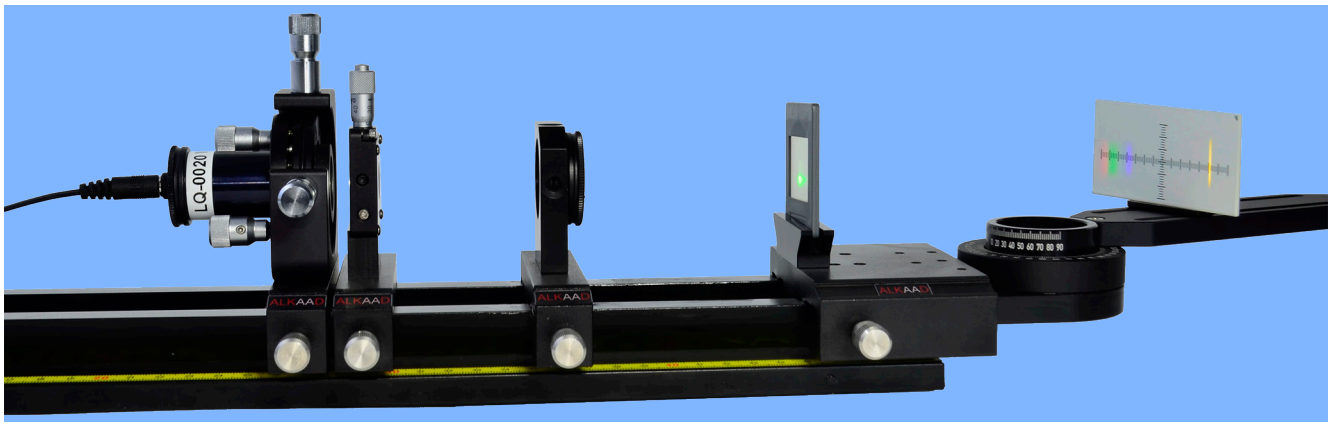
PE-0900 Diffraction Grating



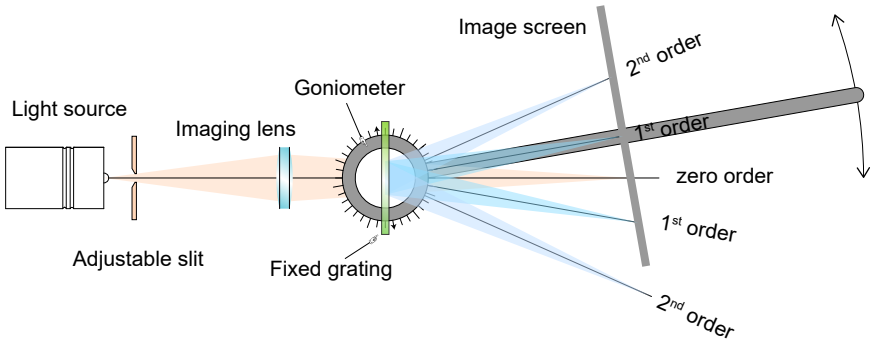
Keywords

Grating Constant
Reflection Grating
Diffraction Order
Amplitude Grating
Transmission Grating
Phase Grating,
Spectral Resolution

Introduction

Joseph von Fraunhofer, the investigator of the solar lines, invented the diffraction grating in 1821. This optical element showed a much higher dispersion than any glass prism and allowed Fraunhofer to investigate the solar spectrum in a resolution much better than ever seen before. Enormous quality improvement as well as optimization of the manufacturing technique of ruled gratings are the results of Henry Rowlands efforts in development of diffraction gratings. His gratings were used worldwide and were unbeaten in quality and resolution for decades. Nowadays holographic techniques using the interference of laser beams allow manufacturing gratings with larger grating constants and bigger size. The experiment comprises transmission gratings of different grating constants (lines per cm) a green laser with known wavelength of 532 nm and a white LED lamp emitting a variety of different spectral lines. The resulting interference pattern is imaged on a white screen with mm scale to measure the angle of the emitted light. Applying gratings with different parameter the resolution power is demonstrated. By using a mesh like two-dimensional grating impressive patterns of light spots are created and the analogy to the principles of x-ray diffraction on crystal lattices or atomic layers demonstrated.

How it works



The emitted radiation of the light source illuminates the adjustable slit. The image of the slit is projected by means of the imaging lens to the image screen which is fixed to the goniometer arm. After passing the grating the incident light is divided into multiple orders and the spectral distribution becomes visible as vertical bars (line), the image of the slit. The intensity of the image on the screen depends on the adjusted width of the slit. Closely neighboured lines may merge if the width of the slit is too wide. At this point the resolution comes into consideration and other gratings (1) with different grating constants are applied.

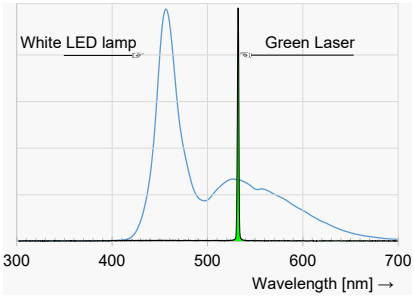


Fig. 4.44: Spectral distribution of the used light sources

Fig. 4.45: Spectral distribution of the white LED seen behind the grating

Two different light sources are used. One is a green emitting laser (2) with a very narrow spectral distribution and the other a white light LED (3) which emits a broad spectrum as shown in Fig. 4.44. A white and translucent screen () is provided to take impressive photographs of the created diffraction pattern. The Fig. 4.45 shows such a photograph. In the centre the zero order appears and symmetrical to it the ± 1st order. Moving the screen closer to the grating also the 2nd order appears, however, with much lower intensity. The green laser is used as wavelength reference (532 nm) to calibrate the setup for quantitative measurements.

Optics Experiments

PE-0900 Diffraction Grating consisting of:

Item	*Code*	*Qty.*	*Description*	*Details page*
1	CA-0040	1	Set of 5 transmission gratings	127 (8)
2	LQ-0020	1	Green (532 nm) DPSSL in ø25 housing	118 (1)
3	LQ-0200	1	White LED in ø 25 Housing	119 (6)
4	MM-0032	1	Mounting plate C30-V on carrier MG20	93 (5)
5	MM-0110	1	Translucent screen on carrier MG20	94 (10)
6	MM-0300	1	Carrier with 360° rotary arm	95 (20)
7	MM-0420	1	Four axes kinematic mount on carrier MG20	96 (24)
8	MP-0150	1	Optical Bench MG-65, 500 mm	93 (8)
9	MP-0220	1	White screen with XY scale on block	93 (9)
10	OC-0140	1	Achromat f=40 mm in C30 mount	99 (9)
11	UM-PE09	1	Manual Diffraction Grating	

Highlights

Basic experiment
Impressive images
Intended institutions and users:
- Physics Laboratory
- Engineering department
- Electronic department
- Biophotonics department
- Physics education in Medicine