Frank-Hertz

The Bohr model of the atom, while not a completely correct quantum mechanical model of the atom, does describe many of the accepted features of atomic theory. The Bohr model describes the atom as consisting of negatively charged electrons orbiting in circles, due to the Coulomb force, around a central positively charged nucleus. In Bohr's model, the electrons can only orbit at certain radii and the electron's energy remains constant at each radius. The electron can move from one energy level (one orbit) to another by absorbing or emitting radiation.

The Franck-Hertz experiment provided support for the Bohr model of the atom. In the Franck-Hertz experiment, electrons were accelerated through a low-pressure gas. Collisions of the electrons with the gas atoms could provide enough energy for the electrons in the gas atoms to move from one energy level to another. In the experiment, a potential difference is applied between the cathode, C, where the electrons are emitted and an anode, A. (See diagram below.) A conducting plate, P, is placed behind the anode. The plate is held at a slightly lower potential than the potential at the anode. Electrons with enough energy will reach the plate, and can be measured as an electron current. As the potential difference between the cathode, C, and the anode, A, is increased, some of the electrons may collide with the gas atoms, lose energy and not make it to plate P. If the Bohr model is correct, that only discrete energies can cause changes in the atoms, how would the electron current at plate P be effected, as the voltage between the cathode and the anode is increased? What would a plot of electron current vs. potential difference look like? Record your predictions in your lab notebook.

Read about the experimental set-up of the Franck-Hertz experiment in the handout or in a different text or online. Write in your own words in your lab notebook how the experiment works. Describe the experimental set-up, the data to be taken and how the expected data would support the Bohr model.

Discuss your understanding and predictions with the TA before preceding with the lab.