

Phase II detector

S. Tanaka (KEK)

Super KEKB Phase 2

w/QCS and Belle II

w/o Vertex detector

BKG study

Luminosity tuning

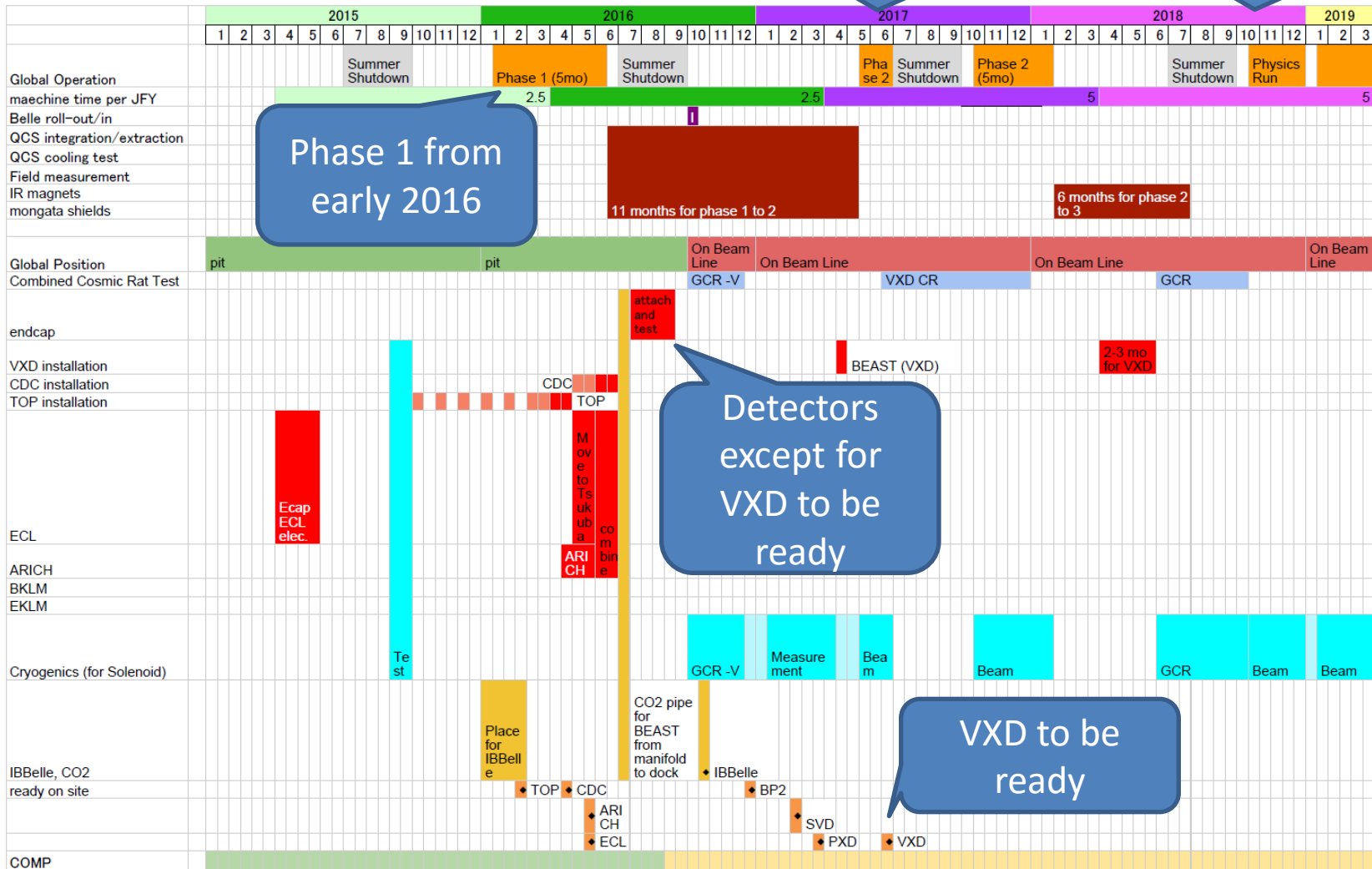
Target luminosity:

