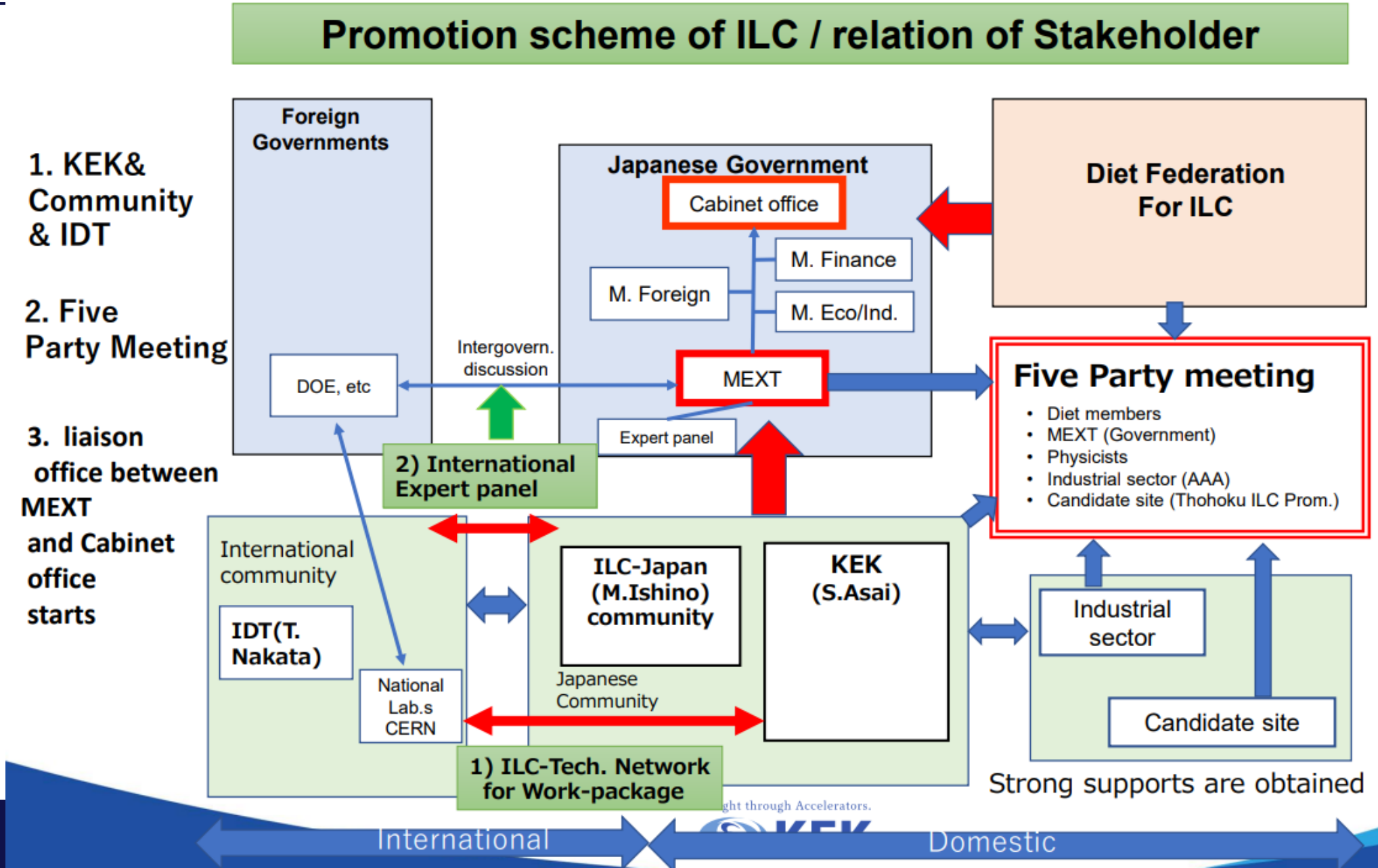
LCWS2024 AND KEK REPORT

Frank Zimmermann

FCC-ee Optics Design Meeting #189 & 58th FCCIS WP2.2 meeting, 25 July 2024

LCWS'24, The University of Tokyo, 8-11 July 2024

Opening by Shoji Asai



Programme of the first day

Registration
Foyer, Ito International Research Center 08:30 - 09:00

9:00
Opening remarks *Shoji Asai*
Ito Hall, Ito International Research Center 09:00 - 09:10

Physics case for Higgs and Electroweak precision *Jorge De Blas Mateo*
Ito Hall, Ito International Research Center 09:10 - 09:30

ILC status *Tatsuya Nakada*
Ito Hall, Ito International Research Center 09:30 - 09:42

CLIC status *Steinar Stapnes*
Ito Hall, Ito International Research Center 09:42 - 09:54

0:00
Status of the C3 R&D *Caterina Vernieri*
Ito Hall, Ito International Research Center 09:54 - 10:06

Physics case for e+e- at 500 GeV and above *Georg Ralf Weiglein*
Ito Hall, Ito International Research Center 10:06 - 10:26

coffee
Foyer, Ito International Research Center 10:30 - 11:00

1:00
HALHF status *Brian Foster*
Ito Hall, Ito International Research Center 11:00 - 11:12

XCC status *Tim Barklow*
Ito Hall, Ito International Research Center 11:12 - 11:24

Energy recovery at a Linear Collider *Vladimir Litvinenko*
Ito Hall, Ito International Research Center 11:24 - 11:36

CEPC status *Jie Gao*
Ito Hall, Ito International Research Center 11:36 - 11:48

FCCee status *Frank Zimmermann*
Ito Hall, Ito International Research Center 11:48 - 12:00

2:00
Muon collider status (remote talk) *Daniel Schulte*
Ito Hall, Ito International Research Center 12:00 - 12:12

Higgs Factory detector R&D *Srini Rajagopalan*
Ito Hall, Ito International Research Center 12:12 - 12:32

14:00
ITN: accelerator developments *Shinichiro Michizono*
Fukutake Hall 14:00 - 14:15

ECFA Higgs-EW-top factory study *Aidan Robson*
Ito Hall, Ito International Research Center 14:00 - 14:15

CLIC: accelerator developments *Philip Burrows*
Fukutake Hall 14:15 - 14:30

Beyond collider experiments at a Linear Collider *Yasuhito Sakaki*

C3: accelerator developments *Ankur Dhar*
Fukutake Hall 14:30 - 14:45

Challenges for MC generators *Jürgen Reuter*
Ito Hall, Ito International Research Center 14:30 - 14:45

CEPC: accelerator developments *yuhui li*
Fukutake Hall 14:45 - 15:00

Opportunities and Experimental Challenges at the Higgs *Junping Tian*

15:00
FCCee: accelerator developments *Frank Zimmermann*
Fukutake Hall 15:00 - 15:15

