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INTRODUCTION

State of a N -spin $\frac{1}{2}$ system: $|\psi\rangle = \sum_{\vec{\sigma}} C(\vec{\sigma}) |\vec{\sigma}\rangle$
 $\rightarrow 2^N$ variables

Mean field Ansatz: $C(\vec{\sigma}) = \prod_i C_i(\sigma_i)$
 $\rightarrow 2N$ variables

But:
 $\langle S_i^z S_j^z \rangle - \langle S_i^z \rangle \langle S_j^z \rangle = \begin{cases} \frac{1}{4} - \langle S_i^z \rangle^2 & \text{if } i = j \\ 0 & \text{if not} \end{cases}$

GRADIENT ALGORITHM

Aim: Find $|\psi\rangle$ which minimize $\langle \psi | H | \psi \rangle$, with Hamiltonian H and state

$$|\psi\rangle = \sum_{\vec{\sigma}} \left(\prod_P C_P(\vec{\sigma}_P) \right) |\vec{\sigma}\rangle$$

EPS ALGORITHM

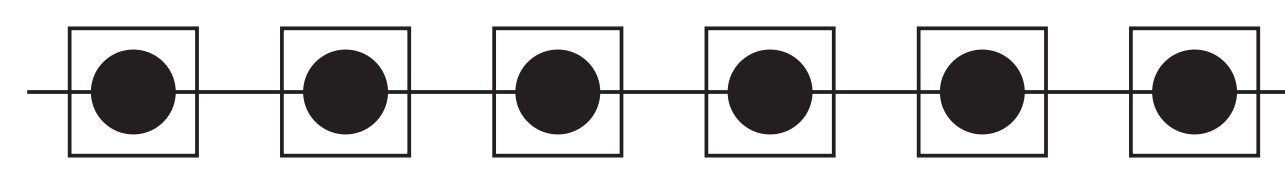


Figure 2: Mean field

$\rightarrow 2N$ variables

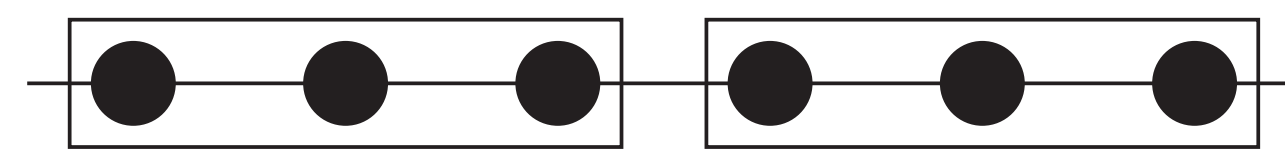


