

「光」，是隨處可見的東西。不，「光」應該是讓我們眼睛隨處看到東西的東西才對。常聽說當一樣物質的速度超越光速時就會有不可思議的事情發生，例如穿越時空等等。那麼，到底光速有多快呢？



光速，意指光在真空中的速率，是一個物理常數，一般記作  $c$ ，精確值為 **299,792,458** 公尺每秒 ( $\approx 3.00 \times 10^8$  m/s)。根據狹義相對論，宇宙中所有物質和訊息的運動和傳播速度都不能超過  $c$ 。光速也是所有無質量粒子及對應的場波動（包括電磁輻射和重力波等）在真空中運行的速度。在相對論中， $c$  起到把時間和空間聯繫起來的作用，並且出現在廣為人知的質能等價公式中： $E = mc^2$ 。

光速= $3 \times 10^8 \text{ms}^{-1}$ ，這數值實在是太虛無縹緲了。不如一起測量出光速吧！

快要到情人節了，大家收到的巧克力除了能夠吃以外，還能夠計算出光速！我們可以利用微波爐的電磁波特性簡易測量光速。微波屬於電磁輻射，速度與光速相同。當微波爐加熱含水分又可融化的物質，如巧克力、日式棉花糖，其局部融化點間的距離便可計算出電磁波長 ( $\lambda$ )；配合微波頻率 ( $f$ )，便可計算電磁波速度 ( $v$ )。

Steps:

1. 將巧克力裝在盤子上，然後放進微波爐加熱半分鐘。
2. 測量並記錄巧克力上“最軟” - “最硬”之間的長度 ( $d$ )。



3. 從微波爐標牌上記錄微波的頻率 (frequency)。(例如 1234Hz)
4. 最後, 我們就能從波速 ( $v$ ) = 波長 ( $\lambda$ )  $\times$  頻率 ( $f$ ) 這條公式中測量出光速了。

## 實驗原理

取出巧克力後, 我們可以明顯看到巧克力不是均勻受熱的。因為微波是一種橫波 (transverse wave), 所以它的能量傳遞方式是波浪形的。正正因為是以波浪形通過巧克力, 所以巧克力才會不均勻地受熱, 以致於表面有軟硬之分。軟的部分代表此處微波處於峰值 (crest) 的高熱量。硬的部分代表此處微波處於谷值 (trough) 的低熱量。

而最軟和最硬之處之間的距離 ( $d$ ) 就是一段微波從峰值 (crest) 到谷值 (trough) 之間的距離, 也是  $1/2$  波長。將  $d$  乘以 2 就能得出微波的波長 ( $\lambda$ )。將  $\lambda$  乘以微波爐的頻率 ( $f$ ), 我們就能得出光的速度啦! ( $c = f \lambda$ )

# 5 Things You Didn't Know About Light

## 1) The light from the aurorae is the result of solar wind

When solar winds from cosmic events like solar flares reach Earth's atmosphere, they interact with particles of oxygen atoms, causing them to emit stunning green lights. The waves of light - termed the aurora borealis and aurora - are typically green, but hues of blue and red can be emitted from atmospheric nitrogen atoms, as well.

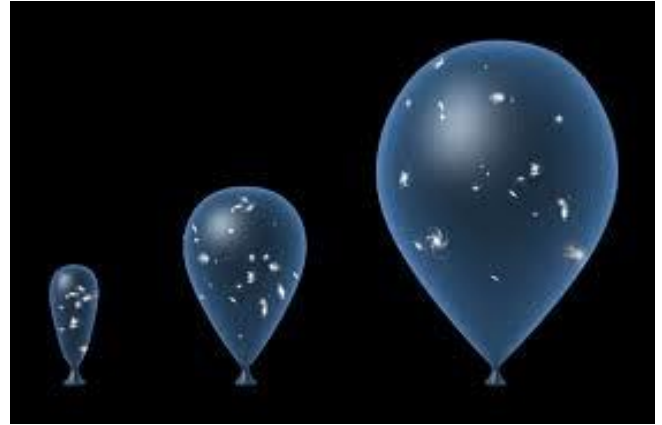


## 2) Neutrinos are not the first things to apparently outpace the speed of light

The Hubble telescope has detected the existence of countless galaxies receding from our point in space at speeds of light. However, this still does not violate Einstein's theories on relativity because it is space - not the galaxies themselves - that is expanding away (a symptom of the Big Bang), and "carrying" the show galaxies along with it.

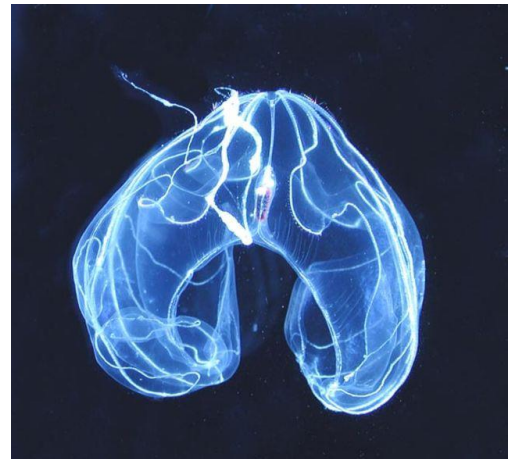
### 3) This expansion means there are some galaxies whose light we'll never see

As far as we can tell, the Universe is expanding at an accelerating rate. On account of this, there are some who predict that many of the Universe's galaxies will eventually be carried along by expanding space at a rate that will prevent their light from reaching us at any time in the infinite future.



