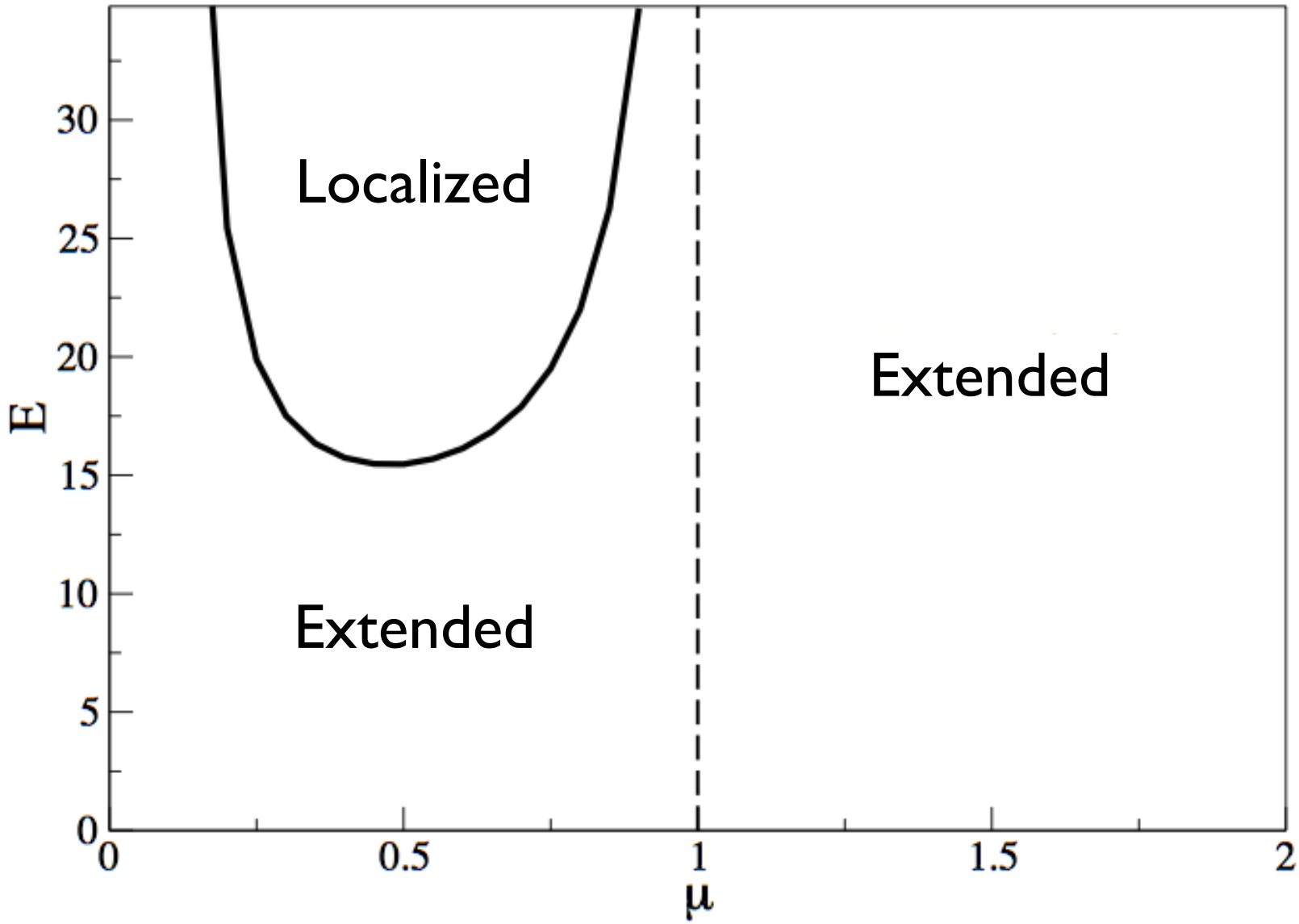
The phase diagram



All wave-functions are extended for $\mu > 1$

In agreement with
Bordenave & Guionnet '13

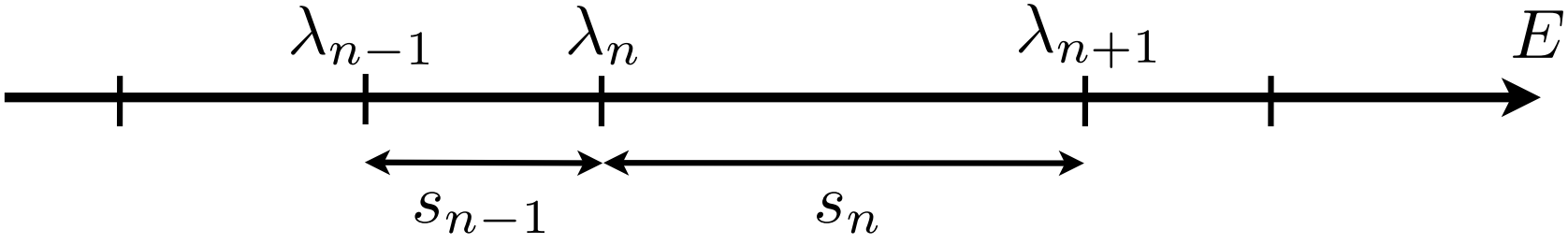
Poisson Matrix + "GOE" perturbation

Sparse matrix
power-law entries
level spacings of $O(1/N\rho(E))$
(possibly) Poisson statistics

+

Wigner RM
matrix elements of $O(N^{-\frac{1}{\mu}})$
GOE statistics

$$\mathcal{P} \qquad + \qquad \epsilon N^{-\frac{1}{\mu}} \mathcal{W}$$



Dyson brownian motion: Lee, Schnelli, Stetles & Yau '14

$$\sqrt{\langle \delta s_n^2 \rangle} \simeq \frac{2\sqrt{3}\epsilon^2}{N^{\frac{2}{\mu}-1}} \gg \langle s_n \rangle = \frac{1}{N} \qquad \text{for} \qquad \mu > 1$$

Numerics: Exact Diagonalization

Exact diagonalizations of Lévy Matrices of size $N = 2^m$
$m = 8, \ldots, 15$

Averages over the disorder ⟶ 2^{22-m} samples

Energy is resolved in 64 intervals ν
centered around $E_\nu = \langle \lambda_n \rangle_{n \in \nu}$

Statistical properties of the eigenvalues and of the eigenvectors

Level statistics

★Distribution of the ratio of adjacent gaps $r_n = \dfrac{\min\{s_n, s_{n+1}\}}{\max\{s_n, s_{n+1}\}}$

