Strategy Toward 10^{35}

Y. Ohnishi

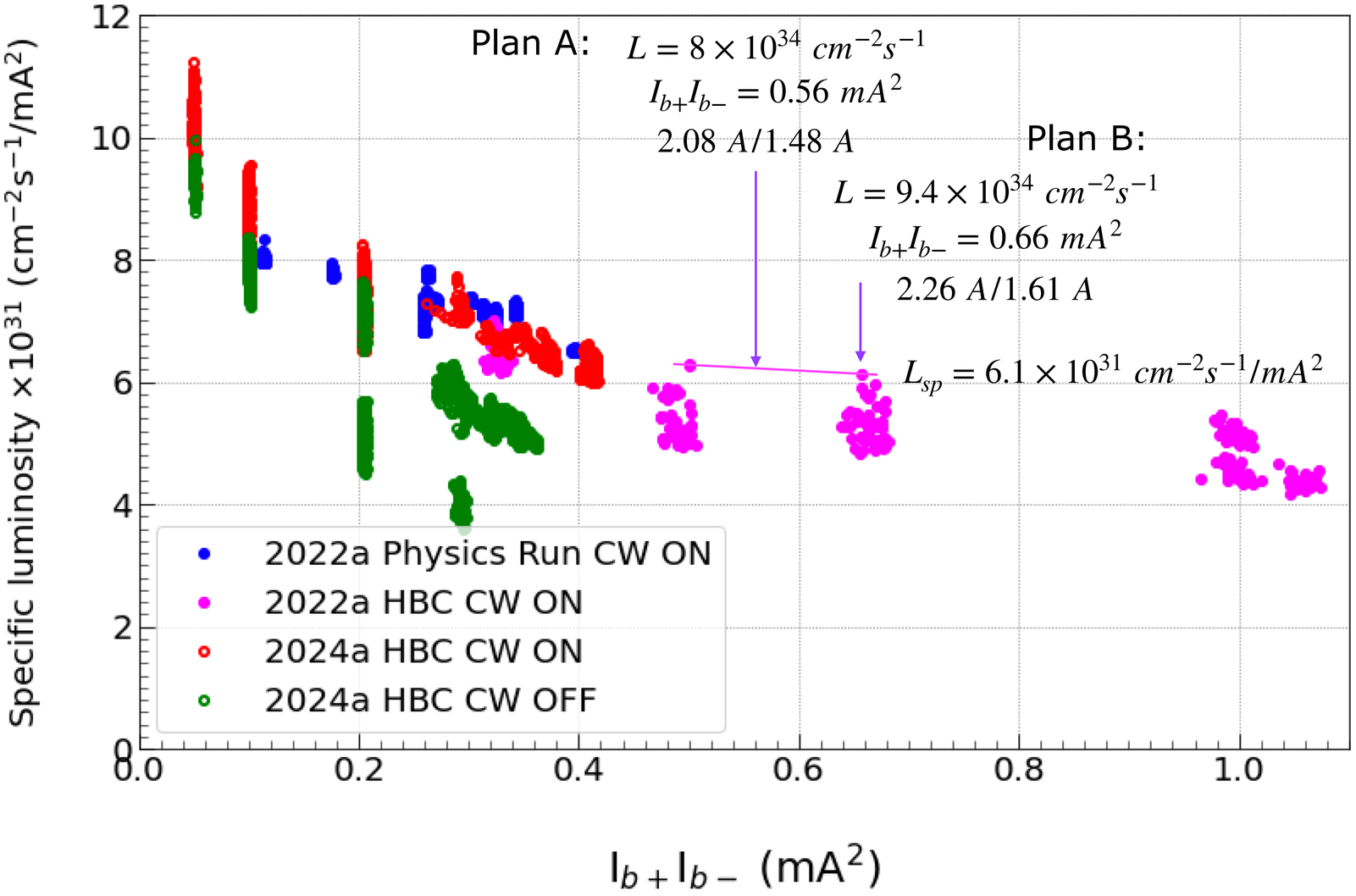
Machine Parameters

	June 8, 2022		Target at post-LS1 (1)		Target at post-LS1 (2)		Unit
Ring	LER	HER	LER	HER	LER	HER	
Emittance	4.0	4.6	4.0	4.6	4.0	4.6	nm
Beam Current	1321	1099	2080	1480	2750	2200	mA
Number of bunches	2249		2346		2346		
Bunch current	0.587	0.489	0.89	0.63	1.17	0.94	mA
Horizontal size σ_x^*	17.9	16.6	17.9	16.6	17.9	16.6	μm
Vertical cap sigma Σ_y^*	0.303		0.217		0.178		μm
Vertical size σ_y^*	0.215		0.154		0.126		μm
Betatron tunes ν_x / ν_y	44.525 / 46.589	45.532 / 43.573	44.525 / 46.589	45.532 / 43.573	44.525 / 46.589	45.532 / 43.573	
β_x^* / β_y^*	80 / **1.0**	60 / **1.0**	80 / **0.8**	60 / **0.8**	80 / **0.6**	60 / **0.6**	mm
σ_z	4.6	5.1	6.5	6.4	6.5	6.4	mm
Piwinski angle	10.7	12.7	10.7	12.7	10.7	12.7	