$1 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$

Schedule as of

Phase 2 from
2017

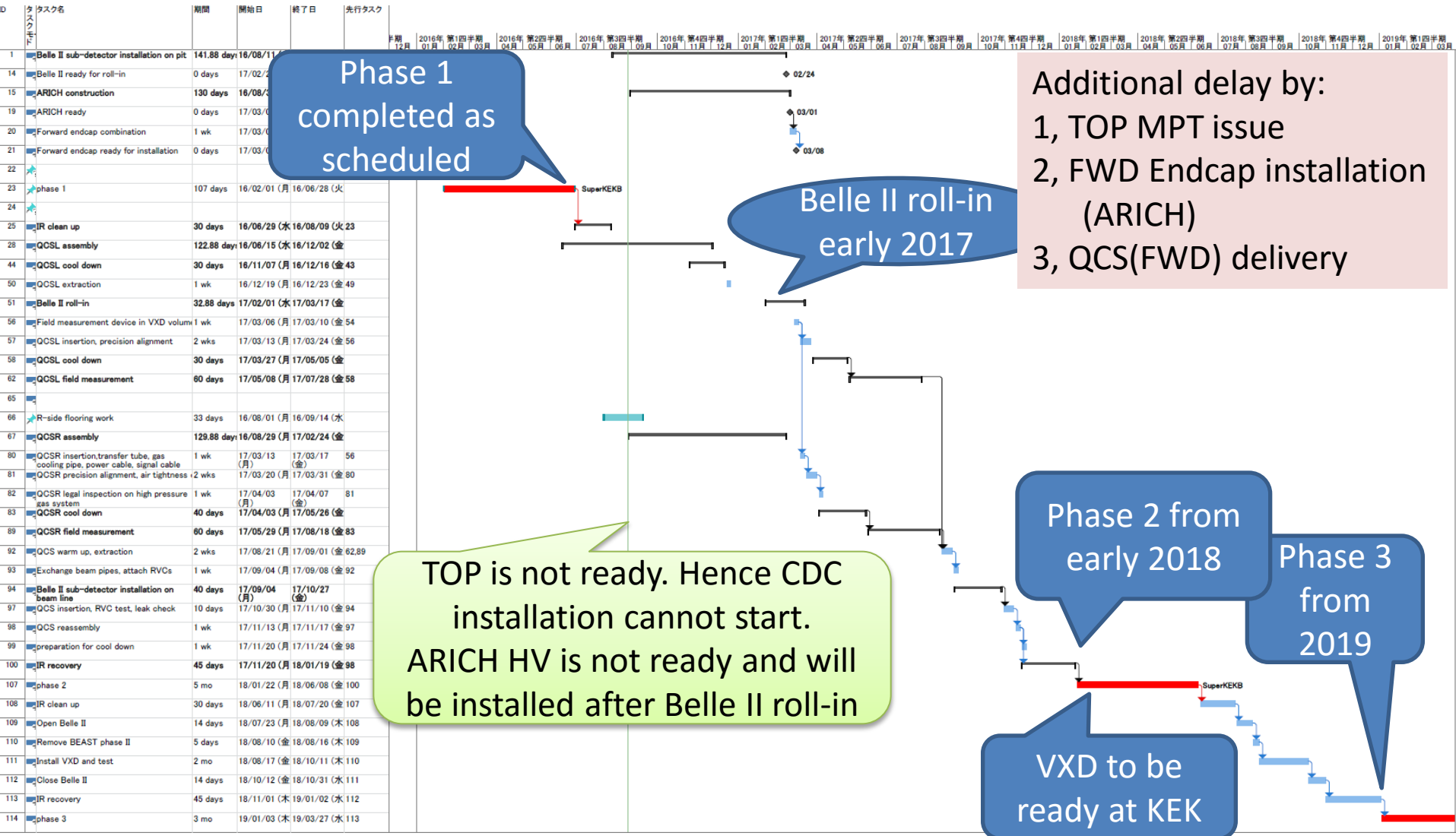
Phase 3 from
2018



Belle II Schedule shown before

Schedule

(possibly, but it will be decided in next B2GM)



Introduction

- There are many kind of parallel activities in the phase 2 period
 - Beam commissioning to start collision (machine group: **KCG**)
 - Forward luminosity monitors(ZDLM) for knob tuning
 - First try of BG control (mainly KEK belle group: **BCG**)
 - Beam collimators control study to reach to moderate BG
 - BG studies of each compartment to check consistency with simulation
 - Neutron measurement (fast and slow)

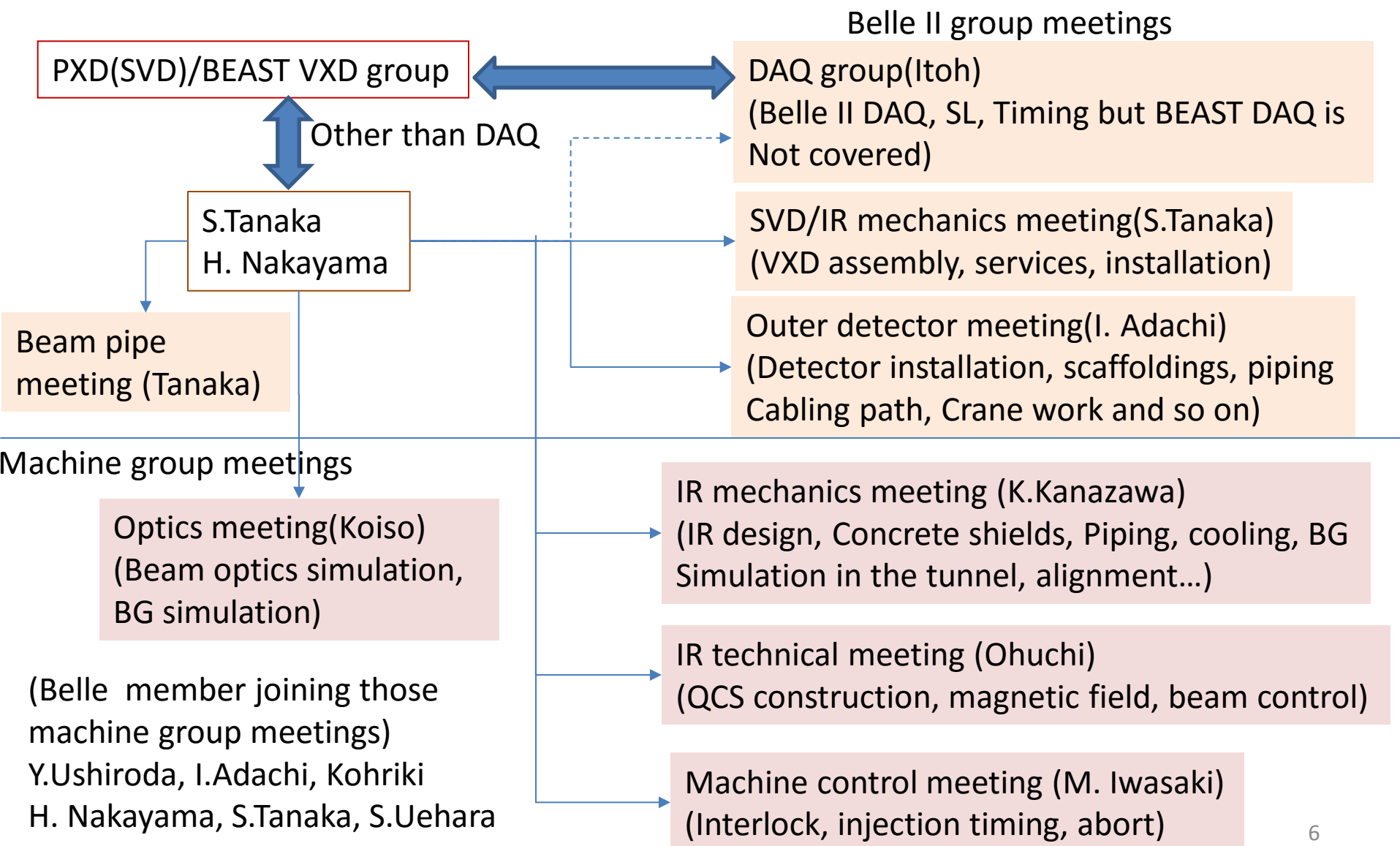
(Phase 2 BG may be larger BG than designed level by non-optimized beam condition and collimator settings)
 - Belle II DAQ commissioning with partial VXD sensors (**Belle II DAQ**)
 - Full Belle II DAQ (VXD: one ladder for each layer)
 - Slow control (also communication with machine)
 - PXD RoI finding by CDC+SVD tracking data
 - Optimization of interlock system
 - Slow info. Some alarms or abort by environmental or rad. monitors
 - First info.: beam abort by hard wired signals

