New Teltron equipment

Here we look at four of the latest Teltron Tubes for use in the physics laboratory: the Perrin Tube, Thomson Tube, Electron Diffraction Tube and the Dual Beam Tube.

All the tubes examined incorporate electron-gun assemblies contained within an evacuated clear glass bulb.

This new breed of tube can be mounted in a universal tube holder set at an angle, unlike the older ones. This new style holder (Figure 1) allows for easy access to the tube connections using five built-in 4 mm sockets at the rear of the neck brace. The cathode in each tube can be heated either directly or indirectly. Like the anode, it is in the form of a cylinder. A filament protection circuit is integrated into the neck brace to prevent excess voltage being applied to the cathode heater circuit. The base of the holder has a guide slot built in for attaching Helmholtz coils at distances varying from 68 mm to 150 mm apart. An auxiliary coil can also be inserted into the stepped front of the holder in an axial configuration.

A table summarising the experiments that can be performed with each tube can be found at the end of this article.

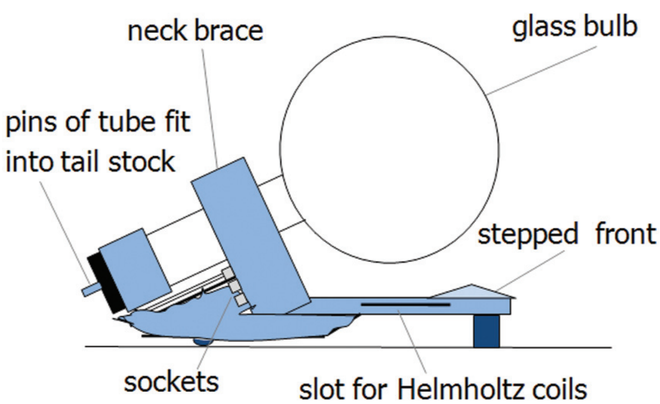

Figure 1 *- Teltron Tube in new-style holder.*

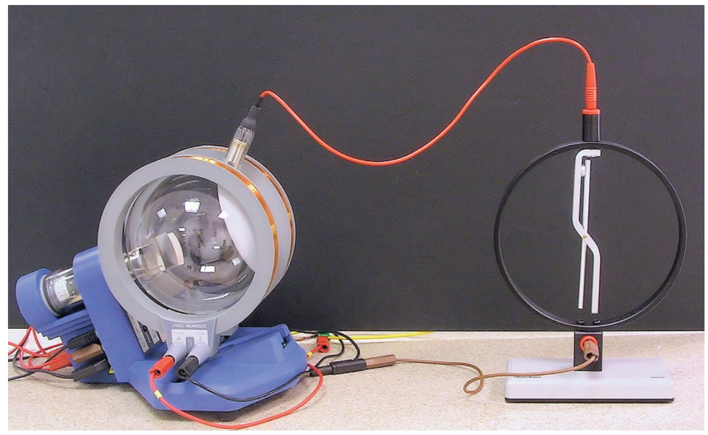

Figure 2 *- Perrin Tube attached to electroscope*

Perrin Tube

Description: In this tube, electrons emitted by the gun form a narrow beam of circular cross section which produces a spot on a fluorescent screen coating the end of the tube. A small glass tube with a Faraday cage is set on the top of the glass bulb at an angle of about 45^{o} to the undeflected beam. The electron beam can be deflected into the Faraday cage electromagnetically by means of Helmhotz coils. Lissajous Figures can be produced on the fluorescent screen by deflecting the beam in two perpendicular planes, either with two sets of Helmholtz coils, or one coil set plus electrostatic deflection with the small plates near the anode.

Thomson Tube

Description: In this tube, the deflection of the electron beam can be achieved either electrostatically by means of built-in parallel plates or electromagnetically by using the Helmholtz coils. The beam is intercepted by a flat mica sheet. One side of this is coated with a fluorescent screen. The other side is printed with a millimetre graticule so that the path of the electrons can

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where participants commented that the course had given them the confidence to tackle challenging leadership issues and the high value they placed in learning from other participants' experiences in addition to the sessions provided by nationally recognised experts.

In addition an independent evaluation by the Scottish Centre for Research in Education (SCRE) [3], a requirement of Scottish Government funding, commented that overall SSERC CPD has had a substantial impact on many CPD participants and, perhaps more importantly, has also been translated into changes in the practice of many teachers.

Currently applications are being accepted for a *Leading for Excellence in Science* course on 21st to 24th November 2010 and 17th to 18th March 2011 (closing date - 17th September 2010).

Application forms are available from: sheila.maclellan@sserc.org.uk and a draft programme is available on the Science3-18.org website [4].

