Annexure-I

The Golden Jubilee Commemoration Medal – Chemical Sciences (2013) Lecture

Single Molecule Magnet Behavior in 3d/4f and 4f Complexes

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Single-molecule magnets are a new family of molecular materials. Heterometallic and homometallic complexes containing lanthanide ions have been investigated for this purpose. In this talk emphasis will be given on the design of new polyfunctional ligands that have the capability to assemble both homo- and heterometallic complexes containing lanthanide ions. The synthesis, structure and properties of these new family of molecular magnets will be discussed.

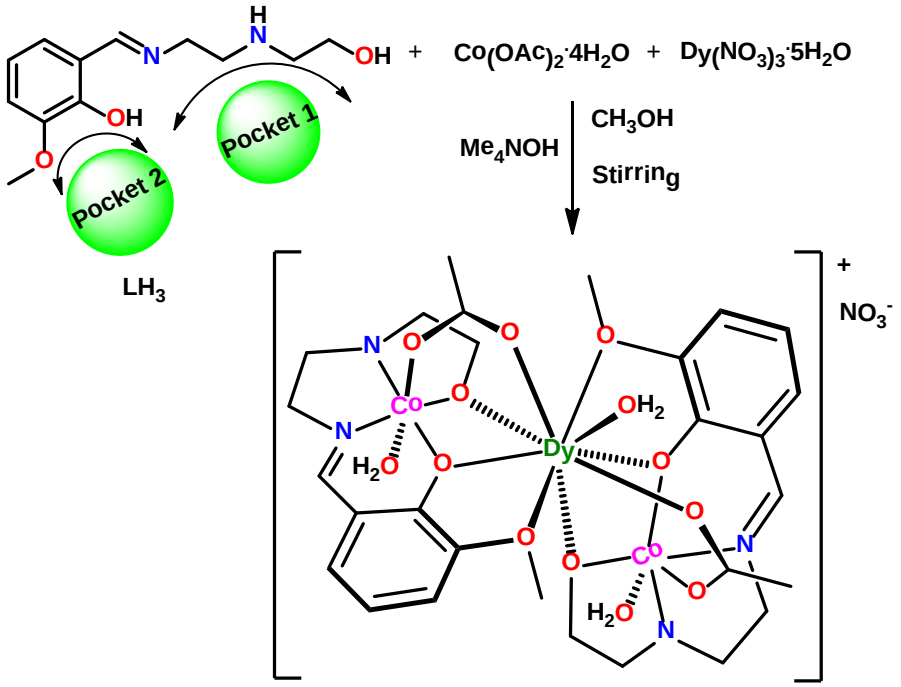

Figure 1 A trinuclear complex containing a central Dy^{III} flanked on either side by diamagnetic Co^{III}

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Shanti Swarup Bhatnagar Medal (2016) Lecture

The degenerating brain: mechanisms to therapy

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Brain related disorders contribute up to one-third of the total disease burden in both developed and developing countries. Among the brain related disorders, which comprise of both neurological and psychiatric illnesses, a cause of serious concern are the age-related disorders such as senile dementia including Alzheimer's disease and Parkinson's disease (PD) etc. These disorders are progressive and irreversible and the etiopathogenesis of these disorders are poorly understood. They are characterized by loss of specific cells within certain regions of the brain leading to selective loss of function. Our research focuses on understanding the molecular mechanisms underlying the selective cell death with a view to identify targets that can be used for disease modifying therapy and also identify such molecules from the knowledge base of traditional medicine. PD is a progressive movement disorder that results primarily from the death of dopaminergic neurons in the substantia nigra (SNpc). We have identified redox driven activation of cell-specific death signaling pathways and downregulation of cell survival pathways that contribute to the pathogenesis of Parkinson's disease and explains the failure of drug that went into clinical trials.

Traditional systems of medicine, such as Ayurveda offer a knowledge base that can be utilized for development for therapeutic intervention strategies for treatment of these disorders. Utilizing the knowledge base from Ayurveda, we have identified an herbal extract that reverses AD pathology. The remarkable therapeutic effect of the extract is mediated through up-regulation of low-density lipoprotein receptor-related protein (LRP) in the liver indicating that targeting the periphery offers a novel mechanism for rapid elimination of amyloid peptide for reversing the behavioral deficits and pathology seen in Alzheimer's disease.

CV Raman Medal (2016) Lecture

Atoms and Molecules in a Confined Environment

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It is known that quantization arises from imposing boundary conditions, the classic example being a particle in a box. The talk will illustrate how properties of atoms and molecules change because of confinement, using endohedral fullerenes as examples. For example, the stretching frequencies of molecules like water and ammonia confined to a fullerene (C_{60}) cage exhibit a blue shift. Hydrogen bond between water molecules breaks inside the cage. Although small molecules like B_2 and O_2 retain their paramagnetic property, Ge_2 exhibits a spin cross over as it rotates inside the cage. The noncovalent interaction between rare gases undergoes a quantitative change due to confinement inside a carbon nanotube.