Figure 3: Disjoint plaquettes of size 3

$\rightarrow 2^3 \frac{N}{3}$ variables

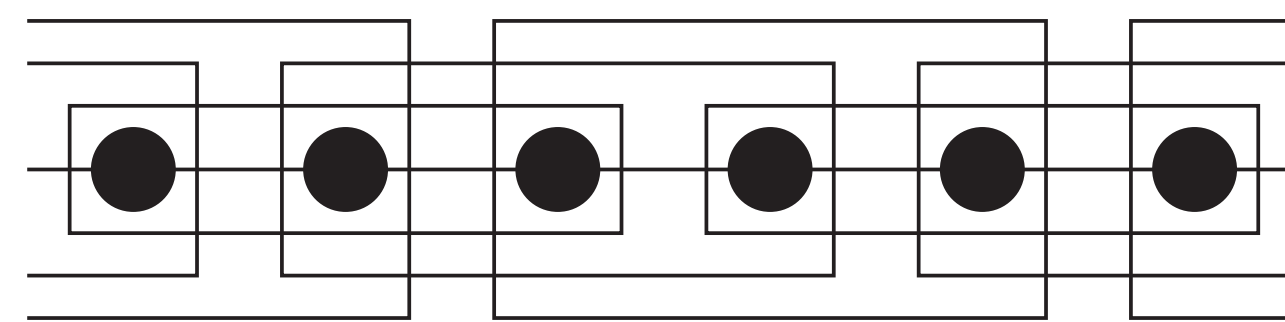


Figure 4: EPS with plaquettes of size 3

$\rightarrow 2^3 N$ variables

EPS DELOCALIZED

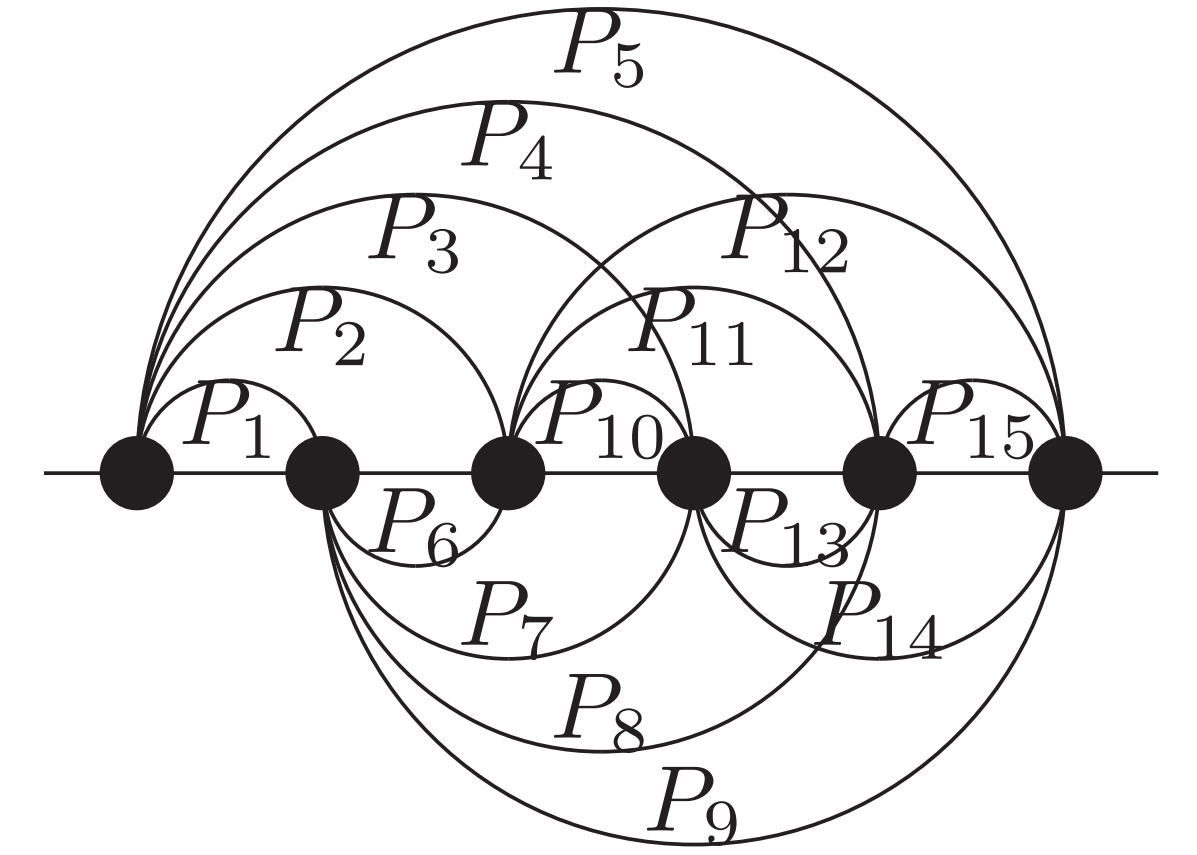


Figure 1: EPS with delocalized plaquettes of size 2

ENERGY

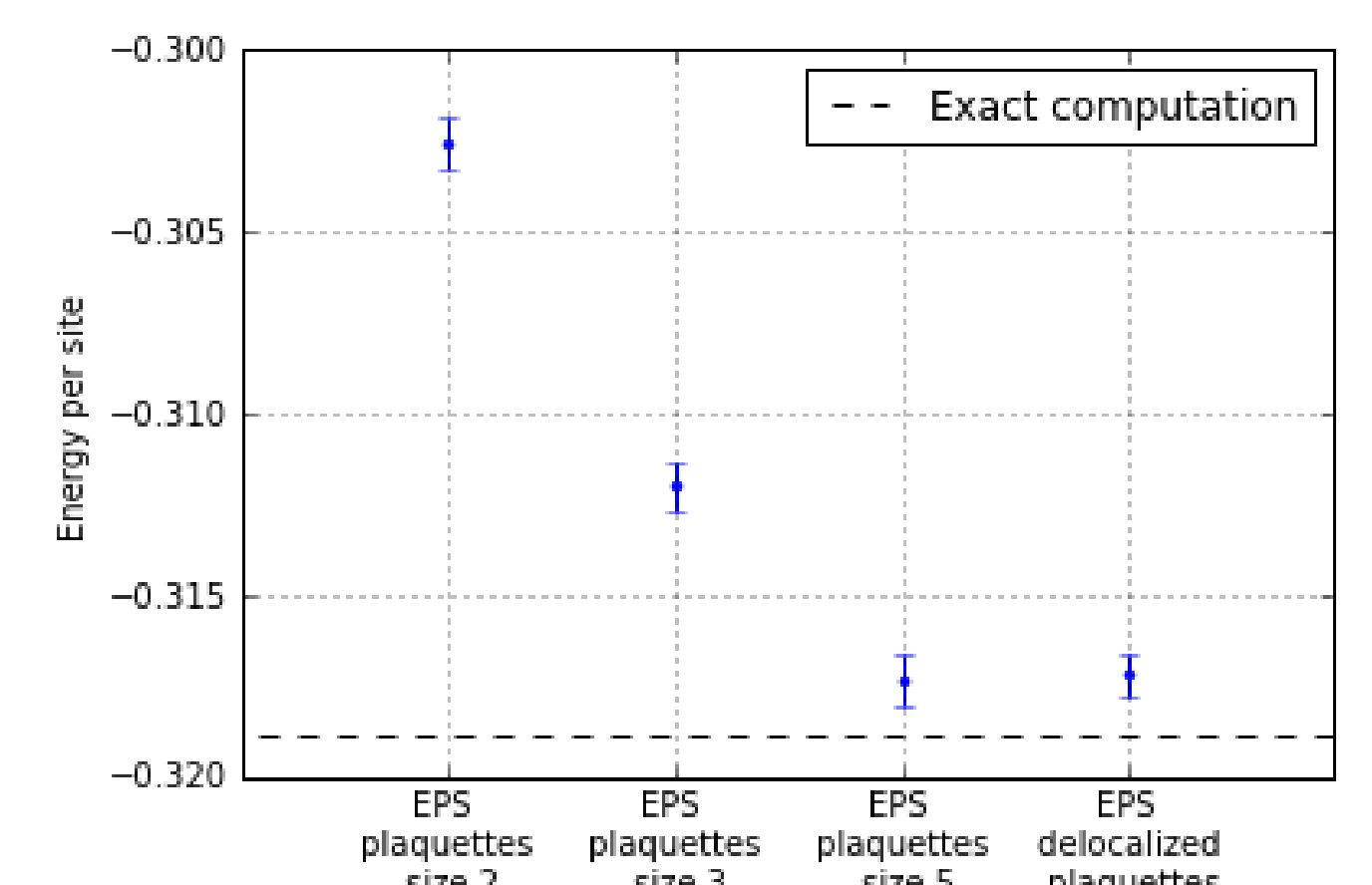


Figure 7: Energy of an XX-model chain of size 30 founded with different EPS algorithms

