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Integrability and Quantum Chaos in $\mathcal{N} = 4$ SYM from the Spectral Rigidity

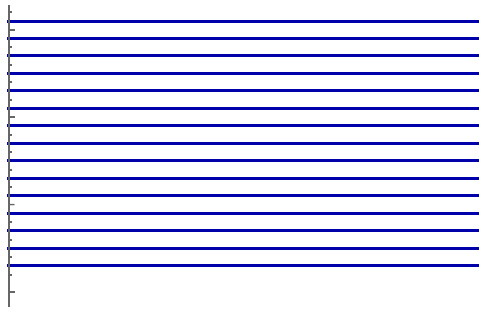
arXiv:2011.04633 (& arXiv:2005.14254)
with Tristan McLoughlin & Raul Pereira

1st LIJC Gong Show

Anne Spiering

What is spectral rigidity?

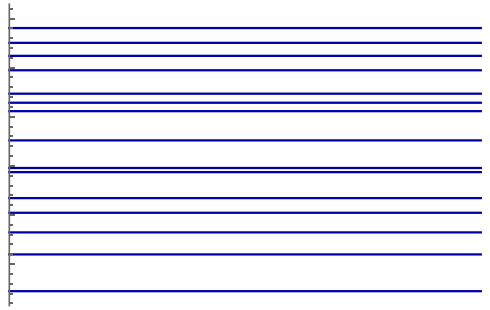
examples of spectra



uniform distribution

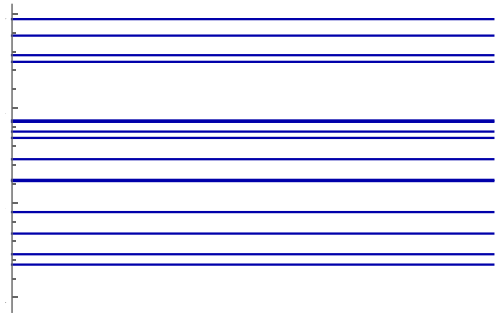
- harmonic oscillator

maximum rigidity



RMT

- e.g. heavy nuclei [Wigner '51]
- quantum-chaotic models
  [Bohigas, Giannoni, Schmidt '84]



Poisson distribution

- integrable models
  [Berry, Tabor '77]

not rigid

measure for the spectral rigidity:

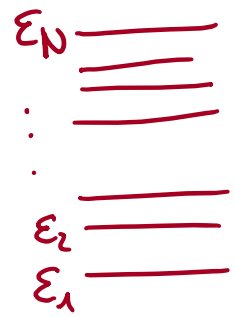
Dyson-Mehta statistic $\Delta_3(l)$

[Dyson, Mehta '63]

