PRACTICAL COLLIMATION FOR SINGLE-MODE, PM AND MULTIMODE FIBERS.

Schäfter+ Kirchhoff ships all collimators prealigned and collimated for either a specific wavelength defined by the customer or a typical wavelength. The collimation is performed using professional collimating telescopes.

Please note: The fibers used in this adjustment procedure are all equipped with an end cap when aligning for wavelengths ≤ 520 nm.The adjustment wavelength is given on the label for each collimator/coupler. If a fiber with end cap was used it is marked by "EC".

However, it might be necessary for a customer to readjust the collimating setting and collimate for another wavelength or simply readjust the collimation setting without having a professional collimating telescope at hand.

The following describes some tricks and tips for the collimation adjustment of single-mode, PM or multimode fibers. Please note that single-mode and PM collimation is significantly different than multimode collimation.

PRACTICAL COLLIMATION OF A SINGLEMODE OR PM FIBER

The collimated beam diameter $Ø_{beam}$ is a function of the collimating focal length f' and the numerical aperture NA of the single-mode fiber.

For a specified fiber NAe^2, the beam diameter $Ø_{beam}$ (defined at its $1/e^2$-level) for a focal length f' is given by:

$$\emptyset_{beam} = 2 \cdot f' \cdot \mathrm{NA}_{e^2}$$

COLLIMATION COMPARING BEAM DIAMETER SIZES

To check and align the collimation setting of the fber collimator, couple a radiation source of appropriate wavelength into the fiber collimator. Direct the beam to a target about half a Rayleigh length z_R away:

$$\frac{z_R}{2} = \frac{\pi \cdot \emptyset^2_{beam}}{8 \cdot \lambda}$$

Here λ is the optical wavelength and $Ø_{beam}$ the collimated beam diameter ($1/e^2$ level).

When correctly collimated, the laser spot diameter on a target about $z_R/2$ away must have approximately the same diameter such as the beam directly behind the fiber coupler. Additionally, make sure that there is no focused spot between the fiber coupler and the target at $z_R/2$.

Please note: For fiber collimators with a focal length f‘ > 30 mm it is best to use a shearing interferometer.

PRACTICAL COLLIMATION OF MULTIMODE FIBERS

MINIMAL BEAM DIAMETER AT THE COLLIMATING LENS

In case of a multimode fiber, a collimated beam has its smallest diameter right after the collimating lens. From this point on, the spot diameter increases linearly with distance to the lens. The divergence θ depends on the core diameter $Ø_{core}$ and the collimating focal length f‘:

$$\theta = \frac{\emptyset_{core}}{2f\prime}$$

The collimated beam diameter is

$$\emptyset_{beam} = 2 \cdot f\prime \cdot NA$$

.NA is the multimode fiber NA.

SPECIFIC BEAM DIAMETER IN DISTANCE D

In some cases it might be more practical to focus the beam in a specific distance D from the fiber collimator, rather than to collimate the beam. A convinient distance D is:

$$D \approx 2 \cdot \ f'^2 \frac{NA}{\emptyset_{core}}$$

When focussing to this distance D, the core diameter $Ø_{core}$ is imaged to a spot that has approximately the same size such as the collimated beam right after the fiber collimator.
This is a printout of the page
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