# Laser test stand for double-sided silicon microstrip sensors*

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## Introduction

A test stand based on an infrared laser was set up as a tool for tests and verifications of double-sided silicon strip detector modules. It can be used to study prototype assemblies with silicon sensors. Furthermore, it can be used to test front-end chips for timing, pile-up behavior and rate capability. This test stand is planned to be used for quality assurance tests of modules of double-sided silicon microstrip sensors for the $\overline{\text{P}}$ANDA Micro-Vertex-Detector (MVD) [1]. Systematic and reproducible tests can be done in order to verify the full functionality prior the integration in the detector. A laser test stand enables a variety of test options while being more flexible compared to test beam times at accelerator facilities.

## Laser Test Stand

The system is build around a laser with a wavelength of 1060 nm. Light of this wavelength has an attenuation length in silicon in the order of 1 mm, therefore electron-hole-pairs are created nearly uniformly inside a sensor with a thickness of several 100 $\mu$m. Together with the short pulse length of less than 200 ps (FWHM) it emulates the signal generation of a charged particle crossing a silicon detector. The external triggering of the laser with a jitter better than 40 ps and a minimum time difference of 12.5 ns between triggers allows measurements for time resolution and pile-up behavior. The intensity of the laser can be adjusted, which relates to different energy depositions. A micro-focus optic at the end of the single-mode optical fiber allows a minimum beam diameter of 10 $\mu$m. The laser is moved via an x-y-stage with a travel of 100 x 100 mm$^2$. It features position accuracy and repeatability better than 1 $\mu$m. An additional device allows the manual adjustment of the z-axis for focusing the laser on the sensor. The movement of the x-y-stage and the triggering of the laser is software controlled. The readout of the detector modules employs the same VME FPGA-based DAQ system [2] that is used for lab tests with radioactive sources and test beam times. Figure 1 shows a photograph of the test stand studying a double-sided silicon microstrip sensor bonded to APV25 front-end chips [3].

Figure 1: The picture shows the setup. The working area with the laser and the x-y-stage is housed in a light tight box lined with black foil. The rack below comprises laser driver, controller of the x-y-stage and auxiliary components. The readout components can be seen on the right.

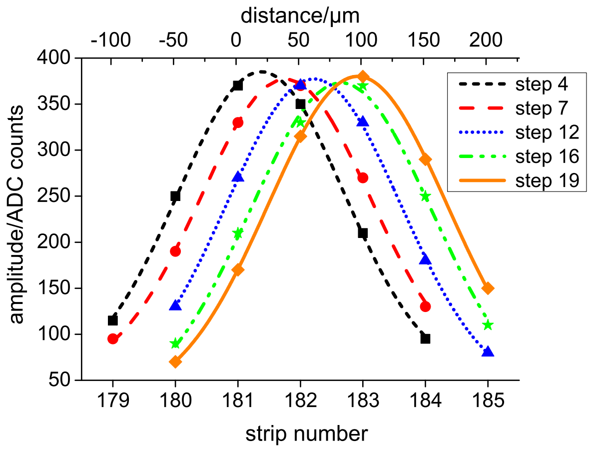


Figure 2: The plots shows the induced charge into different strips of a sensor with 50 $\mu$m strip pitch for various positions of the laser. Each curve illustrates the signal distribution in the strips at one position. Several steps with a step size of 5 $\mu$m were performed.

## References

[1] $\overline{\text{P}}$ANDA Collaboration, arXiv:1207.6581v2 [physics.ins-det], November 2011.

[2] R. Schnell et al., JINST 6 (2011) C01008.

[3] L. Jones, "APV25-S1: User guide version 2.2", RAL Microelectronics Design Group, (2001).

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