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How Torsion as Presented by De Sabbata and Sivaram in Erice 1990 Argument as Modified May Permit Cosmological Constant, and Baseline as to Dark Energy

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Abstract

Based on the idea of cyclic conformal cosmology, we discuss how torsion may allow for a cosmological constant, which links the ideas given by Beckwith and QaZi 2023 to a presentation as far as Torsion as given by de Sabbata and Sirvaram, Erice 1990. The 1990 article claims that Torsion cancels Cosmological vacuum energy whereas our formulation leads to a left over cosmological constant 10^{-121} times vacuum energy. Meantime speculation as to how all this relates to black hole physics and speculation given by Corda which replaces traditional firewalls with a different formulation are included as that presentation by Corda uses the idea of a quantum number n, which ties into our own Cosmological constant presentation.

Keywords

Inflation, Gravitational Waves, Penrose CCC

1. Introduction: Review of the Purported Role of Torsion Given by De Sabbata and Sirvaram 1990 in Its Cancelation of Vacuum Energy/Cosmological Constant. Versus a Preview of What We Will Be Doing

First of all I wish to thank the referee for his following comments which are reproduced verbatim: These are put into the introduction and they are meant as an addendum to the derivation which I tried to put in, for the sake of readability of this document, the oversight which I did not see due to lack of experience in torsion physics. So after this synopsis is included, I will commence to add in the derivational points adhered to in this review right after my text.

Here are some of the points raised by the referee, in his review of my docu-

ment.

Quote

There are other papers in which it is pointed out that the torsion term (quoted often by Bekenstein) can indeed give rise to a residual Cosmological constant term of the observed magnitude. This has also been used to generate inflation.

The present Reviewer has always been an advocate for a lambda term. So I agree with the Author that torsion term can give rise to a lambda term. Of course the source of the spin density in the present paper is that of primordial BH, but essentially a similar argument. Equations 4 to 14 are just the same as in Ref. [1].

End of quote.

To wit, what I wish to do is to adhere to the fundaments of the basic document, and then proceed to address the issues brought up by the referee, *i.e.* in references presented he uses different arguments as to what generates spin density than I do, but I used, as he noted, spin density as a direct product of primordial black holes forming initially.

The other difference is in that my primordial black holes are scaled via Bose Einstein condensation, and also are linked to gravitons.

Having said that, more of the referees review is included in the end of this paper, whereas we refer to three references which the referee thought was of import and consideration at the end of my summary of the arguments presented.

2. The Basic Argument as to Black Holes as a Source of Torsion Given for Review

To begin this look at [1] [2] [3] which purports to show a global cancellation of a vacuum energy term, which is akin, as we discuss later to cancelling the following completely [3] [4]

$$\rho_{\Lambda}c^2 = \int_0^{E_{\text{Plank}}/c} \frac{4\pi p^2 \mathrm{d}p}{(2\pi\hbar)^3}\cdot\left(\frac{1}{2}\cdot\sqrt{p^2c^2+m^2c^4}\right) \approx \frac{\left(3\times10^{19}\ \text{GeV}\right)^4}{(2\pi\hbar)^3} \xrightarrow[E_{\text{Plank}}/c\to 10^{-30}]{} \frac{\left(2.5\times10^{-11}\ \text{GeV}\right)^4}{(2\pi\hbar)^3} \tag{1}$$

In [1], the first line is the vacuum energy which is completely cancelled in their formulation of application of Torsion. In our article we are arguing for the second line. In fact, in our formulation our reduction to the second line of Equation (1) will be to confirm the following change in the Planck energy term given by [1]

$$\frac{\Delta E}{c} = 10^{18}\ \text{GeV} - \frac{n_{\text{quantum}}}{2c} \simeq 10^{-12}\ \text{GeV} \tag{2}$$

The term n (quantum) comes from a Corda derived expression as to energy level of relic black holes [4].

We argue that our application of [1] [2] will be commensurate with Equation (2) which uses the value given in [2] as to the following *i.e.* relic black holes will

contribute to the generation of a cut off of the energy of the integral given in Equation (1) whereas what is done in Equation (1) by [1] [2] is restricted to a different venue which is reproduced below, namely cancellation of the following by Torsion

$$\rho_{\Lambda}c^2 = \int_0^{E_{\text{Plank}}/c} \frac{4\pi p^2 \mathrm{d}p}{(2\pi\hbar)^3} \cdot \left(\frac{1}{2} \cdot \sqrt{p^2c^2 + m^2c^4}\right) \approx \frac{\left(3\times 10^{19}\ \text{GeV}\right)^4}{(2\pi\hbar)^3} \tag{3}$$

Furthermore, the claim in [1] is that there is no cosmological constant, *i.e.* that Torsion always cancelling Equation (3) which we view is incommensurate with **Table 1** as of [3] which is given below. We claim that the influence of Torsion will aid in the decomposition of what is given in **Table 1** from [3] and will furthermore lead to the influx of primordial black holes which we claim is responsible for the behavior of Equation (2) above.

