

Status of data taking and run plans

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Strategy in 2021 (shown in Feb)

- **Collect as much data as possible** to produce as many physics results of publication quality as possible during LS1.
 - In 2021, we should exceed at least $424 \text{ fb}^{-1} = \text{BaBar at } Y(4S)$.

Mar.

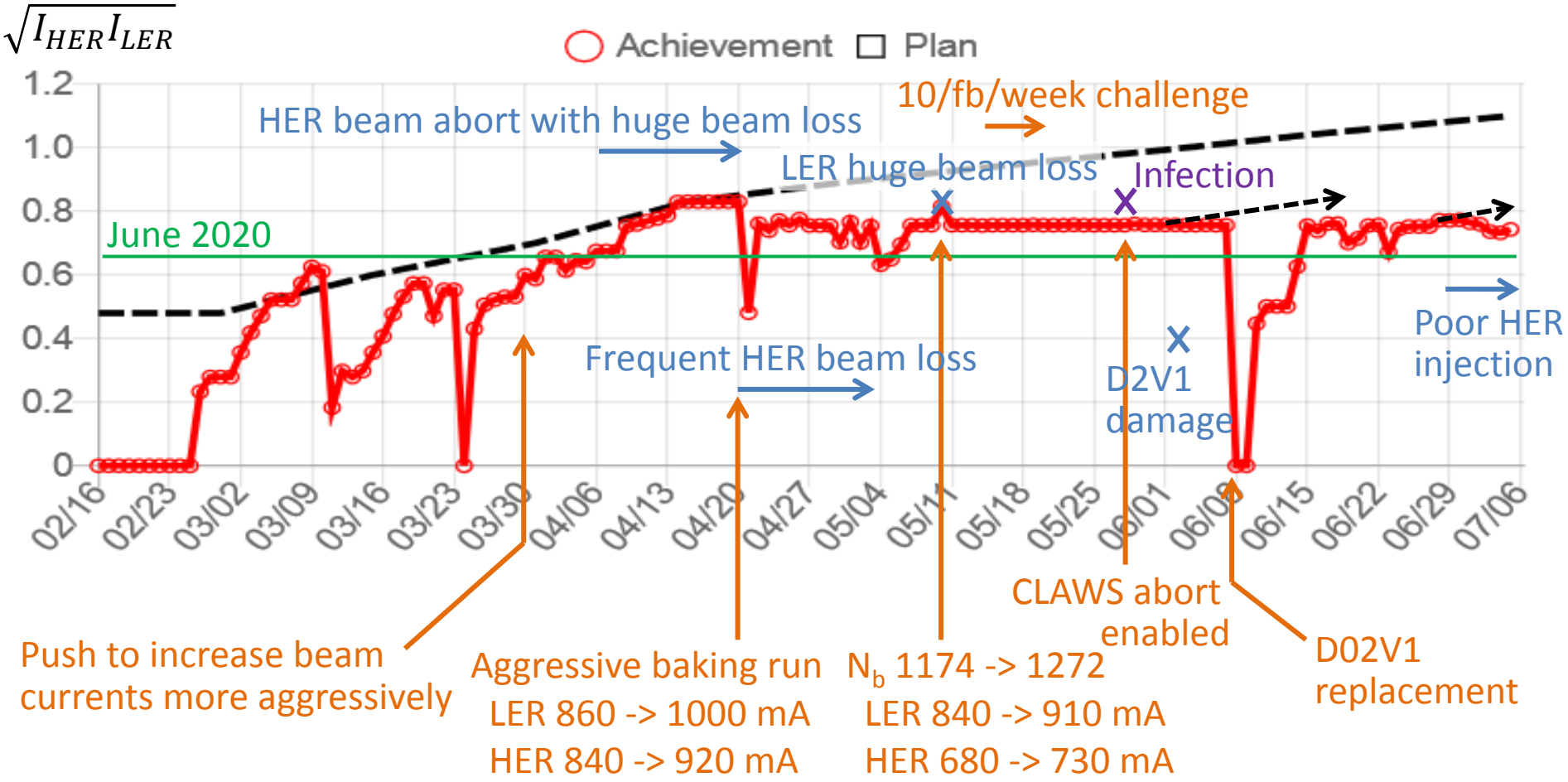
- Restore the same luminosity performance as June 2020, $2.4 \times 10^{34} / \text{cm}^2/\text{s}$ at LER 712 mA, HER 607 mA, 978 bunches with the same optics and collimator settings. ($\rightarrow \sim 1.4 \text{ fb}^{-1}/\text{day}$ incl. eff.)

Apr.

- Change 978 \rightarrow 1565 bunches and **increase the total beam currents**.
 \rightarrow Target: $3.8 \times 10^{34} / \text{cm}^2/\text{s}$ ($\sim 2.1 \text{ fb}^{-1}/\text{day}$ incl. eff.)

