CCC Heep Woh College
Science Society Newsletter (March 2024) - Modern Science

Problem in the Month: Why 1 + 1 = 2?
Submit your answer to s201901056@ccchwc.edu.hk to have a chance to win a small gift!

2023-2024 Science Society
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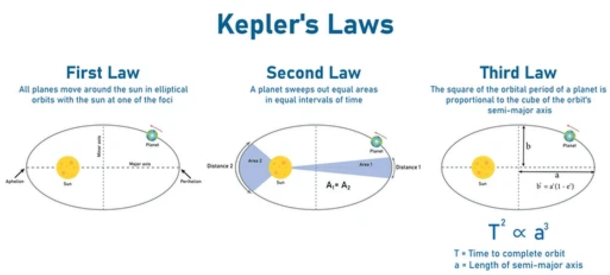
克卜勒定律

太陽系中的行星依照一定的規律在軌道上運行。太陽系的八顆行星繞太陽公轉的軌道初看是以太陽為中心的圓形，但實際上是橢圓形的。此外，太陽系行星遵循一條定律，即它們沿著一個橢圓軌道運行，其中太陽是焦點之一。太陽不是公轉軌道的中心，而是其中一個焦點。這是德國天文學家約翰內斯·克卜勒(Johannes Kepler)在 1609 年觀測後發現的結果，被稱為"克卜勒第一定律"或"橢圓定律"。當我們觀察太陽系的整體圖像時，發現行星軌道並不是以橢圓形而是以圓形表示，這意味著行星的橢圓軌道的兩個焦點都位於太陽內部，這意味著這些橢圓非常接近圓形。克卜勒也發現了"行星與太陽連線所掃過的面積在一定時間內相等"的第二定律(面積定律)。這表明當行星靠近太陽時，其移動速度會加快，而遠離太陽時則會減慢。此外，還有"所有行星的公轉週期的平方與軌道半長軸的立方成正比"的第三定律(調和定律)，這意味著距離太陽較遠的行星其公轉週期較長。



白洞是什麼？和黑洞有什麼差別？宇宙中真的存在白洞嗎？

很多人都知道黑洞，這種神奇的天體一開始只是科學理論的預言，很多年後才被天文觀測證實。2019年，人類發布了第一張巨型黑洞的真實照片，舉世轟動。那麼，與之對應，是否存在性質完全相反的所謂「白洞」呢？

白洞是根據物質世界的對稱性，純粹由理論引申出來的概念。最早使用這名詞的是1971年耶爾明的一篇文章。簡單來說，白洞就是黑洞的時間反演。與黑洞類似，白洞也有一個視界。但與黑洞不同的是，所有物質和能量都無法進入視界，只能從視界內部逃逸出來。所以，白洞是宇宙中的噴射源，白洞視界裡的奇點也許藏匿著無窮無盡的物質，以與黑洞吞噬物質相反的方式向外界噴吐物質和能量。

顯然，白洞的說法是非常原始的，具有狂想性質。目前，沒有觀測證據證實白洞的存在。不過，在科學發展史上，確曾有些「輕狂」的猜想起推動進步的作用。有鑑於此，白洞理論還是值得注意的。

什麼是脈動變星？

脈動變星是一種不穩定恆星。

所謂不穩定恆星，是相對於能夠長時間穩定發光發熱的主序星而言的。不穩定恆星的亮度、溫度、體積、質量等參數會存在不同程度的較為明顯的變化，其變化的形式和原因是多種多樣的。

脈動變星，是指恆星的亮度像人的脈搏、或心臟搏動一樣，發生有節奏的週期性變化。變化的原因是，星體有節奏的膨脹和收縮。這是主序星演化到晚期脫離主星序後出現的結構不穩定現象。脈動變星在脈動過程中，星體的亮度、視向速度、星體半徑、有效溫度、顏色都會改變。

脈動變星的一類著名代表是造父變星，這類變星又是由其最著名的代表恆星－仙王座的造父一（仙王座 δ 星）來命名的。造父一的光變週期為 5 天 8 小時 46 分 38 秒，像鐘錶一樣精準。最亮時 3.6 等，最暗時 4.3等，變幅 0.7 星等，亮度相差 1.9 倍。

那麼，造父變星在亮度最大時，是否正好對應其半徑最大時呢？ 對造父一的仔細研究表明，亮度的最大值並不與半徑的最大值相對應，而與溫度最大值相對應。這說明，其亮度變化的主要因素是溫度變化。而恆星收縮得比較小時，其溫度較高，所以造父變星的亮度與其半徑大小的關係是差不多負相關的。

