



The Nobel Prize in Physics 1925

Presentation Speech

Experimento de Franck y Hertz

Presentation Speech by Professor C.W. Oseen, member of the Nobel Committee for Physics of the Royal Swedish Academy of Sciences, on December 10, 1926*

Your Majesty, Your Royal Highnesses, Ladies and Gentlemen.

The Physics Nobel Prize for the year 1925 has been awarded to Professor James Franck and Professor Gustav Hertz for their discovery of the laws governing the impact of an electron upon an atom.

The newest and most flourishing branch of the great tree of physical research is atomic physics. When Niels Bohr founded this new science in 1913, the material at his disposal consisted of data concerning the radiation of glowing bodies, which had been accumulated over several decades.

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One of the earliest findings in the field of spectroscopy was that the light emitted by a glowing gas when observed through a spectroscope, splits up into a large number of different lines, called spectral lines. The fact that simple relationships exist between the wavelengths of these spectral lines, was first discovered by Balmer in 1885 for the hydrogen spectrum, and demonstrated later by Rydberg for a large number of elements.

Experimento de Franck y Hertz

Two questions relating to theoretical physics arose as a result of these discoveries: How is it possible for a single element to produce a large number of different spectral lines? And what is the fundamental reason behind the relationships that exist between the wavelengths of the spectral lines of a single element? A large number of attempts were made to answer these two questions, on the basis of the physics which we are now accustomed to call classical physics. All were in vain. It was only through a radical break with classical physics that Bohr was able to resolve the spectroscopic puzzles in 1913.

Experimento de Franck y Hertz

Bohr's basic hypotheses can be formulated as follows:

Each atom can exist in an unlimited number of different states, the so called stationary states.

Each of these stationary states is characterized by a given energy level.

The difference between two such energy levels, divided by Planck's constant h , is the oscillation frequency of a spectral line that can be emitted by the atom.

In addition to these basic hypotheses, Bohr also put forward a number of specific hypotheses, with the aid of which it was possible to calculate the spectral lines of the hydrogen atom and the helium ion.

The extraordinarily good agreement with experience obtained in this way, explains why after 1913 almost a whole generation of theoretical and experimental physicists devoted itself to atomic physics and its application in spectroscopy.

Experimento de Franck y Hertz

Bohr's more specific assumptions have had the same fate as that which sooner or later overtakes most physical hypotheses: science outgrew them.

They have become too narrow in relation to all the facts which we now know. For a year now attempts have been made to solve the puzzle of the atom in other ways. But the new theory which is now in process of being established, is yet not a completely new theory. On the contrary, it can be termed a further development of Bohr's theory, because among other things in it Bohr's basic assumptions remain completely unchanged. In this overthrowing of old ideas, when all that has been gained in the field of atomic physics seemed to be at stake, there is nobody who would have thought it advisable to proceed from the assumption that the atom can exist in different states, each of which is characterized by a given energy level, and that these energy levels govern the spectral lines emitted by the atoms in the way described. The fact that Bohr's hypotheses of 1913 have succeeded in establishing this, is because they are no longer mere hypotheses but experimentally proved facts. The methods of verifying these hypotheses are the work of James Franck and Gustav Hertz, for which they have been awarded the Physics Nobel Prize for 1925.

Experimento de Franck y Hertz

Franck and Hertz have opened up a new chapter in physics, viz., the theory of collisions of electrons on the one hand, and of atoms, ions, molecules or groups of molecules on the other. This should not be interpreted as meaning that Franck and Hertz were the first to ask what happens when an electron collides with an atom or a molecule, or that they were the originators of the general method which paved the way for their discoveries and which consists of the study of the passage of a stream of electrons through a gas. The pioneer in this field is Lenard. But Franck and Hertz have developed and refined Lenard's method so that it has become a tool for studying the structure of atoms, ions, molecules and groups of molecules. By means of this method and not least through the work of Franck and Hertz themselves, a great deal of material has been obtained concerning collisions between electrons and matter of different types. Although this material is important, even more important at the present time is the general finding that Bohr's hypotheses concerning the different states of the atom and the connexion between these states and radiation, have been shown to agree completely with reality.

