1. Introduction

The Laser Beam Stabilization *Compact* is a modular system. The most commonly used 4-axes system consists of a controller, two Piezo-driven mirror mounts (e.g. *P2S30*) and two position detectors (e.g. *Si-4QD*). Due to its modularity, it is possible to realize different setups with the advantage that the system can be easily integrated into existing laser setups. According to our experience, there is always a suitable solution to place the components. In this paper, we describe the most common configurations that are used in many different applications.

The detectors can be placed behind high reflective mirrors. Since they are very sensitive, they can work with the leakage behind the mirrors. This has the advantage that no further components have to be inserted into the beam path. However, it is also possible to use a glass plate or a beam splitter in the beam path to direct a reflection to the detector. This can be necessary, for example, for laser beams with larger beam diameters. The transmission of the Piezo-driven mirrors is possible for lasers with beam diameters of up to approx. 10 mm.

2. Setup configurations

The following examples refer to the 4-axes system with two Piezo-driven mirrors and two detectors. They can be applied for a 2-axis system with the change that the second Piezo mirror ("actuator 2") and detector 2 are not used in similar configurations.

2.1. Standard setup

Figure 1 shows a typical 4-axes setup of the system. We recommend this setup in most cases. Here, the laser beam first hits the first Piezo mirror and then a Piezo mirror / detector combination. The last system component in the setup is detector 2, which is placed behind a mirror.

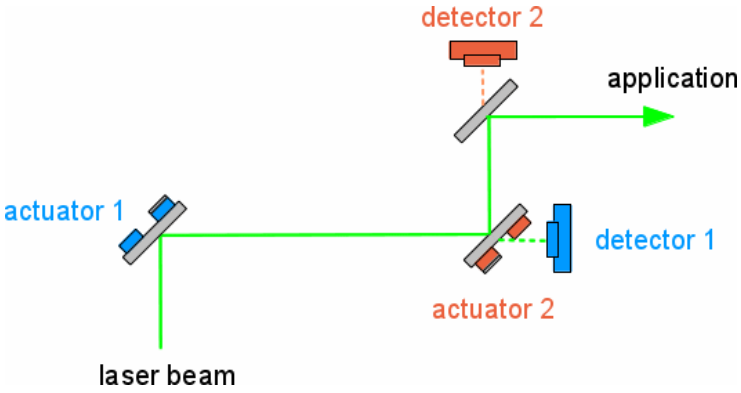

Figure 1: Standard setup for stabilization of a laser beam in position and direction.

2.2. Setup for large beam diameters

For laser applications where the beam diameter is larger than the sensor area of the detector we recommend the use of lenses for beam size reduction in front of the detectors. In general, the reduction of the beam size by the lenses should only be made as small as necessary. An exception is the case described in section 2.3, where the lens in front of detector 2 is used for angle discrimination.*

A typical setup for large beam diameters is shown in figure 2. The main difference to the standard setup, besides the lenses, is that detector 1 is now not in transmission behind the Piezo mirror labelled with actuator 2. This can be necessary because for large beam diameters the free aperture of the Piezo mirror may be too small, or in case of mirrors larger than 1 inch. In the latter case the design of the mirror holder does not allow a transmission. Then the detector can simply be placed behind another mirror or a beam splitter. It should be placed as close as possible to actuator 2 in the beam path.

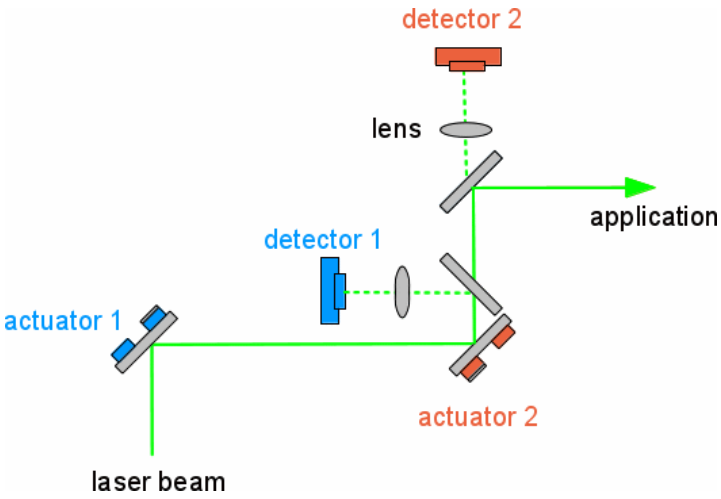

Figure 2: Configuration for large beam diameters.

2.3. Setup for short distances

If the distances between the Piezo mirrors and the associated detectors are relatively short, it can be advantageous to use the second detector to specifically detect the deviations of the beam angle. This can be achieved by using a lens. Figure 3 shows this setup configuration. Detector 2 is placed in the focus of the lens. Since the lens transfers angular deviations of the beam to position changes of the focus spot, the detector can detect the angular deviations with highest resolution.

