



SPS reference measurements

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Goals



- During LS2 there will be ~20 months shutdown for the SPS
- Many components and also beam parameters will change significantly
- Re-commissioning will be very challenging
 - To provide some guidance and to have some means of comparison we need **a good snapshot of the situation before LS2**
 - For this we are collecting a **list of reference measurements** to be done in every machine – also in the SPS
- Presentation of the **current list along with the status of the individual measurements** – organized according to beam type



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Questions to answer:

- **Is the list complete?**
- **Identify measurements that need dedicated time.**
- **Allocate time slots for dedicated measurements before end of PR.**
- **Discuss strategies on how to collect, organize and store “data”.**



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Data types storage, analysis and retrieval



- The idea is, to have a **unified catalogue of the reference measurements** for a quick overview
- We will need a **centralized storage** of all collected data (logging, applications, manual acquisition etc.), together **with plots as well as analysis scripts**



Data storage, analysis & Co



- We have prepared and will prepare **more SPSOP Jupyter notebooks** on SWAN
 - Jobs can be re-run to combine and analyse data
- Plots from above analysis, screen shots during measurement campaigns with operational online tools, entire data objects,... will be stored, categorised in the **new reference measurement system**
 - See Anthony's talk on the 31st of August: Based on log book tools with screen shot capability and browsing + JAVA API to be added in each application
- Also, lots of 2018 run measurements and analysis results to be found in the online beam commissioning check list results
 - E.g. aperture measurements, mains harmonics, alignment results and orbit analysis
 - Nevertheless plan to also add everything in reference measurement system

```
In [1]: import acc_library as al
```

```
In [16]: %matplotlib notebook
```

```
In [3]: t0 = al.str2datetime('05May18_10-00-00')  
t1 = datetime.datetime.now()
```

```
In [4]: variables = ['SPSQC:EXTRACTED_INTENSITY']
```

```
In [5]: data = al.fromTimberToDataFrame(variables, t0, t1, fundamental='SPS%SFTPRO2%')
```

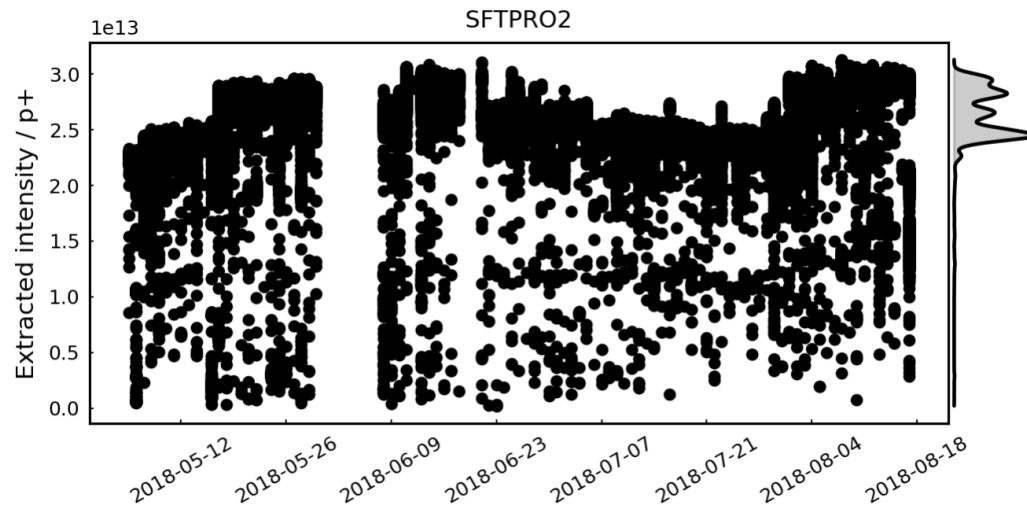
```
In [6]: data.head()
```

```
Out[6]:
```

	SPSQC:EXTRACTED_INTENSITY	cycleStamp
2018-05-05 10:00:07.335	2.246702e+13	1.525514e+18
2018-05-05 10:00:21.735	2.262265e+13	1.525514e+18
2018-05-05 10:00:36.135	2.279714e+13	1.525514e+18
2018-05-05 10:00:50.535	2.273584e+13	1.525514e+18
2018-05-05 10:01:04.935	2.295277e+13	1.525514e+18

```
In [29]: dates = data.index.date.astype('O')
```

```
In [41]: ax = al.plotHist(dates[data[variables[0]] > 1e11], data[variables[0]][data[variables[0]] > 1e11], plot_prop=['ko'], histSize=0.5, hist_opt={'c':'k'})  
ax.set_ylabel('Extracted intensity / p+')  
ax.xaxis.set_tick_params(rotation=30)  
ax.set_title('SFTPRO2')
```



```
Out[41]: Text(0.5,1,u'SFTPRO2')
```

