# Adjustment of an MDT Element as Beam Shaper

## Pre-Adjustment

Before obtaining a flat-top it is recommended to make a pre-adjustment to watch the so called “Poggendorff Rings” (fig. 2) that appear in case of internal conical refraction. First it has to be ensured that the MDT element can be fine adjusted with micrometer screws in the vertical and horizontal plane.
The beam shaping MDT element has to be pre-adjusted with an input beam of small diameter.
It means that for pre-adjustment the incoming beam diameter should be at minimum 20% (in best case about 10%) of the diameter that is required for flat-top generation. The divergence should be as small as possible.
For adjustment and also beam shaping the input beam must be depolarized or circular depolarized (i.e. with help of a λ/4-plate).
To get a small input beam diameter you can use a pinhole or also a lens (fig. 1 and 2). Using a lens you must ensure that the Rayleigh length of the focussed beam is at minimum (recommended) two times bigger than the crystal length. Also a combination of pinhole and lens may lead to good results. A second lens with small focal length behind the MDT crystal can be used to magnify and transfer the resulting beam profile onto a screen (fig. 1 and 2).
For detailed information of the pre-adjusting procedure please read the following chapters.

## Pre-Adjustment in more Detail

1. All components are installed like in fig. 1. Notice that this setup is only one example. For example the λ/4-plate must be removed if your laser source is depolarised or the lens can be replaced by a pinhole or the screen and lens can be replaced by a CCD detector system (see also chapter “Pre-Adjustment” from above).

2. Assumed that the crystal is not adjusted one will see two light spots onto the screen. Rotation of the λ/4-plate will change the intensity of one light spot.
The λ/4-plate must be rotated as long as this spot reaches its intensity maximum.

3. The crystal is rotated in the horizontal plane as long as the mentioned light spots lie onto a vertical axis (fig. 1).

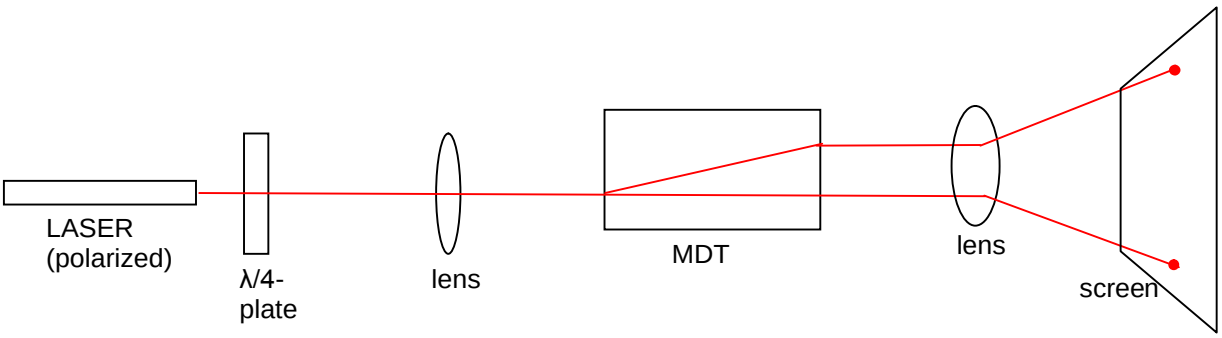


*Fig. 1: Example of pre-adjustment for beam shaping in case of visible laser radiation.*

4. The MDT crystal is rotated vertically so that both spots come closer to each other and finally build – quite quickly – two interacted light rings onto the screen (fig. 2). To see this effect the adjustment must be done with a precision of at least ± 0.2°.