- Calibration of BG monitors
 - Checking dependency of BG monitor with respect to SVD and PXD data
- Beam injection BG study
 - BG damping time measurement for Trigger veto gate
 - requiring storing veto gate width to the database with moderate update timing
- First try of operating CO2 cooling system for VXD sensors
 - Checking water vapor level by sucking air
 - cold and warm dry volume

Communication path(before your coming to KEK)

(Computing, physics and software are independently organized.)

This is just reference information to know who knows which information



Communication path after starting beam operation

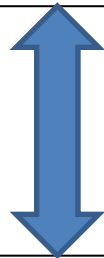
- Monday meeting by weekly (Belle II operation meeting)
 - Joining all of sub activities to discuss schedule, results and issues
- Daily communication

KEKB machine control room

KCG: KEBK Commissioning Group (three shift in a day)
(Beam operation)

BCG: Belle Commissioning Group (mainly by KEK staffs)
(Beam mask control, supporting communication between KCG and Belle,
Safety control at Tsukuba hall)

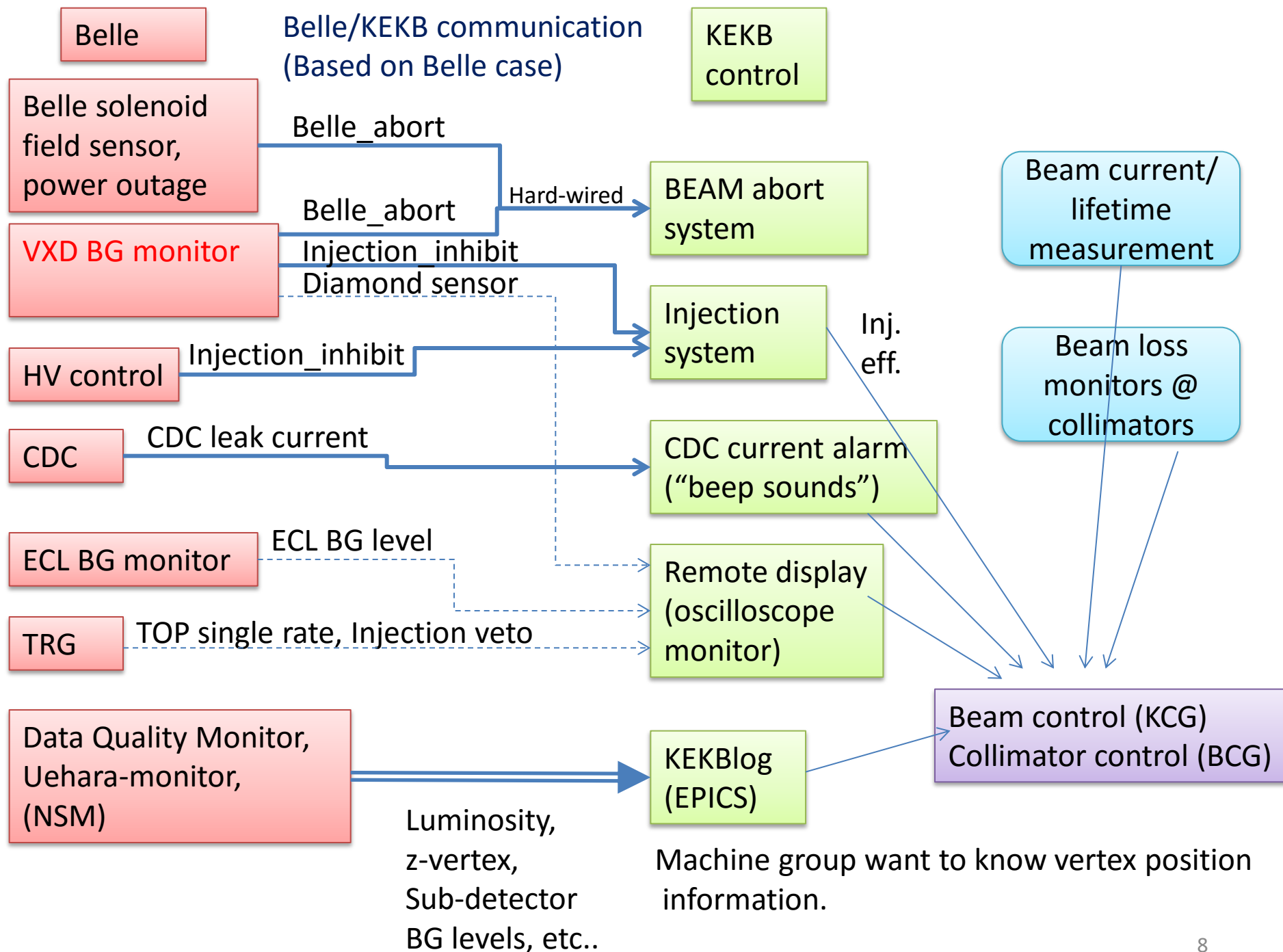
KCG meeting (9:00am everyday only in beam operation period)