Francesco



General



Measurement	Status	Data source	Comments
Aperture		From measurements	
Alignment		In checklist	
BPM gains		YASP	
BLM thresholds		LSA	
Radiation survey			
Mains harmonic spectrum		Logging	
Vacuum pressure around the ring		Logging	
Reaction times for interlocking: mains trip, hardware interlocked BLMs		Screenshots	



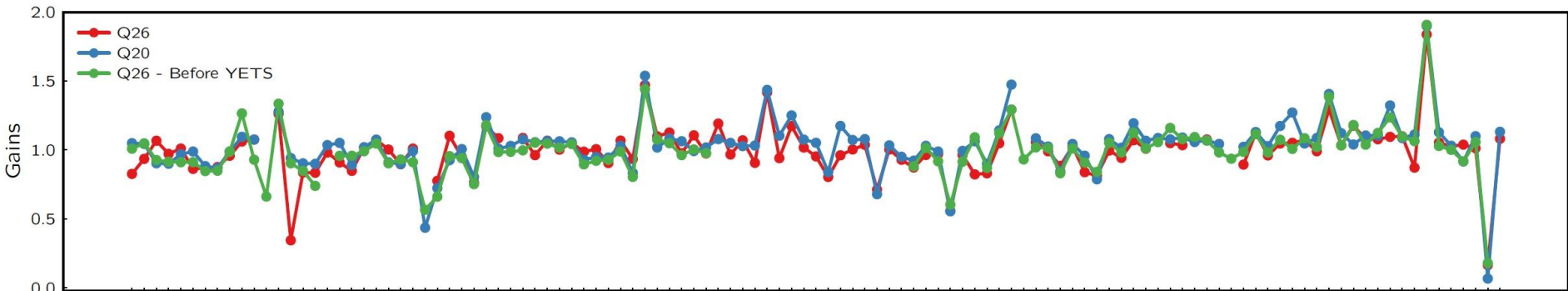
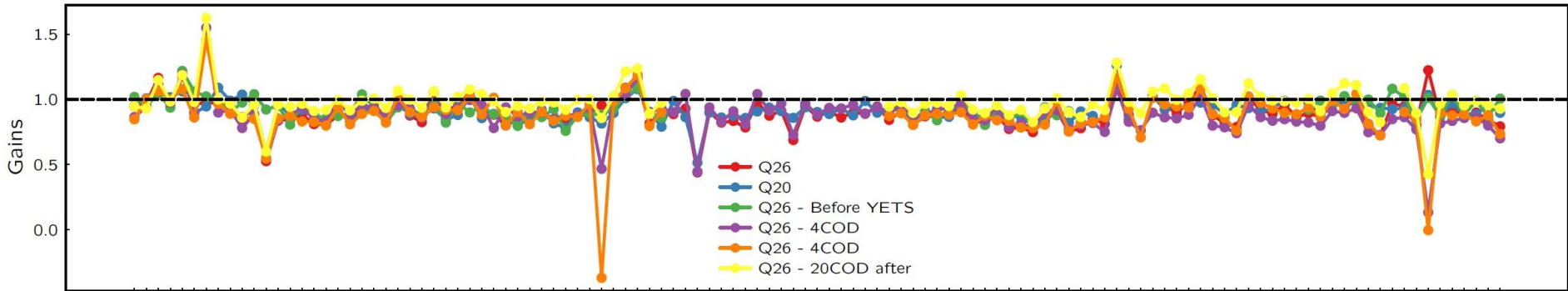
General