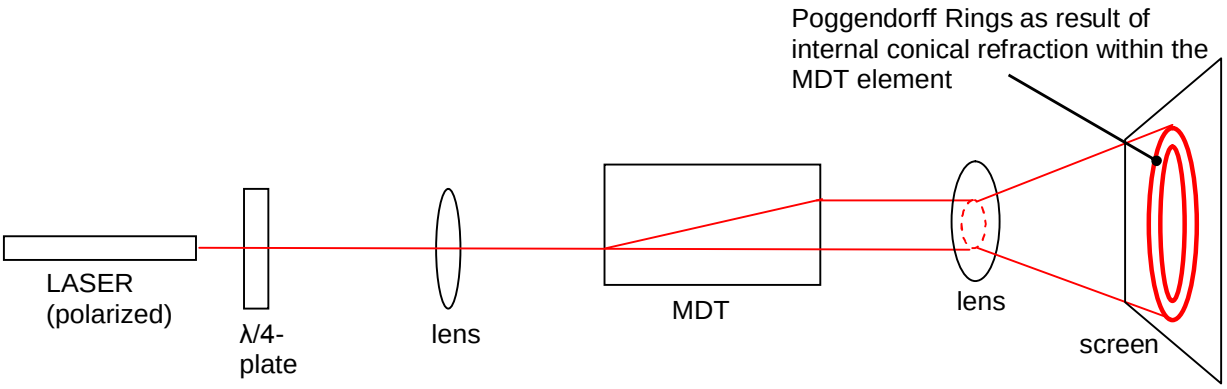


*Fig. 2: Two interacted light rings can be watched onto a screen as result of a MDT element which is a orientated and adjusted for the effect of conical refraction.*

5. The lens behind the MDT is moved in small steps along the beam axis so that the mentioned light rings can be seen as sharp as possible.

6. The λ/4-plate should be readjusted as long as the intensity distribution within the light rings is homogeneous.

## Final Adjustment for Flat-Top Generation

After the pre-adjustment all additional optical components in front and behind of the MDT have to be removed, except the λ/4-plate if you are working with a polarized laser beam. Up to here don't change the position of the MDT !
Behind the MDT you have to place a CCD camera to watch the beam profile.

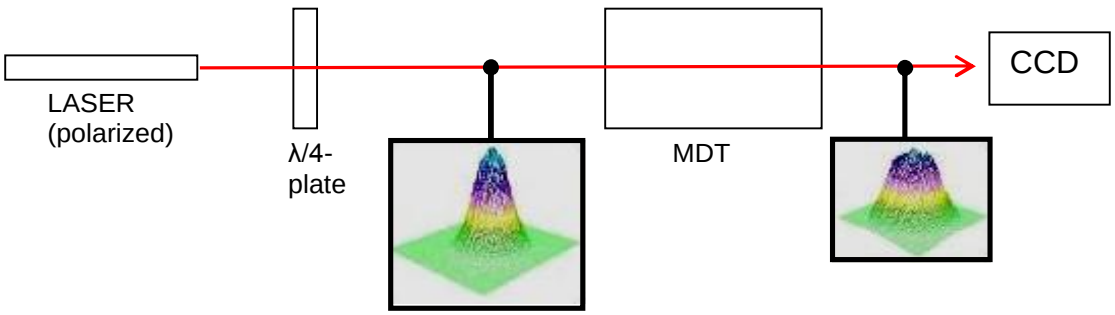


*Fig. 3: Flat-Top generation with one single MDT element*

Now tilt carefully the MDT only with help of micrometer screws in the horizontal and vertical position as long as your CCD cam quite suddenly sees a homogeneous flat-top beam profile. The required precision of adjustment is approximately 0.1 °.
If the quality of the resulting flat-top is not satisfying, although the MDT is well adjusted, you have to move the MDT in direction or away from the laser source in order to adapt the diameter of the incoming beam (which is always a bit divergent) to the MDT length. It means that on the entrance facet of the crystal you should have the required diameter of the incoming beam, which is written on the delivery receipt, quotation or also bill.
Also the distance between MDT and CCD cam is important to watch a flat-top of good quality.
Just play a bit with the distance “MDT-CCD” to optimize the flat-top profile.