### 4) Bioluminescence lights the ocean deep

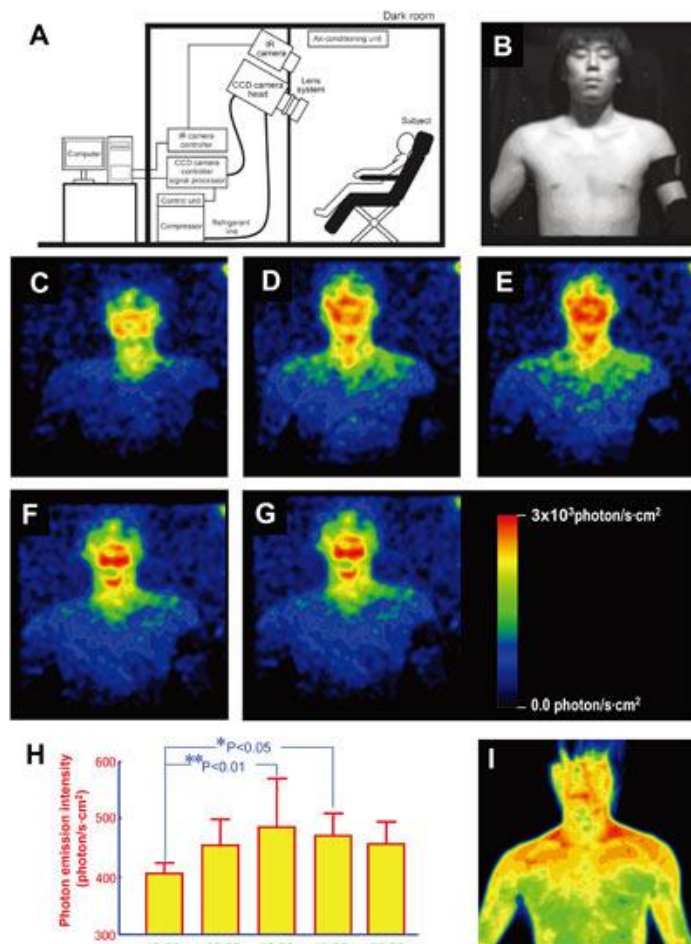
More than half of the visible light spectrum is absorbed within three feet of the ocean's surface; at a depth of **10 meters**, less than **20% of the light** that entered at the surface is still **visible**; by **100 meters**, this percentage drops to **0.5%**. In fact, at depths of over **1000 meters** — a region of the ocean dubbed the "**aphotic zone**" — there is **NO detectable light** whatsoever. As a result, the **largest source of light** in the Earth's **oceans** actually emanates from **animals residing in its depths**; marine biologists estimate that between 80 and 90 percent of deep-sea creatures are bioluminescent .



### 5) Bioluminescence: also in humans!

**Bioluminescence** isn't just for jellyfish and the notorious, nightmare-inducing Anglerfish; in fact, **humans emit light**, too. **All living creatures produce some amount of light as a result of metabolic biochemical reactions**, even if this light is **not readily visible**. Back in 2009, a team of Japanese researchers reported that "**the human body literally glimmers**," after using incredibly sensitive cameras (**the light is a thousand times weaker than the human eye can perceive**) to capture the first evidence of human bioluminescence, pictured here. It's worth mentioning that images C, D, E, F, and G, are not thermal images, but actually pictures of emitted *photon* intensity over the course of an average day.

This time-dependent photon emission is illustrated in the chart shown in figure H. Figure I shows the thermal image you're more accustomed to seeing.



# QAQ RELAX TIME @W@

	4		2	1				
8		7					9	
2			8			4		1
3					2	9		5
		5	7		8	6		
7		6	5					4
5		1			4			9
	6					7		8
				2	7		5	

Answer

6	9	1	7	2	9	8	3	4
8		7	4	1	5	3	2	6
9		3	2	4	8	1	7	5
4		1	8	3	9	5	6	7
3		6	2	3	8	7	4	1
5		7	4	6	8	1	9	5
1		4	1	6	2	9	7	3
2		6	1	9	7	8	5	4
8		9	2	6	3	4	7	1
7		3	8	1	5	2	6	4

## ! Comic Corner!

SPEED OF LIGHT - BY MEERASAPRA

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In February, **Science Society** will hold a **competition** called 「科學透視 Show Science」

The **Final** will be held on **24/2!!**

**Prizes are given for the winners!**

**Deadline** of application: **13/2!!**

For more details, please refer to the **poster** posted on the board, thank you!

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