Applications of solution-state NMR: From metabolomics to understanding RNA-protein interactions

A Talk by

Dr. Jeetender Chugh

Indian Institute of Science Education and Research, Pune

E-mail: cjeet@iiserpune.ac.in

About the Speaker

Jeetender Chugh obtained his Ph.D. in Biomolecular NMR spectroscopy in 2008 from TIFR, Mumbai. He was a postdoctoral fellow at the University of Michigan before joining IISER Pune in 2013. His lab focuses on various aspects of solution NMR spectroscopy, including theoretical design and implementation of new NMR experiments to probe the biophysical characteristics of RNA, protein, and RNA-protein complexes. He is also looking at metabolic profiles of various body fluids (urine, blood, saliva etc.) in normal and disease conditions and cell extracts under various stressed conditions to understand and correlate the metabolic pathways with specific disease/stressed Conditions.

Talk Abstract

NMR spectroscopy can measure dynamics at atomic resolution and deduce structural, kinetics, and thermodynamic characteristics of many motional modes occurring at different time scales. In addition, the unique properties of NMR, including a high degree of reproducibility, inherently non-destructive, relatively easy methods for sample preparation, and highly quantitative nature, have made it an eminent technique useful in several disciplines of metabolomics. This talk will discuss a few applications of NMR encompassing metabolomics and RNA-protein interactions.

The tightly regulated interactions between RNA-binding proteins (RBPs) and RNAs play a vital role in complex cellular pathways like small RNA biogenesis, post-transcriptional RNA modification and gene regulation, RNA transport, non-coding RNA-mediated regulation, etc. The number of RNA-protein complexes submitted in the Protein Data Bank (3900) is a tiny fraction of the number of protein structures (1,68,289), highlighting the challenges in determining structures of such complexes that are highly dynamic, multi-component and often short-lived in nature. Using state-of- the-art NMR-based dynamics experiments and molecular dynamics simulations, we have shown that TRBP dynamically targets topologically different dsRNAs (due to internal loops and bulges) uniquely; and both intrinsic and RNA-induced conformational dynamics in TRBP are pivotal for such substrate promiscuity.

Type 2 diabetes mellitus (T2DM), or non-insulin dependent diabetes, is increasing worldwide. Initially considered as the disease of the West, increased prevalence is now being reported in developing countries like India. T2DM is characterized by defects in insulin secretion, signaling, and production. The major pathological features associated with T2DM include hyperglycemia (elevated levels of glucose) and dyslipidemia (elevated free fatty acids), which ultimately lead to impaired insulin secretion by pancreatic β-cells and their untimely death by apoptosis (glucolipotoxicity).The metabolic signatures associated with glucotoxicity, lipotoxicity, and glucolipotoxicity in in vitro and murine models of T2DM and a comparison of metabolic signatures in healthy individuals and diabetic populations from Pune will be discussed.

Hosted By

Prof. Kavita Dorai, Dept. of Physical Sciences & Convener NMR Facility,
IISER Mohali

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