

# Spill Optimisation for eXperiments (SOX)

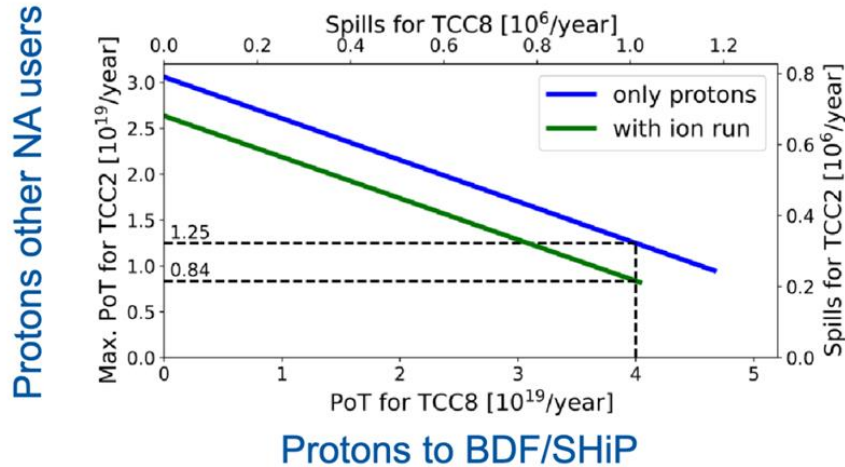
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173rd EATM

13/08/2024

# Context

With a new dedicated experimental user (SHiP) joining the SPS North Area, a coherent strategy is needed to deliver the desired flux and quality to the different CERN facilities. of both protons and ions.