Crab waist ratio	80	40	80	80	80	80	%
Beam-Beam ξ_y	0.0407	0.0279	0.0444	0.0356	0.0604	0.0431	
Specific luminosity	7.21×10^{31}		7.62×10^{31}		9.31×10^{31}		$cm^{-2}s^{-1}/mA^2$
Luminosity	4.65×10^{34}		1×10^{35}		2.4×10^{35}		$cm^{-2}s^{-1}$

10^{35} and 2.4×10^{35} are tentative and considered by Y. Funakoshi.

Specific Luminosity

$\beta_y^* = 1\ mm$



Plan C:
If we can squeeze β_y^*,
$L = 10^{35}\ cm^{-2}s^{-1}$
at 0.8 mm
with 2.08 A / 1.48 A

Assumption:
$L_{sp} \propto \frac{1}{\beta_y^*}$

Parameter Consideration

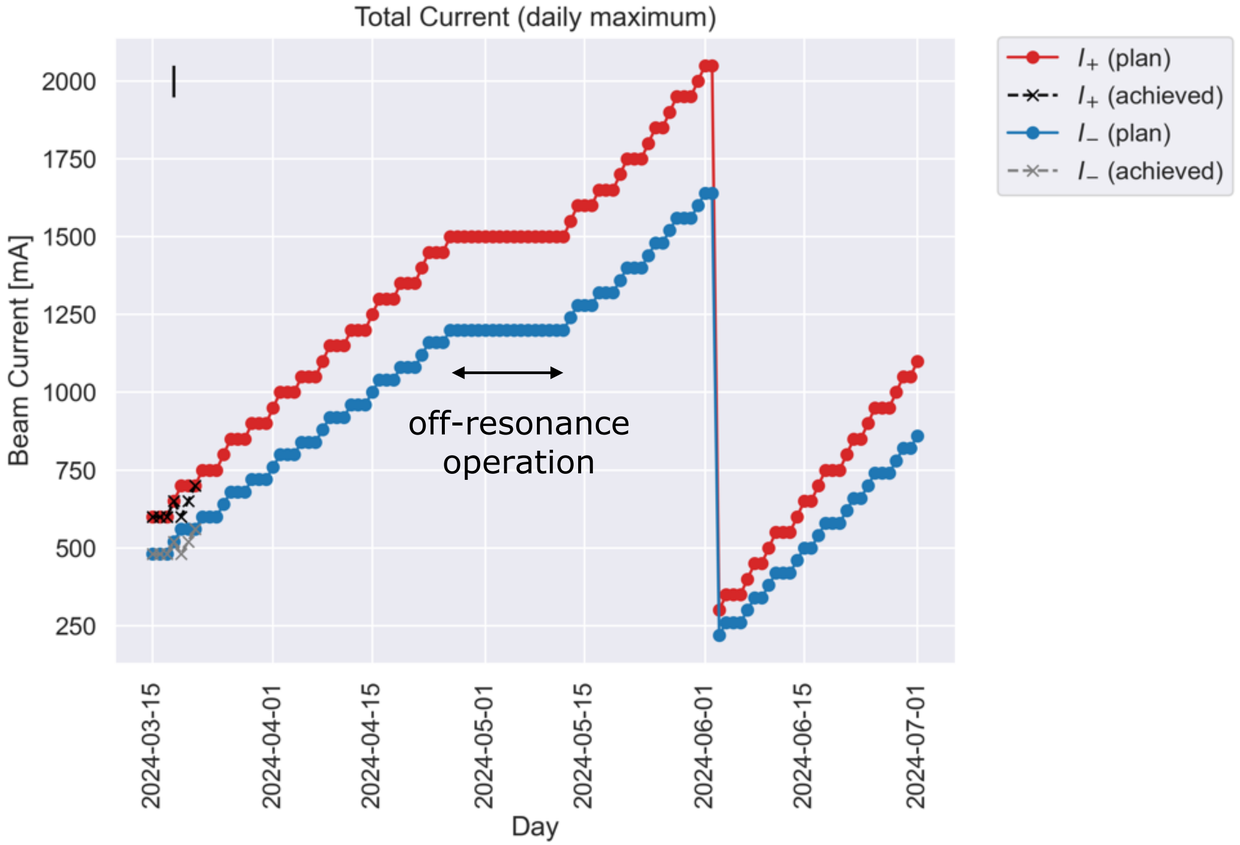
	Plan A	Plan B	Plan C
β_y^* (mm)	1	1	0.8
L_{sp} ($cm^{-2}s^{-1}/mA^2$)	6.1 x 10^{31}	6.1 x 10^{31}	7.6 x 10^{31}
$I_{b+}I_{b-}$ (mA^2)	0.56	0.66	0.56
I_{LER} / I_{HER} (A)	2.08 / 1.46	2.26 / 1.61	2.08 / 1.46
L ($cm^{-2}s^{-1}$)	8 x 10^{34}	9.4 x 10^{34}	10^{35}

