Systems with a strong interaction to an environment

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1 Transitions in the P(s)

We are interested in finding the transitions of from a GOE to Poisson statistics on the nearest neighbour distribution ($P(s)$) when the parameters change from the ergodic regime to the non-ergodic one.

Spectra was obtained with two different methods, in the first one we break the symmetry by varying the Ising interaction between the spins on the closed chain. For the second one we decomposed the open chain into reflection symmetry sectors.

Animations of the $P(s)$ for a chain in the two cases varying different components of the magnetic kick. As the colour lines in the Fig. 1 shows.

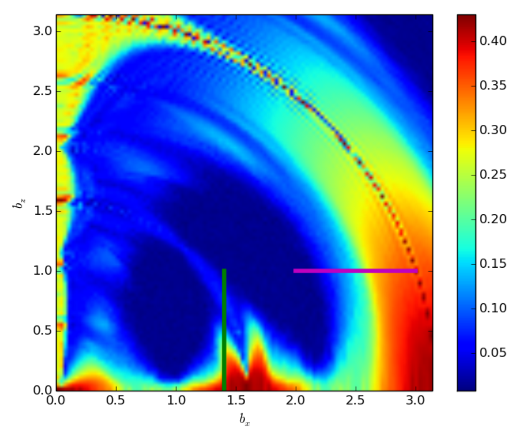

Figure 1

The animations are ass follows

- “Ps _transition1” - Closed chain $J = 1$ $b_x = [2, 3]$ $b_z = 1.$ $\Delta J = 0.1$ $*$
- “Ps _transition1_sym” - Open chain $J = 1$ $b_x = [2, 3]$ $b_z = 1.$ reflection symmetries used $*$
- “Ps _transition2” - Closed chain $J = 1$ $b_x = 1.4$ $b_z = [0, 1]$ $\Delta J = 0.1$ $*$
- “Ps _transition2_sym” - Closed chain $J = 1$ $b_x = 1.4$ $b_z = [0, 1]$ reflection symmetries used $*$

Comparing the two methods we see that breaking symmetries using small variations in the Ising interaction in the chain gives a better shaped $P(s)$. Also the transitions shows some correlation with the map 1 only in some places of the regime, this remains a mystery

2 Purity decay

We start by studying "model3" and "model4" (see "models.cu"). Our first analysis is made with the parameters that make both systems A and B ergodic. The parameters are $[J_c, J_p, J_s, \Delta J, \Delta b, b_x, b_z]$

Where:

- J_c - Interaction of C with A.
- J_p - Interaction between A and B.
- J_s - Centre of internal interactions of A and B.
- ΔJ - Such that $J_i \in [J_s - \Delta J, J_s + \Delta J]$.
- Δb - Such that $b_{\{x,z\}_i} \in [b_{\{}x,z\} - \Delta b, b_{\{}x,z\} + \Delta b]$.
- b_x - Centre of magnetic component x.
- b_z - Centre of magnetic component z.

We fix all parameters except J_p and we calculate an average of the purity defined as:

$$< \gamma >_{T_1}^{T_2} = \frac{1}{T_2 - T_1 + 1} \sum_{t=T_1}^{T_2} \gamma(t). \quad (1)$$

It's important to note that the average of the purity is extremely sensible to the times over the average is made. As given a long sufficient time purity always decays to its lowest value.

IMPORTANT- Seeds are as follows $--Cseed0--Eseed1463--PARAMseed8589$.

