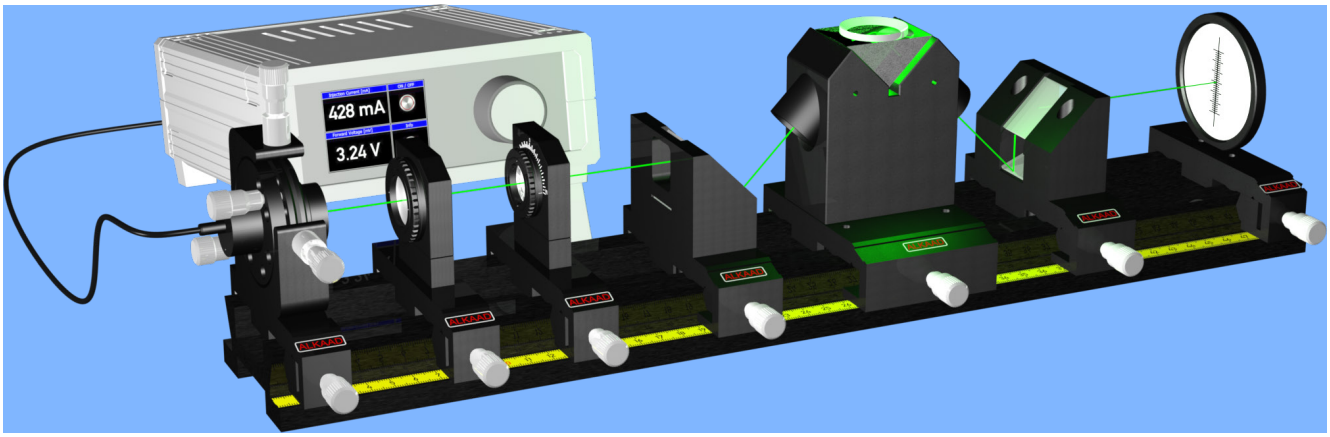
PE-0700 Abbe Refractometer



Index of Refraction
Dispersion
LED Beam Forming
Prism
Shadow Line
Polarizer
Total Reflection
LED Light Source
Refractometer

Ernst Abbe was not the first and not the only scientist who developed a convenient refractometer, but his refractometer is – in several varied and updated versions – the most widespread and most common refractometer nowadays. Although the refractometer have been replaced at the beginning of the 20th century by more specialised spectroscopic methods, it is still an important instrument for the purity control of liquids. Consequently the Abbe refractometer developed from an laboratory instrument in basic research to an indispensable monitoring tool in industry.
This experiments utilises an Abbe type refractometer. As light source a green LED is used for best eye sensitivity. Before the invention of LED, the standard yellow line of Sodium has been used. Due to the manifold of available wavelengths of the LED, ranging from UV to IR, many tasks can be performed in industrial manufacturing, chemistry and food industry. When placing drops of a test liquid on top of the prisms the shadow line of the light beam on the screen is shifted. From this value and the device parameter the index of refraction is calculated. Liquids with known different index of refraction are provided.

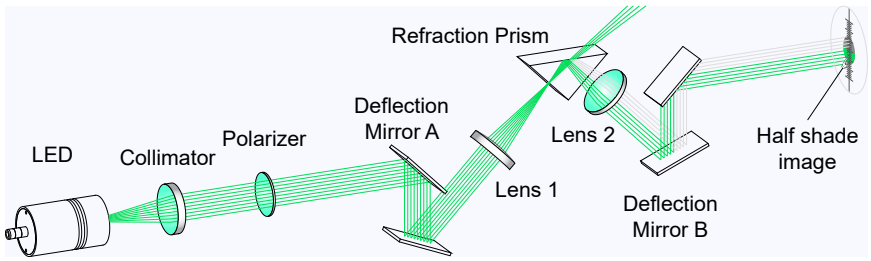


Fig. 2.36: Refractometer setup

The light of the green LED is collimated, polarized and guided by the deflection mirror (A) to the refraction prism via the lens (2). The lens (2) creates a divergent beam in such a way that the hypotenuse of the prism is illuminated under different angles of incidence. All rays having an angle of incidence greater than the critical angle of total reflection are leaving the prism, whereas the other are deflected and imaged via the lens (2) and the deflection mirror (B) to the translucent screen. Since parts of the beam are cut off, the initial round beam shows a clear dark area. The critical angle of total reflection depends on the index of refraction outside the prism. If a liquid or other optical transparent material is applied to the hypotenuse of the prism, this angle changes and with it the position of the dark / bright line of the half shade image, allowing the determination of the index of refraction of the applied material.

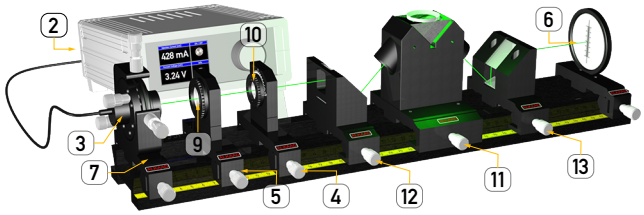


Fig. 2.37: Description of the components

The green emitting LED (3) is connected to the adaptive controller (2) which recognizes the type of the LED and automatically sets the operation limits accordingly. The emitted light is collimated by the achromat (9) to an almost parallel beam. The polarizer (10) is used to improve the contrast of the dark-bright line of the half shade image. The deflection mirror assembly (12) guides the light into the refraction prism assembly. It contains a lens to create divergent light. Another lens images the beam via the deflection mirror assembly(13) to the translucent screen (6). The test liquid (1) is applied to the top of the refraction prism. A ring shaped wall prevents spilling and can be removed for cleaning.

PE-0700 Abbe Refractometer consisting of:

Item	*Code*	*Qty.*	*Description*	*Details page*
1	CA-0010	1	Set of test liquids	
2	DC-0024	1	LED adaptive controller	
3	LQ-0220	1	Green LED in ø C25 housing	
4	MM-0028	1	Mounting plate C25-S with angle gradation	
5	MM-0030	1	Mounting plate C30 on carrier MG20	
6	MM-0110	1	Translucent screen on carrier MG20	
7	MM-0420	1	Four axes kinematic mount on carrier MG20	
8	MP-0150	1	Optical Bench MG-65, 500 mm	
9	OC-0140	1	Achromat f=40 mm in C30 mount	
10	OC-0710	1	Polarizer in C25 mount	
11	OM-0460	1	Refraction prism assembly	
12	OM-0462	1	Deflection mirror unit, left	
13	OM-0464	1	Deflection mirror unit, right	
14	UM-PE07	1	Manual Abbe Refractometer	

Highlights

Basic experiment

Intended institutions and users:
- Physics Laboratory
- Engineering department
- Electronic department
- Biophotonics department
- Physics education in Medicine