The Cathode Ray Tube site

electronic glassware
history and Physics Instruments

Crookes tubes

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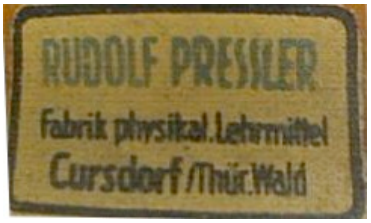
The scientist Sir William Crookes paved the way for many discoveries. He worked in his own laboratory in London where he did all of his experiments with different types of near vacuum tubes.
A lot of Crookes tubes stood at the base of further discoveries like the X-ray tube and the Braun tube which developed later on into our well known TV tube.
German glassblowers like Otto Pressler, Emil Gundelach and Müller-Uri made many types of Crookes, Hittorf and Geissler tubes in the beginning of the 20th Century. The tubes were sold to schools and universities for classroom demonstration by companies like Max Kohl and Leybold.
In WW II the Pressler factory was bombed but they managed to go on, after the war the name changed in VEB and produced then manly radiometers for hard western currency. On the website of Jogis-Röhrenbude you can find the complete Pressler story.
The biography of Sir William Crookes can be found on the website of the University of Oxford
For everyone who likes to know more about the background of this old tubes, there is now a new book in German language. Check this website for more info.

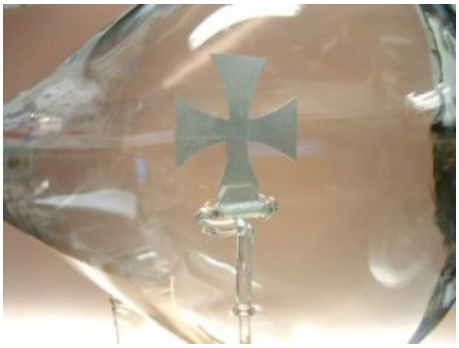
Sir William Crookes
1832-1919

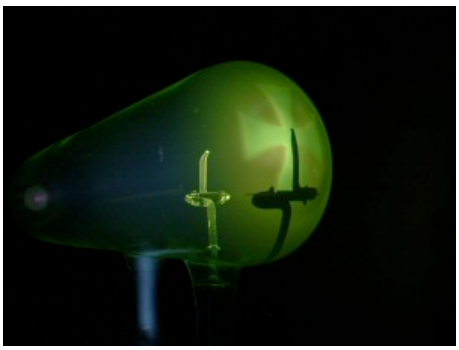
Caution.
When these tubes are activated with high voltage
a small amount of soft X-Ray's are produced !
Don't use tensions more than 5000 Volts.



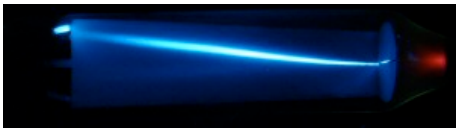
The Maltese Cross tube is one of the most famous Crookes tubes. The tube demonstrates that electrons go in a straight line and don't go through metal. The cross can actually lay down and stand up (mechanical). When the cross lies down, the glass face of the tube emits a green glow when the electrons strike the glass wall, when it's right up you will see the shadow of the cross.
After a while the glass gets "tired" and the glow is less strong, when the cross then falls, the previous unexposed glass glows brighter than the surrounding glass. The tube shown is an early Pressler tube.

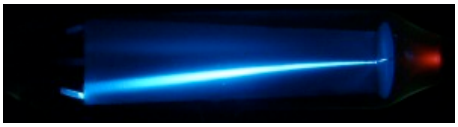
Crookes Maltese Cross tube



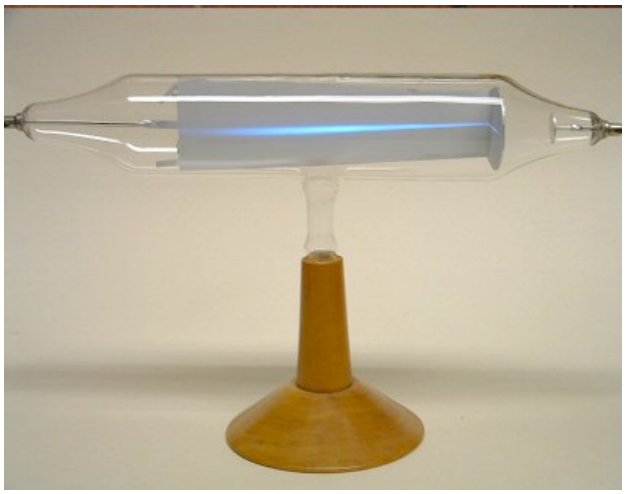


Activated tube





The Cathode Ray Deflecting tube demonstrates the influence of a magnetic field to the electron beam.
The visible beam appears on the aluminum sheet covered with phosphor, will bent away from the center
when a magnet is held near the tube.

