

Optical adjustment of free space single gap THz-Antennas

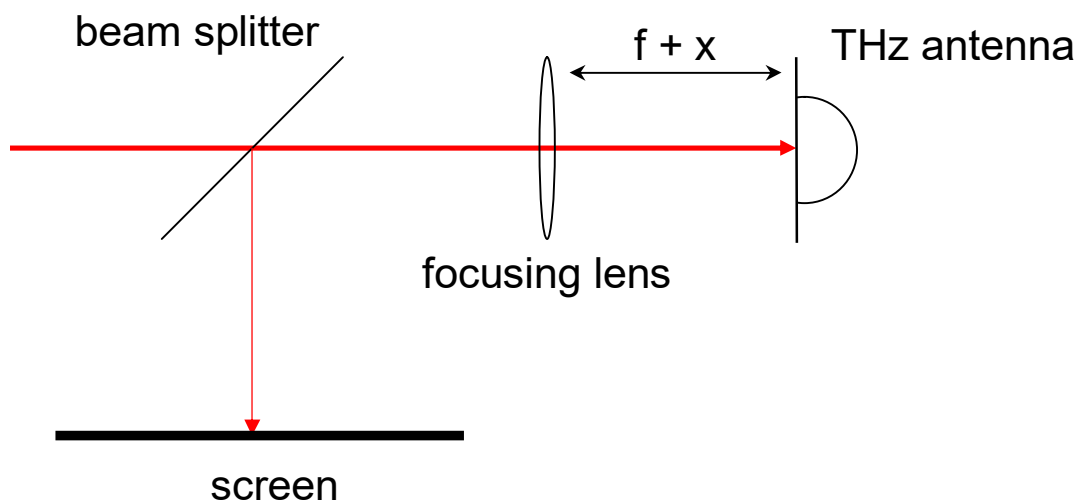
It is very important to illuminate the correct spot of the THz antenna structure to ensure a good THz signal.

3 steps have to be carried out to do a perfect alignment.

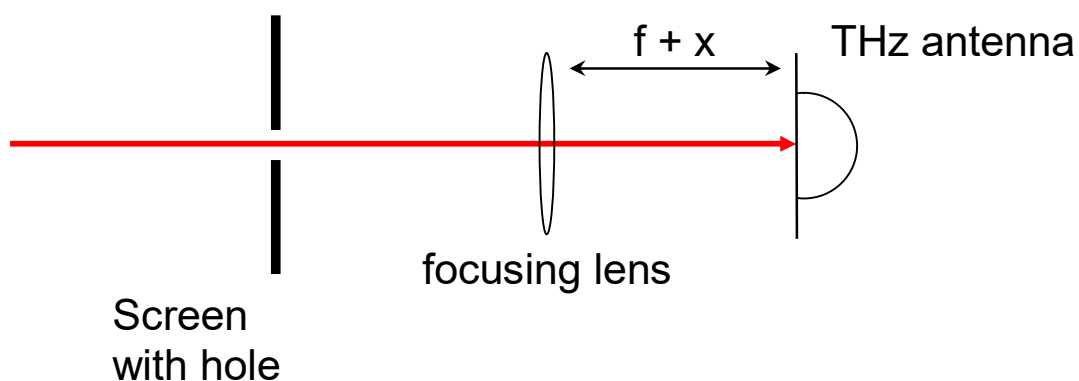
1. Use a reflected image of the PCA structure to find the gap
2. Minimize the antenna resistance
3. Maximize the THz-Signal

1. Get an image of the PCA structure

An image of the antenna structure formed by the reflected light can be achieved by the use of a beam splitter (e.g. thin glass plate) in front of the focusing lens. The lens has to be shifted a small distance x away from the antenna chip to get this image.



An alternative set-up using a screen with a hole for the laser beam is shown below:



According to the thin lens formula $\frac{1}{f} = \frac{1}{S1} + \frac{1}{S2}$ the image will be visible on a screen in a distance $S2$ from the lens. (f – focus length, $S1$ – object distance, $S2$ – image distance)

$$S2 = \frac{f(f + x)}{x} \text{ with } S1=f+x$$

The magnification M of the image is determined by the focal length f and x as well.

$$M = \frac{S2}{S1} = \frac{f}{x}$$

Example:

Imagine an antenna structure with a $5\mu\text{m}$ wide gap. The antenna is illuminated through a lens with 10mm focal length. To see the gap structure a magnification of 20 is favoured. The lens has then to be shifted $f + 0.5$ mm away from the antenna chip. The image will appear at $S2 = 210$ mm in front of the lens.

When the image is visible on the screen the laser spot has to be directed exactly into the gap area of the PCA. The position can always be checked on the screen.

2. Measure the resistance of your PCA

After the laser spot hits the right position the lens must be shifted back to the original position $S1 = f$ so that the focus is on the chip surface. Afterwards the resistance of the antenna should be monitored. Minimizing the antenna resistance is the next step towards perfect alignment.

3. Maximize your THz signal

Once the minimum resistance is achieved a THz measurement can be started. A nice THz pulse should be already measurable. The alignment process will then be finished by the search for maximum THz signal strength.