Connection among spots and spin direction

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Abstract

Dear guys, let me try to answer to your questions: is there any connection among spots and spin direction? Let me analyze in some details the following Fig.(1). These are the contour plots at one fixed time of the modulii of the density matrix elements (to be more precise the logarithm of, otherwise only the yellow zone appears). I put a label upon each spot, 1,2,3,4 so that 1 labels the lower left spot along the diagonal; 2, the upper diagonal one, and 3,4 the off–diagonal spots.

Consider now the main diagonal ($z = z'$) and the cross diagonal ($z = -z'$). In this way 3D plots becomes 2D plot and it's much easier to check the relations required.

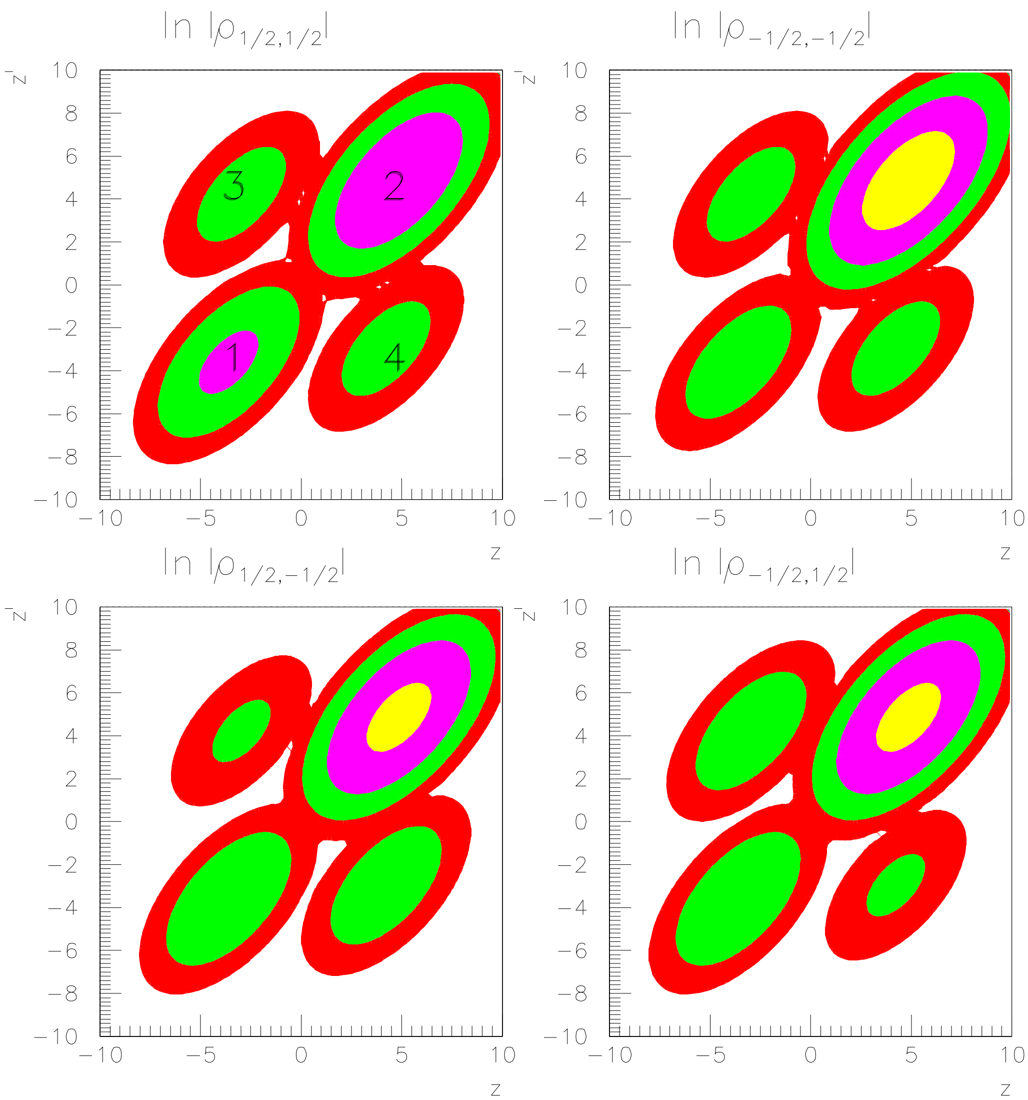

FIG. 1. Logarithm of density matrix as contour plots for a dissipative case with $D = 10$, $\beta = 0.001$, and data $\eta = 0.3$, $z_0 = -4$, $p_0 = 0$, $\epsilon = 400$ at time $\tau = 52$. Colors are as follow: white $(-20, -16)$, red $(-16, -12)$, green $(-12, -8)$, magenta $(-8, -4)$, yellow $(-4, 0)$.

Results for diagonal are reported in Fig(2). In the left upper picture I plot $Real\ \rho^1_{1/2,1/2}(z, z, \tau)$ (where the subscript 1 indicate the bump number 1 in Fig.(1)) as a black line and $Real\ \rho^1_{-1/2,-1/2}(z, z, \tau)$ for the same bump 1 as a red line. As crosses I have indicated the curve obtained multiplying $Real\ \rho^1_{-1/2,-1/2}(z, z, \tau)$ by k^{Re}_1.

