Supplementary information of "Real space Mott-Anderson electron localization with long-range interactions: exact and approximate descriptions"

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Figure 4 of the manuscript has been reproduced in Figure S1 with four different realizations of disorder. The qualitative evolution of the densities is similar to the realization discussed in the main manuscript. These additional examples show that the localization can happen at different positions for various values of the disorder strength within the same realization. The transition between peaks localized at two different positions results in an avoided crossing. Near the avoided crossing, the ground state is a mix of the two states leading to a two-peak structure (see bottom-right panel) even if the two particles are not interacting. These avoided crossings are responsible of the slow convergence of the mean of the single-particle occupation entropy in the weak interaction regime ($L = 1$ and $L = 2.5$). Indeed, at an avoided crossing two orbitals are occupied which gives a value of S close to 0.7 which slows the convergence of the mean of S towards values close to 0. These outliers have been removed when computing the mean values displayed in Figure 8 of the main manuscript to speed up the convergence of the mean.

In addition, we also report the exact and KS SCE ground-state densities in the presence of interactions for two other realizations than the one displayed in Figure 6 of the main manuscript. Note that these two realizations are the same as the ones in the top row of Figure S1. Once again the qualitative analysis of the evolution of the densities is the same as the one discussed in the main manuscript. One can see on these two additional examples that the avoided crossings at the KS SCE level do not happen at the same values of V as the exact ones. This leads to differences of position of localization between KS SCE and the exact results as can be observed in the $L = 1/V = 75$ and $L = 50/V = 50$ of Figure S2.

Finally, the bottom panel of the seventh figure of the main manuscript is reproduced here without shift to show the real values of the position-space information entropy.

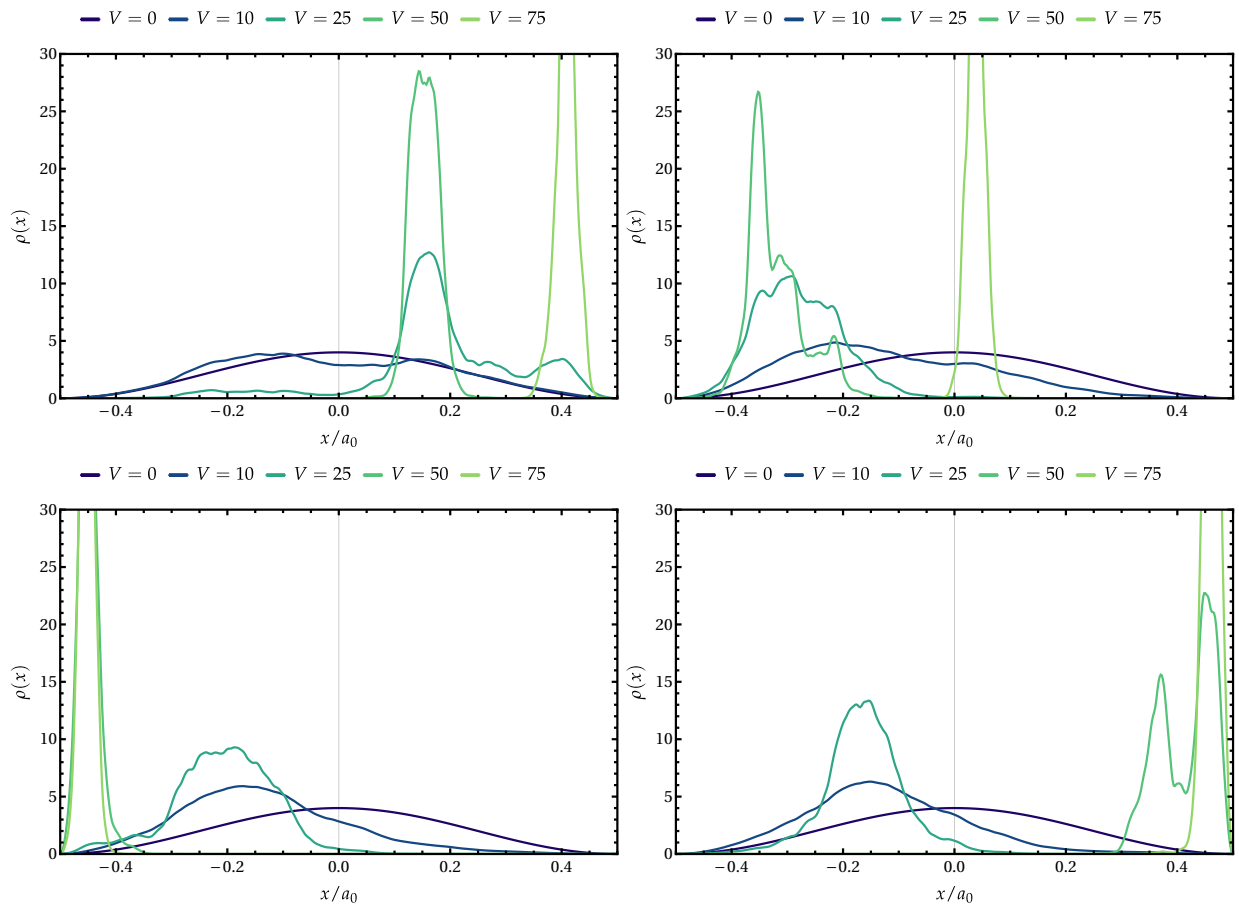

FIG. S1: Electronic densities (solid lines) of two non-interacting electrons for various values of the potential strength V and four different realizations of the disorder. The height of the potential (dashed line) is non-indicative, it has been adjusted just to show its shape on the same plot.