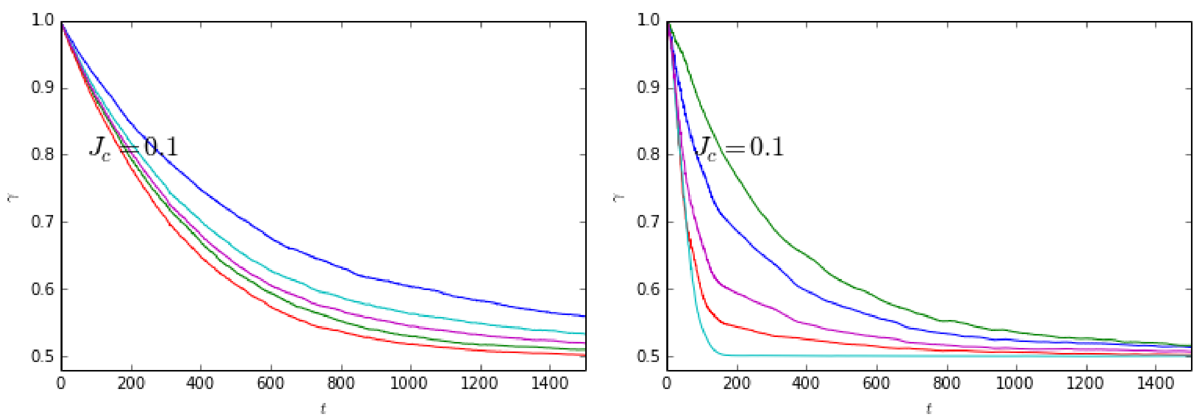

Figure 2

We see that in order to gain a precise understanding of the velocity of the decay in purity we need to take averages over the ensemble of initial states in C.

For $< \gamma >_{100}^{200}$ using the parameters $J_c, J_p, J_s, \Delta J, \Delta b, b_x, b_z = [0.05, 0., 1.0, 0.1, 0, 1.0, 1.0]$ and $J_p \in [0, 2\pi]$. $\dim([A, B, C]) = [4, 8, 1]$.

For "model3" - "model3 _open" we obtain

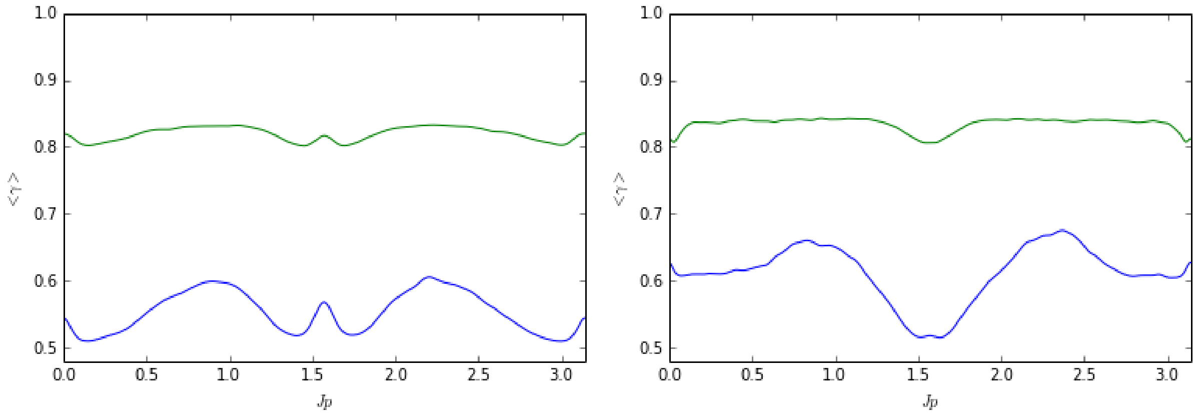

Figure 3

With the same parameters for “model4” - “model4 _open” $\dim([A, B, C]) = [4, 8, 1]$.

