

# Beam Quality Tracking in the PS

Frank Tecker, for the PS Beam Commissioning WG

# Contents

- Pre-LS2 Beam Quality Measurements
  - Online displays
  - Occasional measurements
  - Offline
- Post-LS2 Additions
  - BQM
  - Some additions

# Online BQM

- No dedicated logging server à la SPS
- A few dedicated applications
  - Operation display
  - MTE Spill Inspector Vista
  - NToF Inspector
  - IRRAD display
- Occasional dedicated measurements

# Operation display

- For different cycles (protons, MTE, ions)
- Intensity along cycle
- Transmission
- Losses
- MTE: extraction



# Operation display (MTE)



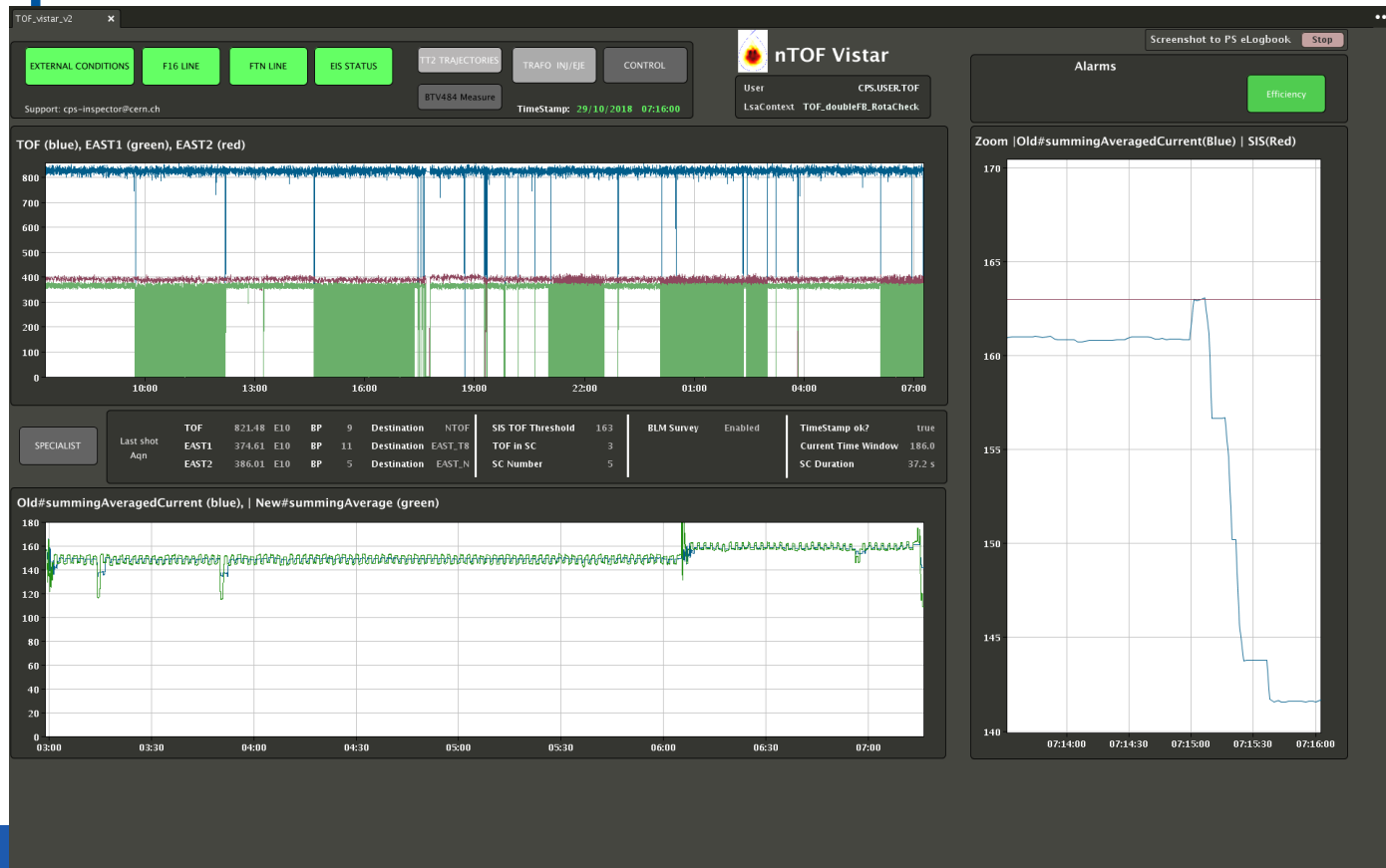
# MTE Spill Inspector Vistar

- Spill structure
- 1<sup>st</sup>/2<sup>nd</sup> instance
- 200MHz capture
- Tune
- Trajectories



