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PART 1:

Journal Name:	Physical Review & Research International
Manuscript Number:	**MS: 2013_PRRI_3363**
Title of the Manuscript:	**Quantum Gravity and the Holographic Mass.**

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PART 2: **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)*
Compulsory REVISION comments	**The author defined the holographic mass and applied it to the black hole and the proton. There are some interesting coincidences, e.g. similarity with strong force and Yukawa potential in short range in the study. However, There are still some questions to be answered: 1)The meaning of holographic principle(HP) is definitely not that used in the paper. Moreover, the area in Eq.(4) should be surface area. Generally, HP is no problem when used in black holes, but it is problematic when used in the weak gravitational field. How to guarantee its validity when used in the system of protons? 2) The black hole mass and proton mass were obtained from different formula (Eq. 9 and Eq. 24), although they were explained in holographic principle. Why? 3) The author described a system in section5 to use the gravitational interaction to explain the strong force. Where could we see the evidence of gluon? Or does the gluon derived from the evolution of graviton? 4) For the system consisted of two protons, there indeed are many coincidences. But if they cannot be extended into other systems, e.g. three protons etc., the phenomena described in the paper is not enough to support their conclusion.** **In a word, the conclusions obtained in the paper are highly implicative in the physical mechanism. However, it is interesting to understand further these coincidences found by the author. The paper is not**	1) This paper utilizes what is referred to as a generalized holographic approach to the physical properties of the objects studied. One should keep in mind that the "holographic principle" was loosely named after the analogy of a hologram by 't Hooft due to the Bekenstein conjecture that the information of the volume of the black hole may be holographically expressed on the 2 dimensional screen of it's horizon surface area. (We have added a comment in parentheses in the manuscript on line 75 to reflect this comment.) In our approach we generalize the holographic principle (as defined in the first few paragraphs of section 2) to explore the physical attributes of the relationship between the 3 dimensional volume information structure and the surface horizon utilizing Planck spherical units (PSU). This is consistent with the dimensional reduction of the earlier holographic entropy calculation by our predecessors, yet generalized by the use of PSUs and extending to gravitation as demonstrated in Section 2. We have added a sentence in the Introduction (lines 84 to 91) to clarify our use of the holographic principle. We have added the word "surface" to the sentence below equation (4). To address the reviewer's general comment on

	proper to be published in the present form.	coincidences, the approach in our paper has demonstrated in equations (9) to (21) to be exactly equivalent to the Schwarzschild solution to Einstein's field equations. If one examines the algebra in detail all that is done is a manipulation of fundamental constants emerging from our generalized holographic approach clearly tying the geometry to the Schwarzschild gravitational solution. Since it is a continuous algebraic derivation from the holographic geometric solution (eq. 9) to the Schwarzschild solution (eq. 21) with no free parameters or hidden variables this section cannot be deemed to be coincidental. Furthermore, the inverse relationship of the geometric solution (see the clarification to your question #2 below) generates an extremely accurate (if not exact) value of the charge radius of the proton. This value was just confirmed by muonic measurement at the Paul Scherrer accelerator in Switzerland (published on January 25th 2013) to be 0.84087(39)x10^-13cm, a difference of 0.000366x10^-13cm from the predicted value in our paper which is within a standard deviation or within the margin of error of the experiment *(A. Antognini, et. al., "Proton Structure from the Measurement of 2S-2P Transition Frequencies of Muonic Hydrogen", Science, vol. 339, 25 January 2013)*. We understand that this new measurement significantly disagrees with the standard model yet it confirms the earlier, not as accurate, 2010 measurement cited in our paper and is now becoming regarded as most likely the correct value. Furthermore, considering that the same geometric relationship eventually outputs

