In this figure, the diagnostic package is visualized as being a 3-slit diagnostic for emittance measurement followed by position/profile monitor (such as an OTR) for phasing and momentum spread measurement. With the quad off, the beam experiences ~1 m dispersion at the profile/position monitor, with propagated beam envelope functions [3] on the order of 3 m in both transverse planes. This meets the requirements for phasing and momentum spread measurement. With the quad properly excited, the beam experiences zero dispersion at the 3 slit emittance diagnostic, with propagated horizontal and vertical beam envelope functions of 6 and 12 m, respectively [4]. This meets the emittance measurement requirement.

Recommendations

We recommend use of the option 3 concept. A detailed DIMAD design input stream is available on the cebafh cluster in the following file,

~douglas/../../../../prinzipal/usr/users/optics/IRFEL_optics/irapr96/baseline/injection/725revtest

with output in

~douglas/../../../../prinzipal/usr/users/optics/IRFEL_optics/irapr96/baseline/injection/725revout

References

[1] G. Krafft, private communication (25 July 1996) of requirements for 3-slit emittance measurement.

[2] H. Liu, DIMAD deck for injection line, private communication.

[3] Propagation was done using the injection line data of Reference 2.

[4] *ibid*.

A second “reverse bend” option is shown in Figure 2. In this case, the final injection line dipole is reverse energized, and used to bend the beam away from the module, alleviating the crowding discussed above.

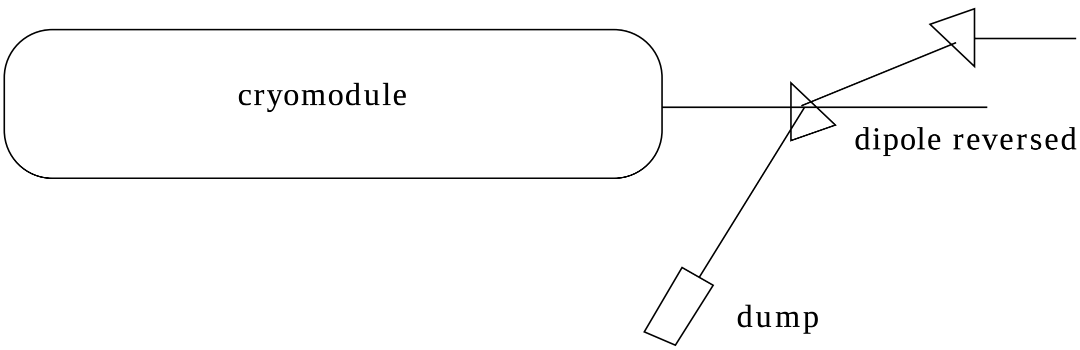

Figure 2: “Reverse-bend” option for diagnostic dump transport.

This case readily provides the 1 m dispersion needed for phasing and momentum spread measurements. However, the beam exits the final dipole with a 40^{o} pole face angle; this causes severe horizontal defocussing and leads to horizontal beam envelope function blow up. At a point 2 m downstream of the dipole, the dispersion is ~1.6m and the horizontal beam envelope function (propagating values established by H. Liu [2]) is well in excess of 100 m. This leads to horizontal total spot sizes of order 5 cm, beyond the acceptance of the system.

A third option is presented in Figure 3. In this concept the final injection line dipole is switched off and a 20^{o} reverse bend (with proper sector dipole orientation) installed immediately downstream. This dipole provides horizontal focussing without imposing vertical defocussing, generates additional dispersion, and moves the beamline away from the cryomodule. This avoids significant crowding.

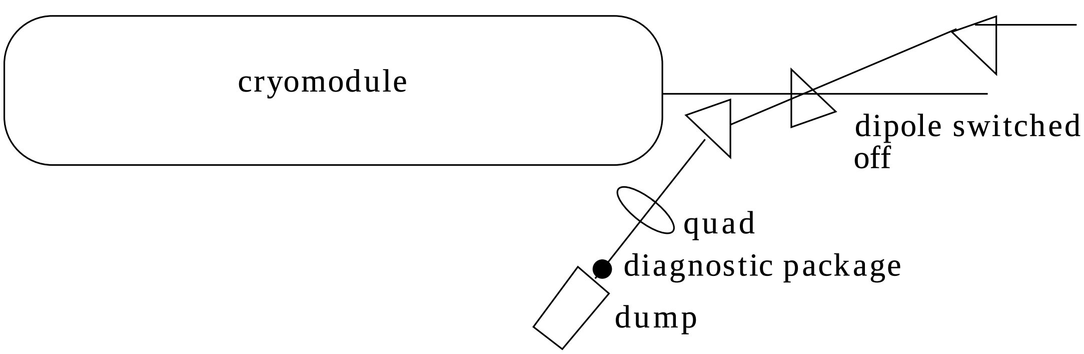

Figure 3: “Straight ahead” option for diagnostic dump transport.

10 MeV Diagnostic Dump Transport Design

D. Douglas

Abstract

A design for the IR FEL 10 MeV diagnostic dump transport is described.

Requirements

The IR FEL 10 MeV diagnostic dump line must allow low-loss transport of beam from the driver injection line to the 10 MeV diagnostic dump. It must also provide opportunity for three measurements:

1. phasing of injector cryounit cavities
2. measurement of 10 MeV beam momentum spread
3. measurement of 10 MeV beam emittance

The first measurement requires a dispersion of ~1 m at some point in the transport. The second measurement requires small beam envelope functions ($\beta < 5$ m) at the dispersed point. The final measurement requires [1] moderate beam envelope functions ($5 \text{ m} \leq \beta \leq 20 \text{ m}$) at a point of zero dispersion.

Options

A simple "straight-ahead" option for the diagnostic dump transport is displayed in Figure 1. In this option, the final injection line dipole is switched out, and the beam propagated straight to the dump. This option is not desirable, inasmuch as it crowds the beamline up against the cryomodule.

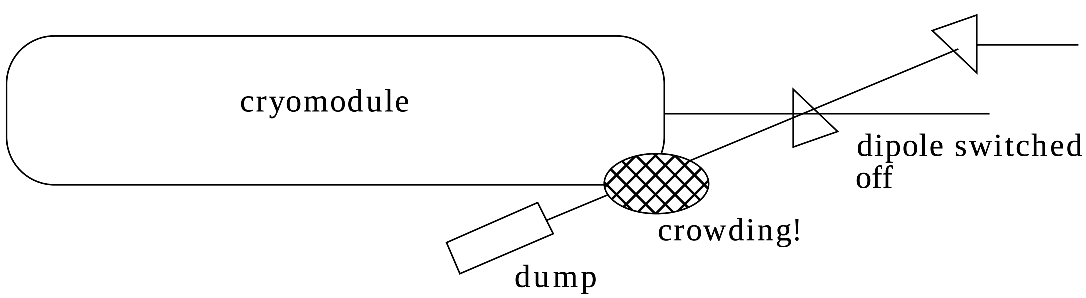

Figure 1: "Straight ahead" option for diagnostic dump transport.

The crowding of the beamline against the cryomodule inhibits introduction magnets for beam envelope and dispersion control and diagnostics required for beam properties measurements.