

discussion for phase-2 (BEAST II) (revised)

Jan. 21, 2015

7th Belle II VXD workshop

Targets of phase-2 operation (1)

We have a lot of targets in the phase-2 operation. We have to keep them in our minds and have proper strategies to achieve them.

- Beam commissioning to start collision (machine group: **KCG**)
 - Forward luminosity monitors(ZDLM) for knob tuning
- First try of BG control (KEK Belle group: **BCG**)
 - BG studies of each compartment to check consistency with simulation
 - Studies of relation between VXD hits and monitor hits
 - Beam collimators control study
 - Neutron measurement (fast and slow)
- Belle II commissioning with partial VXD sensors (**Belle II shift**)
 - Full Belle II DAQ
 - Slow control (also communication with machine)
 - PXD RoI finding with CDC+SVD tracking data
 - Detector noise check
 - **And investigation and confirmation to install the full VXD**
- Optimization of interlock system
 - Slow info. Some alarms or abort by environmental or rad. monitors
 - First info.: beam abort by hard wired signals

Targets of phase-2 operation (2)

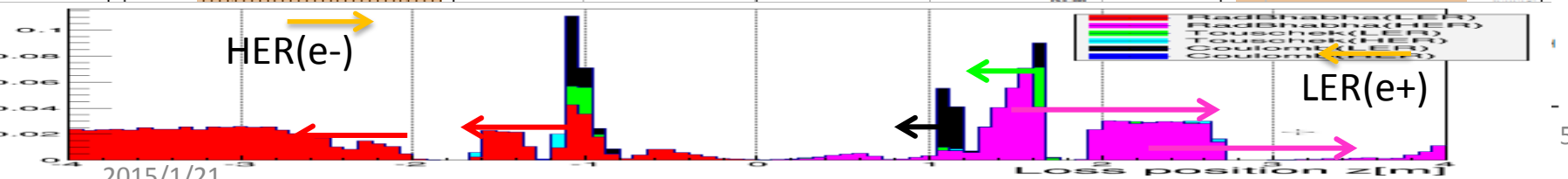
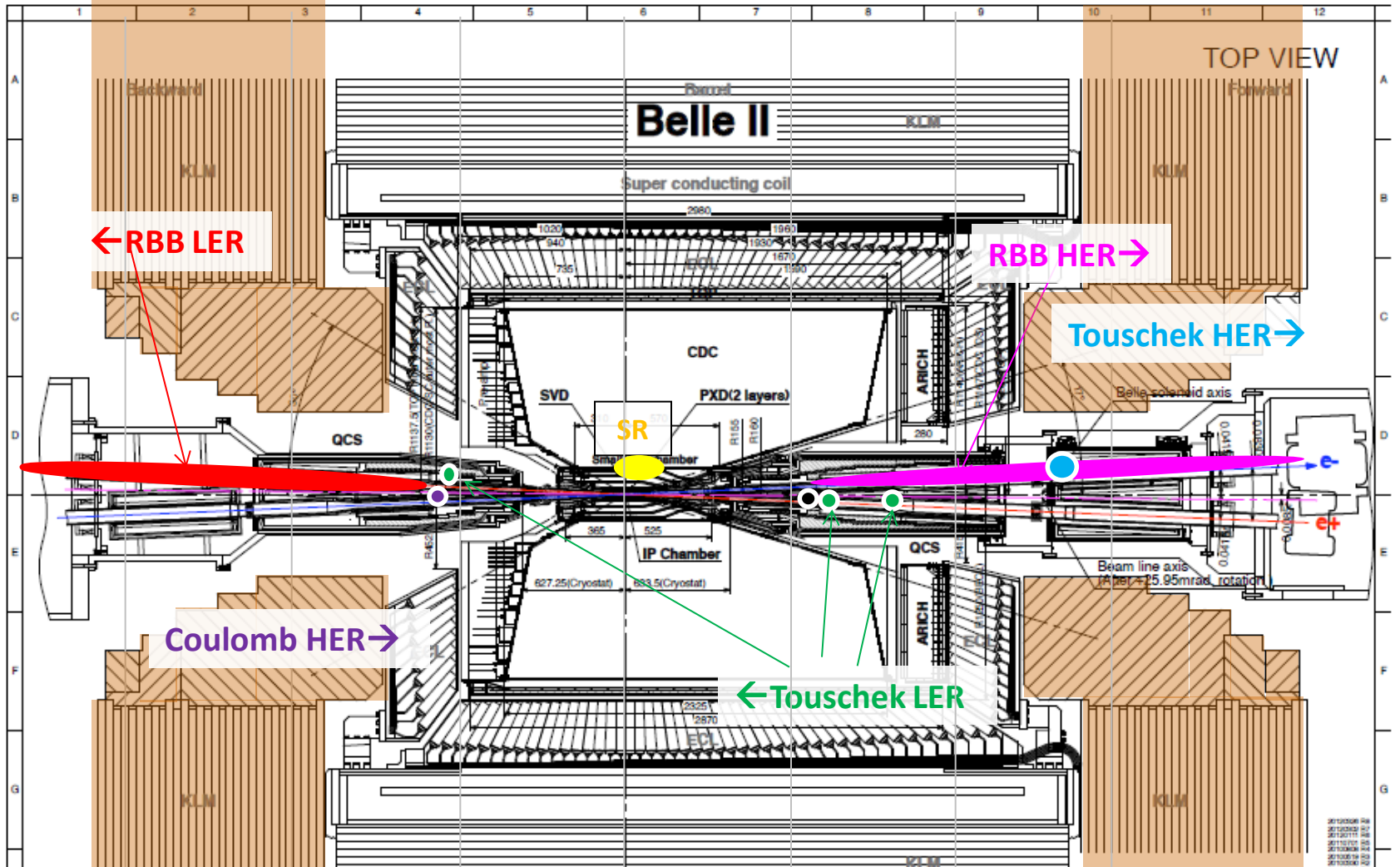
- Beam injection BG study
 - BG damping time measurement for Trigger veto gate
 - requiring storing veto gate width to condition database
 - With moderate update timing
- First try of CO2 cooling system for VXD sensors
 - Checking water vapor level by sucking air
 - cold and warm dry volume
- Others?
- Target luminosity at phase-2 is $L \sim 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$, and BG structure is not exactly same as phase-3. We need somehow extrapolation to expect phase-3 beam BG.
 - how to extrapolate it?
 - Effect from each BG component has to be studied separately by BG MC.
 - The MC simulation for BEAST detectors is performed by Igor??? (Hawaii). Can we ask him to perform also MC for our detectors? Otherwise we have to find a person who can work on that.
 - This extrapolation can be done only after the BG is will controlled by collimator studies.

