

Book Launch on 101st Foundation Day of Bose Institute

Bose Institute at Kolkata just concluded its year-long centenary celebration on 29th November 2017. Bose Institute was founded by Acharya J.C. Bose on 30th November 1917. The 30th November 2017 marks the 101st Foundation day of the Institute which was celebrated by inviting a Nobel Laureate scientist Ada Yonath, a Professor of Structural Biology of the Weizmann Institute, Israel to deliver 79th Acharya J C Bose Memorial Lecture on an interesting topic titled “Next Generation Environmental-friendly Antibiotics”. Resistance to antibiotics posed a severe problem in contemporary medicine. Recent structural studies of ribosomes from a multi-resistant pathogenic bacteria revealed novel structural motifs which prevents chances of modification and hence prompted to design new class of antibiotics with optimized chemical and other properties.

Among other programmes like distribution of awards to students etc., a book on D.M. Bose titled “D.M. Bose : A Scientist Incognito” authored by Suprakash C Roy and Rajinder Singh published by Bose Institute as a part of its centenary celebration was released by Prof. Bikash Sinha, a reputed physicist, in the packed auditorium of Bose

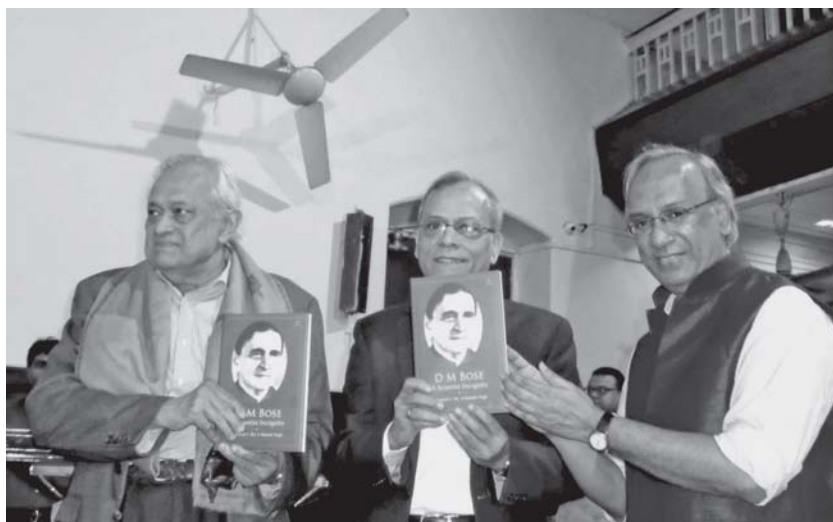
Institute on 30th November 2017. The book is a tribute to Dr. D.M. Bose, a noted scientist who took over the charge of the Bose Institute as its Director in 1938 after the demise of J.C. Bose. It is no exaggeration to mention here that D.M. Bose was an institute builder who turned Bose Institute into a modern and thriving research institute with his able leadership.

According to the authors, in spite of D.M. Bose’s significant contributions in science, literary and many other areas, he was virtually a scientist incognito. Professor Siddhartha Roy, Director, Bose Institute in his preface echoed the same sentiment “It is unfortunate that the full extent of the significance of D.M. Bose’s scientific work is not widely known or properly appreciated. His leadership of Bose Institute and other contributions in fostering scientific research and science awareness in this country have also not been adequately discussed. In this context, it is, therefore, most befitting that as a part of its Centenary Celebration, Bose Institute is publishing the comprehensive and meticulously researched biography of D.M. Bose”

The book has been written by a unique combination of two authors, one a physicist and the other a historian of science. Prof. Suprakash C Roy was Professor of Physics at Bose Institute, Kolkata and currently is the Editor-in-Chief of the journal *Science and Culture* and a Member of the National Commission of History of Science while Rajinder Singh is associated with the University of Oldenburg in Germany who has authored 20 books and numerous articles on history of science. He is also an Editorial Collaborator and Editor of the journal *Science and Culture* and *Indian Journal of History of Science* respectively.

The book is priced Rs.350/- only and is available at Bose Institute and Indian Science News Association (ISNA) at a discounted price. □

Arunansu Dasgupta
Indian Science News Association



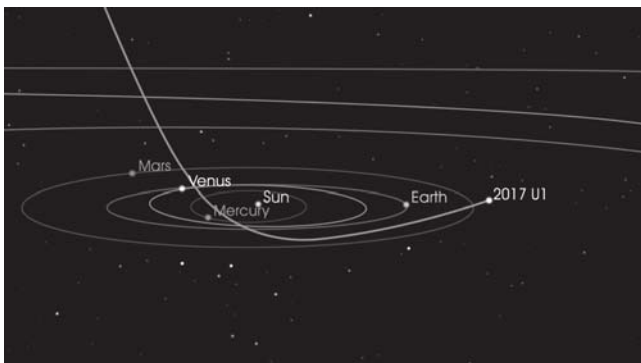
Release of the book “D.M. Bose: A Scientist Incognito” by Professor Bikash Sinha (Left), Professor Siddhartha Roy, Director, Bose Institute (Right) and one of the authors Professor S.C. Roy (Centre) also joined.

