

**Meeting:** 1003, Atlanta, Georgia, SS 38A, AMS-SIAM Special Session on Orthogonal Polynomials—Random Matrices—Integrable Systems: Interdisciplinary Aspects, I

1003-60-390      **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, and **Arno B.J. Kuijlaars** ([arno@wis.kuleuven.ac.be](mailto:arno@wis.kuleuven.ac.be)), Department of Mathematics, Katholieke Universiteit Leuven, Celestijnenlaan 200 B, B-3001 Leuven, Belgium. *Large  $N$  limit of Gaussian random matrices with external source.*

We consider the Hermitian random matrix ensemble with external source,

$$\frac{1}{Z_N} e^{-N \operatorname{Tr}(\frac{1}{2} M^2 - AM)} dM$$

where  $A$  has two distinct eigenvalues  $\pm a$  of equal multiplicity. This model exhibits a phase transition at  $a = 1$ , since the eigenvalues of  $M$  accumulate on two intervals for  $a > 1$ , and on one interval for  $0 < a < 1$ . We obtain the large  $N$  asymptotics of the correlations between zeros in the cases  $a > 1$ ,  $0 < a < 1$ , and in the double scaling limit, in a vicinity of  $a = 1$ . The study is based on a  $3 \times 3$  Riemann-Hilbert problem and on the Deift/Zhou nonlinear steepest descent method. We prove that the limiting eigenvalue correlations are expressed in terms of the sine kernel in the bulk of the spectrum, in terms of the Airy kernel at the edge, and in terms of the Pearcey kernel in the double scaling limit. The analysis for the case  $0 < a < 1$  involves a global opening of lenses, which is a new phenomenon in the Riemann-Hilbert approach, and in the double scaling limit, it involves a construction of the parametrix in the critical region, in terms of the Pearcey integral with varying parameters. (Received September 13, 2004)