ yield degradation by target offset

- e+ yield degrades ~50 % by offset e+ generation
- it can be improved to 78 % by
  - utilizing transverse kick by proper orientation of FC slit
  - e- incident position optimization



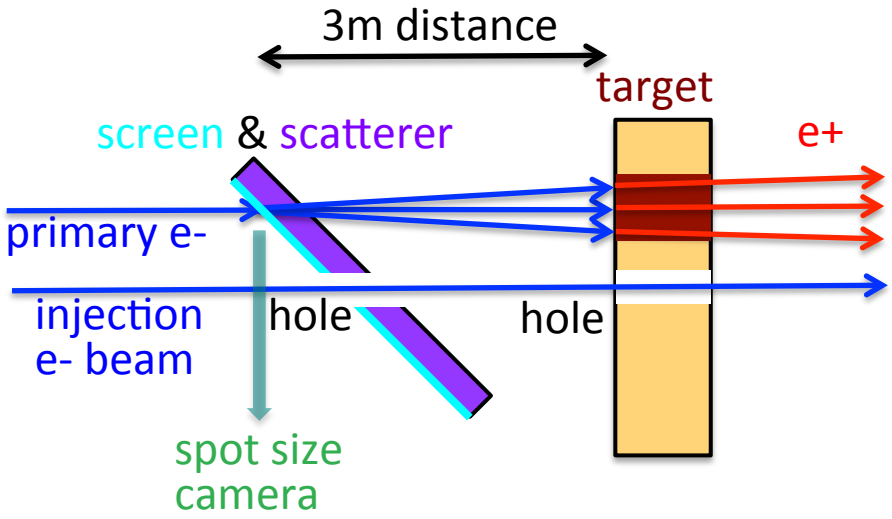


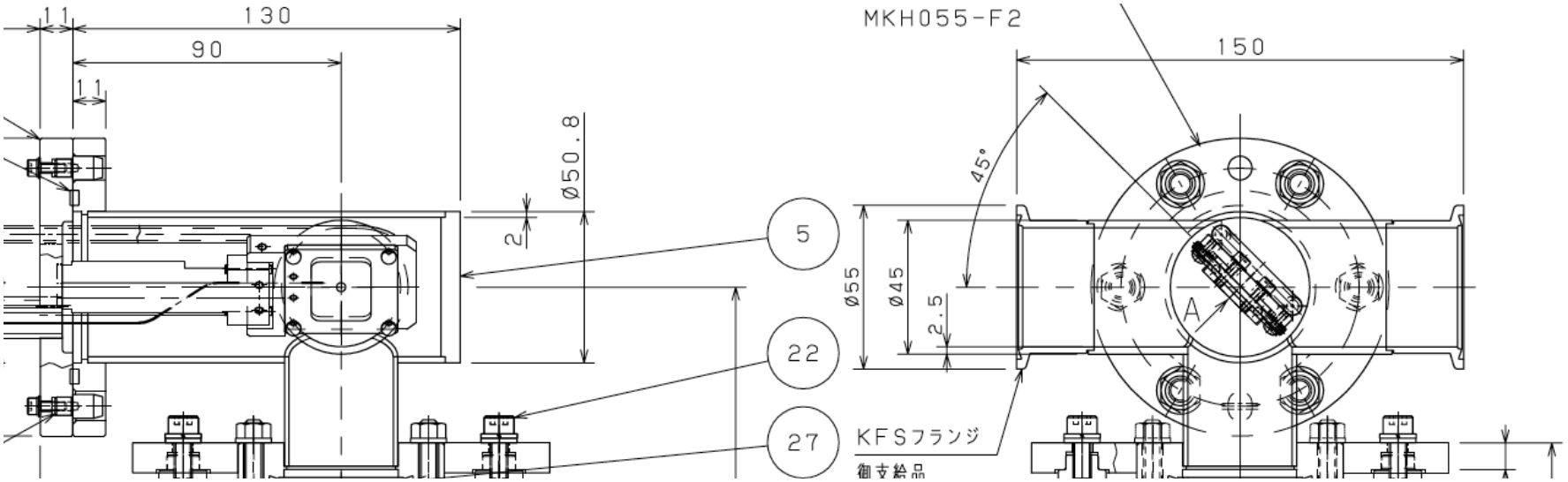


data by Zang Lei

beam spoiler

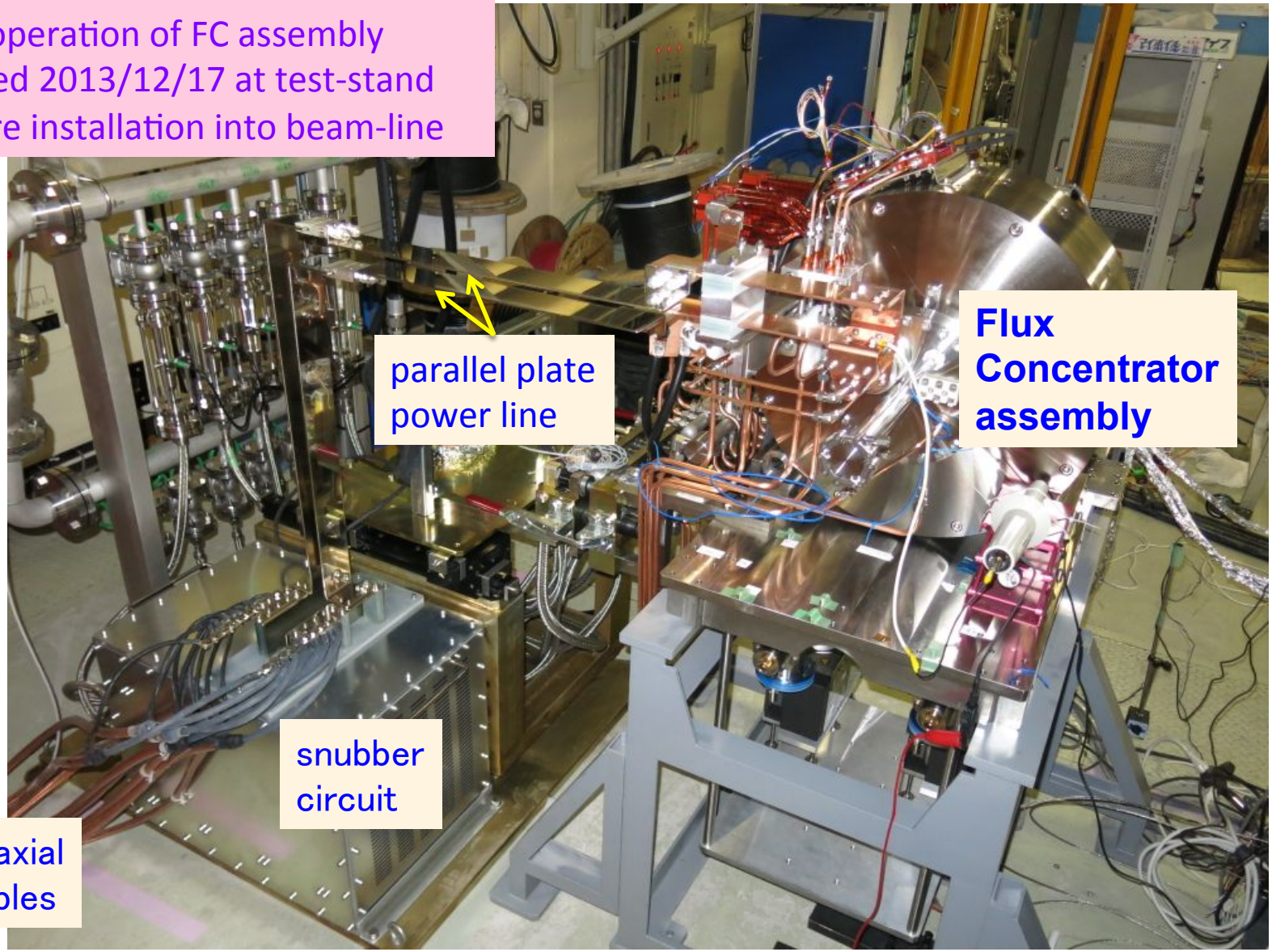
- **beam spoiler** to enlarge beam spot on target to be $\sigma_x, \sigma_y > 0.7$ mm to avoid target destruction
- spot size monitoring screen Al_2O_3 (0.14 mm thick)
  + scattering Al foil (0.25 mm thick)
  [total material thickness = 0.05 X_0]