From the picture we can safely says that

$$Real\ \rho^1_{1/2,1/2}(z, z, \tau) = k^{Re}_1\ Real\ \rho^1_{-1/2,-1/2}(z, z, \tau) \tag{1}$$

Left lower inset in Fig(2) is the same for the imaginary part.

Again we have

$$Im\ \rho^1_{1/2,1/2}(z,z,\tau) = k_1^{Im}\ Im\rho^1_{-1/2,-1/2}(z,z,\tau) \tag{2}$$

and (numerically)

$$k_1^{Re} = k_1^{Im} = 9.5 \equiv k_1 \tag{3}$$

so that

$$\rho^1_{1/2,1/2}(z,z,\tau) = k_1 \rho^1_{-1/2,-1/2}(z,z,\tau) \tag{4}$$

Let us now analyze the upper right picture, where I plot $Real\rho^2_{1/2,1/2}(z,z,\tau)$ (where the subscript 2 indicate the bump number 2 in Fig.(1)) as a black line and $Real\rho^2_{-1/2,-1/2}(z,z,\tau)$ for the same bump 2 as a red line. As crosses I have indicated the curve obtained multiplying $Real\rho^1_{1/2,1/2}(z,z,\tau)$ by k_2^{Re}, so that

$$Real\ \rho^2_{-1/2,-1/2}(z,z,\tau) = k_2^{Re}\ Real\ \rho^2_{1/2,1/2}(z,z,\tau) \tag{5}$$

Right lower inset in Fig(2) is the same for the imaginary part.

Again we have

$$Im\ \rho^2_{-1/2,-1/2}(z,z,\tau) = k_2^{Im}\ Im\ \rho^2_{1/2,1/2}(z,z,\tau) \tag{6}$$

and (numerically)

$$k_2^{Re} = k_2^{Im} = 9.5 \equiv k_2 \tag{7}$$

so that

$$\rho^2_{-1/2,-1/2}(z,z,\tau) = k_2 \rho^2_{1/2,1/2}(z,z,\tau) \tag{8}$$

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Moreover we have, numerically :

$$k1 = k_2 \tag{9}$$

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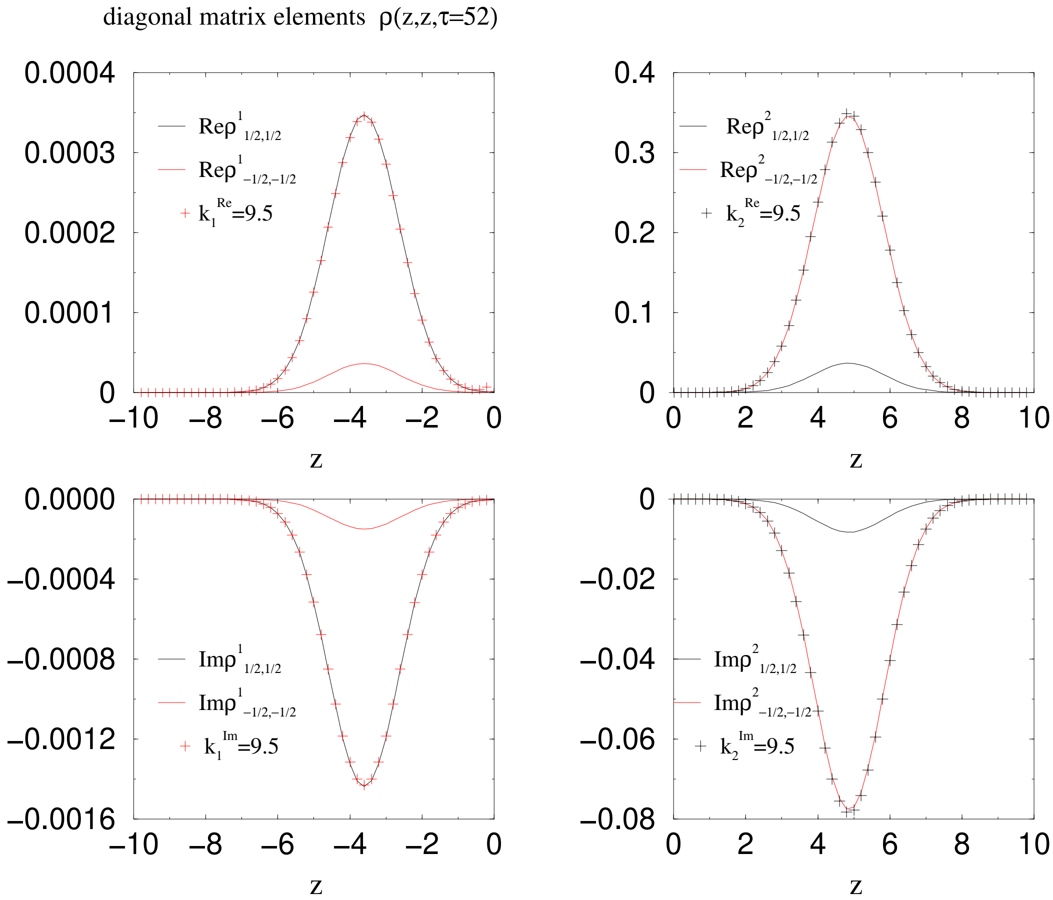

FIG. 2. Comparison among the first (left column) and the second (right column) bump. Real parts above, imaginary lower. The section along the diagonal $z = z'$ as been shown.