Oganesyan & Huse '07

★Overlap between subsequent eigenvectors

$$q_{n,n+1} = \sum_{i=1}^{N} |\langle i|n\rangle||\langle i|n+1\rangle|$$

GOE

Level repulsion
Eigenvalues are strongly correlated
Gaussian amplitudes

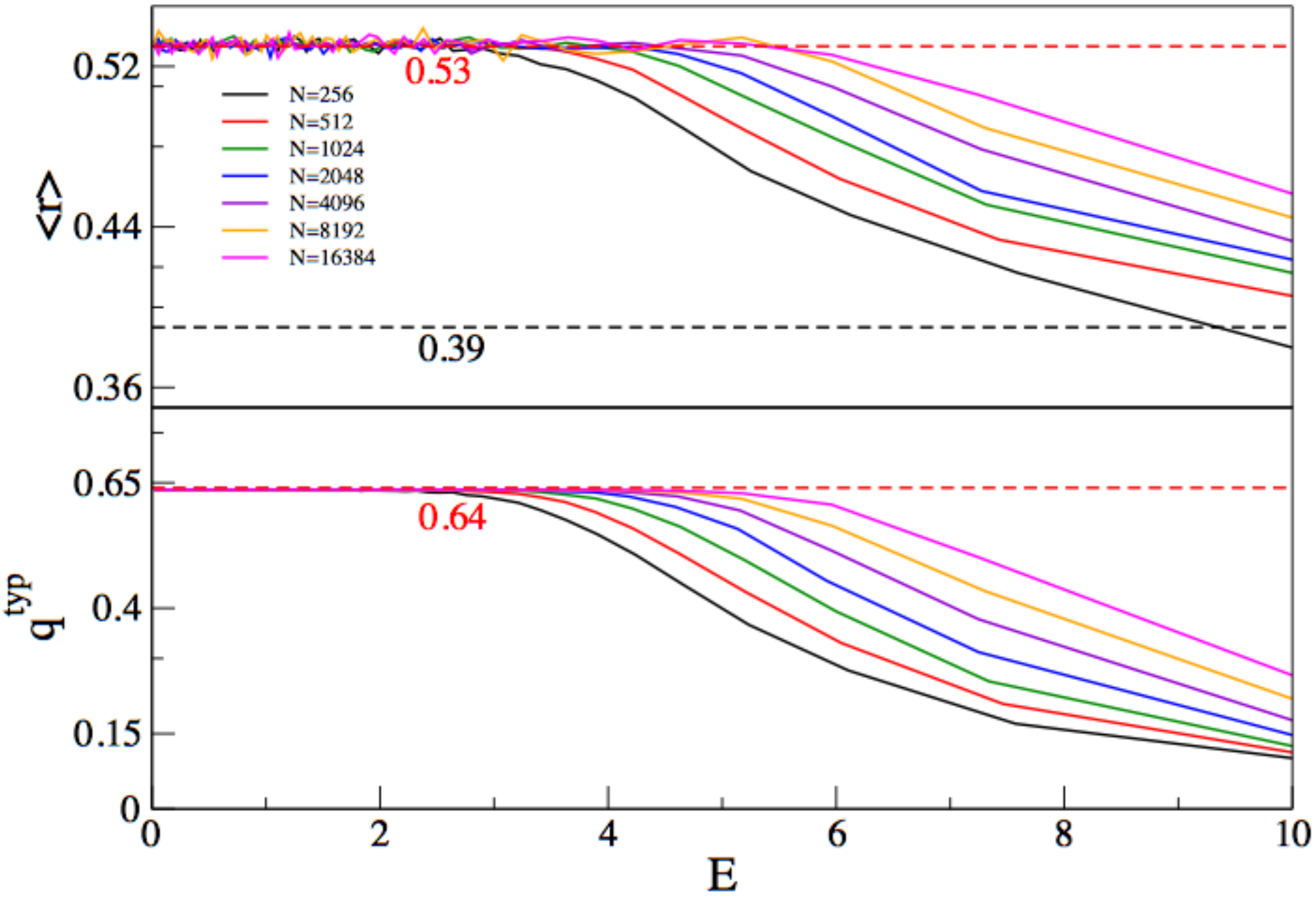
$$\Pi_{GOE}(r)$$
$$\langle r\rangle \simeq 0.53$$
$$\langle q\rangle \simeq 2/\pi$$