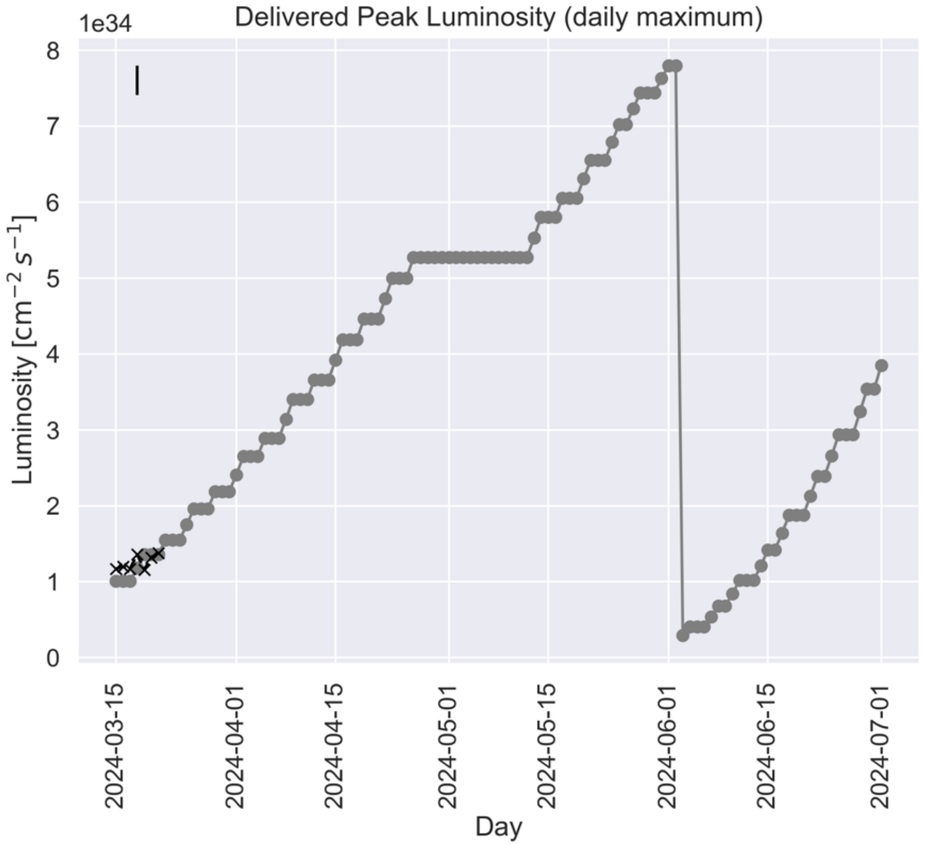
- **Plan A**
  - L_{sp} Is Realistic. Bunch Currents Are Reachable. Less than 10^{35}.
- **Plan B**
  - L_{sp} Is Realistic. Bunch Currents Are Challenge. Close to 10^{35}.
- **Plan C**
  - 10^{35} Is Reachable. L_{sp} Is Realistic under Some Assumptions. Beam Currents Are Challenge. Long Time Operation Is Necessary. Risk: DA and Injection.

Pan of 2024ab

T. Ishibashi

Number of Bunches Is Fixed at 2346 Bunches.





