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Thimble decomposition and Wall Crossing Structure for Physical Integrals

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A growing body of evidence suggests that the complexity of physical integrals is most naturally understood through geometry. Recent mathematical developments by Kontsevich and Soibelman [arXiv:2402.07343] have illuminated the role of exponential integrals as periods of twisted de Rham cocycles over Betti cycles, offering a structured approach to address this problem in a wide range of settings. In this talk, I will first introduce the key tools underlying this structure and then apply them to show how families of physically relevant integrals, ranging from holomorphic exponentials to logarithmic multivalued functions, can be reformulated within this language. For holomorphic exponents, I will present an explicit decomposition of a family of integrals into thimbles expansion together with a detailed analysis of the wall-crossing structure behind the analytic continuation of its relevant parameter. Finally, I will discuss the generalization to multivalued functions, which provides the appropriate framework for describing Feynman integrals in special representations.
In this context, the thimble decomposition is expected to match the decomposition into Master Integrals, while the study of the wall-crossing structure yields a precise count of independent Master Integrals (or periods), circumventing complications arising from Stokes phenomena

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