Request for machine/BG/detector study
Machine maintenance schedule/work plan

Belle II operation room (B3)

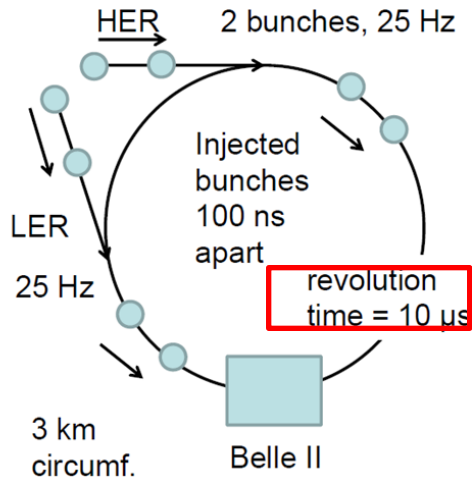
Belle II operation member->shift work



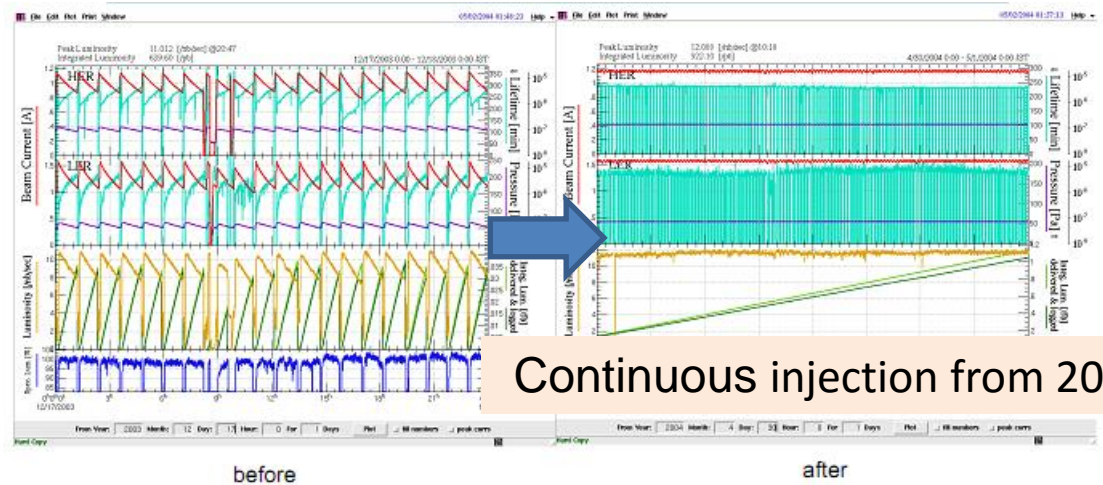
What is most challenge on SuperKEKB?

- LER Beam lifetime : ~600s on designed beam condition
 - Continuous injection is necessary to keep beam current
 - 25 Hz(LER)+ 25 Hz(HER) beam injection
 - Injection BG around unstable beam Injected bunches
 - Some time window have to veto trigger (GDL and transition to gated mode for PXD) no to record the Injection BG events.
 - The veto gate width is directly related to detector efficiency
 - Large veto window : safer operation but loosing efficiency
 - Optimized (shorter) veto window: getting better efficiency
 - How to measure injection BG?
 - By Diamond sensors on the IP beam pipe (by current)
 - By CLAWS(scintillator) only on phase 2 (by hit rate)
 - By ECL oscilloscope view (@operation room on KEKB case)
 - But with Pt cut-off

50 Hz beam injection



Injection BG

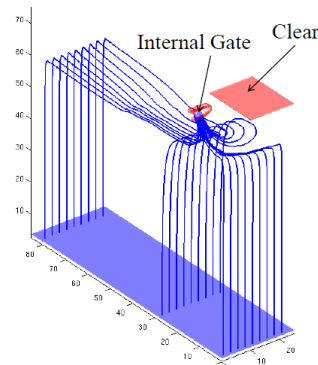


The injection BG is vetoed by revolution signal from machine.

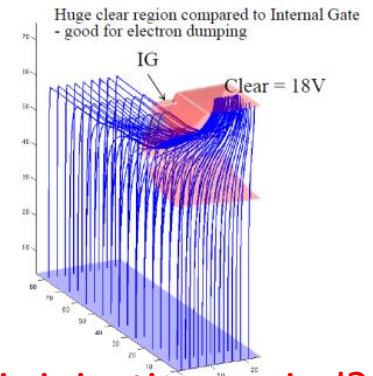
(The beam life time is ~600s for LER by Touschek effect)

