3.6-meter telescope detects kilonova emission

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In news– First data taken by the 3.6-meter telescope has detected unexpected kilonova emission from ‘a long-duration gamma-ray burst’.

Key findings-

- While tracing a burst of high-energy light detected in 2021, from the outskirts of the Milky Way located approximately 1 billion light-years away, astronomers have spotted the first astronomical event in which a long gamma-ray bursts (GRBs) has been accompanied by the unexpected **discovery of a kilonova emission.**
- Generally, **kilonova are visible and infrared light associated with short-period GRBs** thought to be heat produced by the radioactive decay of heavier elements.
- **Photometric observations taken with the 3.6 m Devasthal Optical Telescope(DOT) have provided vital information on the earliest phase of a kilonova ever detected,** radically changing the understanding of scientists about the origin of GRBs.
- **GRBs are powerful astronomical cosmic bursts of high-energy gamma-ray. GRB emits more energy in a few seconds than our Sun** will emit in its lifetime and has **two distinct emission phases:**
    1. **The short-lived prompt emission** (the initial burst phase that emits gamma-rays).
    2. A long-lived multi-wavelength afterglow phase.
- **The prompt emission (initial gamma-ray emission) of GRBs are automatically discovered** by space-based gamma-ray missions such as NASA’s Fermi Gamma-ray Space Telescope, Neil Gehrels Swift Observatory, and India’s AstroSat.
- In recent years, scientists have discovered a special

phenomenon called a **kilonova of visible and infrared light with short-period GRBs, also known as a potential source of gravitational waves.**

- It has been hypnotized that the heat produced by the radioactive decay of heavier elements may emit kilonova. This process also produces heavier elements, such as gold and platinum.
- However, observing kilonovas at near-infrared wavelengths is technically challenging, and **only a few telescopes on Earth, including the 3.6-m DOT of the Aryabhatta Research Institute of Observational Sciences (ARIES), can detect kilonova and gravitational wave objects** at these wavelengths upto faint limits.
- The scientists from the ARIES, an autonomous institute of DST, used data from the **3.6 m DOT** of the ARIES along with other telescopes, including Hubble Space Telescope in studying the aftermath of the long GRB (GRB 211211A), detected by the NASA's Neil Gehrels Swift Observatory and the Fermi Gamma-ray Space Telescope on December 11, 2021.
- The high-energy outburst lasted about a minute, and follow-up observations taken from the 3.6-meter Devasthal Optical Telescope identified a kilonova.
- The spectral energy distribution of GRB afterglow is usually explained in terms of non-thermal emission (due to synchrotron radiation).
- However, in this event, both thermal and non-thermal emissions were included in the spectral energy distribution of the afterglow, modeled using the magnificent and dim observations of the 3.6 m DOT.

3.6 m Devasthal Optical Telescope(DOT)-

- It is a clear-aperture **Ritchey–Chrétien telescope built by Aryabhatta Research Institute of Observational Sciences(ARIES).**
- It is **located at the Devasthal Observatory site near**

Nainital, Kumaon, India. ARIES operates another 1.3m telescope at the same location.

- The telescope was activated remotely in March 2016 by Indian and Belgian Prime Ministers.
- The telescope optics has been built in collaboration with the Belgian firm Advanced Mechanical and Optical System (AMOS).
- The 3.6m DOT is currently the **largest reflecting telescope in Asia.**
- It intends to fill a large longitudinal gap in the 4m class of telescopes in the Asia region.
- It features an optical spectrograph, a CCD imager and a near-infrared spectrograph.
- The telescope is also the **first of its kind in India that features an active optics system**, featuring a wavefront sensor and pneumatic actuators which compensates for small distortions in the shape **of the 4.3 tonne mirror due to gravity** or atmospheric aberrations.