First Ever Interstellar Visitor to the Solar System

Astronomers have for decades theorised that there should exist objects, remnants of planetary formation – asteroids or comets – moving around between the stars and occasionally passing through our solar system. But this long awaited expectation eluded the astronomers until recently. On the night of October 19, 2017, Rob Weryk, a Postdoctoral astronomer at the University of Hawaii Institute for Astronomy (IfA) first detected during his nightly search for near-earth objects with the help of UH's Pan-STARRS 1 telescope on Haleakala, Hawaii a small unusual object, 400 meters (less than a quarter of a mile) in diameter, moving in with a high speed. Its high incoming speed, 25.5 km/sec (15.8 miles/sec), made him realise that this object could not be a normal asteroid or comet seen in the solar system. “*This object came from outside our solar system*”, said Weryk. He then checked the image archive of Pan-STARRS and found the object in the images taken the previous night. In fact, Marco Micheli, an IfA graduate, analysed his own follow-up images taken at the European Space Agency's telescope on Tenerife in the Canary Islands and came to the same conclusion.

The Minor Planet Centre, Cambridge, Massachusetts has temporarily designated the object “A/2017 U1”. David Farnocchia, a trajectory expert at NASA's Jet Propulsion Laboratory (JPL) at Pasadena, California voiced similarly: “*This is the most extreme orbit I have ever seen. It is going extremely fast and on such a trajectory that we can say with confidence that this object is on its way out of the solar system and not coming back.*”

An analysis of the object's trajectory revealed that it came from the constellation Lyra, approached our solar system from almost directly ‘above’ the ecliptic, i.e. perpendicular to the approximate plane (in space) that most planets and asteroids orbit round the sun. On September 2, the object crossed under the ecliptic just inside the orbit of Mercury and made its closest approach to sun on



September 9. Tugged by the gravity of sun, it made a hairpin turn ‘under’ the solar system and passed under the orbit of earth - its closest path by earth - on October 14 at a distance of about 24 million km (15 million miles), i.e. nearly 60 times the distance to the moon. It is now looping back above the planetary plane and shooting at 44 km/sec (27 miles/sec) toward the constellation Pegasus. NASA's visualisation of the trajectory of this interstellar visitor is depicted herein.

Paul Chodas, Manager, Centre for Near-Earth Object Studies, JPL, NASA said: “— *So far, everything indicates this is likely an interstellar object, but more data would help to confirm it.*” Also, since it is an extra-stellar object, the first ever of its kind visiting the solar system, the rules for naming it do not exist. The same have to be framed by the International Astronomical Union.

The first interstellar visitor to the solar system is most welcome. We just have to wait for the confirmation of the interstellar origin of the visitor and for its christening. □

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November 10: World Science Day for Peace and Development

In 2001, the United Nations Educational, Scientific and Cultural Organisation (UNESCO) proclaimed 10th November as the World Science Day for Peace and Development (WSDPD) and has been celebrating this day across the globe every year since 2002 with the objective of highlighting (i) the importance and relevance of science in society and our daily lives and (ii) the need to engage wider sections of the public (i.e. other than the members of the scientific community) in debates on emerging scientific issues. In fact, WSDPD aims to ensure that citizens are kept informed on scientific developments because science, peace and development are interlinked.

The theme for the current year (2017) is ‘Science for Global Understanding’ since science is central to global understanding and it promotes individuals and local communities to share knowledge on science for actions and attitudinal change. Global Understanding (GU) also assists in designing, developing and implementing the actions that are needed for the change we aim for. GU is thus the key to peace and sustainable development. Below is the poster

for 2017 WSDPD. It highlights an interconnected world, where local solutions contribute to solving global problems, using a play on molecular diagrams. It was created by Razan Jilani with the kind support of Jordan, host of the 2017 World Science Forum (WSF).



The UNESCO WSF, organised every two years, is one of the world's major science events. It brings together hundreds of scientists and provides linkages between scientists, industry and policy makers to focus on the social and economic relevance, influence and responsibilities of science. Concerned by the growing criticism of scientific integrity and denial of scientific findings by the members of the non-scientific communities across the globe, the WSF has convened a meeting of the scientists and policy-makers from around the world in Jordan this week. This is because all programmes of UNESCO consider the building of trust in science and the fostering of scientific excellence as its central themes.