# NToF Inspector Vistar

- Intensity history
- TOF/EAST cycles
- Average intensity



# IRRAD Vistar

- Beam profiles
- Reference
- No history



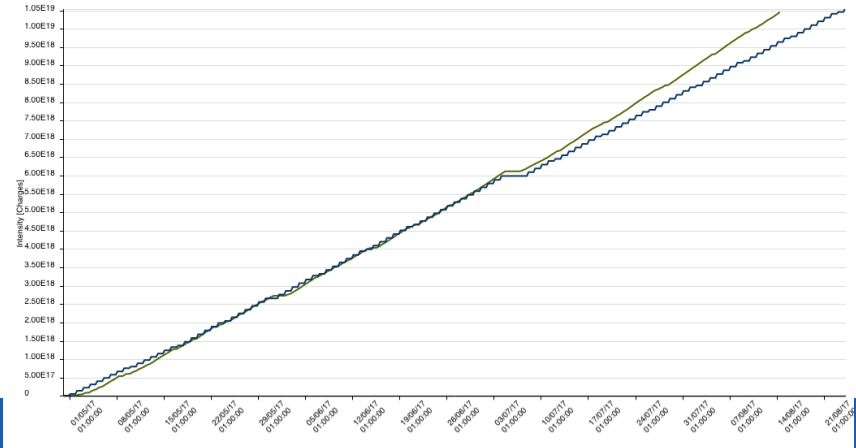


# Occasional measurements

- Bunch splitting / bunch length (from BSM)
- Longitudinal parameters
  - Emittance, momentum spread (Tomoscope)
  - Injection oscillations (Tomoscope)
  - Satellite population (Tomoscope/BSM)
  - RF signals and loops (voltage, phase, synchro,...)
- Transverse injection oscillation amplitude
- Tunes along the cycle

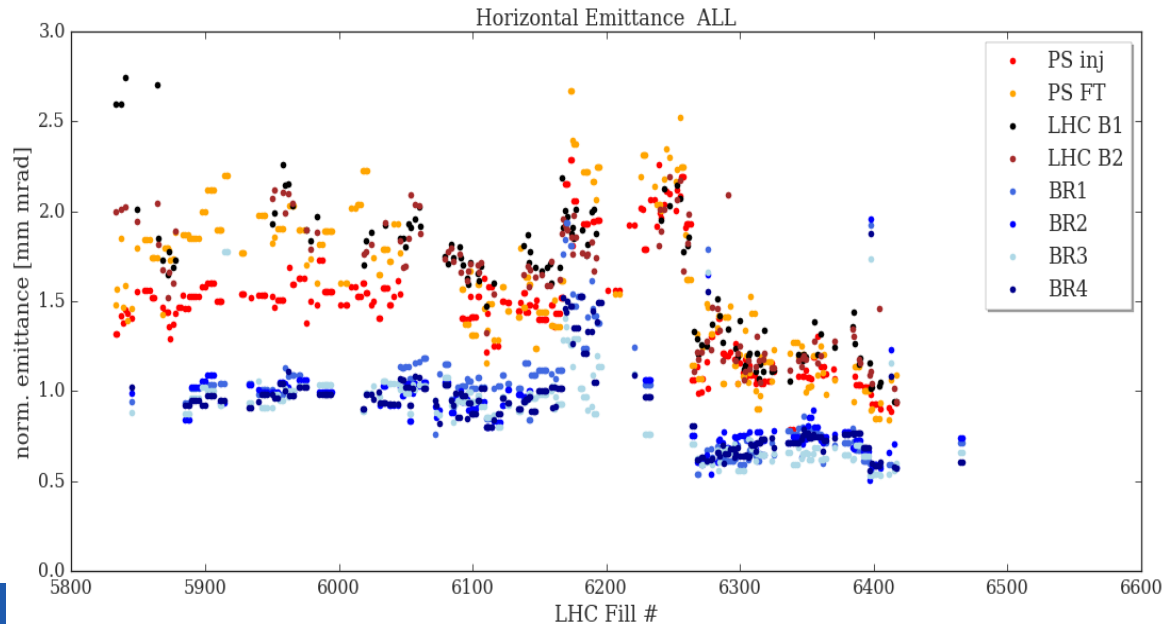
# Off-line

- Many beam measurements are logged in DB (intensity, losses, wire scans, ...)
- Some private scripts to look at long-term evolution (J.Dalla-Costa, O.Hans, F.Tecker)
- Occasionally used
- NToF integrated intensity statistics web page
- Intensity evolution