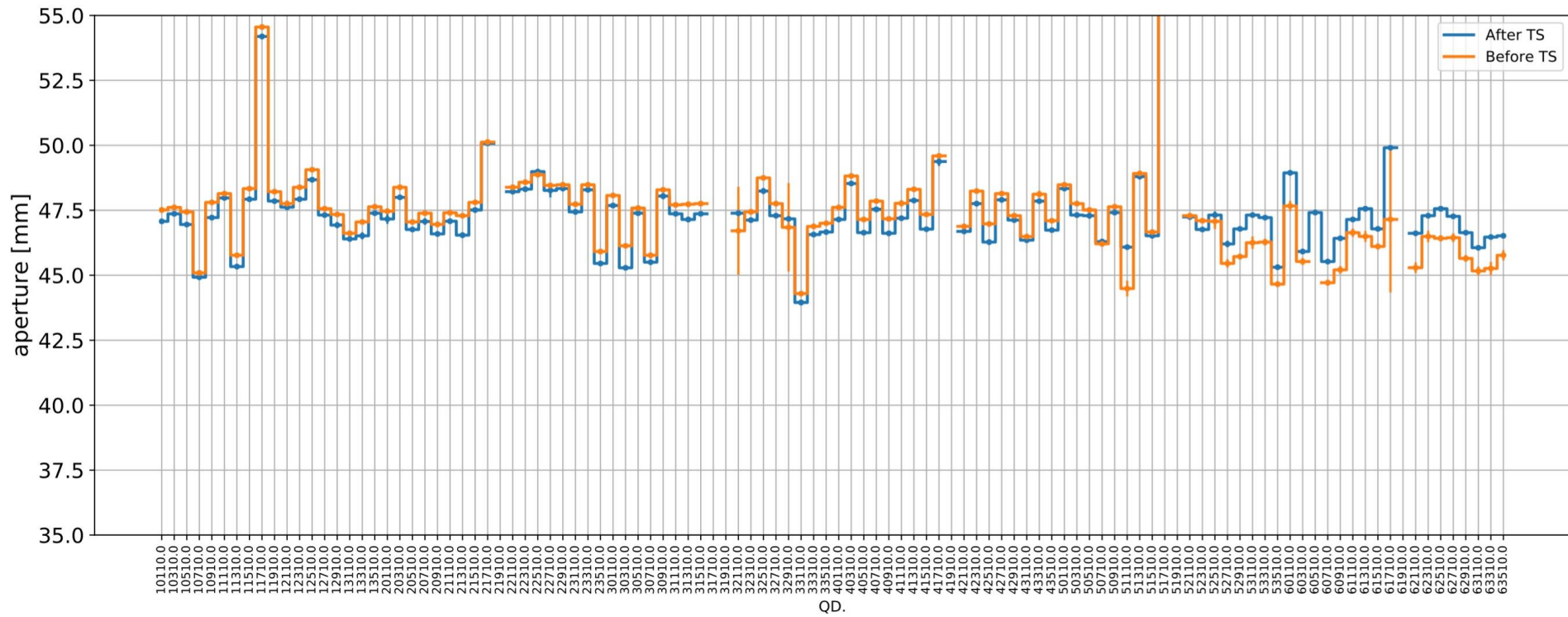


Measurement	Status	Data source	Comments
Orbit along the cycle		YASP	Multi-acquisition
Orbit at flattop		YASP	
Tune functions & measurements		LSA + AutoQ	
Chromaticity function & measurements		LSA + AutoQ	
Transmission, extracted intensity and dump intensity		Logging/Stats	
Losses around the ring for given intensity		Logging/Stats	
Longitudinal beam profiles		FC manual acquisition	



