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Time structure and useful muon rates for MICE at RAL

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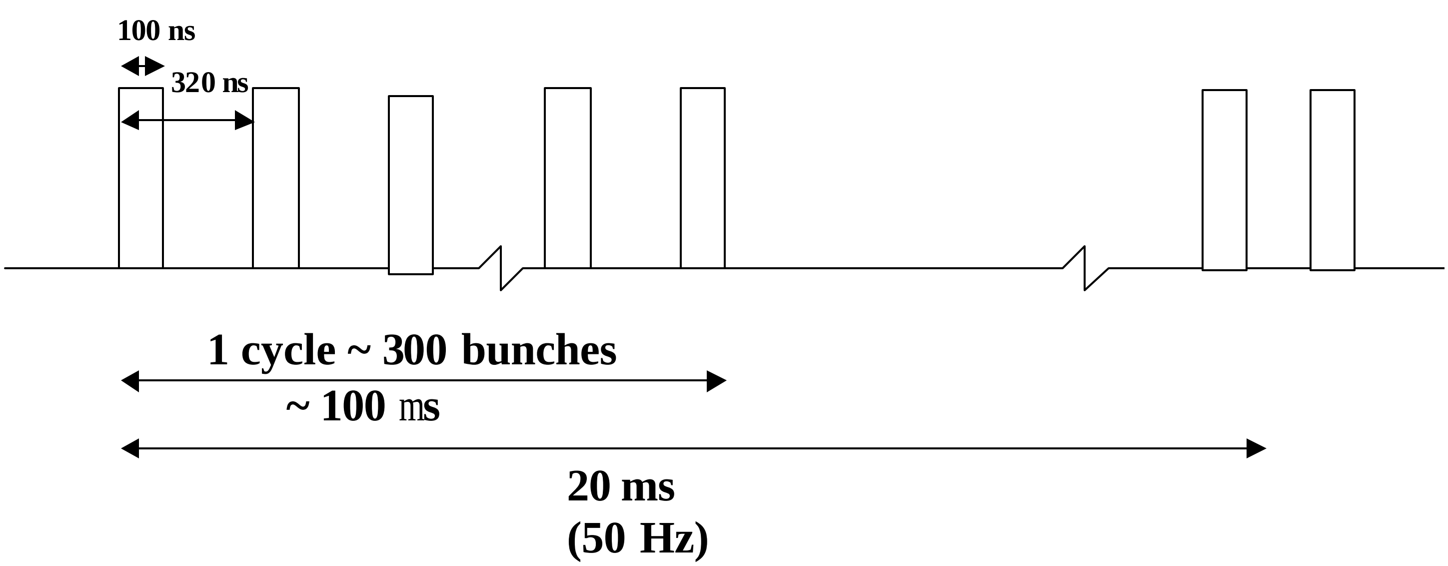
This note describes the time structure of the envisaged MICE running mode at RAL. It is determined by several elements.

1. The repetition rate of ISIS, which is 50 Hz.
2. Each time ISIS is cycled, the target is inserted in the ISIS ring during the ISIS flat-top which has a duration of 100 microseconds. During these 100 microseconds, the beam is hit by the target and pions and muons are produced.
3. The proton beam is constituted of 2 bunches of 100 ns length pushed by an RF system operating at 3.1 MHz, i.e. of period 320 nanoseconds.

The time structure of the beam reaching MICE is therefore as follows.



This gives a total number of 400X50= 20 000 bunches per second. Let us assume that an adequate rate is of about 1 muon per bunch reaching the first TOF of MICE. The reduction factors calculated by P. Janot were: 1/4 of the muons (i.e. 100 muons per ISIS cycle) remain within the acceptance after the two diffusing plates situated at the first TOF and 10 meters downstream; 1/6 of the muons are in phase with the RF and are accelerated on crest. This leads to a number of good muons of about 16 per ISIS cycle. MICE would then be cooling 800 muons per second, if the RF were pulsed at 50 Hz with a flat top duration of 100 μs.

This is probably too optimistic, since the refurbished RF power supplies can presumably not run for more than a duty factor of 0.001, imposing operation of the RF for 1 ms every second. R. Garoby quoted a rise time of 150 microseconds, to which one should add a flat top of 100 microseconds to match the beam structure. This gives a total pulse length of 250 microseconds, and a RF pulsing rate of 4 Hz.

Mice will cool around 64 muons per second, providing a measurement of cooling with a statistical precision of 1% for 1000 good muons, taken in 16 seconds, and 10^{-3} in 1600 seconds, i.e. less than half an hour.

Nevertheless, the rate of events to be treated will certainly be much higher. The muons that are not on the crest of the RF wave will certainly be kept, and a fraction of the 'lost muon' will have to be measured at least in the upstream tracking device. Further more it might be interesting for calibration purposes to run MICE also when the RF is not pulsed. Assuming running at a total of 8 Hz (half of the data with the RF off) one still needs to envisage a total rate of around 3000 particles to be reconstructed per second, with a rather large uncertainty due to possible beam related backgrounds, and the efficiency of the emittance generation devices for MICE.