BEAM PROFILE MEASUREMENTS WITH THE 2-D LASER-WIRE AT PETRA*

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Abstract

The current PETRA II Laser-Wire system, being developed for the ILC and PETRA III, uses a piezo-driven mirror to scan laser light across an electron bunch. This paper reports on the recently installed electron-beam finding system, presenting recent horizontal and vertical profile scans with corresponding studies.

INTRODUCTION

Laser based beam profile monitors and in particular the laser-wire (LW) have proven to be the only way to measure electron (or positron) bunch profiles when several factors might limit the usability of traditional profiling methods such as wire scanners or screens. For example, when spot-sizes to be measured go below the micron scale [1], or the bunch current or energy become too high and a physical wire will be destroyed. Furthermore, LWs are also essentially non-invasive.

The principle on which the LW is based is the inverse Compton scattering produced in the collisions between electrons and laser photons. By counting the number of Compton scattered photons produced as a function of the laser position, it is possible to reconstruct the spatial electron distribution. Several aspects (and limits) of the LW are being considered, such as the achievable resolution [1], speed [2] [3], but most important, its reliability as an electron beam diagnostics tool.

We describe here the upgrade of the 1D (vertical) LW tested previously at PETRA [4] to a 2D bunch profiler, where the laser can be sent to collision in either the horizontal or the vertical direction alternatively. In this paper we describe the major upgrades and differences with the previous 1D scanner.

2-D SCANNER FEATURES

The experimental setup of the 2D LW is shown in Fig.1. The high power laser is installed in a laser-lab connected through a pipe with the accelerator tunnel. The laser beam is transported from the source to the vertical breadboard by means of a two-lens relay system which conjugates the images of the laser beam in two different positions: 3m before the first lens and 6m after the second.

Once in the tunnel, the beam is first expanded to approximately 30 mm diameter and collimated by a telescope (in order to obtain the tightest spot-size at the interaction plane) and then sent to a motorized flipper mirror which acts as a remotely controllable path selector. Depending on the flipper mirror position, the laser beam is driven to a different scanning arm, vertical profiler

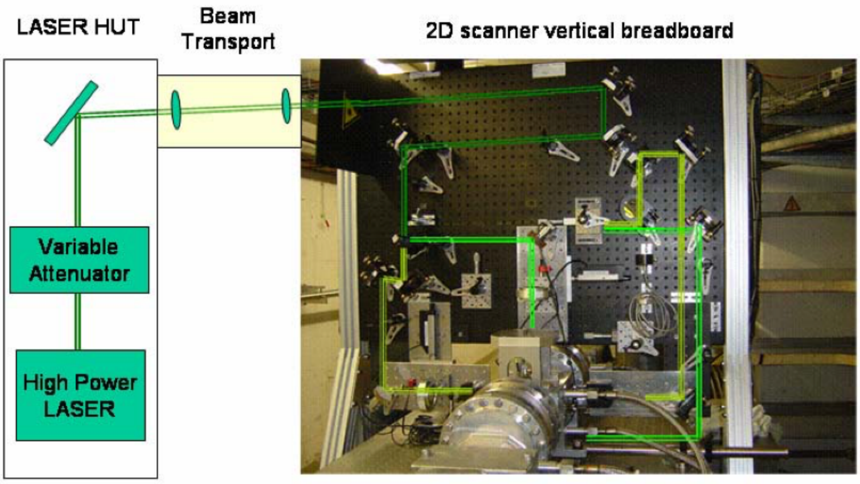

Figure 1. Representation of the LW experimental setup. The laser light is transported from the lab to the vertical breadboard using a relay imaging system. The two different paths (VP and HP) are traced using different colours.

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