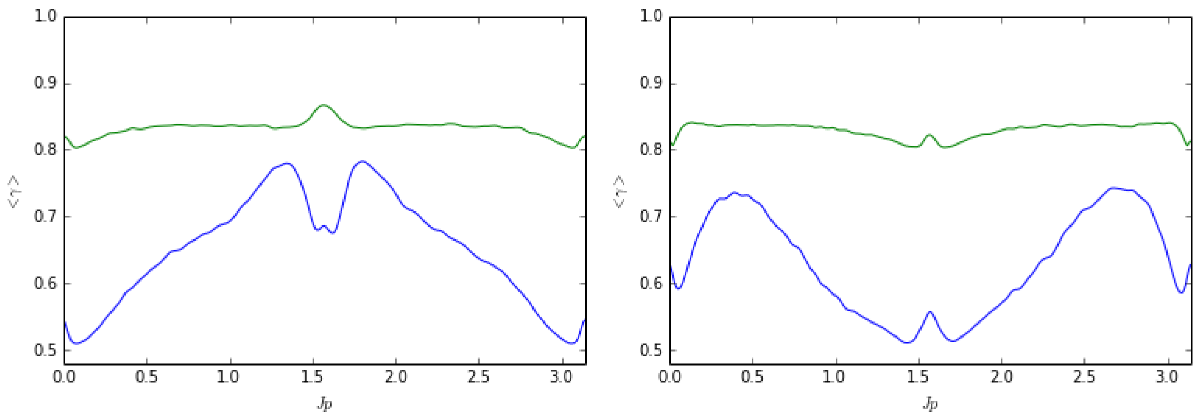

Figure 4

Now we vary the size of models A and B.
$\dim([A, B, C]) = [3, 9, 1]$.

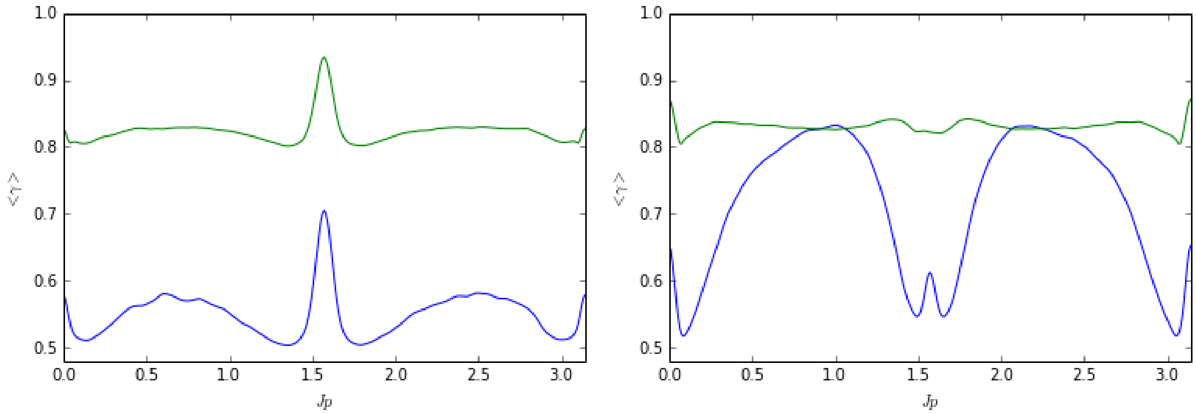

Figure 5

$\dim([A,B,C]) = [6,6,1]$.

