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Wigner Chaos and the Semicircle Law

In classical stochastic analysis, the L^2 space of a Brownian filtration has a natural orthogonal decomposition, the Wiener–Itô chaos. The free probability analogue is known (amusingly) as the Wigner chaos decomposition. The first (non-trivial) level of the chaos includes only semicircular random variables.

In this talk, I will answer the following question: given a sequence X_1, X_2, X_3, \dots of (self-adjoint) random variables all in a *fixed* level of the Wigner chaos, under what circumstances do X_n converge in distribution to the semicircle law? Normally, this requires convergence of moments of all orders; in this case, as I will discuss, convergence in distribution is equivalent to *convergence of the 4-th moment*.

This is joint work with Roland Speicher.