Thin Lenses

Lenses have become a part of our everyday life: For short and long sighted people they make it possible to see a sharp image of the world, they are widely used in cameras and projectors, etc.

Goals: You know several methods to verify a non-linear relation between two quantities. Moreover you practise interpreting measured data with the help of spreadsheets.

Devices:

- Optical bench with measurement scale
- Light source
- Punched metal plate
- Different convex lenses
- Focussing screen

Procedure:

A Choose a convex lens. Write down its number and the nominal focal length.

B Sketch the punched pattern and measure some of its characteristic dimensions.

C Find an arrangement of the lens and the screen so that the image on the screen is as sharp as possible. Read the positions of the object (metal plate), the lens and the image (screen) from the scale.

Hint: You may assume that all three are centred on the riders.

D Measure the dimensions of the image on the screen. Refer to the lengths in B.

E Repeat the measurement for at least twelve different arrangements.

F Take a second lens and write down its number and nominal focal length. Find an arrangement where the image is formed by two lenses in series and read the positions of object, lens and image and the image's dimensions.

Analysis:

1. Draw the optical path for one of the measured arrangements to scale. Determine the focal length from this construction.
2. Calculate the focal length for this arrangement with the lens equation.
3. Graph the reciprocal value of the image distance vs. the reciprocal value of the object distance. Perform a linear regression. What is the physical meaning of the slope and the axis intercept? Calculate the focal lens from the axis intercept.
4. Show with a formal calculation that the product of object and image distance is proportional to their sum. Check this by graphing the two quantities in a diagram. Determine the focal length with the help of a linear regression.
5. Check the formula for the lateral magnification with your measured data.
6. Calculate the image distance and the image size for the setup in F from the object distance and the lenses' focal lengths. Compare the result to the measured values.

Requirements: If you do not write a report on this experiment, work at least on steps 1 to 3 of the analysis. The complete interpretation is required for a report.

Hand in your report or interpretation and the lab journal by Friday, 29 October 2010.