



Indian Institute of Technology Guwahati  
भारतीय प्रौद्योगिकी संस्थान गुवाहाटी  
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# चिंतन

The Monthly Newsletter of IIT Guwahati

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## IIT Guwahati inaugurates North East Centre for Biological Sciences and Healthcare Engineering (NECBH)

Indian Institute of Technology Guwahati inaugurated the instruments facilities of North East Centre for Biological Sciences and Healthcare Engineering on 19th January 2021. The newly inaugurated facility at the Institute will cater to the needs of scientists and engineers to enhance the research and innovation in the field of biological sciences and healthcare engineering in this region. Prof. T. G. Sitharam, Director, IIT Guwahati, inaugurated and dedicated the facilities to the nation, in the presence of Prof. S. K. Kakoty, Deputy Director of IIT Guwahati, and other dignitaries.

Several advanced research equipment such as state-of-the-art field emission scanning electron microscope, single crystal X-ray diffractometer (S-XRD), powder X-Ray diffractometer (P-XRD), nuclear magnetic resonance spectrometer (NMR), confocal microscope, fluorescence assisted cell sorter (FACS), scanning tunnelling microscope (STM), universal testing machine (UTM), dynamic mechanical analyzer (DMA) etc are part of the instruments facilities of NECBH. The Centre also holds research facilities in the healthcare engineering for healthcare informatics,

cardiovascular information processing, retinal image processing, pathological speech processing, product design and testing. The gait and motion analysis facility in NECBH is the only one of its kind in the entire North East. This facility will be useful not only for researchers but also for the patients, physically challenged persons and medical practitioners. In addition, over 30 twining projects were funded by NECBH through collaboration between the researchers of the North East institutes and IIT Guwahati. To dissipate the knowledge, the Centre also conducts training programs and workshop not only in IIT Guwahati but also in other institutes in the North East states.

Speaking during the event, Prof. T. G. Sitharam, Director, IIT Guwahati, said, "Our focus is to serve North East India primarily, and to benefit the local people of the region. NECBH is the institute's recent endeavour towards this with an emphasis on the biological sciences and healthcare engineering with the support of Department of Biotechnology (DBT), Government of India."



Speaking about NECBH, Prof. G. Krishnamoorthy, Coordinator, NECBH, IIT Guwahati, said, “NECBH provides an excellent platform for the research community in the North East for academic networking and research collaborations. So far, more than 450 researchers and students from over 60 institutes have participated in various programs of the Centre and we look forward for continuing this.”

NECBH was established at IIT Guwahati with the support of North-Eastern Biotechnology Programme Management Cell of Department of Biotechnology, Government of India.

The vision and mission of NECBH includes:

- Creating the infrastructure facility with advanced and sophisticated instruments to cater to the increased demands of experimental facilities in the north eastern region
- Conducting training programs and workshops to provide knowledge and a platform to connect the experts and the innovate researchers
- Catering the interest of the academic community in north east by funding projects to carry out cutting edge research that will have futuristic impact through collaborations

To have greater visibility for the new Instruments facilities, heads of nearly 65 academic and research institutes of the North East were invited to virtually join the inaugural event that was live telecast.







## IIT Guwahati signs MoU with Kaziranga University, Jorhat

Indian Institute of Technology Guwahati signed a Memorandum of Understanding (MoU) with Kaziranga University, Jorhat for closer engagement in the areas of Curriculum enhancement, Research and Development besides improving the entrepreneurship ecosystem in the region.

As a part of the agreement, IIT Guwahati would assist the university in setting up advanced laboratories for experimental work in various areas of engineering and science.

The MoU was signed between IIT Guwahati Director Prof. T. G. Sitharam, and Kaziranga University Vice-Chancellor Dr. P. K. Mishra on 28 January, 2021.

“IIT Guwahati through its highly qualified faculty and excellent research infrastructure will provide necessary support and guidance to both student entrepreneurs and aspiring investors of Kaziranga University to facilitate their growth and prosperity,” Prof. Sitharam said while addressing the participants during the MoU signing ceremony.







## IIT Guwahati researchers find new clues to how and why stars die

Researchers from the Indian Institute of Technology Guwahati, in collaboration with researchers from Max Planck Institute for Physics, Munich, Germany, and Northwestern University, USA, have revealed important clues to understand the death of massive stars and have also revealed the problems with the existing models. They found that all three species of the neutrinos from the supernovae are important contrary to the common treatments with only two flavors.