In her message on the occasion of the WSDPD 2017, Irina Bokova, the Director-General of UNESCO said *“Sciences, Technology and Innovation (STI) provide key answers to build peace and bolster sustainable development. — This why STI stand at the heart of the 2030 Agenda for Sustainable Development and the Paris Agreement on Climate Change. UNESCO has developed a unique approach to promote global scientific cooperation while encouraging local actions. — UNESCO has made trans-disciplinarity the cornerstone of its work for sustainability; building networks with multiple stakeholders such as museums, universities, private and public sectors, governments and NGOs. This year’s theme for the World Science Day for Peace and Development, Science for*

Global Understanding, encompasses UNESCO’s approach to develop scientific cooperation between and within societies, combining global sustainability and local actions and knowledge.

— In this context, science diplomacy will be a powerful instrument for the use of science as a foundation for a culture of cooperation. Investment in science education will be equally crucial. We need to grant equal access to enrolment in sciences all persons, starting at an early age, with a strong focus on girls.

In this spirit, I call upon all stakeholders, well beyond scientific circles, to mobilise in order to release the full potential of sciences for development and peace.”

In the words of Flavia Schlegel, Assistant Director-General for the Natural Sciences, UNESCO, *“An important contribution that UNESCO and science & technology centres can bring to global understanding is the unique opportunity to combine global sustainability and local action. The dialogue among science, policy, and everyday lives should be constant and multidirectional. Global sustainability can learn so much from best practices and success stories.”*

World’s science centres and science museums are scheduled to announce Friday, November 10 as the 2017 International Science Centre and Science Museum Day (ISCSMD). In conjunction with UNESCO’s WSD, ISCSMD is poised to celebrate this day and demonstrate these institutions as the most influential combined force on earth for engaging the public with science, technology, related decision-making and direct action to solve the critical issues that our planet is facing.

India is celebrating WSDPD 2017 in a grand manner. Schools, colleges, scientific organisations, science centres and science museums from West Bengal, Uttar Pradesh, Tamilnadu, Odisha, Maharashtra, Karnataka, Haryana, Gujarat and Andhra Pradesh are planning to hold scientific talks and demonstrations, competitions on essay writing, poster and slogan, elocutions, quiz contests, puppet shows, workshops, movie screenings, etc. - all centered round sustainable development and gender equality - on Friday, the 10th November. In West Bengal, the participants are Science City, Kolkata, BITM, Kolkata and Science Centres of Bardhaman, Digha, North Bengal and Purulia.

World Science Day for Peace and Development has an enviable success story. It has generated many concrete projects, programmes and funding for science around the world. Remarkably, it has even been able to initiate cooperation between scientists living in countries suffering

from mutual conflict. A typical example is the UNESCO-supported creation of the Israeli-Palestinian Science Organisation.

This importance of the WSD can be best highlighted by the concluding comments of Schlegel in her Editorial entitled 'Science for Global Understanding' to the 10th November issue of *Science*: "We are reminded on this World Science Day that global understanding calls on all of us to nurture, strengthen and defend sound science across borders and disciplines." □

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Could Deadly Infectious Diseases Emerge Due to Global Warming?

Most people are aware that global warming has resulted in melting of ice caps, rise in sea levels, and a greater propensity for extreme weather conditions over the past decade. But very few understand the consequences of some of these phenomena in emergence of new (and old) diseases in hitherto unaffected regions of the globe, which were once considered to be safe. Melting permafrost (a layer of frozen soil) can release infectious pathogens that have been frozen in "suspended animation" for many centuries in the Arctic clime. For example, in 2015, scientists discovered a giant virus (*Mollivirus sibericum*) that infects amoeba, within the melting permafrost in Siberia. Importantly, this virus was still infectious even after 30,000 years! Moreover, with soaring global temperatures, vector-borne diseases, which have traditionally been a problem in the tropical regions of the world, will now spread to higher latitudes due to expansion of the flight range of vectors, especially mosquitoes like *Aedes*, *Anopheles* and *Culex*.

Some deadly diseases that could re-emerge are highlighted below:

Smallpox Could Make a Comeback : Smallpox is a devastating disease caused by the Variola virus. It was one of the most feared diseases worldwide. In 1980, following an historic global campaign of surveillance and vaccination, the World Health Assembly declared that smallpox was eradicated from the face of the Earth. However, in recent years, with increasing global temperatures coupled with melting ice caps, scientists fear that smallpox could re-emerge from the most unlikely of

places, namely, defrosting human corpses. Virologists believe that thawing bodies infected with the deadly virus could potentially begin a fresh cycle of infection, should humans make contact with the remains.