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Shanti Swarup Bhatnagar Medal (2013) Lecture

Urban Health and Climate Change- A Systems Approach

Indira Nath

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Humanity has entered the Anthropocene era and is in the midst of the greatest urbanization in history. Asia and Africa are the fastest growing and fastest urbanizing continents. In addition, climate change induced by man made activities is leading to change in health patterns and emerging diseases. The traditional dual burden of communicable and non-communicable diseases has become a triple burden caused by disability due to road accidents. In 2007 we reached a threshold where 50% of the world's population lived in cities. By 2050 it is projected that 70% of the population would be urban dwellers. The rapidity of urbanization combined with climate changes is presenting challenges to all countries but more so to low and middle income countries. Migration of refugees due to conflicts and internal migration from rural to urban areas pose additional problems. Informal settlements provide manpower for the cities but also breed illnesses due to poor infrastructure and density of people. Urbanization also leads to heat islands which change vector behavior and thus infectious diseases. Whereas malaria vector breeds in clear water and may reduce in heat spots and seen more in rural areas, mosquitoes causing dengue, chikangunya and dengue breed in heat islands and in stagnant water within water coolers, empty vessels, tires etc. Cholera associated with bad sanitation is another problem in urban areas. Floods caused in cities due to bad city planning aggravate water borne diseases. Migration further brings in diseases that may not have existed locally. Life style diseases such as cardiovascular diseases, diabetes, obesity and hypertension have been linked to urban living.

Managing cities and providing services for health and wellbeing requires an integrated trans disciplinary approach and cannot be handled in silos. Decision makers need to be provided holistic advice. A systems approach is required as a city has an integrated organic structure. Thus policies and informed decisions can be made with good data provided by multiple agencies and experts. Policy makers need to interact with experts, doctors and city planners need to talk to each other as well as policy makers and the civil society. Economies are in danger if health of a nation is severely affected. Thus analysis of systemic issues with credible data is essential for managing health in the urbanized world of the Anthropocene era.

Sunder Lal Hora Medal Lecture (2014)

Making headway from genome architecture to genome medicine with impressive technologies and big data

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Notable advances in our understanding of the information concealed in the human genome have been witnessed in the recent years, with implications for human health and disease. While common single nucleotide polymorphisms discovered on human genome sequencing in the previous decade paved the way to generate big data for common complex disorders, the contemporary next generation sequencing approach has enabled identification of rare and ultra- rare variants in the genome, thus revolutionizing the genetic analysis of single gene disorders. Concomitant progress in functional genomics and systems biology approaches are providing insights into the etiological mechanisms underlying diseases with promising leads for new therapeutics.

A few exciting discoveries of disease causing genes for familial forms of intellectual disability and Parkinson's disease and risk conferring genes for rheumatoid arthritis and ulcerative colitis, made in the laboratory, using the large patient resource available in the ethnically distinct Indian population, will be presented. Further, the novel approach of 'Ayurgenomics', combining the Ayurveda doctrines of subgrouping of individuals into three predominant prakriti groups with contemporary genome tools, which is being explored in the laboratory to address clinical and phenotypic heterogeneity plaguing complex disorder genetic analysis, will be discussed. A novel initiative of newborn screening for inborn errors of metabolism, an example of translational medicine, will be shared.

INSA-Vainu Bappu Memorial Award (2016) Lecture

X-ray Emissions from the Solar System Bodies

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Our knowledge about the X-ray emissions from the solar system bodies has significantly improved during the last two decades. The advent of higher-resolution X-ray spectroscopy with the Chandra and XMM-Newton X-ray observatories has been of great benefit in advancing the field of planetary X-ray astronomy. Several new solar system objects are now known to shine in X-rays at energies generally below 2 keV, with total power outputs on the MW-GW scale. Apart from the Sun, the known X-ray emitters now include planets (Mercury, Venus, Earth, Mars, Jupiter, and Saturn), planetary satellites (Moon, Io, Europa, and Ganymede), all active comets, asteroids, the Io plasma torus (IPT), the rings of Saturn, the coronae (exospheres) of Earth, Mars, Venus, and the heliosphere. Recently, the puzzling X-rays from Pluto have been observed. I will summarise the recent advances in the area of solar system X-rays and provide an outlook into the future.

Jawaharlal Nehru Birth Centenary Lecture (2014)

Plant Survival under stress environment

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Plants encounter many environmental stresses during their life span. The tolerance limits of stress varies with the species. Bothe abiotic stresses like drought, salinity, temperature, nutrients etc and biotic stresses cause serious damage to the plants and in crop plants leads to yield losses. It is envisaged that such stresses may further have an enhanced impact with changing climate conditions. It is therefore imperative that we understand the biochemical and molecular basis of stress sensitivity and tolerance in order to develop technologies for improving stress tolerance traits in crop plants.

During the last two decades , and with the complete genome analysis of Arabidopsis and rice and other plants, we now have a comparatively a better understanding of some of the mechanisms of stress tolerance/ sensitivity. Using various techniques of differential screening our group has identified stress regulated genes and has linked the function of a number of such genes to stress tolerance. One such pathway , on which the group has been working is the glyoxalase pathway which has two enzymes , glyoxalase I and II, both working in tandem to detoxify methylglyoxal, a toxic compound . The levels of methylglyoxal were found to increase in response to stress. We have shown that by overexpressing both glyoxalase I and II , the transgenic plants were able to tolerate higher level of stress. This was demonstrated both in the model plant tobacco as well as in a crop plant, rice. The gene organization of glyoxalase I and II in rice revealed that there are about 10 genes encoding glyoxalase I and three genes encoding glyoxalase II. A few of these members have been studied in details. One of the member , unlike anything reported in animal systems , was found to be activated by nickel and another one was localized into the nucleus. One of the glyoxalase II was found to be regulated by glutathione. It was also found that some of the members do not show glyoxalase activity. We have also found that triose phosphate isomerase , which regulates MG levels, it regulated by MG itself . This and other data indicate that MG may be involved as a signal molecule in plant stress physiology. Our group has also developed transgenic rice plants with glyoxalase genes and genes of ion homeostasis which tolerate stress conditions. Taken together the our results suggest that glyoxalases and methylglyoxal could be considered as important biomarker for plant stress tolerance.

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