Link to the research paper:

<https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.125.251801>

The results of this crucial work have been recently published in the journal, Physical Review Letters (PRL), and has garnered worldwide attention from the astrophysics community. The research has been carried out by Dr. Sovan Chakraborty, Assistant Professor, Department of Physics, IIT Guwahati, along with his research scholar, Ms. Madhurima Chakraborty, in collaboration with Dr. Francesco Capozzi, Postdoctoral fellow, Max Planck Institute for Physics, Munich, Germany, and Dr. Manibrata Sen, Postdoctoral fellow, Northwestern University, USA.

Supernovae: the super explosions at the time of death of large massive stars are considered to be the cradle of birth for new stars and synthesis of the heavy elements in nature. At the end of their life, the stars, especially massive ones, collapse resulting in an immense shock wave that causes the star to explode, briefly outshining any other star in its host galaxy. The study of supernovae and the particles they release helps us understand the universe because almost all matter that makes up the universe is a result of these massive explosions.

“However, the mechanism of these super explosions is not yet completely solved and has remained one of the enigmas of nature”, says Dr. Sovan Chakraborty, Assistant Professor, Department of Physics, IIT Guwahati. The solutions to the toughest challenges to the core collapse mechanism of the huge supernovae come from the tiniest subatomic particles called neutrinos.

During the core collapse supernova explosion, neutrinos are created in several particle processes. Due to their neutral nature and extremely weak interaction with stellar matter the neutrinos escape the dying star and carry 99% energy of the collapsing star. Thus the tiny neutrinos are the only messenger bringing information from the deepest interiors of the star. The Nobel physics prize in 2002 was shared by Masatoshi Koshihara for the detection of neutrinos from the Supernova SN1987A at the Kamiokande neutrino detector situated in Japan.

Neutrinos on the other hand have their own complexities. In the last seven decades after the discovery of neutrinos physicists have come a long way in understanding these incredible particles. However, there are still many open questions like understanding their flavor structure and the ordering of the masses of different neutrinos. In fact, supernovae are the only natural source where neutrinos and antineutrinos of all three species (electron, mu and tau ‘flavors’) are produced in substantial amounts. This creates additional complexities.

However, the existing supernovae models predicted that the mu & tau neutrinos & antineutrinos have very similar properties and are considered as a single species. This simplified the supernova neutrino problem and most studies are done under the assumption that all types behave the same way when ejected from the star’s dying core.

Speaking about this Dr. Sovan Chakraborty explains, “This information is very crucial for the reason that in the extremely dense supernovae core neutrinos interact with other neutrinos and may interchange flavors. This conversion may happen rapidly (in nanosecond time scale) and flavor interchange can affect the supernovae process as the different flavors are emitted with different angular distribution. These ‘fast’ conversions are nonlinear in nature and are not confronted in any other neutrino sources but supernovae. We for the first time did a non-linear simulation of fast conversion with ‘all’ the three neutrino flavors in supernovae.”

This becomes possible as new supernova simulations show the presence of muons in the supernovae and in turn produce asymmetry between muon neutrinos and antineutrinos, taken to be zero otherwise, implying three flavor effects.

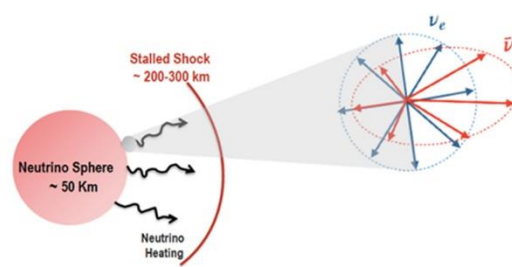


Co-author Dr. Manibrata Sen pointed out, "These three flavor studies change the results dramatically in comparison to the existing two flavor results and can have major implications for particle and astrophysics of supernovae neutrinos".

Dr. Francesco Capozzi, presently a Postdoctoral fellow at the Virginia tech University, USA cautioned, "The models used in our research work too have some simplifications, more generic studies are being done by our team and other competing groups. The clearer answers will need more precise muon supernova simulations which are appearing to be one of the most promising solution to the problems of core collapse mechanism".

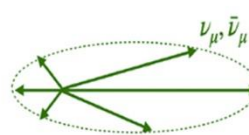
Meanwhile, these new results give a clear message that the differences between the three flavors of neutrinos are all relevant, and ignoring the presence of any of the flavors gives us an incomplete picture of fast flavor exchange.

