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**Pavel M. Bleher\*** ([bleher@math.iupui.edu](mailto:bleher@math.iupui.edu)), Department of Mathematical Sciences, Indiana University-Purdue University, Indianapolis, 402 N. Blackford Street, Indianapolis, IN 46202. *Large  $N$  asymptotics of the partition function of a random matrix model.*

We prove a number of results concerning the large  $N$  asymptotics of the free energy of a random matrix model with a polynomial potential  $V(z)$ . Our approach is based on a deformation  $\tau_t V(z)$  of  $V(z)$  to  $z^2$ ,  $0 \leq t < \infty$  and on the use of the underlying integrable structures of the matrix model. The main results include (1) the existence of a full asymptotic expansion in powers of  $N^{-2}$  of the recurrence coefficients of the related orthogonal polynomials, for a one-cut regular  $V$ ; (2) the existence of a full asymptotic expansion in powers of  $N^{-2}$  of the free energy, for a  $V$ , which admits a one-cut regular deformation  $\tau_t V$ ; (3) the analyticity of the coefficients of the asymptotic expansions of the recurrence coefficients and the free energy, with respect to the coefficients of  $V$ ; (4) the one-sided analyticity of the recurrent coefficients and the free energy for a one-cut singular  $V$ ; (5) the double scaling asymptotics of the free energy for a singular quartic polynomial  $V$ . This is my joint work with Alexander Its. (Received September 25, 2004)