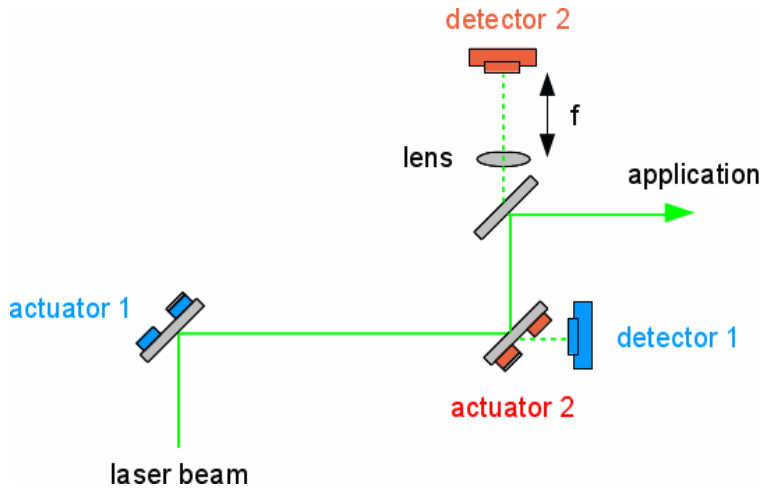

Figure 3: Modified setup with a lens for angle discrimination in front of detector 2.

The associated actuator 2 compensates for these deviations. Thus, the system ensures perfect correction of position errors via the actuator / detector pair 1 and angular stabilization via the actuator / detector pair 2. The focal length of the lens can be e.g. f = 200 mm. It should in any case not be too short, so that the focus spot on the detector does not become too small.*

2.4. Setup with a „combi detector“

Our modular system with individual detectors also allows a setup configuration, which we call a combi detector setup. In this case, both detectors are placed together behind the same mirror or beam splitter. This can be advantageous in certain applications where it may not be possible to place detector 1 close to actuator 2. The configuration is shown in figure 4. Both detectors are placed behind the last mirror in front of the application. At this location they detect the beam position and angle. The lens in front of detector 2 is used for angle discrimination as shown in section 2.3.

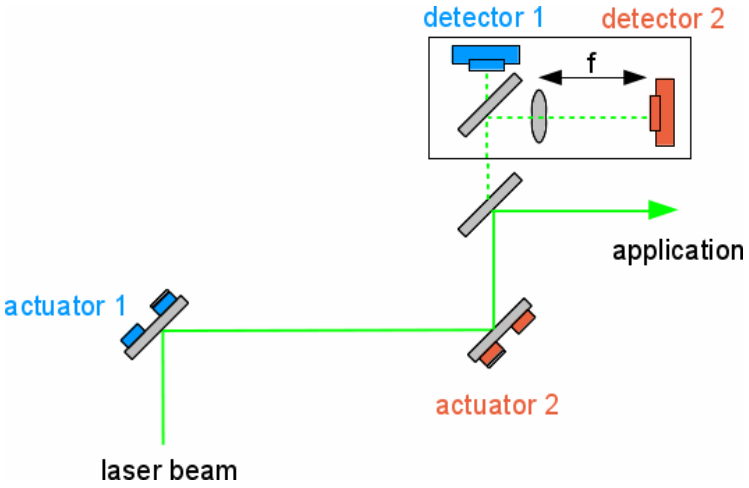

Figure 4: Combi detector setup. Both detectors are placed behind the same mirror in the setup. The lens in front of detector 2 is used to detect the beam angle.

2.5. Setup for two laser beams

Our *Compact* controller has two independent control stages, each for one Piezo mirror and one detector. Since the control stages do not influence each other, they can also be used to stabilize two laser beams independently. It is thus possible to stabilize the beam position or the beam angle of the two beams with one *Compact* system. The 4-axes system is thus used as a double 2-axes system. A schematic setup is shown in figure 5.

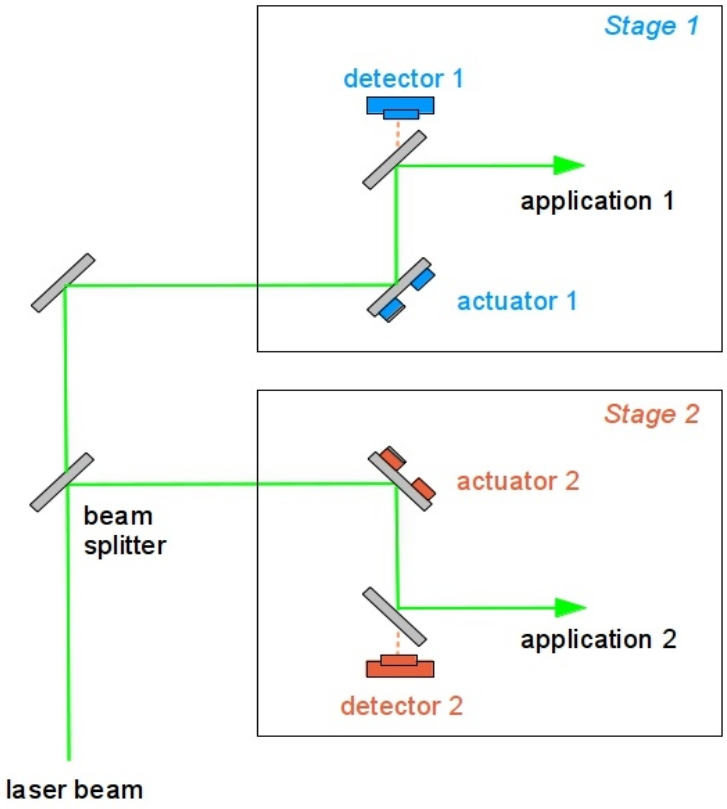

Figure 5: Setup for an independent stabilization of two laser beams with a 4-axes system as a double 2-axes system.

* Further notes and information on the setup configurations with lenses can be found in our white paper "Optimization of the setup with lenses".

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