Present Commissioning Issues
&
Tentative Next Run Plan

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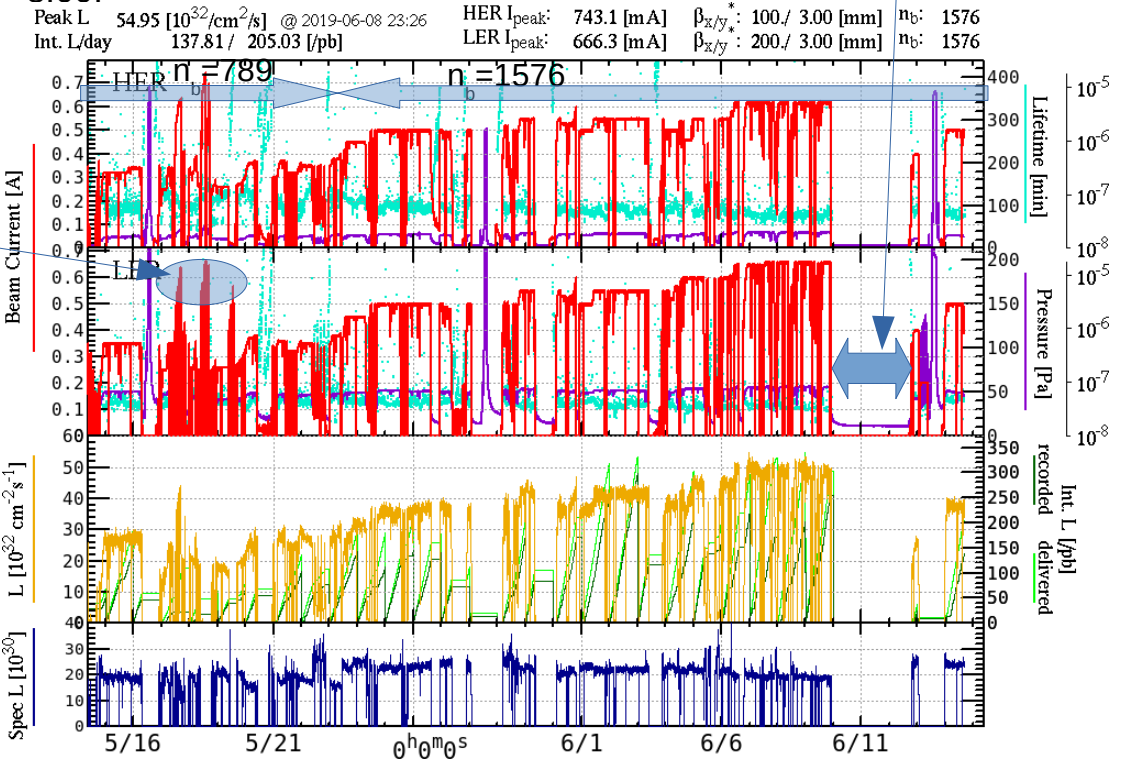
Luminosity Performance

- 5.495 x 10^{33} $cm^{-2}s^{-1}$ is achieved during Belle2 data taking with continuous injection.
- Actual daily production rate is reached to 297.85 pb^{-1} @ 2019-06-02 00:00 ~ 24:00.
- Expected maximum daily production rate is 334.20 pb^{-1}.
  - 111.40 pb^{-1} per shift is achieved @ 2019-06-05 00:00 ~ 8:00.

