Notes about the Lab AO

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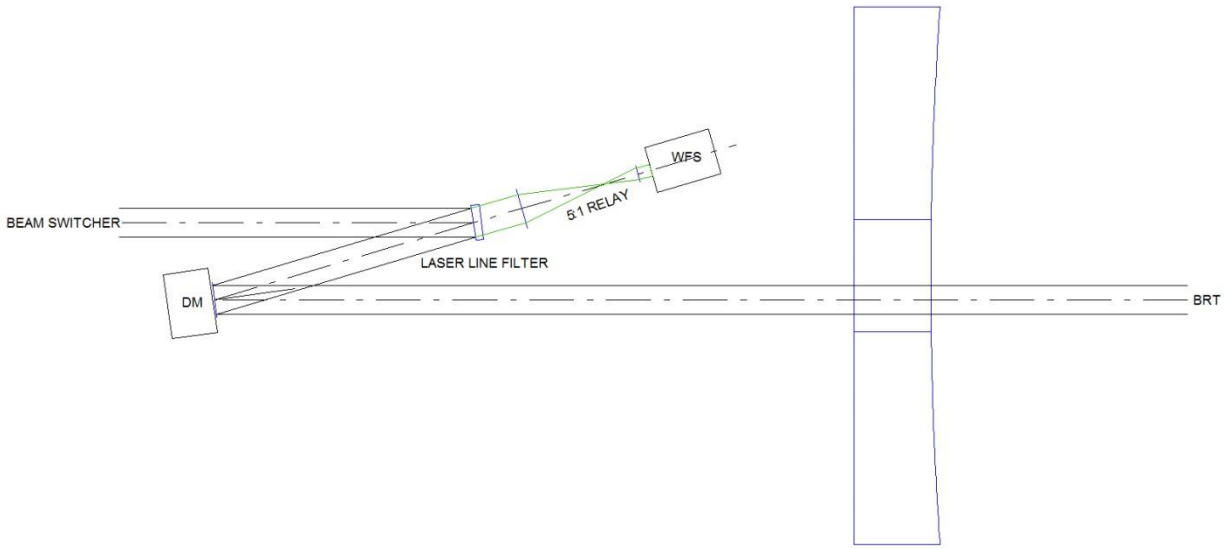

The DM is usually put in pupil plane thus as long as the pupil is stable, the beam footprint is also stable on it. This makes the calibration of the WFS-DM also stable and the wavefront correction the best. In our case however, a pupil plane after the BRT is 3-10 m in front of the BRT primary depending on the telescope and the configuration of the array and changes during observation. The lateral position of the pupil also changes a few percent of the beam diameter as the cart moves on the rails. It would be possible to put the DM in pupil plane at the cost of more complex optics/mechanics which is not worth it.. Thus unless we implement a pupil stabilizing system, we have to live with the fact that the pupil will move a lot axially and a little laterally with respect to the DM. In light of this, let's put the DM to a convenient place right behind the BRT primary.

Since the wavefront aberration is stable along the beam from the pupil to the DM the axial position of the DM is not critical in this respect. However, the angular magnification is 53.3x after the BRT, thus when the pupil is 10 m from the DM, then 1 arcsec pointing error on the sky corresponds to 2.5 mm beam shear on the DM. Assuming that the tip/tilt is locked, the expected beam shear due to pointing uncertainties will be much smaller than 2.5 mm. The effect of lateral beam wandering on the DM is that the wavefront correction gets worse. This is because the DM is controlled with the assumption that the beam is where it was when the DM-WFS system was calibrated and that is no longer true. However, as long as the beam wandering is comparable or smaller than the inter-actuator distance on the DM this calibration error may be tolerable.

The angle of incidence on the DM is ~10°. After reflection on the DM, the laser beacon part of the beam is transmitted through a splitter while the rest is reflected toward the beam-switcher. The beam path is shifted by 40-50 mm, so the beam-switchers will have to be shifted. Behind the laser line filter is a telecentric relay pair to match the beam to the lenslet array and also to conjugate the lenslet array and the DM. If the lenslet array and the DM are conjugate, the position of the centroid of the S-H pattern on the WFS is proportional to the beam position on the DM. This signal could be used to tilt the cart secondary to stabilize the beam on the DM if needed.

OKOtech (www.okotech.com) sells complete AO systems (DM, driver, WFS, software, computer) based on different DMs including a 30 mm 39 actuator membrane DM which looks ideal for us. Info has been requested.