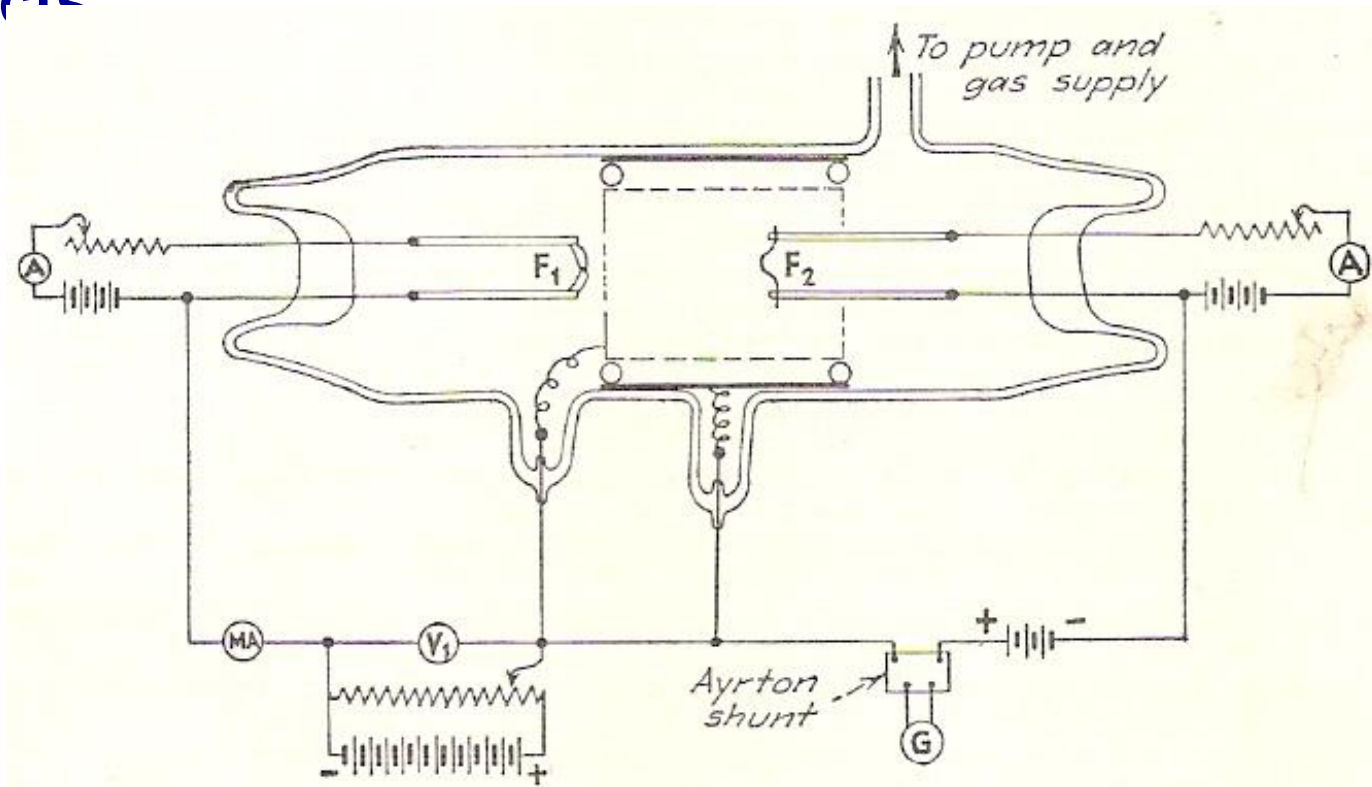
Experimento de Franck y Hertz

Professor Franck. Professor Hertz. Through clear thinking and painstaking experimental work in a field which is continuously being flooded by different hypotheses, you have provided a firm footing for future research. In gratitude for your work and with sincere good wishes I request you to receive the Physics Nobel Prize for 1925 from the hands of our King.

**From Nobel Lectures, *Physics 1922-1941*, Elsevier
Publishing Company, Amsterdam, 1965**

Experimento de Franck y Hertz

Transformations of kinetic energy of free electrons into excitation energy of atoms by impacts



Experimento de Franck y Hertz

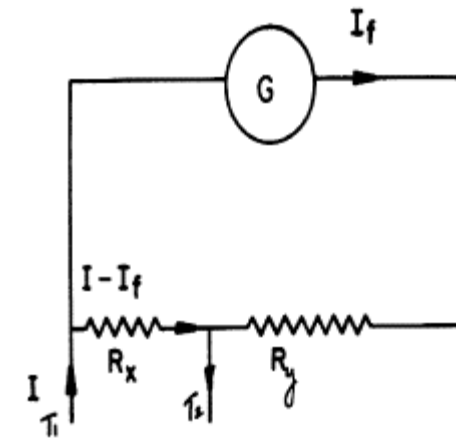
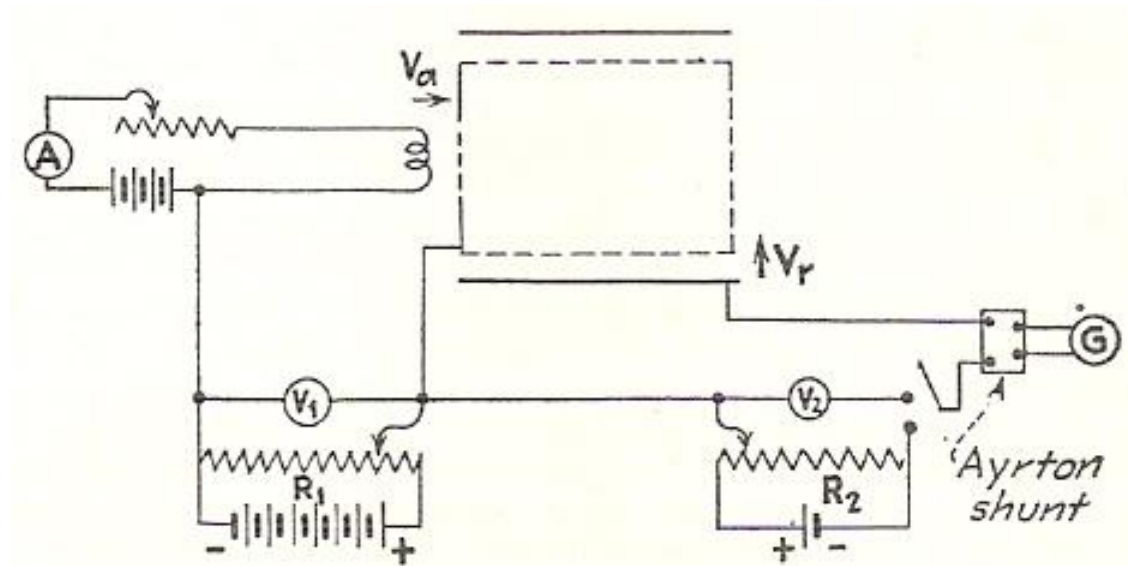
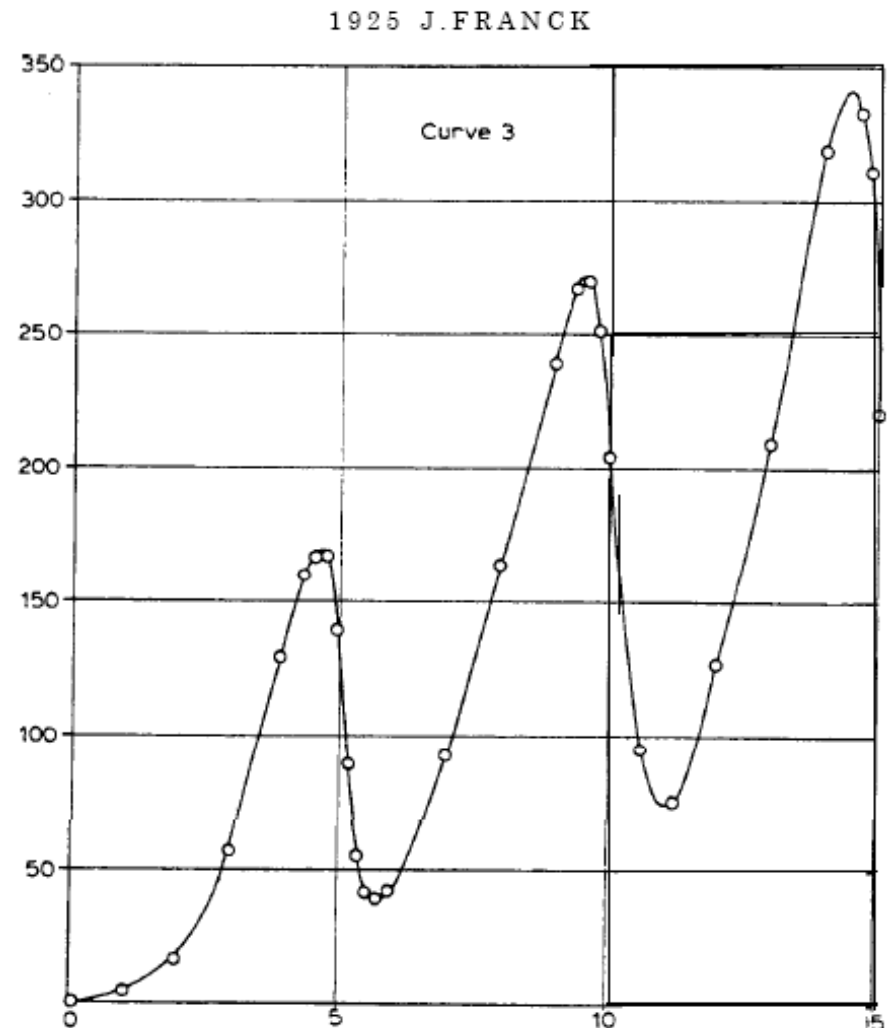