CORRELATION

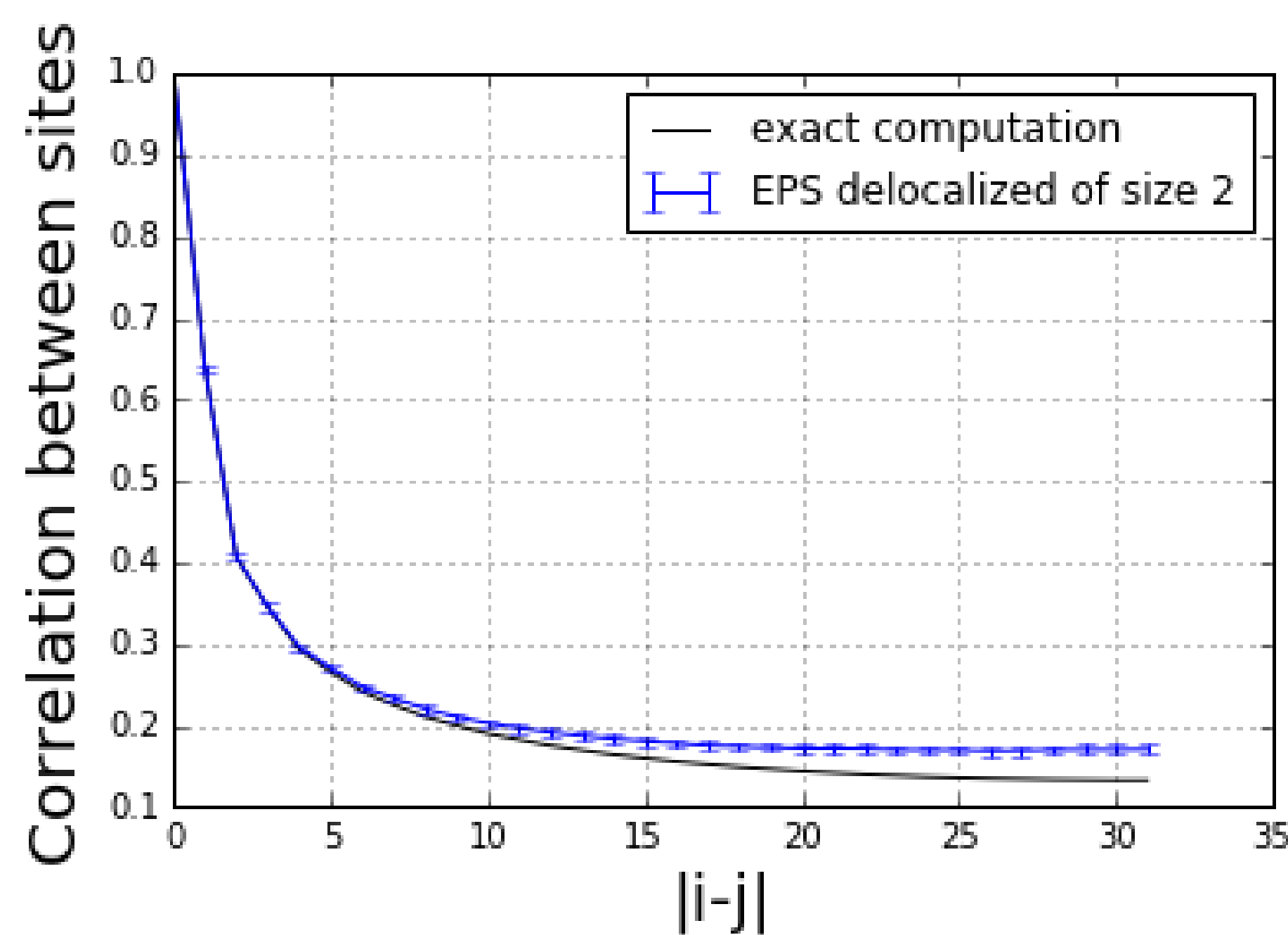


Figure 5: Correlation function along x axis between sites i and j of an XX-model chain of size 62