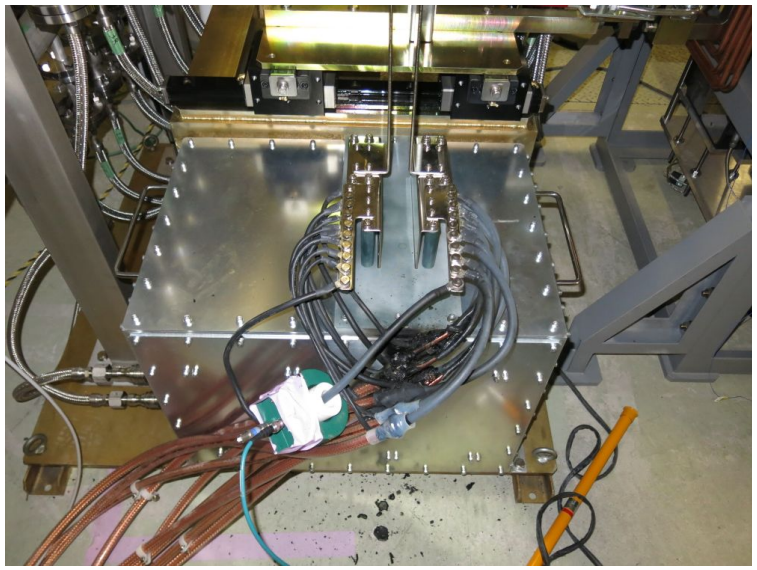
FC Test-stand at KLY gallery

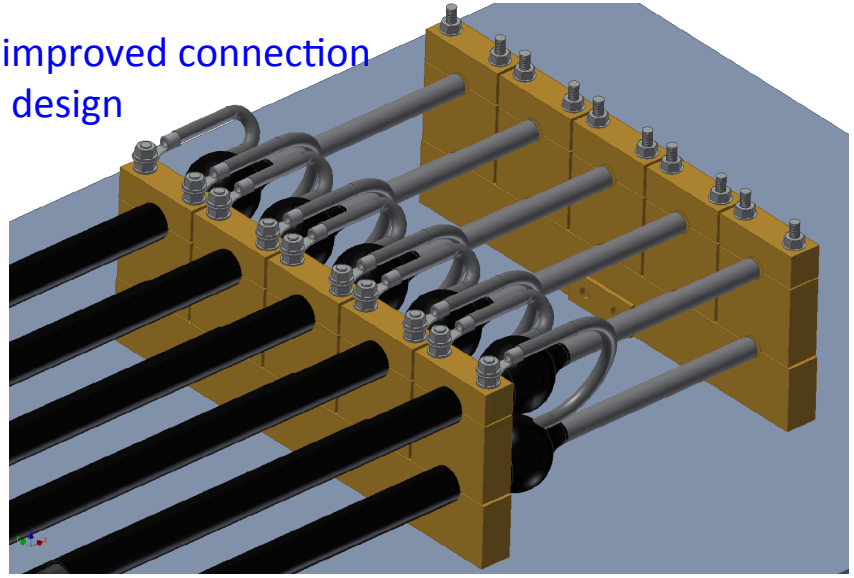
test operation of FC assembly started 2013/12/17 at test-stand before installation into beam-line



