SCIENCES & BIOENGINEERING SCIENCES

The Research Group
Structural Biology Brussels

has the honor to invite you to the public defence of the PhD thesis of

Israel Pérez Chávez

to obtain the degree of Doctor of Bioengineering Sciences

Joint PhD with Université libre de Bruxelles

Title of the PhD thesis:
Fluorescent protein-based biosensors to shed light on hepatic glycolysis and metabolic regulation

Supervisors:
Prof. Dr. Joris Messens (VUB)
Prof. Dr. Daria Ezerina (VUB)
Prof. Dr. Esteban N. Gurzov (ULB)

The defence will take place on

Wednesday, February 4, 2026 at 5 p.m. in auditorium I.0.01

The defence can be followed through a live stream: Public PhD Defense Israel Pérez/Defensa doctorado Israel Pérez | Meeting-Join | Microsoft Teams

Members of the jury

Prof. Dr. ir. Remy Loris (VUB, chair)
Prof. Dr. Anastassia Vorobieva (VUB)
Prof. Dr. Hennie Valkenier (ULB)
Prof. Dr. Valérie Wittamer (ULB)
Prof. Dr. ir. Joachim Goedhart (Universiteit van Amsterdam, NL)
Prof. Dr. Bart Ghesquière (KU Leuven)

Curriculum vitae

In 2020, Israel obtained his MSc in Biology: Molecular and Cellular Life Sciences at VUB. At the end of 2020, he began his PhD in the Redox Signaling Lab under the supervision of Prof. Dr. Joris Messens, and Prof. Dr. Daria Ezeriņa. In 2021, Israel was awarded a FRIA F.R.S.-FNRS Fellowship to support his doctoral project in a joint-PhD project together with the STML laboratory under the supervision of Prof. Dr. Esteban N. Gurzov. He has published in 5 peer-reviewed journals, from which two as first author, and one as joint first author. He participated in one international conference and coordinated several practical courses for MSc programs.

Abstract of the PhD research

The liver performs essential metabolic functions, and disruptions caused by viruses, alcohol, or fat accumulation can lead to severe diseases, including fibrosis, cirrhosis, and liver cancer. This thesis explores the potential of genetically encoded fluorescent biosensors to uncover metabolic mechanisms underlying such conditions, with a focus on glycolysis, a central driver of metabolic remodeling in the liver. Chapter 1 provides an overview of available biosensors for monitoring liver-related metabolic pathways and the types of questions they can address. Subsequent chapters examine two glycolytic biosensors that detect distinct intermediates: glucose 6-phosphate (BUGI) and fructose 1,6-bisphosphate (HYlight), which reflect the rate-limiting step of glycolysis. I designed and built BUGI, but it showed low analyte affinity and poor performance in mammalian cells. Meanwhile, HYlight, released during the development of BUGI, displayed superior selectivity and functionality. After comparing both probes (Chapter 2), HYlight was selected, although key information on its properties remained obscure. Chapter 3 fills these gaps and introduces a method to convert HYlight fluorescence into absolute fructose 1,6-bisphosphate concentrations in single cells, revealing micromolar levels rather than the previously assumed millimolar range. In Chapter 4, I apply HYlight to investigate the roles of genes (PTPRK, PTPRF, TXNIP) implicated in modulating glycolytic flux in various pathophysiological contexts, underscoring the value of HYlight for studying liver metabolism. The thesis concludes by discussing current barriers to broader biosensor adoption, future biosensor development, and the prospects of HYlight as a tool for glycolytic assessment. Overall, this work highlights the significant promise of fluorescent biosensors as reliable instruments for metabolic research and for advancing understanding of liver disease.