The Dyson-Mehta statistic

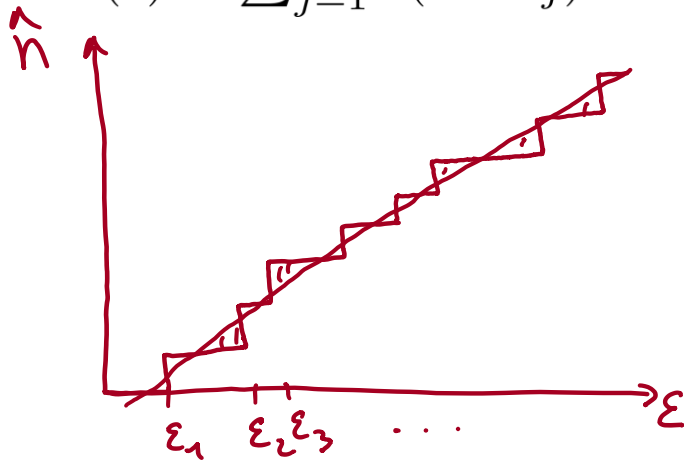
energy sequence

$\varepsilon_1, \varepsilon_2, ..., \varepsilon_N$



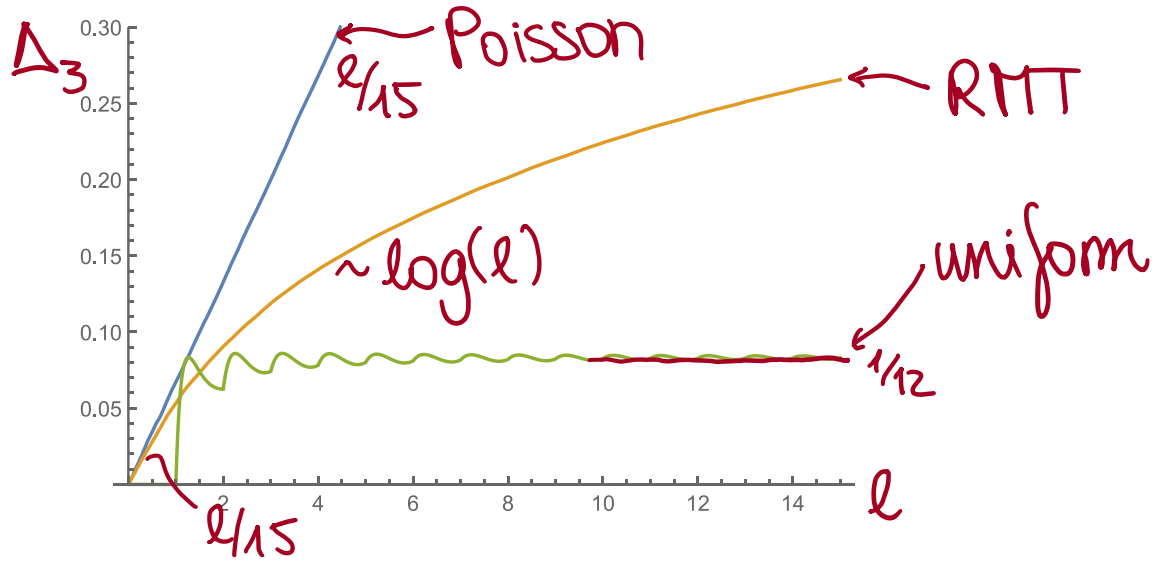
staircase function

$\hat{n}(\varepsilon) = \sum_{j=1}^{N} \theta(\varepsilon - \varepsilon_j)$



Dyson-Mehta statistic

$$\Delta_3(l) = \frac{1}{l} \left\langle \min_{A,B} \int_{\varepsilon_0}^{\varepsilon_0 + l} d\varepsilon \, (\hat{n}(\varepsilon) - A\varepsilon - B)^2 \right\rangle$$

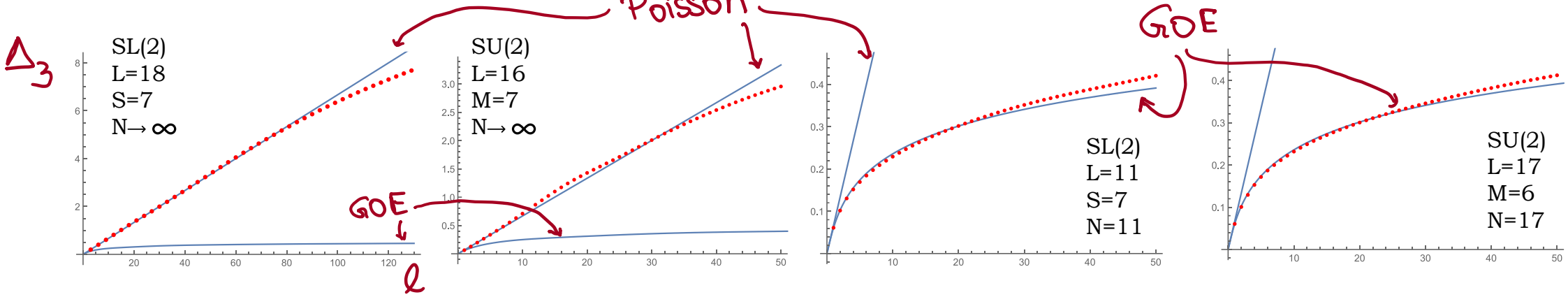


$\Delta_3(l)$ probes long-range correlations

and is related to the two-level correlation function and the spectral form factor.

Rigidity of $\mathcal{N} = 4$ SYM spectra

Results for $\mathcal{N} = 4$ SYM theory @ 1-loop



→ planar spectrum resembles Poisson distribution ~ integrability
non-planar spectrum described by RMT (GOE) ~ quantum chaos

Further evidence from NNS distribution & information entropy of eigenvectors [arXiv: 2011.04633]

Analytical results for the non-planar spectrum from perturbation theory [arXiv: 2005.14254]