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Feasibility of Beam Rastering in BL2C4

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Abstract: From the beam line layout and optics point of view, we investigated the feasibility of beam rastering in beam line 2C4, by using the existing ANAC AC magnets and meanwhile minimizing any movements and changes to be made in the existing beam line. This note summarizes the outcomes.

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1 Requirements and Constraints

- The existing quadrupole triplet in 2C is too far from the 2C4 target to create a narrow spot (≤ 3 mm, 2rms) at the target. The minimum spot size that is currently achievable is ~ 6.5 mm (2rms) at the target. This is too large for the beam rastering. Thus, we shall need to add in extra quadrupole magnets to allow narrowing down the beam spot at target.

- The only area that is possible to accommodate additional magnets is between the isolation valve downstream the switching magnet 2CVB1 and the wire scanner 2C4VM3. See diagram Fig.1. The space available there is only ~ 1.5 m, within which it's anticipated to add in two quadrupole magnets and two AC magnets.

- The two ANAC AC magnets that currently exist in the BL2A have a maximum field strength of 133 G and an effective length of 11.52 inches for each. These two magnets together can generate 5.0 mrad deflection in both x and y for the 110 MeV proton beam.

2 Working Assumptions

- The maximum radius of beam ratation shall be 7 mm at the target while the instantaneous beam spot size shall be 3 mm (2rms) in both x and y. This implies that we shall need a lever arm of ≥ 1.4 m from the AC magnet centre to the target.

- The additional two quadrupoles shall be the same type of magnets as the existing triplet 2CVQ1,2CVQ2,2CVQ3; they have an insertion length of 8.5 inches and pole gap of 4 inches.

- The existing diagnostics box 2C4VM2.2 CAP and the steering magnet 2C4VSM2 (see photo Fig.2) both shall be removed, but the steering function shall be realized by powering the quadrupoles asymmetrically, and the toroid and capacitive probe shall be relocated into the diagnostic box 2CVM1.

- A vacuum pumping port should be added to the diagnostic box 2C4VM3.

3 Implementation

It is feasible that we add in extra 2 quadrupoles to narrow down the beam spot, followed by 2 AC magnets to rotate the beam on the target. The local area shall become quite congested, though. The lever arm from the AC magnets to the target shall stay constant at 1.4 m, independent of the instantaneous beam size. Fig.3 shows the proposed layout and the calculated beam envelopes.