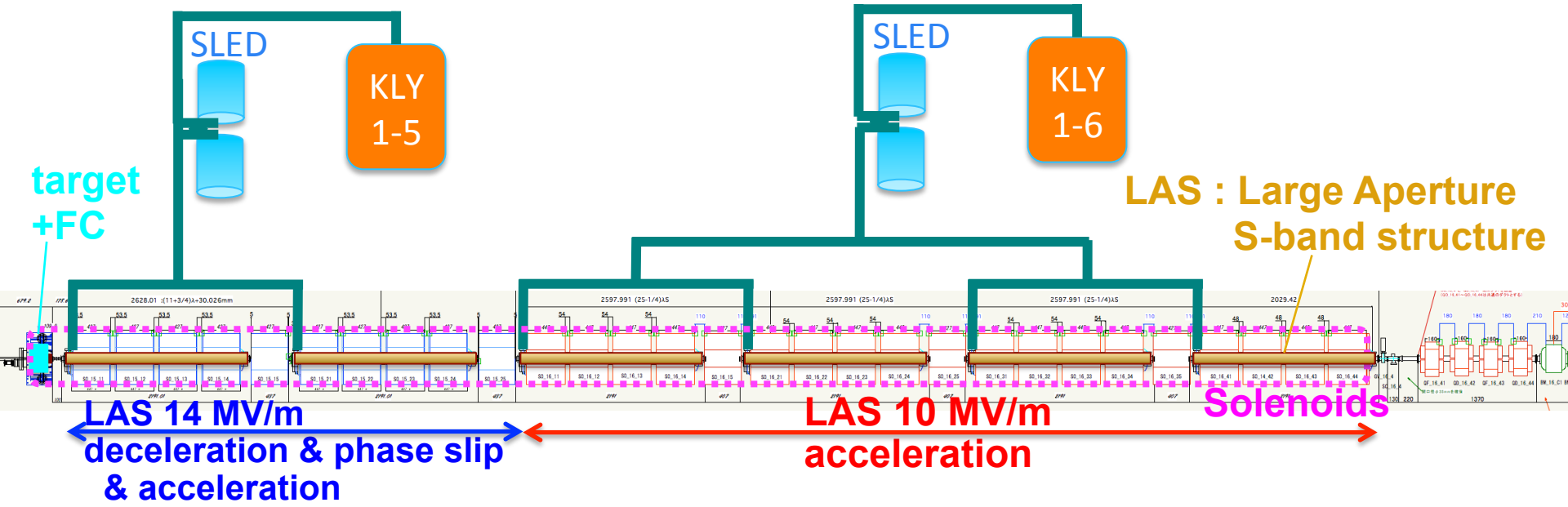
FC test stand fire accident

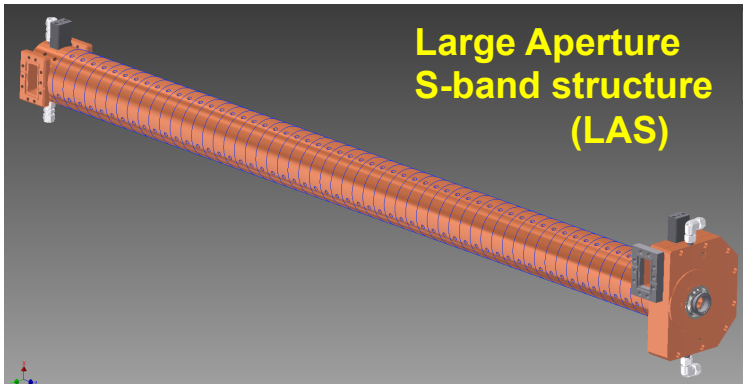
- fire accident during operation test on 2013/12/21, 22
- power cable burned at the connection to snubber circuit
- improved cable connection and new snubber circuit under fabrication
- restart test operation in April 2014
  beam line installation in May 2014





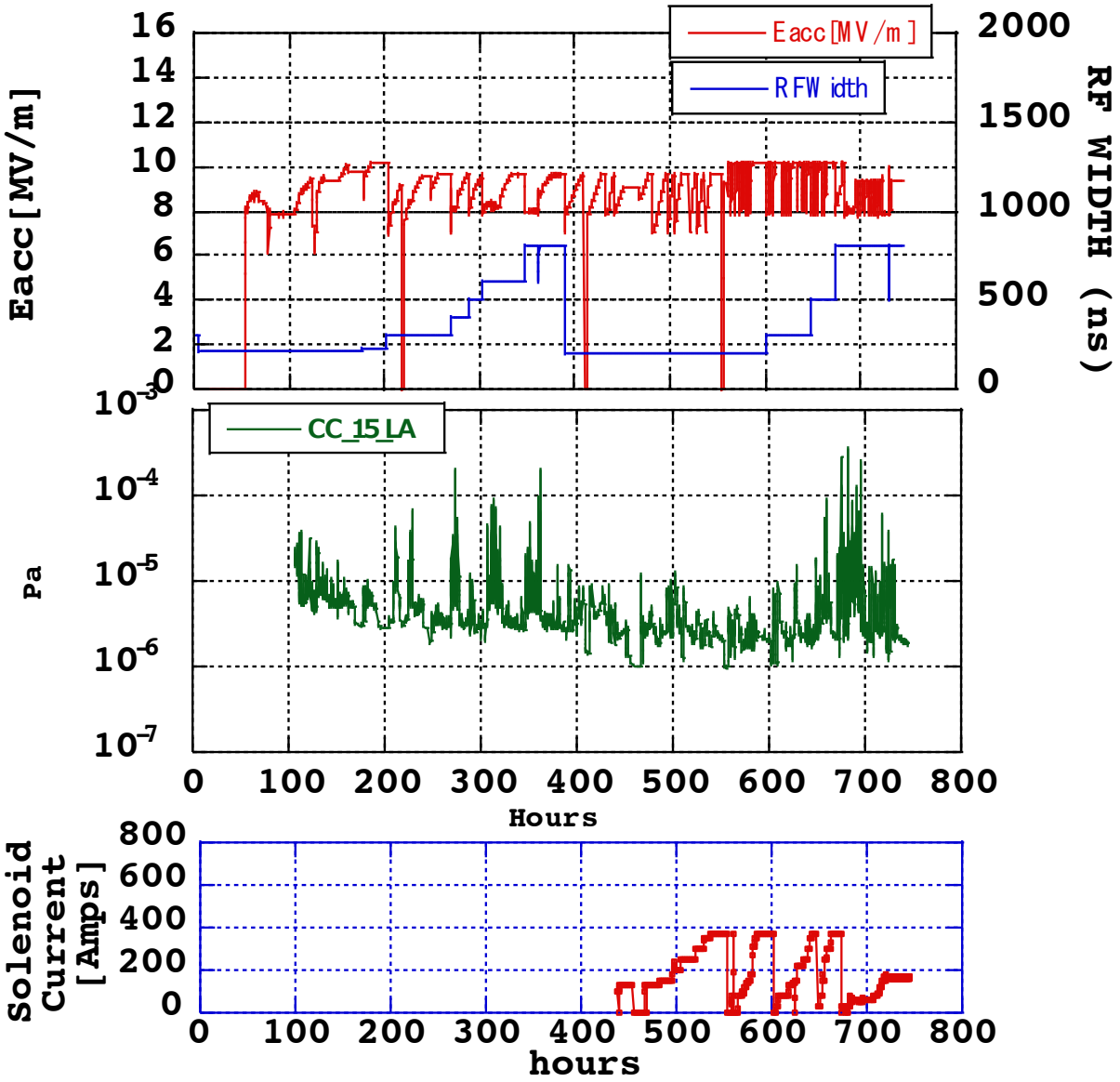
Positron Capture Section





- LAS with SLEDs for sufficient field gradient
- breakdown issue of LAS in solenoid field
- needs careful RF conditioning