PXD case : to avoid injection hits

Normal operation:
Signal charge drifts
into internal gate



Gated operation
Charges from
background drift
directly to clear gate

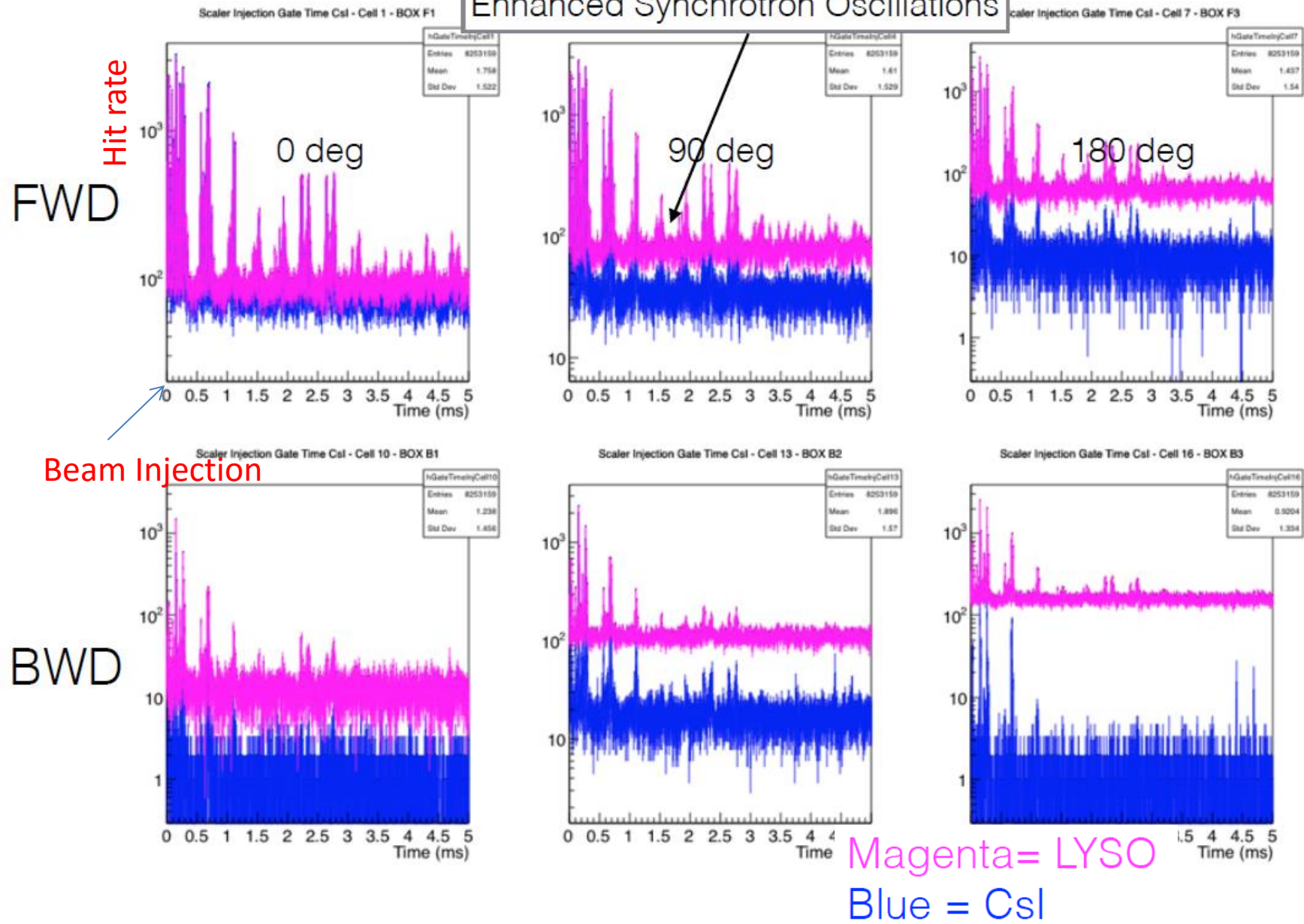


PXD can measure pedestal on this injection period?

Injection noise measurement by Phase 1 data

HER - Phase Shift 305 deg - 50% Inj Eff.

