Algebraic geometry, originating from the analysis of multivariable polynomials, is a fundamental field of mathematics. Its modern form relies on abstract algebraic techniques, particularly commutative algebra, which allow for solving geometric problems concerning zero sets.

The central focus of this field is on algebraic varieties, which are geometric interpretations of the zero sets of polynomial equation systems. Examples of such varieties, such as curves in the plane, include lines, circles, parabolas, ellipses, hyperbolas, and elliptic curves of degree three.

Algebraic geometry plays a crucial role in contemporary mathematics and conceptually connects with many other fields, such as mathematical analysis, topology, and number theory. One of the main goals of this field is the classification problem of algebraic varieties.

This project focuses on studying a special class of algebraic varieties known as projective hyper-Kähler varieties. These varieties hold a key position in the classification, serving as fundamental components of algebraic varieties. Our primary goal is to approach the challenging problem of classifying hyper-Kähler varieties, particularly in the lowest unexplored dimension, which is four. We expect our research to make significant advancements in this area, opening new perspectives for many problems in classical geometry and analysis. We also anticipate their application in physics and cryptography.

This topic is closely related to my current interests and the subject of my habilitation, which I defended in September 2017.