

# Partial transposition of random states and non-centered semicircular distributions

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(Submitted on 1 Nov 2010)

Let  $W$  be a Wishart random matrix of size  $d^2$  times  $d^2$ , considered as a block matrix with  $d$  times  $d$  blocks. Let  $Y$  be the matrix obtained by transposing each block of  $W$ . We prove that the empirical eigenvalue distribution of  $Y$  approaches a non-centered semicircular distribution when  $d$  tends to infinity. The proofs are based on the moments method. This matrix model is relevant to Quantum Information Theory and corresponds to the partial transposition of a random induced state. We show for example that a mixed state on  $C^d$  tensor  $C^d$ , obtained after tracing out a random pure state over some ancilla, is typically PPT (hence undistillable) for large  $d$ , whenever the dimension of the ancilla exceeds  $Cd^2$  for some constant  $C$  (conjecturally,  $C=4$ ).

Comments: 17 pages, 1 figure

Subjects: **Probability (math.PR)**; Quantum Physics (quant-ph)

Report number: Mittag-Leffler-2010fall

Cite as: [arXiv:1011.0275v1](https://arxiv.org/abs/1011.0275v1) [math.PR]

## Submission history

From: Guillaume Aubrun [[view email](#)]

[v1] Mon, 1 Nov 2010 09:46:24 GMT (24kb,D)

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