- **We put priority on the luminosity rather than the beam background reduction** in terms of the accelerator tuning/operation.
 - Limits: L1 rate $< 13\text{-}14 \text{ kHz}$ for DAQ, TOP PMT hit rate $< 3 \text{ MHz}$ + luminosity

Daily max beam current (A) during physics run

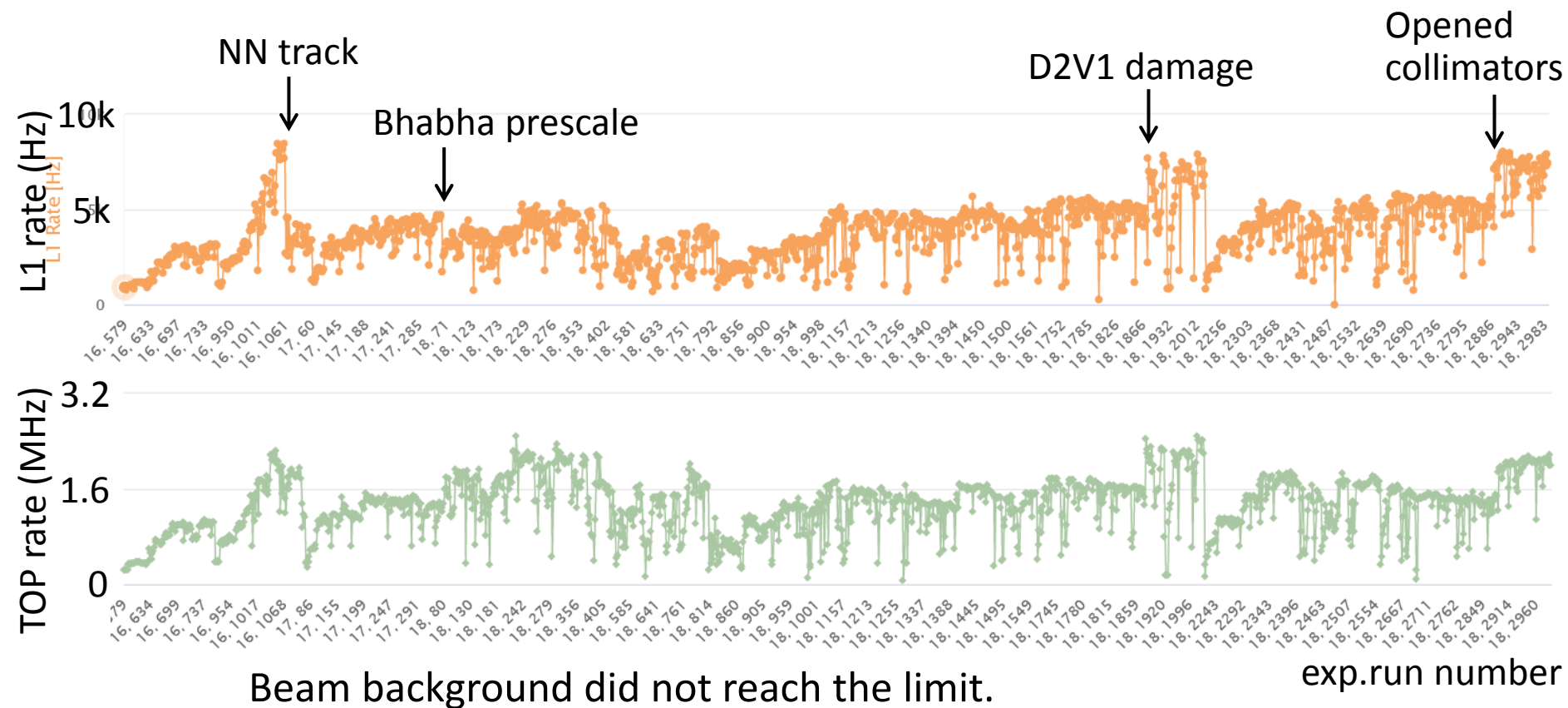


Increasing the beam current is a tough challenge.

- PXD, DCU and collimators were damaged by the huge beam loss on May 10.
- It is yet unresolved what happened during the baking run, which resulted in the frequent HER beam loss, and what is the cause of the huge beam loss.

