

Summary of Previous Research Achievements

During my master's studies, I specialized in algebraic geometry, a field that studies geometric objects known as `algebraic varieties`. While algebraic geometry traditionally focuses on these tractable classes of spaces, its ideas and methods have, in recent years, found broad applications across mathematics and related disciplines, such as mathematical physics and statistics.

My research focuses on moduli spaces of quiver representations, in particular `quiver varieties`. These spaces, which can be viewed as parameter spaces of matrix orbits, are relatively simple geometric objects. Nevertheless, they serve as powerful tools for studying deep and still poorly understood phenomena that span multiple areas of mathematics. Moreover, as prototypical examples of algebraic varieties, they capture the essential features of the subject, and techniques developed in this setting can often be generalized to broader classes of geometric objects.

Within this framework, I have studied `wall-crossing phenomena` in moduli spaces. More recently, I have investigated their relationship with transformation formulas of `hypergeometric functions` and established a precise correspondence between them. This work was carried out in collaboration with Junichi Shiraishi (see publication 13 in my list of works). Through presenting my research in seminars organized by Prof. Shiraishi, I have also incorporated perspectives from integrable systems, representation theory, and mathematical physics.

In ongoing joint work, motivated by a systematic understanding of affine type A Laumon partition functions, we have formulated a K -theoretic wall-crossing formula. As an application, we derived a functional equation for the type A_1 Laumon partition function in K -theory and provided a geometric proof of the Kajihara transformation formula. A notable feature in the K -theoretic setting is that the q -Borel transform of the partition function, rather than the partition function itself, becomes a multiple hypergeometric series satisfying transformation formulas. This observation suggests the possibility of deriving q -difference equations via wall-crossing formulas. Furthermore, for general affine type A Laumon partition functions, we have formulated conjectural functional equations based on computations by Prof. Shiraishi.

Hypergeometric functions play a central role in modern mathematics and serve as a fundamental source of many key concepts. Through this research, I aim to contribute to a deeper understanding of these functions and to further develop connections with the extensive body of existing work in this area.