OPTHAMOLOGY : SCIENCE & TECHNOLOGY

NEWS : When physics merged with biology to revolutionise ophthalmology

WHAT'S IN THE NEWS ?

Femtosecond lasers, with ultra-short pulses, enable precise surgeries and have potential applications in vision correction, cataract surgery, and cancer therapy.

Einstein's Theory of Stimulated Emission (1917):

- **Introduction:** Albert Einstein introduced the concept of stimulated emission, a critical process where an excited electron releases a photon.
- **Mechanism:** The released photon has the same energy, phase, and direction as the incident photon, leading to a chain reaction of photon emission.
- **Significance:** This process is the foundation of laser technology, enabling the amplification of light into a coherent, highly focused beam.

Chirped Pulse Amplification (CPA) (1980s):

- **Developers:** Gérard Mourou and Donna Strickland.
- **Process:**
    - **Stretching:** A short laser pulse is first stretched in time to reduce its peak power.
    - **Amplification:** The stretched pulse is then amplified without damaging the amplifying material.
    - **Compression:** Finally, the pulse is compressed back to its original duration, resulting in an ultrashort, high-intensity laser pulse.
- **Impact:** CPA revolutionized laser technology, allowing for the creation of powerful laser pulses without damaging the materials involved in the amplification process.
- **Recognition:** This breakthrough earned Mourou and Strickland the Nobel Prize in Physics in 2018.
- **Applications:** CPA has significant applications in various fields, including medical surgery, materials processing, and scientific research.

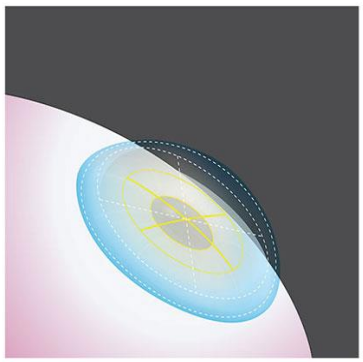
Femtosecond Lasers:

- **Pulse Duration:** Emits light pulses lasting only a few femtoseconds (quadrillionths of a second).
- **Wavelength:** Typically operates in the infrared range with a wavelength of 1053 nm.
- **Precision:** The ultra-short pulses allow for extremely precise cutting of tissues with minimal heat diffusion to surrounding areas, reducing collateral damage.
- **Applications:**
    - **Medical Surgeries:** Used in vision correction procedures like LASIK, cataract surgeries, and potentially in cancer therapies.
    - **Cancer Therapy:** Offers the possibility of targeting and destroying cancer cells with high precision while sparing healthy tissues.

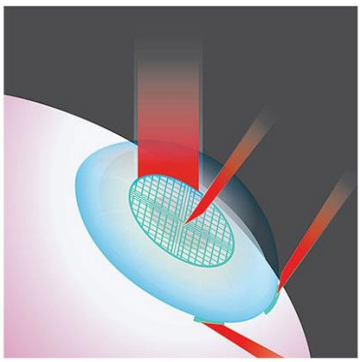
- **Source: https://epaper.thehindu.com/ccidist-ws/th/th_delhi/issues/97332/OPS/GV8D8U1EG.1+GHQD8U1TR.1.html**

Cataract Surgery

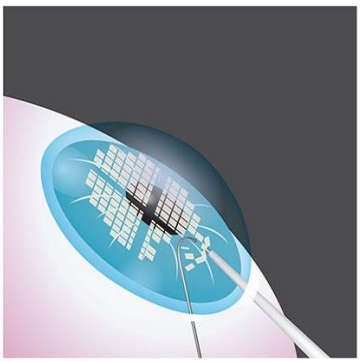
(bladeless laser method)



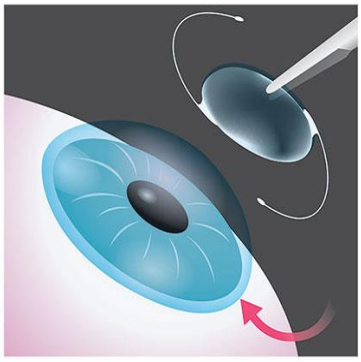
① Computer scan diameter lens.



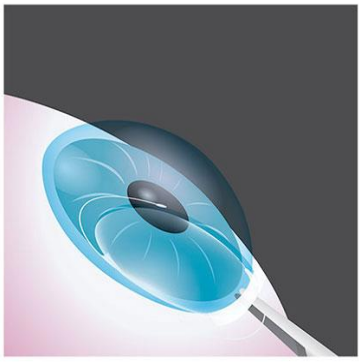
② Use femtosecond laser for cutting around lens In pieces, and cutting open for small tool inserts.



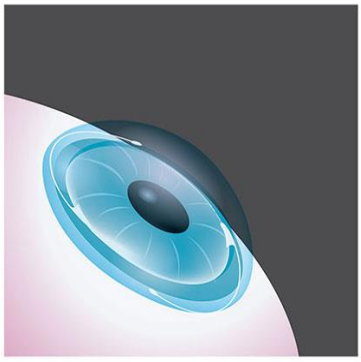
③ Use small rake and suction tool remove scrap lens.



④ Artificial intraocular lens (IOL) is placed in eye.



⑤ Insert artificial intraocular lens (IOL) In the opens tool slots.



⑥ Artificial intraocular lens (IOL) into position, The surgery is finish.