10 STEERING OF THE HGHG BEAM WITH THE ELECTRON BEAM

We studied steering effects on the electron and light beam trajectories using a small corrector magnet located 18.4 cm upstream of the radiator. Five cerium-doped yttrium aluminum garnet (YAG) beam position measurement screens located at regular spacing through the radiator were used to observe the electron trajectory. A pyroviewer thermal imaging camera 1.7 m downstream of the end of the radiator was used to measure the deviation of the light beam.

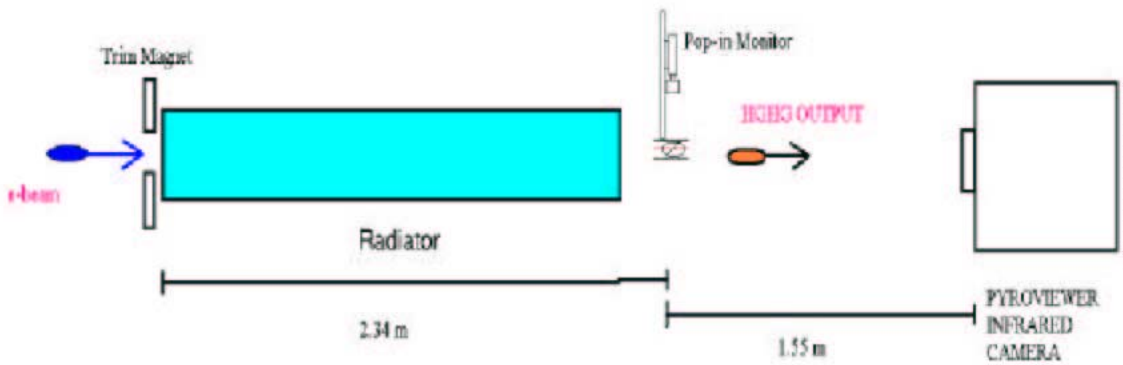

Figure 10-1 Schematic diagram of the steering measurement set up

Steering correctors were varied separately in each plane to induce a maximum electron beam offset of 1.0 mm (horizontal) and 0.5 mm (vertical) on the fifth YAG screen, situated 18 cm downstream of the exit of the radiator. The electron beam steering produced a maximum HGHG output centroid displacement of 2.5 mm (horizontal) (see Figure 10-2) and 1.0 mm (vertical) (see Figure 10-3) at the thermal camera.

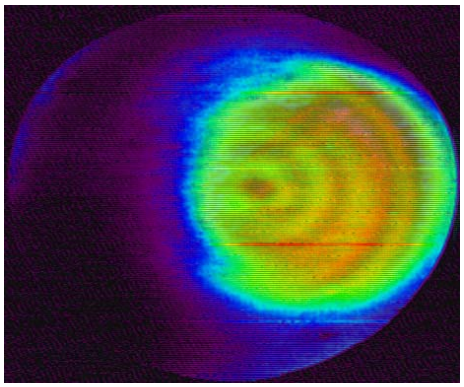

Figure 10-2 (a) The HGHG beam steered to the right

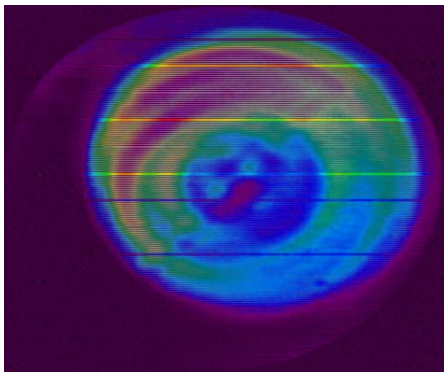

Figure 10-2 (b) The HGHG beam with no steering

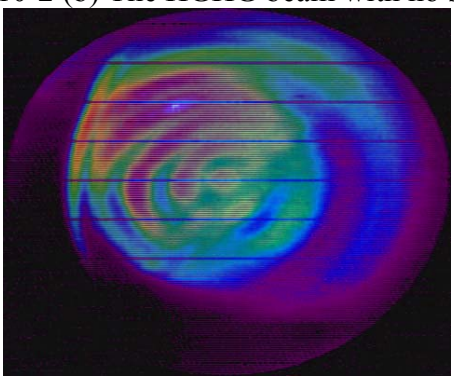

Figure 10-2 (c) The HGHG beam steered to the left

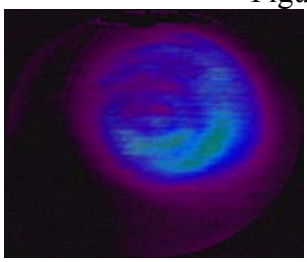

Figure 10-3 (a) steered up

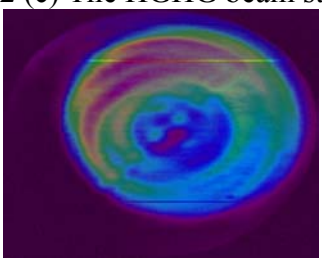

Figure 10-3 (b) no steering

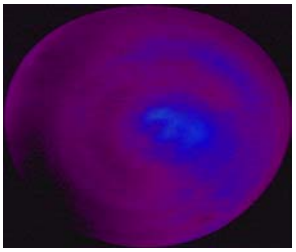

Figure 10-3 (c) steered down

The horizontal steering of the electron beam did not cause observable intensity reduction. Figure 10-4 shows the horizontal (top) and vertical (bottom) electron beam trajectories in the radiator wiggler for the two cases.