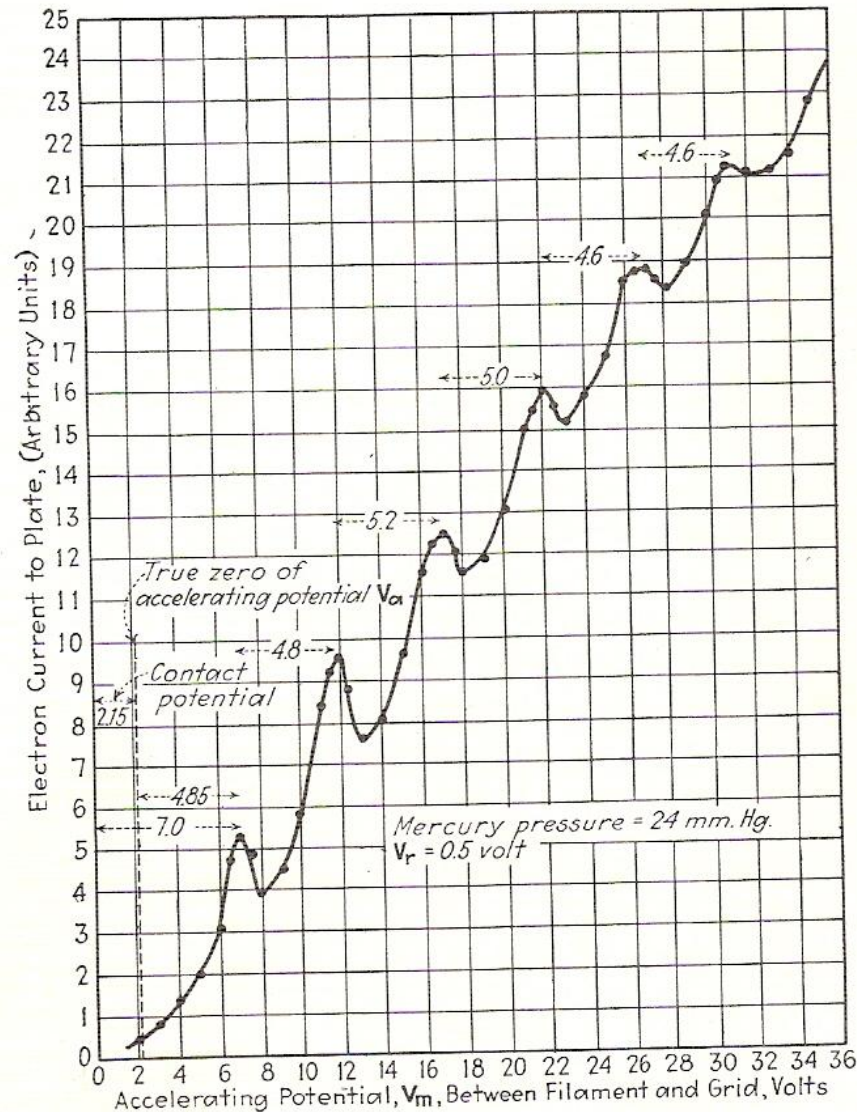
Fig. 4

Ayrton Shunt Method. Sometimes a shunt resistance needed is too low for the resistances actually available (e.g. need 0.007 Ω , but only have 1 Ω). The lowest available resistance can be used as R_x , but another resistance, R_y , must be put in series with R_g to protect the galvanometer. Generally, if R_x is used, then R_y should be: $R_y = ([I/I_f] - 1)R_x - R_g$