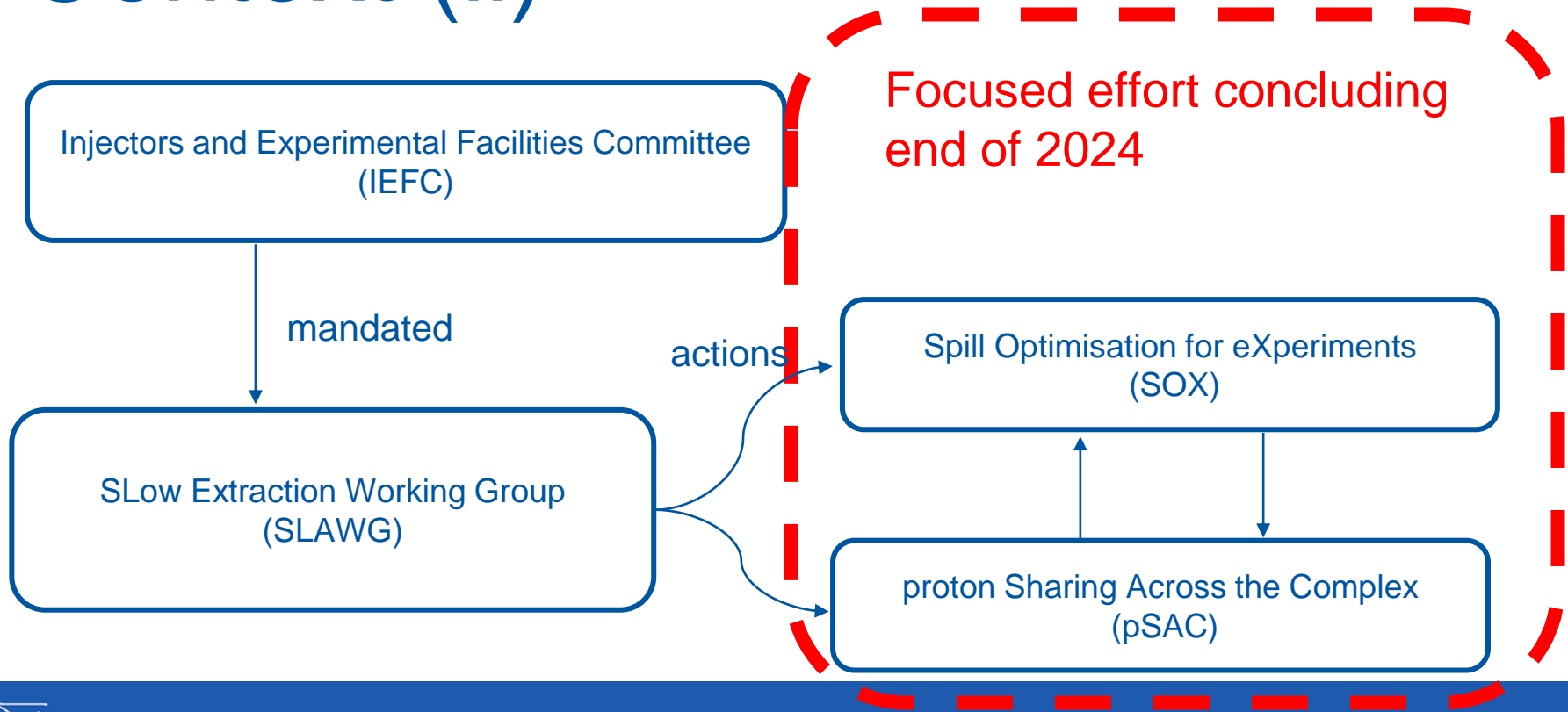


North Area wants  
~  $5 \times 10^{19}$  protons/year...  
a la CNGS ( $\sim 4 \times 10^{19}$  p<sup>+</sup>/y)

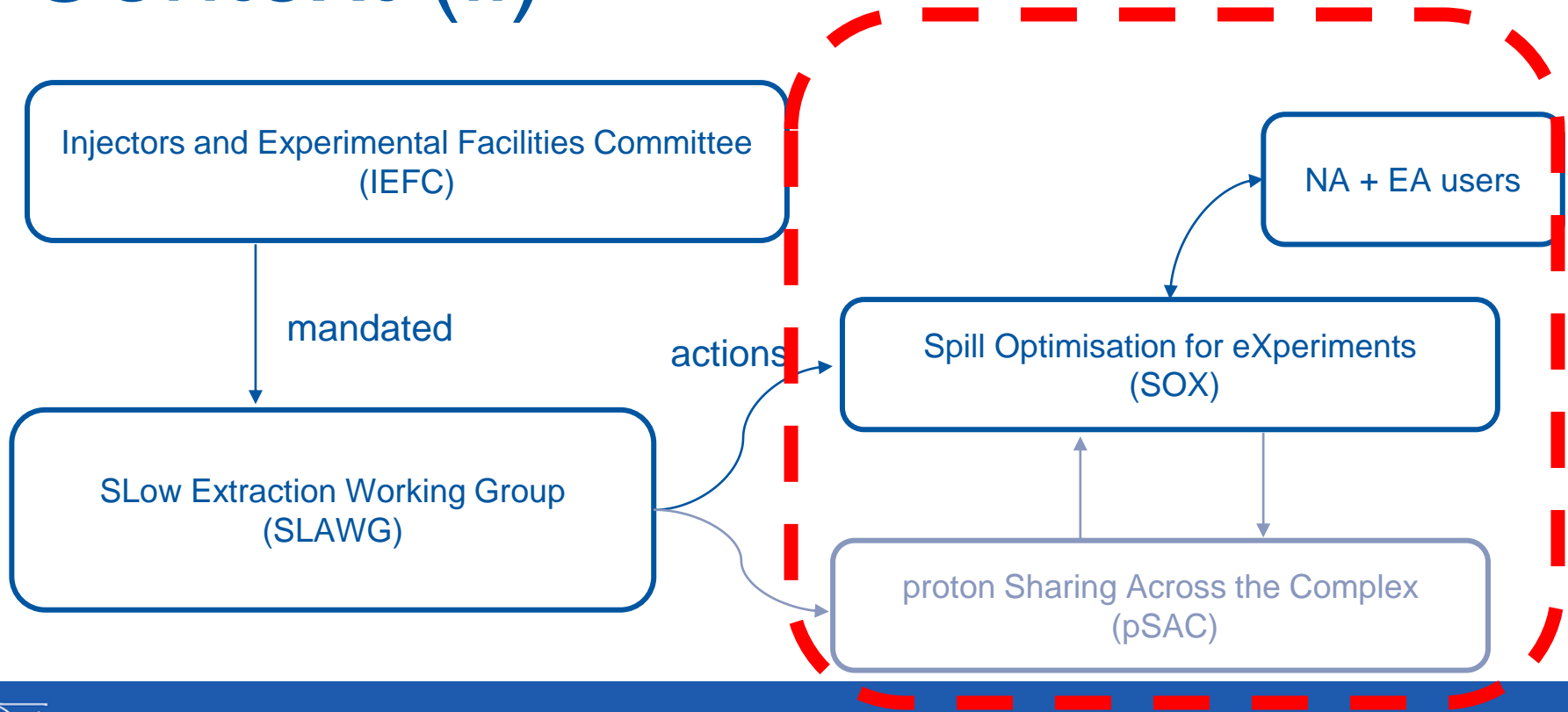
... but, slow extracted...

