Every living creature requires energy to survive and reproduce. In humans, this vital energy is produced by tiny powerhouses called mitochondria, found in almost every cell. When these mitochondria encounter problems, it can lead to various diseases, including cancer, neurodegenerative conditions, and abnormal inflammatory responses. Despite their critical role, mitochondria have a relatively small set of genetic instructions to guide their functions, and they can't function in isolation. Many of the proteins essential for optimal mitochondrial performance are created in different parts of the cell and then transported into the mitochondria. One such group of proteins, known as the FASTK family, plays a crucial role in ensuring that mitochondrial RNA, which is vital for gene expression within mitochondria, is processed correctly. Human FASTK family of proteins contains six members, five of which, the FASTKD proteins, are exclusively found within the mitochondria. Despite their importance in the fundamental aspects of mitochondrial biology, we currently lack a deep understanding of how these FASTKD proteins work, how they interact with RNA and other proteins, and what their precise structures look like.

The research I aim to conduct is focused on unravelling the role and mechanisms of action of FASTKD proteins in mitochondrial RNA metabolism. I plan to perform experiments involving biochemistry and molecular biology to uncover the unique characteristics of FASTKD proteins and their specific preferences for RNA substrates. Additionally, I intend to determine the detailed three-dimensional structure of FASTKD proteins, both when they are on their own and when they are bound to RNA, using a cutting-edge technique called electron cryo-microscopy. This rapidly advancing method allows scientists worldwide to gain insights into complex molecular structures. Furthermore, I will explore how FASTKD proteins come together to form larger assemblies within human mitochondria and attempt to visualize these structures. My research endeavours will contribute to our understanding of how human FASTKD proteins function in mitochondrial RNA metabolism, bringing us closer to identifying the underlying causes of certain mitochondrial disorders.