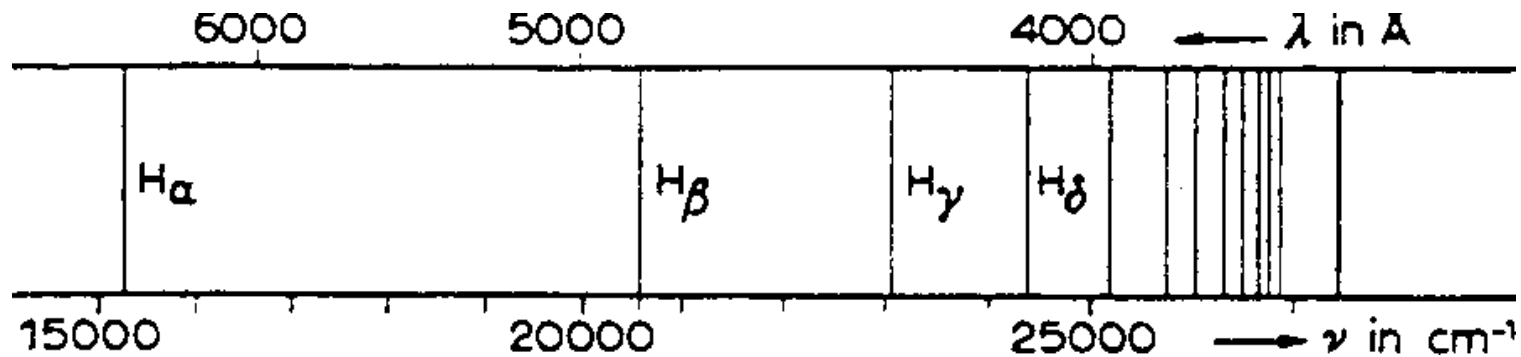
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ELECTRON-IMPACT TESTS AND BOHR'S THEORY 115

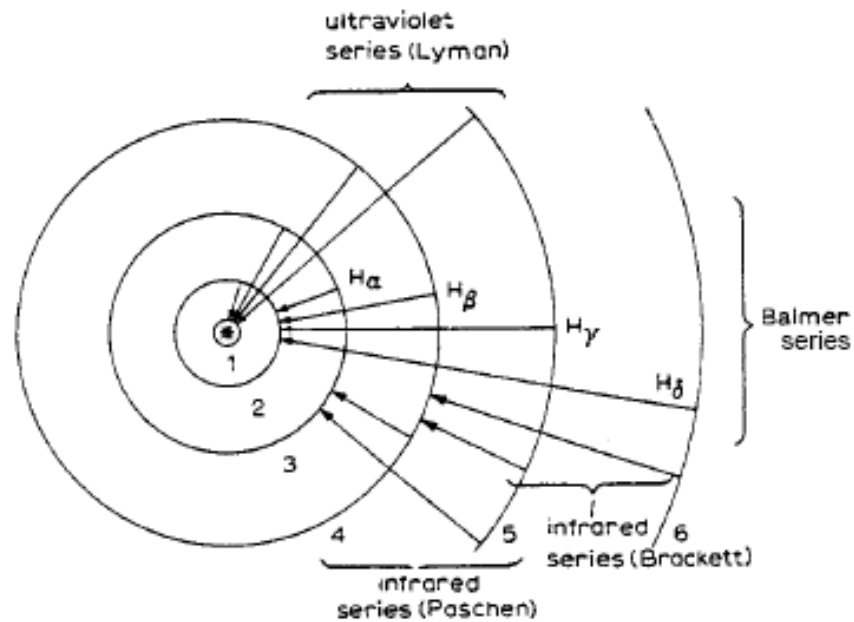


Fig. 2.

