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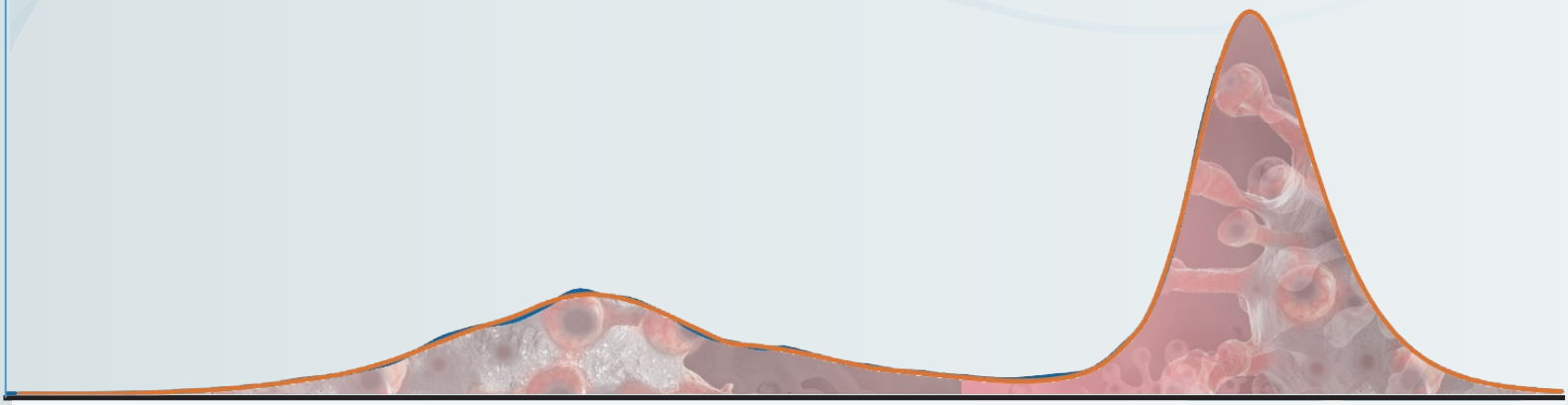
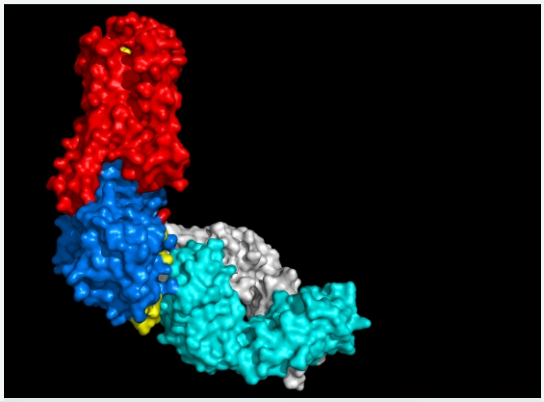
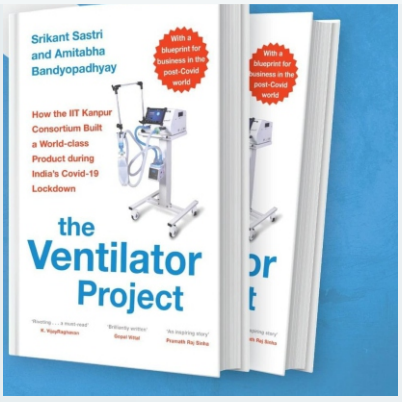
R&D Newsletter

Indian Institute of Technology Kanpur







Covid Week

IIT Kanpur organized a week-long series of talks on various aspects of COVID 19 modelling, biological research, healthcare and management issues of the problem by inviting the field specialists and eminent academicians working in the field. Starting from 17th May, 2021 and ending on 21st May 2021, five webinar has been arranged which focused on the problem at length. The talks in the virtual platform were well attended by the researchers and people working in these domains.

The highlights of the talks are as follows.

