Coherence and width of spectral lines with Michelson interferometer

LEP 2.2.06

Related topics

Fraunhofer and Fresnel diffraction, interference, spatial and time coherence, coherence conditions, coherence length for non punctual light sources, coherence time, spectral lines (shape and half width value), broadening of lines due to Doppler effect and pressure broadening, Michelson interferometer, magnification

Principle and task

The wavelengths and the corresponding lengths of coherence of the green spectral lines of an extreme high pressure Hg vapour lamp are determined by means of a Michelson interferometer.
Different double slit combinations are illuminated to verify the coherence conditions of non punctual light sources. An illuminated auxiliary adjustable slit acts as a non punctual light source.

Equipment

Michelson Interferometer	08557.00	1
High pressure mercury vapour lamp CS 50 W	08144.00	1
Power supply for Hg-CS/50 W Lamp	13661.93	1
Optical profile bench, l = 100cm	08282.00	1
Base for optical profile bench	08284.00	2
Slide mount, h = 30 mm	08286.01	5
Lens holder	08012.00	3
Object holder 50×50 mm	08041.00	1
Swingin arm	08256.00	1
Barrel base -PASS-	02006.55	2
Stand tube	02060.00	2
Mounted lens f = 20 mm	08018.01	1
Mounted lens f = 200 mm	08024.01	1
Iris diaphragm	08045.00	1
Coloured filter, green, 525 nm	08414.00	1
Ground-glass screen 50×50 mm	08136.01	1
Diaphragm holder, attachable	11604.09	1
Measuring magnifier	09831.00	1
Slit, adjustable up to 1 mm	11604.07	1
Diaphragm with 4 double slits	08523.00	1

Problems

1. Determination of the wavelength of the green Hg spectral line as well as of its coherence length.
2. The values determined in 1. are used to calculate the coherence time and the half width value of the spectral line.
3. Verification of the coherence condition for non punctual light sources.

Set-up and procedure

Fig. 1 shows the experimental set-up to determine coherence and wavelength. The half opened iris diaphragm, set in a lens support, is situated directly before the light exit tube of the Hg lamp. The lens (f = 20 mm) and the green filter are placed about 30 cm from the iris diaphragm. Both components are together in the plug-on diaphragm support. The distance between the carrying plate of the interferometer and the lens is about 16 cm. The ground-glass screen, on which the interference pattern may be observed with the assistance of the f = 200 mm lens, is placed perpendicularly to the direction of the incident light beam. To start with, the two images observed

Fig. 1: Experimental set-up to determine coherence and wavelength of spectral lines.