References

[1] - http://tinyurl.com/Science-Portrait
[2] - http://science.rolls-royce.com/award_winners/finalists_2009-10/
[3] - http://tinyurl.com/CPD-evaluation
[4] - http://tinyurl.com/Leading-for-Excellence

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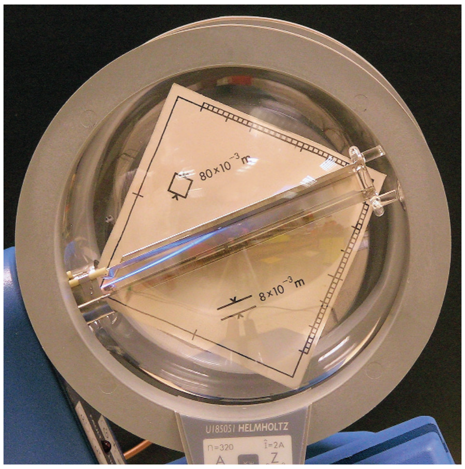

Figure 3 - Thomson Tube.

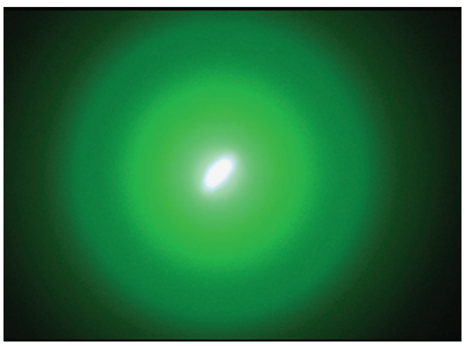

Figure 4 - Display from Electron Diffraction Tube.

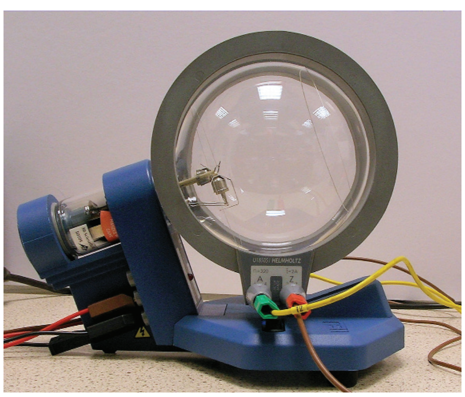

Figure 5 - Dual Beam Tube.

be easily traced and the radius of curvature measured. In a separate experiment, by applying a high voltage to the deflection plates and suitably adjusting the current flowing in the Helmholtz coils, it is possible to cancel out the deflection produced by each field.

Electron Diffraction Tube

Description: In this apparatus, electrons emitted by the heated cathode are constrained to a narrow beam by an aperture and are then focused by means of an electron-optical system. The resulting tight electron beam passes through a micro-mesh nickel grating situated at the aperture of the gun. Onto this grid a thin layer of polycrystalline graphitised carbon has been deposited by vaporisation. This layer affects the electrons in the beam much like a grating. As a result of diffraction, an interference pattern, comprising of two concentric rings, is formed on the fluorescent screen. The undeflected electron beam continues to be visible at the centre of the rings. Decreasing the anode voltage makes the rings appear wider apart, supporting de Broglie's postulate that wavelength increases as momentum is reduced.

Dual Beam Tube

Description: The Dual Beam Tube has two electron guns - axial and perpendicular. The tube is filled with helium at low pressure. A common deflector plate is provided for both guns. The electron beam source is an oxide cathode heated indirectly via a heating coil. The electron paths show up as a fine, slightly greenish beam due to impact excitation of helium atoms in the

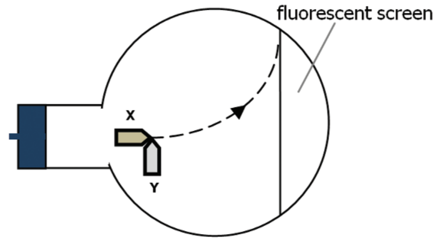

Figure 6 - Using axial gun X.

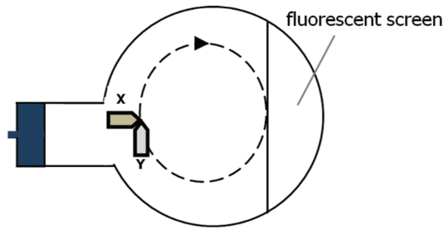

Figure 7 - Using perpendicular gun Y.

tube. The specific charge *e/m* of the electron can be determined from measurements of the curved path produced when either of the electron beams (from axial or perpendicular gun) passes at right angles through the magnetic field generated between the Helmholtz coils (Figures 6 and 7).

Other Possible Uses. These experiments could be used to support the teaching of magnetic and electrostatic electron deflection in the Electrical Phenomena unit at Advanced Higher Physics level and of particle accelerator studies in the new Higher Physics course. They could also form the basis for an Advanced Higher investigation. Advice on safety issues with Teltron Tubes can be found in SSERC Bulletin 208 [1].

Tube	Experiments which can be performed
Perrin	Evidence for particulate nature of cathode rays; estimation of *e/m* ; demonstration of Lissajous Figures.
Thomson	Estimation of *e/m* by means of magnetic deflection or by field compensation; determination of electron velocity.
Electron Diffraction	Support for de Broglie's postulate; estimation of the wavelength of moving electrons.
Dual Beam	Estimation of *e/m* using two different methods, one using the axial beam, the other using the perpendicular beam; studying the helical path of electrons.

Reference

[1] http://tinyurl.com/teltron