BG sources and Radiation tolerance

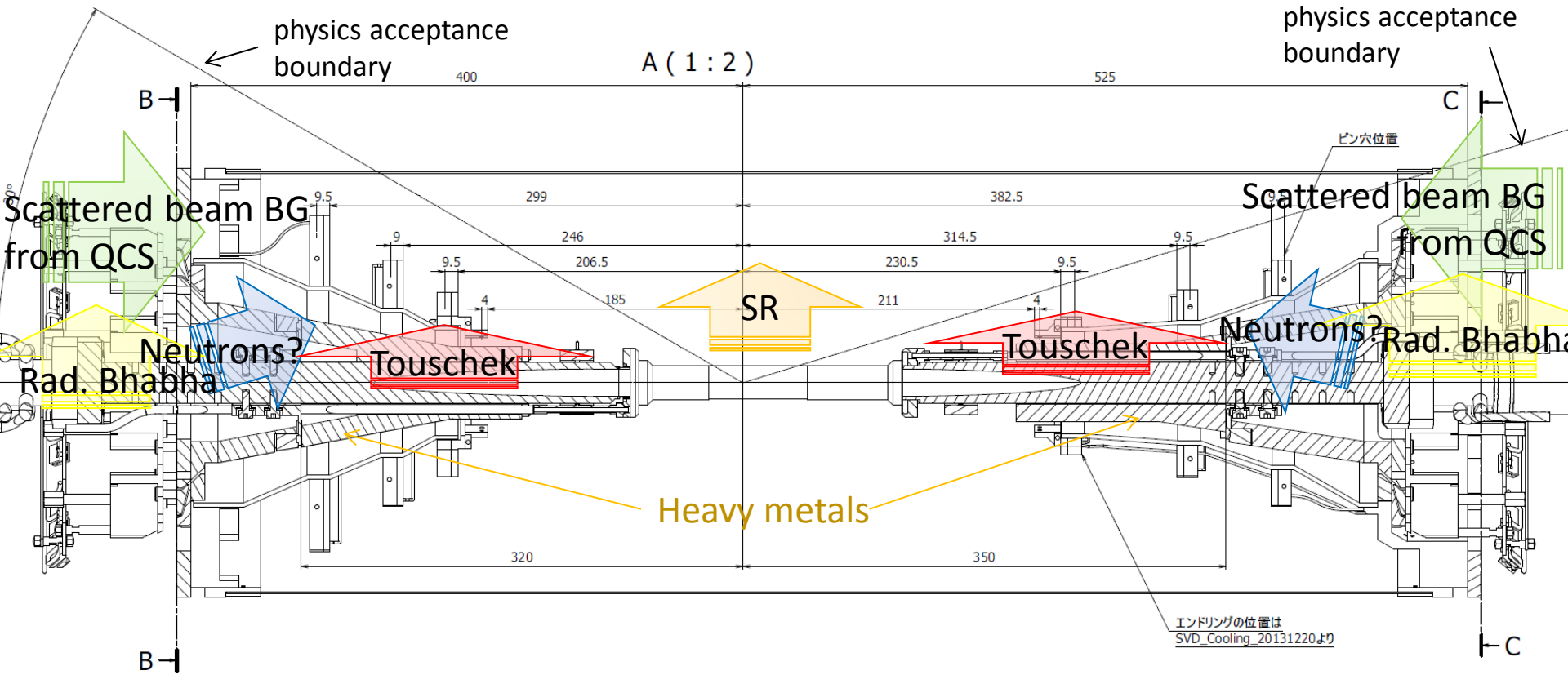
- BG source
 - 4-fermion final state QED process (Lum.)
 - Touschek effect (Beam size and energy)
 - Beam-gas interactions (current, pressure)
 - Synchrotron radiation
 - Radiative Bhabha scattering (Lum.)
 - Injection BG
 - Unexpected noise BG?

Background picture

Ver. 2014.6.18



Expected beam BG in VXD volume



Phase-2 sensors in VXD volume

sensor	contact person	number	location	DAQ	note
PXD + SVD	C. Marinas K. Nakamura	2 PXD modules 4 SVD ladders	decided +X	Belle II DAQ	
diamond w/ PIN diode (beam BG, abort)	L. Vitale	4 diamonds 64 PIN diodes	diamond: decided	Belle II monitor DB	PIN diode location: around diamond and beam pipe
FE-I4 pixels (Synchrotron rad. and track multiplicity)	C. Marinas	3 arms	decided (90, 180, 270)	?	arm design has to be fixed
Scintillator (beam BG)	C. Marinas	2 ladders	decided (45 and 135)	?	
Scintillator PIN diode (beam BG)	H. Nakayama K. Nakamura	?	not decided		
BGO (Bhabha events)	Terry (NTU)	8 (if space allows)	under discussion	BEAST DAQ	fixation method has to be decided
temperature (NTC), humidity (DMT242B) (crosscheck for FOS)	L. Vitale	?	not decided	Belle II monitor DB	
FOS + L-shape	I. Vila D. Moya	?	?	?	sensor on outer cover?

2015/1/21

Baseline plan of PLUME: behind the FE-I4

Issues on the previous table

- **Blanks should be filled by a deadline.**
 - The deadline will be discussed on the Feb. B2GM in schedule discussion.
 - Location of PIN diodes is not urgent issue, but number should be determined to discuss service and cabling.
- **More detailed information is necessary.**
 - Data path, front-end and back-end system
 - Which quantities to be stored on DAQ
 - Necessary trigger
 - See the next Tanaka-san's slide
- **Update this table on the Feb. B2GM**
 - KN will prepare an updated version.