Belle II operation in 2021ab

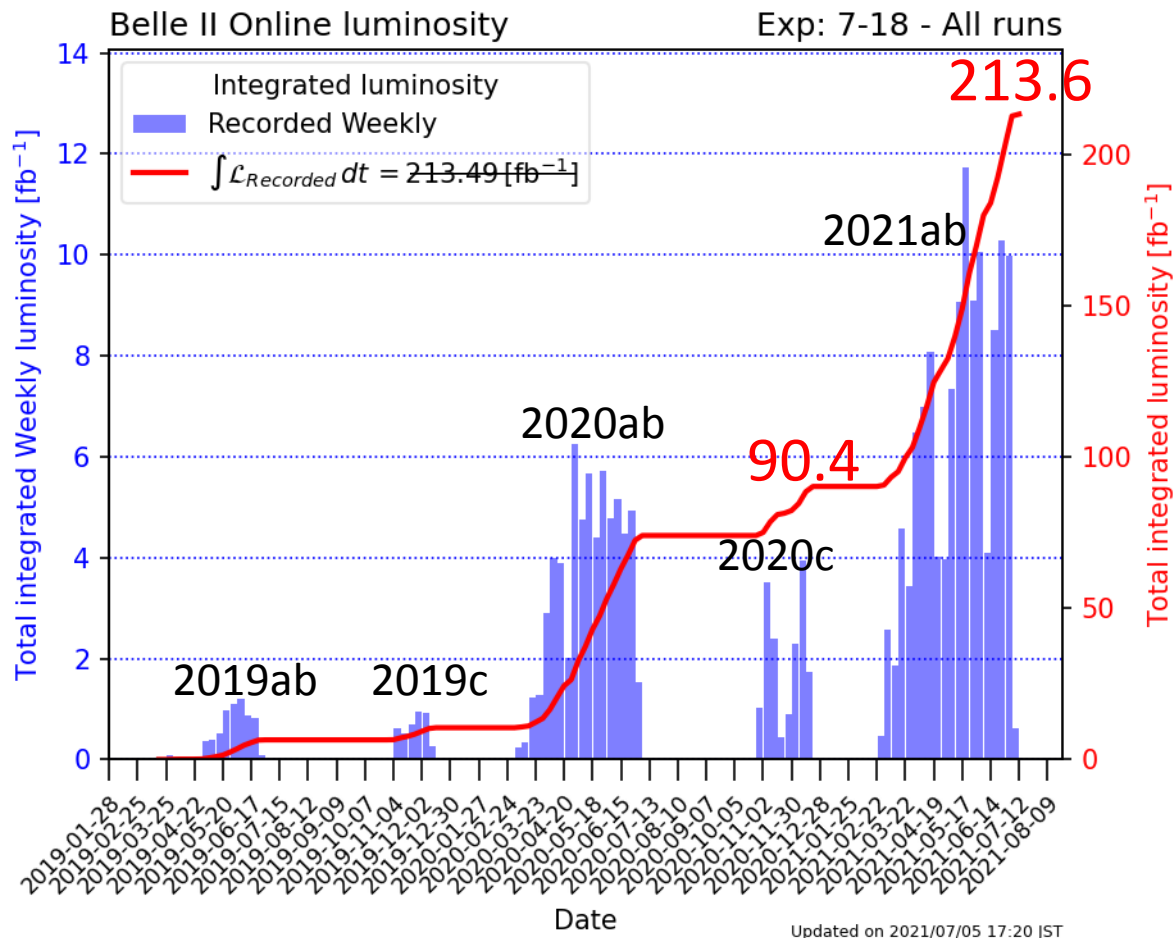
- **L1 NN track trigger** since 3/20 → Talk by Christian
- **HLT filtering** since 3/24 (exp17) → Talk by Karim
- **Prescale of L1 Bhabha trigger** since 4/7 (exp18)
 - L1 rate was kept below the DAQ limit without applying prescales to the main trigger bits.



Collimator tuning

- Collimator tuning is an important task in the operation and requires expertise and experience. It requires close connection with the SuperKEKB and beam background groups.
- The collimator group, lead by I. Nakamura, was formed to make the efforts more visible and to involve more people.
- Collimator tuning will play an important role for increasing the beam current.
 - Strategy reversal:
Close collimators to suppress the beam background → Open collimators
 - Not to sacrifice the physical aperture, which could limit the beam lifetime.
 - To avoid beam instability
 - Currently limited by the beam injection quality not by the background.
 - Cannot open collimators to avoid frequent beam aborts by bad injections.
 - Need more studies and tuning to effectively suppress the background.

Online recorded luminosity



Off-resonance runs:

- 2.6/fb in Apr
- 6.2/fb in Jun

(Total 18.2/fb in phase3)

Caveat:

Online luminosity plots in the Confluence page are not exactly correct because they use the data in Run Registry, which are sometimes wrong for unknown reasons.

