Friendly Floatees Rubber Ducks Revealing Ocean Secrets

IN the year 1992, during transportation of a consignment of 29,000 plastic toys consisting of yellow ducks, red otters, green frogs and blue turtles, a cargo ship named *Ever Laurel* got caught in a storm in the North Pacific Ocean. The consignment bound from Hong Kong to Tacoma, Washington, released huge numbers of plastic toys into the ocean.

The incident attracted much attention. Seattle-based oceanographers Curtis Ebbesmeyer and James Ingraham, who were at that time working on an ocean surface current model, noticed the event. Approximately 29,000 floaters presented researchers with 600 data points and gained popularity as the Friendly Floatees.

Over an extended period, the Floatees were being discovered at various locations, starting from the Scottish Islands to Newfoundland, Eastern Australia to Tacoma, along the coasts of Hawaii and Japan. A detailed study of the floating pattern of these plasticized items led to the discovery of various ocean currents. The first of them was found washed up on the beach at Silka, Alaska, in November 1992; a location 850 miles away from its bound destination of Washington. The next year, 400 toys were reported on the Eastern Coast of the Gulf of Alaska. A number of them moved northwards and were discovered on the beaches of Hawaii, along the coast Linda of Japan and various other Asian countries.

Based on the available data and resources, Jim Ingraham developed a computer model OSCUR (Ocean Surface Current Simulation). The model was powered by the use of air pressure to calculate the direction and speed of ocean currents, which helped Ebbesmeyer to predict the location of recovery of these Floatees. As the plastic goodies began to slowly emerge in various parts of the world, Ebbesmeyer's predictions kept hitting the mark, rendering the model viable. Various theories suggest that the Floatees might have been pushed northwards through the Bering Strait and trapped in the Artic back ice, though such claims remain unconfirmed.

A decade has gone by with the Floatees still making the rounds of the ocean, without any possible degradation. This led scientists to believe that they travelled a much longer distance and that plastic degradation is an unusually slow process.

In 2012, Erik von Sebille from the University of New South Wales in Australia predicted the existence of six major garbage patches in the ocean which was further detected through satellite-tracked drifters. The information led to the discovery of the largest garbage patch in the North Pacific Gyre which has developed into a massive island of floating debris containing tiny plastic fragments and chemical sludge. Geologists are of the opinion that soon plastics might become a part of the rock record, deposited on the beaches or in the deep ocean. Providing viability to this opinion are US researchers, who described a new type of solid rock found in Hawaii, containing plastic bags, rope and bottle tops. It is being termed as plastiglomerate.

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Miniature ducks find themselves braving the deep dark waters of the ocean

Arctic Sea Ice is Melting Faster than Ever



Rahul Mohan, Dr Avinash Kumar, and Juhi Yadav (L to R), scientists at NCPOR, Goa

A recent study by the National Centre for Polar and Ocean Research (NCPOR), Goa, India, has pointed out that the Arctic sea ice is melting at an alarming rate, especially during boreal or northern hemisphere summer. The study published in the journal *Heliyon*, highlights the increasing decline of the Arctic sea ice due to climate change. It reports that September sea ice extent declined to 4.71 million square kilometres (km^2) in 2018, its lowest in the past four decades.

The study to measure the extent of Arctic sea ice loss was led by Dr Avinash Kumar and his team of scientists comprising Dr Juhi Yadav and Dr Rahul Mohan, from NCPOR. "Seasonal sea ice extent of 2018 recorded minimum between September 19 and 23. Prior to 19 September 2018, sea ice extent had declined at a rate of nearly 14 thousand km^2 per day which was significantly faster than in most previous years," observed Dr Kumar.

The study also showed that September of 2018 was the third warmest on record, with temperature differences of the air above the Arctic Ocean ($\sim 3.5°C$) slightly higher than that of the Arctic land ($\sim 2.8°C$).

The decline in sea ice can lead to accelerated global warming and climate changes. "The faster loss of sea-ice for the whole Arctic Ocean during September demonstrates that there are substantial variations in surface air temperature, and there is a correspondence between the fluctuations in surface air temperature in the Arctic and global regions," added Dr Avinash Kumar.

The Arctic is warming twice as fast than the rest of the globe, a phenomenon known as arctic amplification. Arctic sea ice loss is attributed to several factors such as rising global temperatures. The study suggests that due to more open seas in winters, the growth of sea ice is delayed, leading to a disproportionate loss of sea ice occurring during summer.

For the study, researchers obtained data of arctic ice extent, thickness, and volume from 1979-2018 from globally-available satellite data and applied modelling techniques. They also studied its correlations with atmospheric and surface temperatures and sea pressure. As a result, they were able to see how ice in the arctic region has changed over the last four decades. It also helped them to predict the possible sea ice scenario in the coming years. The group is now planning to expand their work to study how sea ice melting and intrusion of warm ocean waters are related.

