MD2401: Beam-Based Measurement of the MKD Rise Time

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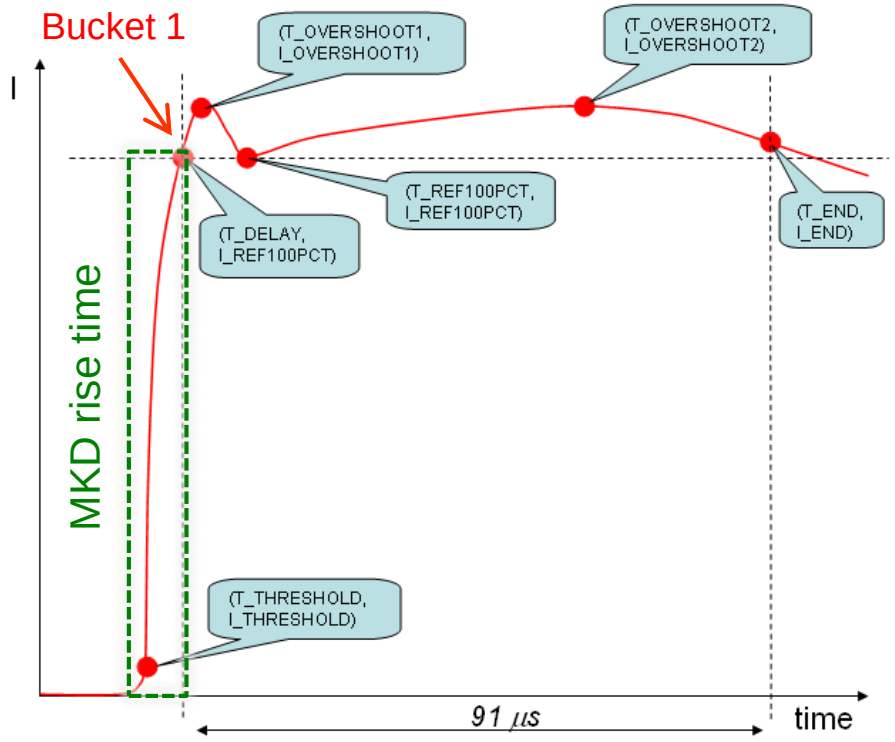
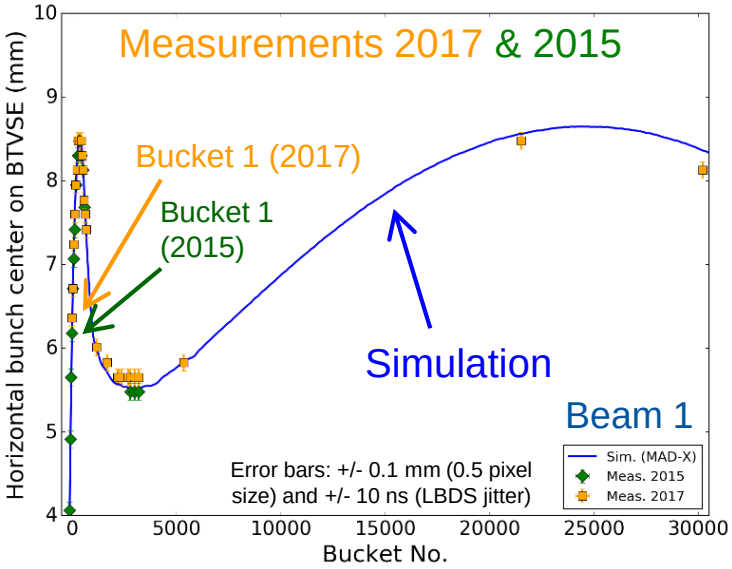
Introduction

Extraction Kicker (MKD) waveform:



J. Uythoven, Naming of characteristic points of MKD and MKB waveforms, derived quantities and logical tests – Version 2, EDMS No. 910572

- During commissioning in 2016 and in 2017, a beam-based measurement of the MKD waveform excluding the rising edge was performed (no injection into the abort gap).
- The rising edge was measured in 2015 by using a hardware bypass in the tunnel [M. Fraser et al., IPAC'16, THPOR052].
- **MD4: Measurement of the rise time by using the variable AGK.**