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1925 G. HERTZ

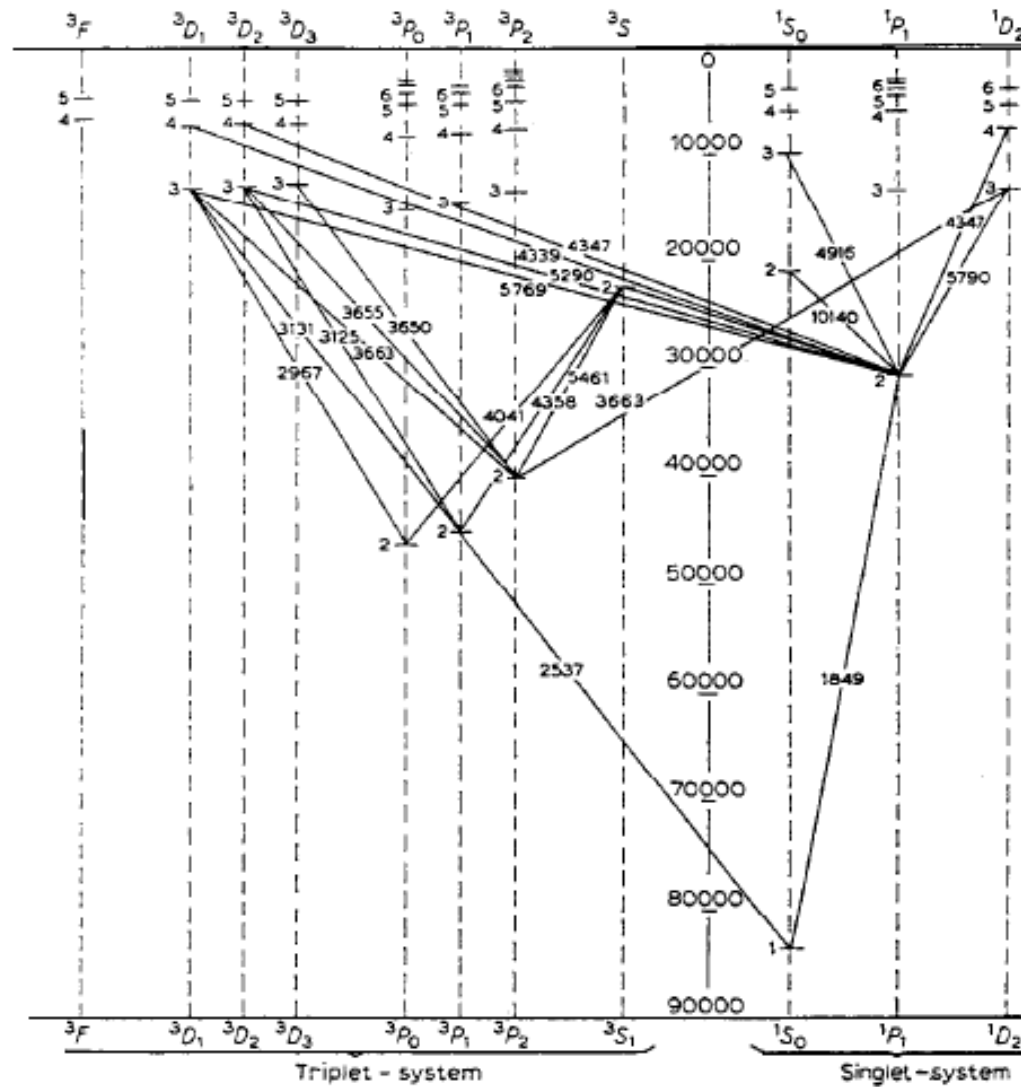
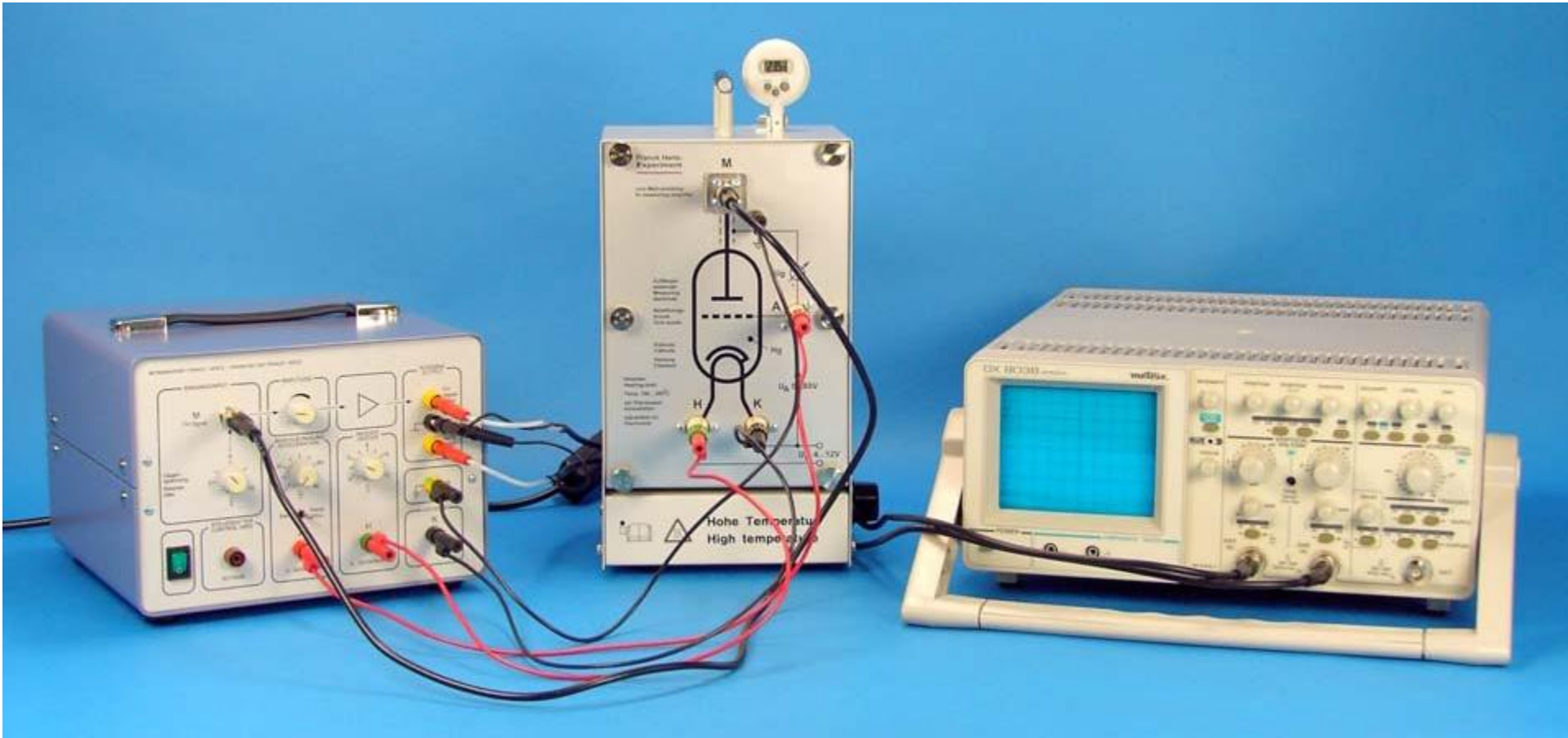
 $J=L+S$ $2S+1L_J$ $6s^2$ $1S_0$ $6s\ 6p$ $3P_1$

Fig. 3.

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Experimento de Franck y Hertz

<http://phys.educ.ksu.edu/vqm/free/FranckHertz.html>

Franck-Hertz Experiment - Microsoft Internet Explorer

Datei Bearbeiten Ansicht Favoriten Extras ?

