

PBL: 20th Century Physics 活動單元：近代物理

By Amanuel Assefa, Byron Lin, Jonathon David White

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0. Introduction 簡介

在這個單元，你要處理基本電子在三個不同物理學領域的模擬實驗，在你開始作答問題前，玩玩看每個模擬實驗，熟悉每個模擬實驗的操作，並利用這些模擬來回答問題。

In this activity unit, you will perform virtual experiments with three different public domain physics simulations [dealing with basic electricity](#). Before you start answering the questions, play with each simulation. Get familiar with each of the different effects and buttons of the animations. Where there are tabs, utilize them.

1. Black Body Spectrum 黑體輻射光譜

- 1.1 Download, Run and Play with the PhET Simulation Blackbody spectrum
(Traditional/Simplified Chinese version of simulation is available in the provided link)
 - a. English (Java): <https://phet.colorado.edu/en/simulation/blackbody-spectrum>
- 1.2 Make use of the temperature bar, What are the temperatures for oven , light bulb and the sun ? 利用溫度計，找出火爐、燈泡及太陽的溫度？
- 1.3 What did you observe when changing the temperature on the intensity of wavelength emitted ? List of real life emitted colors by hot things ? 調整溫度，觀察溫度跟各波長輻射處的強度有何關係?列出生活中會熱到發光的東西有哪些？
- 1.4 How does the peak of the intensity behave when we increase the temperature ? What kind of wavelength of light is emitted? Whats the reason behind for the shift ? 強度的峯值隨溫度升高有何改變?光的波長有何改變?請說明為何光譜會橫移？
- 1.5 Find the B , G ,R light intensity indicators . What are the intensity levels in percentage for light bulb ? From your home which bulbs look similar to which light sources ? [hint: florescent , LED , incandescent bulbs] 找出藍、綠、紅光的強度指標。燈泡的強度百分比是多少?你家有類似於燈泡的光源嗎？
- 1.6 What is the maximum temperature for the simulation ? What rays do reside to left and right of the rainbow colors of spectrum shown ? what is a wavelength ? Whats the general conclusion for radiation with temperature ? 模擬的最高溫是幾度?可見光之外的兩側是哪種射線?波長是什麼?請說明溫度與輻射之間的關係？

2. Rutherford Scattering 拉塞福散射實驗

2.1 Download, Run and Play with the PhET Simulation Rutherford scattering and Build an atom lab (Traditional/Simplified Chinese version of simulation is available in the provided link)

- a. English (Java): <https://phet.colorado.edu/en/simulation/rutherford-scattering>
- b. English (Java):https://phet.colorado.edu/sims/html/build-an-atom/latest/build-an-atom_en.html

2.2 [plum pudding atom] Use this model . This was an early model of an atom . A radio active element is available (I.e it can emit alpha particles) . What are the alpha particles made of ? 利用此模型，這是早期的原子模型。有放射性元素可用， alpha particles 是由什麼組成的

2.3 [plum pudding atom] Use this model . If we assume we have a limited understanding of atoms . How do we use radio active elements to find out the structure of an atom ? State the steps you took and the results you found . 假設我們對原子結構了解有限，我們要如何利用放射性元素找出此原子的結構?說明擬採取的步驟及你發現的結果?

2.4 [Rutherford atom] In this lab how do the alpha particles behave when they reach the atom? What do we need to manipulate so the alpha particles pass with out being deflected ? 在此實驗 alpha particles 打到原子後的行為為何?我們要如何操作才使大部分的 alpha particles 通過原子而不被偏折?

2.5 Why do alpha particles are used to detect the nucleus of an atom ? What is approximate diameter of nucleus of atom ? 為何用 α -particles 來檢測原子核?原子核的直徑為何?

2.6 [build an atom :- atom] Use the second listed simulation. Build an atom , tick the show stable/unstable. Can you relate how alpha particles could be emitted ? Why don't we have very large atomic number elements ? Why do we have radio active and unstable elements in the periodic table ? 勾選顯示穩定/不穩定。alpha 射線是怎麼被做出來的?為何自然界不存在原子數非常大的原子?放射性的原子和不穩定得原子有什麼共同點?

3. Neon lights and Discharge lamps 氖氣燈和其它氣體放電燈

3.1 Download, Run and Play with the PhET Simulation Neon lights and Discharge lamps lab (Traditional/Simplified Chinese version of simulation is available in the provided link)

- a. English (Java): <https://phet.colorado.edu/en/simulation/discharge-lamps>

3.2 [single atom] What does the right side of the simulation chart represent . How can we control the energy at collusion indicator for the single atom ? 模擬圖的右側表示什麼。要如何控制能量，當勾選 single atom 時?

- 3.3 What states does the atom has before and after being hit by an electron ? Explain by using the eV chart . [hint : explore different atoms ,use spectrometer] 原子在被電子撞到之前與之後有何不同?利用電子伏特圖。[提示：用光譜，探討不同原子]
- 3.4 What happens to the electron after it hits the atom ? Use the slow simulation to observe closely . [use configurable atom] 電子撞到原子之後發生什麼事?用慢動作(slow simulation)觀察
- 3.5 [multiple atoms] How many levels did you notice when electrons are fired on the atoms . What happens to the atoms and how do they react ? 當電子撞到原子你觀察到有幾種狀態，撞到原子之後原子有何反應?
- 3.6 What can we conclude using the spectrometer , do atoms have the same photon absorption spectrum as their emission spectrum ?我們可以用光譜得到什麼結論，同樣的原子他的吸收光譜跟發射光譜有什麼關係?
- 3.7 How can we use this emission of light to our advantage ? List the applications we can utilize. 這些光譜測量對我們的生活有所改進，請舉例?
- 3.8 Which instrument helps us to identify what other stars and planets are made of ? How ? Which principle plays a major role ? 什麼儀器可以幫助我們了解行星及恆星是由麼物質所組成的?這是怎麼做到的?

4. Student Comments

4.1 Did you enjoy the activity? 你喜歡這個活動馬 ? Choose one”

- LOVED 喜爱
- 75%
- 馬馬虎虎
- 25%
- HATED 憎恨

Why? 為什麼 ?

4.2 Suggest one or two additional questions that could be asked concerning any of the simulations you played with. (If we add your question, you will get 1% bonus marks for the course!) 如果你的問題被使用，加1分！（最多加5分）

Activity	Suggested Question	Answer to suggested question

4.3 Any suggestions to improve this activity? 有沒有別的意見？

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