Anthrax Could be Revived : There was an outbreak of anthrax in herds of reindeer in July 2016 in the Siberian tundra within the Arctic Circle, where over 2000 reindeer were killed. A 12-year-old boy died and at least twenty people were hospitalized after being infected with anthrax. Interestingly, the cause was a 75 years old reindeer carcass that had been trapped under a layer of frozen soil known as permafrost. The carcass had thawed out due to the heatwave in the summer of 2016 (the year with the highest temperature in recorded history), releasing the bacterium *Bacillus anthracis*, which wreaked havoc among the reindeer herds. Importantly, the spore form of this bacterium can remain intact for centuries at low temperatures afforded by the permafrost. With increasing global temperatures, more permafrost will melt. Under normal circumstances, superficial permafrost layers about 50 cm deep melt every summer. But now, global warming is gradually exposing older layers of permafrost that could potentially open a Pandora's Box of deadly infectious diseases.

Zika Virus Disease Could Expand Further Globally : Zika virus belongs to the family *Flaviviridae*, which also includes yellow fever virus, Japanese encephalitis virus, dengue virus and others. Chikungunya virus is also closely related to these viruses. Zika virus generally doesn't produce any symptoms or at the most, mild symptoms like fever, rashes and joint pain, which usually resolve by itself within a week. However, recent outbreaks in Brazil and other parts of South America and the Caribbean have shown that the virus can cause severe birth defects like microcephaly. In this disease, babies are born with abnormally small brains, to mothers who had been infected with the virus during pregnancy. Zika is currently mostly confined to the tropics like South and Central America, Southeast Asia, parts of Africa and southeastern states of USA. Studies have predicted that with rising global temperatures *Aedes aegypti*, the vector for zika virus as well as others like dengue virus and chikungunya virus may spread to many temperate regions of the world, which were previously considered as safe. Vulnerable regions include North America, the Arabian Peninsula, southern Iran and inland Australia.

Tick-borne Diseases Could Spread to Newer Niches : Like mosquitoes, the habitats where ticks can thrive can undergo dramatic geographical expansion if

global warming continues unabated. Some tick-borne diseases are highlighted below:

- **Babesiosis:** This is an emerging parasitic disease that is caused by *Babesia microti* and spread by the bite of infected *Ixodes scapularis* ticks, which are mostly found in wooded, brushy, or grassy areas. This disease occurs primarily in USA, but has also been reported from other parts of the world, including India. It mainly occurs in the summer months, when the ticks as well as humans are most active. Therefore, with longer and warmer summer months, more people could acquire the illness in the future, than what the current disease burden data show.
- **Lyme Disease:** This disease is caused by the bacterium *Borrelia burgdorferi* and spread by ticks belonging to the genus *Ixodes*. It is mainly prevalent in USA, but has also been recently reported from India. With increasing temperatures, the ticks are likely to spread to newer habitats, where they are currently absent.
- **Crimean-Congo Hemorrhagic Fever (CCHF):** This disease is caused by the CCHF virus, which is a tick-borne virus (*Nairovirus*) of the *Bunyaviridae* family. In the Indian context, CCHF was first reported from Ahmedabad, Gujarat in January 2011. Since then, outbreaks have occurred every year in various districts of Gujarat. The disease has since spread to Rajasthan also. Therefore, this tick-borne viral disease is also expanding geographically, and is likely to spread further with soaring temperatures.

Cholera Outbreaks Could Increase : The cholera bacterium, *Vibrio cholerae*, prefers warm water to flourish. Therefore, with increasing global temperatures, large water bodies will become warmer, which will lead to cholera outbreaks with increased frequency and intensity. Climate change is also linked to adverse weather conditions like hurricanes, tornadoes and extensive flooding. Severe flooding has the potential to spread cholera far and wide, along with the contaminated water. In India, the Ganges delta in the Bay of Bengal is endemic for cholera, where the disease has been reported since 1817. In recent times, the ongoing cholera outbreak in Yemen has been devastating, with 396,086 confirmed cases, 419,804 suspected cases and 1,992 deaths.

Conclusion : Pathogenic microbes are normally unable to survive for long periods outside their host. However, the soil under the permafrost, especially within

the Arctic Circle, can provide an ideal shelter for deadly viruses and bacteria that can remain dormant for thousands of years. Research findings by scientists have raised concerns that deadly pathogens like smallpox, or unknown viruses thought to be extinct, could be lurking in the permafrost. Importantly, global warming, coupled with human activities such as drilling or mining in regions like Siberia, which was previously completely frozen, could disturb microbes that have been dormant for millennia. Therefore, scientists have warned that if global warming is not checked immediately, there is a real threat that unknown viruses and bacteria could be resurrected and cause global pandemics in the future. □

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Dwindling ‘Windshield Phenomenon’: Insects in Germany Are Disappearing

