Jozsa *et al.* Reply: The central point of the Comment [1] by Burt, Ekstrom, and Swanson is the claim that our clock synchronization protocol is circular (and hence not valid). We maintain that this claim is false. However our paper does unfortunately contain errors in the description of Cs atom atomic clocks and we are grateful to Burt *et al.* for pointing out these errors. Nevertheless our paper also gives a description of the protocol in terms of spin half particles in magnetic fields which clearly and correctly demonstrates the validity of the protocol as a gedanken experiment, which, as emphasized in our title, is predicated on the prior existence of shared entanglement.

The synchronization protocol may be described in terms of any kind of (time evolving) two-level quantum system. The validity of the protocol is especially clear (from just elementary quantum mechanics) when described in terms of spin half particles in magnetic fields, as given throughout the paper, but especially on p. 2012 (last two paragraphs in the first column and the first paragraph in the second column). In the paper we also consider the protocol in terms of Cs atom qubits. Burt *et al.* make no mention of the spin half version of the protocol but they point out that "the paper also contains errors in its description of how atomic clocks work." We agree with this criticism (and indeed our simplified model of a Cs atomic clock does not accurately describe the details of an actual time standard) but this does not imply that the actual protocol itself is invalid.

Burt *et al.* go on to argue the circularity of our protocol from our description in terms of the Cs atom qubit implementation, even though their central point (that we cannot legitimately take $\delta_1 = \delta_2 = \delta$ without requiring prior synchronization) is clearly not valid in the spin half model. It is well known that a two-level atom is isomorphic as a quantum system to a spin half particle in a magnetic field. Thus there must also be a valid implementation of our protocol in terms of Cs atoms. This would evidently be more complicated than what we have presented, involving consideration of the interaction of laser light with atoms and associated phase matchings to implement the operations correctly. But such a discussion would not further clarify the main point of the paper (i.e., the protocol's essential principles) beyond the description already given in terms of spin half particles.

The Comment also contains various additional points that we would not endorse, in particular, throughout the third paragraph. The claim that Eq. (2) contains the wrong time dependence is incorrect as can easily be verified by elementary quantum mechanics from Eq. (1). Our protocol is criticized on the grounds that it requires Alice and Bob to possess perfect frequency standards and that separated quantum systems should undergo identical unitary evolutions. But such idealized assumptions are routine in all quantum information gedanken protocols (such as teleportation and dense coding) that rely on shared perfect singlets. However Burt *et al.* conjecture that quantum clock synchronization schemes might have a special phase sensitive nature that sets them apart from other quantum information processing protocols, and we agree that this would be an interesting subject for further study.

In summary, we acknowledge that our description of Cs atom clocks and the physical implementation of our protocol in terms of Cs atom qubits does unfortunately have some elements that are incorrect. But the main claim of the Comment, that the protocol is circular, is false. The Letter, as it stands, contains an alternative, clear, and correct description of the protocol in terms of its spin half particle implementation.

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[1] Eric A. Burt *et al.,* preceding Comment, Phys. Rev. Lett. **87**, 129801 (2001).