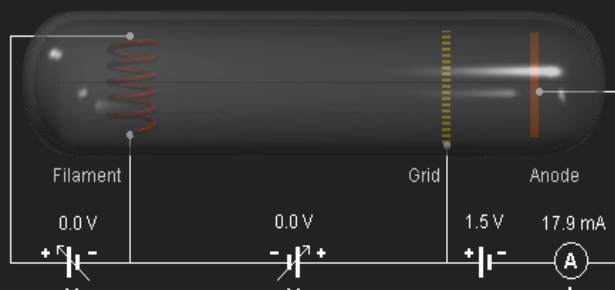
Zurück Suchen Favoriten

Adresse <http://phys.educ.ksu.edu/vqm/free/FranckHertz.html> Wechseln zu Links

QUANTUM MECHANICS

PROJECT SIMULATIONS RESEARCH

Franck-Hertz Experiment



Filament 0.0 V
Grid 0.0 V
Anode 1.5 V 17.9 mA
 V_F V_G I_A

Gas
☒ Neon (Ne) ☐ Mercury (Hg)

Filament Voltage (V_F)
0 Volts 5 10

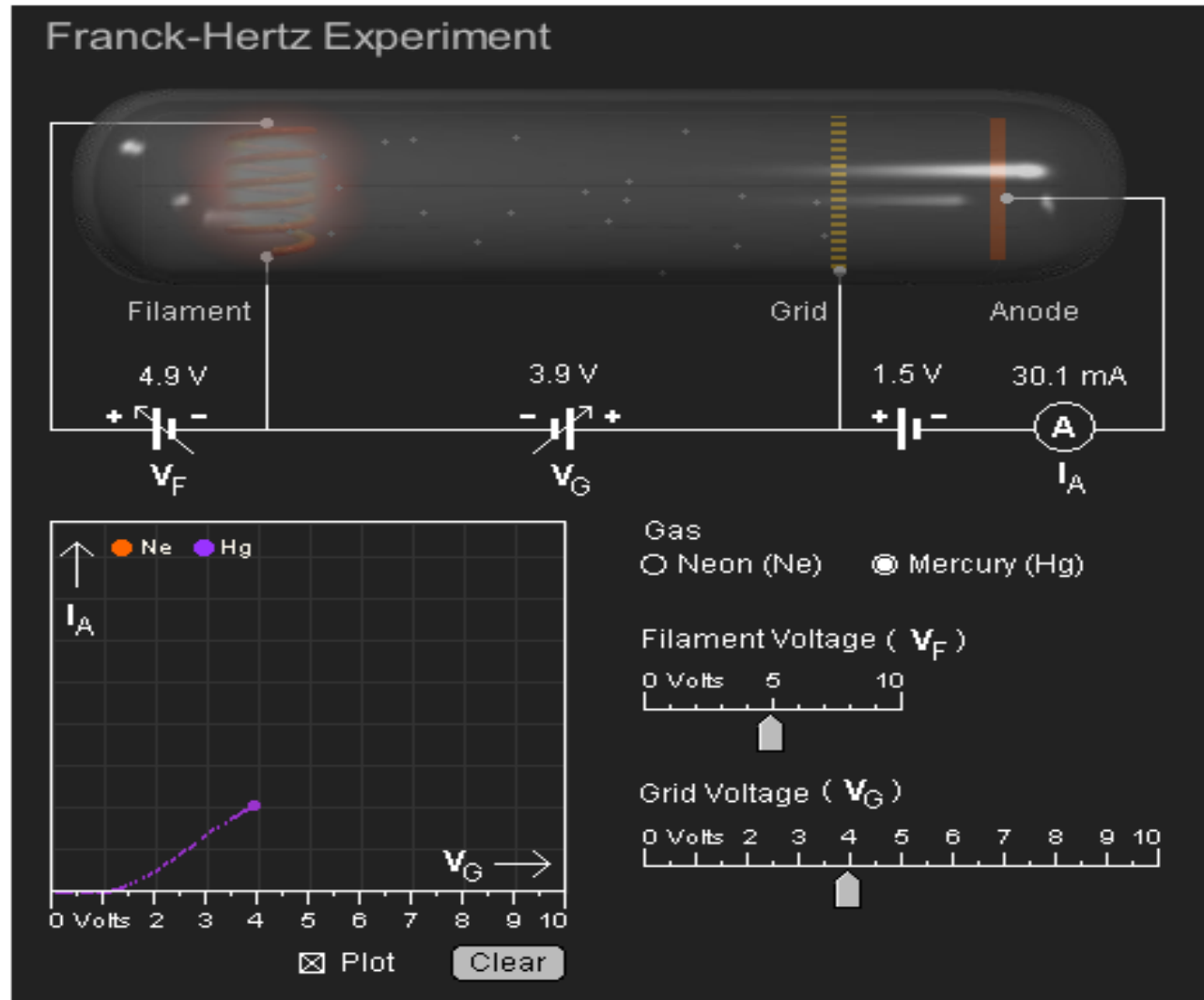
Grid Voltage (V_G)
0 Volts 2 3 4 5 6 7 8 9 10

I_A vs V_G plot. Legend: Ne (orange dot), Hg (purple dot). X-axis: V_G (0 to 10 Volts). Y-axis: I_A . Plot button and Clear button are visible.