Procedure: Overview

- Approach: Use **single pilots (~5e9 p+) at injection energy** to measure beam position on BTVSE as a function of the bucket number. Beam will be dumped after each injection. No ramping foreseen.
- Only **Safe Beam** will be used. No change of the Safe Beam Flag foreseen.
- The variable AGK must be modified in order to inject into the abort gap. **AGK changes and revalidation will be done according to the new procedure:**
  - N. Magnin, Operational Procedure, *Procedure to change the length of LBDS Abort Gap Keeper,* to be published on EDMS

Procedure: Steps during MD

1) Preparation of the MD (~2 hour)
   - Insert BTVSE and verify correct timing (with BI)
   - Change settings of **variable AGK** (ABT)
   - Disable abort-gap cleaning
   - Mask **abort-gap interlocks in SIS** (OP rights required) that check
     - LhcMkiAgkLength, AbtFib6Card, MKI kick length settings, LAST_LEGAL_INJECTION_BUCKET
   - Disable steps in the **injection sequencer** (OP rights required) that check
     - if first bucket is not after LAST_LEGAL_INJECTION_BUCKET
     - if last bucket is not after LAST_BUCKET
     - MKI kick length
   - Mask in **Injection BIS**:
     - MKI2/8 BETS/AGK/Erratic
   - Note: The masking of the abort-gap interlocks in the SIS and the Injection Sequencer should follow the same procedure as required for the revalidation of the AGK (e.g. after change of filling pattern).

Procedure: Steps during MD

2) Measure Beam 1 (~3 hours)
   - Inject one pilot. Dump beam and record positions at BTVSE.
   - Check beam stability on BTVSE and BTVDD, e.g. take 3 shots on three different characteristic points of the waveform. The rms horizontal position should vary by not more than 0.2 mm on the BTVSE.
   - Measure required buckets: 20-30 shots (injection and manual dump of one pilot).
   - Remove BTVSE
3) Measure Beam 2 (~3 hours)
4) Recovery after the MD (~2 hours)
   - Reset the variable AGK to nominal values for both beams
   - Unmask in Injection BIS: MKI2/8 BETS/AGK/Erratic
   - Revalidate correct setting of the AGK: beginning edge and end edge of the abort gap (with 20 ns margin due to LBDS jitter).
   - Unmask abort-gap interlocks and enable abort-gap cleaning