The Biology of Coronavirus Infection

Prof. Dibyendu Das,
Dept. of Biologocal Sciences & Bioengineering

Virus are nature's simplest replication machines, they undergo dynamic structural organisation in their life cycle during host cell entry, replication and transcription of viral genome, assembly and budding from host cell to establish infection and escape host-immune system. The speaker focussed on the SARS-COV-2 coronavirus, which caused the ongoing pandemic worldwide and currently a major threat to public health. He discussed on the molecular virology behind virus entry, replication and budding process of SARS COV-2 virus to establish COVID infection.

Covid-19 Care Management from the Perspective of a Non-Professional Caregiver

Dr. Vishal Kumar Chitikeshi
MD (Pulmonology), AIG Hospitals, Hyderabad

The speaker elaborated the typical presentation of the symptoms, what to do at an early, mid- and late-stage of the disease. Some of the myths about Covid care have imposed undue burdens, without any productive outcomes, on the friends and family. He addressed some of theose issues. Finally, Dr. Chitikeshi reached out to the engineering colleagues seeking their help in enabling us to fight this disease better with engineering implements.

https://youtu.be/N7uH5HwV-MQ

The COVID SUTRA

Prof. Manindra Agrawal
Dept. of Computer Science & Engineering

Since Spanish Flu pandemic, mathematical models are being used to explain and project the trajectories of spread of the virus in a population. For Covid-19 pandemic, existing models do not work well due to two novel features of this pandemic. Firstly, a very large number of cases remain undetected, making an estimate of actual infections difficult. Secondly, the spread of the pandemic over the population has been slow due to various measures adopted to contain it, and estimating population currently under the coverage of pandemic is difficult. A new model, named SUTRA, has been proposed to robustly estimate above two quantities, besides standard parameters governing the spread of pandemics, from the daily new infections time series. Prof. Agrawal described the model and some of its predictions in his talk.

https://youtu.be/_Pum4HQK5tQ

SIIC - A vibrant incubation & innovation ecosystem at the epicentre of nation's fight against COVID-19 pandemic

Prof. Amitabha Bandyopadhyay
Dept. of Biological Sciences & Bioengineering

Startup Incubation & Innovation Centre of IIT Kanpur was established in 2001. SIIC has been a bright spot in the national incubator landscape. SIIC has always promoted companies that were in the business of manufactured goods. This ecosystem delivered spectacularly and contributed to India's fight against COVID-19 pandemic. Prof. Bandyopadhyay showcased different aspects of SIIC and specifically highlighted contributions of SIIC incubatees in India's fight against COVID-19 pandemic.

https://youtu.be/TmsQndf7IJo

An overview of COVID19: Pathogenesis, Immune Response and Vaccines

Prof. Nagma Parveen
Dept. of Chemistry

The talk addressed three major aspects related to COVID-19. Dr. Praveen started with pathogenesis of COVID-19 which includs hypoxia, diffuse alveolar damage and hyper-inflammation. She introduced the basics of human immune system that is essential for combating any foreign agents or pathogens. This set the basis for understanding the required molecular design of vaccines against SARS-CoV-2. The speaker gave a comprehensive list of vaccine candidates that are either approved or are at different stages of clinical trials. Finally, she showed a few findings on the efficacy of some of these vaccines against different strains of SARS-CoV-2, and the international efforts on decoding variants of the virus.

https://youtu.be/cXotXVMYv-I

Science Day Celebration

To mark the celebration of National Science Day, IIT Kanpur hosted a virtual event on February 28, 2021. The theme of this year was '**Energy**'. Prof. Abhay Karandikar, Director IITK inaugurated the event with his opening remarks. He emphasized on the significance of Sustainable Energy and IITK's giant leap towards the same by establishing the Department of Sustainable Energy Engineering. The three speakers of the event were Prof. Ashish Garg, Head of Sustainable Energy Engineering Department, Prof. Sameer Khandekar, Head of Mechanical Engineering Department and Prof. Jishnu Bhattacharya, Department of Mechanical Engineering.