Plan A Plan C

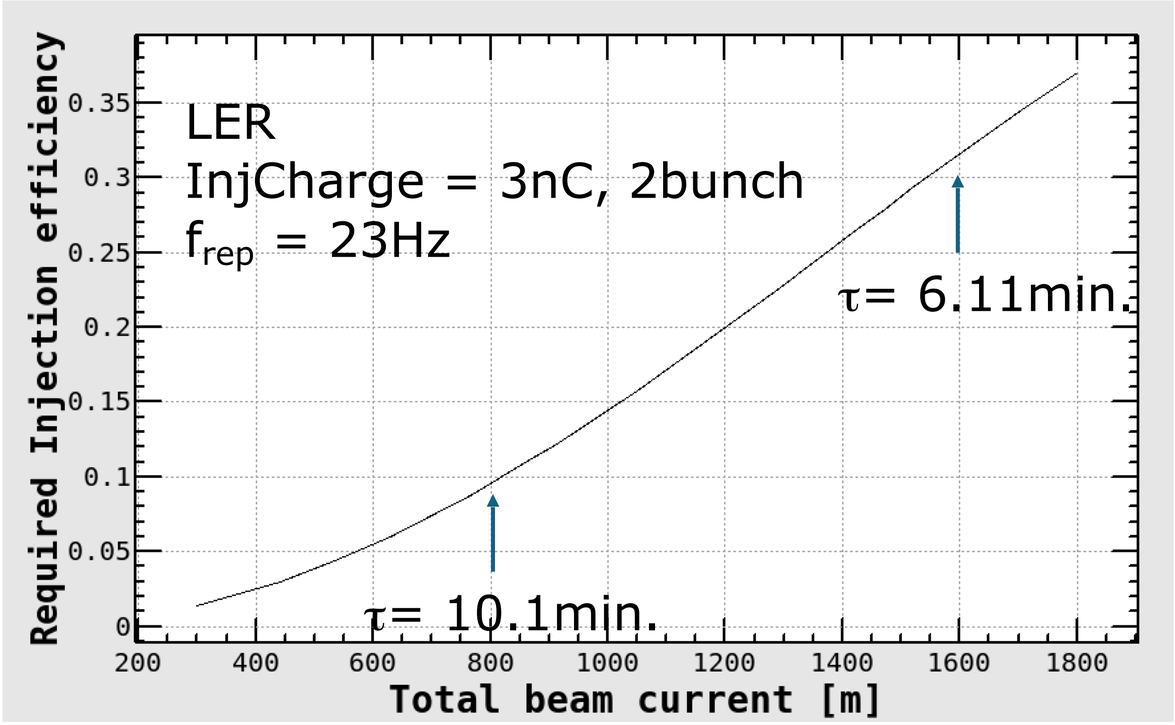
Plan A Plan C

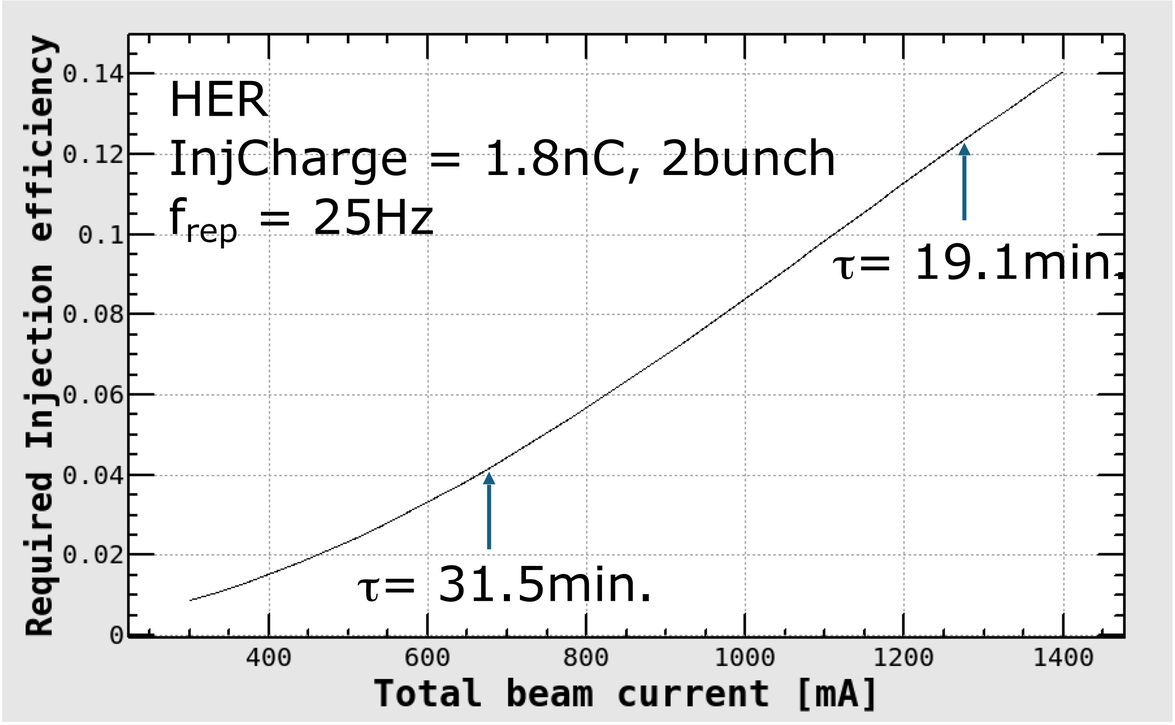
81 fb^{-1} 130 fb^{-1}

90 % efficiency
w/o Machine Study and Any Troubles

Lifetime and Injection

Required Minimum Injection Efficiency