Dr. Chakraborty added, "Three flavor studies are essential as the fast oscillations may actually influence the solution to the question, i.e., why and how some massive stars die as supernovae and some don't."

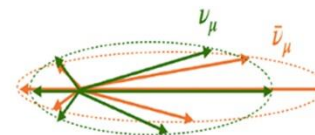


Schematic picture of the neutrino emission zone at supernova core. Supernova shock loses energy and get stalled. Trapped neutrinos diffusing from the supernovae core dump energy behind the stalled shock. This neutrino heating can rejuvenate the stalled shock and give successful core collapse supernova.

Zoomed plots of flavor dependent zenith angle distributions of neutrinos close to their emission region. Different distribution for electron neutrinos and antineutrinos.



Effective two flavor picture: same zenith angle distributions for mu neutrinos and antineutrinos



Three flavor picture: different zenith angle distributions for mu neutrinos and antineutrinos.

## IIT Guwahati signs MoU with NECHRI Jorabat, Assam for identifying novel biomarkers for cancer diagnosis, prognosis and therapy

Indian Institute of Technology (IIT) Guwahati, has signed a Memorandum of Understanding (MoU) with North East Cancer Hospital and Research Institute (NECHRI), Jorabat, Assam, on Tuesday 12th January 2021 at IIT Guwahati. The collaboration between IIT Guwahati and NECHRI started in 2014.

Both IIT Guwahati and NECHRI have been engaged in identifying novel biomarkers for cancer diagnosis, prognosis, therapy and recurrence. Both the institutes have also been engaged in identifying cancer susceptible population from North East India. This collaboration has already identified novel targets for oral cancer (a leading cancer burden in India) drug discovery. This research has been published in highly reputed International Journal "Biomolecules" in 2019 (<https://www.mdpi.com/2218-273X/9/7/253>). More research publications are underway.

Based on these results both IIT Guwahati and NECHRI have been conducting research to develop novel drugs for the treatment of oral cancer. In addition, both the institutions are engaged in developing



Before (Sanduleak-69 202) and After (SN1987A) supernova explosion. The whole galaxy is illuminated from the brightness of the explosion.



various strategies to help cancer patients from North East region. The MoU will enable IIT Guwahati and NECHRI to strengthen more collaborations and to help cancer patients from NE region. In addition, studies have been already started to identify different cancer susceptible populations from North East region and to help to prevent this deadly disease among these population.

The institute has already obtained over 500 cancer samples from patients registered with from NECHRI. The researchers involved in this collaboration are currently examining these samples to identify novel prognosis, therapeutic and recurrence biomarkers for the better management of the patients from North East region. Recently, a joint project proposal has been submitted by NECHRI and IIT Guwahati to ICMR to identify novel therapeutic targets for Triple Negative Breast Cancer from North East patients. In addition, both the institutions have shared their expertise as resource persons in different conferences and workshops organized.

Commenting on the MoU, Prof. T. G. Sitharam, Director, IIT Guwahati, said, "IIT Guwahati has world-class expertise and infrastructure in cancer research and is committed to helping the North East region. The aim of this MoU is to initiate more active collaboration with NECHRI and to identify different biomarkers for the early diagnosis of cancer and cancer drug discovery. This MoU would help both the institutions to conduct interdisciplinary research in cancer and share the expertise between clinicians and scientists. In addition, more focus will be given in the prevention of cancer in NE region. Moreover, different cancer awareness programs will be initiated jointly by IIT Guwahati and NECHRI to educate the people about different risk factors of cancer to avoid them. The main aim of this MoU is to eradicate cancer from North East region, which is known as the hub of cancer in India."

Prof. Kunnumakkara from the Department of Biosciences and Bioengineering, IIT Guwahati, said, "Today is an important milestone for the people in North East Region as a world-class science and technology institute joins hands with one of the prestigious cancer hospitals and research institutes to eradicate cancer from North East region. This initiative will specifically focus more for the prevention of cancer in North East region and to identify the high-risk population.

Dr. Munidra Narayan Baruah, Managing Director and Chief Physician of NECHRI said, "Cancer diagnosis and treatment is expensive, therefore most patients in India cannot afford it. However, this collaboration with IIT Guwahati is historic and would help us to develop indigenous instruments, diagnostic devices and drugs that are affordable for our population through an interdisciplinary approach."