Highlights from LHC detector upgrades *Gustaaf Brooijmans et al.*

Energy Upgrades of a linear Higgs factory *Emilio Nanni*
Fukutake Hall 15:15 - 15:30

Highlights from detectors for EIC *Taku Gunji*
Ito Hall, Ito International Research Center 15:15 - 15:30

coffee
Foyer, Ito International Research Center 15:30 - 16:00

16:00
Introduction and Kick-off Presentations *Brian Foster et al.*
Ito Hall, Ito International Research Center 16:00 - 16:45

Plenary discussion *Aidan Robson et al.*

17:00
Ito Hall, Ito International Research Center 16:45 - 17:30

Posters: Posters and Reception

Physics goals of full Higgs factory program (M. Peskin)

350 GeV: top quark threshold

a short run (200 fb-1) gives m(t) to < 50 MeV

550 - 600 GeV: above the ttH, ZHH thresholds

Higgs couplings to 1% in $WW \to H$ 2nd!

top quark EW form factors (SMEFT parameters) to parts per mil

measurement of top Yukawa in $e^+e^- \to t\bar{t}H$ to 3%

measurement of triple H coupling in $e^+e^- \to ZHH$ to 20%

precision study of $e^+e^- \to W^+W^-$, $e^+e^- \to f\bar{f}$ for global SMEFT fits, 10's -TeV BSM sensitivity, CP violation probes 2nd!

Physics goals of full Higgs factory program (M. Peskin)

800 - 1000 GeV: final Higgs Factory stage

Higgs couplings to <1% in $WW \to H$ 3rd!

top quark EW form factors (SMEFT parameters) to parts per mil 2nd!, resolution of degeneracies in SMEFT fit

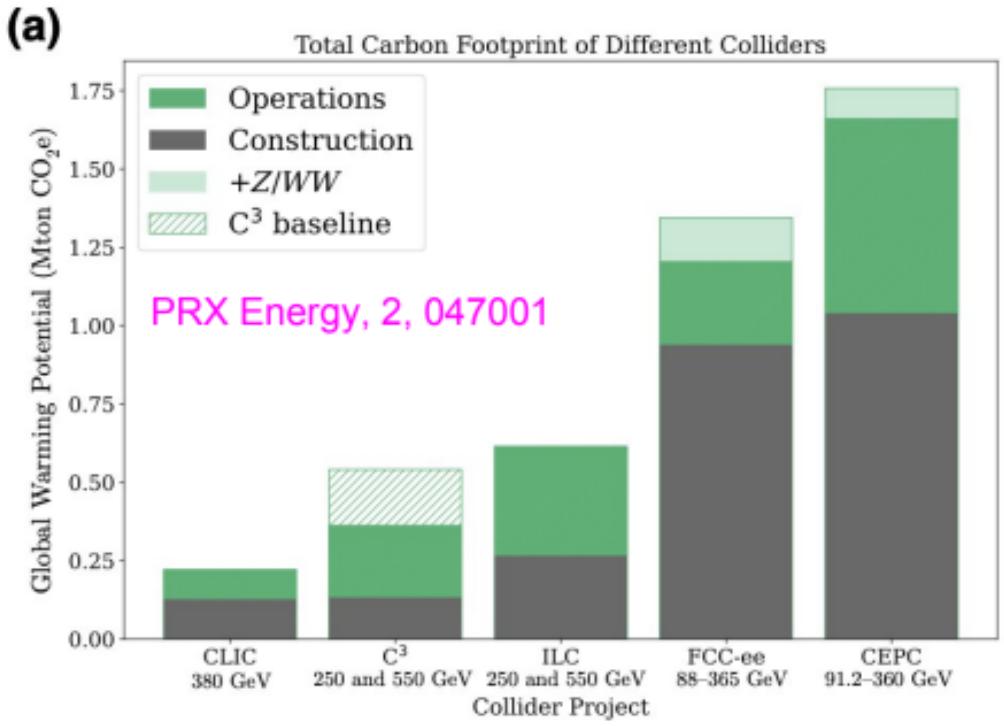
measurement of top Yukawa in $e^+e^- \to t\bar{t}H$ to 1% 2nd!

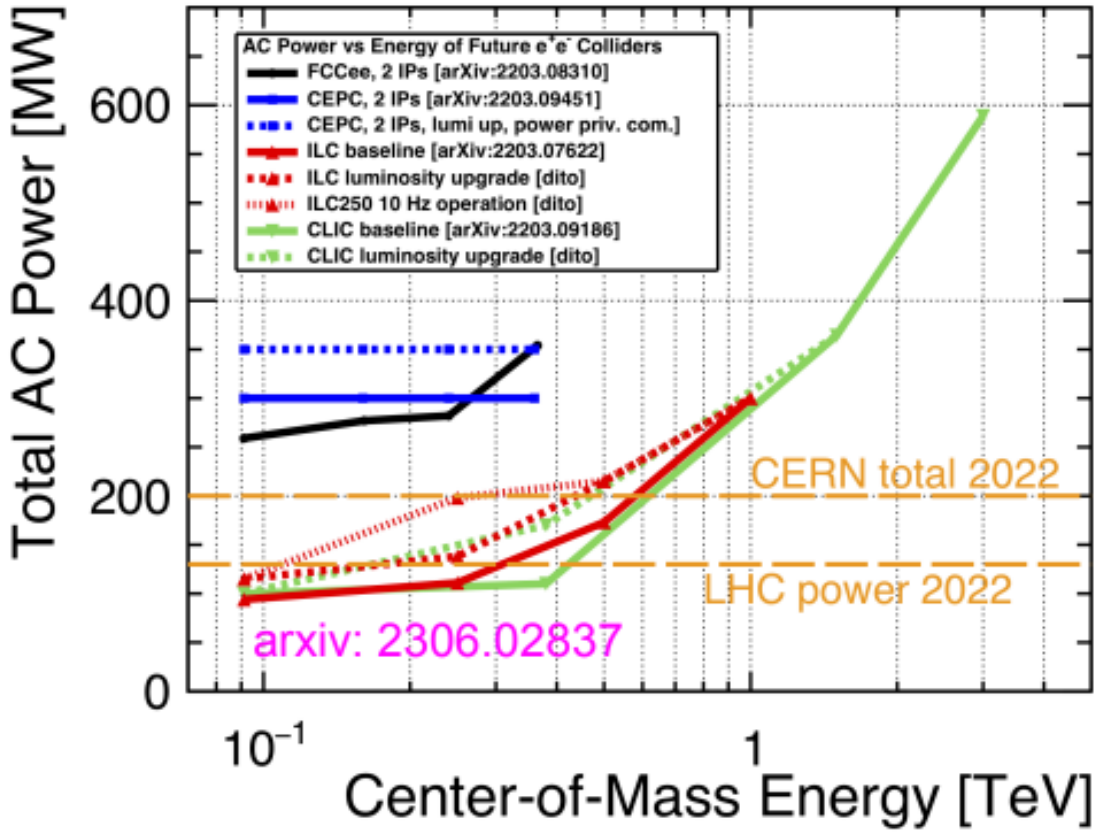
measurement of top Yukawa in $WW \to t\bar{t}$ to few % 3rd!

measurement of triple H coupling in $e^+e^- \to \nu\bar{\nu}HH$ to 10% 2nd!

precision study of $e^+e^- \to W^+W^-$, $e^+e^- \to f\bar{f}$ for global SMEFT fits, 100 -TeV BSM sensitivity, CP violation probes 3rd!