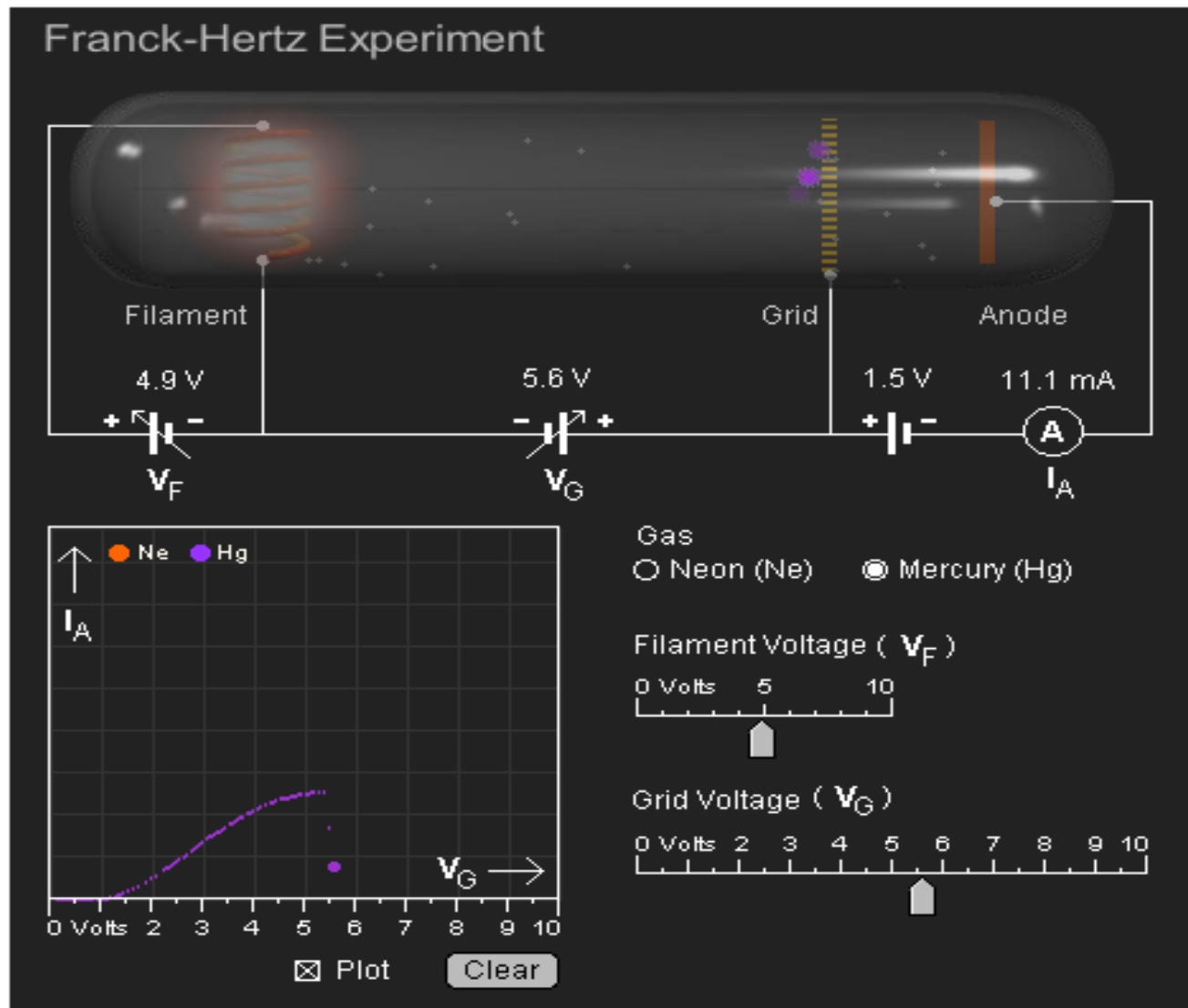
Start Franck-Hertz Experim... The Physics Teacher,...

DE 07:50 p.m.

Experimento de Franck y Hertz

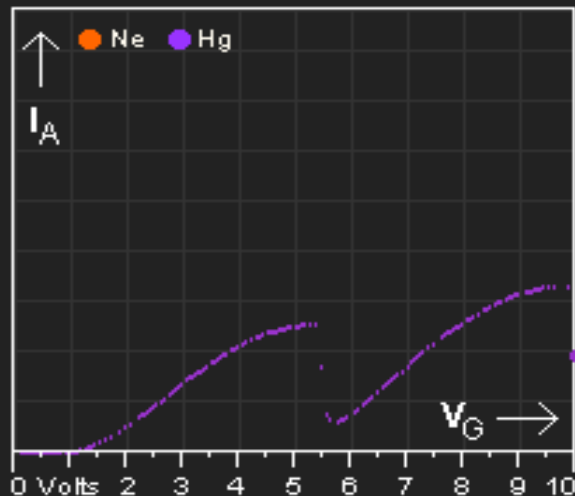
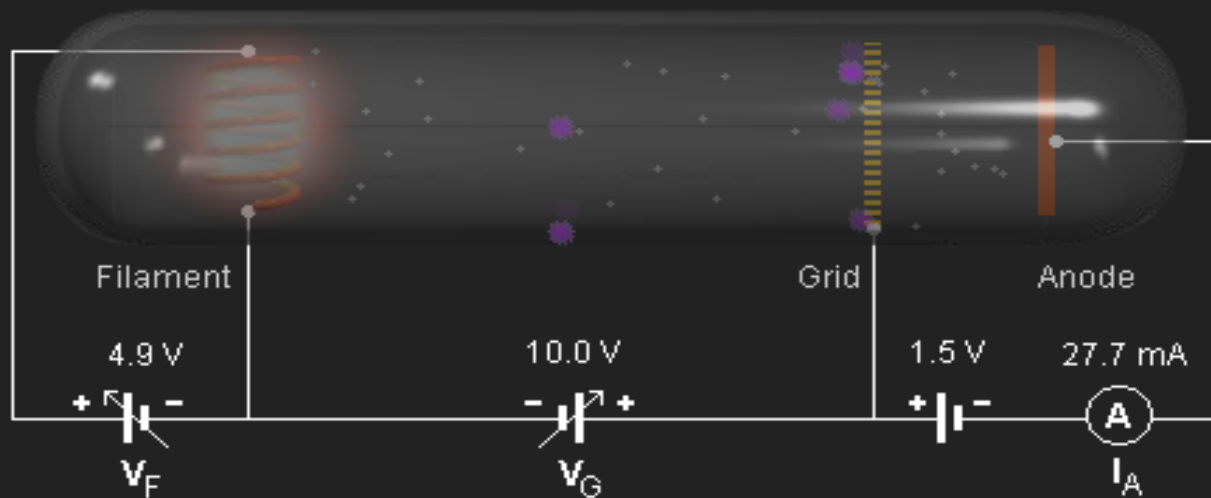