Decades ago plentiful of insects used to inhabit Germany. Wolfgang Wägele, Director, Leibniz Institute for Animal Biodiversity, Bonn says: “*If you talk to people, they have a gut feeling. They remember how insects used to smash on your windscreen.*” This widespread experience in earlier days – the smashing of the windscreens of moving cars by insects – is called the ‘windshield phenomenon’ by the entomologists. As Scott Black, Executive Director, Xerces Society for Invertebrate Conservation, Portland, Oregon recalls, when he used to drive his 1969 Ford Mustang Mach 1 car in Nebraska in his teens, “*I used to have to wash my car all the time. It was always covered with insects. But it is a visceral reaction when you realize you don’t see that mess any more.*”

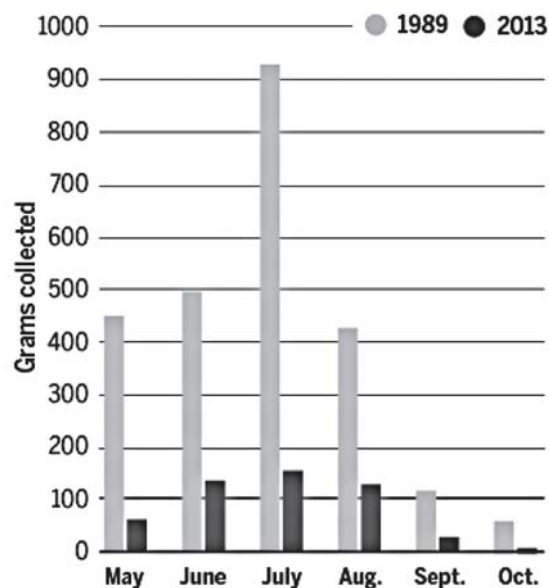
Regardless of the causes, one thing is for certain – insects are disappearing from Germany. A new study has revealed that in just three decades, insect populations in nature reserves in Germany have plummeted by more than 75%. The pattern is consistent over western and northern Germany, from the region around Bonn and Cologne to the countryside south of Berlin. This important revelation has been brought to the fore by the Krefeld Entomological Society (1905) near Düsseldorf, a dedicated group of mostly amateur entomologists who have been observing, recording and collecting flying insects at more than 100 nature reserves in western Europe for the last three decades. The Society has about 50 members which also include

ecologists, teachers, telecommunication technicians, a book publisher, priests and the like. The Society has its HQ at a former school in the centre of Krefeld, an industrial town on the banks of the Rhine river. The classrooms of the school now store more than a million insect specimens collected from Germany in particular and western Europe and the world in general and individually pinned and named in display cases. The active members of the Society have by now published more than 2,000 papers on insect taxonomy, ecology and insect behaviour.

At first glance, Germany's 'Red List' of endangered insect species does not look alarming. The reasons are two-fold. Firstly, few species are tagged extinct because they exist in one or two important sites. It was ignored that many of them have disappeared from large areas where they were once common. For instance, only three bumble bee species are now listed to have vanished across Germany. But the Krefeld region has lost more than half of the two dozen of bumble bee species that were documented by the Society in the early 1900s. Secondly, scientists keep track of important insect species like domesticated honey bees, monarch butterflies and lightning bugs, the alarming decline in whose population has been easily detected. But the most 'non-charismatic species' like moths, hover flies, beetles and numerous other insects are usually ignored.

This is exactly where the Krefeld Society has made enormous contribution. In 2013, they checked the data from one of their earliest (since 1989) trapping sites only to find that the total mass of their catch had fallen by nearly 80%. In order to check if it was a one-time affair, they set up the traps again in 2014, and the result was very similar. They found similar dramatic declines in dozen other sites by more direct comparisons. They monitor each site once every few years, but they set up identical traps at the same place each time to ensure flawless comparisons. Each such trap, developed as per the design (1930) of a Swedish entomologist, René Malaise, resembles a floating tent of white fabric with a base of black mesh fabric and a collection jar – a plastic container – at its summit. This jar has an opening into another jar of alcohol. The traps collect mainly insects that fly a meter or so above the ground, the alcoholic vapour gradually intoxicates them, and they fall into alcohol. To avoid depletion of insect populations by this method, each trap is designed to catch only a few grams per day, which is equivalent to the daily diet of a shrew. The nature reserves are 'semi-natural' habitats like former hay meadows (full of wild flowers, birds, small mammals and insects) and parts of agricultural fields as well.

The mass of insects collected in the Orbroicher Bruch nature reserve in northwest Germany dropped by nearly 80% in 24 years, which appears to be the most 'weighty disappearance' on record (picture below). The Krefeld data reflect a particularly steep decline in the population of hover flies - important pollinators often mistaken for bees. Thus, in one reserve, the traps collected 17,291 hover flies from 143 species in 1989 as against only 2,737 flies from 104 species in 2014.