Poisson

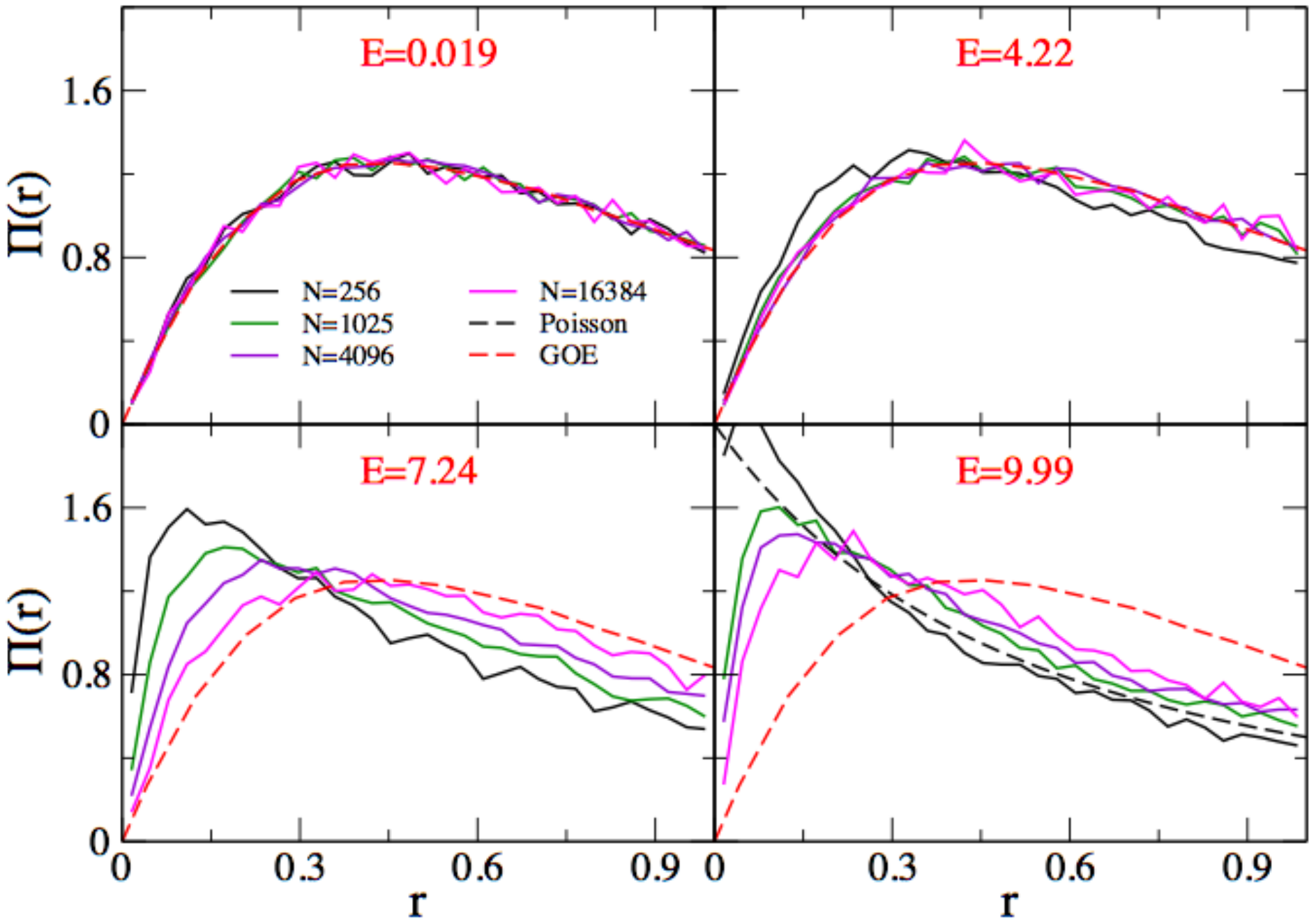
No level repulsion
Wave-functions are exponentially localized on distant sites

$$\Pi_P(r) = 2/(1+r)^2$$
$$\langle r\rangle \simeq 0.39$$
$$\langle q\rangle \to 0$$

