Vertical Beam Size Measurement at CesrTA Using Diffraction Radiation

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ABSTRACT

Over recent years the first Diffraction Radiation (DR) beam size monitor has been tested on a circular machine. At CesrTA, Cornell University, USA, the sensitivity and limitations of the DR monitor for vertical beam size measurement has been investigated. DR emitted from 1 and 0.5 mm target apertures was observed at 400 and 600 nm wavelengths. In addition, interference between the DR signals emitted by the target and mask has been observed. In this report, we present the recent observations and discuss areas for improvement.

DIFFRACTION RADIATION

1. Electron bunch moves through a high precision co-planar slit in a conducting screen.
2. Electric field of the electron bunch polarizes atoms in the screen surface which emit radiation in two directions:
   - along the particle trajectory called “Forward Diffraction Radiation” (FDR).
   - in the direction of specular reflection called “Backward Diffraction Radiation” (BDR).
3. Visibility of the vertical polarization component of the DR angular distribution is sensitive to vertical beam size.

Parameters:
- E = 2.1 GeV
- Single bunch electron beam in storage ring
- Target aperture = 0.5 mm

A comparison of projected vertical polarization components (PVPCs) for different beam sizes.

ODR WITH PVPC TECHNIQUE

A beam offset of 120 μm obtained using a least squares fit for ODR data given parameters:
- σx = 17.6 μm, σy = 4.68 μrad and coplanarity offset 40 nm.

Contour plots of ODR vs ODR show the enhancement of the side fringes due to interference.

CONCLUSION

The vertical beam size measurements from the Diffraction Radiation monitor installed at CesrTA are presented. Using a 0.5 mm target and 600 nm wavelength, interference effects in the angular distribution between the mask and target have been investigated. Further study of these interference effects have been explored via direct imaging of the target surface. These observations show evidence for the presence of shadowing.

REFERENCES


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