Carte for each sensor to know each status

Belle II sub-detectors have already defined everything below items

- Sensor name:
- Contact person on the commissioning:
- Purpose of the sensor on the BEAST:
- Number of sensor channels and sensor design:
 - Defined or on discussion
- Space allocation for sensor and services and bracket design:
 - fixed or on discussion
- Data output to:
 - KEKB operation room (EPICS or other special)
 - Belle II control room(database or other format)
 - BEAST DAQ (individual readout chain)
 - Using to create Belle abort signal or interlock
- Requiring input for analysis?
 - Injection timing (i.e. injection BG study)
 - Some other component (i.e. timestamp)
- Data format:
 - defined or on discussion
- Online monitor software:
 - finished, designed or on discussion

referred from Shuji's slides
(IN2P3-KEK, Jan 2015)

Service space (1)

- As we saw in previous slide, we have a lot of sensors.
- We should discuss service space beforehand.
 - Sensors – cables – dock-boxes – cables – readout
 - How large dock-boxes do we need ?
 - Where readout electronics is located ?
 - Access to the top of Belle II is very difficult during phase-2 operation. Electronics on E-hat is rather preferable.
- Of course, we need to know the number and location of sensors for this discussion.
 - Let's fill the table for our start point.
 - I'd like to fix a rough idea by B2GM.
 - Do we need some BG MC inputs to decide locations?
- BGO location?
 - 3D design of phase-2 PXD+SVD system has been prepared by Tscharlle.
 - We can give the design to Terry.
 - However, there are cooling block materials just in front of BGO crystals in current design.
 - Start discussion with BGO group including this problem, and think about what impact BGO has in the physics analysis on the B2GM.

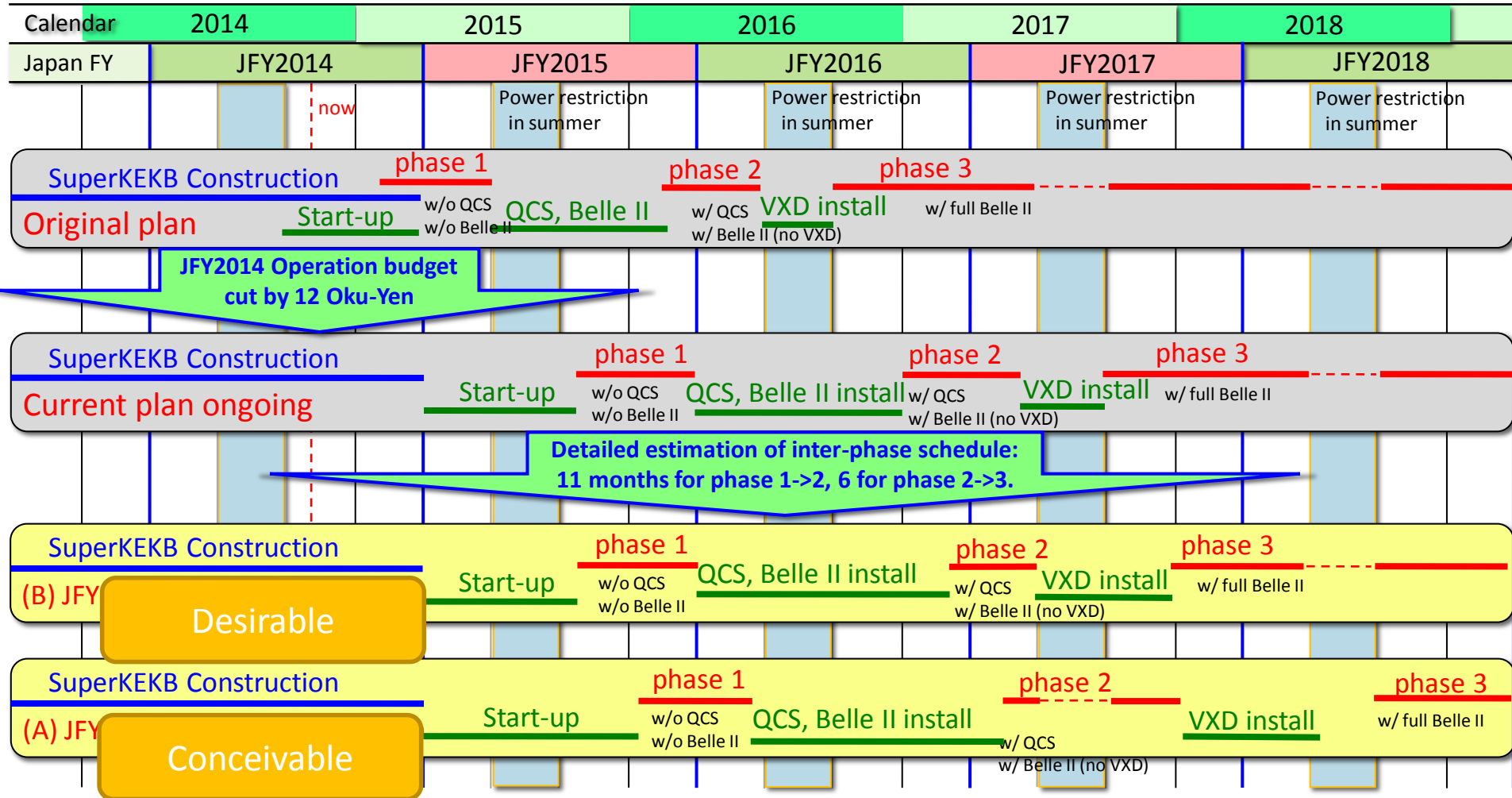
Service space (2)

