5. Description of Parts

5.1 Movement Measurement Holder

The revolving mechanism of this movement measurement holder is a drum-controlled precision lead screw to drive an adjustable slit to move. The central position of the slit can be read on a ruler scale with a pointer. An input optical tube and a tube for mounting a photo detector head are attached to the front and back of the slit, respectively. If the drum revolves one cycle, the slit moves by 1 mm; if the drum turns by one minimal scale, the slit moves only by 0.01 mm.

5.2 Photo Detector Head

A silicon photo cell is used as the photo detector for the measurement of diffraction intensity in this system. The spectral response range of the silicon photo cell is from 200 nm to 1050 nm.

5.3 Digital Photo Current Amplifier

This digital photo current amplifier is connected to the photo detector head through a XS12K3P connector. It is an easy-to-use digital instrument for relative intensity measurement. Measurement range can be selected by pressing down corresponding buttons. If a higher intensity is encountered, the amplifier will be saturated with "1" is displayed. Under such case, either reducing slit width or changing to larger range can bring it to a normal reading.

6. Experiment Examples

6.1 Observe Fraunhofer Diffraction Patterns of Single-Slit and Single-Wire

1) Insert the semiconductor laser head in the laser holder. Place the laser holder in a carrier and put them on the rail. Mount the movement measurement holder on the rail. Turn on the laser, and adjust the height of the laser head to let the laser beam be the same height of the tube on the movement measurement holder. Turn the drum to move the slit to an appropriate position and adjust the direction of the laser head, so that when the movement measurement holder is moved backward along the rail, the tube is always aligned to the optical input of the slit.
2) Place the adjustable silt on the X-translation carrier and put it behind the laser head on the rail. Put the white screen onto a carrier and place it at approximately 60 cm behind the slit. Once the slit is orientated vertically with a suitable width, a Fraunhofer diffraction pattern of the slit can be observed on the white screen as seen in Figure 5.

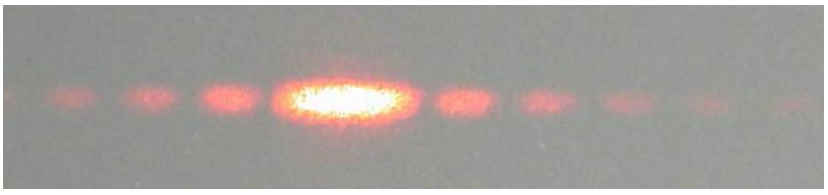

Figure 5 Fraunhofer diffraction pattern of a single slit

4) Further adjust the location of the slit to let the laser beam pass through the center of the slit.
5) Observe the diffraction pattern on the white screen. If necessary, adjust the direction of the slit to let the slit in vertical and the diffraction pattern is observed horizontally.

6) Adjust the width of the slit to make it comparable to the wires provided (between 0.05 mm and 0.2 mm). Make sure a clear diffraction pattern is maintained with different orders of diffraction appropriately separated.
7) Replace the slit with the wire plate (3 wires on it), select a wire and readjust the location of the wire. Observe the diffraction pattern of the wire on white screen and compare the two diffraction patterns.

6.2 Measure and Plot Diffraction Intensity Distribution of Single-Slit and Single-Wire

1) Remove white screen off the rail. Turn on the photo current amplifier. Turn the drum of the movement measurement holder to let the maximum diffraction intensity in the center enter the photo detector head. Then turn the drum slightly in either direction to move the slit left and right while monitoring the reading from the amplifier.
2) Record the location of the photo detector head from the ruler and the scale on the drum. In the meantime, record the value of relative intensity from the digital photo current amplifier.
3) Turn the drum in one direction in step of 10 minimal scales (corresponding to a slit movement of 0.1 mm), record the position of the slit with corresponding relative diffraction intensity read from the photo current amplifier until 0-2 order maximal and 1-3 order minimal diffraction locations are covered.

   (Note: it is normal to observe fluctuations from laser power output and/or detector current output. It is recommended to allow a warm-up time of 10 to 20 minutes for both laser and detector before use. In fact, if the fluctuations are less than 10%, the measurement of diffraction intensity is less affected.)
4) Measure and plot the diffraction intensity distribution of a single slit and its complement (single wire), respectively. Compare the two plots.

7. Safety and Handling lab Precautions

- Avoid direct eye exposure to laser beam to prevent serious eye damage caused by strong laser radiation
- The output beam from the semiconductor laser should never be directly incident onto the photo detector head as otherwise permanent damage may occur to the detector
- The photo detector head should never be directly exposed to light beams from a laser or any other strong light sources in close distances
- Never fully close the width of the single-sided adjustable slit as otherwise it may damage the edge of the slit blades