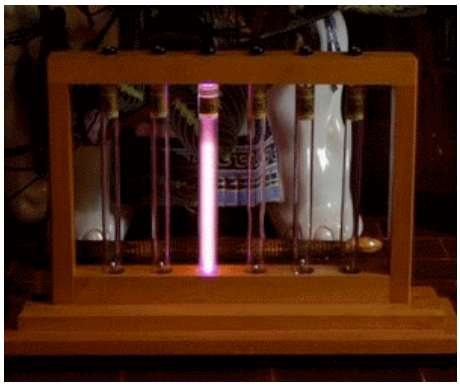


Crookes Cathode Ray Deflecting tube.

Mineral tubes are real beauty's in the Crookes tube world.
They glow beautiful when the tube is activated.
A nice tube can be seen at the collection of the University of Innsbruck.
Different samples of fluorescent minerals, shells, coral or gemstones were used. Here is a list of some common used minerals.

Color	mineral
red	chalk
yellow	apatite
bright green	willemite
bleu	scheelite
brown	dolemite
violet	magnesite

Small chalk sample
in activated tube.



Cross vacuum scale

Picture courtesy of Alastair Wright.

The Cross vacuum scale demonstrates the phenomenon of discharge at different pressures (vacuum) inside the tubes. The pressures varies between 40 Torr (mmHg) lowest vacuum (left tube) to 0.03 Torr the highest vacuum. (right tube) In this high vacuum, used in many Crookes tubes, X-Ray's are produced, the glass emits here a green glow. If you click on the picture you will see a larger model made by NARVA the successor of the Pressler company.

Crookes mineral tube

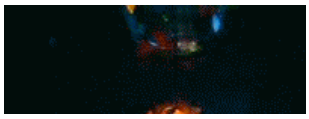
Crookes radiometer

The radiometer invented by William Crookes in 1875 stood at the base of his later developed railway tube. The four vanes are spinning in a glass envelope with a pressure of 1 Torr, when exposed to light the vanes turn. Due to heating of the vanes which are black on one side there is movement, this is called thermal creep. The black side of the vanes are a little hotter than the silver side so the gas molecules pushing to the black side turning the vanes.

Crookes flower tube

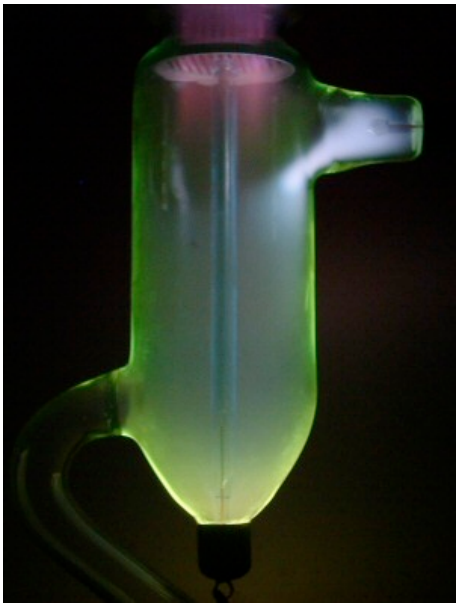
30 cm in height with a paddlewheel on top, early 20th Century.
This tube can be found in the Max Kohl catalog nr.100 band III page 1015 on the site of the Max Planck institute, The Virtual Laboratory.
This was one of the most expensive tubes!

The Crookes flower tube or bouquet tube is also a beautiful



piece of craftsmanship, these tubes were made in different sizes. The copper flowers are covered with different phosphors, the vanes on top are made of mica and turn when the tube is activated forming a moving shadow on the flowers below. The stream of electrons demonstrates kinetic energy in form of the turning vanes, and show that they travel in straight lines which can be seen by watching the phosphors lightning when there is no obstruction in in the way of the electrons