BPM gains









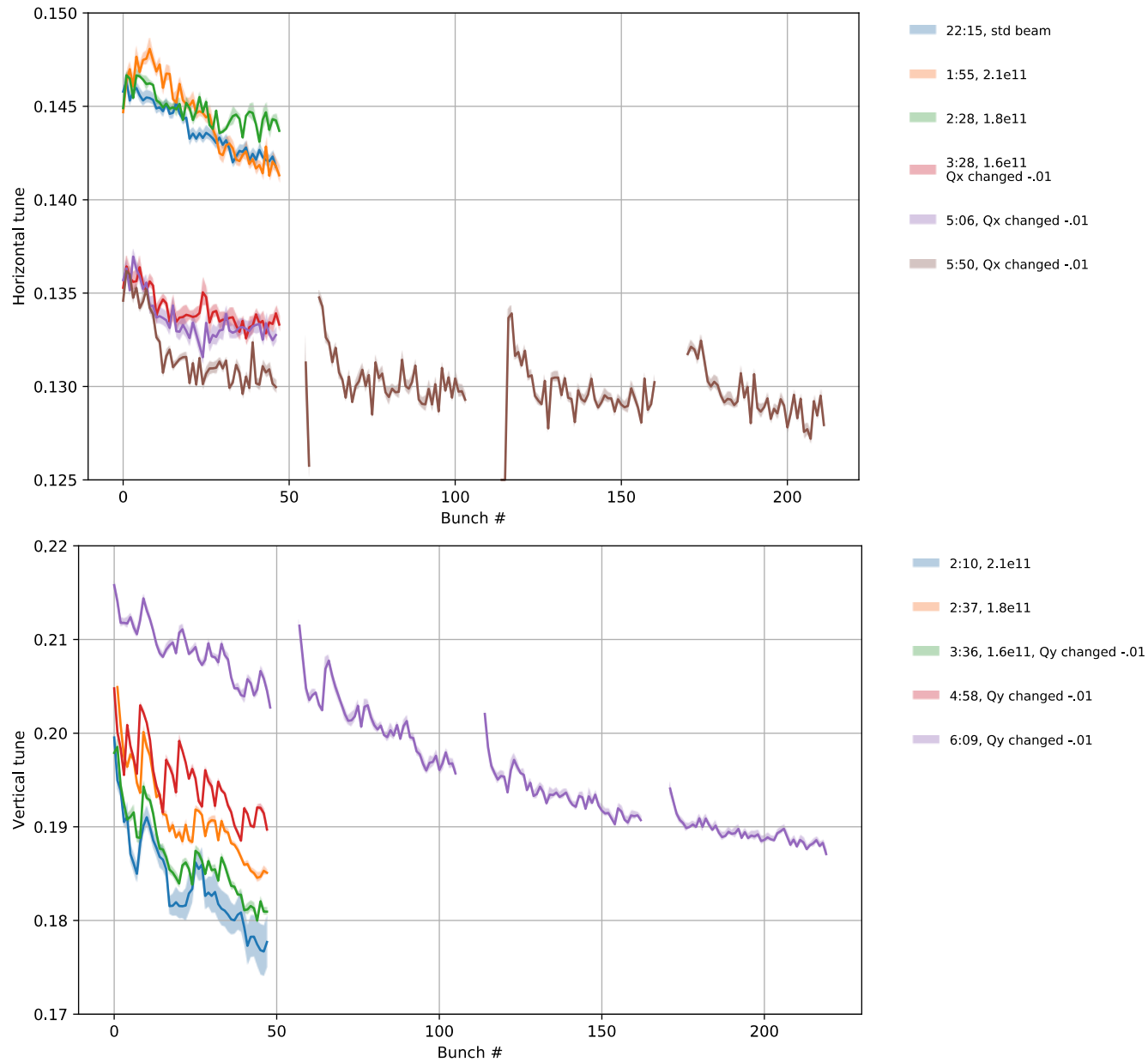
Measurement	Status	Data source	Comments
Golden trajectory in TT10		YASP	Store also name from dataset catalog
Golden orbit at injection		YASP	Store also name from dataset catalog
Trajectory in TI 8 and TI 2 from the golden		YASP	
Auto-tune steps for given intensity		LSA + logging	
Losses on transfer line collimators for given intensity and beam type (BCMS and LHC25NS)		Logging	
Emittances for given bunch intensity and beam type (also INDIV beams such as vanDerMeer,...)		Logging	
Emittance blowup through cycle – bunch-by-bunch		Logging / acquired data	
Tune-shift with intensity		Logging / acquired data	Transverse + longitudinal – MD time needed
Scraper settings for given bunch intensity and beam type		LSA	



Measurement	Status	Data source	Comments
TT10 SEM grids		Screenshots	Dedicated
BTV images and settings		Screenshots / LSA	Dedicated – MKP ON and OFF
BTV images at septa and start of TL		Screenshots / LSA	Dedicated
Long. blow up settings		LSA	
Calculated bucket area function		LSA	
Rephasing signals		Application & screenshot	
Phase profiles		FC manual acquisition	
Beam loading		FC manual acquisition	
OASIS MKP		Screenshots	
200 ns batch spacing reference oscillations (in mm)		Application	
Losses at extraction		Logging	

