Assaf and Akkermans Reply: The authors of the preceding Comment [1] show, using a Cauchy-Schwartz inequality, that $\overline{\delta T_{ab}\delta T_{a'b'}} \leq \overline{T}_{ab}\overline{T}_{a'b'}$. There is a flaw in their argument as we now explain. According to (4) of the Comment, the average transmission coefficient is

$$\overline{T}_{ab} = \sum_m \sum_i |A_i^{\{m\}}|^2, \tag{1}$$

where m runs over the internal configurations of *all* the atoms present in the sample. This step is essential in order to use the Cauchy-Schwartz inequality. Notice that this expression is not written in [2] for the reason that it is wrong. To understand why it is so, it is important to keep in mind that in multiple scattering theory, the *average* transmission coefficient is given by the sum of the *probabilities* P_i to diffuse along every possible spatial sequence i, namely,

$$\overline{T}_{ab} = \sum_i P_i. \tag{2}$$

In the presence of additional degrees of freedom, either classical or quantum, we need to modify these probabilities, $P_i \to \tilde{P}_i$, so as to include them. By comparing (2) (written with the $\tilde{P}_i$'s) and (1), we are led to

$$\tilde{P}_i = \sum_m |A_i^{\{m\}}|^2. \tag{3}$$

This expression is not the probability to diffuse along the path i since this path is built out of a finite set of atoms (having $\{m_i\}$ Zeeman quantum numbers), while the summation in (3) takes into account all atoms in the sample. As a result, the probability to diffuse along a given path i increases as we add more atoms to the sample, which is clearly unphysical.

The correct expression for the average transmission coefficient is

$$\overline{T}_{ab} = \sum_i \sum_{\{m_i\}} |A_i^{\{m\}}|^2, \tag{4}$$

where $\{m_i\}$ stands for the atoms building up path i. The notation $\{m\}$ in $A_i^{\{m\}}$, used for the sake of simplicity, should not hide the fact that $A_i^{\{m\}}$ involves only the atoms along the sequence i. Similarly, the correct expression which replaces (3) written in the Comment, is

$$\overline{\delta T_{ab}\delta T_{a'b'}} = \sum_{\{m_i\}\{m_i'\}} \sum_{\{m_j\}\{m_j'\}} \sum_{ij} A_i^{\{m\}} A_i^{\{m'\}*} A_j^{\{m'\}} A_j^{\{m\}*}$$
$$= \left| \sum_i \sum_{\{m_i\}\{m_i'\}} A_i^{\{m\}} A_i^{\{m'\}*} \right|^2. \tag{5}$$

This expression is precisely what is meant by the overline on the right-hand side of Eqs. (4) and (5) given in [2] as is written in the text that follows Eq. (2). Finally, relations (4) and (5) given above cannot be related through the Cauchy-Schwartz inequality. This disproves inequality (4) of the Comment.

We comment now on the other points raised in [1]. The summations inside the squared modulus in the right-hand side of (5) correspond to cross terms that arise when calculating the product of probabilities and not of *amplitudes*. The "which path" argument raised in connection with [3] is irrelevant, because in the experimental setup we have proposed (see Fig. 1 in [2]), there are, at any time, many photons within the atomic sample. Therefore, photons being indistinguishable, it is impossible to assign a given path to a given photon. The experiment of Itano *et al.* [3] deals with the effect of "which path" information on the interference pattern. There it is specified that their results are valid only when photons are scattered one by one, and not simultaneously. But this is not our case, for which a classical light beam is incident onto a macroscopic atomic cloud, so that many photons are being scattered simultaneously by different atoms.

The authors raise the issue of coherent backscattering (CBS) in order to strengthen their point of view. This results from a misconception of both CBS and Rayleigh law for fluctuations. CBS is an interference effect between time reversed paths and it is described by a cooperon. The enhanced fluctuations of light intensity we describe in [2], as well as the Rayleigh law itself, are described by a diffuson. The fluctuation enhancement is not related to the quantum nature of the additional degrees of freedom but results from the mere fact that more degrees of freedom are added to the system. This shows up in additional terms in the elementary vertex out of which the classical diffuson is built. An analogous enhancement would have been obtained for the case of classical (i.e., nonquantum) degrees of freedom.

In conclusion, we disagree with the criticisms raised in the Comment [1], which, we believe, result from a misunderstanding of our work.

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