Experimento de Franck y Hertz



Experimento de Franck y Hertz

Franck-Hertz Experiment

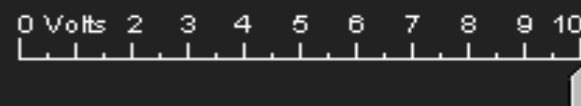

☒ Plot

Clear

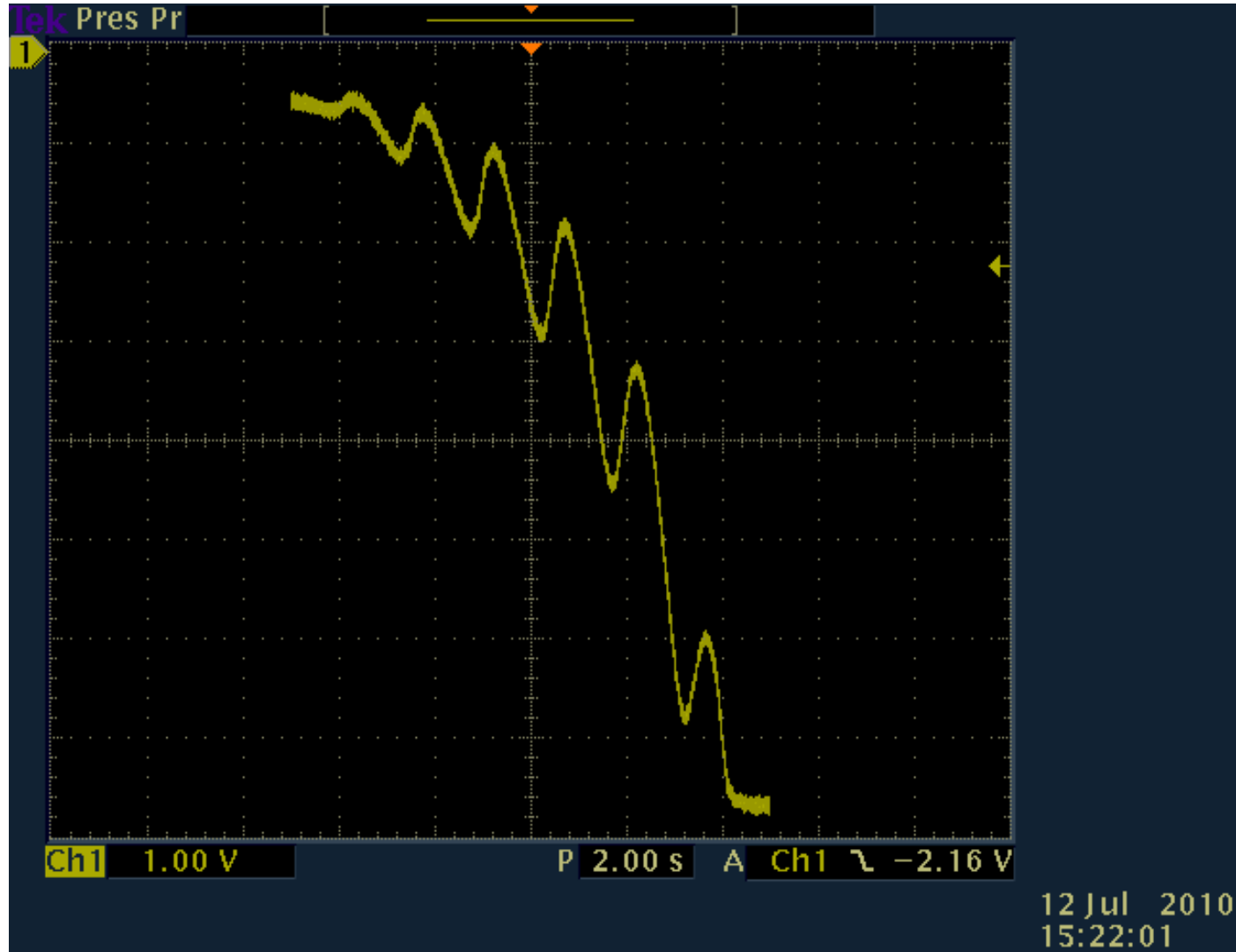
Gas

○ Neon (Ne)

● Mercury (Hg)

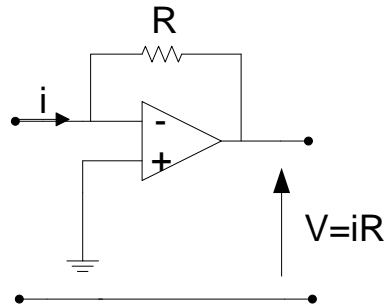
Filament Voltage (V_F)Grid Voltage (V_G)

Experimento de Franck y Hertz

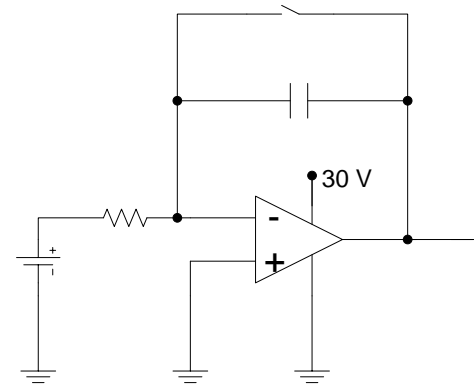


Experimento de Franck y Hertz

Amplificador de corriente



Generador de barrido



Amplificador de corriente