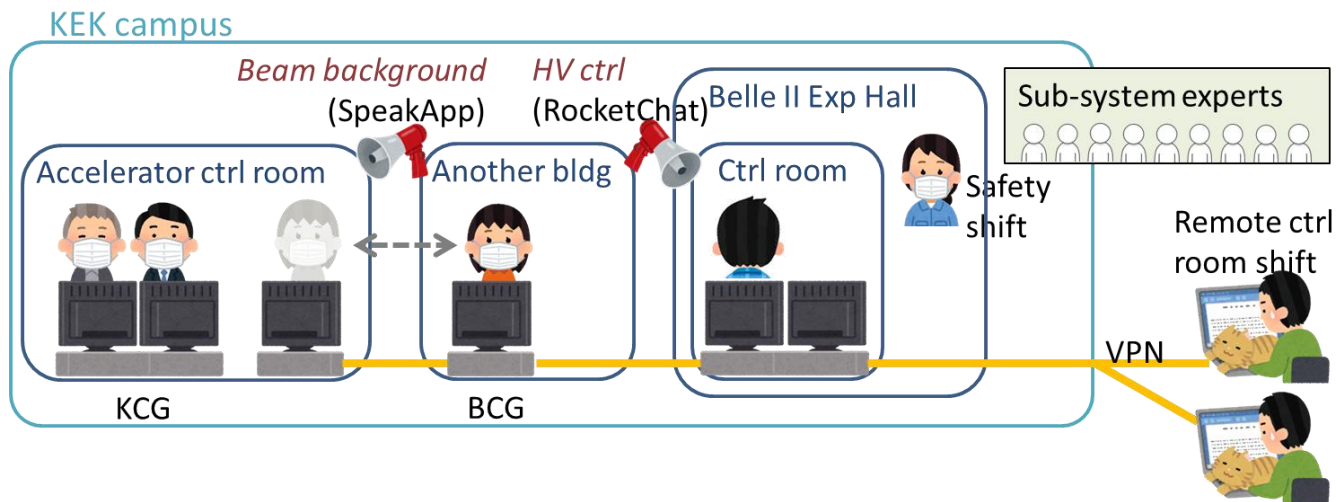
Caveat:

There is a discrepancy between the ECL online luminosity PV for phase3 and the sum of all experiments in phase3.

Belle II operation shifts in 2021ab

Same scheme as 2020c

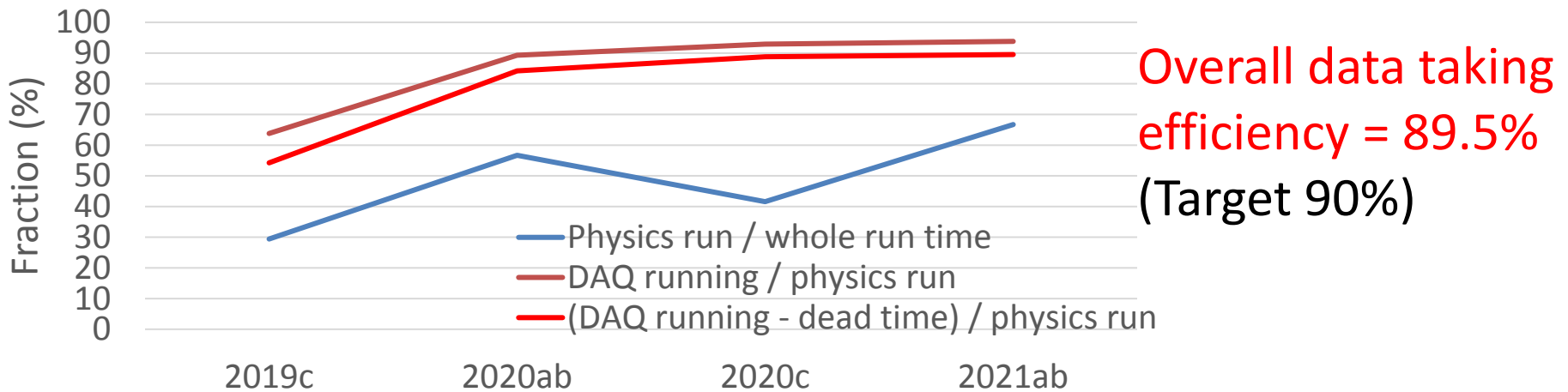
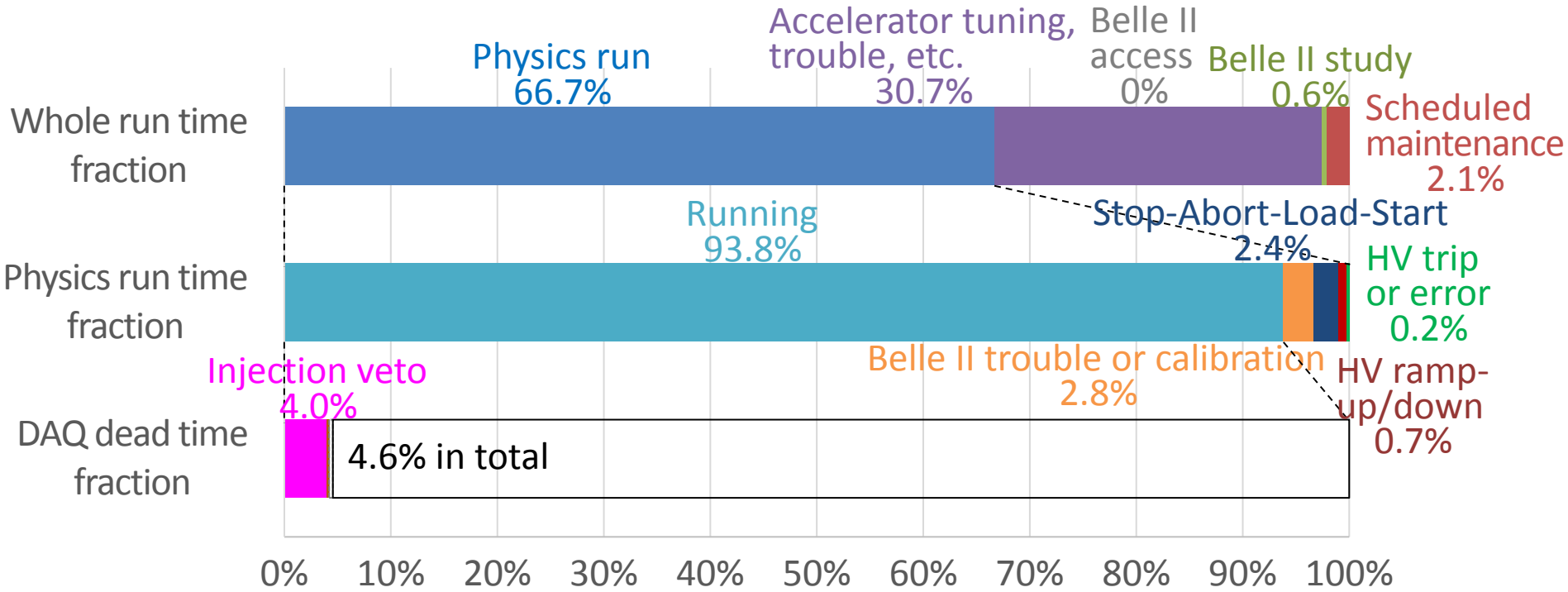
- Keep minimizing person-to-person contact, avoiding 3C, and taking hygiene.
- 2 remote + 1 local CR shifters
 - ... Remote shifters are actively working, and load on local people has been reduced.