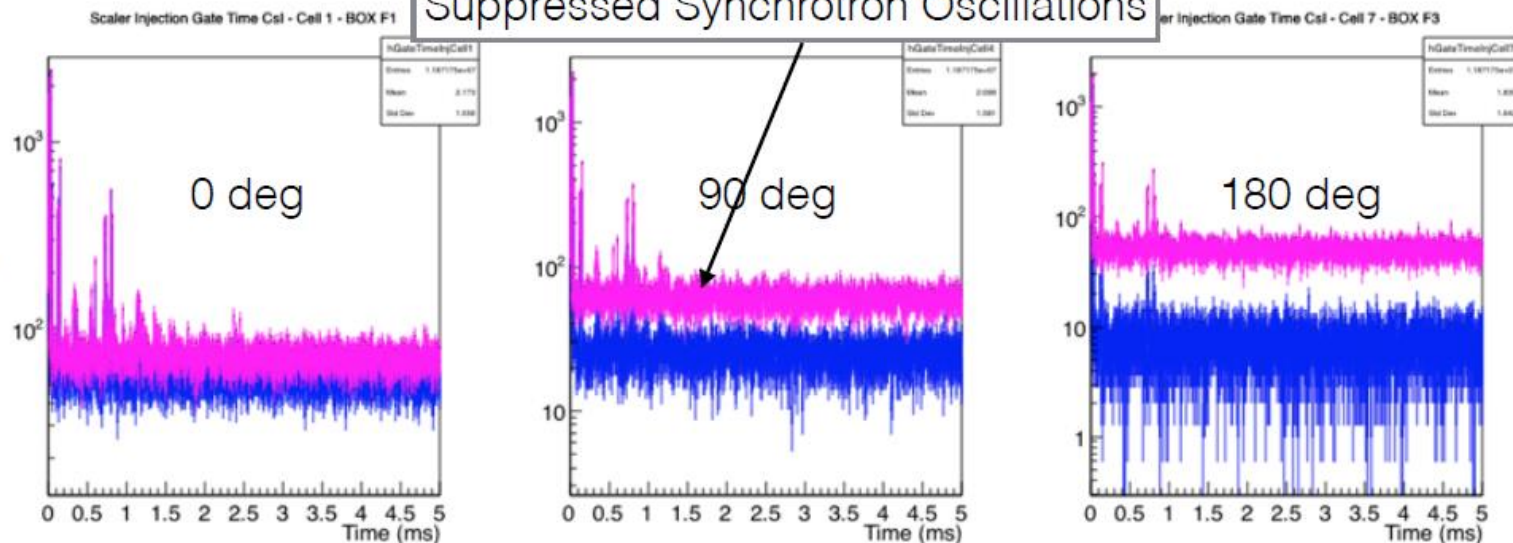
Enhanced Synchrotron Oscillations



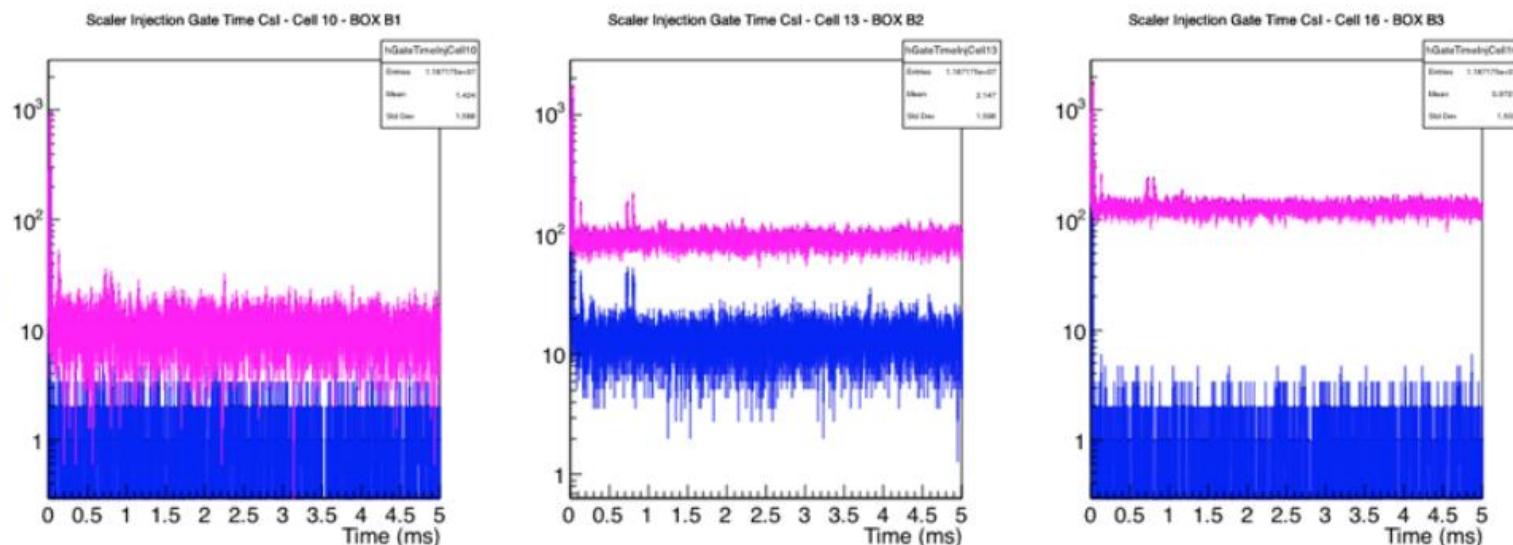
HER - Vert. Steering VM27E=-0.465 - 35% Inj Eff.

Suppressed Synchrotron Oscillations

FWD



BWD



Injection BG can be changed by injection condition

Calibration

- Pedestal data
 - No Zero data suppression to check for whole signal line
- Test pulse to check the signal response
 - No Zero data suppression
 - DAQ(FTSW) or trigger group(common) can provide it?
 - The data will be stored as the calibration data?

Calibration work by Local run (no beam)

It was the case(every half day) on BELLE/KEKB.

This test can start from GCR well before phase2

Advanced calibration work(I am not sure):

Pedestal/ test pulse trigger in beam abort gap?

(to check data quality of each sub-detector)