The members of the Krefeld Society are trying to correlate the dwindling insect populations with factors like weather, changes in vegetation, etc., but no straightforward correlation has yet emerged. Nevertheless, changes in land use surrounding the nature reserves, the use of water-soluble neonicotinoid pesticides (introduced in the 1980s and now world's most popular pesticides) in agricultural fields and a striking change in the diets of insect-eating birds since the 1940s (around the time DDT was introduced as an agricultural insecticide) are believed to play a role in the observed decline in insect population, especially in Germany. The loss of huge amounts of habitat is considered to play a crucial role. The members of the Krefeld Society are now working together to develop 'biodiversity weather stations', a kind of automated monitoring stations combining audio recordings, camera traps, pollen and spore filters and automated insect traps.

The big question still looms large – where have all the insects in Germany gone? □

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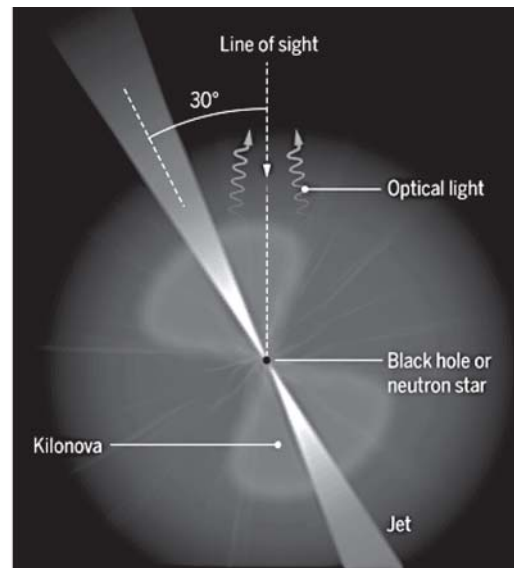
Merging Neutron Stars and a Celestial Light Show: Beginning of an Era of Gravitational Wave Astronomy

At 12:41 universal time on August 17, 2017, physicists at USA and Italy recorded an unprecedented view of a cosmic phenomenon - gravitational waves lasting for 100 seconds at frequencies rising to thousands of cycles per second (c/s), covering every wavelength of light from gamma ray to radio waves along with a 'kilonova', a glow which faded from light blue to dim red in a matter of days. Three massive gravitational wave detectors – twin 8-km-long detectors at the Laser Gravitational-Wave Observatory (LIGO) in Hanford, Washington and in Livingston, Louisiana and the 6-km-long Virgo detector near Pisa, Italy – recorded this observation. This was the fifth event of this type, the four previous ones (beginning with the first one reported by LIGO in early 2016) lasting for, at the most, a few seconds and the gravitational waves rippling at frequencies of tens of c/s. This gift from nature was described as a “*life-changing event*” by a radio astronomer at Texas Tech University at Lubbock, Texas.

When an isolated pair of massive stars collapse to infinitesimal points, gravitational fields, known as ‘black holes’ are left behind, and these fields do not contain any matter that might radiate. In contrast, when slightly smaller stars explode in supernovae, dead cores consisting of nearly pure neutrons and known as ‘neutron stars’ are left behind. When such orbs collide, they generate debris glowing with light of all wavelengths. This is exactly what happened in this recent cosmic event. Thus, whereas the earlier four signals came from pairs of huge black holes quickly spiralling into each other, the new fifth signal revealed rapid and spiral collapsing of two lighter neutron stars, 1.1 and 1.6 times as massive as the sun.

Indeed, two seconds after the gravitational signal was recorded, the Fermi Gamma-ray Space Telescope of NASA picked up a burst of high energy photons, i.e. a gamma-ray burst. Within minutes, the three detectors at USA and Italy confirmed the gravitational signal in their data. The physicists could triangulate and locate the source, about 60 times the size of the moon, to within a 30-square-degree patch of sky (Picture below). Within hours, several groups of astronomers identified a new source of light in the periphery of galaxy NGC 4993. About two weeks later, the source began to emit x-rays and radio waves. As per the Deputy spokesperson for the LIGO collaboration, “*This is the first time we have a 3D IMAX view of an astronomical event.*”

This astronomical event resulted in three significant advances in the field. Firstly, it explains the origin of gamma-ray bursts, the second most powerful event in cosmos. Earlier, since the 1990s, the theorists thought that bursts shorter than two seconds originate when neutron stars merge to create a black hole. Longer bursts, lasting minutes, were thought to originate from the collapse of individual massive stars. But the present event clearly demonstrates that, in the words of a theorist, “*If you have gravitational waves with a burst, you know, it has to come from a double neutron star.*”