unit 1-5 RF conditioning history

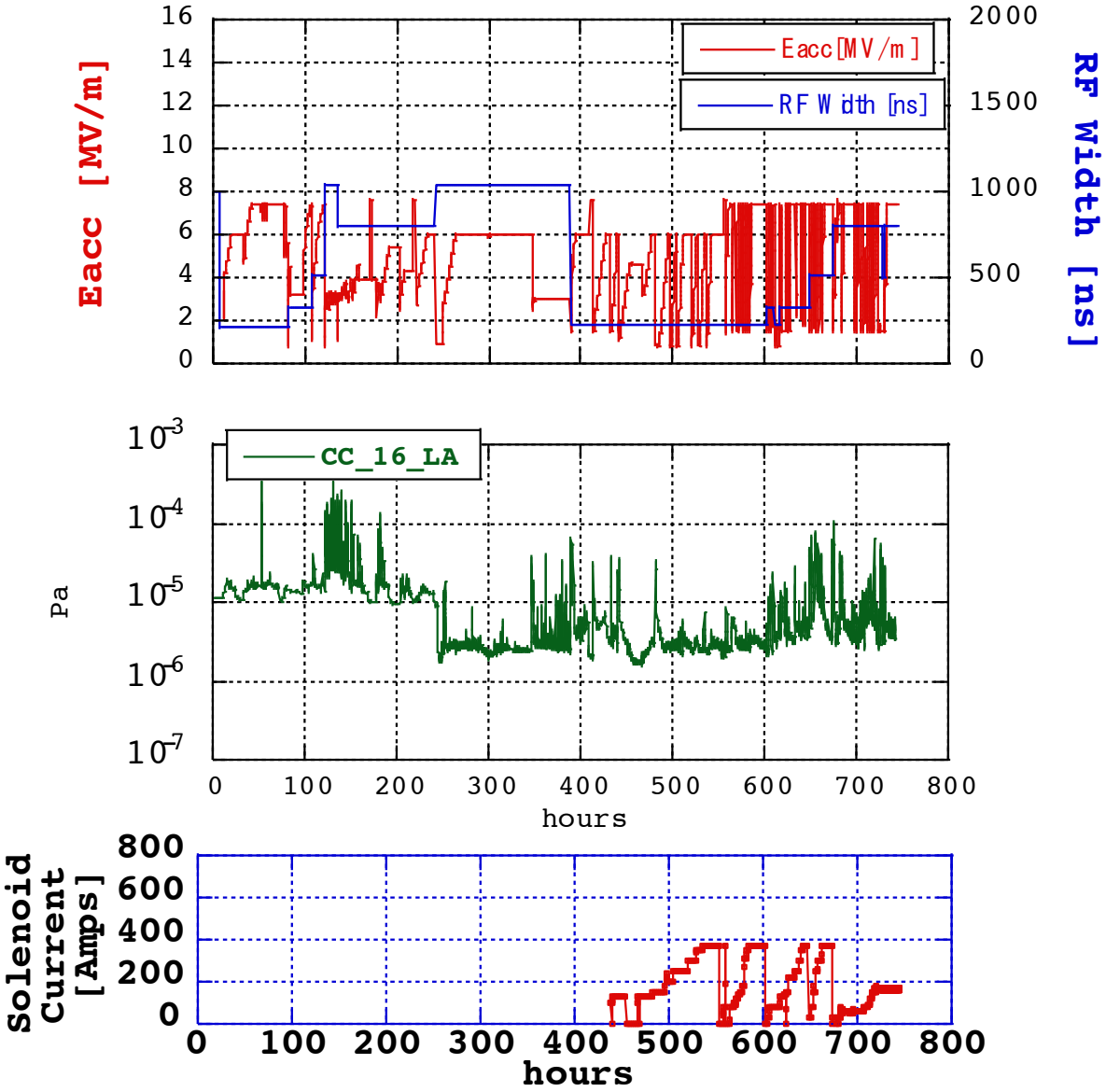


1-5 unit

RF conditioning

in solenoid field

unit 1-6 RF conditioning history

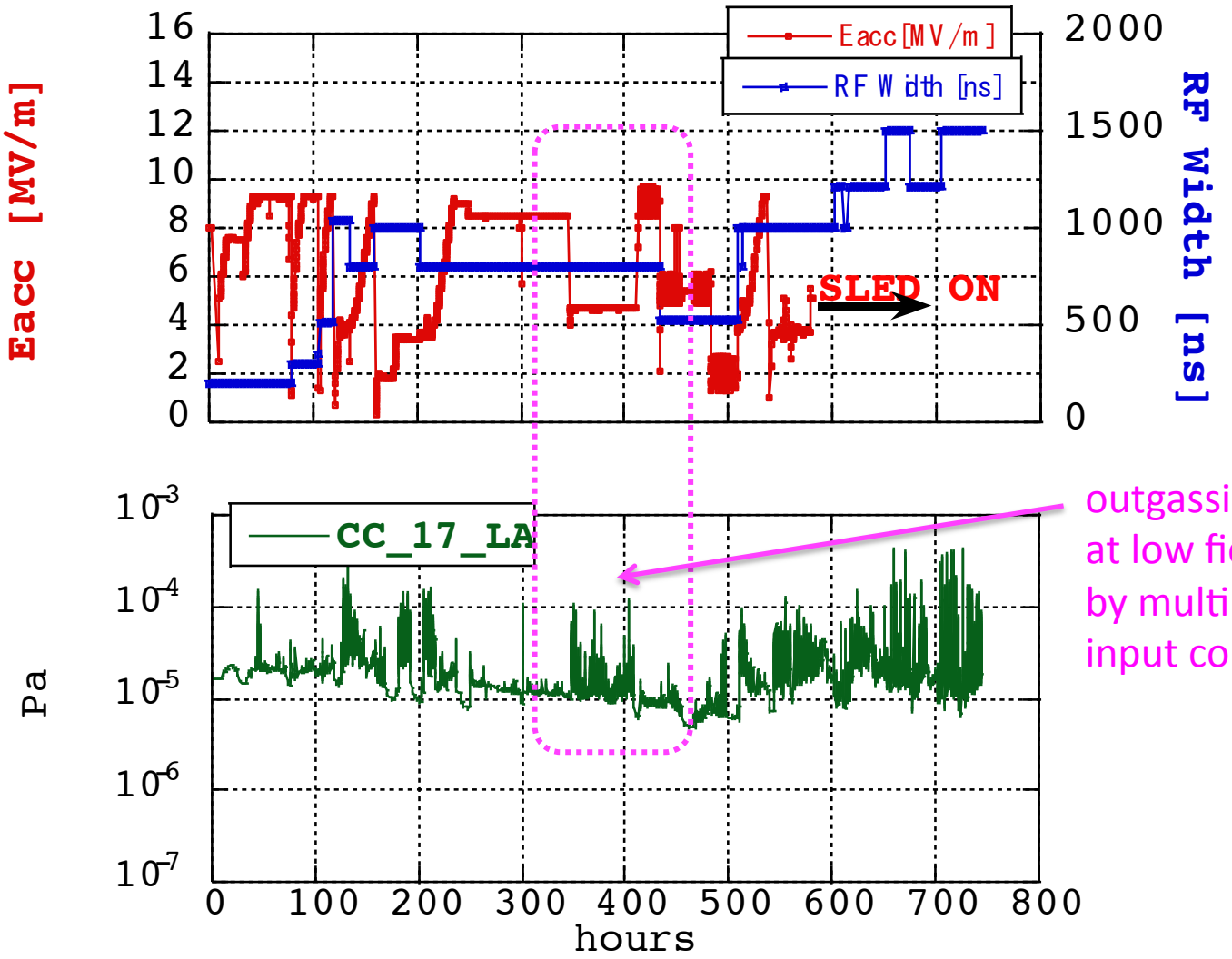


1-6 unit

RF conditioning

in solenoid field

unit 1-7 RF conditioning history

