

THE UNIVERSITY



OF HONG KONG

*Institute of Mathematical Research  
Department of Mathematics*

# COLLOQUIUM

## Simple Questions, Rich Structures

**Professor Antonio Malheiro**

NOVA University of Lisbon

Date:	February 10, 2026 (Tuesday)
Time:	2:30 – 3:30pm
Venue:	Room 210, Run Run Shaw Bldg., HKU

### Abstract

Many algebraic structures are defined by simple local rules, yet exhibit remarkably rich global behaviour. A central theme in modern mathematics is understanding how such structures encode symmetry, complexity, and computability, and how these properties can be detected through combinatorial and geometric models.

In this talk, I will start from classical ideas in the theory of automatic groups, emphasizing the existence of multiple equivalent characterizations -- language-theoretic, geometric, and algorithmic -- and their role in solving the word problem efficiently. I will then explain how these ideas motivate natural notions of automaticity beyond groups, leading to analogous questions for monoids.

This perspective leads naturally to the study of the plactic monoid, whose structure admits several characterizations, including a description in terms of Kashiwara crystals. I will explain how this viewpoint allows one to extend classical results to other types, such as  $B_n$ ,  $C_n$ ,  $D_n$ , and  $G_2$ . Finally, I will discuss how similar ideas inspired the introduction of quasi-crystals in the context of the hypoplactic monoid, providing a flexible framework that retains key combinatorial and symmetry features while allowing new phenomena to appear.

The talk will focus on the underlying ideas and connections rather than technical proofs, and is intended for a broad mathematical audience.

*All are welcome*