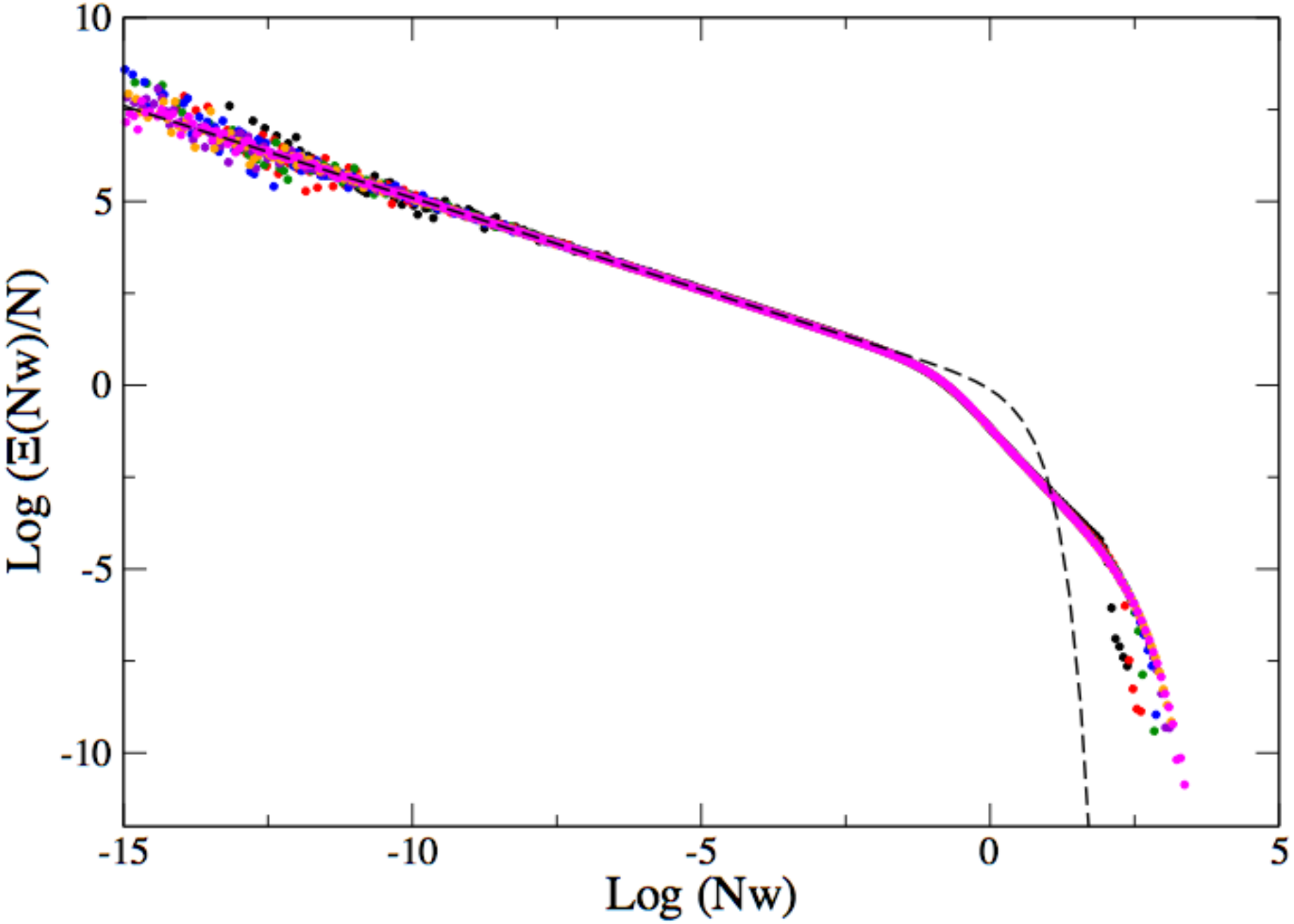
Level statistics for $\mu \in (1, 2)$



