



Period Mappings and Period Domains (Cambridge Studies in Advanced Mathematics)

By James Carlson, Stefan Müller-Stach, Chris Peters

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The concept of a period of an elliptic integral goes back to the 18th century. Later Abel, Gauss, Jacobi, Legendre, Weierstrass and others made a systematic study of these integrals. Rephrased in modern terminology, these give a way to encode how the complex structure of a two-torus varies, thereby showing that certain families contain all elliptic curves. Generalizing to higher dimensions resulted in the formulation of the celebrated Hodge conjecture, and in an attempt to solve this, Griffiths generalized the classical notion of period matrix and introduced period maps and period domains which reflect how the complex structure for higher dimensional varieties varies. The basic theory as developed by Griffiths is explained in the first part of the book. Then, in the second part spectral sequences and Koszul complexes are introduced and are used to derive results about cycles on higher dimensional algebraic varieties such as the Noether-Lefschetz theorem and Nori's theorem. Finally, in the third part differential geometric methods are explained leading up to proofs of Arakelov-type theorems, the theorem of the fixed part, the rigidity theorem, and more. Higgs bundles and relations to harmonic maps are discussed, and this leads to striking results such as the fact that compact quotients of certain period domains can never admit a Kahler metric or that certain lattices in classical Lie groups can't occur as the fundamental group of a Kahler manifold.

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Review

"[T]he work of Carlson, Müller-Stach, and Peters gives structure and overview to this important but sometimes relatively inaccessible branch of geometry."

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"This book, dedicated to Phillip Griffiths, provides an excellent introduction to the study of periods of algebraic integrals and their applications to complex algebraic geometry. In addition to the clarity of the presentation and the wealth of information, this book also contains numerous problems which render it ideal for use in a graduate course in Hodge theory."

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