		the *exact* value for the gravitational coupling constant and that our cosmological solution is exact, our prediction for the proton charge radius (being within a standard deviation of the experiment) is highly unlikely to be coincidental. It is just as unlikely of a coincidence that the Hawking-Bekenstein entropy turned out to be a quarter of the surface of a holographic horizon or for that matter h-bar being the correct quantization value of the ultraviolet spectrum of a black body radiation. There are many other results in our manuscript that demonstrate that the theory is self-consistent, predictive and, in our opinion, not coincidental. We do, however, appreciate the reviewer comment that these findings should be further understood. To answer the question of the application of HP to the so called "weak gravitational field" of the proton, our generalized approach clearly demonstrates that the strong force may be a function of the vacuum fluctuations generating the equivalent of the Schwarzschild gravitational strength and is thus within a strong field. Equation (33) for example clearly demonstrates that the gravitational mass (the Schwarzschild mass) is involved due to the Planck scale fluctuation structure within spacetime. We eventually define this function of the vacuum structure as the holographic mass unifying energy and show that it is exactly equivalent to the gravitational coupling constant to the strong force. Clearly a very strong field at the proton horizon. Furthermore in the Yukawa potential Section 5, this strong gravitational interaction is

		demonstrated to have the correct range to define proton to proton interaction. We acknowledge the reviewer's comment and have added clarification under equation (34). 2) Equation (9) describes the use of the relationship of the number of PSUs in the interior of the black hole object divided by the number of PSUs on the surface horizon and multiply the ratio by the Planck mass to obtain an exact solution to the mass of the object. The reviewer compares this with equation (24) when it is more appropriately compared to the form in equation (42), or equation (24) is best compared with the form in equation (11), where in either case the inverse of the volume to surface ratio is utilized. However, this inverse relationship provides the rest mass of the proton, a different value than the Schwarzschild mass of a proton. The inverse relationship of information across the boundary screen of the horizon is consistent with the dimensional reduction of the holographic hypothesis and is within the original concept of holographic analogy initiated by 't Hooft from the Bekenstein conjecture and is part of the generalization of the holographic principle we utilize and in some cases called the holographic mass. Furthermore as discussed above and as shown in equation (33) and (34) and shown in equation (46) the cosmological solution is as well involved in producing the rest mass of the proton and is equivalent to the gravitational coupling constant. However we have added lines 265 to 267 to clarify. 3) In this paper, we are able to derive a gravitational solution to the strong force as being related to the

		relativistic mass of proton to proton spin interaction derived from the angular frequency generated from our *generalized* holographic solution. The resulting topological perturbation details are not addressed here. We intend to address them in future publications where we treat the gluon flux tube jet structures as a product of the spacetime Planck vacuum background collective behaviour. Here, the gluon strings are treated utilizing an extended center vortex approach, significantly advanced by 't Hooft, in which the surface area of a Wilson loop relative to the vortex string defines the confining gluon flux tube yielding a graviton description of the gravitational potential. Based on the reviewer's valid question/comment and insight, we have added language to that effect in our manuscript from line 460 to 465 to clarify our approach and give a general sense of our direction (although this level of detail could obviously not be addressed fully here). 4) At this time there is no analytical solution to the three-body problem and as such, as the reviewer probably knows, all of the quantum mechanics results past the hydrogen atom or the two-body solutions of one proton and one electron, are approximations usually dealt with a series expansion such as the Taylor series. Yet the physics of quantum mechanics are still considered valid and most of quantum theory is done modelling particle to particle interaction as individual two-body problems. The three-body problem is an outstanding issue in physics and is not within the scope of our paper. However in general, we can estimate that a larger orbital radius would occur if more than two constituents were involved. The result on our graph would tend towards the force weakening as

		expected from the Yuwaka potential. In future explorations of our generalized holographic principle, which clearly generated the angular frequency and the interaction time of the proton, we are hopeful to find n-body solutions with relevant analytical results and precise computations. We have added language in our conclusion (line 609 and 610) to reflect our intent of addressing more complex systems in the future. We hope this satisfies the reviewer's comments. Thank you for your time and consideration.
Minor REVISION comments		
Optional/General comments		