ILC at CERN vs FCC-ee (R. Pöschl)





- Carbon footprint of all LC projects << Carbon footprint of circular machines
- Until ~500 GeV power consumption remains in ball park of current CERN power consumption
- Estimated operation cost for ILC ~390 MILC (plus 700-1000 FTE)
  - Compare with 1.3 BCHF for FCCee as estimated by German BMBF

Official LCWS2024 workshop photo

SuperKEKB run 2024ab summary meeting (Part 1)

2024ab Summary Meeting (Part 1)

Friday Jul 12, 2024, 10:00 AM → 6:00 PM Asia/Tokyo

Meeting Room (SuperKEKB Control Building)

Description: SuperKEKBコントロール棟会議室 + Zoomのハイブリッド形式

Zoom Information

https://us02web.zoom.us/j/82851262494?pwd=AsbbikQacTR8yyFVHrN4iYKbbDwCGa.1

ID: 828 5126 2494

Pass code: 686132

午前の部：渡邉（議長）、森（書記）

午後の部（1）：森（議長）、小林（書記）

午後の部（2）：小林（議長）、杉本（書記）

There are minutes attached to this event. Show them.

10:00 AM → 10:20 AM **Belle II Report, Beam Aborts, Collimator Tuning** 20m
Speaker: Kenta UNO (KEK IPNS)
2024.07.12_Kuno.pdf

10:30 AM → 10:50 AM **Sudden Beam Loss and Knocker Study** 20m
Speaker: Hitomi IKEDA (KEK ACCL)
20240712まとめme...

11:00 AM → 11:20 AM **Beam Monitor** 20m
Speaker: Gaku MITSUKA (KEK ACCL)
2024abSummary_M...

11:30 AM → 11:50 AM **Optics Issues** 20m
Speaker: Hiroshi SUGIMOTO (KEK ACCL)
Optics2024ab_HSu...

1:30 PM → 1:50 PM **QCS**
Speaker: Xudong WANG (KEK ACCL)
QCS 2024ab(wang)....

2:00 PM → 2:20 PM **Magnet System**
Speaker: Shu NAKAMURA (KEK ACCL4)
20240712 運転まと...

2:30 PM → 2:50 PM **RF System**
Speaker: Tetsuya KOBAYASHI
SKB-2024ab-Summ...

2:50 PM → 3:00 PM

3:00 PM → 3:20 PM **Beam lifetime and injection issues**
Speaker: Dr Yoshihiro FUNAKOSHI (KEK ACCL)
BeamLifetimeIssue... BeamLifetimeIssue...

3:30 PM → 3:50 PM **Beam-beam related issues**
Speaker: Dr Yoshihiro FUNAKOSHI (KEK ACCL)
BeamBeamIssuesF... BeamBeamIssuesF...

4:00 PM → 4:20 PM **Ring Acceptance and Beam Injection**
Speaker: Yukiyoshi ONISHI (KEK)
2024ab_Aperture.pdf

SuperKEKB: sudden beam loss

1 What is “SBL(Sudden Beam Loss)” ?

H. Ikeda

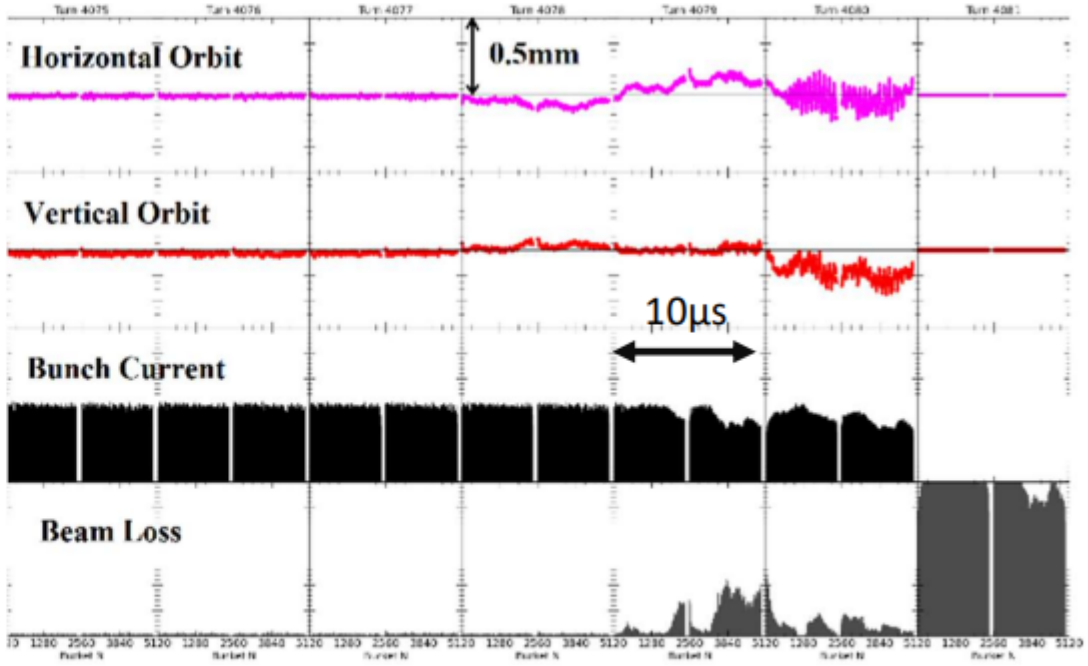
前兆現象なしに１ターン (10μs) 以内に突然発生するビームロス ＝ Sudden Beam Loss（SBL）

- LS1以前からSBLは観測されており、原因は不明。
- 蓄積ビームのかなりの部分が、アボートトリガーが発報されて、ダンプされる前に失われる。

SBLによって生じる問題

- コリメータやその他の加速器コンポーネントの損傷
- QCS クエンチ
- Belle-II 検出器へのB.G.＆損傷
- 電流値を上げた時に起こることが多いため、大電流を積むことが難しい。

