

# Sir Chandrashekhara Venkata Raman (C.V.Raman)

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- Raman was an **Indian physicist** who carried out ground-breaking work in the field of light scattering.
- He was **born on 7th November 1888** in Trichinopoly, Tamil Nadu.
- Because of his father's interest, he appeared for the **Financial Civil Services (FCS) examination** and topped it.
- In 1907, he went to Calcutta and joined as Assistant Accountant General.
- Meanwhile he **conducted research** at the Indian Association for the Cultivation of Sciences on the **areas of vibrations and acoustics**.
- He got an opportunity to join the **University of Calcutta in 1917, as the first Palit Professor of Physics**.
- He held the position of **permanent visiting professor at BHU**.
- On **28 February 1928, Raman led an experiment with K. S. Krishnan, on the scattering of light**, when he discovered what is called the Raman effect.
- It gave further **proof of the quantum nature of light**.
- The field of Raman spectroscopy came to be based on this phenomenon and **Ernest Rutherford referred to it in his presidential address** to the Royal Society in 1929.
- Raman was **president of the 16th session of the Indian Science Congress in 1929**.
- He won the **1930 Nobel Prize in Physics** "for his work on the scattering of light and for the discovery of the Raman effect".
- He was the **first Asian and first non-white to receive any Nobel Prize in the sciences**.

- In 1933, Venkatraman became the **first Indian director of the Indian Institute of Science (IISc)**.
- In 1943, he started a company called Travancore Chemical and Manufacturing Co. Ltd. (now known as TCM Limited) which manufactured potassium chlorate for the match industry.
- In 1947, he was appointed as the **first National Professor** by the new government of Independent India.
- Raman retired from the IISC in 1948 and **established the Raman Research Institute in Bangalore in 1949**.
- He served as its director and remained active there until his death in 1970.

### His works

**Raman Effect:** Raman conducted research about **light scattering in gases, liquids and solids**. He and his team used **monochromatic light** – sunlight that had been filtered to leave only a single color – and found that a variety of different liquids indeed changed the color of the light. They **first observed this in April 1923, but very weakly**.

When **light meets particles that are smaller than the light's wavelength, the light spreads in different directions**. This occurs when photons encounter molecules in a gas. In **1928** C.V.Raman discovered that a **small portion of the scattered light acquires other wavelengths than that of the original light**.

This is **because some of the incoming photons' energy can be transferred to a molecule, giving it a higher level of energy**. His team experimented to find a particularly strong color change in light scattered by glycerol. They observed the effect in gases, crystals and glass. In Raman's work the **light scattered by liquids was polarized, which ruled out the possibility of fluorescence**.

This phenomenon which came to be known as the **Raman effect – a**

**color change accompanied by polarization**, had never been seen before. The inelastic scattering was a very strong confirmation of quantum theory.

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(A) Blue light approaches a molecule, and then (B) Lower energy green light leaves the molecule.

This is **inelastic scattering**, i.e. the light has given some of its energy to the molecule, causing it to vibrate more strongly. Only **about 1 in ten million photons undergoes inelastic scattering**.

**Raman Spectroscopy (1929)**: Raman showed that the **energy of photons scattered inelastically serves as a 'fingerprint' for the substance the light is scattered from**. Raman spectroscopy is now commonly used in chemical laboratories all over the world to identify substances. It is also **used in medicine to investigate living cells and tissues, even detecting cancers** without causing harm. Laser light rather than sunlight is used as the source of photons.

**Work on acoustics**: Raman **worked on the acoustics of musical instruments**. He worked out the theory of transverse vibration of bowed strings, on the basis of superposition of velocities. He was also the **first to investigate the harmonic nature of the sound of Indian drums** such as the tabla and mridangam. He also investigated the **propagation of sound in whispering galleries**.

**Raman-Nath theory**: Raman and his student, Nagendra Nath, provided the correct **theoretical explanation for the acousto-optic effect** (light scattering by sound waves), in a series of articles. **Modulators, and switching systems** based on this effect have enabled optical communication components based on laser systems.

**Other investigations carried out by Raman were** experimental

and theoretical studies on the diffraction of light by acoustic waves of ultrasonic and hypersonic frequencies (published b/n 1934–1942) and those on the effects produced by X-rays on infrared vibrations in crystals exposed to ordinary light.

### **Honours:**

- India celebrates **National Science Day** on 28 February of every year to commemorate the discovery of the Raman effect in 1928.
- He was elected a **Fellow of the Royal Society in 1924**.
- He was **knighthooded in 1929** for his discovery of the Raman Effect, becoming Sir Chandrasekhara Venkata Raman.
- In 1930 he won the **Nobel Prize** in Physics.
- In 1941 he was awarded the **Franklin Medal**.
- In **1954 he was awarded the Bharat Ratna**.
- He was awarded the **Lenin Peace Prize** in 1957.
- **He resigned from the Fellowship of the Royal Society in 1968** for unrecorded reasons, the **only Indian FRS ever to do so**.
- The American Chemical Society and the Indian Association for the Cultivation of Science in 1998 recognised Raman's discovery as an **International Historic Chemical Landmark**.
- **Postal stamps** featuring Raman were issued in 1971 and 2009.