## IIT Guwahati Student team develops a digital health system to take healthcare to larger populations in remote areas.

Two research scholars of IIT Guwahati, Ms. Mitali Basak, 3rd year Ph.D. scholar, Center for Nanotechnology, IIT Guwahati, along with Dr. Shirsendu Mitra, former PhD scholar at the Department of Chemical Engineering, IIT Guwahati (presently an Early Career Fellow at IIT Gandhinagar), have been recognised for an entry to the global Charm Health Innovation Challenge.

Ms. Mitali Basak and Dr. Shirsendu Mitra teamed up and participated in the competition under the category of "Student Innovators" and submitted an idea of a benchtop digital setup integrated with an algorithm to record initial screening parameters like body temperature, pulse rate, eye and tongue analysis of a patient remotely. A situation like COVID demands human interactions to be as minimal as possible. In view of this, the current innovation serves a potential tool for healthcare management remotely, taking care of physical as well as social distancing norms.



The device developed by the scholars is capable of remotely doing primary health check-up. Further, a robust algorithm along with cloud interfacing is expected to enable the device to store large volumes of health data for future benefit.

The winners of this challenge will be decided after submission of a prototype based on the proposed innovation. Ms. Basak and Dr. Mitra are working on the prototype which is expected to be ready within the next 4 months. This innovation challenge includes a cash prize of \$2500 for the top 2 winners. Apart from this, once the winning innovation is fully developed, its commercialisation will be taken forward by the organisers.

Charm Health Innovation challenge is a Digital Healthcare focused technology competition organised by two California based organisations namely, Charm Health and iValley. It is a platform for innovators and entrepreneurs to showcase their innovative technological solutions and new business models of healthcare, Artificial Intelligence assisted patient care and remote monitoring incorporating Artificial Intelligence and Virtual Reality (AI/VR) and Natural language processing (NLP), wearables and devices. (<https://www.innovationchallenge.com/challenges/charm-health-innovation-challenge>)

The challenge is to identify a focus area from Telehealth & Telemedicine; Digital Therapeutics & New Business Models; Tech-Led Innovations; Healthcare Analysis; mHealth, and Billing & Fitness, and submit a written proposal of the solution. The proposal includes the use of one or more Charm Health application programming interfaces to implement the solution or should describe how this would be used in a similar electronic health record platform.



Ms. Mitali Basak, Student, IIT Guwahati



Dr. Shirsendu Mitra, Alumni, IIT Guwahati

## IIT Guwahati Scientists gain international recognition for their work on Quantum Entanglement

A research team at IIT Guwahati, led by Prof. Amarendra Kumar Sarma, Professor, Department of Physics, have studied the workings of quantum entanglement, a phenomenon that continues to baffle the finest scientific minds of the world. The team's theoretical research on cavity optomechanical systems has potential applications in quantum information science and can contribute towards understanding the boundary between classical and quantum physics. The team, comprising Prof. Amarendra Kumar Sarma and his research scholars, Dr. Subhadeep Chakraborty and Mr. Sampreet Kalila, have recently summarized their understanding in an invited review article in a prestigious research journal AVS Quantum Science published by American Institute of Physics (<https://doi.org/10.1116/5.0022349>). The article is published as featured article of the journal this month.

Prof. Sarma was invited to write a review article for the journal in recognition to his seminal works in quantum optics. Prof. Sarma and his group, in recent years, published their research articles in the area of quantum optics in various prestigious journals such as Physical Review A, Journal of Optical Society of America B, Annals of Physics, Scientific Reports and so on. Some of the most recent works by Prof. Sarma's research group could be found in the following links:  
<https://doi.org/10.1103/PhysRevA.100.063846>  
<https://doi.org/10.1364/JOSAB.34.001503>  
<https://doi.org/10.1016/j.aop.2018.03.007>  
<https://doi.org/10.1038/s41598-018-32743-1>  
<https://doi.org/10.1103/PhysRevA.102.043719>

Quantum physics, the field of Science that has ridden on the shoulders of such giants as Niels Bohr, Werner Heisenberg, and Erwin Schrödinger, continues to be researched by labs all over the world, to help unravel the workings of the universe. This study of subatomic particles and forces forms the basis of the computer chip, the electric current, laser power, and even light from the sun.

One of the most fascinating, and perhaps bizarre traits of quantum mechanics is quantum entanglement, the interaction among quantum systems such as subatomic particles, in ways not possible in our larger, perceivable classical world. When two subatomic particles, like a pair of electrons, are entangled, it is



impossible to measure properties of one without affecting the other. No matter how far they move apart, if one is tweaked, measured, or observed, the other seems to instantly respond, even if the whole world now lies between them.

