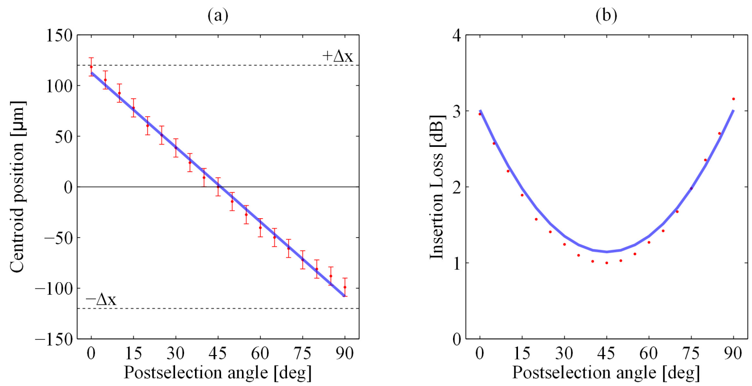

Fig. 4. (a) Measurement (dots) of the beam's centroid position as a function of the postselection angle β. The solid line corresponds to a linear fit given by $\langle x \rangle = -2.45\beta + 113\ \mu m$ with correlation coefficient $R = 0.998$. (b) Measured insertion loss (dots) and theory (solid line) obtained from Eq. (4) with $\Phi = 54^\circ$ as fitting parameter.

sponds to a linear fit given by $\langle x \rangle = -2.45\beta + 113\ \mu m$. The correlation coefficient of the linear fit ($R = 0.998$) indicates that our device exhibits a linear response over the interval $0^\circ \leq \beta \leq 90^\circ$. The minimum beam shift is limited by the angular resolution achievable when selecting the output polarization. As an example, if a rotation stage with resolution of 10 arcmin is used to select the output polarization, a beam displacement of 400 nm can be obtained since the sensitivity of our device is 40 nm/arcmin (2.45 μm/deg). If we compare this result with other commercial alternatives, such as the Edmund Optics plate beamsplitter #49-684, that provides a sensitivity of $\approx$ 360 nm/arcmin, or the Thorlabs tweaker plate XYT-A, with sensitivity $\approx$ 200 nm/arcmin, we observe that our device compares favorably since beam displacements with steps eight and five times smaller, respectively, can be obtained when using the same rotating stage to rotate the parallel-plane plate. In Fig. 4(b) we show the measured (dots) and theoretical (solid line) insertion loss, given by Eq. (4) for $\gamma = 0.96$ and the fitting parameter $\phi = 54^\circ$, which corresponds to a difference in optical path of $\sim 0.094\ \mu m$, mainly due to misalignment. The maximum insertion loss in this region is $\sim$ 3 dB.

4. Conclusions

We have demonstrated a low-loss tunable beam displacer based on the concept of weak value amplification that allows to displace the centroid of a beam with very high sensitivity. Interestingly, the relationship between the beam's centroid shift and the output polarization is linear, and the sensitivity of the beam displacement is limited by the sensitivity available for selecting the output polarization. The presented experimental setup allows to shift the centroid of a Gaussian beam with a beam waist of $\sim 600\ \mu$m, over an interval that goes from $-120\ \mu$m to $+120\ \mu$m in steps of 80 nm. Interestingly, we achieve the sough-after beam displacement without the need to deflect the optical beam with movable optical elements.

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