Secondly, the event reveals a hypothesized object, called a ‘kilonova’, since it glows, briefly though, thousands of times brighter than an ordinary nova. When two neutron stars collapse into each other, they are expected to generate neutron-rich atomic nuclei which increase in size by gobbling neutrons in quick succession and then quickly change their chemical identities through radioactive decay. This ‘rapid neutron capture’, the so-called ‘r-process’, should make the matter glow for a few days, and its light should be reddened by heavy elements that absorb blue wavelengths. This is exactly what happened in this cosmic event. As another theorist said, “*It’s stunning. All of a sudden the curtain lifts and what we see looks pretty close to what we expected.*”

Thirdly, the observation of a ‘kilonova’ solved a long-standing puzzle in nuclear physics – the origin of half the elements heavier than iron, including silver, gold and platinum. Nuclear physicists believed that these elements are generated in the r-process, but they did not know until this event where in the cosmos that happens – in the collapse of single stars or in the merger of neutron stars. The new finding shows that some, if not all, of the ‘mystery elements’ spring from the spiral deaths of neutron stars.

This cosmic event also posed a puzzle – the gamma-rays were relatively faint although the burst was closer than previously recorded short bursts by a factor of 10. But the scientists also provided an explanation. When jets of hot matter move at near-light speed, a gamma-ray burst shoots out along the rotational axis of the newly formed black hole, and radiation is beamed into space like a lighthouse. In the present event, observers were looking at it not perhaps right down the jet but from a slight angle, also termed as a ‘funny angle’. Noticeably, after a long period of 10 Hrs 52 min, i.e. at 23:33 universal time after the arrival of the gravitational waves, an image of NGC 4993 could be snapped.

The findings have been submitted to *The Astrophysical Journal Letters*. It is said to be authored by some 4600 scientists, roughly one third of all astronomers. Additionally, dozens of other papers have been submitted to *Science*, *Nature*, etc. by individual groups. ‘With one spectacular event in the bag, the era of gravitational wave astronomy has begun.’ □

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Experiments on Temperature Influence on Fishes, Nutraceutical Approach and Fish Farmers’ Experiences

In National Seminar on ‘Climate Change : Impact on Aquatic Environment and Fish Health’ organized by Bhubaneswar Chapter of NAAS in association with ICAR-Central Institute of Freshwater Aquaculture, Bhubaneswar and Association of Aquaculturists on 6/9/2017, Dr A. K. Pal, Former Jt. Director, ICAR-CIFE, Mumbai in lead lecture on ‘Climate change impacts on aquaculture - possible remedial measures through nutraceuticals’ discussed about nutraceutical approach in aquafeed, that can reverse stress-mediated deleterious effects (associated with climate change) in fish.

Dr Pal spoke on the availability of oil sardine *Sardinella longiceps* in north-east and south-east coasts of India in recent times (earlier restricted to south-west coast), 23,000 square miles of no-oxygen zone (dead zone) in Bay of Bengal which is further increasing, decrease of dissolved oxygen level with increase in water temperature (T), elucidation of mechanism of thermal tolerance of different fishes, thermal tolerance limits (TTL) of Indian fishes with respect to different acclimation T, thermal tolerance polygon

of catfishes *Horabagrus brachysoma* and *Pangasius pangasius*.

Dr. Pal discussed his research studies on expression pattern of heat shock protein (hsp-70) in liver of *H. brachysoma* at two different acclimation T 20°C and 30°C, interspecific variation in hsp-70 expression, some fishes were found to survive at thermal shock 10°C for 2 hours; we were informed that hsp-70 is expressed in slow manner in people living in hilly regions and thus they remain healthy, mitochondria in body cells is doubled or tripled at critical thermal minimum condition (CT_{min}^m), physiological consequences of hypoxia (DO content less than 2.8ppm) and reduction of body metabolism in fish.

Dr. Pal further discussed about high-tech shrimp culture system in Baruch district of Gujarat with stocking density of 10 lakh PL/ha - polythene lined over entire pond bottom and externally nutrients supplied in pond, research needs on producing cheaper fish through innovative fish feed formulation and feeding strategies. He explained that aquaculture practices help in carbon sink; high biomass of phytoplankton is produced in well-managed freshwater aquaculture system, which helps to reduce climate change by absorbing more CO₂. More is the production of phytoplankton in freshwater and marine water, maximum CO₂ will be absorbed from atmosphere.

