

Frank-Hertz

Prelab

- 1) In 3-5 sentences, explain the Frank Hertz experiment

The experiment is named for James Franck and Gustav Hertz who first performed it in 1914. They accelerated electrons through mercury toward a positively charged grid with a slightly negative plate beyond it. They measured drops in current and recorded the associated voltages; these are the voltages associated with excitations of electrons in the mercury. The experiment demonstrated discrete excited states in atoms, helping confirm the quantum theory that electrons occupy quantized energy states. Franck and Hertz were given the Nobel prize for their experiments in 1925.

- 2) In the process of accelerating electrons through vaporized mercury atoms, the electrons and atoms undergo collisions. What type(s) of collisions do they experience? If energy is transferred, explain the transfer, or explain why it isn't transferred between the electrons and atoms.

When electrons collide with atoms, they do so in ~~an elastic collision~~. They do so in an inelastic collision. The electron does not "stick to" the atom in this experiment, as the mercury gas doesn't become ionized. Energy is transferred from the electron, in the form of voltage ($E = qV$), to the atom in the form of an excited state.

- 3) In the Hg tube, the light emitted by the vaporized atoms has a wavelength of 254 nm. Calculate the amount of absorbed energy [in eV] necessary for this.

$$E = h\nu \rightarrow E = h254 \text{ [nm]} \quad E = hf, f\nu = c \rightarrow E = h\frac{c}{\lambda} = h\frac{c}{254 \text{ [nm]}}$$

$$4.88 \text{ [eV]}$$