Section 4 PEP-N Interaction Region

The large energy asymmetry of the two beams allows the beams to be brought into collision and separated after the collision by a large horizontal bend field located at the interaction point (IP). The present design uses a square field model that is 3 kG over 2 m of length. Figure 4-1 shows a magnet that could be used to generate the central field and Figure 4-2 is a plot of the vertical component of the field from this magnet along the z axis. The IP is located in the center of the field. The 3 kG field corresponds to an accelerator design that has a 500 MeV beam energy for the very low-energy ring (VLER). The VLER is deflected horizontally 182 mrads while the low-energy ring (LER) is deflected 29 mrads. This results in a separation of 30 mm between the two beams at the first parasitic crossing, 0.63 m from the IP, which translates into 42 σ_x for the VLER and 77 σ_x for the LER. This large separation makes any beam-beam effect from the parasitic crossing very small. The beams are separated enough to allow each beam to enter a separate beam pipe 1.3 m from the IP.

The first accelerator element after the dipole field at the IP is a vertically focusing quadrupole (QDI1) for the VLER located 1.5-1.7 m from the IP. QDI1 is constructed from permanent magnet material. The compactness of the design permits this magnet to be 1.5 m from the IP and yet not have any effect on the nearby LER beam. The small design also maximizes the solid angle acceptance of the detector. The next element for the VLER is a horizontally focusing quadrupole (QFI1) located 2.5-2.8 m from the IP. This magnet is far enough away to no longer interfere with the LER.

The LER goes through two horizontal bending magnets on either side of the IP. The first bending magnet is located 3-5 m from the IP and the second is 10.5-12.5 m away. These four magnets control the LER orbit and compensate for the effects the dipole field at the IP has on the LER.

In order to change the energy of the VLER and yet maintain the VLER trajectory at the IP, the IP dipole field is ramped up and down to match any VLER energy changes. The four bending magnets in the LER maintain the collision point in the LER as the central dipole field is changed to accommodate energy changes in the VLER. Figures 4-3 to 4-5 show a layout of the interaction region. Figures 4-4 and 4-5 have expanded scales to more clearly see the elements and beam geometry near the IP.

The horizontal bending magnets in the LER generate significant amounts of synchrotron radiation (SR) that strike the beam pipe in this region. The central bending field at the IP produces 4.7 kW of SR power and the other 4 bending magnets in the LER together produce 6.2 kW of SR power for the 500 MeV VLER design. This power is generally spread over many meters of easily accessible beam pipe and therefore should be easy to cool. However, the impact this radiation has on the detector and whether or not SR masks are needed to shield the detector has yet to be determined.

