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Journal Name:	Physical Science International Journal
Manuscript Number:	2014_PSIJ_10336
Title of the Manuscript:	Entropy and Temperature from Entangled Space and Time
Type of the Article	Regular research paper

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PART 1: Review Comments

	Reviewer's comment	Author's comment (if agreed with reviewer, correct the manuscript and highlight that part in the manuscript. It is mandatory that authors should write his/her feedback here)
<u>Compulsory</u> REVISION comments	Referee report below:	
	The problem of bound states in Quantum Field Theory is a very difficult unsolved problem. That's why any new look at this problem is useful. The authors discuss this problem on the example of two coupled oscillators. In such a rather short paper it is impossible to discuss allthe aspects of the problem. So the presentation depends on authors' preferences and different readers probably will have different preferences. At the same time, it seems to me, that the following point might be confusing. The authors write the Hamiltonian for oscillators as in nonrelativistic quantum mechanics. However, in Poincare invariant theory the Hamiltonian should be written proceeding from irreducible	
	representations of from representations describing	

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local fields. In nonrelativistic quantum mechanics one can consider a particle in the harmonic oscillator potential. However, in QFT there is no harmonic oscillator potential. The authors justify their approach by referring to Dirac's SO(3,2)paper. "Remarkable representations" found in this paper (singletons) are some analogs of oscillator because, as shown later by Flato and Fronsdal, massless particles can be built from singletons. The authors refer to the Wigner little group.However, the singleton representation is special for SO(3,2) and there is no similar representation for the Poincare group. Probably the intention of the authors is to say that in the rest state one can take the wave function in the form in nonrelativisticquantum same as mechanics. This is true, for example in the theory of direct relativistic interactions but not in QFT. So I believe that this pointshould be clarified. I would also like to make some additional comments on the presentation. To take into account those comments or not - this is fully



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optional for the authors. The authors consider the bound state problem in coordinate representation. mention irreducible They papers on representations: by Wigner on irreducible representations of the Poincare group and by Dirac on singletons (irreducible representations of the SO(3,2) group). In those papers an elementary particle is described in momentum representation and angular momentum representation, respectively. The authors do not mention how those representations are related to the coordinate representation and therefore it is not clear how those results can be used in the authors' formalism. Probably the intention of the authors was only to mention possible approaches. Meanwhile, in the case of irreducible representations there is no problem with the probabilistic interpretation while it is well known that Poincare invariant local fields do have this problem. problem of covariance coordinate Α in

A problem of covariance in coordinate representation is difficult for several reasons. For

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example, on quantum level spacial coordinates and time are not on equal footing. This is clear even from the fact that the spacial position operator exists (at least in some approximations) while the time operator does not exist. That's why the wave function describes a distribution in spacial coordinates but it cannot describe a distribution in time. The absence of explicit covariance also follows from the fact that the relativistic function coordinate wave in representation is defined not on the whole Minkowski space but only on a hyperplane of this space. For example, the authors mention Dirac's 1949 paper on the forms of relativistic dynamics. In QFT the momentum and angular momentum operators are given by integrals of the stressenergy and angular momentum tensors over a hyperplane. Then the Dirac instant form is obtained when the hyperplane is t=const, the front form is obtained when the hyperplane is the light cone and the choice of the hyperplane for the point form is a problem. In summary, the fact that



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	the coordinate wave function is defined not in the whole Minkowski space but on a hyperplane	
	breaks the explicit Lorentz covariance.	
Minor REVISION comments		
Optional/General comments		

Note: Anonymous Reviewer