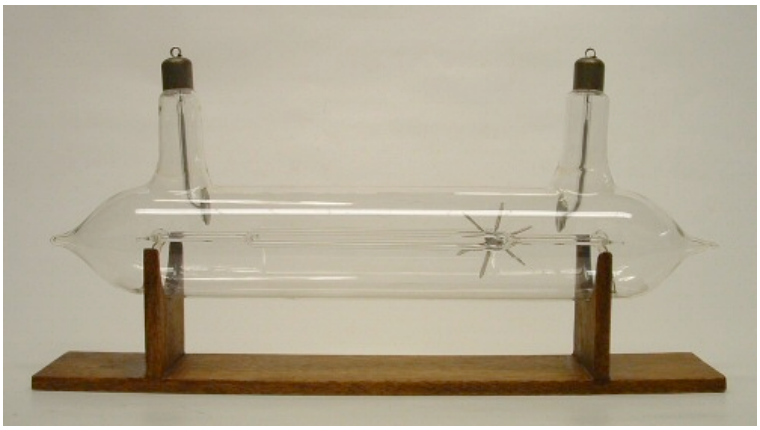
Goldstein Canal Ray Tube

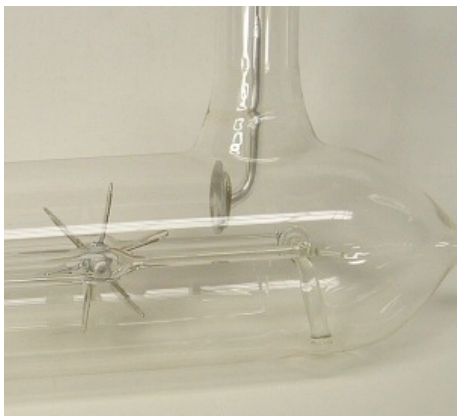


The perforated cathode.

The Goldstein Canal Ray tube.
This tube demonstrates that besides the cathode rays there is another stream that travels in the opposite direction as the electron flow. Discovered in 1886 by Eugen Goldstein (1850-1931) who called it "canal rays". In fact these are positively charged protons, producing a reddish light in the upper part of
the tube while in the lower part the usual green emission of electrons can be seen when they hit the glass wall.
The electrons in the lower part of the tube can be deflected by
a magnetic field but the canal rays almost not.
Goldstein could not explain this phenomenon, it took 12 years before Goldstein's paper was published.
An interesting pdf about the discovery of the proton can be found here.

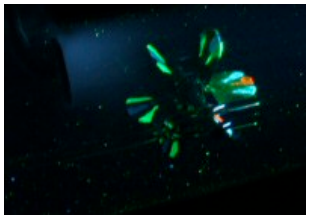
Canal Rays or positive Protons (red glow)

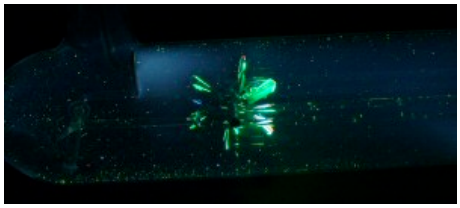




Crookes railway or paddlewheel tube

The Railway tube demonstrates kinetic energy. The electrons bounced at the paddles covered with a small amount of phosphor will turn the paddlewheel to go from one to the other side of the tube.

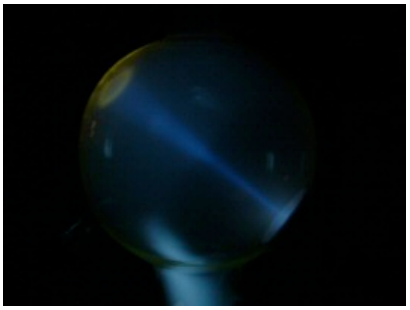




Activated railwaytube

Crookes vacuum tubes (Pressler 7a & 7b)

Activated 7a tube



Activated 7b tube

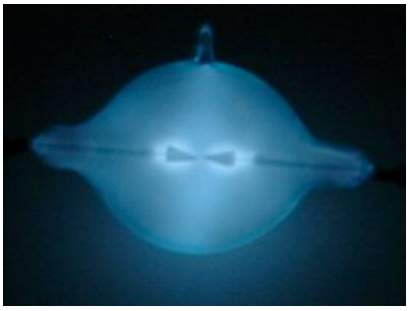
The Crookes Vacuum tube demonstrates the behaviour of the electron beam in different vacuum pressures.

The 7a tube has a low pressure vacuum much like a Geissler tube,

the beam inhere exists between one electrode to the cathode via the shortest way.

The 7b tube however has a high vacuum the difference is clear to see. Radiant matter leaves the hollow cathode in the opposite way (as X-Rays) unlike which of the three anodes is used.

See also the Cross vacuum scale.



Activated tube

Unknown tubes.

With envelope diameters of about 6 centimeters, one with metal electrodes, the other with pyramidal shaped carbon electrodes. One tube will light as seen in the picture left. The other one will not light at all. The last thing I found on this is a similar tube in the Muller-Uri catalog from 1909 called 'a tube with absolute vacuum'.

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