IR FEL Cryomodule Transport Setup Procedure

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Overview

Beamline with relevant diagnostics and correction elements is shown in Figure 1. Nomenclature will be revised to standard in later versions of the procedure

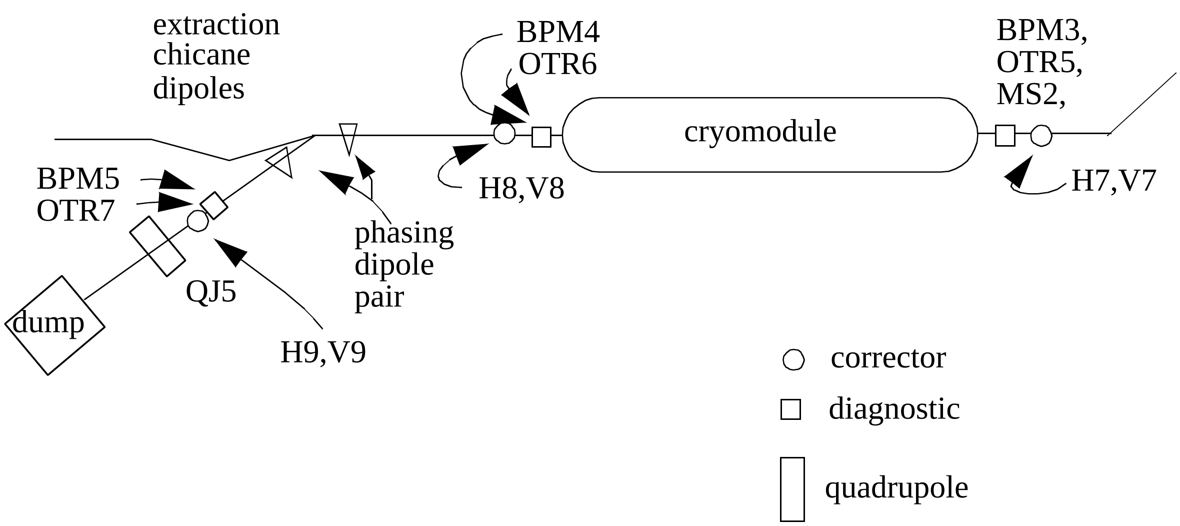

Figure 1: Cryomodule diagnostic and correction system layout.

1.0 Purpose:

Initial setup of machine from front flange of module to front of upstream matching telescope/

2.0 Prerequisites

1. Completed injector setup
2. Completed injection line setup procedure
3. Module RF in idle
4. Extraction chicane dipoles deactivated; phasing dipole pair set for 10 MeV transport to energy recovery dump and phasing quadrupole set to high dispersion mode at 10 MeV.
5. Beam at OTR/BPM at end of module at completion of injection line setup procedure

3.0 Beam to Energy Recovery Dump

1. Verify that beam is at end of module following completion of injection line setup procedure by reading BPM4/OTR6
2. Using H8/V8, thread beam to OTR7/BPM5
   a. If beam cannot be found, it is likely that there is an energy/dipole excitation mismatch. Grid search the parameter space by stepping though phasing dipole pair excitations and

scanning with corrector pair H8/V8. Cross-check dipole excitations with those used in injection line to define 10 MeV beam energy.

3. Thread beam on to dump using H9/V9
4. Calibrate BPM5 by centering in QJ5; resteer after centering using H9/V9
5. Cross check injector momentum spread using dispersed beam on energy recovery dump.

4.0 Injector Checkout/Fine-tuning

With 10 MeV beam parked on energy recovery dump,

1. Aperture scan injection line with S2(H5)/V5 to verify OTR5/BPM3 fiducialization and calibration, alignment of beamline from B2 through the injection point, and excitation of injection line dipoles (particularly B3)
2. Check beam emittance and match at injection point by performing emittance measurement with MS2; rematch as necessary. Reconcile MS1/MS2 measurements offline.
3. Check bunch length at injection point using OTR5.
4. Check momentum compaction (M_{56}) of injection line using time of flight measurement on OTR5
   a. Note that errors in this parameter are due to hardware problems and can be corrected only in hardware. If this is not possible, such errors must be compensated by changes in the injector operating point.
5. Cross check injector momentum spread using dispersed beam on energy recovery dump.
6. For fun, check bunch length after module (if possible) using OTR6 or other diagnostic

5.0 Cryomodule RF On/Phasing/SetEnergy Gain

1. Power up each cavity; for each, proceed as follows (intended to minimize beam loss)
   a. dial phase to restore beam to OTR6.
   b. Resteer with H7, V7 to center on OTR
   c. ramp phasing dipole pair to restore beam to OTR7/BPM5, resteer as need with V8
   d. ramp QJ5 to present energy, as defined by phasing dipole pair; steer beam to dump with H9/V9
   e. transient phase cavity
   f. repeat c, d.
   g. proceed to next cavity
2. Set phasing dipoles and QJ5 to values for 42 MeV kinetic energy. Scale module gradiants to restore beam to dump.
3. Crest module cavities, gang phase module. If needed, scale module gradiants to restore beam to dump.
4. Reset gang phase of module to 12.5^{o} off-crest, and scale module gradiants to restore beam to dump. This sets the module energy gain.

7.0 Measure Momentum Spread/Bunch Length

1. measure momentum spread
2. measure bunch length

8.0 Comments

Do we want to do any lattice verification for the module transport?

Next we move on to thread beam through the wiggler to the first light dump. Once there, we verify the match/optics to the wiggler and from the wiggler to the first light dump.