

Doubling the Target Insertion Rate

P J Smith for MICE VC 163

1) Motivation: ISIS

At 4V of beam loss at the MICE target we are creating 10 V of loss in super period one which is the max measurement level of the system. We can further increase the muon rate by increasing the dip rate without saturating the super period 1 loss monitors.

Note losses around the ring appear \sim linear $>1V$ loss so there is no loss advantage to be gained from running at lower losses.

2) Motivation: Tracker

The dead time issue in the tracker. After a particle hits a detector there is some dead time, this means a second particle coming in after the first and within the dead time cannot be digitised. In the trackers the dead time is caused by the readout, an ADC has to cycle through a large number of channels and digitise each one, a process which takes 5.7 μ s, during which any new particles are ignored. By reducing the rate of particles per spill, you increase the mean time between particles, meaning you get more digital muons per Vms beamloss. There was mention of resuming the work to shorten the dead time by modifying the AFE firmware.

3) Motivation: MICE

Doubling the running rate could increase the rate at which MICE can take data. Of course this requires that this can be demonstrated for the whole chain. Target, DAQ, Online reconstruction. This could have a positive impact upon the shift taking schedule.

Consequently if we can prove that operating at 50/64 Hz is possible there is also a desire to do an activation study at a double insertion rate asap.

Intention:

We initially plan on running the target on ISIS at a double rate on Tuesday the 17th December. The primary motivation is to prove that the target can be setup, synchronised and run with ISIS at the double rate. It will also give an opportunity to alter any target/beam-bump settings that are required to optimise the target's operation.

Background: Target

Target on ISIS (T2.9) has operated in R78 at ~ 0.83 Hz for an extended period. Standard running in R78 is ~ 0.83 Hz with 49mm travel (20 mm BCD). Test T2.8 ran for 3.3 million actuations at this rate. T2.9 currently has ~ 0.5 million actuations on the clock.

In principle there should be no problem with the target running on ISIS at a rate of 50/64 Hz. (0.78 Hz) It is just a case of changing internal delay timings on the target system to match the quicker trigger rate.

The target will run hotter. In R78 it would typically sit at 65-70 degrees C. It maybe slightly different in ISIS due to use of different chiller, longer length of pipes, etc. Target GUI warns if temperature exceeds 70 degrees C and switches the PSU off at 80 degrees C.

The target will run at a reduced acceleration because it is running hotter -> Increased coil resistance reduces current. Voltage is kept constant to ensure we don't get a thermal runaway. Level of effect is:

Typical Target Acceleration (October ISIS) 33.2mm BCD	$\sim 740 \text{ ms}^{-2}$
Target Acceleration Deep Insertion 50/64 Hz R78 20mm BCD	$\sim 690 \text{ ms}^{-2}$

Worse Case is 7% difference. Typically much less.

The different operating characteristics may require that the target operating parameters need optimising to prevent beam scraping on target insertion/extraction. This will likely need doing with the assistance of the beam-bump experts as the beam bump settings may also need optimising.

Ed Overton has had a look at the Target BPS system to ascertain whether any parameters need changing to prevent accidental tripping. We believe that there is enough overhead in the BPS system that we shouldn't be false tripping due to the increased operating rate.

"I used the BPS code to generate a new set of working limits with a temperature range from 15-57C (instead of 15-75C) for all the actuations recorded on T29 since 14/7/13. I then checked that the recorded values for those actuations fell within the limits. The answer is that there were no new BPS 'errors/trips', indicating that we have a good ~18C of headroom on the BPS as stands."

Target GUI:

The Target GUI software has been updated to give a faster update rate. We would like to deploy this before running the target at this faster rate.

These tests don't require the MICE DAQ and so can be done independently of the rest of MICE if necessary.

MICE DAQ:

Yordan does not believe that there will be any problems with the MICE DAQ being able to take data at the increased rate however it would be good to test this.

It is not necessary to have the MICE DAQ functional to test the target and recalibrate the beam bump setup, however if it is possible to test the MICE DAQ at the same time then this is welcome. I don't know if this can be done with the rest of the beam-line out of use?

In either case firmly establishing that the target can operate at the increased rate is still desirable.

Operational Constraints in the MICE Hall:

We would like to do the target double dip rate test asap but the MICE hall is currently being occupied by the RF group for the TIARA testing.

A muon beam line permit can be obtained without the PPS system – the RF crew do not need to use the PPS system to control access to the MICE hall during the TIARA testing.

Running without the PPS has been approved in principle with John Thomason and Paul Wright but with a couple of caveats:

- Initial running needs to be with no-one in the hall – observe the rate monitor for change.
- A limit of 2 (or 4?) hours of running.
- Of course there will be no magnets.

The RF group expects to be working until 19:00 hours in the evening.

I understand that all the paperwork is now in place for a run between Monday 16th and Wednesday 18th December.

Beyond the immediate test we need to determine when the 'Activation Study' can take place. If it is in February will this conflict with other work?