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Non-perturbative quantum geometry, resurgence and BPS structures

BPS invariants of certain physical theories correspond to Donaldson-Thomas (DT) invariants of an associated Calabi-Yau geometry. BPS structures refer to the data of the DT invariants together with their wall-crossing structure. On the same Calabi-Yau geometry another set of invariants are the Gromov-Witten (GW) invariants. These are organized in the GW potential, which is an asymptotic series in a formal parameter and can be obtained from topological string theory. A further asymptotic series in two parameters is obtained from refined topological string theory which contains the Nekrasov-Shatashvili (NS) limit when one of the two parameters is sent to zero. I will discuss in the case of the resolved conifold how all these asymptotic series lead to difference equations which admit analytic solutions in the expansion parameters. A detailed study of Borel resummation allows one to identify these solutions as Borel sums in a distinguished region in parameter space. The Stokes jumps between different Borel sums encode the BPS invariants of the underlying geometry and are captured in turn by another set of difference equations. I will further show how the Borel analysis of the NS limit connects to the exact WKB study of quantum curves. This is based on various joint works with Lotte Hollands, Arpan Saha, Iván Tulli and Jörg Teschner.

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