Beam Synchronous Signals from PS RF Beam Control as Observation Triggers

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Introduction

- **Significant change of revolution frequency in PS**
  - **10% change for protons**
  - **Factor of 2.7 for Pb^{54+}**
  - **Phases of beam synchronous signals depend on delays**

- **RF manipulations change number of bunches or position of first bunch**
  - **No marker to specific bunch**

- **Beam synchronous revolution frequency (TREV) or $h = 8$ (TRF)**
  - **Reproducible phase offsets from cycle to cycle**

- **LHC-type beams after synchronization on flat-top**
  - **All frequencies essentially constant**
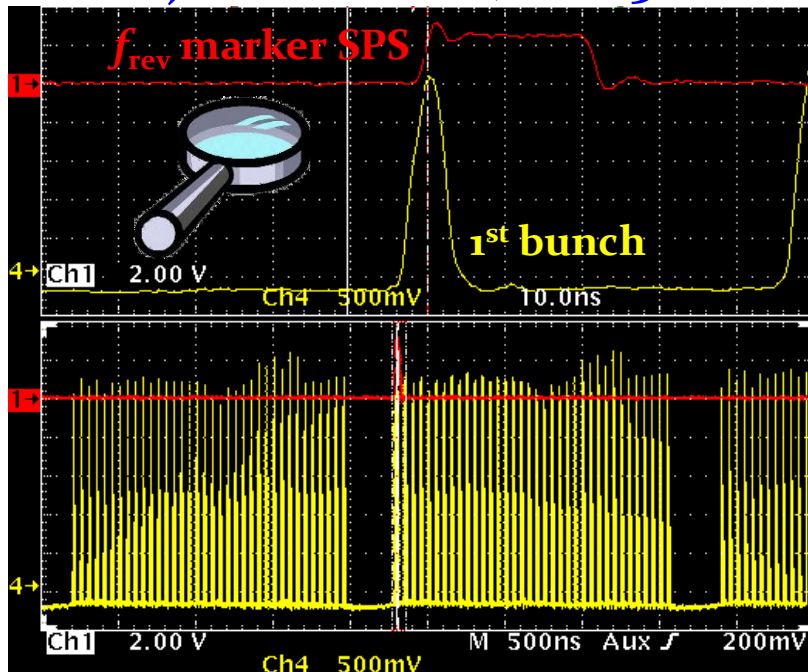 - **Bucket numbering with respect to f_{rev}-marker from SPS**

Distributed beam synchronous signals

- *PS revolution frequency* (TREV)
  - → **Square wave, duty cycle depending on source/beam control**
  - → **Derived from RF to cavities during acceleration**
  - → **Derived from external source (SPS/synthesizer) close to ejection**
    - **Phase with respect to beam depending on:**
      - a) **User (single bunch, multi-bunch LHC-type beam, etc.)**
      - b) **RF manipulation, synchronization, ejection bucket number**
- *PS h = 8* (TRF)
  - **Square wave, ~50% duty cycle**
  - **Generated mainly for triggers to beam transfer elements**
- *'Fiducial' frequency for beam transfer* (TFID)
  - **~20 ns marker, fast rise time**
  - **Common sub-multiple of f_{rev} for sending and receiving machine**
  - **$f_{rev,SPS}$ for PS → SPS, $f_{rev,PS}/3$ for PS→AD**

→ **Convention for extraction of LHC-type beams:**
  1st bunch at fixed phase with respect to $f_{rev,SPS}$ marker
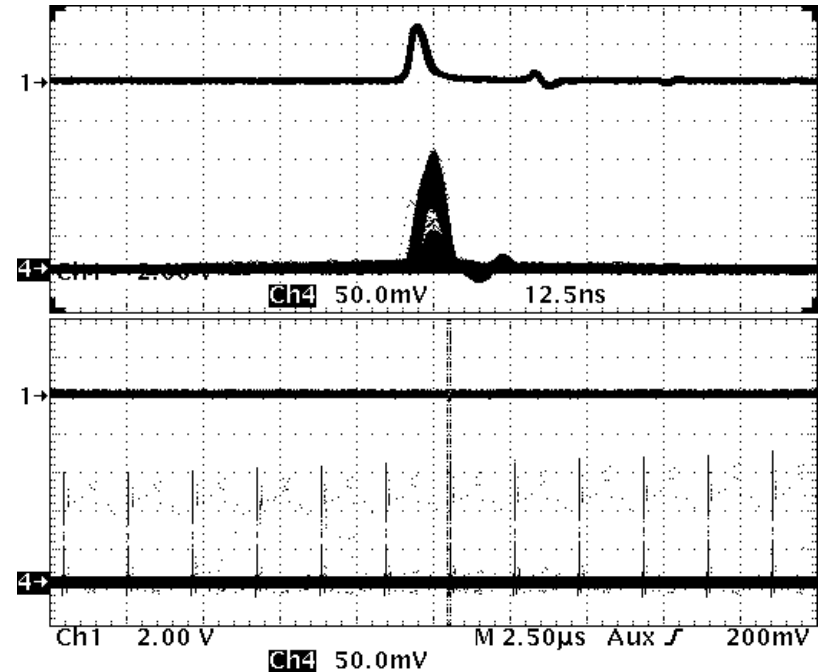
Fixed displays close before ejection

→ **TFID RF train valid for the last ~15-20 ms (LHC-type beams)**

→ **Trigger for all 'fixed' observations (logging, satellite analysis)?**

→ **Requires extra cable connection blg. 353 or 354 → 152 (?)**

PS ejection video, LHC50 ns   **LHCPROBE**

→ **For all other observations (Tomoscope, BSM, etc.) along cycle:**
  TREV + software based bunch analysis sufficient?

Wire scanners

- **Bunch-by-bunch wire scanner measurements need beam/bunch synchronous trigger**

- **Measurement time fixed to ~6 ms before ejection**

- **Use of electronics from LHC for tests**
  - → **Requires 40 MHz RF in building 368 (next to 353)**

→ **Proposal: Distribute beam synchronous 40 MHz (+TFID?)**
  - **Derived from drive signal to 40/80 MHz cavities**
  - **Available during last ~15-20 ms before extraction**
  - **Bunches at reproducible phase from cycle to cycle**
  - **Includes frequency changes for bump compensation**
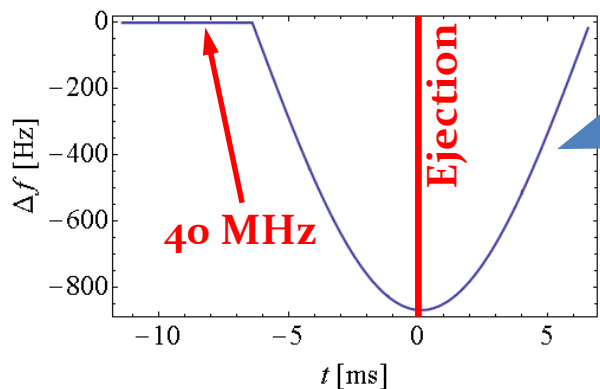
Issue with $\Delta f/f \approx 2 \cdot 10^{-5}$ frequency excursion for wire scanner acquisition?