- Many local and remote shifts were covered by a small number of people.
- Many shift gaps remained until the last moment.

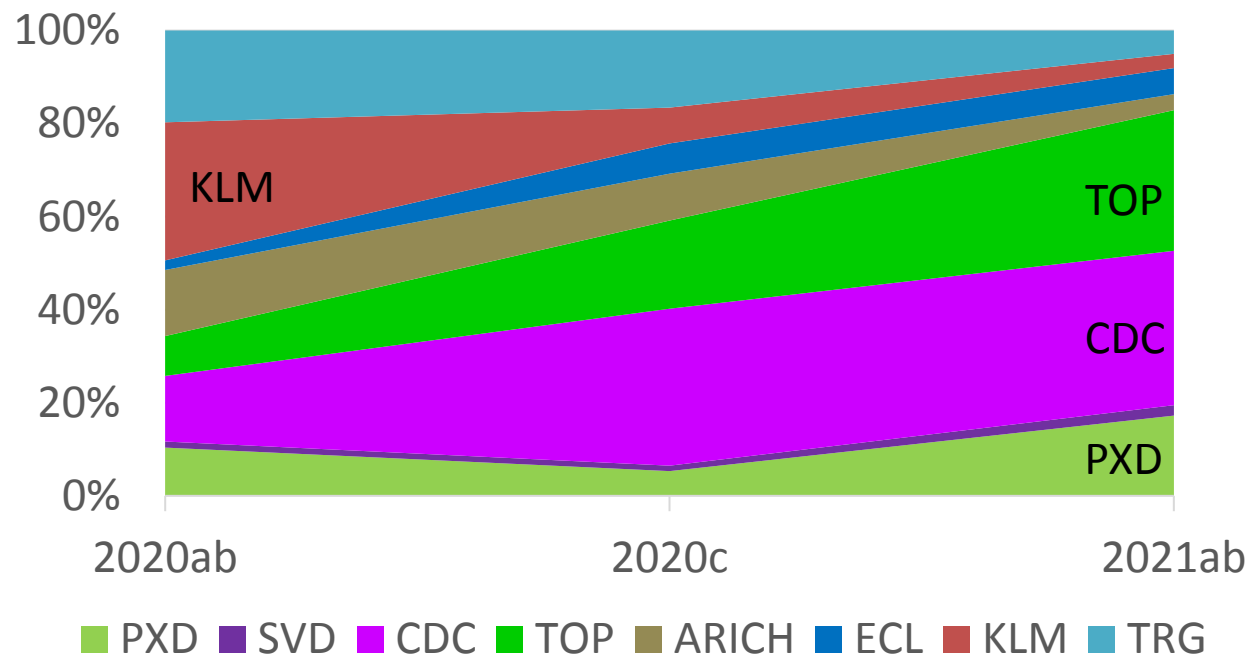
Regional shift managers helped a lot to fill many urgent gaps of CR remote shifts.