We should note in this, that we are assuming that what we refer to later as Torsion spin density is a direct consequence of primordial black holes, and we solidly link the presence of primordial black holes as given in [2] to consequential contributions to our ideas of the cosmological constant. In doing so, we should note that there would be a causal discontinuity between the prior to present universe, as in [2] to a modified Penrose CCC model, of which the black holes prior to Planckian space-time would be enormous whereas what is accessed at the beginning of Planckian space-time would be Plank mass valued initial black holes. This is a breakage of earlier space-time structure, and we leave the further formation of these initially forming black holes, as further research projects which will be necessary when we seek optimal data sets as to forming our research confirmation of this paper's hypothesis.

As we briefly alluded to we are assuming very small initial black holes, and from [2] as using Penrose cyclic conformal cosmology as given in the document [2].

Table 1. Pre to Post Planckian black holes, assuming Cyclic Conformal technology.

End of Prior Universe time frame	Mass (black hole): super massive end of time BH 1.98910^{41} to about 10^{44} grams	Number (black holes) 10^6 to 10^9 of them usually from center of galaxies
Planck era Black hole formation Assuming start of merging of micro black hole pairs	Mass (black hole) 10^{-5} to 10^{-4} grams (an order of magnitude of the Planck mass value)	Number (black holes) 10^{40} to about 10^{45}, assuming that there was not too much destruction of matter-energy from the Pre Planck conditions to Planck conditions
Post Planck era black holes with the possibility of using Equation (1) to have say 10^{10} gravitons/second released per black hole	Mass (black hole) 10 grams to say 10^6 grams per black hole	Number (black holes) Due to repeated Black hole pair forming a single black hole multiple time. 10^{20} to at most 10^{25}

3. Now for the Statement of the Torsion Problem as Given in [1] with a Nod to [5] [6] [7] [8], in the Massless Particle Case, Initially

The author is very much aware as to quack science as to purported torsion physics presentations and wishes to state that the torsion problem is not linked to anything other than disruption as to the initial configuration of the expansion of the universe and cosmology, more in the spirit of [6] [7] and is nothing else. Hence, in saying this we wish to delve into what was given in [1] with a subsequent follow up and modification: We first follow the description of [1] to remove Torsion physics from the quacks.

To do this, note that in [1] the vacuum energy density is stated to be

$$\rho_{vac} = \Lambda_{eff} c^4 / 8\pi G \tag{4}$$

whereas the application is given in terms of an antisymmetric field strength $S_{\alpha\beta\gamma}$ [8].

In [1] due to the Einstein Cartan action, in terms of a SL(2, C) gauge theory, we write from [1]

$$L = -R/(16\pi G) + S_{\alpha\beta\gamma} S^{\alpha\beta\gamma} / 2\pi G \tag{5}$$

R here is with regards to Ricci scalar and Tensor notation and $S_{\alpha\beta\gamma}$ is related to a conserved current closing in on the SL(2, C) algebra as given by

$$J^{\mu} = J^{\mu} + 1/(16\pi G)\varepsilon^{\mu\alpha\beta\gamma} S_{\alpha\beta\gamma} \tag{6}$$

This is where we define

$$S_{\alpha\beta\gamma} = c_{\alpha} \times f_{\beta\gamma} \tag{7}$$

where c_{α} is the structure constant for the group SL(2, C), and

$$f_{\beta\gamma} \cdot \overline{g} = F_{\beta\gamma} \tag{8}$$

where

$$\overline{g} = (g_1, g_2, g_3) \tag{9}$$

Is for tangent vectors to the gauge generators of SL(2, C), and also for Gauge fields A_{γ}

$$F_{\beta\gamma} = \partial_{\beta} A_{\gamma} - \partial_{\gamma} A_{\beta} + [A_{\beta}, A_{\gamma}] \tag{10}$$

And that there is furthermore the restriction that

$$\partial_{\rho} \left(\varepsilon^{\rho\alpha\beta\gamma} S_{\alpha\beta\gamma} \right) = 0 \tag{11}$$

Finally in the case of massless particles with torsion present we have a space time metric

$$ds^2 = d\tau^2 + a^2(\tau) d^2\Omega_3 \tag{12}$$

where $d^2\Omega_3$ is the metric of S^3.

