

## Reply to "Cosmological source of vacuum electromagnetic zero-point energy"

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In considering an Olbers-type radiation model for the source of vacuum electromagnetic zero-point energy (ZPE), we compare Wesson's "time-of-formation" interpretation for the range of sources of the ZPE [preceding Comment, Phys. Rev. A **44**, 3379 (1991)] with the Puthoff-Santos "optical depth" interpretation, and suggest that the latter may be more compatible with astrophysical constraints.

As discussed in the accompanying Comment by Santos [1] and in my Reply [2], Professor Wesson [3] is indeed correct in noting a missing redshift factor in my original paper concerning the source of vacuum electromagnetic zero-point energy (ZPE) [4]. With the missing factor in place, Santos's Eq. (4) and my (Reply) Eq. (3) are in agreement, and can be compared with Wesson's Eq. (5), which agrees for  $z_m \gg 1$  (Wesson's  $t_0 \gg t_f$ ).

Of interest in the comparison is the interpretation Wesson gives to the integral over time (and therefore distance) of the radiation now arriving at a point to constitute the hypothesized Olbers-type contributions to the local ZPE. This he frames in terms of what he calls "time of formation,  $t_f$ " of the sources; that is, a point back in time (distance) at which sources presumably formed and began radiating the presently received radiation. This stands in contrast to the Santos/Puthoff interpretation of

the initial time (represented by redshift factor  $z_m$ ) not as a "time of formation" of the sources, but rather as a measure of the optical depth of unscattered radiation contributing to the local ZPE. This latter interpretation would seem to constrain the astrophysics less harshly than the "time-of-formation" interpretation, since it would then not be a matter of a moment at which sources formed and began radiating, but instead simply the point at which the universe had thinned sufficiently to permit radiation to arrive unscattered at the present time. This alternative interpretation might more easily satisfy Wesson's well-stated requirement for an "astrophysically acceptable reason for the choice of parameters" that would permit an Olbers-type interpretation for the source of vacuum electromagnetic zero-point energy as originally proposed in Ref. [4].

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[1] E. Santos, this issue, Phys. Rev. A **44**, 3383 (1991).

[2] H. E. Puthoff, this issue, Phys. Rev. A **44**, 3385 (1991).

[3] P. S. Wesson, preceding Comment, Phys. Rev. A **44**, 3379

(1991).

[4] H. E. Puthoff, Phys. Rev. A **40**, 4857 (1989).