Data taking efficiency in 2021ab

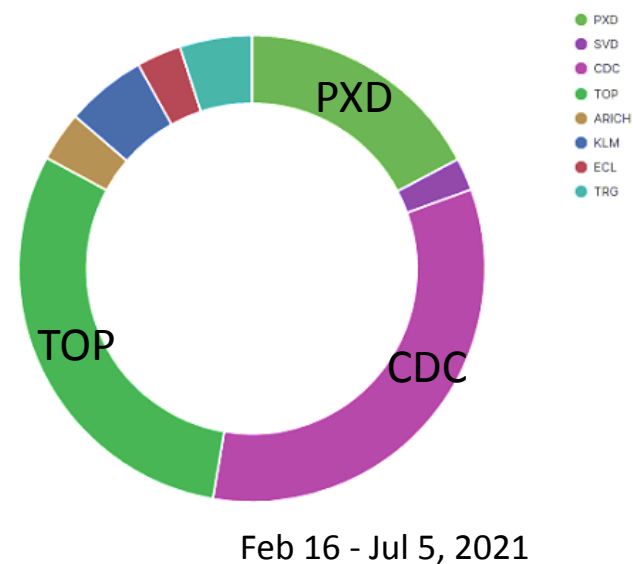


Run stop reasons

Fraction of run-stopping subsystems



2021ab



- Major run stop reasons

- PXD: pedestal reupload

- CDC: FE error

- TOP: busy

} Caused by SEU (~2 times each per 24 hours operation)

Doubled compared to 2020b.

Remarks

- Data taking efficiency has been improved slightly in spite of more frequent DAQ stops due to a higher beam background, thanks to
 - ✓ More automation, recovery tools
 - ✓ Improved documentation, training
 - ✓ Experienced local CR shifters
- To achieve 90% eff, we should continue improving our system:
 - [Short term]
 - Reduce recovery time (e.g. recovery GUI) and time for Stop-Abort-Load-Start (e.g. auto restart)
 - [Long term]
 - Make our system robust against the beam background.
 - Mitigate the beam background by adding neutron shield and machine/collimator tuning.

Plan of above-Y(4S) runs in 2021c

Best scenario (confined between maintenance days)

Target: 10/fb at 10.751 GeV (1st priority); E scan at 10.657 GeV (1/fb), 10.706 GeV (2/fb), 10.810 GeV (3/fb)

Assumption: 1.5/fb/day

Condition: ascending order of the beam energy

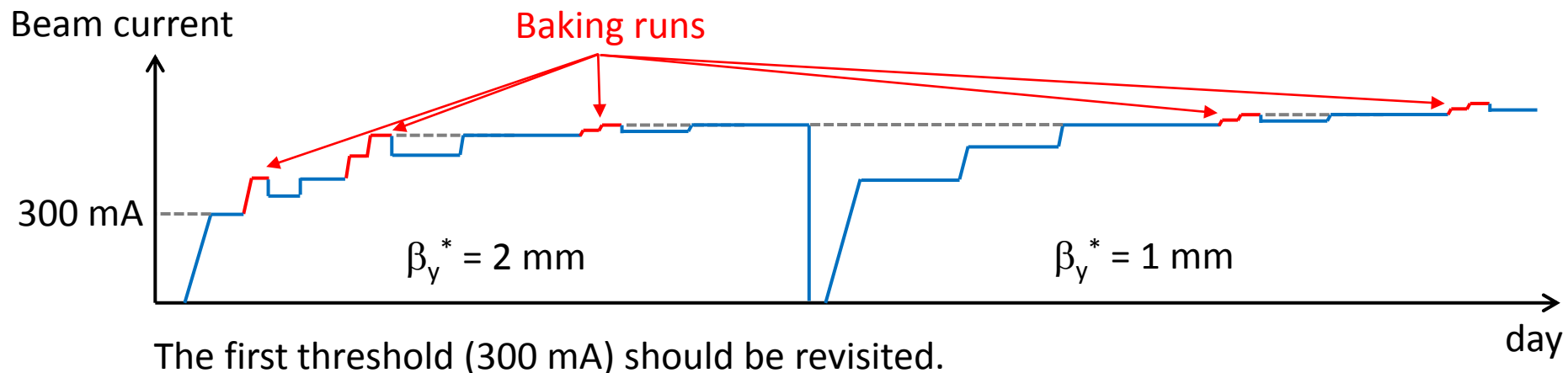
	Day 1 Wed	2 Thu	3 Fri	4 Sat	5 Sun	6 Mon	7 Tue				
Owl		(0.2/fb)	(1.5/fb)	(0.5/fb)		(3.5/fb)	(0.5/fb)				
Day	Maintenance	(0.5/fb)	10.706 GeV	(1.0/fb)		10.751 GeV	(1.0/fb)				
Swing	10.657 GeV	(1.0/fb)	(0.2/fb)	(1.5/fb)		(0.2/fb)	(1.5/fb)				
	8 Wed	9 Thu	10 Fri	11 Sat	12 Sun	13 Mon	14 Tue				
Owl						(9.5/fb)	(0.5/fb)				
Day						10.810 GeV	(1.0/fb)				
Swing						(0.2/fb)	(1.5/fb)				
	15 Wed	16 Thu	17 Fri	18 Sat	19 Sun	20 Mon	21 Tue				
Owl	(2.0/fb)	Contingency									
Day	Maintenance									Y(4S)	
Swing	Y(4S)										