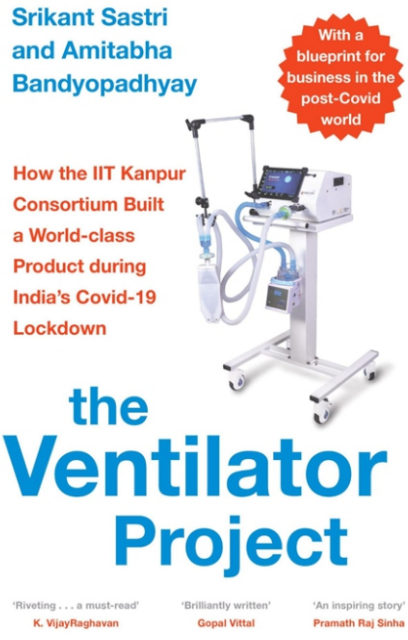
Prof. Garg talked about the challenges and potentials of "Solar Photo voltaics", while, Prof. Khandekar focussed his presentation on Thermal Energy Management and shared his experiences on developing the "Thermal Energy Storage Systems" at the Centre for Environmental Science and Engineering building at IITK. Further, prof. Jishnu Bhattacharya provided an overview of the promise, challenges and the current status of the"Hydrogen as Energy Carrier".

https://www.iitk.ac.in/dord/outreach/science-day

SIIC Corner

IIT KANPUR | INCUBATION AND INNOVATION | STARTUP INCUBATION AND INNOVATION CENTRE IIT KANPUR

Prof Amitabha Bandyopadhyay, Department of Biological Sciences & Bioengineering and Professor In-charge of the IIT Kanpur Incubator, SIIC, was nominated to the **National Startup Advisory Council** in January 2021.



The **Ventilator Project**, authored by Prof. Amitabha Bandyopadhyay and an IIT Kanpur alumni, Mr. Srikant Sastri was launched by Hon'ble Education Minister of India, Shri Ramesh Pokhriyal 'Nishank', at a virtual event on 16 March 2021. It lays out an incredible account of the Noccarc V310 ventilator's creation by the IIT Kanpur Consortium – in an extraordinary span of 90 days!

SIIC Corner

Tech for Tribals is a unique program, launched by TRIFED, Ministry of Tribal Affairs, GoI to make tribals of India "Aatmanirbhar". It focuses to bridge the gap between tribal entrepreneurs and urban markets. FIRST @ IIT Kanpur has been entrusted to run the skill development program of tribal youth across Chhattisgarh and Kerala to help them build their enterprise by commercializing the products using MFPs.

CiTe- Civic Tech Innovation Launchpad 2021 is a collaboration of North DMC and SIIC, IIT Kanpur, supported by Capri Global, which received a tremendous response across startups and innovators in India, with more than 100 applications competing under the call for applications. Five winners across Sanitation & Hygiene, Water Management and Waste Management domains were selected, who will receive a paid pilot project to solve the civic issues with the North DMC.

SIIC launched Mission Bharat 0_2

SIIC, IIT Kanpur launched **Mission Bharat O_2** to support the nation's healthcare systems by developing oxygen plants and concentrators. SIIC will prioritize manufacturing 50 oxygen plants across India over the coming months. *AquaInfra (AIPL)*, a SIIC incubatee, will provide the design of the plant to partner manufacturers to develop plants with capacity of 250 LPM and 500 LPM. The decentralized production will ensure rapid scale manufacturing of the plants, which would culminate in a pan India effort in response to COVID-19. Mission Bharat 0_2 is a big step towards nurturing self sustainable India in the healthcare sector.

The **Kolhapur Startup Mission** was launched in association with Kolhapur Incubation Center, which received more than 600 entries from different start-ups. Six entries were selected, which have kickstarted the work in different domains, under SIIC's guidance.

Through the **REC Innovation Platform**, SIIC is working with the administration and faculty members of the selected 21 govt engineering and science colleges and universities from UP. This initiative is graciously supported by the CSR fund of REC Limited, a GOI enterprise.

Singapore Indian Chamber of Commerce and Industry (SICCI) and SIIC IIT Kanpur signed a MoU on March 10, 2021. The objective of this collaboration is to provide a gateway of opportunities to tech-based start-ups in this cross-border collaboration. To further their shared goal of entrepreneurship development across borders, a new competition was launched on 23rd April 2021 which will allow SIIC and SICCI to promote homegrown and international initiatives operating in the technology domain.