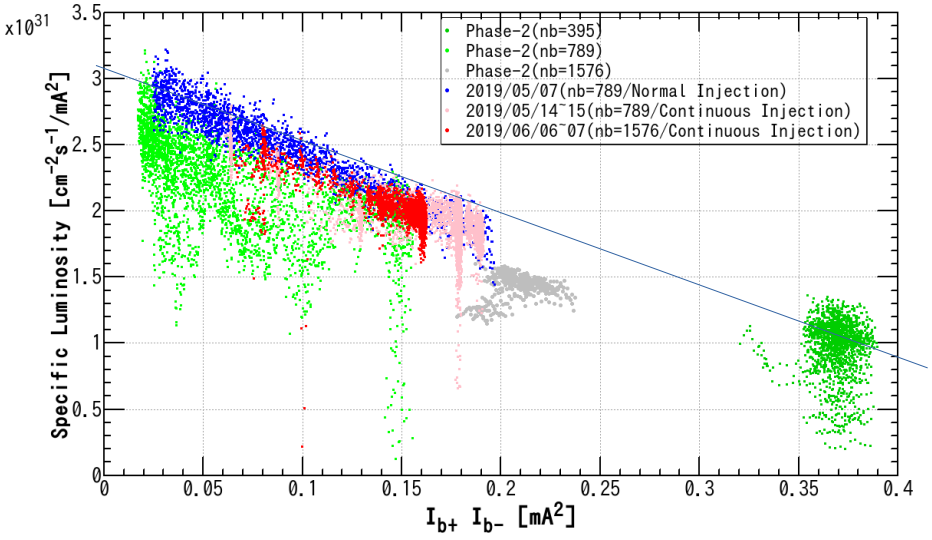
Cooling time
due to QCS Quench

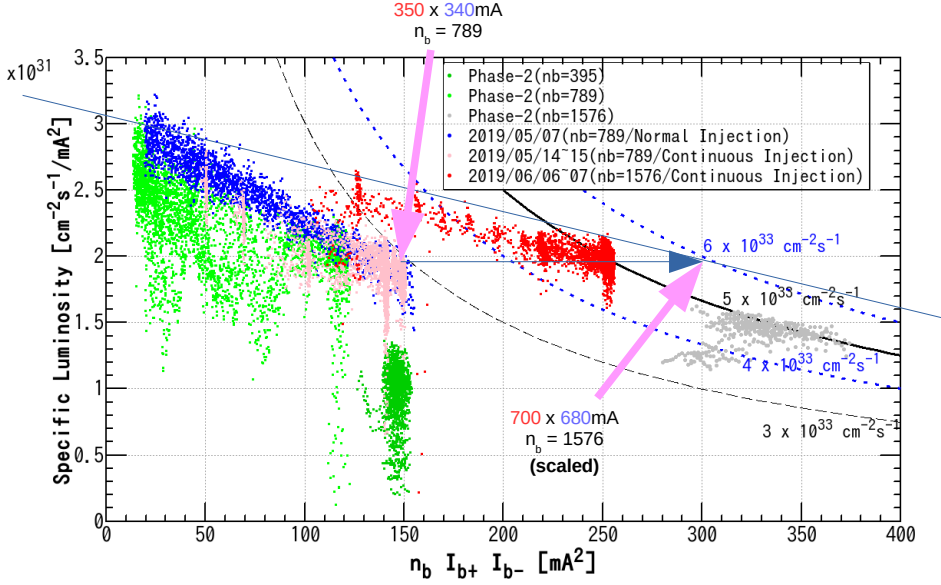
N_b=1576 trial w/o DAQ



Specific Luminosity(β*y = 3mm)

- Phase-3 L_{sp} is almost same as best L_{sp} on Phase-2 n_b=789 operation.
  - Beam-beam parameter is not improved from Phase-2.
- Phase-3 L_{sp} on n_b=1576 WOULD be scaled until 6 x 10^{34} $cm^{-2}s^{-1}$.
  - Phase-3 n_b=1576 operation(red) is different with Phase-2(gray).





QCS Quenches

- 2019/05/27 15:08 QC2LE Quench/No beam
  - QC2LE PS slow down due to IPM IL
- 2019/05/28 01:32 QC1LE/QC2LE Quench/LER Inj.(499/494mA)
  - QC2LE PS slow down due to IPM IL
- 2019/05/31 19:49 QC1RP Quench/LER Inj.(596/600mA)
  - D06V1 loss monitor trip at first
- 2019/06/06 14:53 QC1LE/QC2LE Quench/LER Inj.(650/618mA)
  - QC2LE PS IPM IL
- 2019/06/06 16:41 QC2LE Quench/No beam
  - QC2LE PS IPM IL
- 2019/06/09 22:11 QC*R & ESR/QC1LP Quench/LER Inj.(654/616mA)
  - Long down time to recover cooling system(~ 2days) due to outflow of large amount of He gas.
  - LER D02V1 bottom collimator head is damaged.
  - Big beam loss(~100mA during 3~4turns) is observed before beam abort.

