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Micron Scale Electron Beam Size Measurements Using Optical Transition Radiation

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Optical transition radiation (OTR) is widely used as a tool for transverse diagnostic of electron beams in many accelerator facilities around the world. It is generated when the beam of electrons intercepts a metallic or dielectric screen. The OTR then propagates in the direction of the mirror reflection to the point where it can be detected. Despite the fact that the electron beam can be destroyed by the target it still can be used as a supplementary monitor in addition to the main diagnostics.

Conventionally, the beam size can be extracted directly from the OTR images, however with this approach the resolution is limited to only a few micrometers which is not sufficient for future high energy machines such as CLIC or ILC. It has been shown [1] that the resolution can be dramatically increased by analyzing spatial properties of the OTR vertical polarization. This method was firstly developed and tested at the Accelerator Test Facility 2 (ATF2) in KEK in 2011. Later, during the operation in 2013 this beam profile monitor has successfully demonstrated the ability to measure the beam size of less than one micrometer. At the same time it has been proved experimentally [2] and by simulations [3] that the performance of the optical system directly affects the quality of the beam size measurements.

In order to minimize the effects caused by the optical system and push the resolution of the measurements even further the whole experimental setup has been recently upgraded. The main feature of this major upgrade, developed in collaboration between CERN, John Adams Institute and KEK, is inserting the main optical element (first focusing lens) into the vacuum, as close as possible to the target, in order to minimize aberration effects.

In this report we will present the current status of the experiment, discuss recent experimental results and future plans.

References

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