

Quantum diamond microscope

- Researchers from the Indian Institutes of Technology (IIT) at Mumbai and Kharagpur have built a microscope that can image magnetic fields within microscopic two-dimensional samples that change over milliseconds.
- This has a huge potential for scientific applications, such as in measuring biological activity of neurons and dynamics of vortices in superconductors.
- This is the first time that such a tool has been built to image magnetic fields that change within milliseconds.
- Signals in nature exhibit a range of frequencies magnetism in geological rock samples and rare earth magnets can be constant over months; magnetic nanoparticle aggregation inside living cells takes place in minutes; action potentials in neurons are fast, taking milliseconds, whereas precession of atomic spins in complex molecules takes only microseconds.
- The instrument that this team has built works in the millisecond range.
- The key aspect of this sensor is a “nitrogen vacancy (NV) defect centre” in a diamond crystal.
- Such NV centres act as pseudo atoms with electronic states that are sensitive to the fields and gradients around them (magnetic fields, temperature, electric field and strain).
- “Notably, the fluorescence emitted from these NV centres encodes the magnetic field information,
- Earlier reported magnetic field imaging frame rates were close to 1-10 minutes per frame.
- This would increase to about half an hour per frame for challenging samples like biological cells.
- The instrument built by this group exhibits an imaging frame rate of about 50-200 frames per second, which would translate into a frame acquisition time of about 2-5 milliseconds.

THE HINDU

Monkey pox virus

What is the monkey pox virus?

- Monkey pox is not a new virus.
- The virus, belonging to the poxvirus family of viruses, was first identified in monkey’s way back in 1958, and therefore the name.
- The first human case was described in 1970 from the Democratic Republic of Congo and many

sporadic outbreaks of animal to human as well as human to human transmission has occurred in Central and West Africa in the past with significant mortality

- Since the transmission occurs only with close contact, the outbreaks have been in many cases self-limiting.
- While monkeys are possibly only incidental hosts, the reservoir is not known.
- It is believed that rodents and non-human primates could be potential reservoirs.

Does the virus mutate?

- Monkey pox virus is a DNA virus with a quite large genome of around 2,00,000 nucleotide bases.
- While being a DNA virus, the rate of mutations in the monkey pox virus is significantly lower (~1-2 mutations per year) compared to RNA viruses like SARS-CoV-2.

THE HINDU

Heatwaves and cyclone Amphan

- Rising greenhouse gas emission is the primary factor for anthropogenic (human-induced) climate change.
- The increase in carbon dioxide concentration can trap the radiation

into the atmosphere and not let it go into space.

- This trapping of the extra energy increases the average surface air temperature and warms the climate that we know as global warming.
- As the capacity of the atmosphere to absorb the heat is very less, more than 90% of the extra heat that has been trapped in the climate system has been absorbed by the oceans since 1970, according to IPCC AR5, and IPCC AR6 reports.
- Due to this, oceans are warming globally from the surface to deeper depths.
- The warming of the oceans has severe consequences such as increasing intensity and frequency of extreme events, rising sea levels, melting glaciers, and changing the weather pattern across the globe.
- Faster warming previous studies have shown that due to global warming, the tropical Indian Ocean, at the surface, is warming at a faster rate as compared to the rest of the global ocean.
- The high sea surface temperatures are more susceptible to generating extreme temperature conditions that persist over days to months and are termed as Marine Heatwaves (MHWs).

- This intense warming of the ocean due to MHW has severe socio-economic consequences such as fish mortality, and coral bleaching, and also has the potential to interact and modify other extreme events such as tropical cyclones.
- The anthropogenic warming of the oceans and atmosphere facilitates the generation and intensification of extreme events such as MHWs and tropical cyclones.
- Both marine heat waves and tropical cyclones are the extreme events of the ocean-atmosphere coupled system.
- Our study, published in the Frontiers in Climate, is the first study conducted in the Indian Ocean that investigates the interaction between a marine heatwave and super cyclone Amphan in the Bay of Bengal in May 2020.
- Amphan was the first super cyclone in the Bay of Bengal in the last 21 years and intensified from category 1 (cyclonic storm) to category 5 (super cyclone) in less than 24 hours.
- Amphan was also the costliest tropical cyclone on record in the North Indian Ocean, with reported economic losses of approximately \$14 billion in India, according to the World Meteorological Organisation and 129 casualties across India and Bangladesh.
- According to the latest IPCC report (AR6), Amphan was the largest source of displacement in 2020, with 2.4 million displacements in India alone, out of which around 8,00,000 was pre-emptive evacuation by the authorities
- The cause -found the presence of a strong MHW beneath the track of the cyclone with an extremely high anomalous sea surface temperature of more than 2.5°C that coincided with the cyclone track and facilitated its rapid intensification in a short period.

Sea surface temperature

- The Bay of Bengal exhibits high sea surface temperatures (about 28°C) throughout the year and is more prone to tropical cyclones.
- The Bay of Bengal is home to about 5-7% of the total number of tropical cyclones occurring globally each year and this makes the North Indian Ocean vulnerable to the highest number of fatalities globally.

THE HINDU

Black Death

- A strain of *Yersinia pestis*, the bacterium responsible for the Black

Death pandemic in the 1300s (AD 1346–1353), has been traced back to a fourteenth-century outbreak in what is now Kyrgyzstan.

- The area was located on the Silk Road trade route, which might have helped the Black Death pandemic to spread westward.

THE HINDU

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