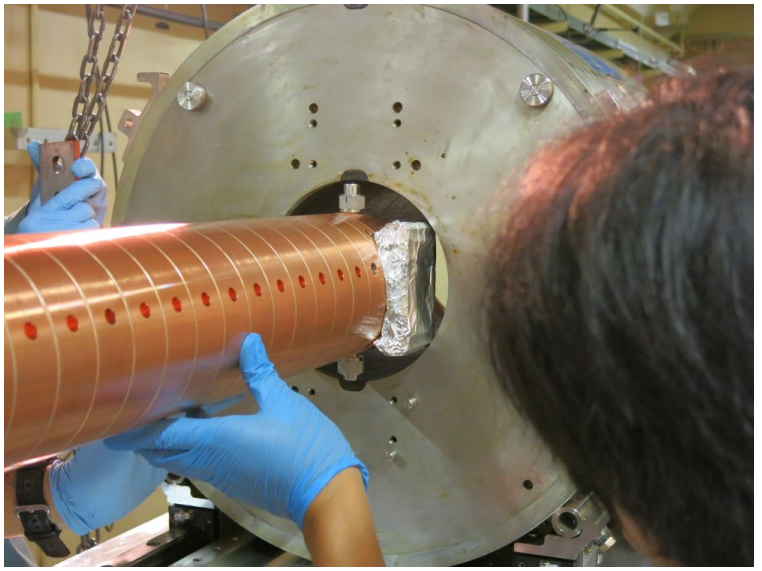


1-7 unit

RF conditioning

in FODO quads

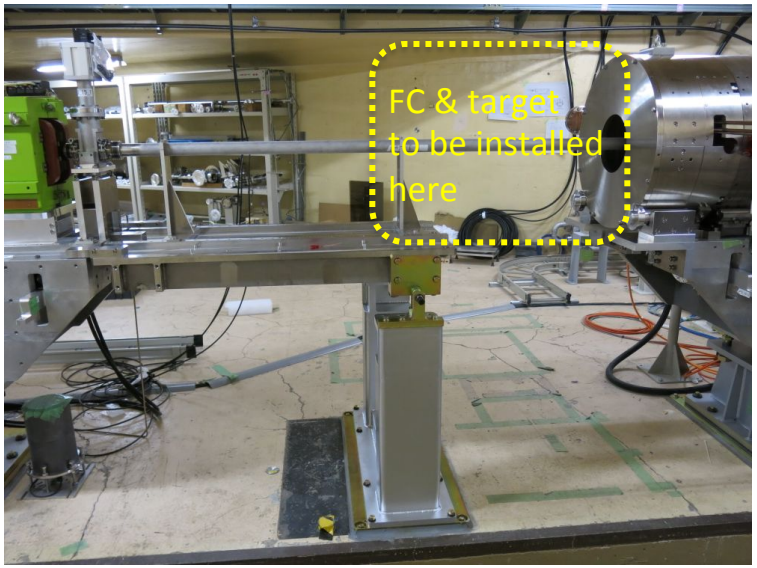
construction photo (1)

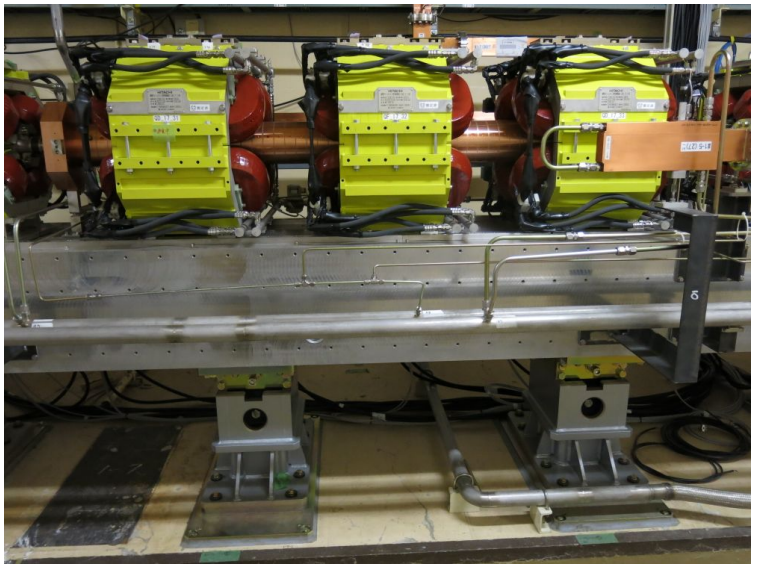


- LAS structures and solenoids are carefully installed in the positron capture section units 1-5, 1-6.