Beam signal measured by
Bunch Oscillation Recorder(BOR) & Bunch Current Monitor(BCM)



SuperKEKB: abort statistics

H. Ikeda

Abort statistics

2024-01-30 00:00:00 ~ 2024-07-01 09:00:59

ring	SBL	BeamLoss	Injection	RF	Mag	VA	EQ	Others	TOTAL
TOTAL	163	588	1801(392)	107	17	19	37	65	2824
Both(LER)	129	86	157 (93*)	2	7	-	-	16	397
Both(HER)	19	143	1135 (247**)	2	-	-	-	3	1302
Both	-	-	-	-	8	-	7	1	16
LER	15	234	199 (12*)	63	1	4	5	24	545
HER	-	125	310 (40**)	40	1	15	25	21	537

*I_LER>10mA

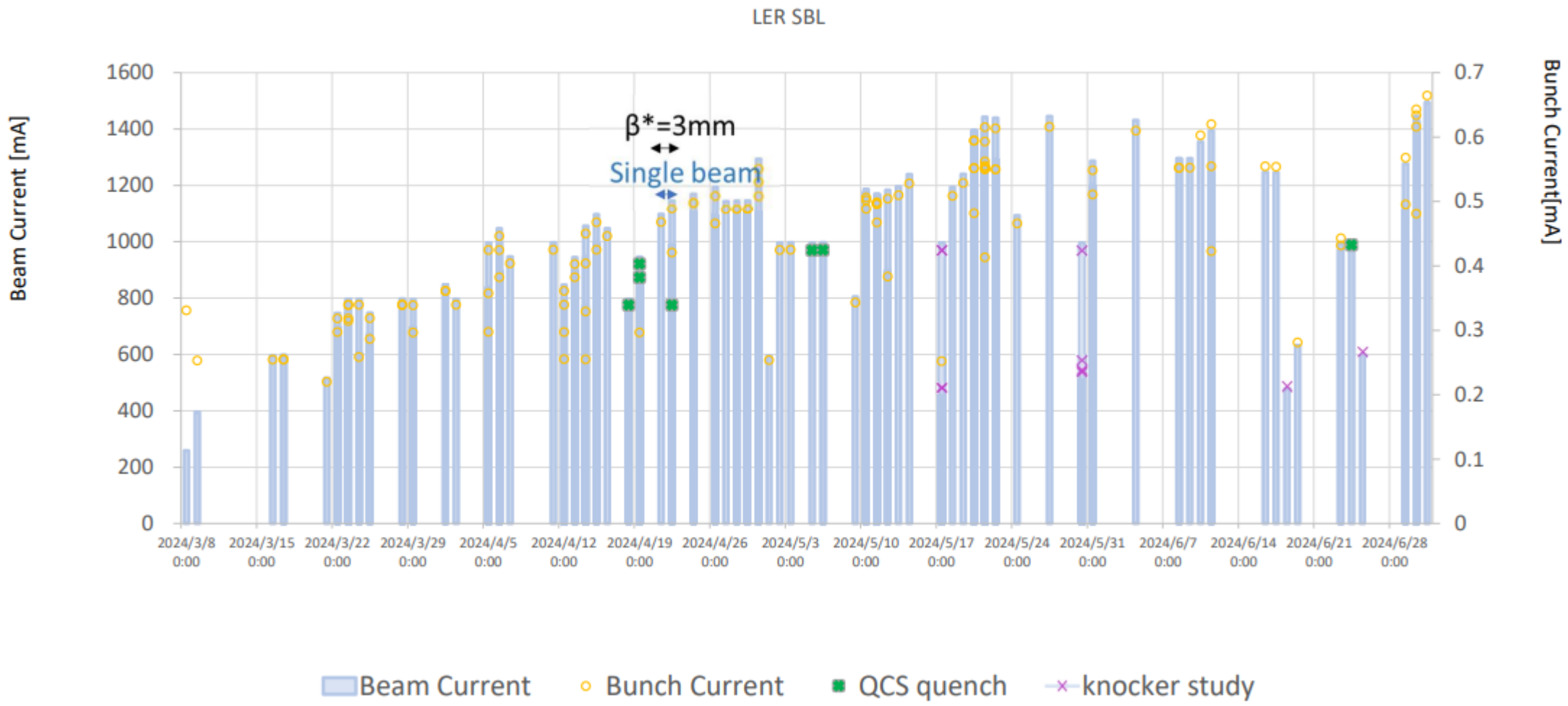
**I_HER>10mA

(S.Ogasawara, M. Nishiwaki et.al)