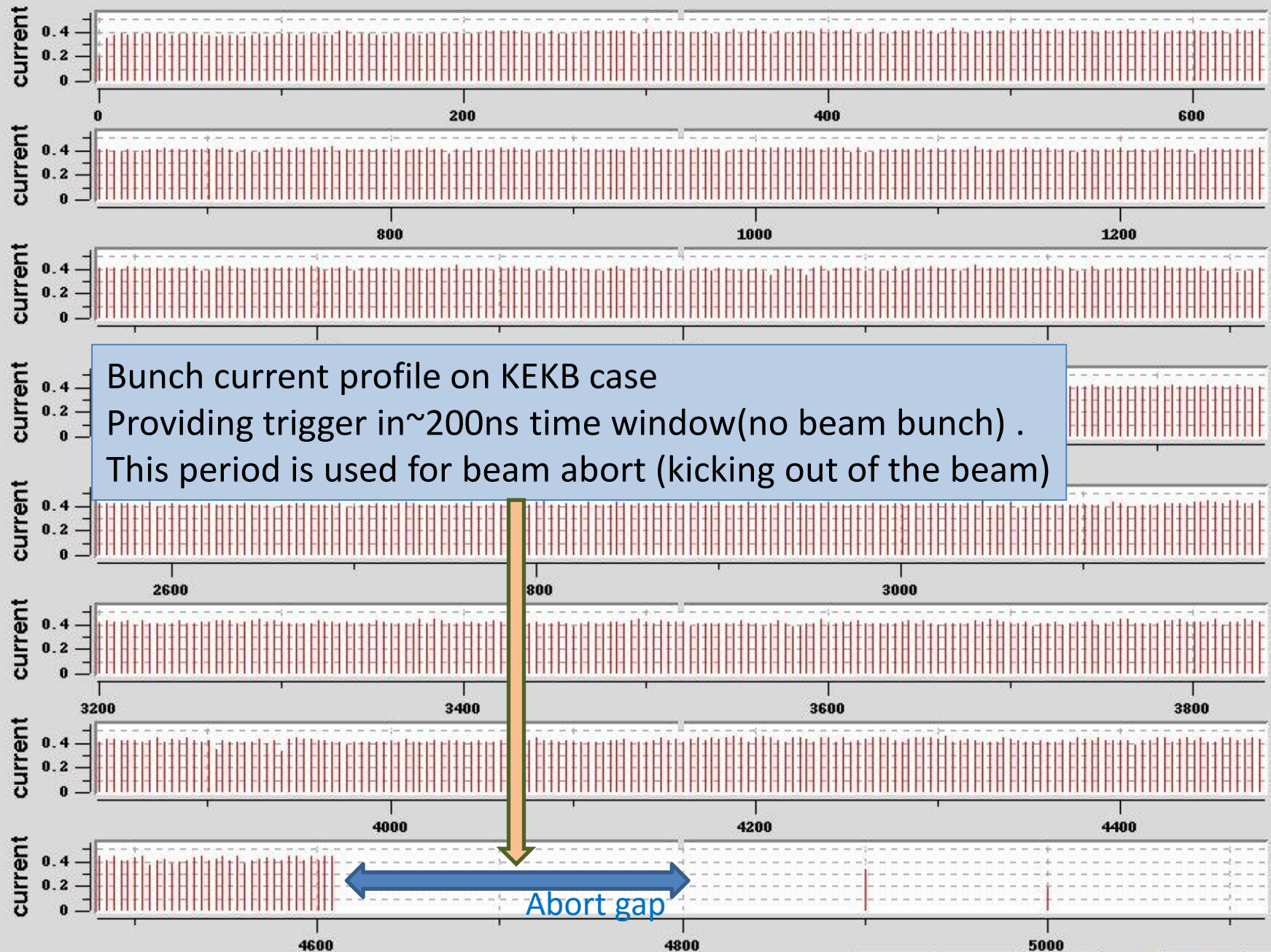
LER Bunch Current Monitor

Sum: 473.771 mA

Ave: 0.410 mA

Max: 0.462 mA

Nb : 1155



Wed Mar 7 17:43:23 2001

Scale

Start

Stop



QUIT

Demo

Start-up steps (as an example)

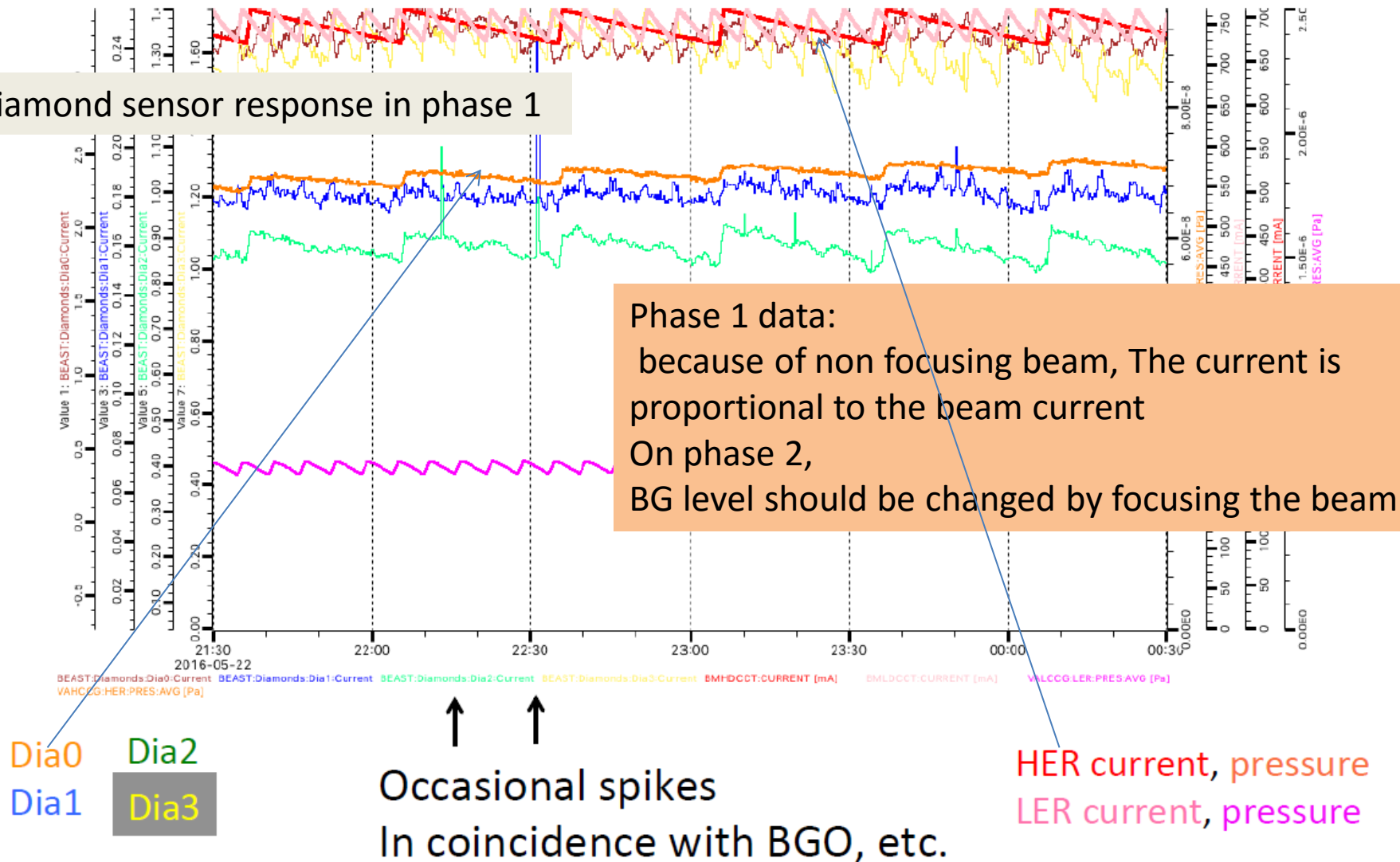
1. Injection veto study
 1. PXD gated mode
 2. GDL veto
2. Belle Abort study(also alarm level settings)
 1. VXD monitors + BEAST sensors
 2. CDC current
3. BG studies (measuring each BG source by special runs)
 1. SR(Synchrotron Radiation photons)
 2. Radiative Bhabha
 3. Touschek
 4. Beam gas
 5. Collimator control
4. Calibration
 1. Pedestal run (on non beam condition)
 2. Alignment by muon pair
 3. Tracking by CDC
 4. Tracking by KLM+(TOP/ARICH)+CDC+SVD
 5. ECL calibration by electron pair
 6. PXD Rol test
 7. K/pi separation (TOP, ARICH)