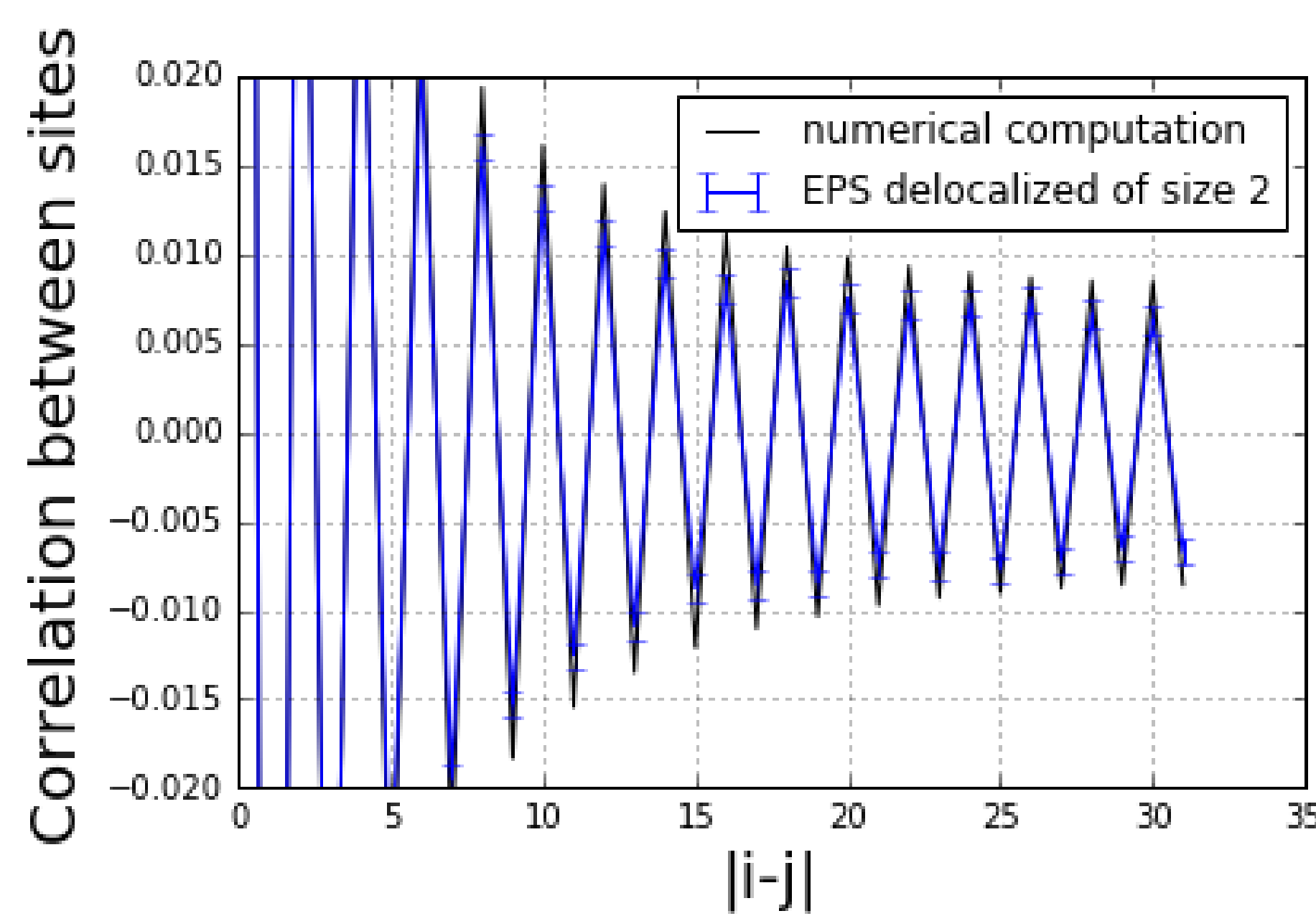


Figure 6: Correlation function along z axis between sites i and j of an Heisenberg chain of size 60