Then the Einstein field equations reduce to in this torsion application, (no mass to particles) as

$$\left(\mathrm{d}a/\mathrm{d}\tau\right)^2 = 1 - r_{\min}^4/a^4 \tag{13}$$

With, if S is the so called spin scalar and identified as the basic $\hbar$ unit of spin

$$r_{\min}^4 = 3G^2S^2/8c^4 \tag{14}$$

4. How to Modify Equation (13) in the Presence of Matter via Yang Mills Fields $F_{\mu\nu}^{\beta}$

First of all, this involves a change of Equation (5) to read

$$L = -R/(16\pi G) + S_{\alpha\beta\gamma}S^{\alpha\beta\gamma}/2\pi G + \left(1/4g^2\right)F_{\mu\nu}^{\beta}F_{\beta}^{\mu\nu} \tag{15}$$

And eventually we have a re do of Equation (13) to read as

$$\left(\mathrm{d}a/\mathrm{d}\tau\right)^2 = 1 - \beta_1/a^2 - \beta_2/a^4 \tag{16}$$

If $g = \hbar c$ we have $\beta_1 = r_{\min}^2, \beta_2 = r_{\min}^4$, and the minimum radius is identified with a Planck Radius so then

$$\left(\mathrm{d}a/\mathrm{d}\tau\right)^2 = 1 - \left(\beta_1 = \ell_P^2\right)/a^2 - \left(\beta_2 = \ell_P^4\right)/a^4 \tag{17}$$

Eventually in the case of an unpolarized spinning fluid in the immediate aftermath of the big bang, we would see a Roberson Walker universe given as, if σ is a torsion spin term added due to [1] as

$$\left(\frac{\dot{\tilde{R}}}{\tilde{R}}\right)^2 = \frac{8\pi G}{3}\cdot\left[\rho - \frac{2\pi G\sigma^2}{3c^4}\right] + \frac{\Lambda c^2}{3} - \frac{\tilde{k}c^2}{\tilde{R}^2} \tag{18}$$

5. What [1] Does as to Equation (18) versus What We Would Do and Why

In the case of [1] we would see σ be identified as due to torsion so that Equation (18) reduces to

$$\left(\frac{\dot{\tilde{R}}}{\tilde{R}}\right)^2 = \frac{8\pi G}{3}\cdot\rho - \frac{\tilde{k}c^2}{\tilde{R}^2} \tag{19}$$

The claim is made in [1] that this is due to spinning particles which remain invariant so the cosmological vacuum energy, or cosmological constant is always cancelled.

Our approach instead will yield

$$\left(\frac{\dot{\tilde{R}}}{\tilde{R}}\right)^2 = \frac{8\pi G}{3}\cdot\rho + \frac{\Lambda_{0\text{observed}}c^2}{3} - \frac{\tilde{k}c^2}{\tilde{R}^2} \tag{20}$$

i.e. the observed cosmological constant $\Lambda_{0\text{observed}}$ is 10^{-122} times smaller than the initial vacuum energy.

The main reason for the difference in the Equation (19) and Equation (20) is in the following observation. We will go to **Table 1** and make the following assertion:

Mainly that the reason for the existence of σ^2 is due to the dynamics of spinning black holes in the precursor to the big bang, to the Planckian regime, of space time, whereas in the aftermath of the big bang, we would have a vanishing of the torsion spin term, *i.e.* Table 1 dynamics in the aftermath of the Planckian regime of space time would largely eliminate the σ^2 term.

6. Filling in the Details of the Equation (19) Collapse of the Cosmological Term, versus the Situation Given in Equation (20) via Numerical Values

First look at numbers provided by [3] as to inputs, *i.e.* these are very revealing

$$\Lambda_{Pl}c^2 \approx 10^{87} \tag{21}$$

This is the number for the vacuum energy and this enormous value is 10^{122} times larger than the observed cosmological constant. Torsion physics, as given by [3] is solely to remove this giant number.