But I am not expert of DAQ, the detail plan should be defined by trigger/DAQ group

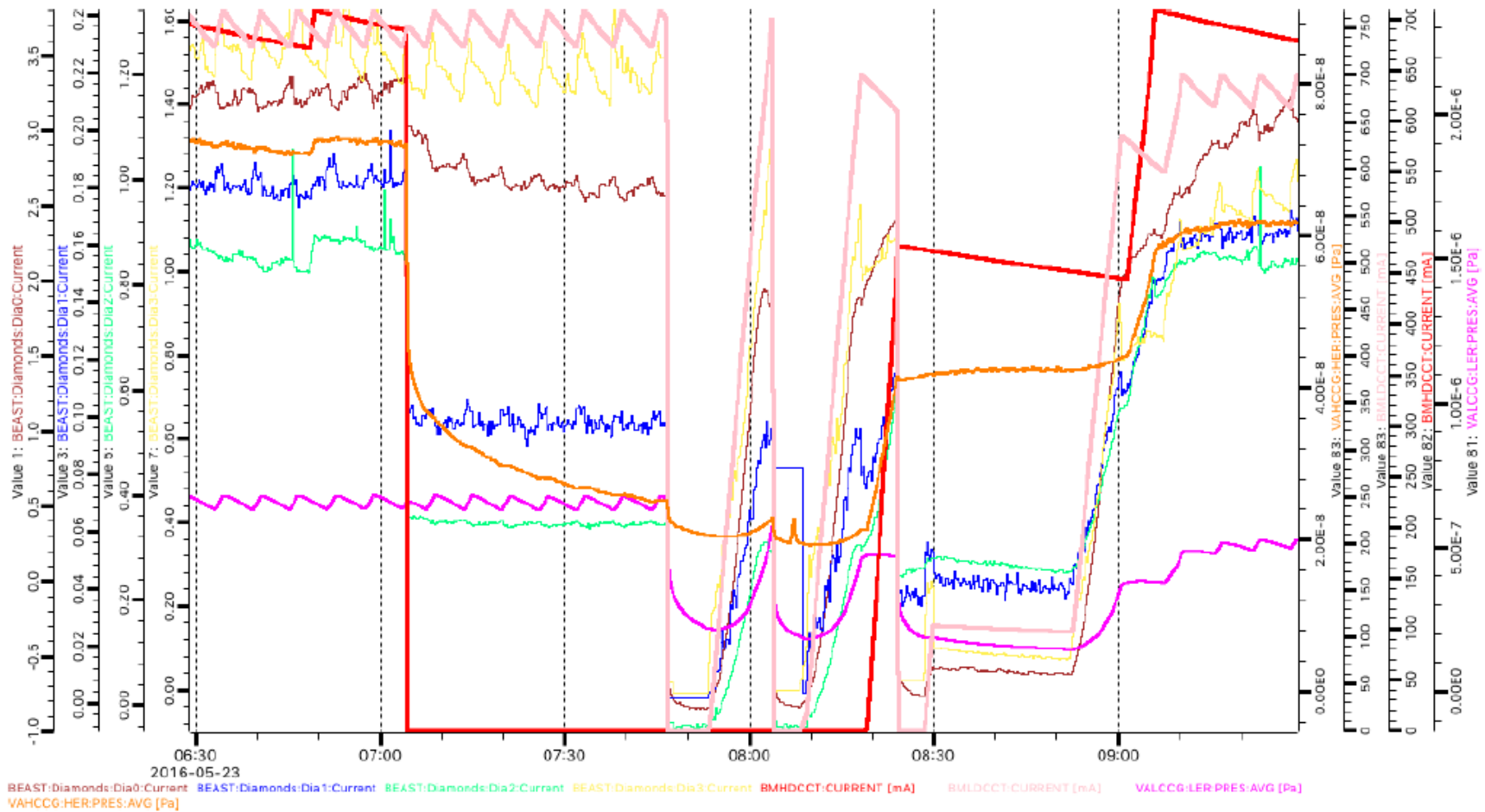
Defining good condition to start DAQ

Diamonds in EPICS - scrubbing

Diamond sensor response in phase 1



Diamonds in EPICS – aborts, refilling



Dia0	Dia2
Dia1	Dia3

↑
HER
Abort

↑
3 LER
Aborts

HER current, pressure
LER current, pressure

Phase 2 SuperKEKB

Phase 2 commissioning:

- Squeezing beta at IP
 - Beam collision tuning
 - Start physics data taking
-
- Single beam operation by pilot(first) bunch in order to optimize beam orbit
 - De-focused beam than designed one (for longer beam life time)
 - Detail plan should be discussed with machine group
 - Normal injection (or continuous injection?)
 - Optimizing of low emittance beam by quad./ bending magnets
 - Colliding beam (start with low current)
 - Beam condition optimization to reach higher Lum.
 - Normal injection? (or continuous injection?)

DAQ/Trigger condition will be heavily related with the beam operation.
The start-up step should be discussed with machine group

Thank you

Gated mode optimization for Injection noise

- Phase II is first chance to measure injection noise by Belle II detector
- Beam injection timing is provided by the Linac group
 - Some measurements have done in phase 1 by BEAST sensors
- Belle II Trigger veto gate(in GDL) for injection noise will be set by trigger group.
- PXD group may need to request change of veto gate width or gate timing to trigger group for PXD acceptable occupancy level.
- Situation:
 - PXD occupancy can be measured in phase II
 - On SVD case, some trigger related to injection gate can be used
 - Veto gate width might be changed by Beam settings
- Issue
 - How to optimize acceptable veto gate width of PXD and GDL for safer operation?