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Reply to “Comment on ‘Effects of quantized scalar fields in cosmological spacetimes with big rip singularities’ ”

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Phys. Rev. D **84**, 048502 — Published 19 August 2011

DOI: 10.1103/PhysRevD.84.048502

Bates and Anderson Reply

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In a previous paper [1] we computed the energy density for massive and massless quantized scalar fields with arbitrary curvature coupling in spacetimes containing a big rip singularity. We found no evidence that backreaction effects due to quantum fields would remove a big rip singularity in our universe if it has one. In their comment on our work, Haro and Amoros [2] solve the semiclassical backreaction equations directly for the case of a conformally invariant scalar field. They find the opposite conclusion.

It seems obvious that the results of a backreaction calculation should supersede those of a background field calculation. However, this is only true if the backreaction calculation yields a physically acceptable solution. In this response we argue that the solutions found by Haro and Amoros are not physically acceptable during the times when the backreaction effects due to the quantum fields are important.

The relevant solutions they find follow the classical expansion for some period of time and then deviate from it significantly. From the plots they display, it is clear that once significant deviations from the classical solution occur these deviations manifest on time scales which are less than the Planck time, independent of the amount of time the system remains close to the classical solution. Such rapid variation in time violates the semiclassical approximation and therefore these solutions are not physically acceptable once they deviate significantly from the classical solution. Thus, in our view, the solutions found by Haro and Amoros do not provide evidence that backreaction effects in the context of semiclassical gravity can remove a big rip singularity in our universe.

Acknowledgments

This work was supported in part by the National Science Foundation under Grant No. PHY-0856050.

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[1] J. D. Bates and P. R. Anderson, Phys. Rev. D, **82**, 024018 (2010).

[2] J. Haro and J. Amoros, Phys. Rev. D