...unprecedented !

# Context (ii)

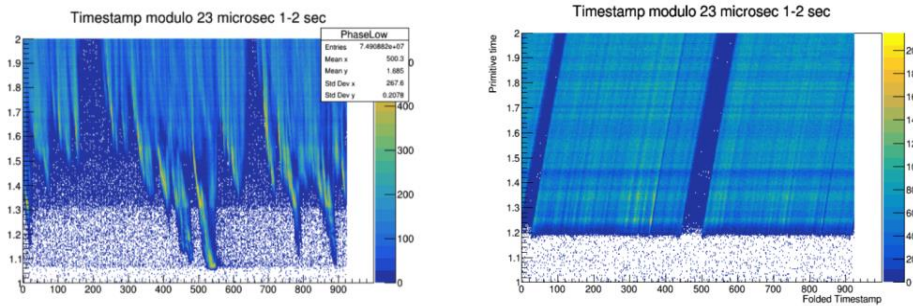


# Context (ii)



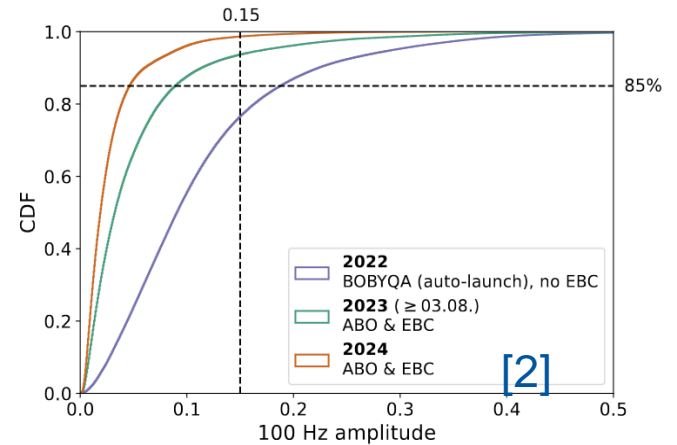
# Goals

- Document the spill quality, intensity and spill length requirements of North and East Area users.
- Propose measures to optimise beam transport and delivery + define future R&D to overcome limits.
- For example,
  - Minimisation of RF structure at beginning of spill (RF manipulations)
  - Minimisation of 50 Hz, 100 Hz ripple (automatic controllers FBC)



Taken from the trigger primitives

[1]



# How to achieve it?

1. Documentation of present and future experimental **spill requirements, proton-flux and spill quality bottlenecks**
2. Development of **common terminology** between the ATS technical groups and the EP users/experiments **to characterize the spill quality**
3. Study and **propose options to optimise beam delivery to the North Area** with the aim to maximise its exploitation



Input from SOX to be employed for cost and resource estimates for the most promising options, with motivation linked to physics reach

# “Food for thought” for users

Spill quality requirements + common terminology:

- **How could a “good spill” be quantified**, i.e. Key Performance Metrics (KPIs)?
- Could these **KPIs be published live for the beam physicists** to use spill-by-spill?
- Could (some of) these **KPIs be computed by beam physicists directly on their own detectors?** E.g. maximum rate variation at timescale X

Limitations:

- Is the current **setup flux-limited?** E.g. could the spill time-length be halved if the flux was doubled to keep total proton counts constant?
- Could the current **setup handle different spill time-lengths** within same super-cycle? E.g. 5 s, 1 s, 5 s, 1 s ...
- Could current **setup handle different # of protons per spill** within the same supercycle? E.g. 40e11 protons per spill, 10e11 protons per spill, 40e11 ...