ENTANGLEMENT ENTROPY

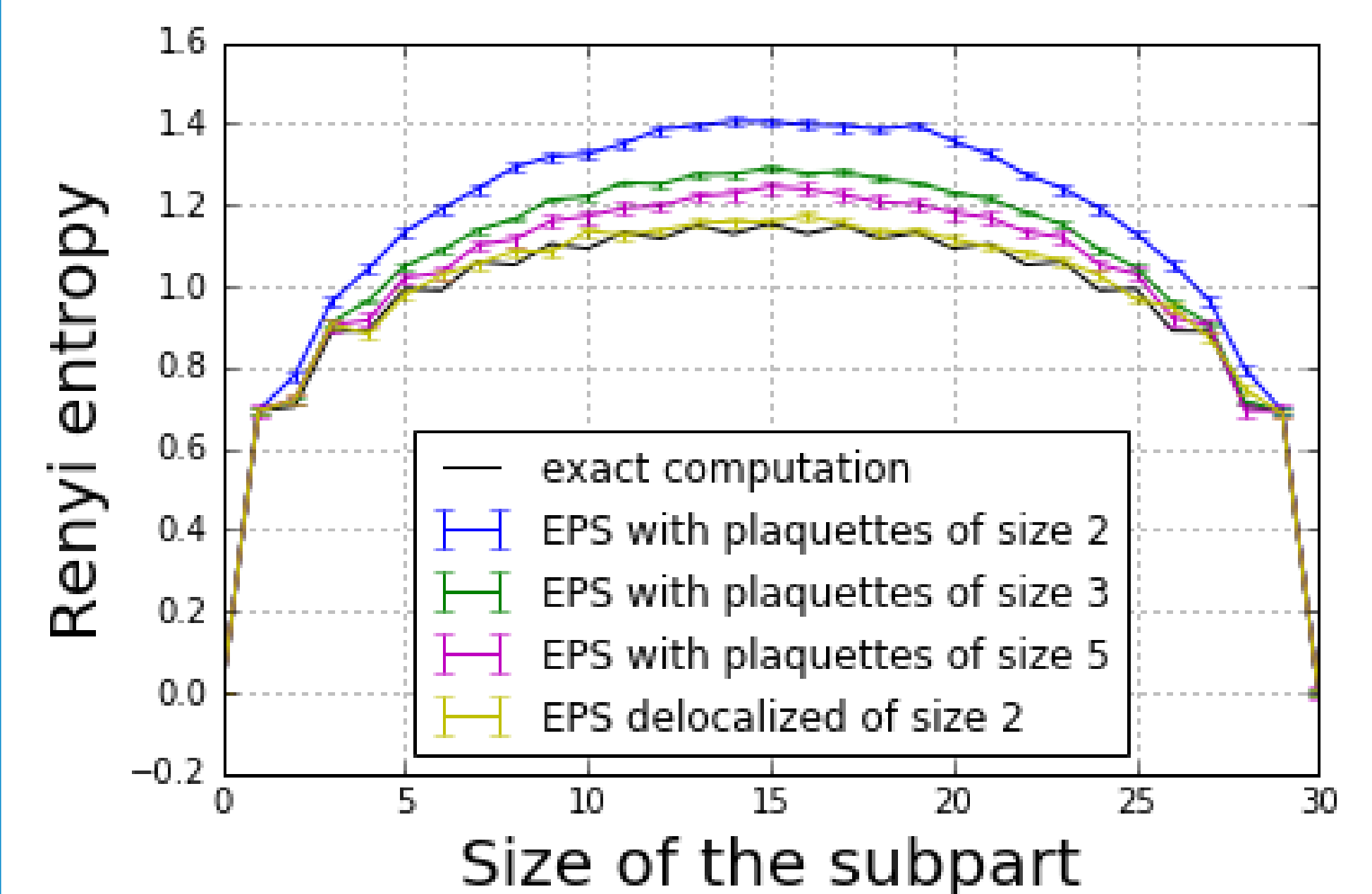


Figure 8: Entanglement entropy as a function of the size of the subsystem of an XX-model chain of size 30