- And, in order to share the space allocation among us, we should share 3D design in VXD space with a common version managing system, e.g. Belle II SVN.
- However, data sizes of some Inventor files (the biggest one, ~4MB, is full VXD assembly file) are too large to put it into Belle II SVN.
 - Recently, a file size limitation was applied on the SVN.
- From my opinion, we should ask to relax the limitation somehow to SVN manager, otherwise we should prepare our own SVN.
 - Any other idea how to share the designs?
- The Belle II SVN should be available for the 3D CAD design files. We can ask the SVN manager to relax the limitation for a specific directory. KN will ask him.

CFRP cone

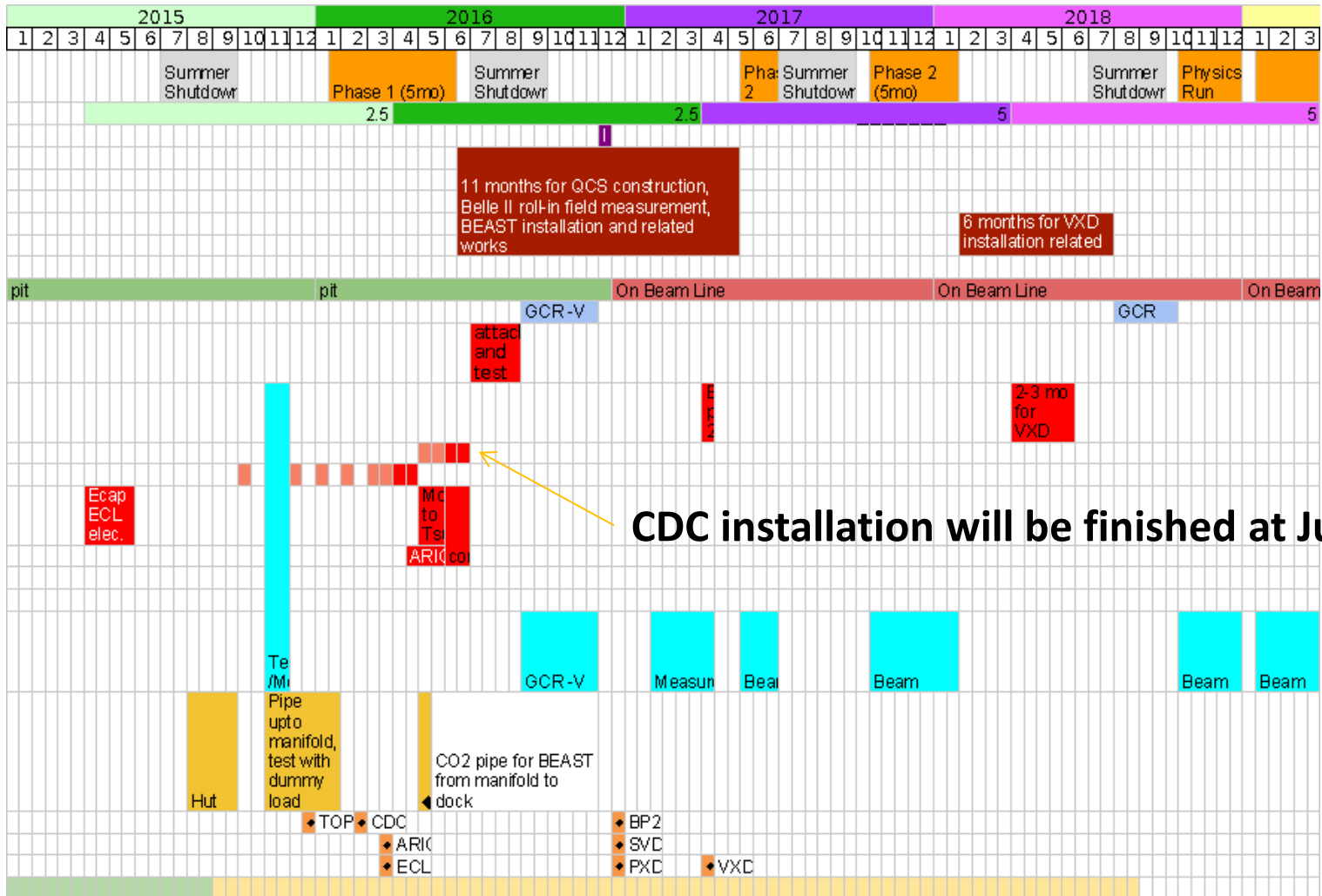
- For phase-3, CFRP cone is necessary to hold SVD ladders.
- However, the phase-2 SVD doesn't use the CFRP cone at all.
 - SVD cartridge is fixed only by endflange.
 - Can we remove CFRP cone?
- Do any groups need the CFRP cone?
 - Diamond detectors or other monitors ? → **No.**
 - This question should be asked also to the BGO group.
- **Baseline: remove the CFRP cone**
 - the ease of assembly
 - larger service space
 - save money for the CFRP cone production

Belle II Schedule



Phase-2 will start at the begin of 2017 in desirable plan.

Detector Construction Schedule (tbc)



CDC installation will be finished at Jun 2016.