## Key Performance Indicators

Parameters

No. of “good” spills delivered

Secondary beam intensity/spill (translated to no. of units on target by beam physicist)

Spill to spill secondary beam Intensity fluctuations

Spill to spill beam position fluctuations

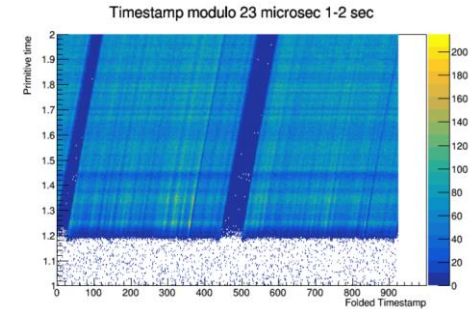
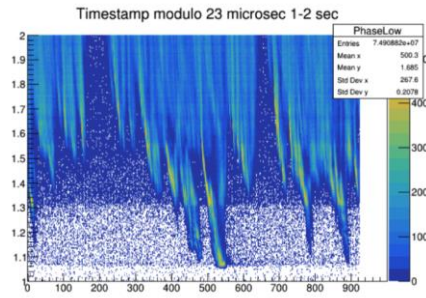
n x 50 Hz limit (flatness of spill)

Effective spill length

Beam purity

# Example of KPI

Minimisation of RF structure at the beginning of the spill, performed by RF team and NA62 in 2022:



Taken from the trigger primitives

Saturated event = event with a number of hits in one station of the beam spectrometer above 150

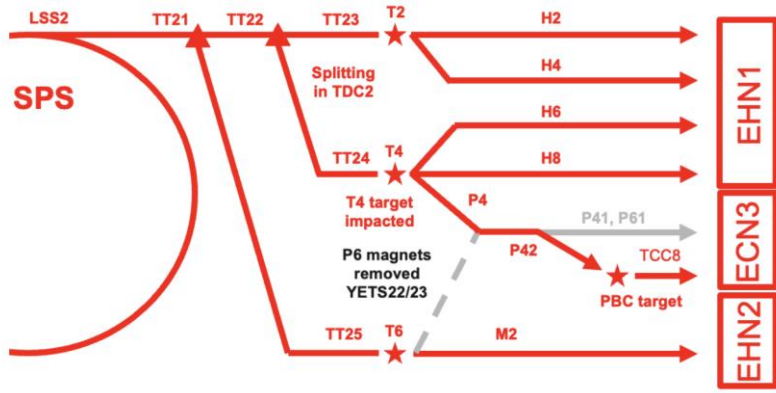
Configuration	200 MHz stop (ms)	Vmin (MV)	Fraction of saturated events
2021			0.21
1)	750	0.9/1.2 + corrections	< 10 <sup>-5</sup>
2)	100	0.9/1.2 + corrections	0.02
3)	300	0.5 no corrections	0.0005
4)	400	0.5 no corrections	0.00003



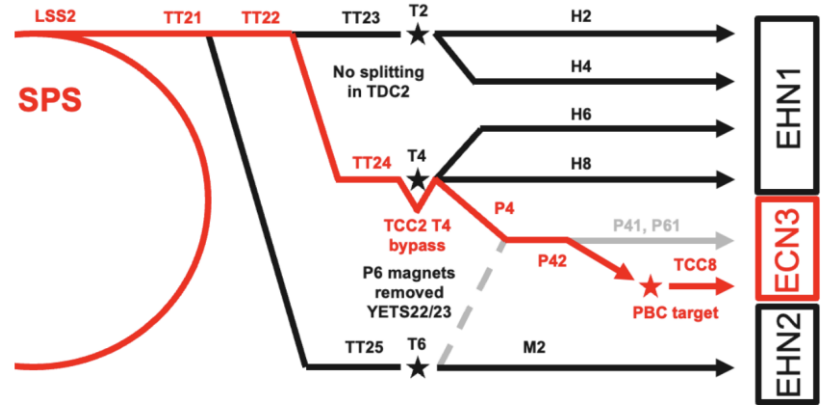
# Next steps

- We ask users to start thinking about points concerning spill quality, requirements and limitations.
- Plan to follow up with focused discussions on specific topics, inviting necessary representatives from users and technical side.

# Extra slides



SFTPRO shared



ECN3 dedicated