Sodium Fluorescent Tube on a Panel

09084.00

Operating Instructions

1. PURPOSE AND DESCRIPTION

The Sodium (Na) Fluorescent Tube 09084.00 is used for determining the resonance absorption and resonance fluorescence of sodium vapour in the visible spectral region. The tube must be heated in order to obtain an adequate vapour density of the sodium for the experiment. This is achieved by placing it in the Oven 09085.93. The front panel is screwed onto the open front of the oven so that the deposited sodium is located in the **upper** part of the tube.

The tube panel and the back of the oven are both fitted with a viewing window so that the irradiation of the sodium fluorescent tube can take place in the oven itself, cf. illustration of experiment set-up.

Another viewing window on the side of the oven enables the resonance fluorescence to be conveniently observed.

2 OPERATION

2.1 General

The oven is connected to the 230VAC mains using the supplied equipment lead with its heat resistant plug; operation on direct voltage is not permissible. Further details can be taken from the operating instructions for the oven.

Note:

– If a complete Franck-Hertz Valve 09084.93 is available for which the same type of oven is used, the front panels can be interchanged, so that the Oven 09085.93 is not needed in this case.

– Maximum oven temperature is about 300°C. Be careful! The carrying handle becomes relatively hot!

– For safety reasons the temperature measurement should not be taken with a mercury thermometer, but instead with a Thermocouple (13615.02) and a Digital Temperature Meter (07030.00). The thermocouple is inserted through the opening at the top of the oven into the interior. The temperature measurement should be taken at about mid-height of the light beam with which the tube is irradiated in the experiment.

– It is recommended that a heat-protective plate is placed under the oven.

– When the tube is operated, sodium diffuses in the glass and becomes brown coloured. This process is accelerated by high temperature. It is therefore recommended that the tube is only operated briefly at temperatures over 150 °C. The service life of the tube at 250 °C is about 50 hours.

2.2 Examples of experiments

2.2.1 Sodium resonance fluorescence

The bright yellow fluorescent glow, which occurs when the heated tube is subjected to an intense light beam of a suitable wavelength (here: λ = 589nm), should be observed through the side window. To do this, a halogen lamp is fitted with a Pico 9 lamp holder. A sodium spectral bulb is then inserted and operated via the power supply for spectral lamps. The set-up corresponds to the left side of Fig. 2; in addition, however, a lens holder, fitted with an iris diaphragm, is mounted on the optical bench directly in front of the lamp. By adjusting the lamp condenser a parallel light beam is produced which can be limited to a diameter of about 2cm with the iris diaphragm. This light beam should irradiate the sodium fluorescent tube approximately at mid-height.

For the experiment to be successful an optimum vapour density should be obtained in the sodium fluorescent tube (by heating it in the oven at about 180 °– 200 °C) and the sodium spectral bulb should have reached its full light intensity (a burning time of about 10 to 15 minutes).

A bright yellow fluorescent glow emanates on all sides from the irradiated middle part of the tube. The contrast to the

surroundings can be improved by observation in a darkened room and by temporarily switching off the heating coil to avoid extraneous light.
At tube temperatures around 150 °C flickering is seen which can be traced to density variations in the sodium vapour.

2.2.2 Sodium resonance absorption

To observe the absorption spectrum of sodium vapour the halogen lamp is again fitted with the 50W halogen bulb and the experimental set-up extended as shown in Fig. 2 (the iris diaphragm between the lamp and the oven is not used). After passing through the oven, the light beam should illuminate a vertical slit (place a convergent lens f = 5cm between the oven and the diaphragm for a possible increase in brightness). The slit is then focused on a screen using a lens (f = 200mm). If a direct-vision prism is inserted into the path of the beam, the light is broken down into a continuous spectrum which exhibits a dark line (Fraunhofer line) instead of the sodium doublet (λ_1 = 588.99nm and λ_2 = 589.59nm). This is an extremely fine line which is only produced with the omission of two discrete wavelengths!
The intensity of the line increases with increasing temperature. At about 260 °C a clear line can seen in a darkened room. Only operate the tube briefly at this temperature.

Further literature:

Versuchseinheit Atomphysik 1	16150.01

Note:
Only remove the sodium fluorescent tube from the oven when it has cooled down to about 60 °C so that stresses in the glass due to temperature changes are avoided.

3 LIST OF EQUIPMENT

For sodium resonance absorption experiment:

Optical Profile Bench, l = 100 cm		08282.00
Base for Opt. Profile Bench	(2x)	08284.00
Slide Mount for Opt. Profile Bench, h = 30 mm	(5x)	08286.01
Oven without front panel		09085.93
Sodium Fluorescent Tube on Panel		09084.00
Halogen Lamp, 50W		08129.88
Thermocouple, NiCr-Ni, 500 °C		13615.02
Digital Temperature Meter		07030.00
Lens Holder		08012.00
Lens, Mounted, f = +100 mm		08021.01
Slit, Adjustable		08049.00
Holder for Direct-Vision Prism		08255.00
Direct-Vision Prism 30 mm x 30 mm		08252.00
Screen, Metal 30 cm x 30 cm		08062.00
Power Supply Variable, 15VAC/12VDC, 5A		13530.93
or		
Variable Transformer, 25VAC/20VDC, 12A		13531.93

For the sodium resonance fluorescence experiment:

Pico 9 Holder for Spectral Lamp	08129.03
Spectral Lamp, Sodium Pico 9	08120.07
Power Supply for Spectral Lamps	13662.93
Iris Diaphragm	08045.00