QCS Quench Issues

- Unstable QC2LE PS IPM(4 events)
  - Repair works is ongoing by NICHICON. (2019/05/28, 2019/06/13)
- QCS quench due to beam loss(2 events)
  - Possibility that QCS quench is caused by dust event is pointed out.
  - Current beam abort system is too slow to protect beam collimator & Belle2 VXD for 2019-06-09 event.
  - Discussion to speed-up beam abort has been started.
  - Lower limit of abort latency of current fill pattern is 10μsec(1-turn) for synchronizing next abort gap.
    - In order to break this limit with current abort kicker system...
      - Introduce fill pattern with multi abort gap (Reduce total number of bunches)
      - Accept extra beam loss caused by raising edge of abort kicker (A part of aborted beam bunches hits accelerator components & Belle2 detector)

Luminosity Performance Issues

- Specific luminosity & beam-beam parameter are lower than designed/planed value.
  - Achieved beam-beam parameter is only 0.02.
    - Extrapolated luminosity is 2 x 10^{35} at design current & design β*y if beam-beam is not improved.
  - Big beam-beam blowup is observed.
    - A possibility of big IP chromatic aberration is pointed out from beam-beam simulation, however, off-momentum optical function measurement result is not consistent with such big aberration.
- Operation beam current limit due to Belle2 detector background
  - Storage beam background due to LER beam-gas Coulomb scattering
  - CDC HV trip due to injection beam background

Machine Study at This June

- High current operation test & machine studies are scheduled during 2019/06/24 ~ 31.
- Extra 1 shift for RF μ=-1 mode damper tuning to prepare high current operation is proposed during 2019/06/19 ~ 21 (day or swing shift).

Date	Time Slot					
	0-6	6-9	9-13	13-17	17-21	21-24
6/24(月)	Physics Run		Backup for μ=-1 mode damper tunig		衝突点垂直軌道フィードバックの試験	
6/25(火)	Physics Run	High Current	Dithering Study			
6/26(水)	Physics Run	High Current	Cap Sigma (BB scan)			
6/27(木)	Physics Run	High Current	Bunch length			
6/28(金)	Physics Run	High Current	RF zero-mode study for high current in HER (蓄積障害時は前倒し)			
6/29(土)	Physics Run		Electron Clound Effect Study			
6/30(日)			*Squeezing β* Trial?*			

Tentative Run Plan until 2020-07-01

- 2019/10/15 ~ 2019/12/12 (~8weeks)
  - Vacuum scrubbing & restore β*y=3mm - 3weeks (Assuming D02V1 head replacement)
  - Prepare β*y=2mm collision - 1week
  - Physics run - 4weeks
- 2020/01/15 ~ 2010/07/01 (~24weeks)
  - Vacuum scrubbing - 1week
  - TEPCO power line work - 1week
  - Vacuum scrubbing & restore β*y=2mm - 1week
  - Squeezing β* study - 1week
  - Prepare β*y=1.5mm collision – 1week
  - Physics run – 18weeks (except 03/20 for TEPCO power line work)
  - High current study - 1week

Machine study time for future beam development is NOT included.

Luminosity Projection

ASSUMPTIONS

(*risky* ⟷ *realistic*)

- Integral Efficiency (~65%)
  - Integration Time Efficiency ~90%
    - 8H maintenance & 4H startup / 2weeks
    - 12H linac study / week
  - SuperKEKB Availability 85%
  - Belle2 Availability 85%
    - Availability @ 2019-06-02 is 89.6%.
- Luminosity Performance
  - Baseline: 0.5 x 10^{34} @ 600/550mA(n_b=1576, β*y=3mm)
  - No beam-beam parameter improvement
  - β*y staging: 2mm @ 2019-11 → 1.5mm @ 2020-02
  - Improvement by squeezing β*y: $1/\sqrt{\beta^*y} \rightarrow 1/\beta^*y$ during operation period
    - **Assuming detector background independence with β*y.**
  - Beam current limit improvement: x√2 @ 2019-12-12 → x2 @ 2020-06-24
    - **Assuming factor 2 improvement of CDC current limit until next summer.**
    - **Assuming no current limit for protecting detector.**
- Machine Study
  - ***No future beam development time is counted.***

Integral Luminosity
13.9 fb^{-1} (2019-10 ~ 2019-12)
112.8 fb^{-1} (2020-01 ~ 2020-07)