Hecker et al. reply: In their comment [1] den Har tog and van Wees (HW) raise objections against our analysis of the experimental data presented in [2]. According to HW, we did not account for the quantum phase incoherence introduced by the Niobium compounds of the investigated Nb/Au hybrid samples. If so, the experimentally derived ratio $X = \frac{\text{rms}(G_{\text{NS}})}{\text{rms}(G_N)}$ would differ substantially from the value $X \approx 2.8$ [2], thereby invalidating the reported agreement between theory and experiment. Here we show by means of a resistor network analysis and by reviewing the information already provided in [3] that these objections are not justified.

A schematic sketch of the system we are analysing is shown in Fig.1, where the dark/light shaded region represents the Au/Nb compound consisting of $N_{\text{Au}}/N_{\text{Nb}}$ phase coherent sub-volumes of size $L_{\varphi, \text{Au}}/L_{\varphi, \text{Nb}}$ and the black bar represents the interface region between Au and Nb ($L_{\varphi, \text{Au}}/L_{\varphi, \text{Nb}}$: phase coherence length of Au/Nb).

![FIG. 1. Decomposition of the system into incoherent partial resistors (see text).](image)

The two basic assumptions of the resistor network analysis (cf. Ref. [2]) are that i) the Au/Nb compound decomposes into $N_{\text{Au}}/N_{\text{Nb}}$ statistically independent sub-volumes and ii) that the CF of any of these volumes are given by the universal value $\text{rms}(G^0_{\text{NS}})$ or $\text{rms}(G^0_N)$, depending on whether the sample is NS or N. An application of these concepts to the particular system shown in Fig. 1 yields the following equations:

$$f_{\text{NS}} = \frac{\text{rms}(G^\text{exp}_{\text{NS}})}{\text{rms}(G^0_{\text{NS}})} = \frac{1}{(2N_{\text{Au}})^{3/2}}$$

$$f_N = \frac{\text{rms}(G^\text{exp}_N)}{\text{rms}(G^0_N)} = \frac{1}{N_{\text{Au}}^2 (R_{\text{Au}} + R_{\text{Nb}})^4}$$

relating the fully phase coherent to the measured values of the CF, respectively. (Note that the extra factor of two in $f_{\text{NS}}$ accounts for the fact that particles contributing to the NS-conductance have to traverse the Au region twice.) In [3] we have set $L_{\varphi, \text{Nb}} = 0$ as the most conservative estimate (leading to the smallest possible value of $f_N$). Now, the precise value of $N_{\text{Au}}$ is unknown to us, i.e. the best we can do is to fix this parameter by means of the experimentally inferred value of $f_{\text{NS}}$. In a second step we deduce a prediction for $\text{rms}(G^0_N)$ by means of the experimental $\text{rms}(G^\text{exp}_N)$, $N_{\text{Au}}$ and the second of the above equations. In this way we find for sample 1 $N_{\text{Au},1} = 1.38 \pm 0.12$ [3] and $X_1 = 4.2 \pm 0.5$ whilst for sample 2 $N_{\text{Au},2} = 1.50 \pm 0.14$ [3] and $X_2 = 3.7 \pm 0.6$. Note that these considerations a) do account for the Nb-phase incoherence and b) lead to ratios between NS- and N-conductance fluctuations which are even larger (roughly by 40%) than those reported in [3].

How does this analysis relate to what was written in [2]? In the Letter the effects of incoherence were discussed in terms of two geometrically estimated effective length parameters, $L^0_{\text{eff}}$ and $L^N_{\text{eff}}$, and a global dephasing length $L_{\varphi}$. The analysis was less accurate than the one above in that both the inhomogeneous distribution of partial resistances and the inequality of $L_{\varphi, \text{Au}}$ and $L_{\varphi, \text{Nb}}$ were neglected. This explains the 40% difference between the two results. Nonetheless the Nb-decoherence was clearly accounted for in [3]. (Otherwise we would have set $L^N_{\text{eff}} = L_{\text{Au}}$.) In other words, an application of HW’s ‘correction’ factor to our result would amount to counting the role of the Nb twice.

Finally let us point out that the above network analysis can yield no more than rough estimates of the decoherence factors, too. The point is that the actual experimental setup is more complex than what Eqs. (1) describe: Firstly, the sample production inevitably leads to the formation of a surface resistance of unknown size between S and N; secondly, the actual NS-interface is not local in space but rather extends over a region of 500 nm. The experimentally measured parameter s do not suffice to unambiguously fix a resistor model describing this more complicated situation. However in all realistic trial scenarios we have been analysing in terms of suitable generalizations of Eqs. (1), the ratio between NS- and N-fluctuations was comparable to, if not larger than the theoretical prediction.

Summarizing we have attempted to clarify our treatment of phase decoherence in [3]: Our work did account for both the incoherence introduced by Au and Nb and we reject the criticism as it is formulated in [1]. Admittedly, however, the experimental data allows for no more than an approximate determination of the decoherence factors (as, indeed, was already pointed out in [2]). Still we maintain that a massive enhancement of the NS-fluctuations, comparable with the theoretical prediction, has been experimentally observed in [3].

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[1] S.G. den Hartog and B.J. van Wees, Phys. Rev. Lett. 80, 5023 (1998).
[2] K. Hecker et al., Phys. Rev. Lett. 79, 1547 (1997).
[3] Note that these values of $N_{\text{Au}}$ are compatible with previous independent estimates (cf. [3]) for $L_{\varphi, \text{Au}}$. 