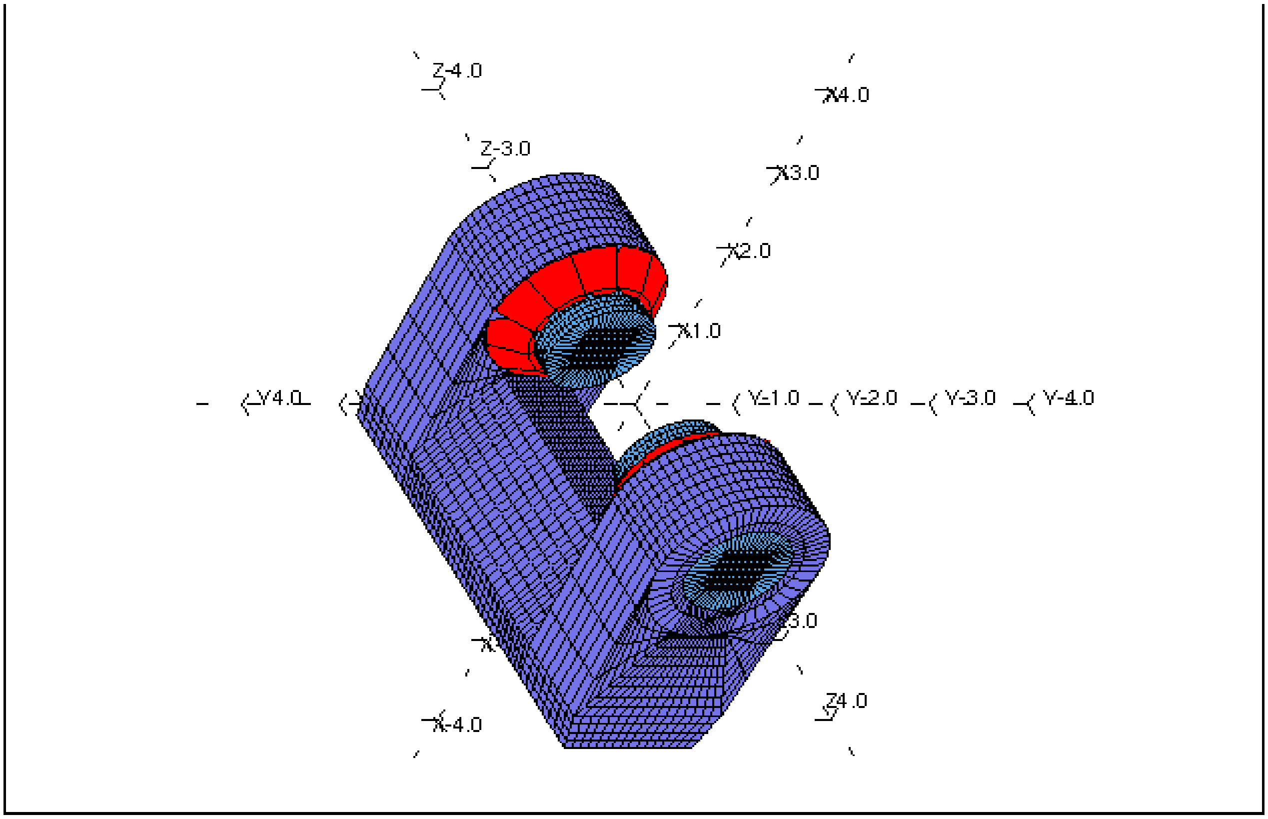

Fig. 4-1: Dipole magnet located at the Interaction Point.