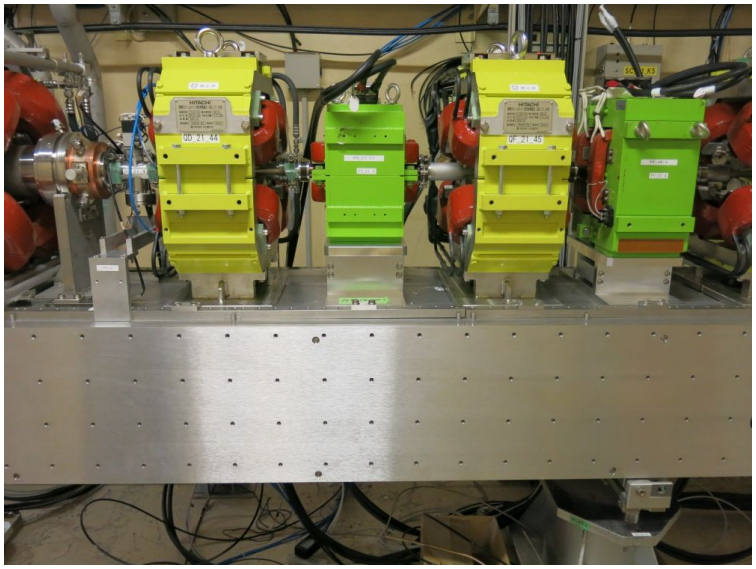
construction photo (2)

construction photo (3)





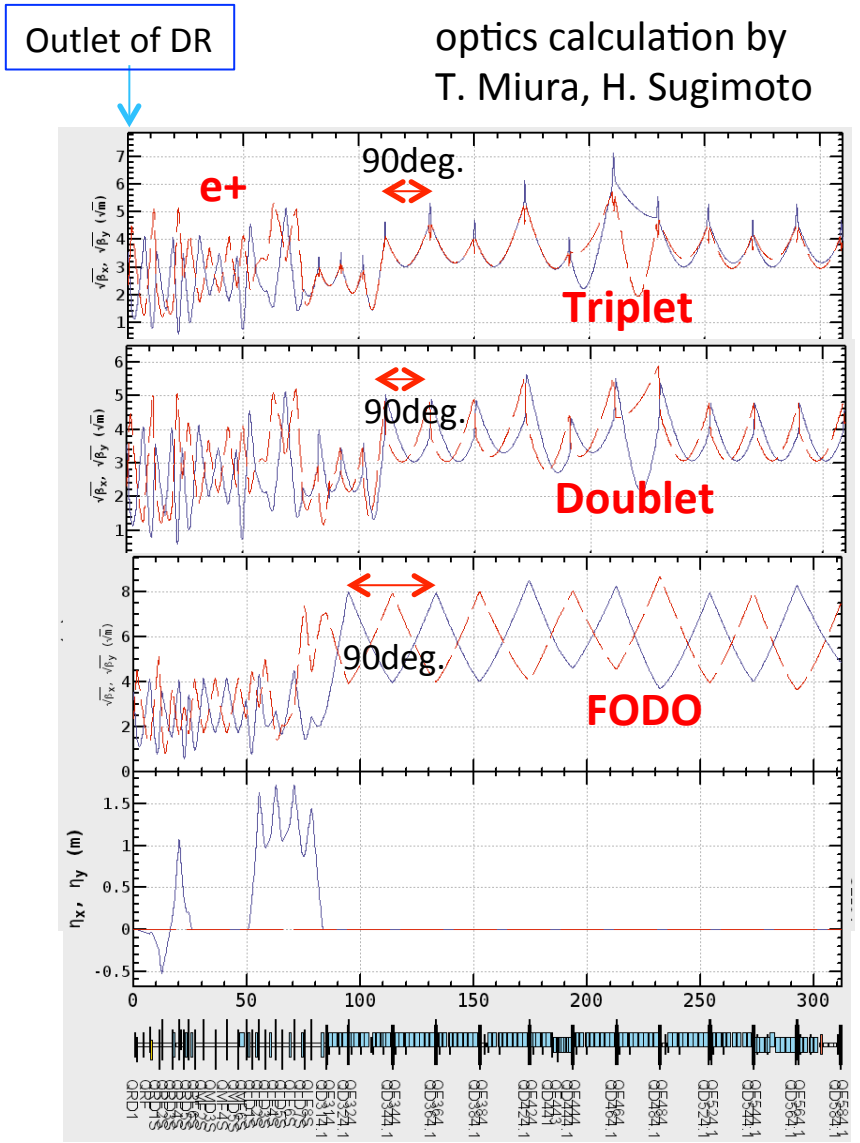
quads around the acc. structures
for short interval