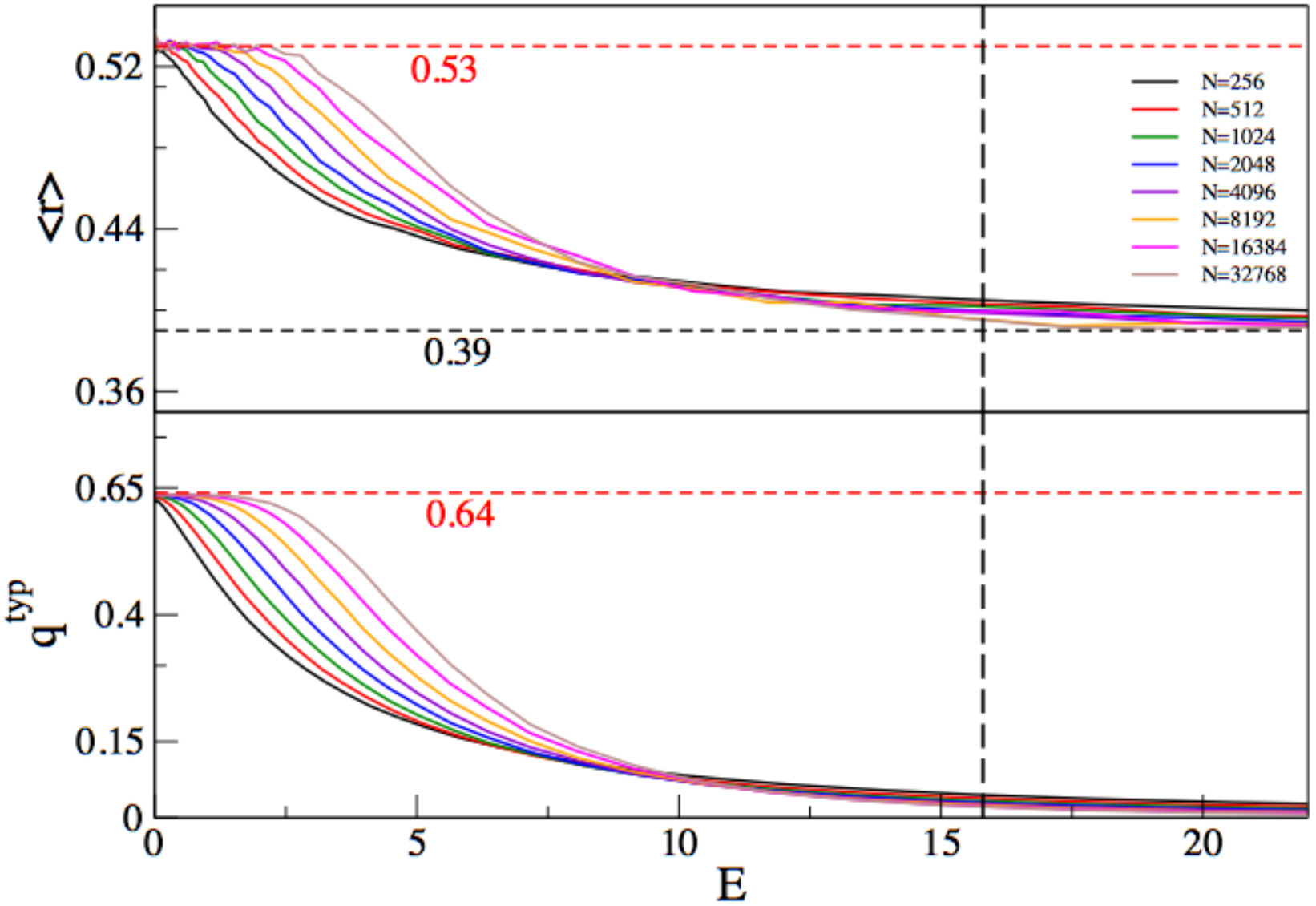
Gap ratio distribution for $\mu \in (1, 2)$



