

## Hippolyte Fizeau and the Speed of Light



Hippolyte Fizeau (1819-1896)  
photo: Charles Reutlinger, Académie des Sciences,  
Smithsonian Institution Libraries

On September 23, 1819, French physicist **Armand Hippolyte Louis Fizeau** was born. He is well known for his calculation of the speed of light and his suggestion to use length of a light wave be used as a length standard.[4]

### **Hippolyte Fizeau – Early Years**

Hippolyte Fizeau was born in Paris as the eldest son of Béatrice and Louis Fizeau, who was professor of Pathology at the Paris Medical School. He attended the prestigious Collège Stanislas in Paris where he became a friend with one of his fellow students, Léon Foucault.[6] In September 1839. Famous Louis Daguerre [5] put on a free course on his new photographic techniques in Paris and the two friends Fizeau and Foucault attended. They watched Daguerre expose a plate in a camera pointing out the window, then after talking about his process for about 30 minutes, he developed the plate using a variety of chemicals to reveal the picture. Although Fizeau and Foucault were impressed they also realized the limitations of the process – it would be wonderful to be able to take portraits, they thought, but the subject could not be expected to remain motionless for 30 minutes. After the course ended they began to experiment to try to speed up the process. [1]

### **Astronomical Photography**

Fizeau entered the Paris Medical School in 1840, but he soon gave up on medicine because of severe migraines and spent some time travelling during which time he regained his health. His new focus of attention should be physics. He attended Arago's lectures at the Observatory, and enrolled in a course on optics at the Collège de France. Furthermore, he began to deeply study notebooks containing the lecture notes taken by his brother who attended courses at the École Polytechnique. It was Arago,[7] who encouraged Fizeau and Foucault in 1845 and suggested that they might attempt to make photographs of an image of the sun produced by a telescope. Thus, Fizeau and Foucault produced what is considered the first astronomical photography.

### **Measuring the Speed of Light**

It was in the field of optics that Fizeau earned a lasting reputation. The original inspiration came from François Arago, who looked for a decisive test between the corpuscular and wave theories of light. If the wave theory was true, the velocity of light had to be greater in moving media, such as water flowing in a tube. The project implied the working out of a terrestrial method of measuring the speed of light, and Arago suggested that this could be done by using a rotating mirror.[2] In 1849, Fizeau calculated a value for the speed of light more precise than the previous value determined by Ole Rømer in 1676.[8] He used a beam of light reflected from a mirror eight kilometers away. The beam passed through the gaps between teeth of a rapidly rotating wheel. The speed of the wheel was increased until the returning light passed through the next gap and could be seen.

### **Discarding the Ether Theory**

Fizeau calculated the speed of light to be 313,300 kilometres per second, which was within about five percent of the correct value (299,792.458 kilometers per second). Fizeau published the first results obtained by his method for determining the speed of light in 1849. In 1851 he carried out a series of experiments in an attempt to detect the luminiferous ether—a hypothetical material that was thought to occupy all of space and to be necessary for carrying the vibrations of light waves. The experimental results failed to demonstrate the existence of

the ether, but his work helped lead to the discarding of the ether theory in the early years of the 20th century.[3] Fizeau was elected a member of the Academy of Sciences in 1860, an a member of the Bureau des Longitudes in 1878. He received the decoration of the Legion of Honour in 1849 and became officer in 1875. In 1866 the Royal Society of London awarded him the Rumford Medal.

### Further Achievements

Fizeau also worked in the field of thermodynamics, where he constructed an interference dilatometer to measure the thermal expansion of solid bodies. In 1850 he measured the speed of propagation of electricity in conductors with Eugène Gounelle (1821-1864). In 1853 he described the installation of a capacitor to increase the efficiency of induction. He then studied the thermal expansion of solids and applied the phenomenon of light interference to measure the expansion of crystals.

Hippolyte Fizeau died at Venteuil on 18 September 1896, at age 76.

### References and Further Reading:

- [1] [Hippolyte Fizeau at MacTutor's History of Mathematics](#)
- [2] [Hippolyte Armand Louis Fizeau Facts at YourDictionary.com](#)
- [3] Chisholm, Hugh, ed. (1911). "[Fizeau, Armand Hippolyte Louis](#)". *Encyclopædia Britannica*. Vol. 10 (11th ed.). Cambridge University Press. p. 452.
- [4] [Fizeau, Foucault and Astronomical Photography](#), SciHi Blog
- [5] [Making Photography Really Operational – Louis Daguerre](#), SciHi Blog
- [6] [Leon Foucault demonstrating the Effect of the Earth's Rotation](#), SciHi Blog
- [7] [Scientist and Politician François Arago](#), SciHi Blog
- [8] [Ole Rømer and the Speed of Light](#), SciHi Blog
- [9] Hockey, Thomas (2009). *The Biographical Encyclopedia of Astronomers*. Springer Publishing
- [10] O'Connor, John J.; Robertson, Edmund F., "[Armand-Hippolyte-Louis Fizeau](#)", *MacTutor History of Mathematics archive*, University of St Andrews.
- [11] [Hippolyte Fizeau at Wikidata](#)
- [12] [NASA | Einstein's Cosmic Speed Limit, NASA Goddard @ youtube](#)
- [13] Solbert, Oscar N.; Newhall, Beaumont; Card, James g., eds. (May 1952). "[Hippolyte-Louis Fizeau \(1819–1896\)](#)". *Image, Journal of Photography of George Eastman House*. Rochester, N.Y.: International Museum of Photography at George Eastman House Inc. **1** (5): 3–4.
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- [15] [Timeline of French Physicists](#), via Wikidata and DBpedia