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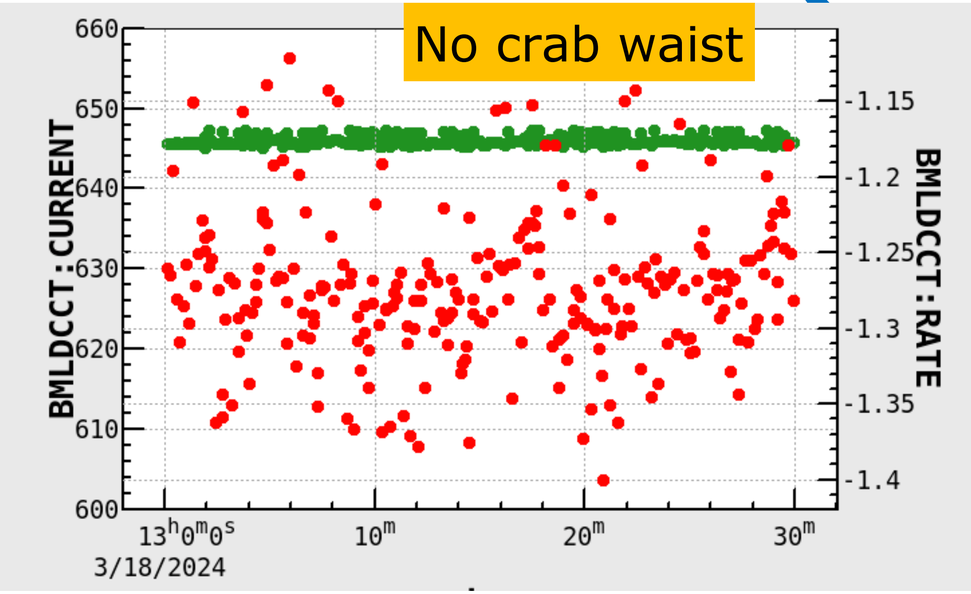
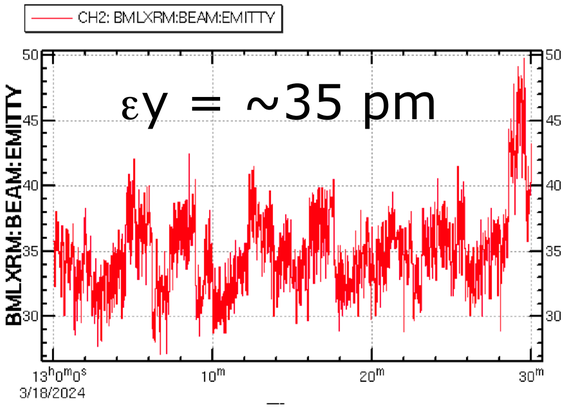
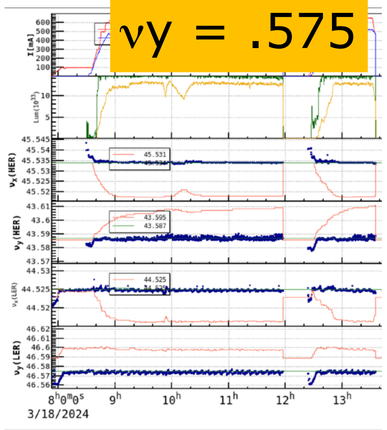
LER lifetime (during top-up injection)