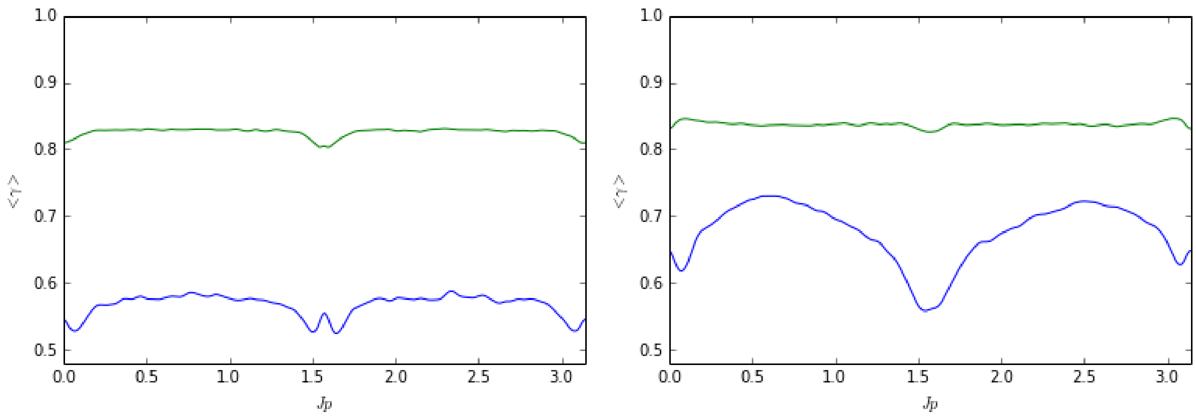

Figure 6

$\dim([A,B,C]) = [6,11,1]$.

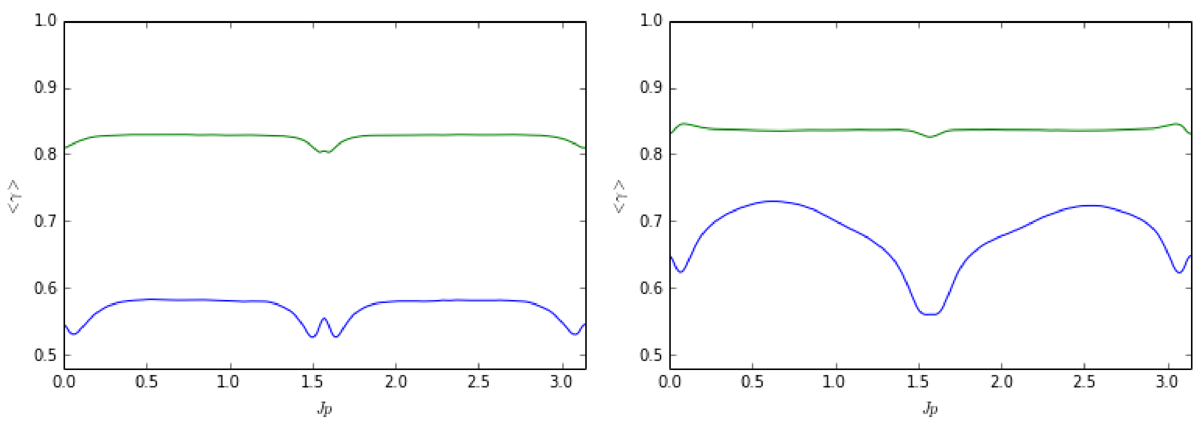

Figure 7

In this model we see how only when A purity decays slowly, as one can expect based on the results on "model1".

The big question this first result show is that, how much topology of the system plays a central role in the conservation of the purity? If so how about the interaction of A and B?

To address this question. With the same parameters for "model5" - "model5 _open" and varying the size of A and B. $\dim([A, B, C]) = [6, 6, 1]$.

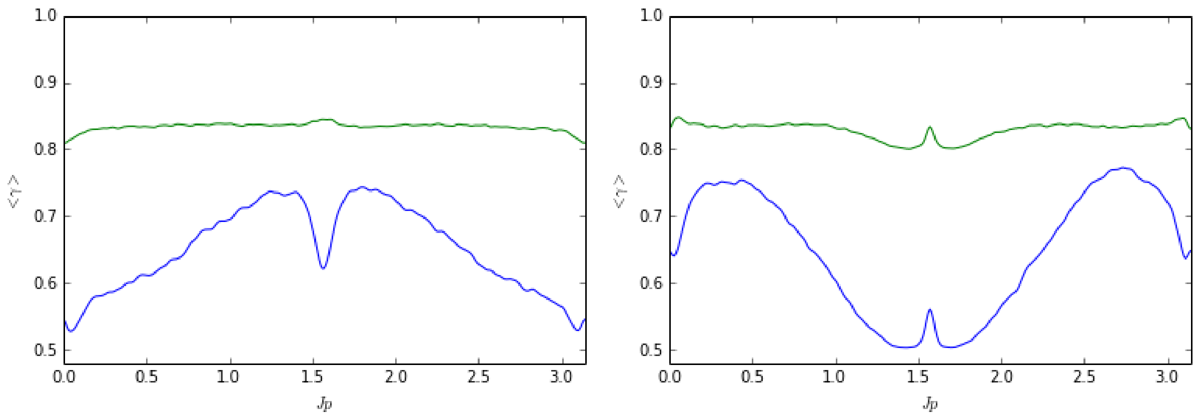

Figure 8

$\dim([A, B, C]) = [8, 8, 1]$.