Summary

- Huge beam losses of unknown causes are a serious issue for the high beam current operation. Need investigations:
 - Figure out the cause (more loss monitors, ...)
 - Mitigate the loss (fast beam abort, collimator setting, ...)
 - Make the hardware robust (fast interlock, hybrid collimator, ...)
- Belle II operation is in good shape, but more improvements are needed to keep the stable operation at a higher beam background.

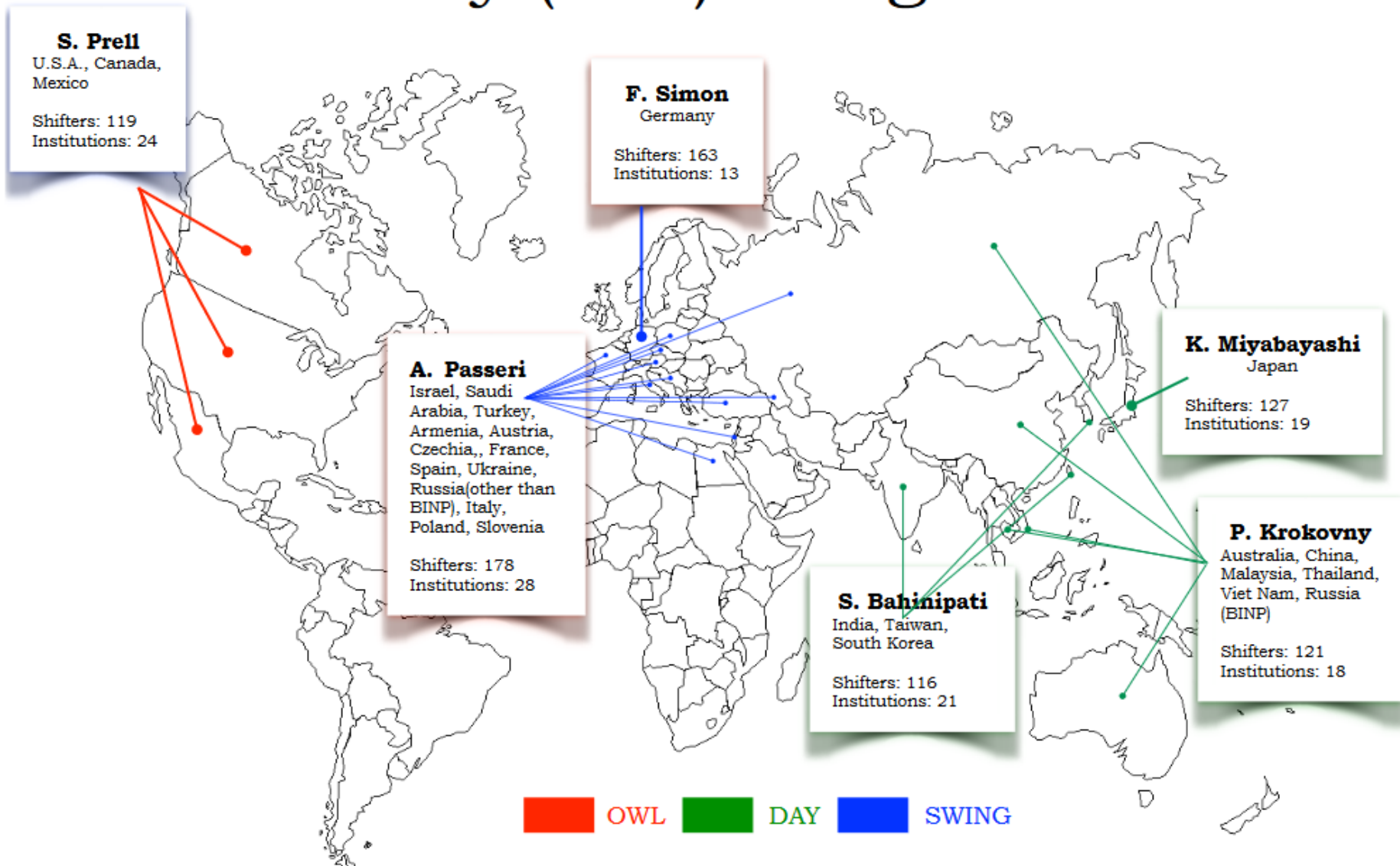
Baking run

- When the beam current is increased above the max current in each run period, Belle II HV is kept at STANDBY for safety (to avoid risk of detector damage by dust event **or beam instability**) until the accelerator is stabilized.
 - **Baking run for 30 min** at the new high current above 300 mA.