SuperKEKB: sudden beam loss

H. Ikeda

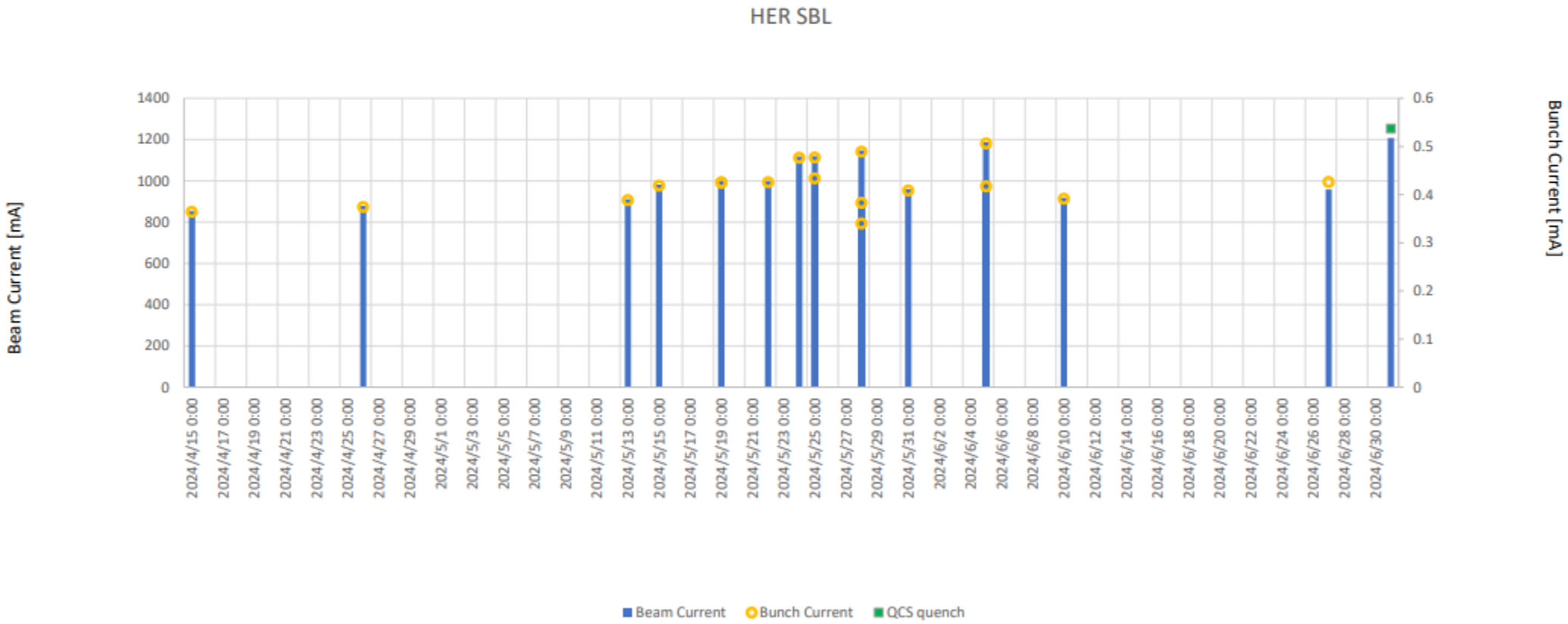
LER SBL statistics



SuperKEKB: sudden beam loss

HER SBL statistics

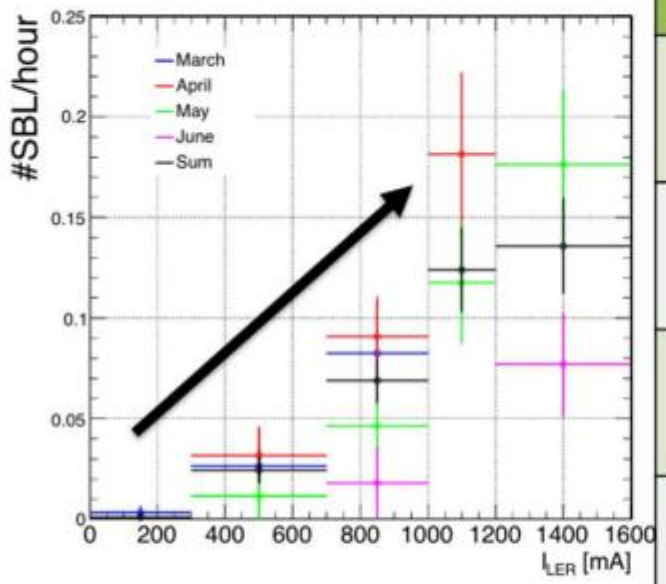
H. Ikeda



SuperKEKB: sudden beam loss

Beam current dependency

H. Ikeda



March.1st - June. 17 at 23:00

I_{LER} [mA]		[300, 700]	[700, 1000]	[1000, 1200]	[1200,]
March	#LER SBL	9	10	0	0
	Operation time [hour]	340	121	0	0
	#SBL/hour	0.026 ± 0.009	0.083 ± 0.026	–	–
April		5	21	20	2
		158	231	110	1.3
		0.032 ± 0.014	0.091 ± 0.02	0.018 ± 0.04	1.6 ± 1.1
May		1	8	15	22
		87	172	127	125
		0.012 ± 0.011	0.046 ± 0.02	0.012 ± 0.03	0.18 ± 0.03
June		0	1	0	9
		32	55	45	117
		0	0.018 ± 0.02	0	0.08 ± 0.03

※ Exclude SBLs and operation time on May17 and May30 (knocker study)

- Frequency (#SBL/hour) depends on the LER beam current
- The frequency (#SBL/hour) in June is reduced
  - Thanks to knocking beam pipes at D10

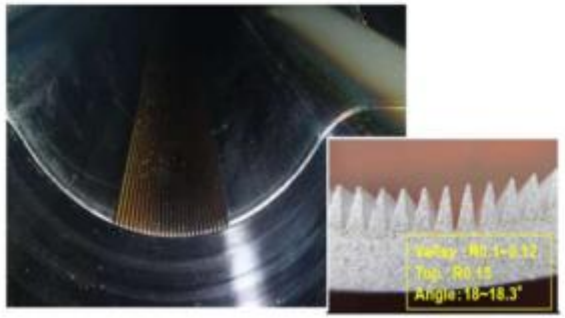
(K.Uno)

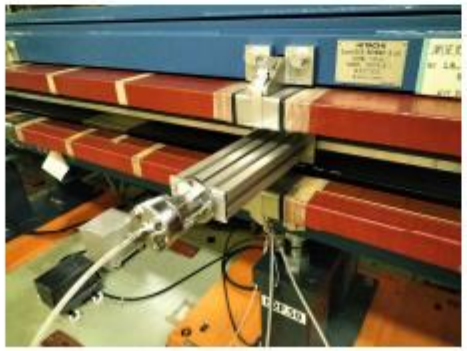
SuperKEKB: sudden beam loss

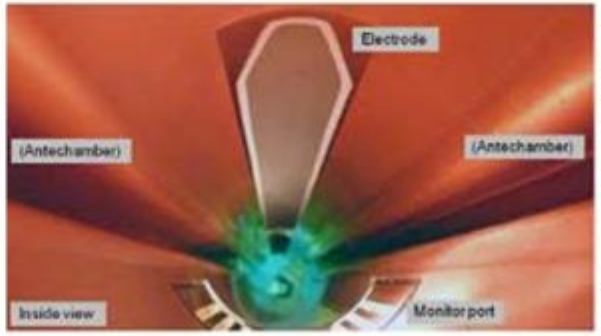
4. Knocker study （5/17, 5/30, 6/18, 6/25）

H. Ikeda

- 再度ノッカー試験をして、ダストイベントを強制的に起こし、どのような現象がみられるかを観測することにした。
- ノッカー設置場所（5/17）
  - LS1中に真空作業があり、ダストが再捕捉される可能性が高い場所。Belle II および QCS の安全のため、ダスト発生点とIP間にコリメータがある場所。
    - D06 アーク部偏向磁石内のgroove付アルミニウム ビーム パイプ
  - 圧力バーストが頻繁にあり、SBLの原因発生を疑われる場所。ダスト発生点とIP間にコリメータがある場所。
    - D10 日光ウィグラー部の電位雲除去用電極付きビームパイプ：銅製ビームパイプにアルミナとタングステンを蒸着して電極を形成（電極はビームパイプ上部）。







