



# Thirty Meter Telescope (TMT)

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## Why in News?

Recently, Indian researchers at the Indian Institute of Astrophysics (IIA) in Bengaluru have developed a **new online tool to create a comprehensive star catalogue** for the **Adaptive Optics System (AOS)** of the upcoming **Thirty Meter Telescope (TMT)**.

## What are the Key Features of Thirty Meter Telescope (TMT)?

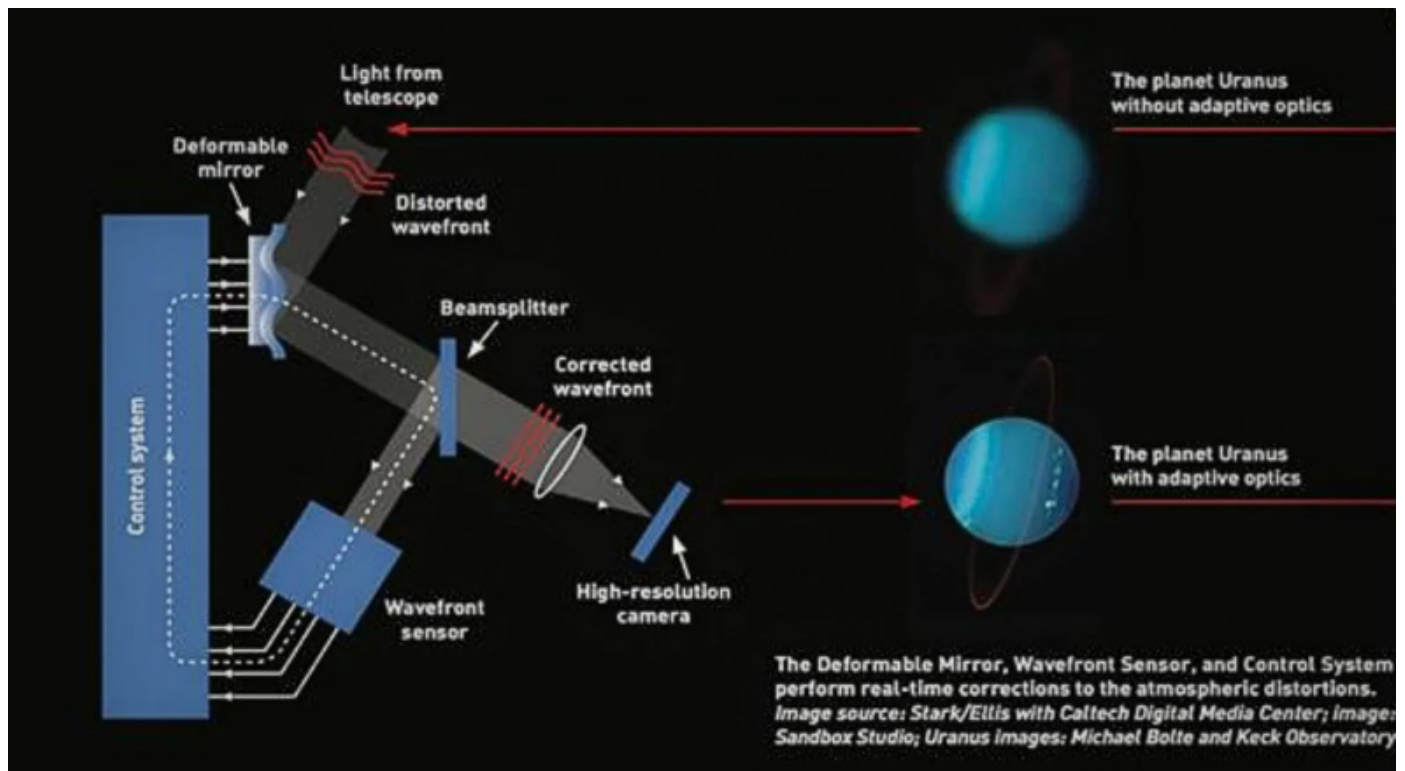
### ▪ About:

- It is an **ambitious international project** coming up at Mauna Kea in Hawaii, involving **India, the US, Canada, China, and Japan** that aims to **advance the understanding of the universe significantly**.
  - **India is a key partner in the TMT project**, with India TMT Center at IIA leading the national collaboration.
- The **TMT is a next-generation astronomical observatory** designed to provide **unprecedented resolution and sensitivity** with its massive 30-meter primary mirror, advanced adaptive optics system, and state-of-the-art instruments.
- The **TMT, the Giant Magellan Telescope, and the [European Southern Observatory's Extremely Large Telescope](#)** represent the **future of ground-based astronomy**.

### ▪ Primary Goals:

- **Study the [early universe](#)** and the formation and evolution of the first galaxies and stars after the Big Bang.
- **Investigate the formation, structure, and evolution** of galaxies across cosmic time.
- **Study the relationship** between supermassive black holes and their host galaxies.
- **Investigate the formation of stars** and planetary systems.
- **Characterise [exoplanets](#)** and study their atmospheres.

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## AO System in Telescope

### ▪ Adaptive Optics System (AOS) and New Online Tool:

- The TMT's AOS, known as the Narrow Field Infrared Adaptive Optics System (NFIRAOS), **uses deformable mirrors and laser guide stars (LGS) to correct atmospheric turbulence**, enhancing image resolution.
- This facility will **project up to nine lasers into the sky to create artificial guide stars**. However, **atmospheric turbulence affects** these laser beams, so measuring atmospheric tip-tilt is uncertain.
  - To correct these effects, the AO system **requires feedback from three real stars**, known as **Natural Guide Stars (NGS)**.
- **Researchers have developed an automated code** that can be **used as an online tool** to create a catalogue of Near Infrared (NIR) stars.
  - The **automated code can compute the expected near-infrared magnitudes of stellar sources** identified in various optical sky surveys using their optical magnitudes.

### Other Major Telescopes

- [PRATUSH Telescope](#)
- [James Webb Telescope](#)
- [Square Kilometre Array Observatory \(SKAO\)](#)
- [Kodaikanal Solar Observatory](#)
- [Euclid Mission for Dark Matter and Dark Energy](#)
- [Tokyo Atacama Observatory](#)
- [3-D Map of the Universe](#)

## Other Similar Projects India is Part of

- **CERN (European Council for Nuclear Research):** Project of the “God particle”
  - **CMS:** CMS is one of the experiments that discovered the Higgs Boson, or ‘God particle’
  - **ALICE:** ALICE created conditions that existed at the time of big bang
- **International Facility for Antiproton and Ion Research (FAIR):** Studying the building blocks of matter and the evolution of the Universe.
  - **NUSTAR (Nuclear Structure, Astrophysics and Reactions)**
  - CBM (Compressed Baryonic Matter)
  - PANDA (Antiproton Annihilation at Darmstadt)

## UPSC Civil Services Examination, Previous Year Question (PYQ)

### Prelims:

**Q1. In the context of modern scientific research, consider the following statements about ‘IceCube’, a particle detector located at South Pole, which was recently in the news: (2015)**

1. It is the world’s largest neutrino detector, encompassing a cubic kilometre of ice.
2. It is a powerful telescope to search for dark matter.
3. It is buried deep in the ice.

**Which of the statements given above is/are correct ?**

- (a) 1 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

**Ans: (d)**

**Q2. In the context of space technology, what is “Bhuvan”, recently in the news? (2010)**

- (a) A mini-satellite launched by ISRO to promote distance education in India
- (b) The name given to the next Moon Impact Probe, for Chandrayan-II
- (c) A geoportal of ISRO with 3D imaging capabilities of India
- (d) A space telescope developed by India

**Ans: C**