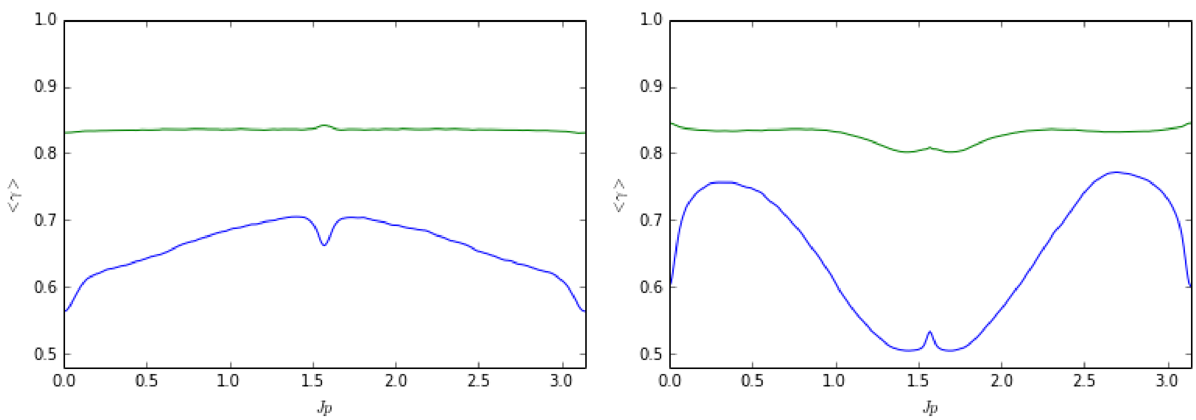

Figure 9

$\dim([A, B, C]) = [3, 3, 1]$.

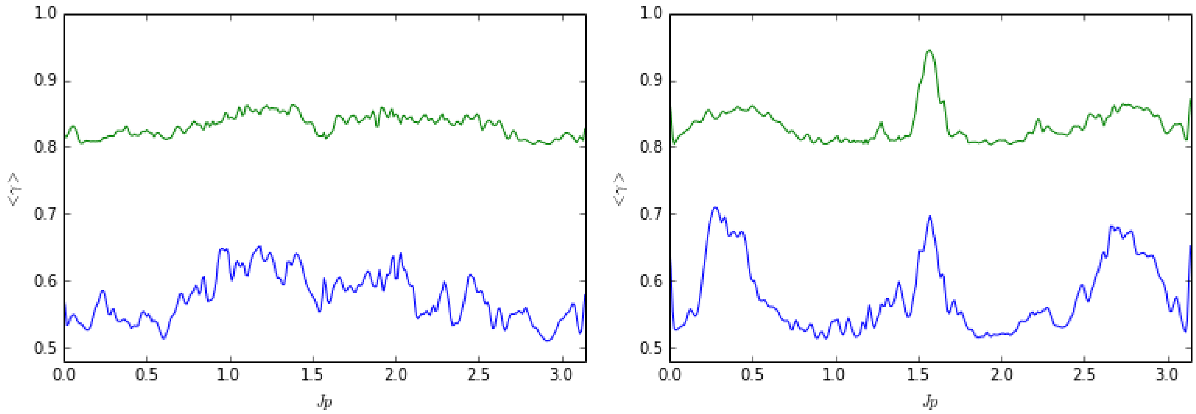

Figure 10

For this case we see how the models size becomes irrelevant as there is a constant symmetry between A and B dictated by their interactions.