（T. Ishibashi, S. Terui et.al）

SuperKEKB: sudden beam loss

Beam pipe with clearing electrode in D10 Nikko Wiggler section

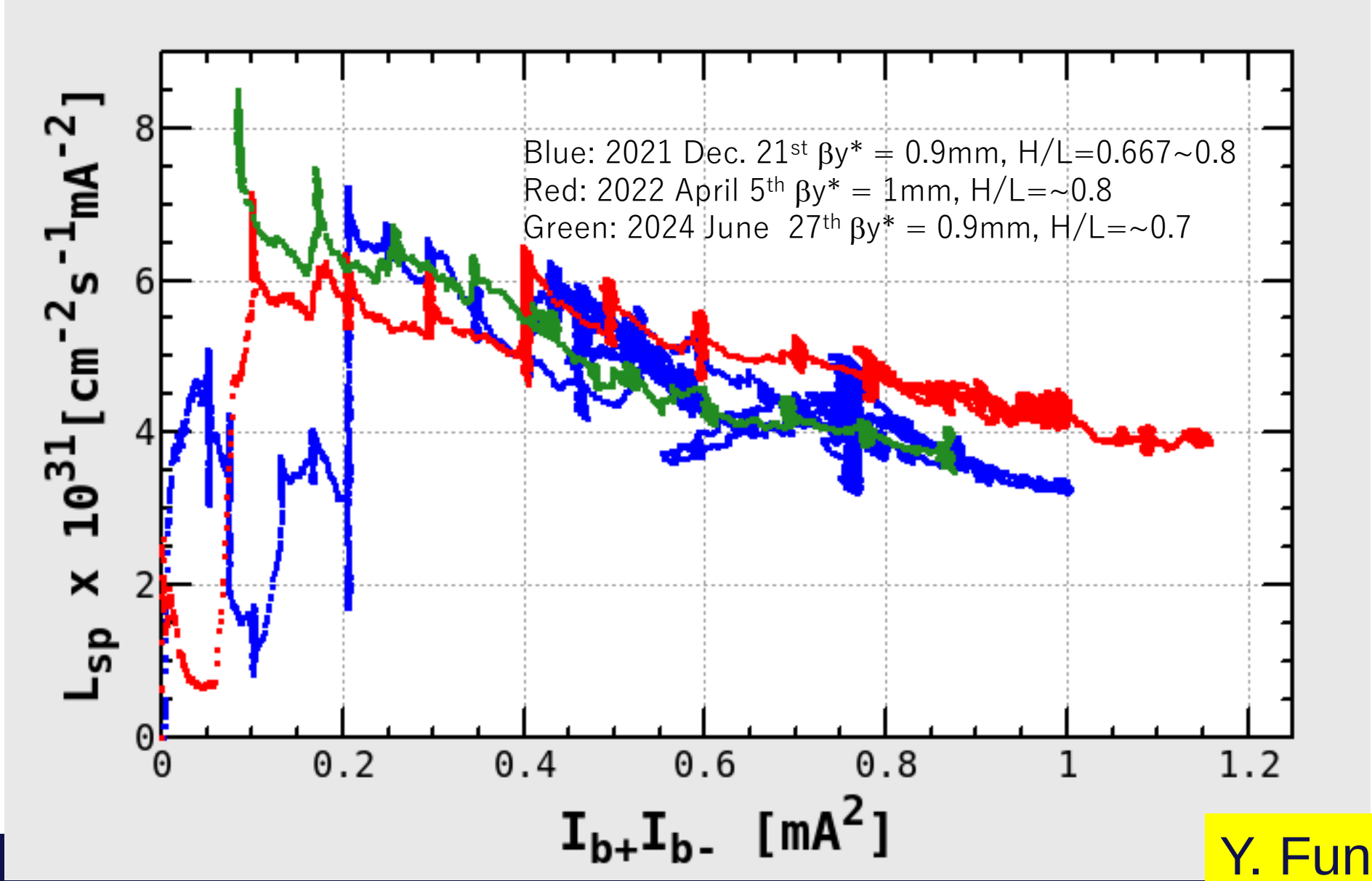
SuperKEKB: sudden beam loss - summary

5. Summary

- 真空バースト、ビームサイズ、Aging効果等から、SBLの原因としてダストが疑われたため、ノッカー試験を行った。
- その結果、メカニズムはまだはっきりしていないが、ダストとSBLの間には何らかの因果関係があるように見える。
- 観測される事象(真空バースト/SBL/その他のAbort)はダストの種類、落下場所、ビーム電流によって異なるように見える。
- 何らかのダストトラップ機構のあるチェンバー（groove付・電子雲除去用電極付）部を叩いた時のみアボートは起きる。
- チェンバーをたたき続けると、その後Abortは減少する。
- 電子雲除去用電極が原因のSBLが多いのは確かなので、シャットダウン中に対応を取る。→真空G.報告（by石橋氏）
- その他のデータも解析中。