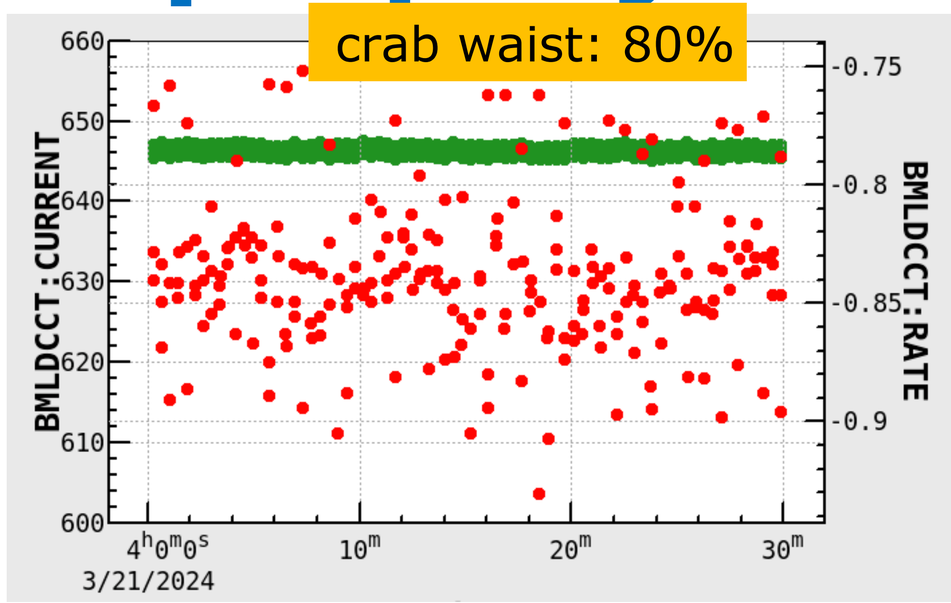


Ave(loss rate) = -1.274 mA/s
Ave(beam current) = 646.0 mA
Lifetime = 8.45 min

νx = .525
νy = .575

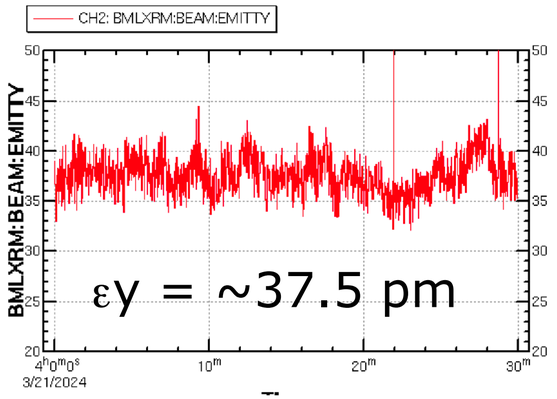


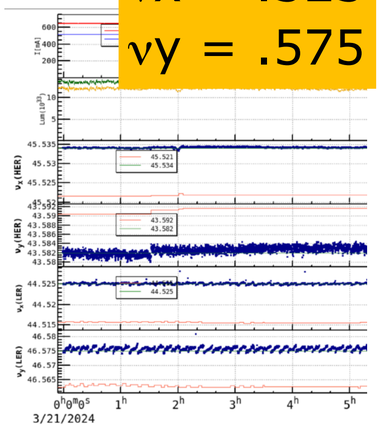




Ave(loss rate) = -0.837 mA/s
Ave(beam current) = 646.3 mA
Lifetime = 12.9 min.