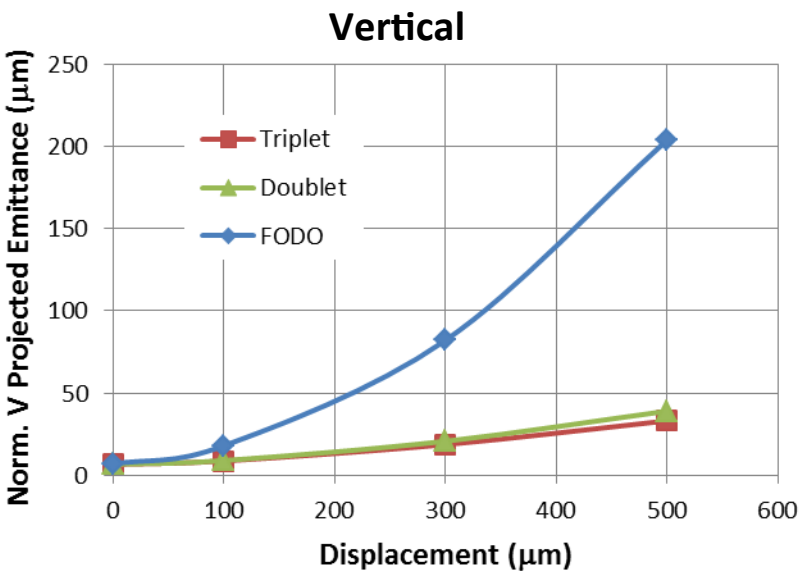
quads and steerings
interleaved

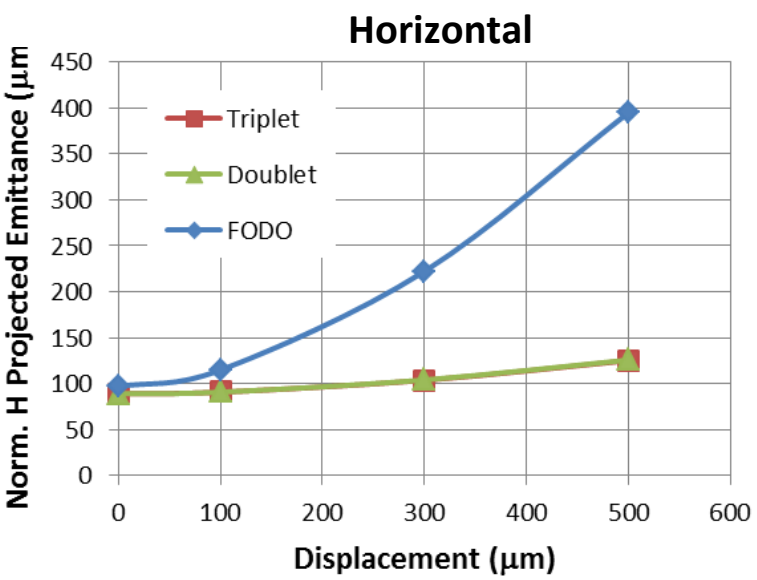
e+ beam optics after DR

- in sector 3, 4, 5 after DR, pulse quads & steerings will be used for e-, e+ mode dependent flexible optics design
- triplet/doublet/FODO designs are compared for magnet spec. determination
  - FODO: best
  - doublet: better
  - triplet: NG
- from emittance growth issue, triplet/doublet are preferred because of smaller beta-function (see next slide!)
- finally doublet is chosen