 - The step size of the current increase in the baking run is determined by the accelerator experts. **The current should not be far from the one during physics run.**
 - **Baking run should be done in the same collision condition as physics run.**
 - Start physics run at a lower beam current by 20 mA or less than the max of the baking run. Gradually increase the current up to the max of the baking run. Meanwhile accelerator tuning is necessary at a constant current.
 - The beam current at physics run is determined by Belle II in consultation with KCG.



Regional shift managers

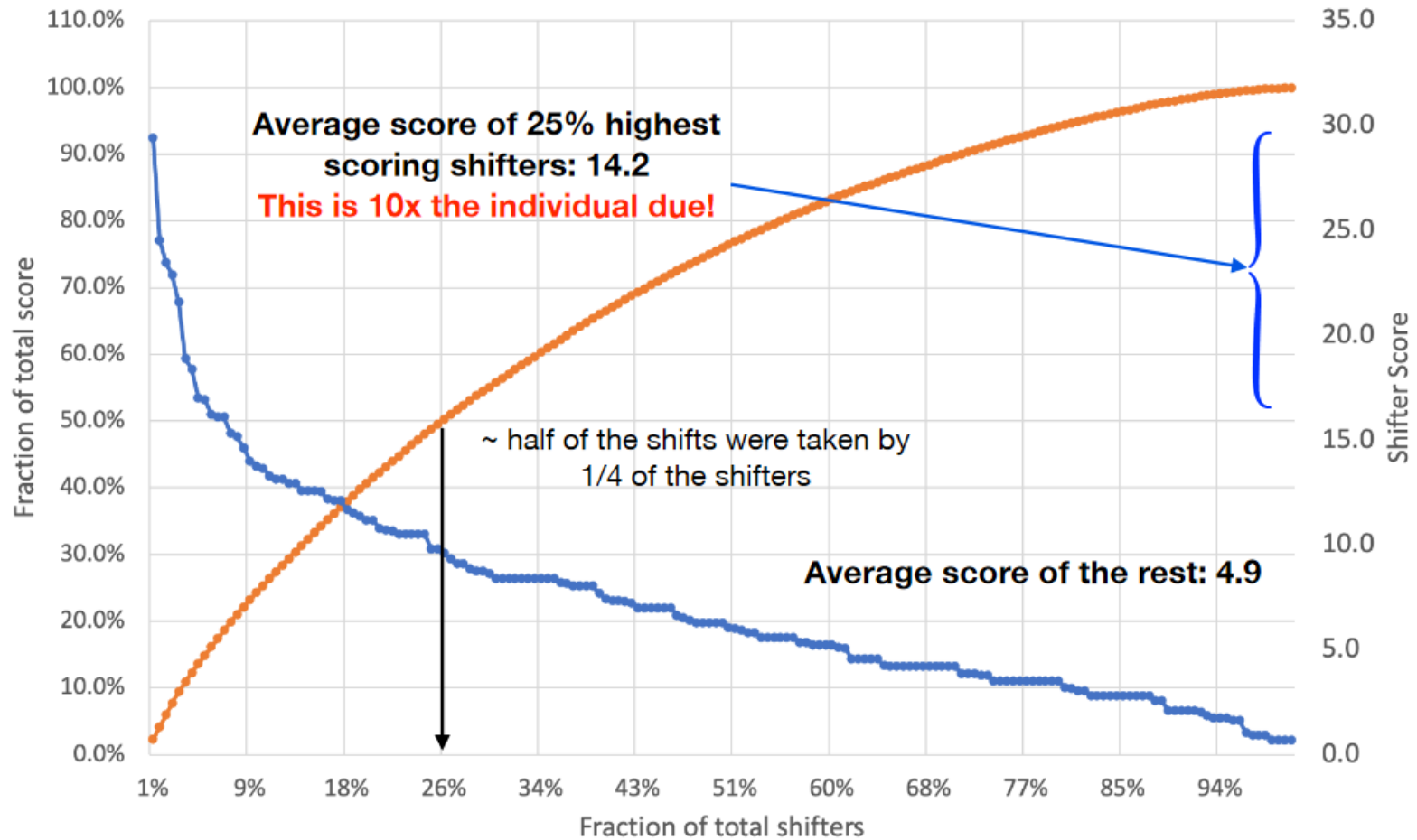
Country (~TZ) Assignments



CR Remote 1&2 Statistics

All CR Remote shifts taken by 177 people (1/5 of the eligible shifters!)

Shifters Score



50% of all the CR Remote shifts were taken by 45 people out of 933

That is LESS than 5% of all eligible shifters

