

## Fluorescent sodium tube on heater panel 1000913

### Instruction manual

10/15 ALF



- 1 Sodium tube
- 2 Front/heater panel
- 3 Viewing window

### 1. Safety instructions

Danger: risk of burns. The heater panel and viewing window can reach temperatures of up to 300°C during operation.

- Place the heater on a heat resistant surface.
- In order to move it when in operation, do not hold the heater except by its insulated handle.
- Allow the equipment to cool before dismantling the experiment.

### 2. Description

The fluorescent sodium tube is designed to demonstrate resonance fluorescence in sodium.

The highly evacuated, argon-filled glass tube, with multiple distilled sodium coating is mounted on a panel with a viewing window and is intended for operation with the heater for the Franck-Hertz experiment.

The entire tube lights up, emitting the yellow Na D line, when heated up and illuminated by light with the sodium spectrum. If however, it is illuminated by white incandescent light, the spectrum of the transmitted light exhibits a dark absorption line where the Na D line would be.

### 3. Technical data

|               |                      |
|---------------|----------------------|
| Dimensions:   |                      |
| Tube:         | 170 x 42 mm approx.  |
| Heater panel: | 230 x 160 mm approx. |
| Weight:       | 550 g approx.        |

### 4. Operation

#### Attachment of the tube to the heater

- Screw the heater panel with the tube to the heater itself using the six knurled screws.
- If you have the heater for the Franck-Hertz experiment, remove the front panel of the heater and screw on the panel with the sodium fluorescence tube in its place.
- Make sure that the tube is located about 2 cm above the heater element. If necessary, carefully push the tube up in its holder.



Fig. 1 Heater panel with sodium fluorescence tube attached to heater

### 5. Sample experiments

The following additional equipment is needed to carry out the experiments:

|  |         |
|--|---------|
| 1 Heater (230 V)                           | 1012820 |
| or   |         |
| 1 Heater (115 V)                           | 1006796 |
| or heater for Franck-Hertz experiment      |         |
| 1 Na spectral lamp                         | 1003541 |
| 1 Choke ballast for spectral lamps (230 V) | 1003196 |
| or   |         |
| 1 Choke ballast for spectral lamps (115 V) | 1003195 |

- All experiments are to be carried out in a darkened room.

#### 5.1 Demonstration of sodium resonance fluorescence

##### Experiment 1

- Set up the Na spectral lamp about 10 cm to the left of the heater, aligned with the viewing window on the left. Do not yet turn on the choke ballast.
- Turn on the heater and set it to a temperature of about 220°C.
- At a temperature of about 100°C, turn on the spectral lamp. It will reach full intensity after a few minutes.

From 180°C to 200°C mist-like movement inside the tube in the sodium light from the spectral lamp can initially be seen. The visibility of this "mist" increases as the temperature rises until the whole tube lights up with yellow sodium light.

Note 1: The ends of the metallic sodium reflector inside the tube will move during the course of the experiment. One thing that can improve the situation is to align the tube such that the end where condensation takes place is facing downwards. In that case, the sodium "mist" can be seen especially clearly at the top edge of the metallic coating.

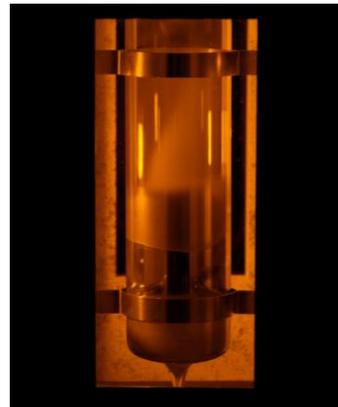


Fig. 2 Mist inside sodium light

## Experiment 2

- Set up the equipment as in experiment 1, but add a 50 mm convex lens between the spectral lamp and the heater so that a slightly converging beam passes through the tube.
- Carry out the experiment as described above.

Within this beam it is possible to see a bright resonance fluorescence. When it is totally dark, it is possible to see weak secondary radiation outside the beam.

Explanation: excited sodium atoms emit resonance radiation uniformly from all sides. For this reason, atoms outside the beam can also be excited to resonate.

### 5.2 Absorption of sodium light from a spectral lamp

Additionally required:

Semi-transparent paper, stand equipment

- Set up the sodium spectral lamp about 50 behind the heater so that the light illuminates the heater from the rear and emerges from the viewing window in the panel at the front.
- Suspend a sheet of semi-transparent paper from a stand in front of the heater so that it is parallel to the front window to use as a viewing screen.
- Carry out the experiment as described in section 5.1

Now the tube appears as a shadow in the light from the spectral lamp between two bright strips of light.

The primary sodium light is almost totally absorbed inside the sodium fluorescence tube. By contrast, direct light that passes uninterrupted through the heater between the window and the tube appears on either side of the tube's shadow.

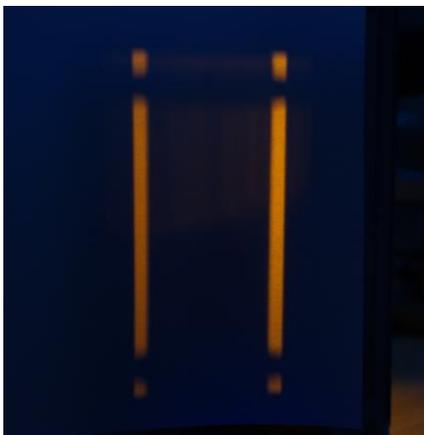


Fig. 2 Absorption of sodium light

### 5.3 Observation of D line in white halogen light

Additionally required:

|                                      |         |
|--------------------------------------|---------|
| 1 Hand spectroscope with Amici prism | 1003531 |
| 1 Experiment light, halogen          | 1003038 |
| 1 Transformer, 12 V, 60 VA (230 V)   | 1000593 |
| or                                   |         |
| 1 Transformer, 12 V, 60 VA (115 V)   | 1000593 |
| 1 Converging lens on rod, 50 mm      | 1003022 |
| 2 Stand bases                        | 1001045 |

- Set up the optical lamp and the convex lens behind the heater in such a way that the light forms a beam as narrow as possible at the point where it is projected upon the sodium fluorescence tube. The spot of light should shine through the tube either just above or just below the metallic reflector.
- Use the hand spectroscope and observe the spot of light that emerges through the window at the side.

A sharply defined yellow line (D line) appears in the spectrum. By slightly varying the position of the spot of light on the tube (letting it shine through the tube at a slight angle), the proportion of the light reflected can be increased, which causes the D line to become even more conspicuous.

### 5.4 D line as a dark feature in white halogen light

- Line up the optical lamp and the convex lens as described in section 5.3.
- Set the heater to 250°C.
- Use the hand spectroscope and view the light passing through the tube from the front.

Observation of the extremely fine line (Fraunhofer line) requires a bit of practice. It is important that a red beam is already visible inside the tube in the focus of the halogen lamp. The operating temperature of the tube should be between 240° and 250°.