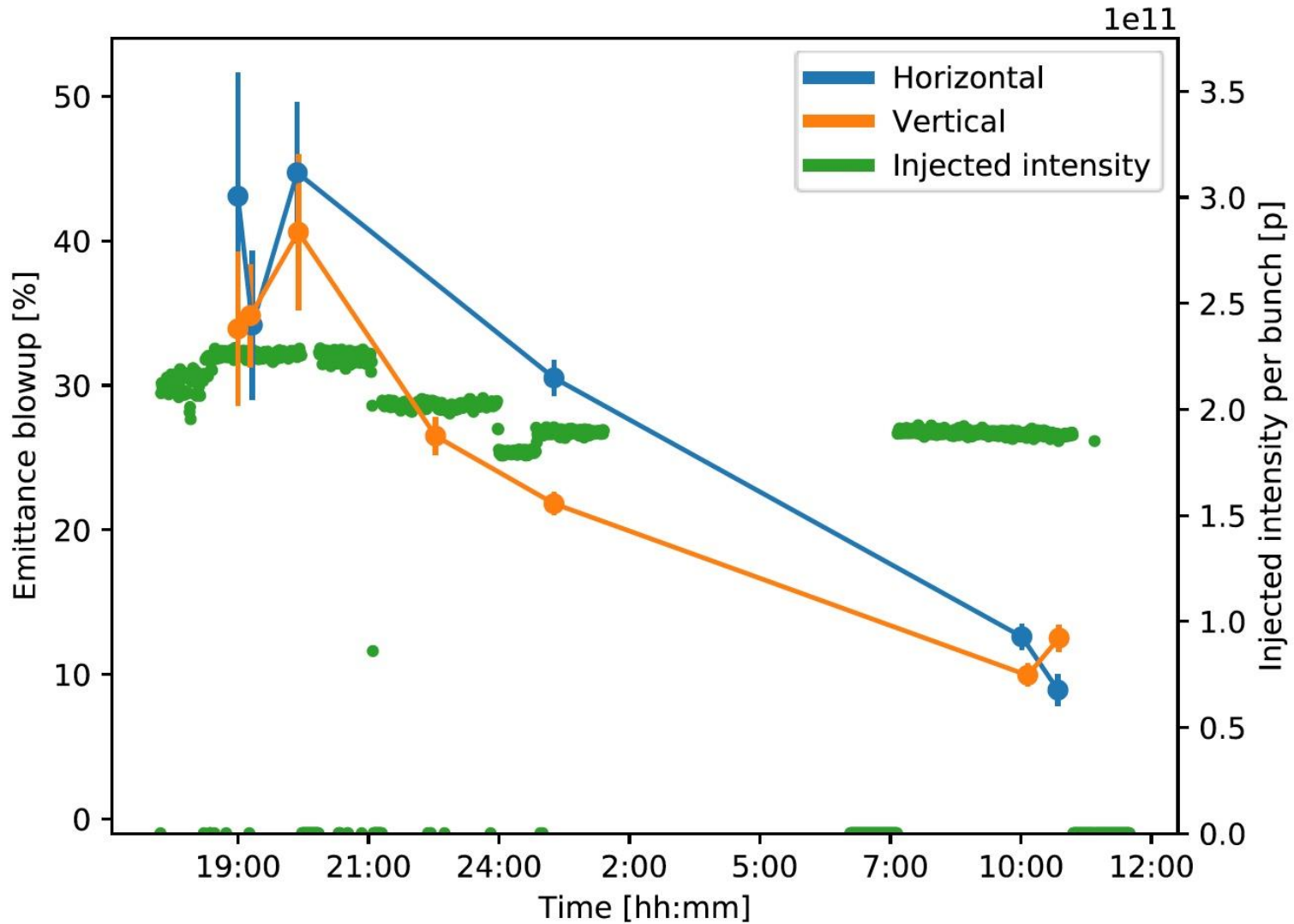


Bunch-by-bunch tune shifts





Emittance blow-up evolution





Fixed Target



Measurement	Status	Data source	Comments
Trajectory in TT10 with all SEMs in	Red	YASP	Dedicated
Trajectory in TT20 with all SEMs in		YASP	Dedicated
Losses at the ZS + normalized losses at ZS and LSS2 for a given intensity	Yellow	Logging	
Losses at splitters for a given intensity		Logging	Need typical variations: normalized losses
Profiles at splitters for a given sharing	Red	Fixed display	Screenshot
Intensity on targets for given extracted intensity (also include T10)	Yellow	Logging	
Emittances of 4 islands plus core for a given intensity	Red	Wire scan app	Screen shot
Spill for a given intensity	Yellow	Logging	
Mini scans in extraction channel	Yellow	Screenshots	
Mini scans at targets	Red	Screenshots	