India Science Wire

IUCAA to Build an Optical Atomic Clock with Unprecedented Accuracy

THE Inter-University Center for Astronomy and Astrophysics (IUCAA) in Pune aims to establish a state-of-the-art Precision & Quantum Measurement Laboratory (PQM-Lab) that will soon come up with an optical atomic clock with ultra-high precision – the clock will not miss a second over the age of the universe (13.8 billion years).

The optical atomic clock will be a masterpiece of science and engineering employing the principles of quantum mechanics to achieve such unprecedented accuracy. Quantum computer, quantum internet and secure communication are going to change the world completely in the near future.

The Department of Science and Technology, India, has launched a flagship programme called Quantum Enabled Science and Technology (QuEST), a collaborative programme of leading research institutes in India. DST has sanctioned about Rs 300 crore to 51 research proposals based on Cryptography, Cryptanalysis, Quantum metrology, Quantum communication and Quantum computers. Establishment of an 'optical atomic clock' is among these research projects.

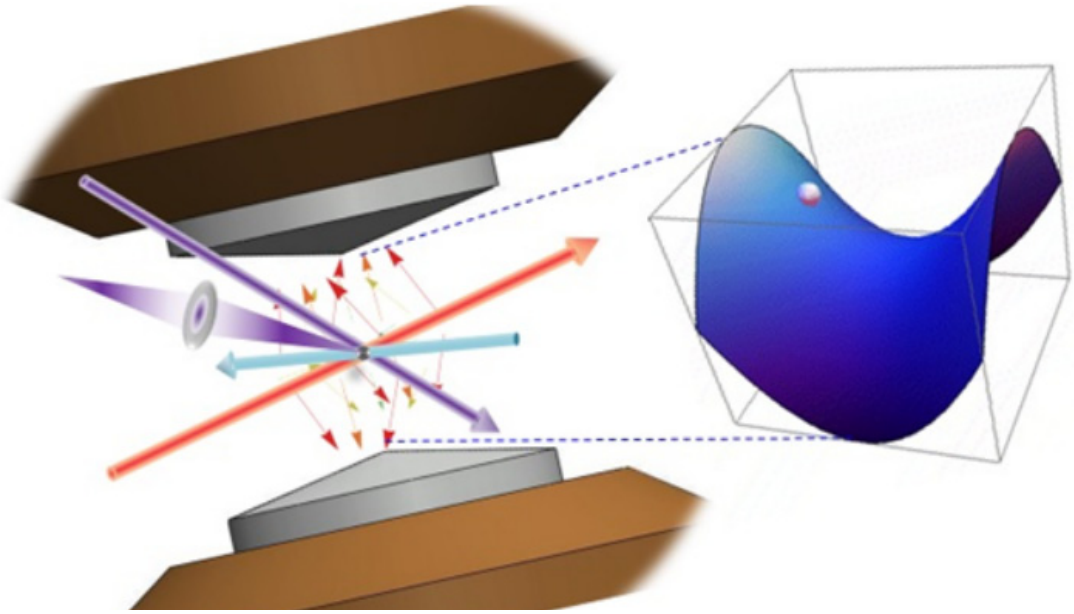
The project will be led by Dr Subhadeep De, associate professor at IUCAA and a specialist in laser cooling and trapping of atoms and ions, and time/frequency metrology.

The PQM-Lab at IUCAA will build a Ytterbium-ion optical atomic clock, which will incorporate an ultra-stable optical resonator that acts as the flywheel oscillator of the absolute optical reference, optical frequency comb for accurate counting frequency of the photons and phase stabilized link fibre for the dissemination of these photons.