νx = .525
νy = .575





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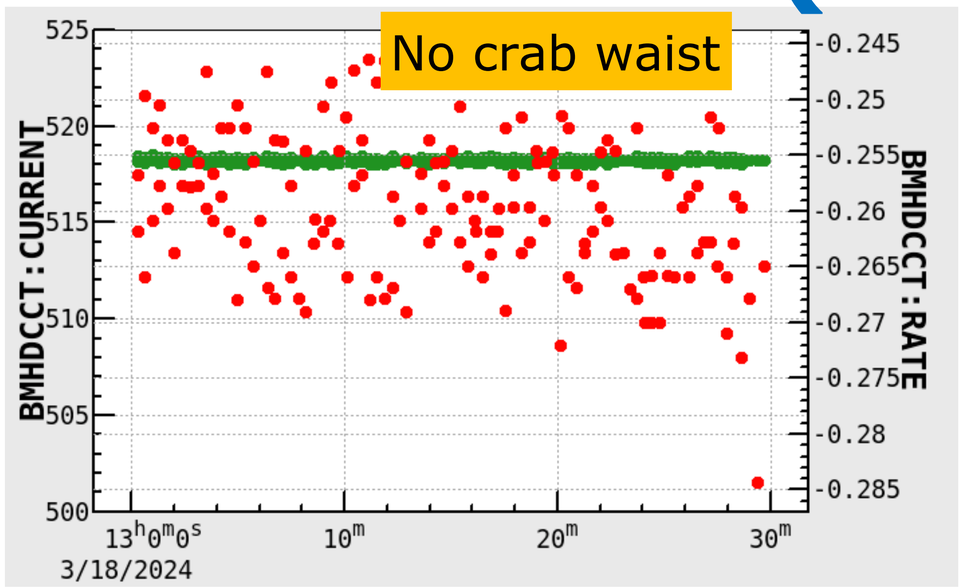
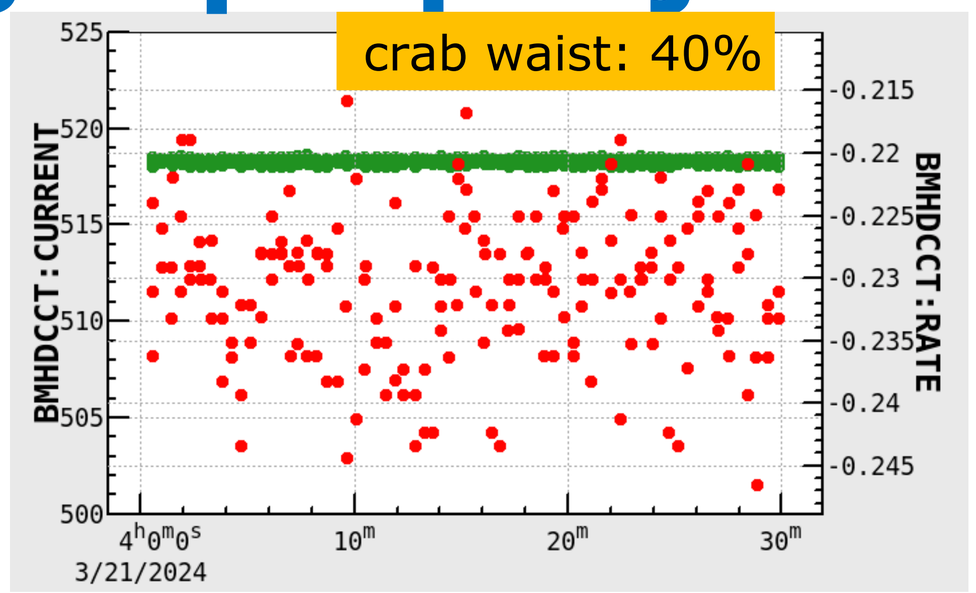
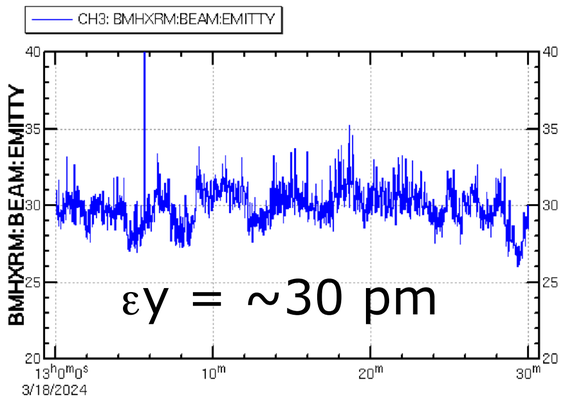
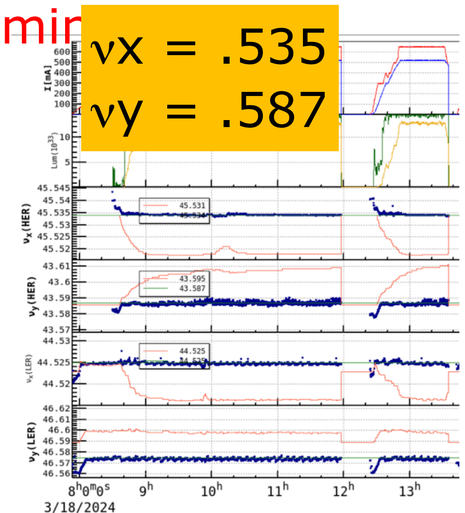
HER lifetime (during top-up injection)



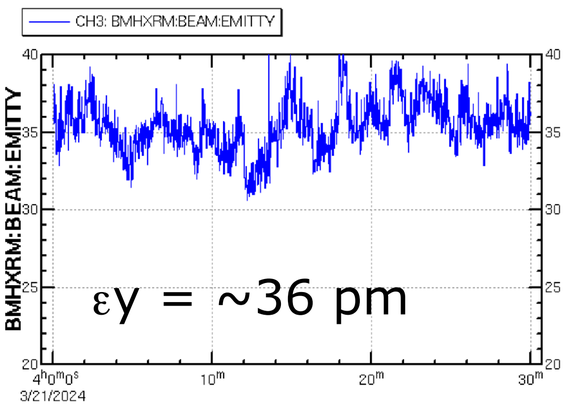


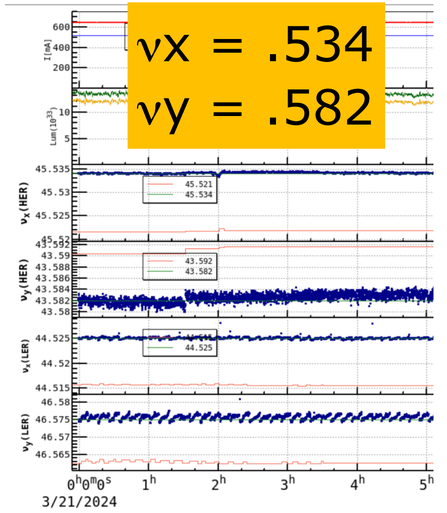
Ave(loss rate) = -.2597 mA/s
Ave(beam current) = 518.2 mA
Lifetime = 33.3 min.