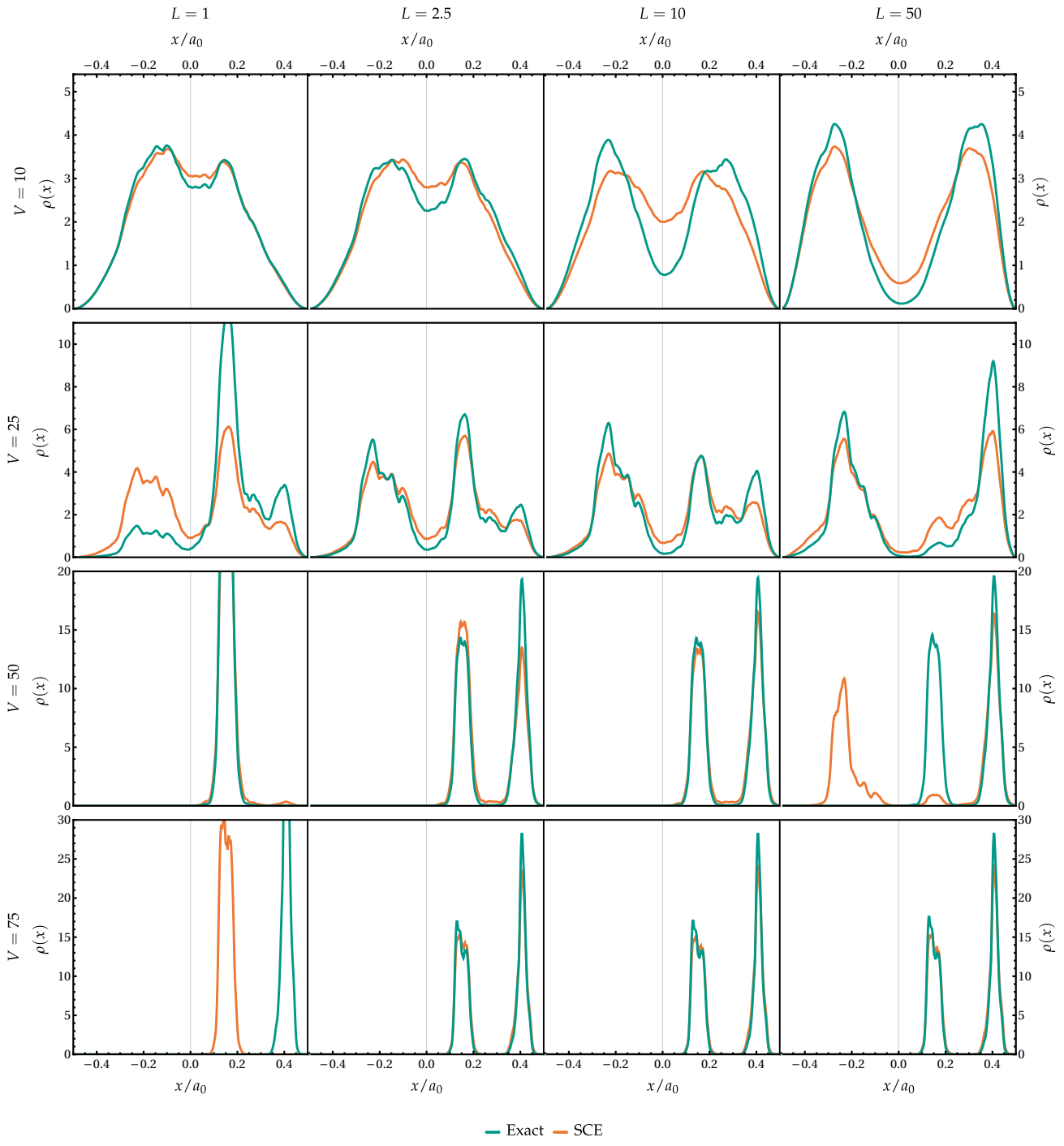

FIG. S2: Exact and KS SCE ground-state electronic densities for a given realization of disorder with various effective interaction strengths L and disorder strengths V.