Startup News about our incubatees:

EndureAir assisted NDRF in search and rescue operations in glacial lake outburst in Uttarakhand in February 2021. Using their fleet of indigenously developed advanced drones, the team performed search operations to look for survivors as well as inspected the hydel power project sites to assess the damage done by the flood.

Kritsnam Technologies made a notable assistance to the Central Water Commision with radar based instruments that would help monitor real-time flood water levels in Uttrakhand thus enabling the government to take timely action.

SaptKrishi is an Agri-Tech start-up working towards the development of low-cost storage and transportation solutions for farmers and traders engaged with horticulture and floriculture. They were featured in Outlook India recently on March 24th.

Recent Project

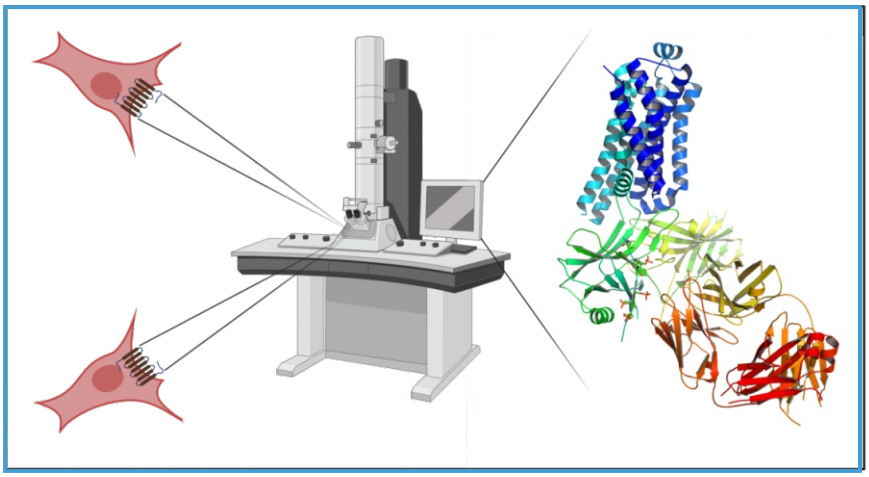
SERB sponsored National Cryo-Electron Microscopy Facility at IIT Kanpur

Sponsor: Science & Engineering Research Board

PI: Prof. Arun K. Shukla (arshukla@iitk.ac.in)
Department of Biological Sciences & Bioengineering

Co-PI: Prof. Appu Kumar Singh (singhappu@iitk.ac.in)
Department of Biological Sciences & Bioengineering

Membrane proteins constitute approximately one third of the total cellular proteome, and they are involved in nearly every biological processes making them one of the most important class of drug targets. High-resolution structure determination of membrane proteins continues to be one of the most challenging but incredibly rewarding research areas in modern biology. Despite an illustrious history of Indian structural biology fraternity, direct structural studies of membrane proteins in India have mostly been an untouched territory, resulting in a significant lack of Indian presence at the global arena in this particular area.



In this backdrop, the current project aims to establish SERB supported **National Cryo-EM facility** at IIT Kanpur focused on structure determination of therapeutically important membrane proteins at high-resolution. This will serve as a springboard for our research program to reach the next level and multiply the impact of research outcomes with direct implications for novel drug discovery. It is envisioned that the **Cryo-EM facility** at IIT Kanpur will serve as the North India hub for users from multiple institutions and industries who are interested in using structural biology as a gateway to understanding fundamental biological processes and leverage the information designing novel therapeutics. This facility will also be a platform for training the next generation of scientists i.e. graduate students and post-doctoral fellows, in this incredibly powerful technology.

eMasters program @ IIT Kanpur

IIT Kanpur has launched the **e-Masters programs** in Communication Systems, Cybersecurity, Power Sector Regulation, Economics & Management, and Commodity Markets & Risk Management. The programs will deliver course content completely online and help upskilling of working professionals with industry experience and expand their career options. The institute has established the Office of Digital Learning to manage the eMasters program with the following activities:

- Establish an appropriate platform for the content creation, lecture delivery, and classroom management
- Liaison with prospective organizations to facilitate admissions
- Coordinate with the departments for content creation, delivery, and management
- Maintain the academic performance data and other relevant records
- Assist the Dean of Academic Affairs in the overall management of the eMasters program

Prof Amey Karkare of the Computer Science and Engineering Department is appointed as the Professor In-charge.