Wave-functions statistics $\mu \in (1, 2)$



Level statistics for $\mu \in (0,1)$

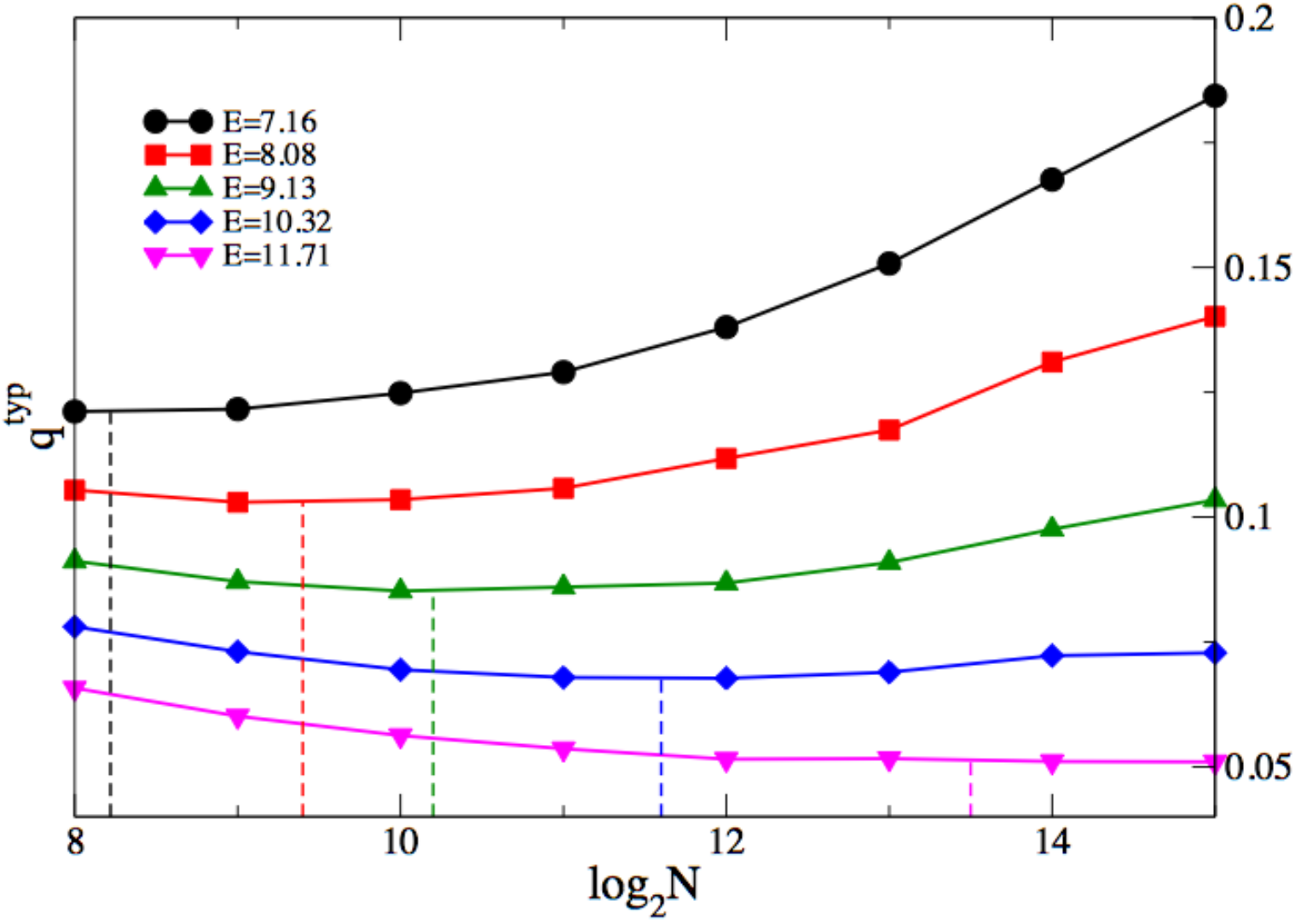


Curves for different N cross much before $E^\star \simeq 15.4$!

Delocalized non-ergodic intermediate phase?