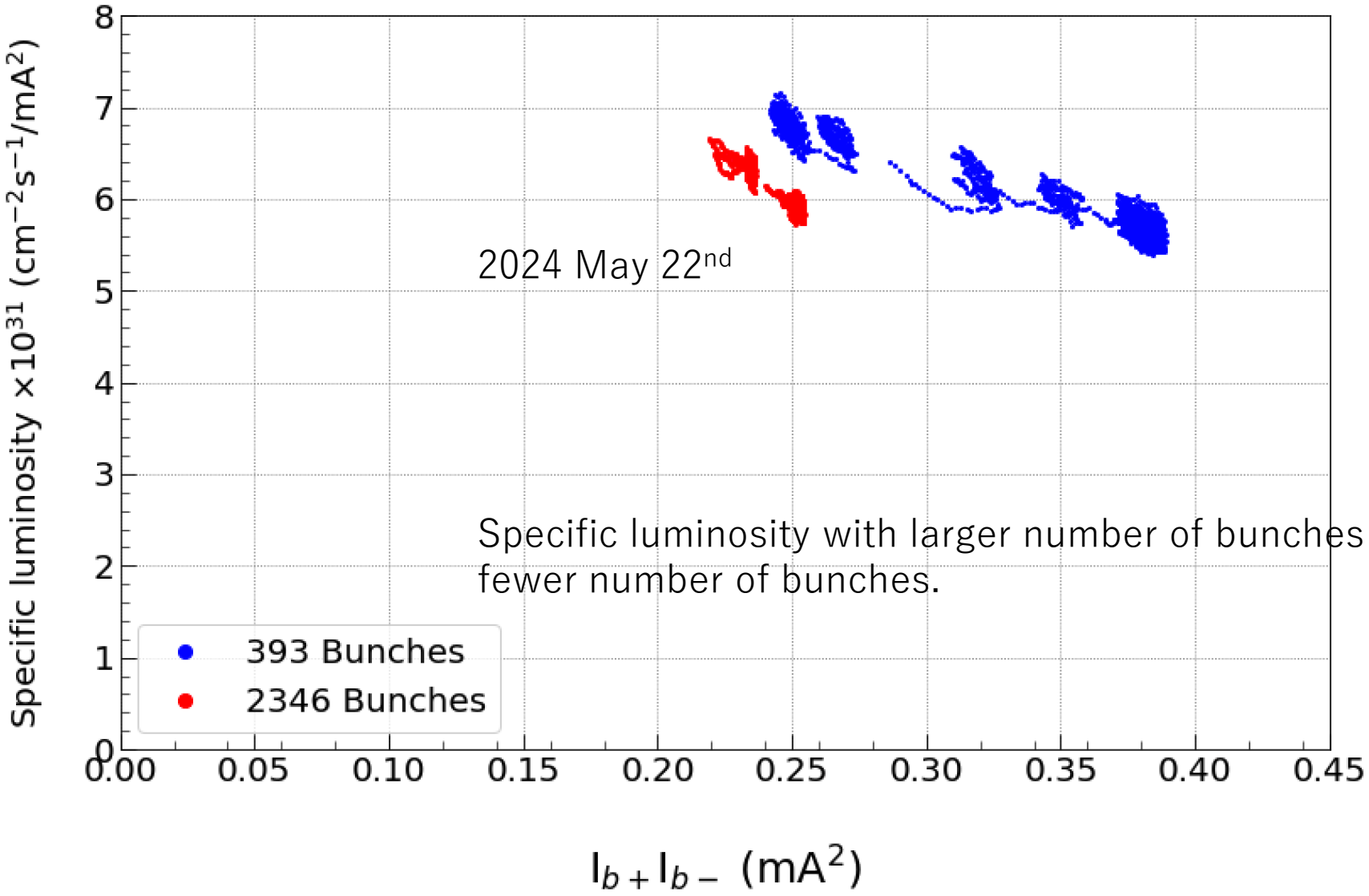
H. Ikeda

SuperKEKB: specific luminosity over the years



Y. Funakoshi

SuperKEKB: multibunch effect in specific luminosity

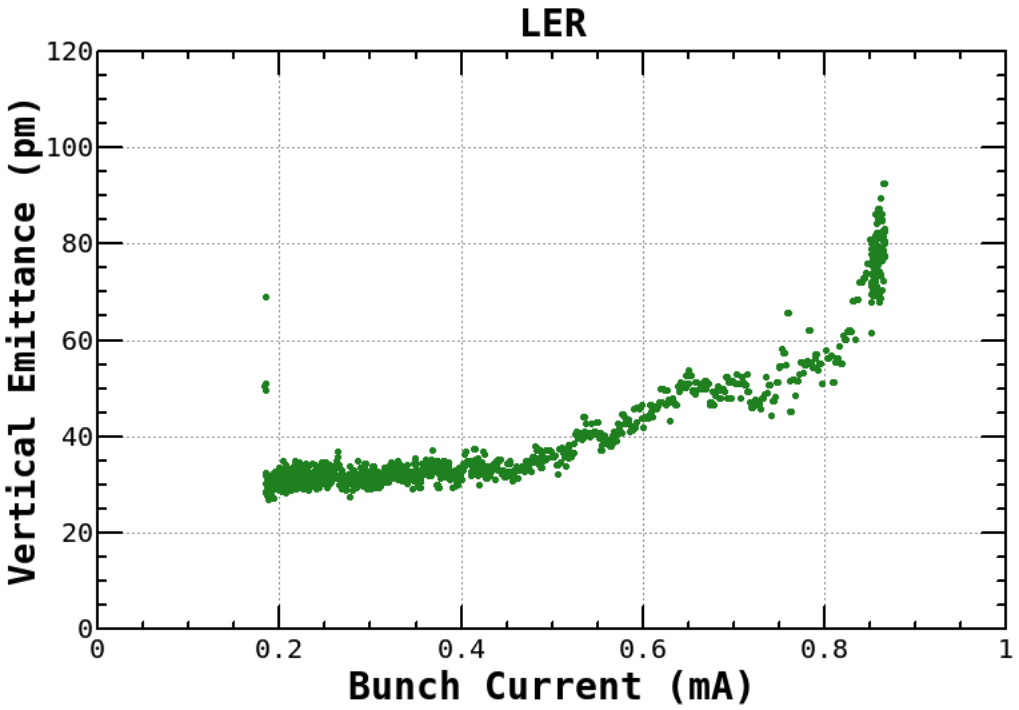


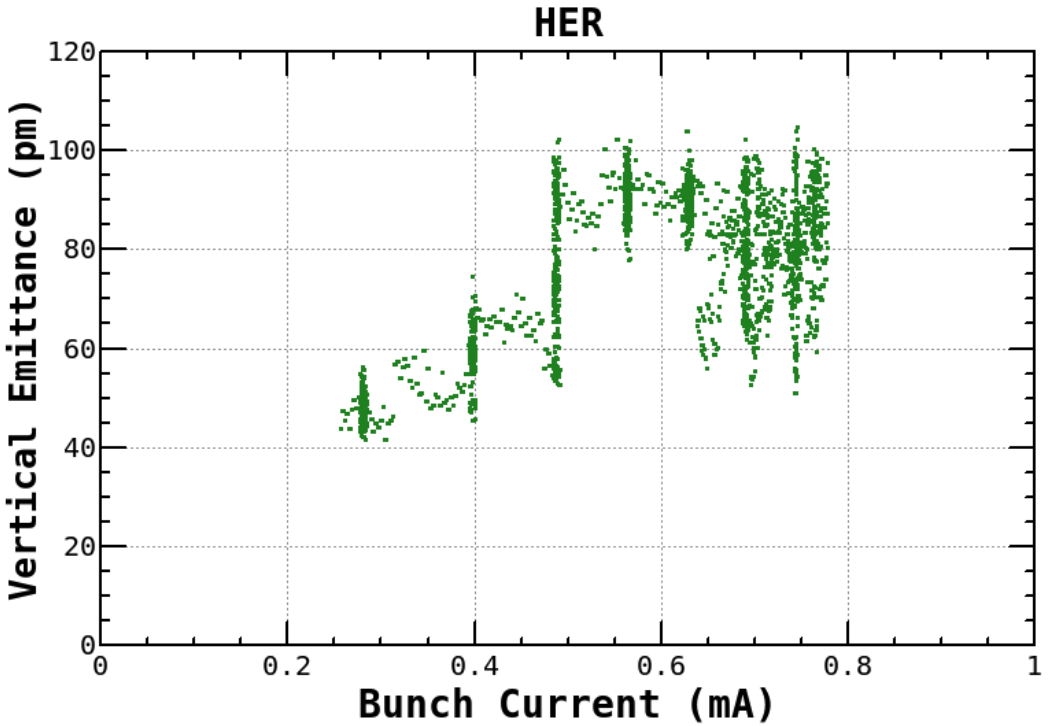
Specific luminosity with larger number of bunches is lower than that with fewer number of bunches.