Recent Project

Design and Develop Indigenous Tactical UAV with Maximum Local Content through Collaboration between the Parties

Sponsor: BEML Limited

PI: Prof. A K Ghosh (akg@iitk.ac.in)
Department of Aerospace Engineering

Co-PI: Prof. Manindra Agrawal (manindra@iitk.ac.in)
Department of Computer Science & Engineering

In this project, a Medium Altitude Tactical Reconnaissance Unmanned Aerial Vehicle is being designed and developed through the IITK-BEML collaboration.

The UAV being designed is of medium weight class, with a maximum takeoff weight of 30 kg and will possess short take-off and landing capabilities. Powered with a hybrid power plant with a military grade engine, this UAV will achieve 8+ hours of endurance, with a service ceiling of 5 km and a maximum speed of 40 m/s. The craft will be structurally robust to handle 3G manoeuvres and will be equipped with state-of-the-art surveillance systems. Safety of the UAV against mission failure due to aerodynamic loss of control will be ensured through a robust autopilot, while its security of ownership against any possible breach of datalink by adversaries will be assured through systems jointly developed with C3i lab, IIT Kanpur.

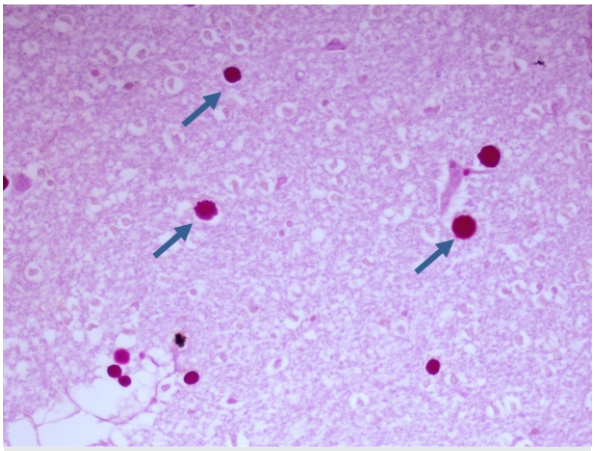
Functional Similarities between the Aged Brain & Neurodegenerative Disorders : Exploring Roles for Genes Implicated in Progressive Myoclonus Epilepsies in Normal Brain Aging

Sponsor: Science & Engineering Research Board

PI: Prof. S Ganesh (sganesh@iitk.ac.in)

Department of Biological Sciences & Bioengineering

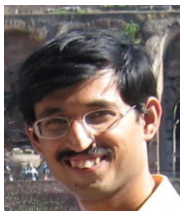
Progressive myoclonus epilepsy (PME) comprises a group of disorders with teenage onset disease-defining symptoms of epileptic seizures. Besides the seizures, patients with PME also show a progressive worsening of neurological functions such as ataxia, muscle wasting, dementia, psychosis, and hallucinations. Intriguingly, these neurological conditions are also observed in aged individuals, suggesting a common underlying mechanism in the neurological deficits. A majority of PMEs run in families (familial), caused by loss-of-function mutations in genes, and the products of a majority of such genes are known to be involved in cellular stress response pathways. It was hypothesized that the genes implicated in the PMEs are neuroprotective, that their expression level in the brain might reduce with ageing, and this reduction in the expression might lead to neurodegeneration and neurological deficits in the aged brain.



Light microscopy image showing glycogen inclusions (arrows) in the brain section of a patient affected with Parkinson's disease

The current project proposes to test this hypothesis using animal models and to come up with ways to delay this deficit by modulating the cellular pathways.