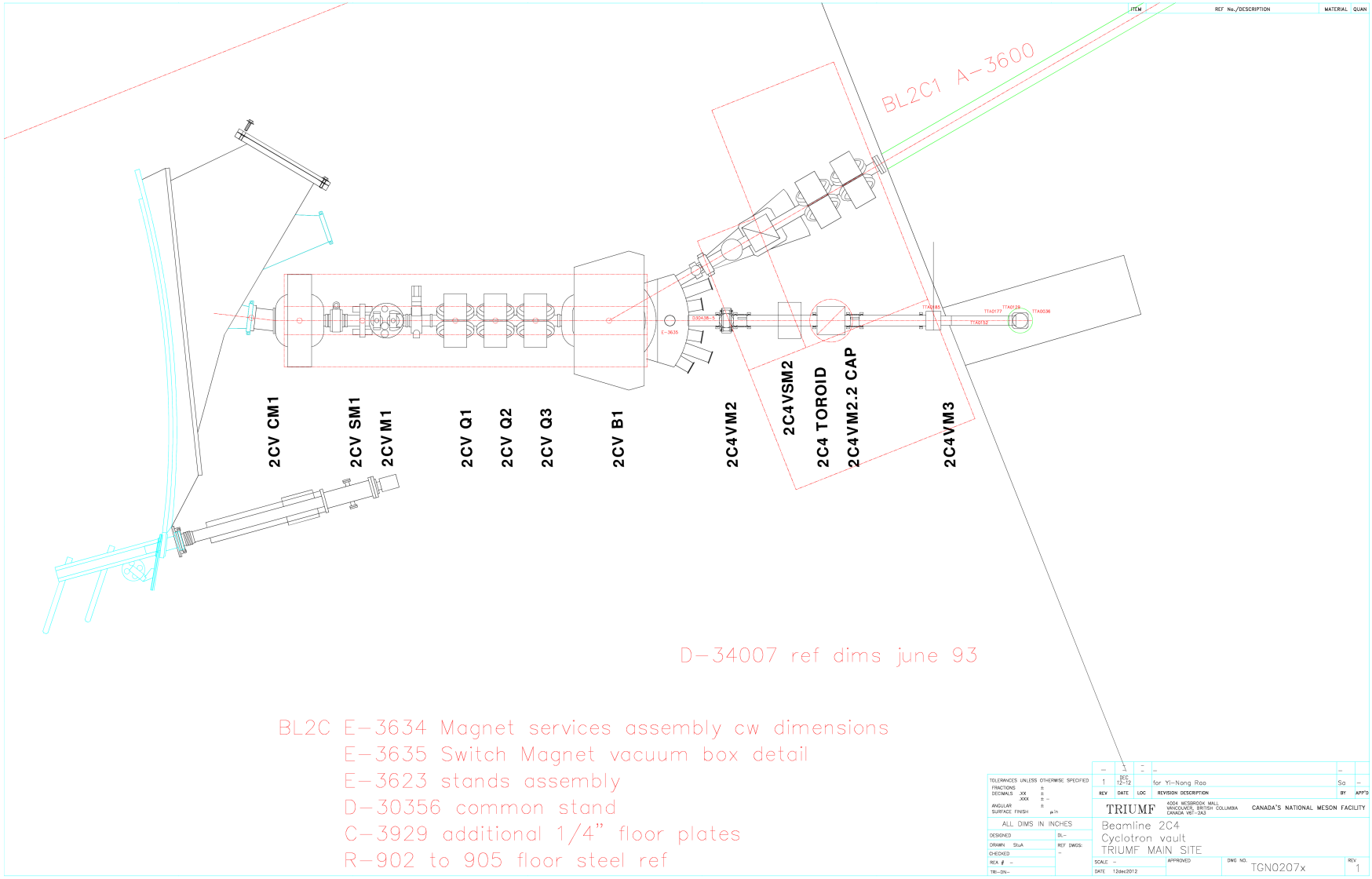

Figure 1: *Diagram showing the layout of existing BL2C.*

Figure 2: *Photo showing the switching magnet, isolation valve, steering magnet and diagnostic box (from left to right) in the existing 2C4.*

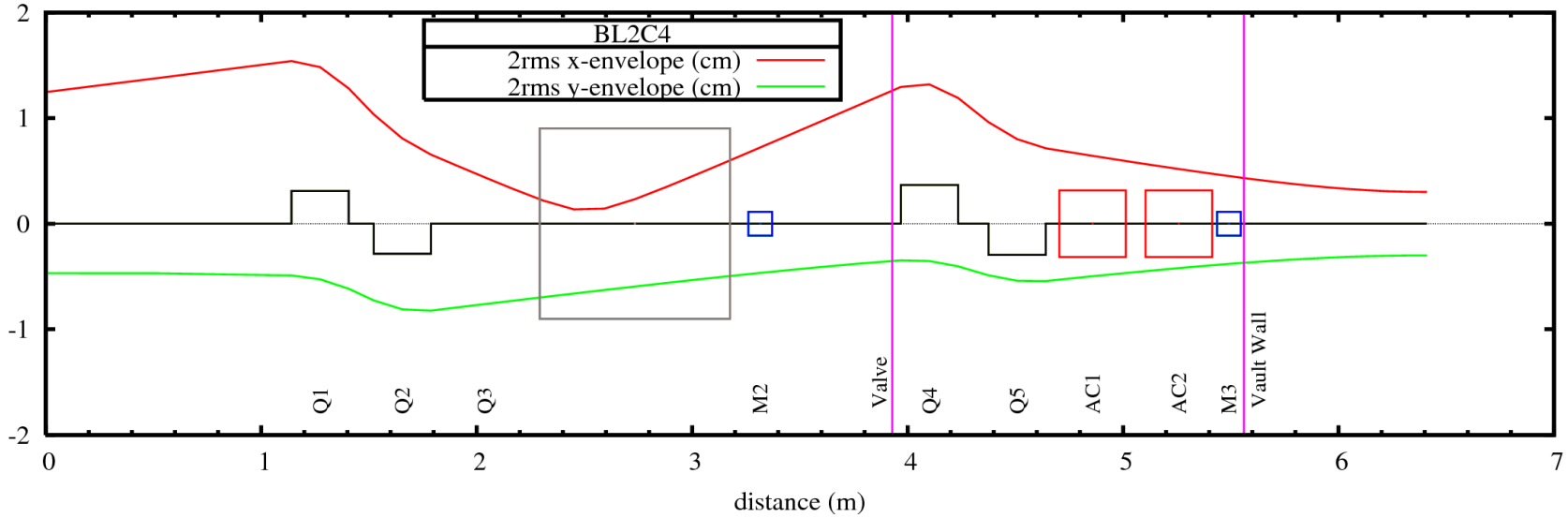

Figure 3: *Layout of the additional two quadrupoles and two AC magnets, and the calculated beam envelope (2rms) at 110 MeV.*