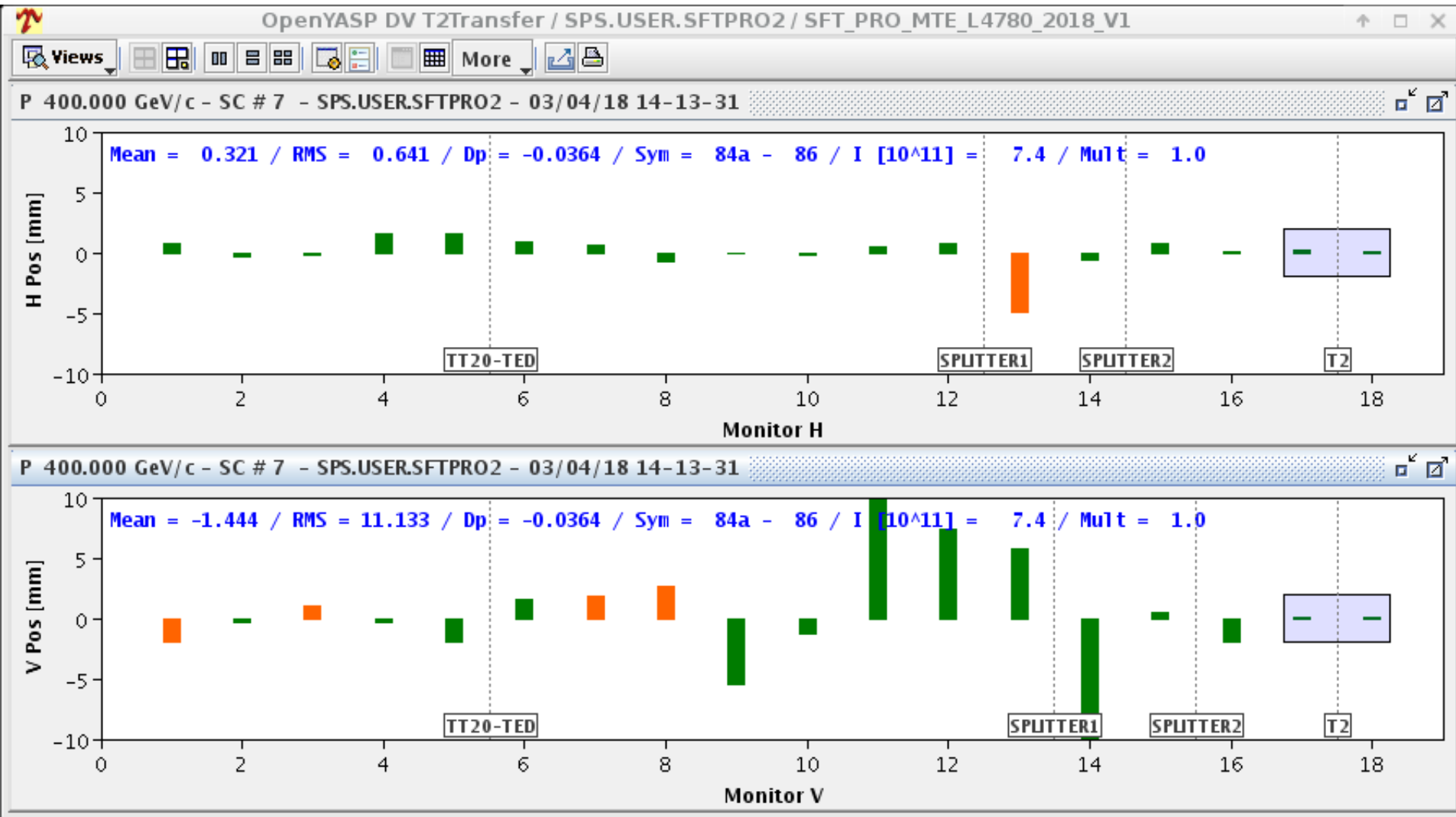
Fixed Target



Measurement	Status	Data source	Comments
Voltage program	Yellow	LSA	
RF gymnastic (OASIS + momentum spread distribution)	Yellow	Screenshot + mom distr app	
Mountain range	Red	Screenshot	Screen shot
Spiral step	Yellow	Screenshot	
BTV images and settings (MKP on and off)	Red	Screenshot	Dedicated
Setting of TBIU for T4			
ZS gaps	Yellow	Logging	