# LHC emittance

- Regular beam emittance measurements by the wire scanner
- Injection/Flat top
- 3 measurements for average
- Logged for LHC super table



# Parameters for monitoring

- Intensity at various times in the cycle => transmission
- Emittance (from WS, regular for LHC, otherwise occasional)
- Longitudinal (Emittance, momentum spread, splitting, injection oscillations, satellite population, extracted bunch length)
- Losses (BLMs, integrated, along the cycle, time windows)
- Radiation monitors
- Orbit / Trajectory (mean / RMS along the cycle, wrt reference) – TT2 (5-turn MTE)
- Injection oscillation amplitude
- Spill structure (MTE TT2, EAST)
- Tunes (offline, online for MTE splitting)
- B-field, PFWs

# Post-LS2

- **BQM**
  - In a first phase longitudinal beam parameters only
  - Up to now no available wall-current monitor (WCM) channel
  - Additional WCM to be installed after LS2
    - Hardware copy of the existing WCM, preparation started
    - Cables pulled
  - Longitudinal parameters of the beam only defined during the very last turns!  
=> Too late to dump in the PS  
=> only “flag” the beam and dump it in the SPS
- **Additional logging**
  - Emittance from BGIs (non-destructive! => online)
  - **SuperCycle composition with LSA users!**
  - Intensity points intermediate plateau

# Summary

- **Online BQM:** Individual programs to follow evolution  
some occasional measurements
- **Offline BQM:**
  - LHC beam emittance for Supertable
  - Intensity, MTE spill, tune, losses, etc. logged
  - Occasional analysis by scripts
- **Post-LS2:** BQM to be added
  - Common tool is welcome



[www.cern.ch](http://www.cern.ch)

# Monitoring details (1)

- Intensity - online:
  - Before/after Injection 1/2
  - Start/End intermediate flat top – after start 2<sup>nd</sup> ramp (BCT Hotspots and CTIM to be added)
  - Before/after Transition
  - Start Flat top (BCT Hotspot and CTIM to be added)
  - Before/after Extraction 1/2
  - TT2 (several BCTs)
- Transmission - online:
  - To be defined from the above
- Emittance:
  - Regular WS measurements of LHC beam by the operators for offline, also MTE
  - Occasionally for other beams
  - Eventually BGI (non-destructive!) - same times as intensity points



# Monitoring details (2)

- Longitudinal:
  - Cycle
  - Reference measurements with Tomoscope (RF manipulations, injection oscillation, ...) - on demand
  - Longitudinal emittance and SigmaP/P via Tomoscope - fixed C-time, on demand
  - Evaluation of satellite population (ghosts) via Tomoscope/BSM - fixed C-time, on demand
  - Bunch length (and SigmaP/P - Abel transform – some development needed ) via BSM - fixed C-time, online and realtime
  - RF signals and loops (RF voltage, phase, synchro...) - all cycle, online and realtime
  - Extraction
  - Bunch splitting symmetry at extraction (intensity in different bunches) via BSM – later on BQM
  - Bunch length at extraction
- Losses - online:
  - BLMs in ring and TT2, EAST, total losses during beam presence
  - Injection, transition (local or global)?
  - Radiation monitors ?

# Monitoring details (3)

- Orbit/Trajectory - online:
  - Orbit mean and RMS along the cycle (wrt reference)
  - Injection oscillation amplitude
  - Trajectory TT2 (MTE for 5 turns)
- Spill structure - online:
  - MTE spill in TT2
  - EAST spill
- Working point:
  - Tunes along the cycle
  - Offline
  - Online for splitting of MTE
- 
- Dedicated BQM next YETS
- 
- Offline for Beam Quality Analysis:
  - B-field measurement
  - PFWs
  - SuperCycle composition !!! With mapping, LSA