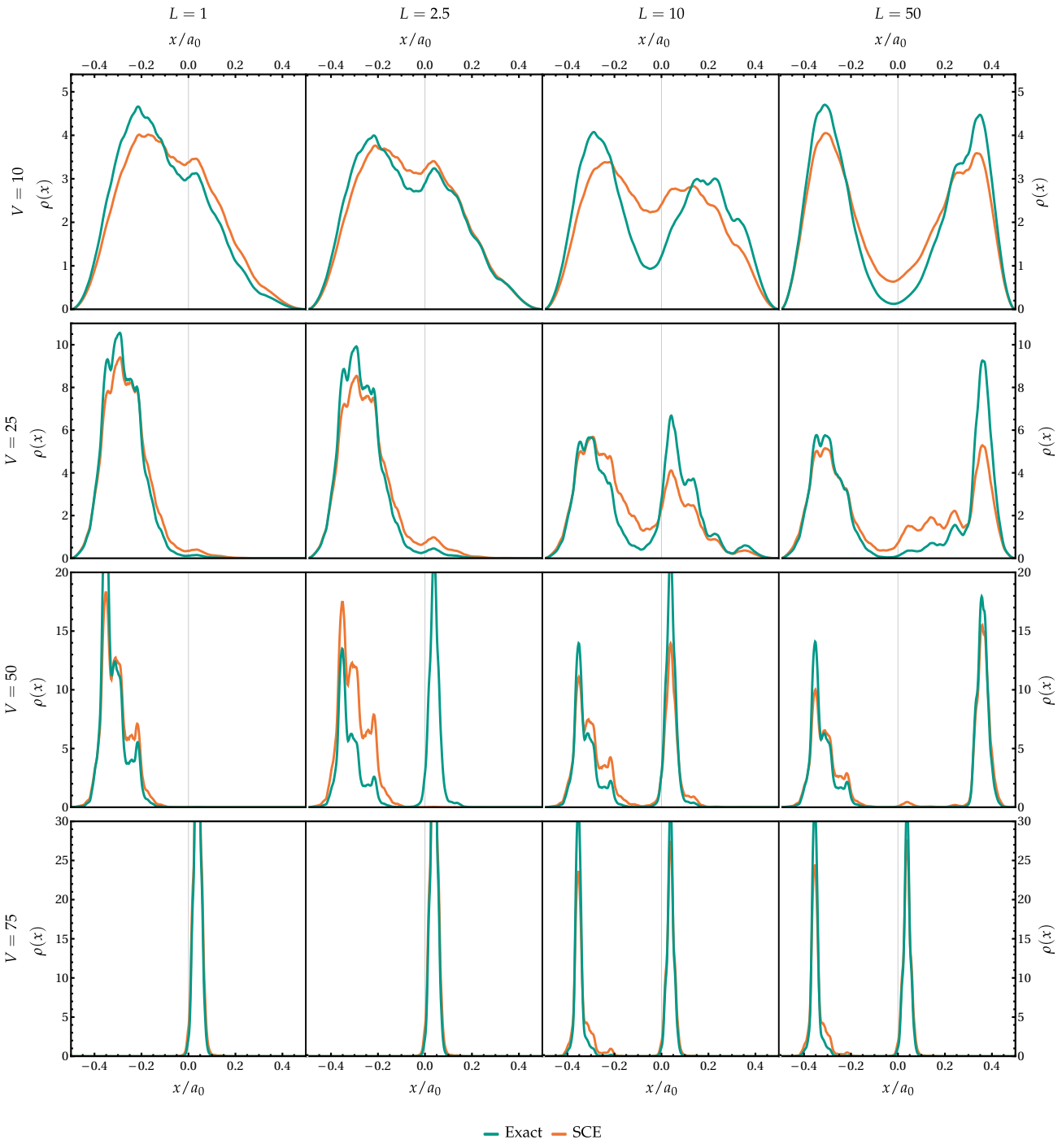

FIG. S3: Exact and KS SCE ground-state electronic densities for a given realization of disorder with various effective interaction strengths L and disorder strengths V.

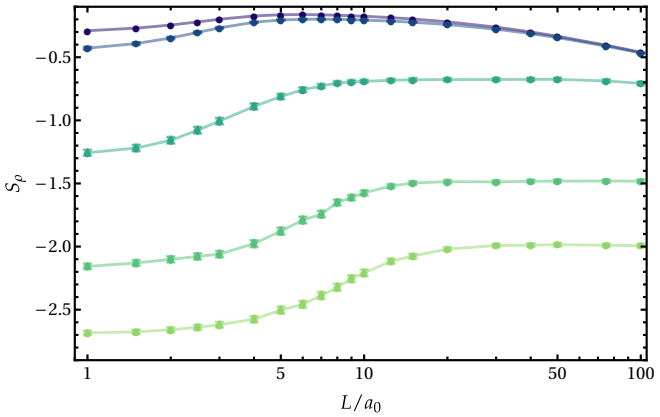

FIG. S4: Position-space information entropy as a function of L for various disorder strengths V averaged over 200 realizations.