Dr. S. Adhikari, Principal Scientist at ICAR-CIFA in Lead Lecture on ‘Climate change and aquaculture environment’ spoke about growth and feed uptake of Rohu being highest at 6ppt salinity in experimental systems, research studies on decline of growth and feed uptake in *Catla catla* beyond 32°C and the same in Rohu in T above 30°C, maximum feed consumption for Catla and Rohu at 28-30°C T, mortality of Tilapia fry by 5% at 38°C and by 35% at 40°C T. There occurred no mortality of neither spawn or fry of *Tilapia nilotica* at 34°C and 36°C T. Dr. Adhikari emphasized on less rainfall causing severe problems relating to water availability in freshwater aquaculture, consumptive water use for freshwater aquaculture in ponds.

We were informed that fish farmers have experienced high mortality of fish stock in recent summer months when T increased to beyond optimum level, entire stock washed out from ponds at times of heavy rainfall, deterioration of pond water quality and contamination due to unforeseen weather conditions during monsoon and summer seasons, increased incidences of fish ecto-parasite *Argulus* sp. infestation in ponds during winter months, many fish hatcheries had to be closed in Andhra Pradesh due to lack of water availability, increase in operational cost for Andhra

farmers every time in reconstruction of ponds due to floods. Accordingly, fish farmers have adopted measures to mitigate these effects of climate change, like pumping freshwater into ponds to cool down T, use of oxygen tablets at high T conditions in summer, maintaining water level in ponds by pumping in water from borewell (during low rainfall), early harvest had to be done irrespective of fish growth in times of drought, use of mesh-like erect structures on pond embankments to prevent fish escape during flood, stocking of advanced major carp fingerlings for faster growth in early-drying ponds. Dr Adhikari suggested some important practical on-farm measures for addressing drought and flood situations in aquaculture practices, controlling pond turbidity. Fishes, being poikilothermal, cannot regulate their body T and are most susceptible to changes in weather patterns and variations in water T.

Other Lead Lectures were presented by Dr. H. K. Pathak, Director, ICAR-National Rice Research Institute, Cuttack on the topic 'Climate change and Indian agriculture - from problems to solutions', Dr. M. K. Das, Former Head, Fisheries Resource and Environment Management Division, ICAR-CIFRI, Barrackpore on 'Potential impact of climate change on freshwater habitat and fish health - adaptation options' and Dr. K. V. Rajendran, Head, Aquatic Animal Health Management Division, ICAR-CIFE, Mumbai on 'Global warming and aquatic animal diseases'.

Dr. J. K. Sundaray, Director, ICAR-CIFA highlighted a study conducted in Norway that with increase in water T, somatic growth has been found to be more in some important fishes but their gills does not grow properly. When water T is increased, fishes need more oxygen to sustain their body functions but their body physiology does not match with demand of oxygen. Improper and shorter growth of gills has less oxygen to supply. The milkfish *Chanos chanos* was abundant in Chilika Lake and Puri coast in Orissa even 12-15 years back but now it is not; the reason is scarcity and less availability (in comparison to earlier years) of a particular group of marine phytoplankton in the north-east coast upon which the fish feed. It is an impact of climate change. □

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Students of Kerala Samajam Model School get exposures of Research Environment at CSIR-NML

A group of 39 students from Kerala Samajam Model School, Sakchi accompanied by one teacher, Ms.

Vrinda Suresh visited CSIR-National Metallurgical Laboratory, Jamshedpur and interacted with scientists and research scholars this morning under the aegis of CSIR-NML School-NML Interactive programme. The students were thrilled to visit the laboratory and interact with working group.

The programme was scheduled for three hours. Dr. P.N. Mishra, Principal Scientist, deliver welcome address and briefed about the programme, discussed an overview of CSIR and NML, its contributions in different branches of Science & Technology. He defined science, science & technology, development of science & technology in Indian perspectives. Dr. S.K. Mandal, Chief Scientist and coordinator of the programme discussed about various units of NML and its role towards research and Development, he also discussed about some basic fact of sciences. The students expressed their fillings, asked numbers of question, and clarify doubt with scientists. Dr. A.K. Sahu, Technical Office gave the vote of thanks. Dr. P.N. Mishra and Shri S.N. Hembram organized laboratory visits in two separate groups.

Students visited creep testing units of MST Division and know about the fatigue, creep, fractures prevailing in different types of industrial components. Mr Aayush, Mr. Bipin Kumar were happy to know about the Asia's second largest creep testing lab is present in India. They further visited Analytical Chemistry Centre and get exposures of practical experiments.

The NML museum was the central attraction among the students & appraised the well decorated museum with plenty of samples and wall mounted posters displayed the latest and old technologies and products developed by the NML.

During the interactive session, number of students asked different questions on minerals, ores, origin of coal, the evolutionary history behind the formation of metal, metals forging, rolling, and heat treatment etc. Teacher and students requested for their next visit to the laboratory for gain deeper knowledge. Teacher expressed their view and was satisfied to know about the consistent effort and research emphasis in various sectors for the ultimate development of India. □

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