還有一類脈動變星是長週期變星，典型代表是鯨魚座的蒭藁增二（鯨魚座 o，注意這裡的 o 是希臘字母，讀作“奧米克戎”），所以這一類的脈動變星 也叫作蔣藁型變星。這顆星亮度的變化範圍極大，從 1.7 等到 10 等，變幅達 8.3 個星等，也就是亮度相差約 2000 倍，最亮時像北斗七星一樣亮，最暗時遠遠暗於肉眼能看到的亮度。西方人稱它為「魔鬼的眼睛」。它的光變週期為 320~370 天，平均 332 天，一年中有半年在 6等以下，肉眼根本看不見，另外半年逐漸變亮。

READY ...

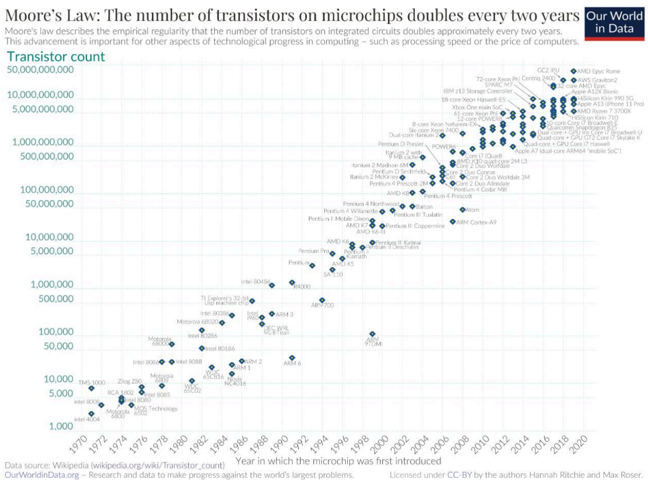
ARE WE READY FOR THE NEXT TECHNOLOGICAL

REVOLUTION BY QUANTUM COMPUTING MACHINES?

Gordon E. Moore, co-founder of Intel, stated in 1965 that the number of transistors on the computer chip doubles approximately every two years, a phenomenon known as Moore's law. It is not a law of nature, but an observation of long-term technological change. About 42 years ago, in 1981, Richard P. Feynman proposed harnessing quantum physics to build a more powerful kind of computer – a quantum mechanical computer for simulating complex physical systems. Since then, the field was progressing slowly and later, in 1994, there was a boom in quantum computation with the introduction of an algorithm for factoring a composite number on a so-called quantum computer by Peter Shor who is a mathematician at Massachusetts Institute of Technology.

What is a quantum computer?

Quantum computers exploit the strange ability of subatomic particles to exist in more than one state at any time. Due to the way the extremely small particles behave, quantum computing operations can be performed faster, and consume less energy, than classical computers. In classical computing, a bit is a single piece of information that can exist in two states- 1 or 0. Quantum computing uses quantum bits, or 'qubits',



instead. These are quantum systems with two states. However, unlike a usual bit, they can store much more information than just 1 or 0, because they can exist in any superposition of these values.

Qubits are considered as separated physical objects with two possible distinct states, 0 and 1. The difference between classical bits and qubits is that we can also prepare qubits in a superposition of 0 and 1 and create nontrivial correlated states of a number of qubits, so-called entangled states.

Classical bits can be in two states - at either of the two poles of a sphere; a qubit can exist at any point on the sphere. This means a computer using these bits can store far more information while consuming less energy than a conventional computer.

How do quantum computers work?

Since quantum computers are not limited to binary states (0 or 1), they encode information into qubits, which can exist in superposition (when two waves or states meet and overlap or interact). Qubits represent atoms, ions, photons, or electrons and their respective control devices that are working together to act as computer memory and processor at the same moment. Because a quantum computer can maintain multiple states simultaneously, it has the potential to be millions of times more powerful than current supercomputers.

Quantum computers will harness the power of these atoms and molecules (rather than silicon- based processor chips) to perform memory and processing tasks. Quantum computers are capable of performing some calculations faster than any silicon computer.

One of the ongoing challenges in quantum computing has been the capacity of computer chips. According to literature, for a functioning quantum computer, one needs to pack these chips with millions of qubits bits that operate off the same concept as the binary bits that run your computer by signaling either 0 or 1, except that a qubit can exist as 0, 1, or as both of these potential states at once.

Until now, it has been difficult to pack more than a few dozen qubits onto a chip. However, there is a new design that aims to overcome the issues, incorporating traditional elements with novel design to accomplish what has not been accomplished before. However, it is still in the testing phase.