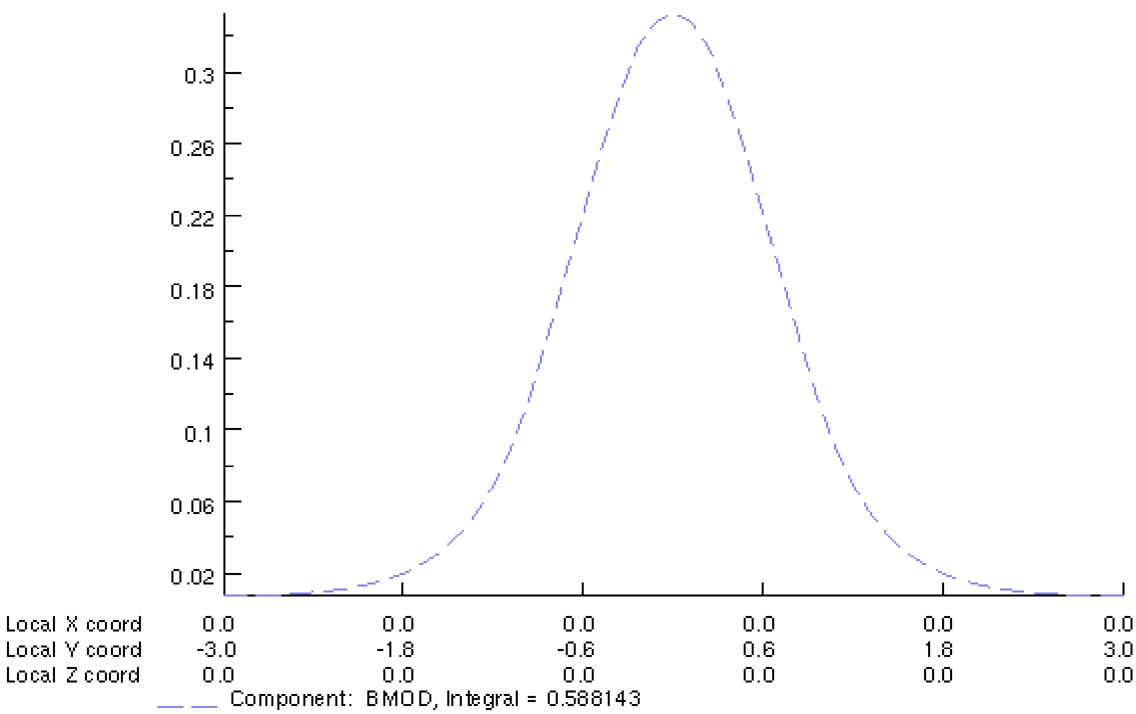

Fig. 4-2: Magnetic field along the beam direction of the dipole at the Interaction Point. The peak field is 0.33 T and the integrated field is 0.59 T m.

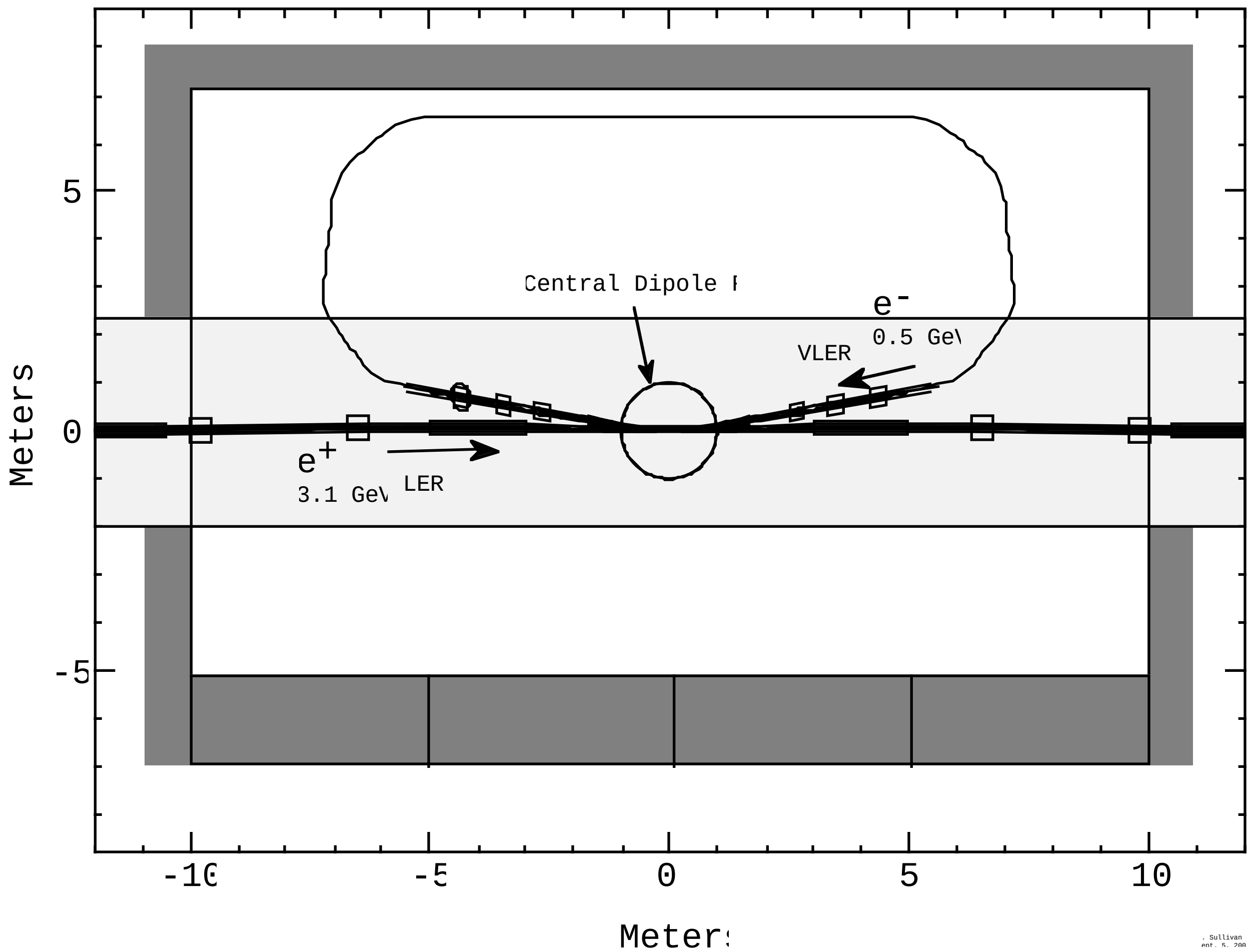

Fig. 4-2: Layout of the IR12. The darker shaded regions are the concrete walls around IR12. The central shaded region is the concrete bridge that connects the two PEP tunnels acroios the hall.

