



# The Quillen metric, analytic torsion and tunneling for high powers of a holomorphic line bundle

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Let  $L$  be a line bundle over a compact complex manifold  $X$  (possibly non-Kähler) and denote by  $h_{\{L\}}$  and  $h_{\{X\}}$  fixed Hermitian metrics on  $L$  and  $TX$ , respectively. We generalize the asymptotics for the induced Quillen metric on the determinant line associated to a higher tensor power of  $L$  to the non-Kähler setting. In the case when  $L$  is ample we also obtain the leading asymptotics for the Ray-Singer analytic torsion of a (possibly non-positively curved) metric on  $L$ , without assuming  $h_{\{X\}}$  is Kähler. The key point of the proofs is to relate the asymptotics of the torsions above to "tunneling", i.e. to the distribution of the exponentially small eigenvalues of the corresponding Dolbeault-Kodaira Laplacians. The proof thus avoids the use of the exact (i.e. non-asymptotic) deep results of Bismut-Gillet-Soulé for the Quillen metric, which are only known to hold under the assumption that  $h_{\{X\}}$  be Kähler. Accordingly the proofs are comparatively simple also in the Kähler case. A brief comparison with the tunneling effect for Witten Laplacians and large deviation principles for fermions is also made.

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