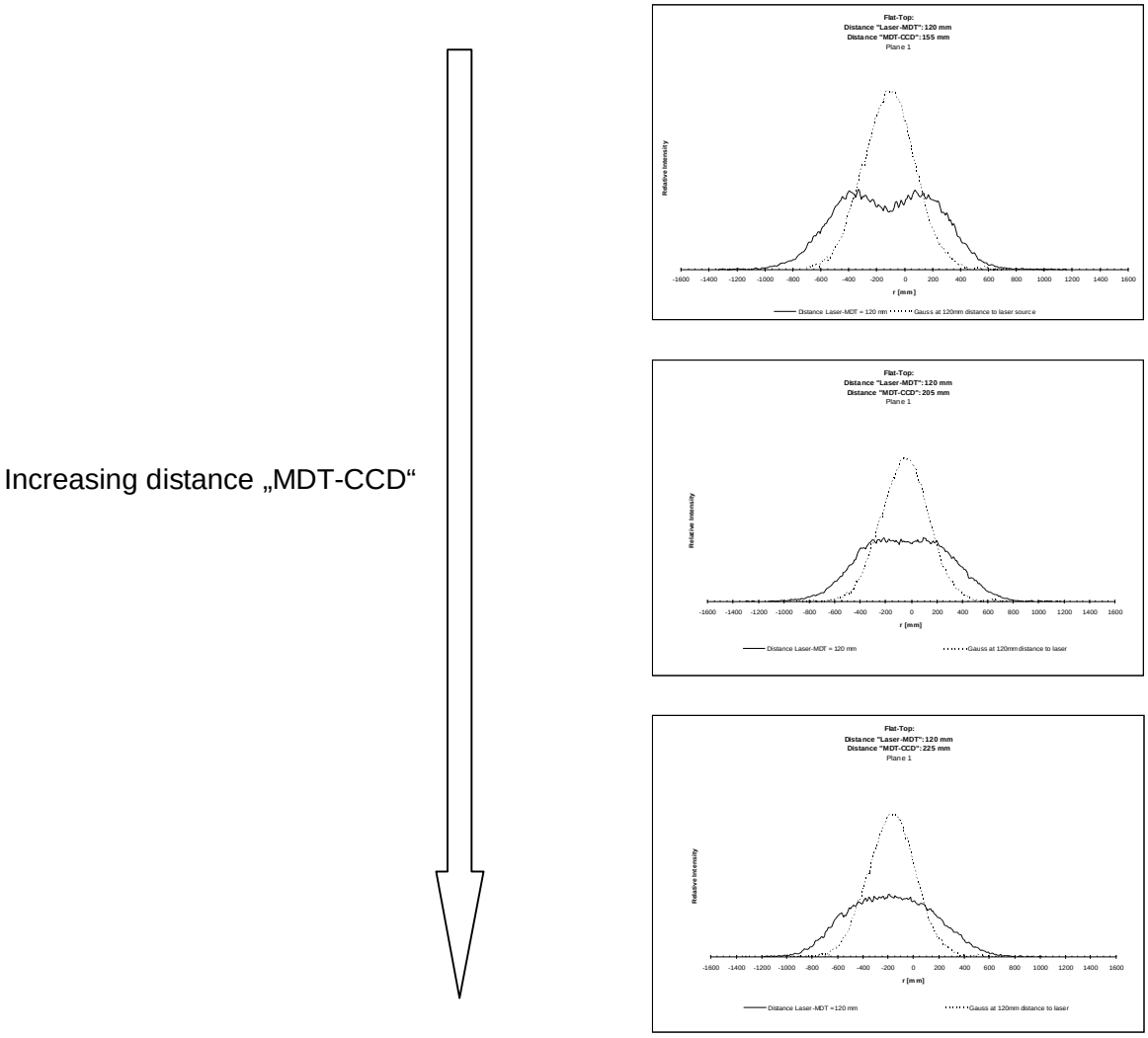


*Fig. 4: Resulting beam profile at different distances to the MDT exit facet*

***Note:***
- ***Beam shaping (and also conical refraction) only works well with depolarized or circular polarized monochromatic radiation.***
- ***For each wavelength and diameter of the incoming beam a well defined length of the MDT element is required to achieve a flat-top. Therefore you cannot use one MDT for different wavelengths or diameters of the input beam.***