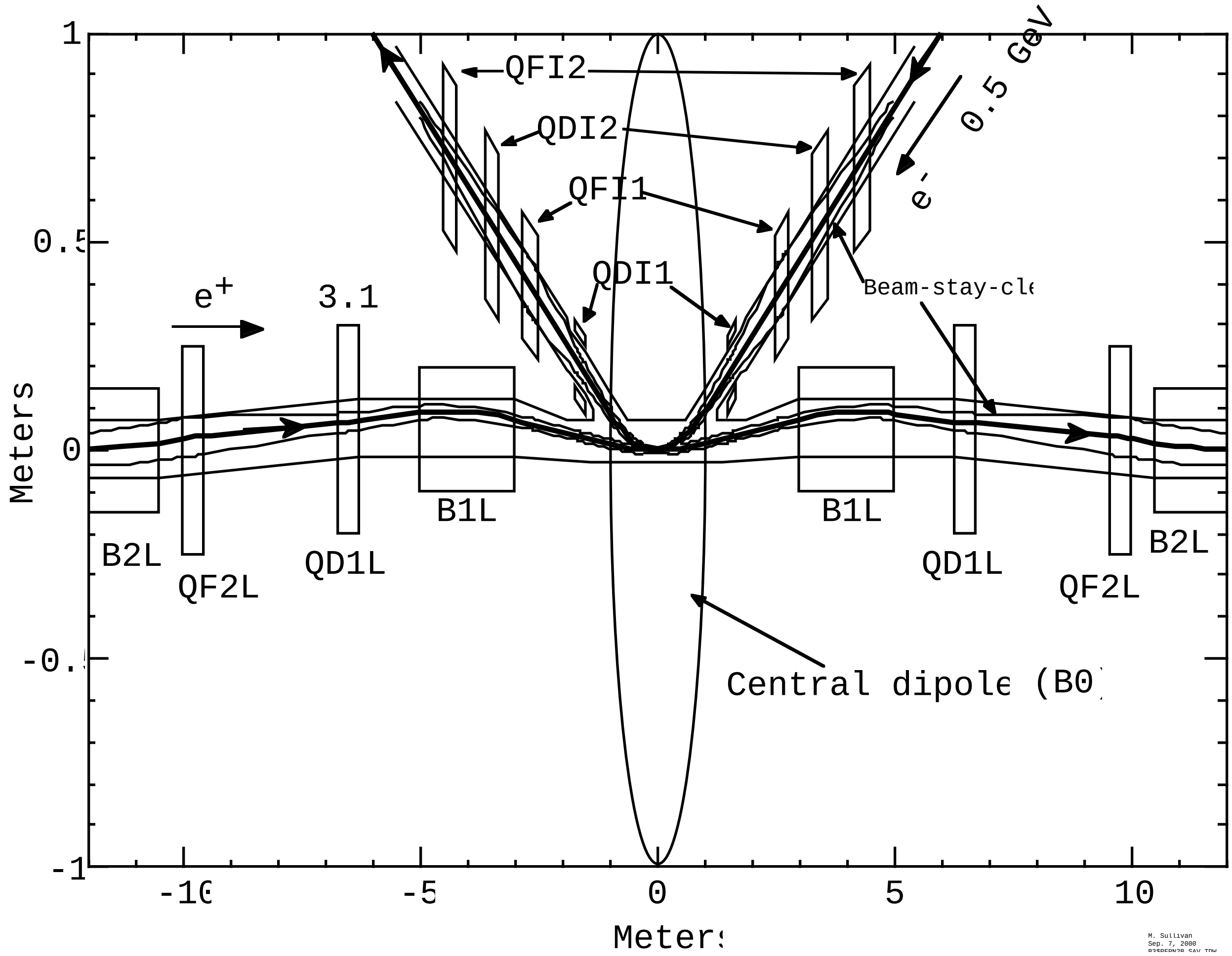

Fig. 4-4: Close up of the PEP-N IR12. Notice the expanded left-hand scale.