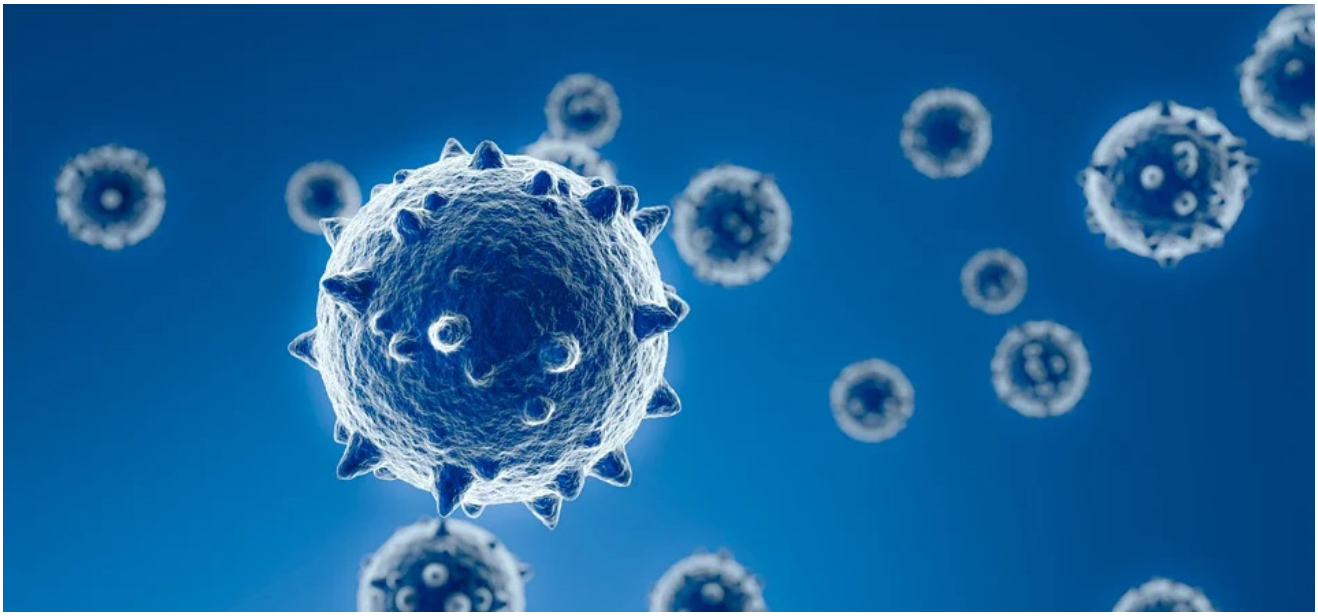
Says Dr De, "Applications of optical atomic clocks are two-fold – time and frequency metrology for accurate timekeeping, and precision experiments to test fundamental aspects of science to answer unsolved mysteries in nature. At IUCAA, we shall focus on exploring fundamental science."

This will not only be open new dimensions in fundamental research but also support the quantum-phenomenon-based technologies being pursued in India under the support of GoI in mission mode.

Dr De envisions that "Most of the quantum technologies, such as a quantum computer, quantum communication, quantum internet, quantum information processing, quantum metrology, quantum simulation, quantum sensors, quantum imaging, quantum materials, machine learning, artificial intelligence, internet-of-things, big data, etc. require precision timing devices. The optical clock is an unavoidable requisite for these technologies, which have the potential of rewriting the world economic order. Apart from its own science goals, the technological outcomes from the PQM-lab will lead to commercializable products. This will help India forge ahead on the path of technology-driven economic growth by import substitution and self-reliance."



Schematic of the single trapped ytterbium-ion confined in an electrodynamic potential created by an ion-trap. It requires five lasers for cooling the ion near the absolute zero temperature followed by probing its clock transition.



Preventing virus spread within households could be key to controlling new outbreaks of COVID-19

MORE effective measures to prevent infection spreading within households are a vital part of preventing a second wave of COVID-19, say researchers at the Universities of Warwick and Birmingham.

In an article published in the *British Medical Journal*, experts at Warwick Medical School and the University of Birmingham's Institute of Applied Health Research argue that robust strategies are needed to prevent in-household transmission, particularly within large, multi-generational households. This should now be a core part of government strategy for controlling the spread of the virus.

Dr Shamil Haroon of the University of Birmingham's Institute for Applied Health Research says: "Recent outbreaks of the virus in English towns such as Oldham predominantly involve communities with large, multigenerational households. Within household, infection is thought to be responsible for around 70 per cent of SARS-CoV-2 transmission. Until an effective vaccine is available, strategies to prevent household transmission need to be prioritised."

Co-author Dr Joht Chandan, from Warwick Medical School at the University of Warwick and the University of Birmingham added: "Household quarantine is likely to remain an important pandemic control measure. Encouraging simple interventions like the wearing of face coverings within quarantined households and providing clear advice on enhanced personal hygiene and the cleaning of shared spaces would be steps that could be vital in protecting the most vulnerable individuals within multi-generational households."

Measures recommended by the team include:

- Effective isolation of the family member first showing symptoms of the virus
- Wearing of facemasks within quarantined households, ideally as soon as the infection is suspected or confirmed
- A renewed emphasis on personal hygiene, including cleaning and disinfecting shared toilets, door handles and other common spaces
- Staggering meal times in households where the infection is suspected or confirmed.

The team also recommends the use of special isolation facilities for those who are unable to successfully self-isolate. This could be in field hospitals, or hotels and hostels – an approach already adopted by several European countries. Effectiveness would depend on reliable and rapid testing measures being implemented. This would enable speedy identification of cases where isolation would be an appropriate intervention.

Reference: Haroon *et al.* (2020). 'COVID-19: Breaking the chain of household transmission', *BMJ*

Source: The University of Warwick, Press Release