Difficult to interpret what Yamauchi-san's brief notice means, but assume phase 1 starts as "early" as Jan. 2016 (=conceivable budget scenario)

Schedule and milestones for phase-2 preparation

- Detailed assembly, test and installation procedure have to be confirmed.
- Draft proposal (very roughly I put dates.)
 - By the end of 2015: phase-2 SVD ladders (B-class) get available
 - Jan. 2016: SVD cartridge assembly and readout test w/ cosmic
 - ???: phase-2 PXD modules and readout system arrive at KEK
 - ???: monitor sensors and readout system arrive at KEK
 - Jun. 2016: phase-2 VXD assembly
 - including monitor sensors
 - BGO will be not available until the end of phase-1.
 - Aug. 2016: Readout test before installation
 - Oct. 2016: phase-2 VXD installation
 - The first trial of our installation method.
 - Will the tools for the final installation method be used at this time? → Yes, they including RVC will be available at this moment.
 - Feb. 2017: VXD test operation
 - May. 2017: Phase-2 operation
- **All of individual studies have to be finished by the begin of 2016!**
- This schedule includes redundant contingencies and makes activities on KEK too long. We should shrink it into more realistic schedule. This milestone has to be discussed again at the Feb. B2GM.
 - Gunchart is preferable.
- IBBelle will be ready at KEK by Summer 2016.