EXTRACT INFORMATION

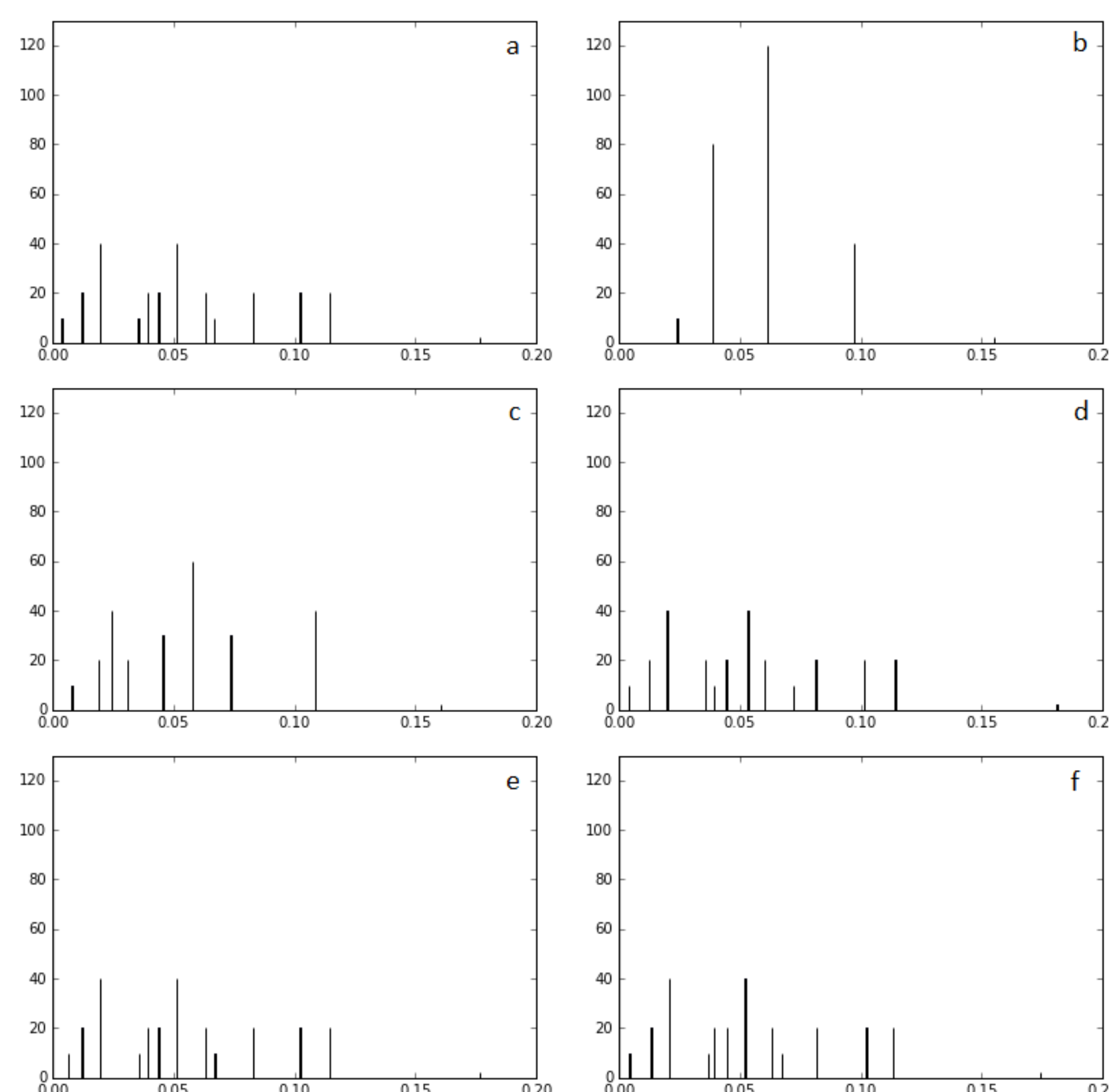


Figure 9: Information contained in the ground state exact diagonalized (a), EPS size 2 (b), EPS size 3 (c), EPS size 4 (d), EPS size 5 (e), EPS delocalized size 2 (f)