In order to remove it, the reference [3] proceeds to make the following identification, namely

$$\frac{8\pi G}{3}\cdot\left[-\frac{2\pi G\sigma^2}{3c^4}\right]+\frac{\Lambda c^2}{3}=0 \tag{22}$$

What we are arguing is that instead, one is seeing, instead

$$\frac{8\pi G}{3}\cdot\left[-\frac{2\pi G\sigma^2}{3c^4}\right]+\frac{\Lambda_{Pl}c^2}{3}\approx 10^{-122}\times\frac{\Lambda_{Pl}c^2}{3} \tag{23}$$

Our timing as to Equation (22) is to unleash a Planck time interval t about 10^{-43} seconds.

As to Equation (22) versus Equation (23) the creation of the torsion term is due to a presumed particle density of

$$n_{Pl} \approx 10^{98}\ \text{cm}^{-3} \tag{24}$$

Finally, we have a spin density term of

$$\sigma_{Pl} = n_{Pl}\hbar \approx 10^{71} \tag{25}$$

7. Future Works to Be Commenced as to Derivational Tasks

We will assume for the moment that Equation (22) and Equation (23) share in common Equation (24) and Equation (25).

It appears to be trivial, a mere round off, but I can assure you the difference is anything but trivial. And this is where Table 1 really plays a role in terms of why there is a torsion term to begin with, *i.e.* will make the following determination, *i.e.*, the term of "spin density" in Equation (22) by Equation (25) is defined to be an ad hoc creation, as to [3]. No description as to its origins is really offered.

1st

We state that in the future a task will be to derive in a coherent fashion the

following, *i.e.* the term of $\frac{8\pi G}{3}\cdot\left[-\frac{2\pi G\sigma^2}{3c^4}\right]$ arising as a result of the dynamics of Table 1, as given in the manuscript.

2nd

We state that the term $\frac{8\pi G}{3}\cdot\left[-\frac{2\pi G\sigma^2}{3c^4}\right]$ is due to initial micro black holes, as to the creation of a Cosmological term. This would follow from Equation (2) being utilized, *i.e.* what we are seeking is utilization of the following.

In the case of Pre Planckian space-time the idea is to do the following [9], *i.e.* if we have an inflaton field [10]

$$\begin{aligned}&\left|\mathrm{d}p_\alpha \mathrm{d}x^\alpha\right| \approx \frac{L}{l}\cdot\frac{h}{c}\cdot\left[\frac{\mathrm{d}l}{l}\right]^2\\ &\xrightarrow[\alpha=0]{}\left|\mathrm{d}p_0\mathrm{d}x^0\right| \simeq \left|\Delta E\Delta t\right| \approx h/a_{init}^2\phi\left(t\right)\\ &\Rightarrow \frac{L}{l}\cdot\frac{h}{c}\cdot\left[\frac{\mathrm{d}l}{l}\right]^2 \approx h/a_{init}^2\phi\left(t_{init}\right)\end{aligned} \tag{26}$$

Making use of all this leads to [8] to making sense of the quantum number n as given by reference to black holes, [4]

$$E_{Bh} = -\frac{n_{\text{quantum}}}{2} \tag{27}$$

3rd

The conclusion of [3] states that Equation (22) would remain invariant for the life of the evolution of the universe. We make no such assumption. We assume that, as will be followed up later that Equation (23) is due to relic black holes with the suppression of the initially gigantic cosmological vacuum energy.

The details of what follow after this initial period of inflation remain a task to be completed in full generality but we are still assuming as a given the following inputs [1] [9]

$$\begin{aligned}&a\left(t\right) = a_{\text{initial}}t^\nu\\ &\Rightarrow \phi = \ln\left(\sqrt{\frac{8\pi GV_0}{\nu\cdot\left(3\nu-1\right)}}\cdot t\right)^{\sqrt{\frac{\nu}{16\pi G}}}\\ &\Rightarrow \dot{\phi} = \sqrt{\frac{\nu}{4\pi G}}\cdot t^{-1}\\ &\Rightarrow \frac{H^2}{\dot{\phi}} \approx \sqrt{\frac{4\pi G}{\nu}}\cdot t\cdot T^4\cdot\frac{1.66^2\cdot g_*}{m_P^2} \approx 10^{-5}\end{aligned} \tag{28}$$

A possible future endeavor can also make sense of [10] as well.