- Data acquisition system and trigger distribution. Event building. Timing (800 ps – 115 μ s)
- Level of integration with Belle II other subdetector systems
- How to disentangle the different types of backgrounds?
- How to determine the VETO width in the PXD?
- How to determine the thresholds (radiation, temperature, humidity)?
- How to ensure a tight VXD volume?
- Additional humidity sensors filling the chamber? How to define cold/warm dry volumes?
- Alignment constants update rate? Stability of the primary vertex?
- Do we need a L-shape profile with a FOS to measure BP vibrations?
- ...

Let's have a face-to-face discussion again at the B2GM period.
4th Feb (BEAST meeting) would be suitable date.

I will ask Sven to arrange a dedicated session for our VXD discussion.

Goals, strategies, and issues for VXD phase-2 commissioning

- Carlos has already prepared comprehensive document.
- I would propose to every related person to go through the document offline and give any feedback to Carlos to share concerns and make a VXD-group document.
- We should prepare a TWiki page where all the information is summarized. The above document should be on the page.

gemba discussion @ Feb. B2GM

- phase-2 VXD assembly procedure
 - 0th version of SVD cartridge was 3D-printed
- Location and service of monitor sensors
 - diamond sensors
 - FE-I4
 - scintillators
 - NTC, humidity sensors
 - BGO
- We need to confirm date (6th Feb?).

backup

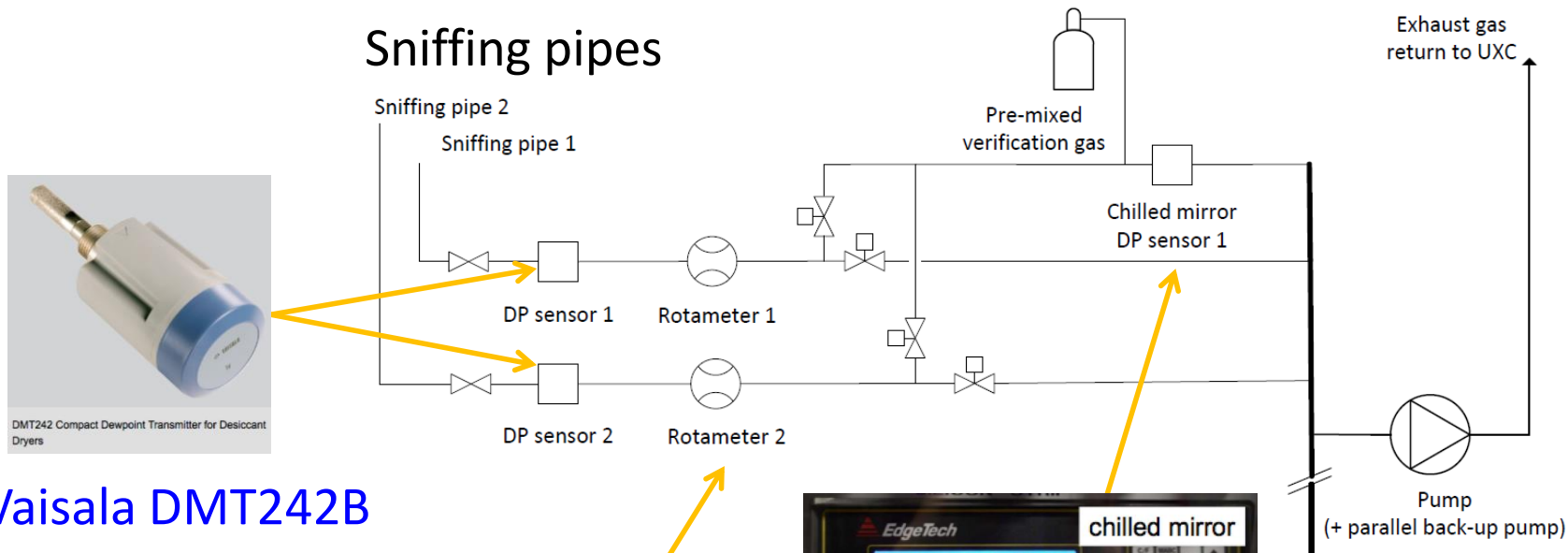
Diamonds for BEAST (location and cabling)