Creation of Science and Technology Content for Indic Wikipedia by IIT Kanpur



Sponsor: Department of Science and Technology

PI: Prof. Arnab Bhattacharya (arnabb@iitk.ac.in)

Co-PI: Prof. T.V. Prabhakar (tvp@iitk.ac.in)

Department of Computer Science & Engineering

Wikipedia is one of the most popular sources of information. Users are increasingly browsing the Wikipedia and different related sources for technical content as well. With the rapid penetration of mobile phones in India and availability of Indian language tools, the importance of Wikipedia in Indian languages has grown manifold. Unfortunately, the quality and quantity of technical content (in the areas of science and technology) in Wikipedia of Indian languages (including Hindi) leaves a lot of scope for improvement.

The current situation of online schooling due to the pandemic has made this more timely than any other period. Thus, while building high quality science and technology content for the Hindi Wikipedia is the primary goal of the project, a more important aim is to inculcate the culture of scientific writing in Indian languages across the country. The project will involve other institutes such as IIIT Hyderabad, CDAC and Wikipedia India.

Recent Project

Himalayan Metamorphic CO_2 fluxes to the Atmosphere: solving the mystery behind a long-standing problem

Sponsor: Science and Engineering Research Board

PI: Prof. Indra S. Sen (isen@iitk.ac.in)

Co-PI: Prof. Dibakar Ghosal (dghosal@iitk.ac.in)

Department of Earth Sciences

Twenty years ago, the pioneering work by *Kerrick* and *Caldeira* posed a seminal question whether degassing of metamorphic CO_2 from orogenic events triggers rapid global warming?

This project will address this long-standing knowledge gap by quantifying the fluxes of metamorphic CO_2 degassed from geothermal springs located along the major Himalayan fault zones. This would be the first attempt to quantify the rate and magnitude of metamorphic CO_2 emission to the atmosphere using direct ambient air measurements, both concentrations and isotopic ratios, to solve a long-standing conundrum - "The most vexing problem we have encountered in modeling the geochemical carbon cycles is to calculate the rate of degassing of carbon dioxide due to igneous and metamorphic activity." *R.A. Berner* and *A.C. Lasaga,* 1989.

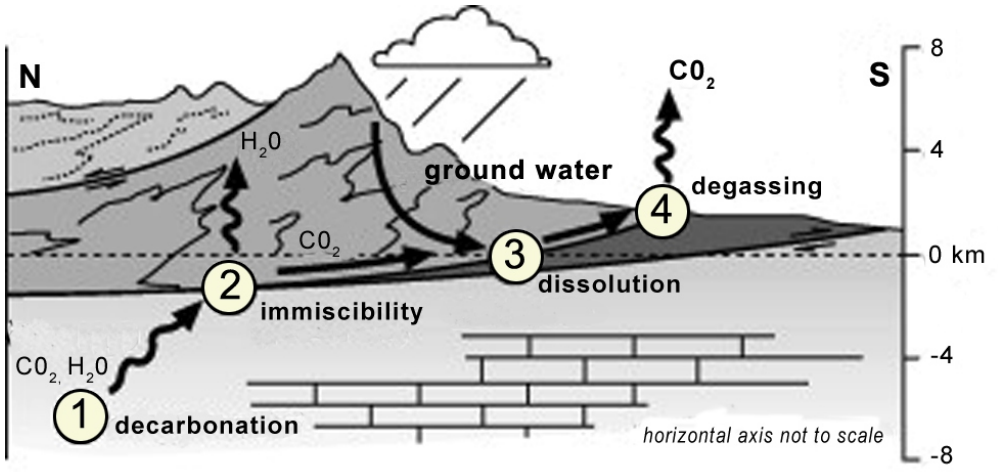


Figure rom Becker et al., 2008, EPSL, 265: (1) prograde metamorphism of carbonate-bearing rocks and organic matter oxidation produce CO2-H2O fluid (2) CO2 exsolves from fluid due to decompression and temperature loss, (3) during migration along fault zones the metamorphic CO2 gets dissolved in meteoric water and (4) degassing near the surface

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