8. Another Brief Reformulation of This Idea to Consider, Similar to the Above Revisiting [1]

$$\begin{aligned}&\sqrt{\Lambda} = \frac{k_B E}{\hbar c S_{\text{entropy}}}\\ &S_{\text{entropy}} = k_B N_{\text{particles}}\end{aligned} \tag{29}$$

And then its reference to the BEC condensate given by [1] [3] as to scaling [11]

$$\begin{aligned} m &\approx \frac{M_P}{\sqrt{N_{\text{gravitons}}}} \\ M_{BH} &\approx \sqrt{N_{\text{gravitons}}}\cdot M_P \\ R_{BH} &\approx \sqrt{N_{\text{gravitons}}}\cdot l_P \\ S_{BH} &\approx k_B \cdot N_{\text{gravitons}} \\ T_{BH} &\approx \frac{T_P}{\sqrt{N_{\text{gravitons}}}} \end{aligned} \tag{30}$$

To begin this look at [1] [2] [3] which purports to show a global cancellation of a vacuum energy term, which is akin, as we discuss later to cancelling the following completely [3] [4].

If so then we will be looking at Equation (3) to be recast as

$$\left(\frac{\dot{\tilde{R}}}{\tilde{R}}\right)^2 = \frac{8\pi G}{3}\cdot\left[\rho - \frac{2\pi G\sigma^2}{3c^4}\right] + \frac{k_B^2 E^2}{3\hbar^2 c^2\cdot\left[k_B^2 N_{\text{particles}}^2\right]} - \frac{\tilde{k}c^2}{\tilde{R}^2} \tag{31}$$

Our analysis from here will delve into different candidate versions as to energy E put into Equation (31) as to what could be expected as to the torsion term and its implications in cosmology, *i.e.* keep in mind that Equation (3) as configured in this situation is assuming in [1] that torsion completely cancels a cosmological constant.

9. What If Energy *E* in Equation (31) Is Thermal?

We then will be looking at

$$\frac{k_B^2 c_1^2 T_{\text{Temperature}}^2}{12\hbar^2 c^2\cdot\left[k_B^2 N_{\text{particles}}^2\right]} - \frac{16\pi G}{9}\cdot\frac{2\pi G\sigma^2}{c^4} \equiv \frac{\Lambda_{\text{observed}}c^2}{3} \tag{32}$$

Assuming that $\Lambda_{\text{observed}}c^2$ is of the order of 10^{-35} and, this comes up with

$$N_{\text{particles}}^2 \approx \frac{12\hbar^2 c^2}{c_1^2 T_{\text{Temperature}}^2}\Bigg/\left[\frac{16\pi G}{9}\cdot\frac{2\pi G\sigma^2}{c^4} + \frac{\Lambda_{\text{observed}}c^2}{3}\right] \tag{33}$$

Becomes smaller and smaller the higher temperature we have initially, and of course this is not viable in terms of applying Equation (31), and the problem becomes well a bit, ridiculous of there is no torsion term. *i.e.* we would be then be looking at N going way past 10^{120}, which is beyond the observed or expected entropy of the universe.

I.e. This is not going to go over well, and the only way to have a huge number of initial "particles" say of initial black holes and say gravitons from the black holes would be if we assume **Table 1** is for the initial Planckian regime to have low temperature values, which is NOT what occurs.

10. By Default, We Will Be Looking Then at Changing the Energy *E* to Being the Corda Value of Energy for a Black Hole, So Then We Will Be Looking at the Following, Namely

$$\frac{\left(\hbar\omega\cdot n_{\text{quantum number}}\right)^2}{12\hbar^2c^2\cdot\left[k_B^2N_{\text{particles}}^2\right]}-\frac{16\pi G}{9}\cdot\frac{2\pi G\sigma^2}{c^4}\equiv\frac{\Lambda_{\text{observed}}c^2}{3} \tag{34}$$

In effect what we would be doing as to Equation (32) would be to state via Equation (2) and energy input into Equation (34).

But the term n (quantum) comes from a Corda derived expression as to energy level of relic black holes [6] after Planckian space time normalization using Equation (27) into the frequency of Equation (34).

The term ω is here presumably Planck frequency, which is of the order of 6.62607015×10^{-34} joule-hertz^{-1} (or joule-seconds) or 3 times 10^{42} Hertz.

We are presuming that in doing so that this is a GW frequency for initial relic GW, from this process.

11. Modeling Challenges Which This Presents, and Future Investigations

First what are the particle N term and the quantum n terms used in Equation (36)? This needs to be explicitly worked out.

Secondly, assume the following, namely from [1] of the following values:

Our timing as to Equation (34) is to unleash a Planck time interval t about 10^{-43} seconds.