Check the end edge of the Abort Gap

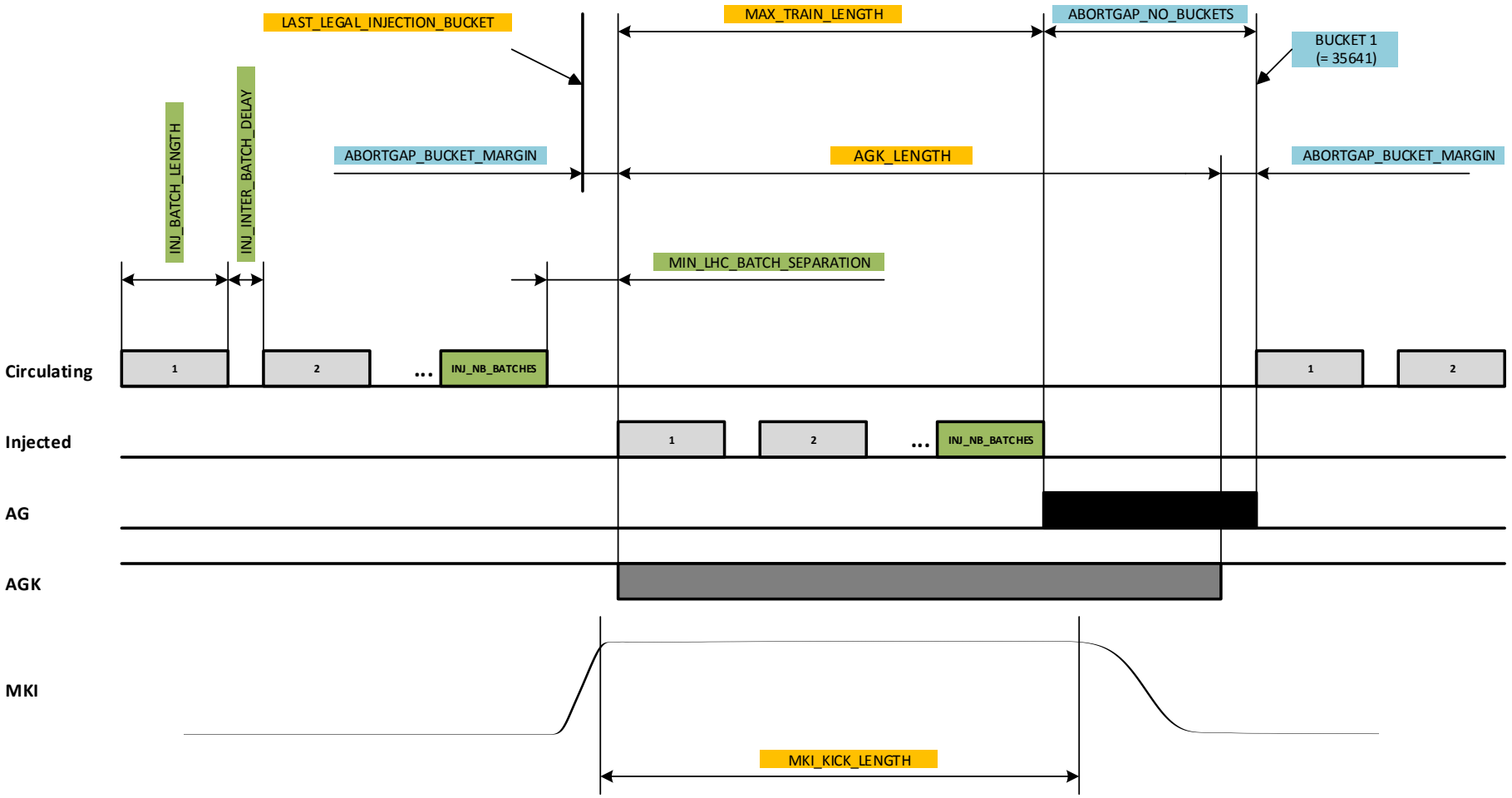
Bucket	Expected Result
1	3x Injected
35631	3x Might not inject sometimes
35621	3x Might inject sometimes
35611	3x NOT Injected

Check the beginning edge of the Abort Gap

Bucket	Expected Result
LAST_LEGAL_INJECTION_BUCKET	3x Injected
LAST_LEGAL_INJECTION_BUCKET + 1	3x Might not inject sometimes
LAST_LEGAL_INJECTION_BUCKET + 2	3x Might inject sometimes
LAST_LEGAL_INJECTION_BUCKET + 3	3x NOT Injected

Thank you for your attention!

Overview of AGK Parameters



N. Magnin, Operational Procedure, Procedure to change the length of LBDS Abort Gap Keeper, to be published

Parameters

Specie	protons
Category	Normal MD
Time required [h]	10 hours
Beams required [1, 2, 1&2]	Both
Beam energy [GeV]	450 GeV
Optics (injection, squeezed, special)	Optics at Injection.
Bunch intensity / number of bunches	One pilot (5e9) for each injection
Transv. emittance [m rad]	Not relevant
Bunch length [ns @ 4s]	Not relevant
Optics change [yes/no]	No
Orbit change [yes/no]	No
Collimation change [yes/no]	No
RF system change [yes/no]	No
Feedback changes [yes/no]	No
What else will be changed?	In order to inject into the abort gap, the AGK has to be modified before the measurement and revalidated after the measurement.
Are parallel studies possible?	No
Other info/requests	No

Motivation

- For LS2 several hardware upgrades of the MKD generators are planned in order to reduce the risk of erratic firing.
  - These hardware changes will have implications for the rise time of the MKD generators.
  - Therefore, the rise time of the current system should be carefully measured in order to validate the current values and probe the margin for future changes.
- Rise time is monitored individually for each kicker, but the most accurate measurement is a beam-based measurement, which includes all delays, etc.
- In view that the rise time must be revalidated after LS2, it must be ensured that the measurement method is working and the rise time has not changed since 2015.
  → Validation of the measurement technique for regular re-measurements.