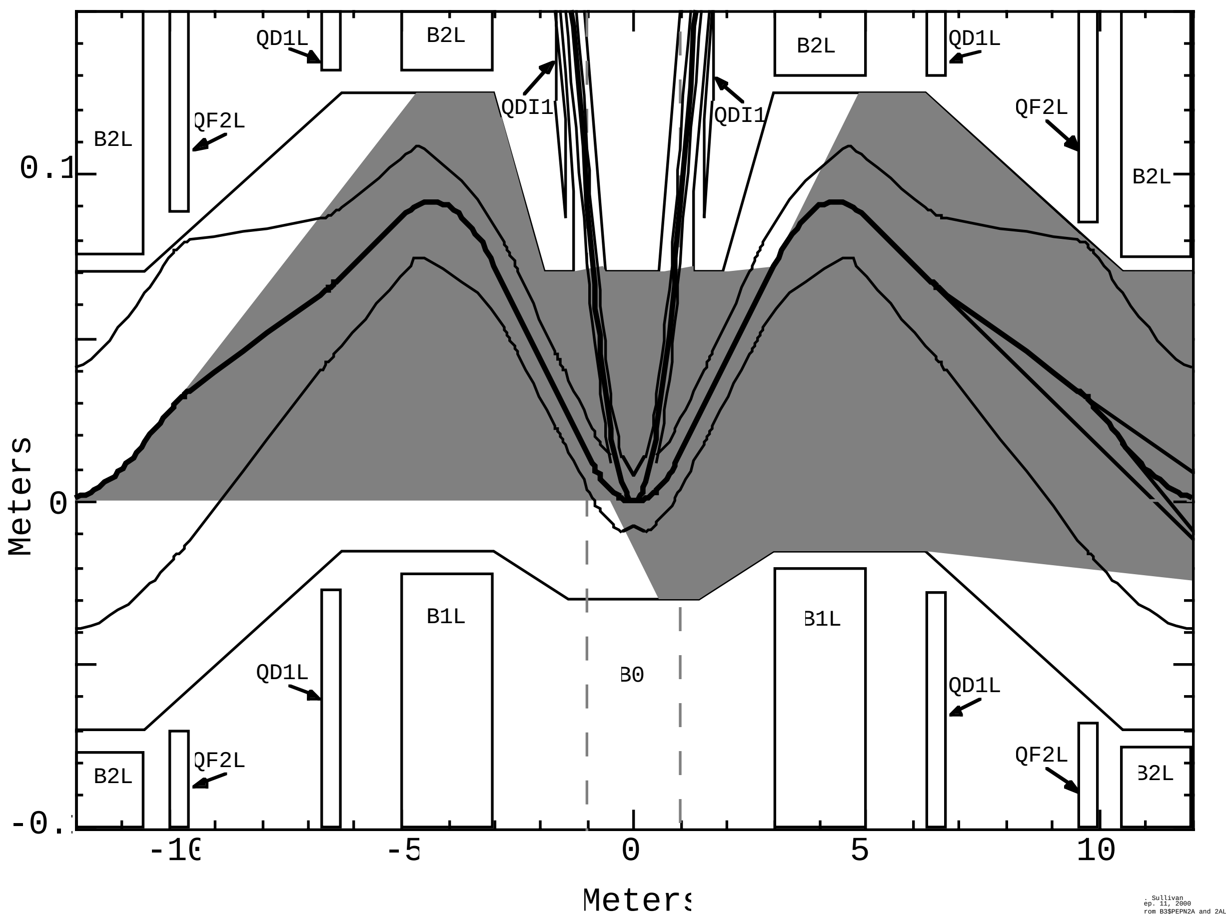

Fig. 4-5: Layout of the PEP-N IR12. Detail drawing of the synchrotron radiation fans generated by the LER for the 0.5 GeV VLER design. Please note the expanded left-hand scale.