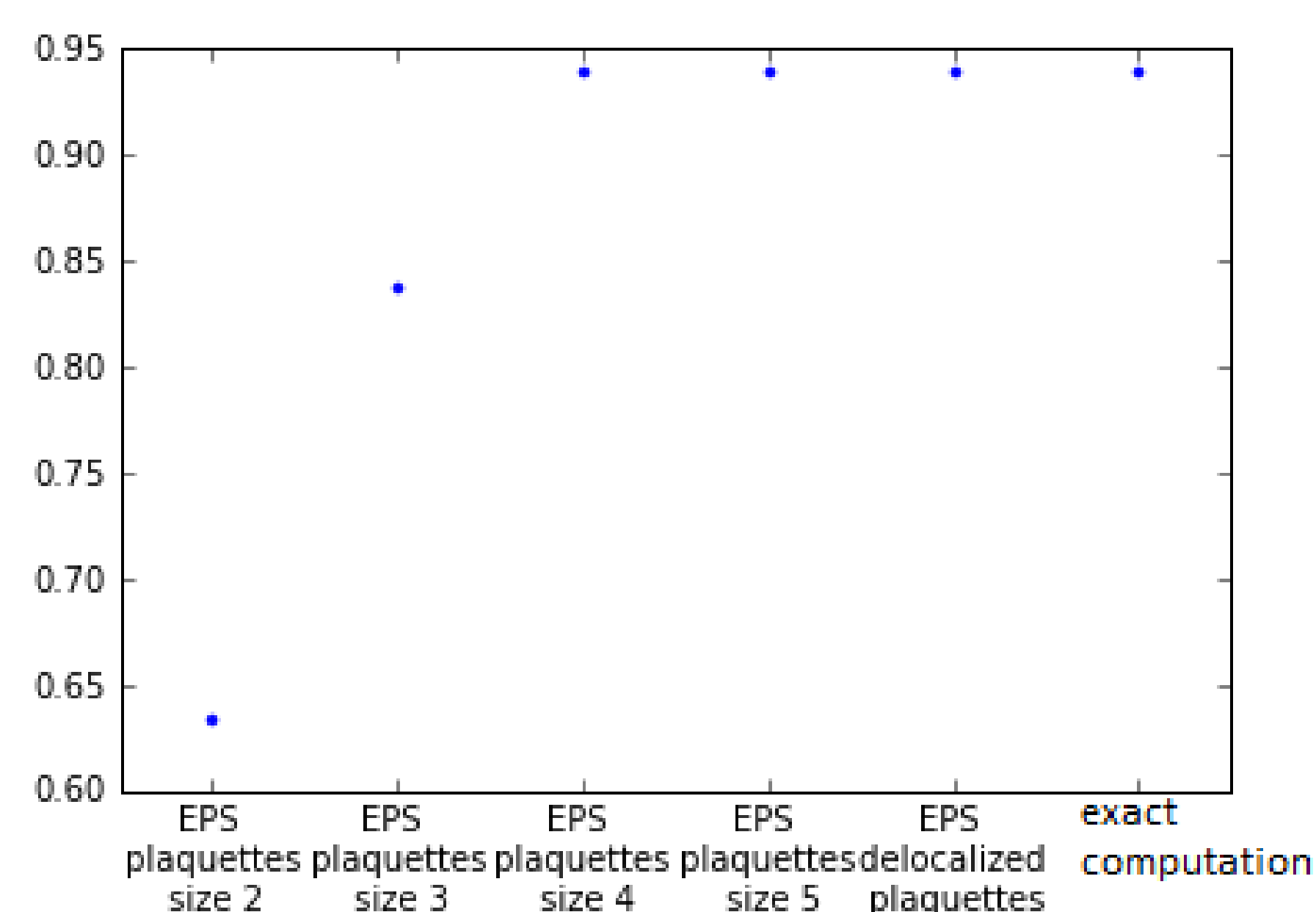


Figure 10: Information entropy of the groundstate founded with different algorithms of an XX-model chain of size 10

CONCLUSION

- Delocalized plaquettes EPS seems to nicely reproduce correlations
 \rightarrow Try to use it on frustrated system
- For a small system, EPS extract lots of information
 \rightarrow What behavior for bigger systems and how to quantify the extraction of the information we want

REFERENCES

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