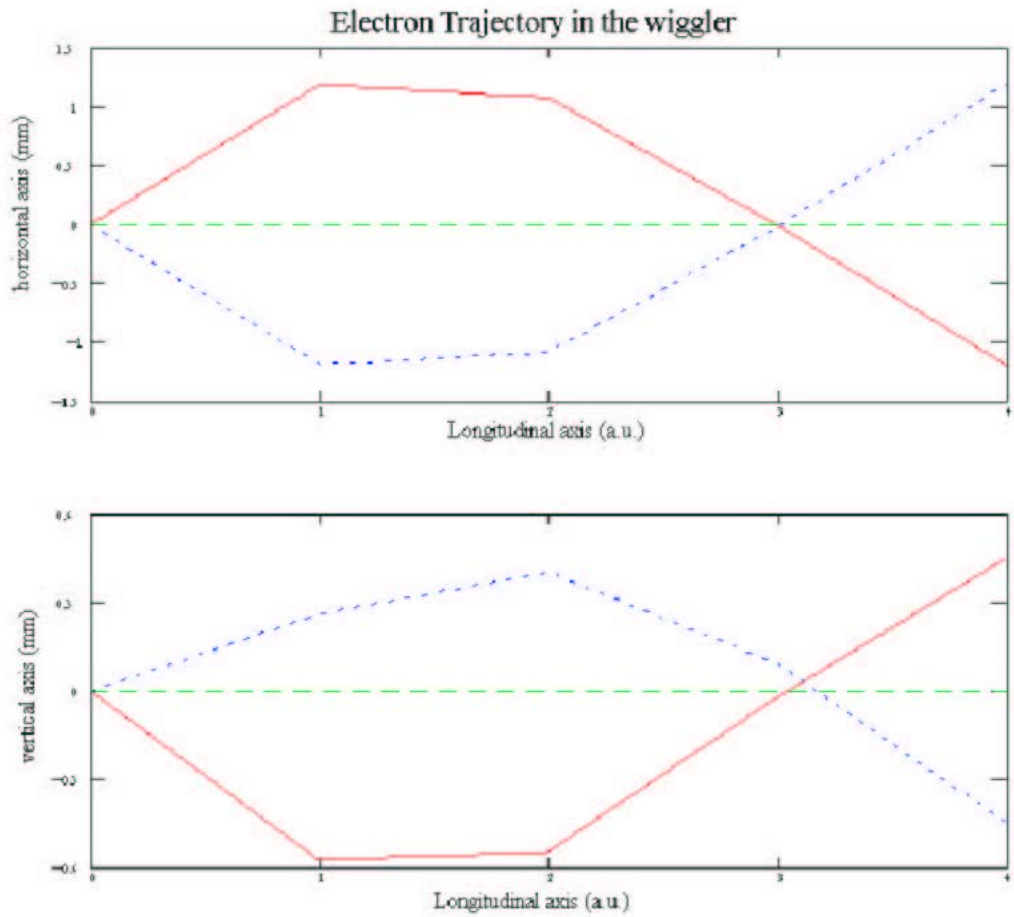

Figure 10-4 Horizontal and vertical electron beam trajectories in the radiator wiggler in the case of steering

The measured shift of the optical HGHG output position at the thermal camera and the shift of the electron beam position on the fifth YAG screen suggest that the HGHG output follows the electron beam [44].

When we steered the electron beam vertically by 0.5 mm at the fifth YAG screen, we observed about 1 mm displacement of the HGHG signal on the thermal camera. In this case, the intensity of the output was reduced because the radiator is a planar wiggler, i.e., the magnetic field increases as one moves out of the midplane in the vertical direction. Due to the change in magnetic field, the resonant wavelength shift is about 25 nm. Since the bandwidth of the HGHG is 20 nm, this field change causes the electrons to lose resonance with the radiation generated earlier in the wiggler.

The result of this measurement may be important if we want to cascade the HGHG procedure to the X ray regime. In order to go to the X ray regime, the design consist of several HGHG radiator sections which the output of one would be used as the

seed of the next section [50,51]. In this design it would be very convenient to be able steer the HGHG output using the electron beam steering.