Y. Funakoshi

SuperKEKB: single beam size vs current

2024 June 27th $\beta y^* = 0.9$mm

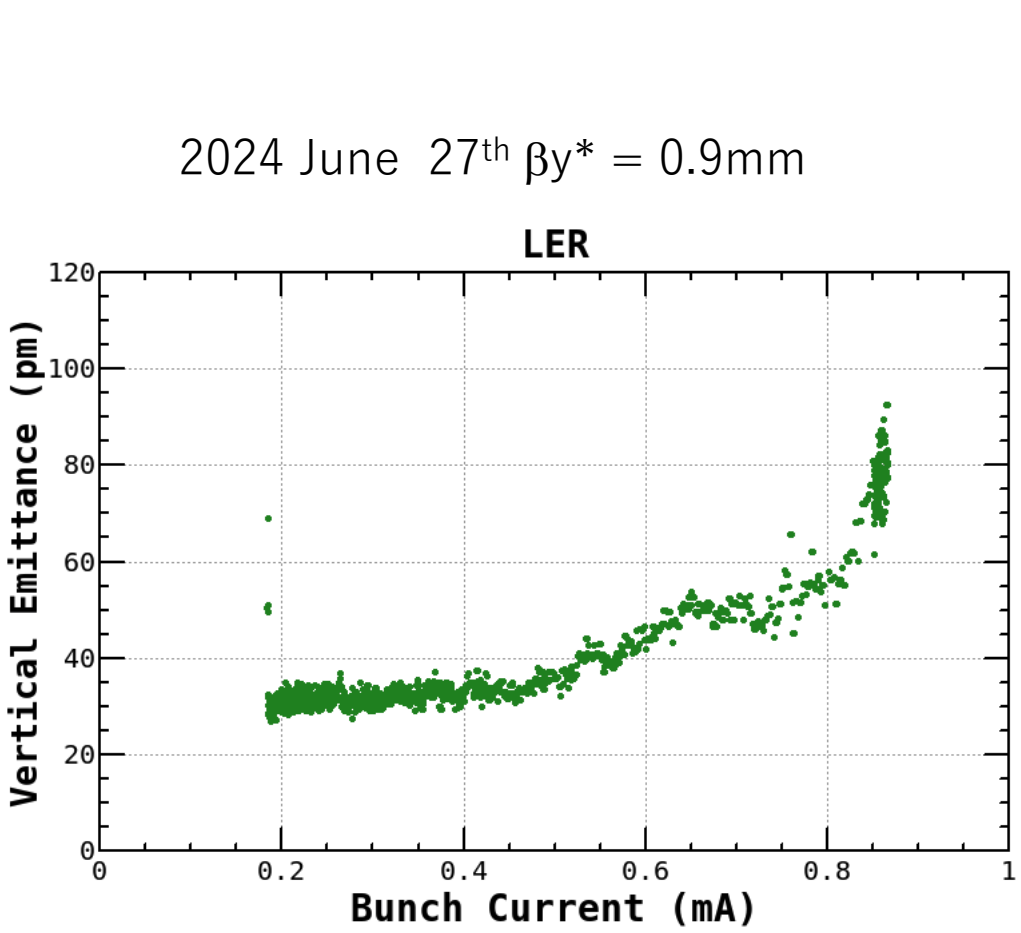




The single beam blowup must be suppressed for a higher luminosity.

Y. Funakoshi

SuperKEKB LER: comparison before and after LS1



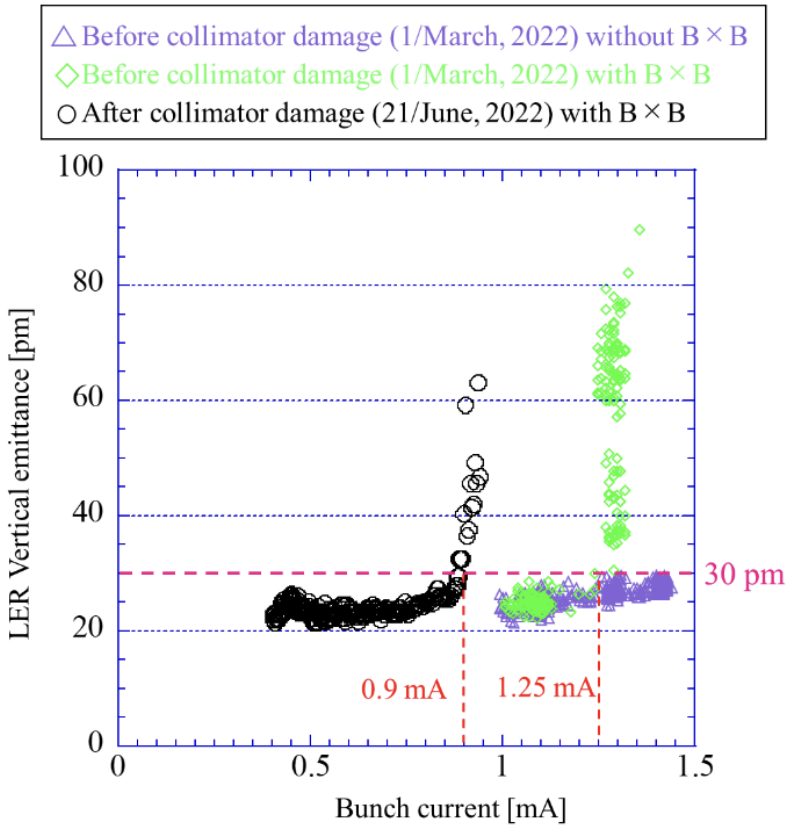


FIG. 10. The vertical beam emittance versus bunch current with $\beta_y^* =$ 1 mm, before (green diamonds) and after (black circles) the event of collimator jaw damage with BxB feedback on. The data of purple triangles show the measurement with BxB feedback off.

Y. Funakoshi

SuperKEKB: beam-beam issues - summary

Specific luminosity

- Specific luminosity with βy^*=0.9mm lower than that with βy^*=1mm end of March.
- Specific luminosity with βy^*=1mm at the end of March similar to that on April 5th 2022.

Beam blowup

- Single beam (single bunch)
  - Serious blowup as function of bunch current in LER and -1 mode peak is high.
  - HER single bunch blowup is also seen.
- Beam-beam blowup
  - Specific luminosity with 2349 bunches is lower than that with 393 bunches by ~10%.
    - Optics distortion at high beam currents is responsible for this?

Beam injection

- Beam-beam effects affect beam injection efficiency largely in LER. Change of tunes improves the effect to some extent. Similar measurement should be done in HER.

Y. Funakoshi