Biroli, Ribeiro-Texeira & Tarzia; De Luca & al '14

Characteristic crossover size N_m

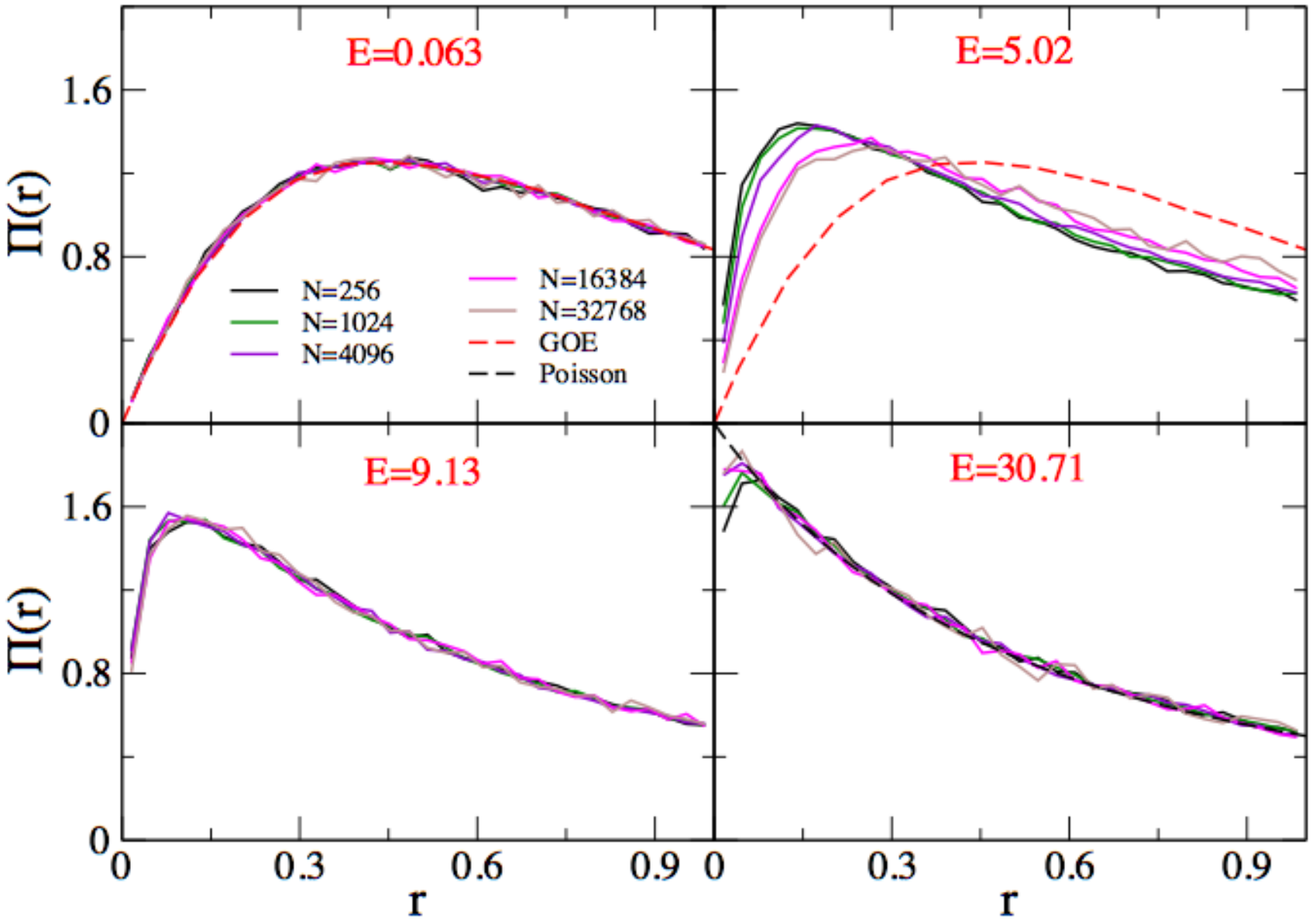


The crossing point drifts towards higher energies as N is increased

$N < N_m \searrow$ Poisson

$N > N_m \nearrow$ GOE

Gap ratio distributions for $\mu \in (0, 1)$



Huge finite size effects in the crossover region !