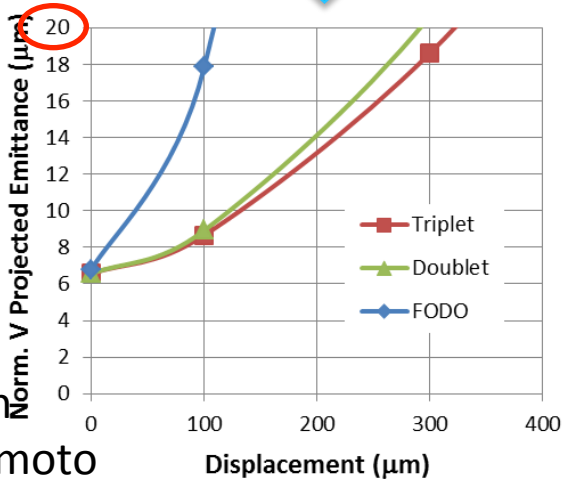


e+ emittance growth





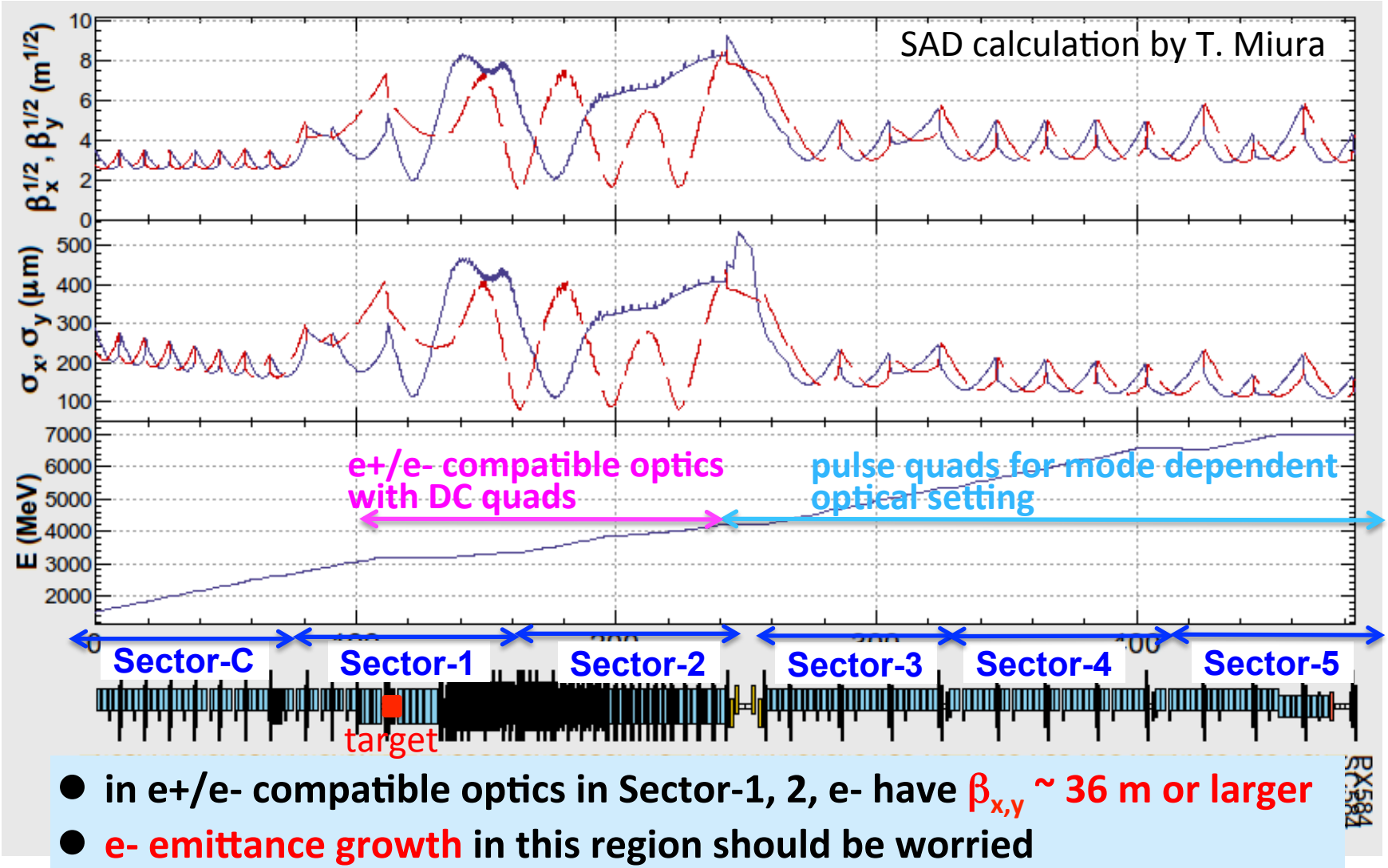
zoom



calculation by H. Sugimoto

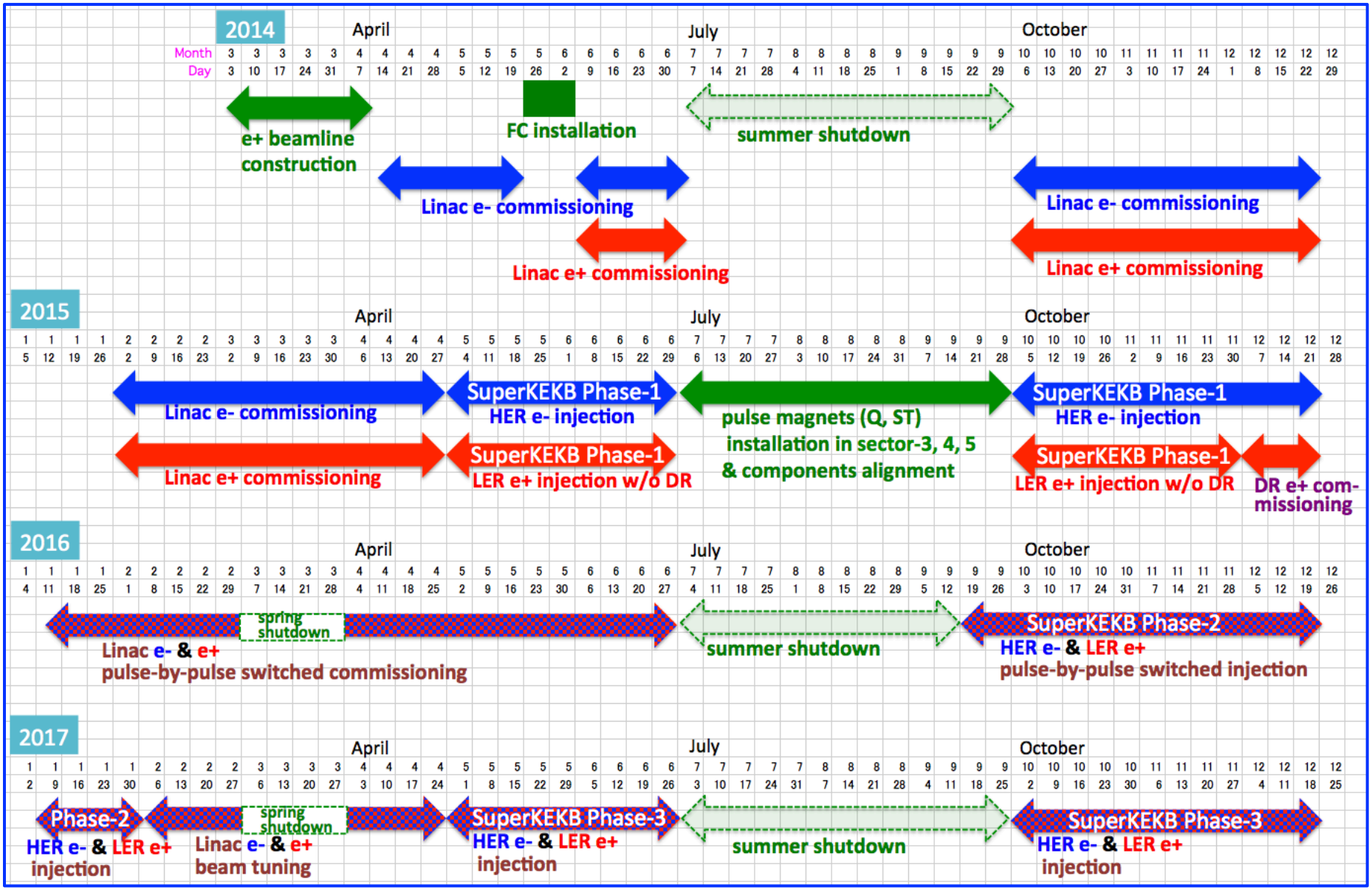
- emittance growth for FODO is significantly larger
- average beta-functions are
  $\beta_{x,y}$ ~16 m for doublet/triplet
  $\beta_{x,y}$ ~36 m for FODO
  (see previous slide!)
- small beta-function is essential to suppress emittance growth

e+/e- compatible optics



- in e+/e- compatible optics in Sector-1, 2, e- have $\beta_{x,y}$ ~ 36 m or larger
- e- emittance growth in this region should be worried
- design consideration started for additional pulse quads

schedule


2014
April
July
October
Month
Day
e+ beamline construction
FC installation
summer shutdown
Linac e- commissioning
Linac e- commissioning
Linac e+ commissioning
Linac e+ commissioning
2015
April
July
October
Linac e- commissioning
SuperKEKB Phase-1
HER e- injection
pulse magnets (Q, ST) installation in sector-3, 4, 5 & components alignment
SuperKEKB Phase-1
HER e- injection
Linac e+ commissioning
SuperKEKB Phase-1
LER e+ injection w/o DR
SuperKEKB Phase-1
LER e+ injection w/o DR
DR e+ com-missioning
2016
April
July
October
spring shutdown
Linac e- & e+
pulse-by-pulse switched commissioning
summer shutdown
SuperKEKB Phase-2
HER e- & LER e+
pulse-by-pulse switched injection
2017
April
July
October
Phase-2
HER e- & LER e+ injection
spring shutdown
Linac e- & e+ beam tuning
SuperKEKB Phase-3
HER e- & LER e+ injection
summer shutdown
SuperKEKB Phase-3
HER e- & LER e+ injection

Summary

1) e+ beam-line construction started last summer and
   to be almost completed in April 2014
2) target & spoiler to be installed in May 2014
3) FC power cable system reconstruction in progress
   after the fire accident
   test operation at KLY gallery in Apr/May 2014
   installation in tunnel in May 2014
4) LAS structures (in capture section units and one FODO unit)
   in RF conditioning
5) pulse quads and steering in preparation for Sector-3, 4, 5
   in doublets system for emittance growth suppression
   (installation ~ 2015 summer ? depending on budget situation)
6) additional pulse quads considered in Sector-1, 2
7) we will start e+ commissioning in June 2014
   (with constraint of half FC current and half DC solenoid current)