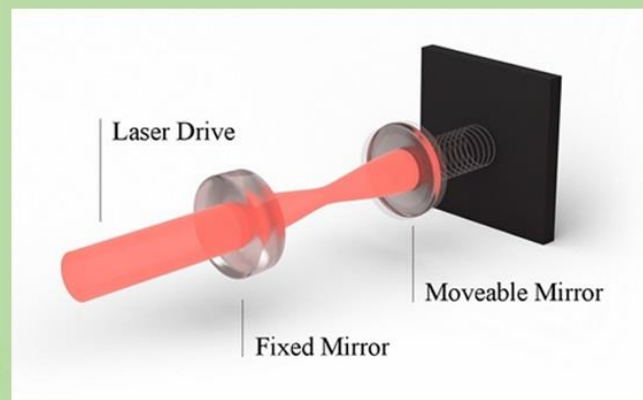
“Nobody knows how or why Quantum entanglement happens”, says Dr. Amarendra Kumar Sarma, Professor, Department of Physics, IIT Guwahati, about quantum entanglement, the phenomenon that baffled even the great intellect of Einstein. “That, however, does not make it unreal – numerous experiments have established that entanglement is indeed a real phenomenon in subatomic systems. In fact, quantum entanglement is the building block of second generation of quantum technology such as quantum computation, quantum cryptography, quantum teleportation, and quantum dense coding”, adds Prof. Sarma.

Various research groups around the world are working towards understanding quantum entanglement across various subfields. Dr. Sarma’s team works on understanding it in the realm of cavity optomechanics, the interaction between light and mechanical objects at low-energy scales.

“In simplified terms, a cavity optomechanical system refers to a set of mirrors where one of the mirrors is fixed while the other one is slightly movable”, explains Dr. Sarma. Surprisingly, this simple model can explain the physics of a plethora of complicated optomechanical systems. Such systems provide a universal tool to achieve quantum control of mechanical motion. But beyond application, the research helps to understand the boundary between classical and quantum physics.

“We have come up with various practical schemes to enhance quantum correlations in optomechanical systems. Apart from entanglement we are looking into the aspects of qubit transfer, photon and phonon blockade also in such systems owing to their tremendous applications in quantum communication and information sciences,” says the lead researcher Dr. Sarma. More recently, the group has addressed the issue of “entanglement sudden death” under the influence of a local noisy environment, a stumbling block encountered by scientists a decade ago. The researchers have proposed a scheme to tackle such shortcomings using an optomechanical platform.

The scientists have published their work in prestigious journals of Physics, and their recent featured article in AVS Quantum Science has provided them the impetus for more rigorous research in unravelling the mysteries of quantum entanglement and other quantum optical phenomena.



Optomechanical System



**Prof. Amarendra Kumar Sarma** Professor  
Department of Physics  
IIT Guwahati



**Dr. Subhadeep Chakraborty**  
Research Scholar  
IIT Guwahati



**Mr. Sampreet Kalita**  
Research Scholar  
IIT Guwahati

## Award & honours



Dr. Akshai Kumar Alape Seetharam, Assistant Professor, Dept. of Chemistry has been selected for membership in the Indian National Young Academy of Sciences (IN-YAS) for a period of 5 years beginning February 2021.





ICoRD'21

8th International Conference  
on Research into Design  
7-10 January 2021  
IDC School of Design  
IIT Bombay

# Congratulations !

## Distinguish Paper Award

### Development and Evaluation of Usability Heuristics for Voice User Interfaces



**Lokesh Fulfagar**  
Alumni  
B. Des. 2015-19 Batch  
IIT Guwahati



**Anupriya Gupta**  
Alumni  
B. Des. 2015-19 Batch  
IIT Guwahati



**Arpit Mathur**  
Alumni  
B. Des. 2015-19 Batch  
IIT Guwahati



**Abhishek Shrivastava, Ph. D.**  
Assistant Professor  
Dept. of Design  
IIT Guwahati

A paper submitted by Lokesh Fulfagar, Anupriya Gupta, Arpit Mathur and Dr. Abhishek Shrivastava has won the "Distinguished Paper Award" at the iCord'2021. ICoRD'21 is the eighth in a series of international conferences held biannually in India to bring together the international community from diverse areas of design practice, education and research.















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