Ave(loss rate) = -.2305 mA/s
Ave(beam current) = 518.3 mA
Lifetime = 37.5 min.





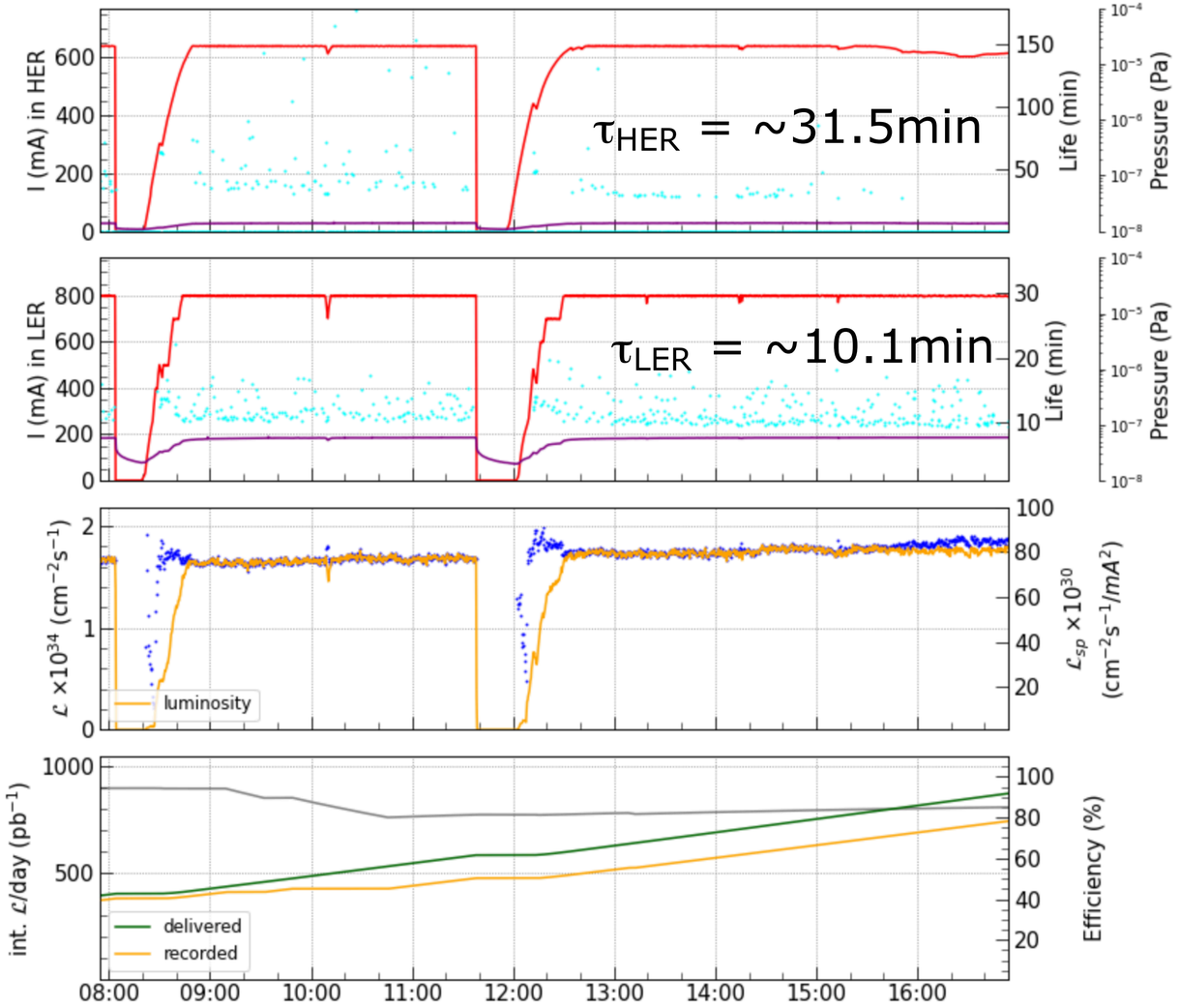
Physics Run (Mar. 24th)

Y. Funakoshi

03/24 07:54:32 - 03/24 16:54:32, 2024 JST

$\mathcal{L}_{peak}$ 1.835 × 10^{34} $cm^{-2}s^{-1}$ @ 14:45:28 03/24 HER I_{peak} 640 mA n_b 2346 β_x^*/β_y^* 60 / 1 mm

int. $\mathcal{L}$/day 742 / 872 pb^{-1} LER I_{peak} 801 mA n_b 2346 β_x^*/β_y^* 80 / 1 mm



HER : Physics Run

LER : Physics Run