We plan to have 4 diamonds (more only if we have spares)

- With a prototype of final readout system already in phase 1
- Possibly with pin diodes very close (they have foreseen 64, see next slide).
- Where to locate them?
- Can we use the final cabling already in BEAST?
- Pin diodes can be useful also for physics run

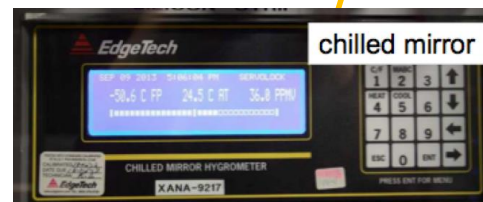
Humidity 2: inputs from Dew Point Sensors

(very preliminary! Needs mechanical design etc)



Vaisala DMT242B
Dew Point Transmitters
[-60, +60]^oC dew point range

Rotameter
flux meters



Edgetech Dewmaster
Chilled Mirror Hygrometer
(for calibrations)

Pump

SVD (phase-3) Construction Schedule

Task	Begin	End	2014												2015												2016												2017			
			01	02	03	04	05	06	07	08	09	10	11	12	01	02	03	04	05	06	07	08	09	10	11	12	01	02	03	04	05	06	07	08	09	10	11	12	01	02	03	04
Ladder parts production	14/01	14/10	[Green bar]																																							
FWD/BWD site setup and assembly tests	14/01	14/08	[Green bar]																																							
L3 site setup and assembly tests	14/01	14/08	[Green bar]																																							
L4 site setup and assembly tests	14/01	14/09	[Green bar]																																							
L5 site setup and assembly tests	14/01	14/09	[Green bar]																																							
L6 site setup and assembly tests	14/01	14/08	[Green bar]																																							
Class C prototypes (mechanical)	14/09	15/02													C C C C C C																											
Class B prototypes (fully working)	14/10	14/12													B B B																											
Class A prototypes (first spare ladder)	14/11	15/01													A A A																											
FWD/BWD assembly production	15/01	15/06													FB FB FB FB FB FB																											
L3 ladder production	15/03	15/07													L3 L3 L3 L3 L3																											
L4 ladder production	15/02	15/09													L4 L4 L4 L4 L4 L4 L4																											
L5 ladder production	15/02	15/11													L5 L5 L5 L5 L5 L5 L5 L5																											
L6 ladder production	15/01	15/12													L6 L6 L6 L6 L6 L6 L6 L6 L6																											
Ladder mount preparation	14/01	15/09	[Green bar]																																							
Ladder mount test & training	15/10	15/12													[Green bar]																											
Ladder mount 1st half shell	16/01	16/03													1 1 1																											
Ladder mount 2nd half shell	16/04	16/06													2 2 2																											
SVD commissioning and test	16/07	16/08																									[Green bar]															
VXD integration	16/12	17/01																									[Green bar]															
VXD commissioning / cosmic run	17/01	17/04																									[Green bar]															
VXD installation	17/09	17/11																									[Green bar]															
Beast phase 2	17/02	17/06																																					B2 B2 B2 B2			
Summer Shutdown	17/07	17/09																																					[Green bar]			
Start of physics run	18/01	18/06																																					P P P P			

Delayed, since L3 and L4 need more time (2-3 months)

Delayed start due to availability of FlexPA (1-2 months)

Class-B, Class-A and ladder production start of L4,L5 and L6 will be delayed due to PAO (problem #2) ~4-6 months?

Shifted due to change of global schedule and current ladder production situation

Shifted according to global schedule

Ladder mount: 6 months → includes margin