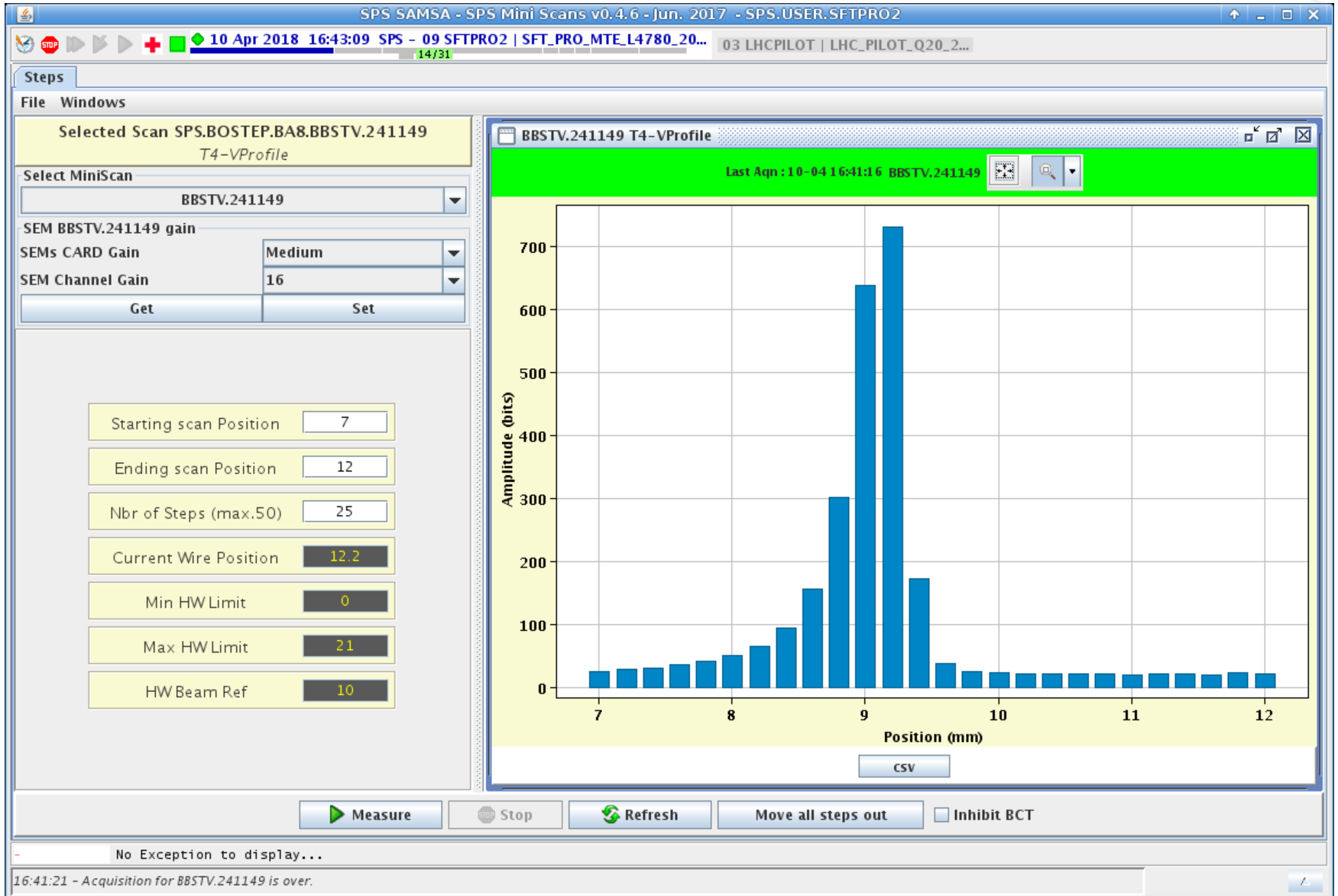


TT20 - T2 TL steering





Miniscan profiles T4





Awake



Measurement	Status	Data source	Comments
Rephase signals	Red	Application & screenshot	
Bunch rotation, bunch length measurement at extraction			
Trajectory in TT41	Yellow	YASP	
Tunes through cycle		AutoQ / screenshot	



HiRadMat



Measurement	Status	Data source	Comments
Tune steps for given intensity		LSA	



Coast



Measurement	Status	Data source	Comments
Emittance blow-up over time on COAST for given chromaticity			
Bunch length evolution		Application	



Conclusions





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Backup