In this last picture Fig.(3), we show the comparison between the bump 3 and 4 . In order to do that we compute the section along the across diagonal $z = -z'$. In the same way as above we numerically prove that

$$\rho^3_{-1/2,-1/2}(z,-z,\tau) = -\rho^3_{1/2,1/2}(z,-z,\tau) \tag{10}$$

and

$$\rho^4_{-1/2,-1/2}(z,-z,\tau) = -\rho^4_{1/2,1/2}(z,-z,\tau) \tag{11}$$

From the results along and across the diagonal we can extend the results to the whole plane (z, z') and for any time τ , so that

$$\begin{aligned}
\rho^1_{1/2,1/2} &= k_1 \rho^1_{-1/2,-1/2} \\
\rho^2_{-1/2,-1/2} &= k_1 \rho^2_{1/2,1/2} \\
\rho^3_{-1/2,-1/2} &= -\rho^3_{1/2,1/2} \\
\rho^4_{-1/2,-1/2} &= -\rho^4_{1/2,1/2}
\end{aligned} \tag{12}$$

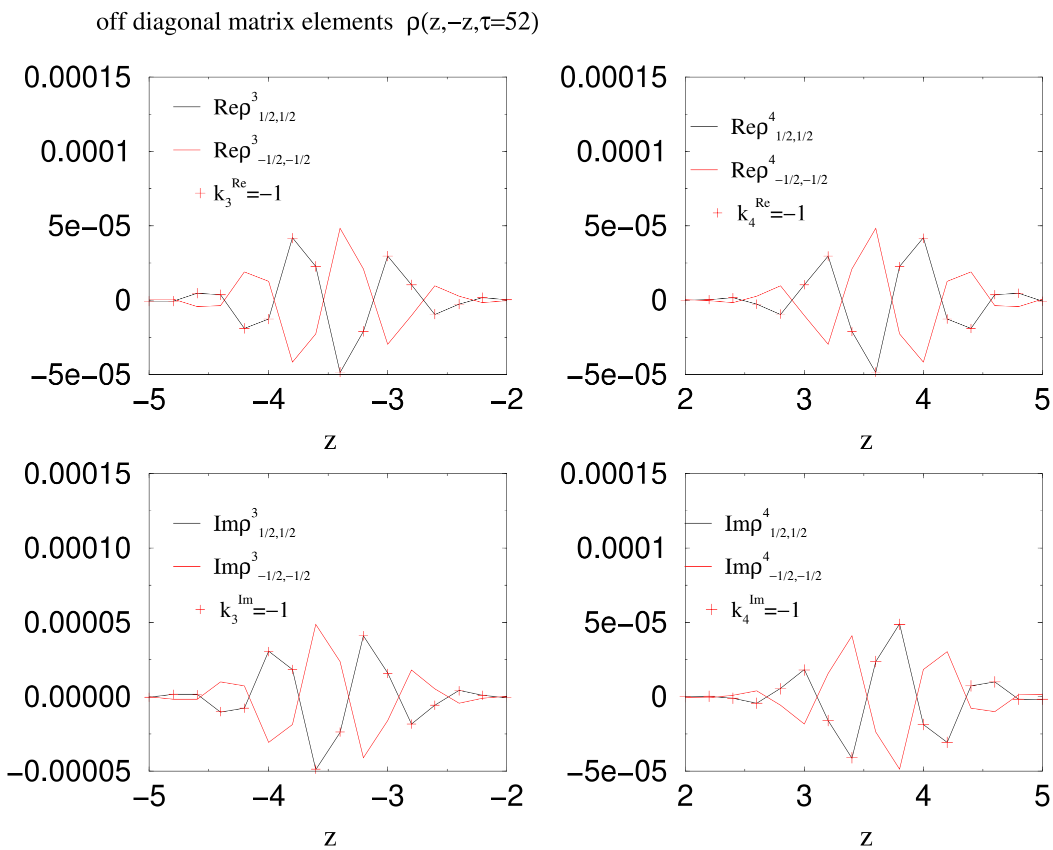

FIG. 3. Comparison among the third (left column) and the fourth (right column) bump. Real parts above, imaginary lower. The section along the crossed diagonal $z = -z'$ as been shown.

This end the numerical demonstration : nothing changes in the decoherence process, at least for small dissipation.

On the other side a stronger dissipation forces the off diagonal peaks to disappear, so as soon as the four peaks structure persists the spin directions keep the same features as the T=0 case.

Let me know if something else is required.

bye, Fausto