As to Equation (34) the creation of the torsion term is due to a presumed particle density of

$$n_{Pl}\approx10^{98}\ \text{cm}^{-3} \tag{35}$$

Finally, we have a spin density term of

$$\sigma_{Pl}=n_{Pl}\hbar\approx10^{71} \tag{36}$$

Would this spin density term be commensurate as to Gravitons as to a BEC condensate? This is the sort of detail which has to be worked out in future modeling of this problem.

12. Now to Include in the Overview by the Referee. FTR; While Outlining Further Research Requirements

The referee specifically delineates in [12] [13] and [14] with this quote.

Quote

There are other papers in which it is pointed out that the torsion term (quoted often by Bekenstein) can indeed give rise to a residual Cosmological constant term of the observed magnitude. This has also been used to generate inflation. For instance see Open Astronomy Journal, 5, 7-11, 2012 and arxiv/0801.1218 (astro-ph), 2008. Here, clearly it is derived that the G × sigma^2/c^4 gives rise to the

lambda term observed. In both references the spin density is shown to be universal for all celestial bodies.

End of quote

We of course delineated spin density via primordial black holes, and it may be useful as to review further more phenomenological data set opportunities as to try to verify the existence of primordial black holes as a contributing factor to the spin density. It is recommended that follow-ups to this document adhere to the necessity of finding equipment and data analysis protocols as to verify this final step and to make it adhere in terms of the phenomenology as well as further intersections with instrumentation requirements which could delve into how to acquire requisite data sets which confirm this suggestion. In addition this will by necessity go into the matter of experimental verification, via data sets of our supposition of gravitons being BEC condensates.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

[1] de Sabbata, V. and Sirvaram (1991) Quantum Effects and the Problem of Cosmological Constant. In: In: Zichichi, A., de Sabbata, V. and Sachez, N., Eds., *Gravitation and Modern Cosmology, the Cosmological Constant Problem*, *Ettore Majorana International Science Series* (*Physical Sciences*), Plenum Press, New York, Vol. 56, 19-36. https://doi.org/10.1007/978-1-4899-0620-5_4

[2] Beckwith, A. (2022) New Conservation Law as to Hubble Parameter, Squared Divided by Time Derivative of Inflaton in Early and Late Universe, Compared with Discussion of HUP in Pre Planckian to Planckian Physics, and Relevance of Fifth Force Analysis to Gravitons and GW. In: Frajuca, C., Ed., *Gravitational Waves - Theory and Observations*, lntechopen, London, UK, 1-18. https://www.intechopen.com/online-first/1125889

[3] Beckwith, A. and Ghafoor, Q. (2023) Using Model of a Universe as Similar to a Black Hole, Ask If We Have to Have Singularities, If We Are Looking at Initial Time Step and Entropy, from the Beginning. *Journal of High Energy Physics, Gravitation and Cosmology*, **9**, 708-719. https://doi.org/10.4236/jhepgc.2023.93058
Cheng, T.-P. (2008) Relativity, Gravitation and Cosmology, a Basic Introduction. Oxford University Press, United Kingdom. https://doi.org/10.1093/acprof:oso/9780199573639.001.0001

[4] Corda, C. (2023) Black Hole Spectra from Vaz's Quantum Gravitational Collapse. 11 p. https://arxiv.org/abs/2305.02184

[5] Poplawski, N.J. (2009) Spacetime and Fields. arXiv:0911.0334

[6] Sciama, D.W. (1964) The Physical Structure of General Relativity. *Reviews of Modern Physics*, **36**, 463. https://doi.org/10.1103/RevModPhys.36.463

[7] de Sabbata, V. and Gasperini, G. (1989) Introduction to Gravitation. World Scientific, Singapore, Republic of Singapore.

[8] Wesson, P. (2006) Five-Dimensional Physics: Classical and Quantum Consequences of Kaluza-Klein Cosmology. World Press Scientific, Singapore, Republic of Singa-

pore. https://doi.org/10.1142/6029

[9] Padmanabhan, T. (2006) An Invitation to Astrophysics. World Press Scientific, World Scientific Series in Astronomy and Astrophysics, Vol. 8, Singapore, Republic of Singapore. https://doi.org/10.1142/6010

[10] Hu, Y.Z., Li, M., Li, N. and Zhang, Z.H. (2015) Holographic Dark Energy with Cosmological Constant. *Journal of Cosmology and Astroparticle Physics*, **8**, 012. arXiv:1502.01156
https://doi.org/10.1088/1475-7516/2015/08/012

[11] Chavanis, P. (2012) Self Gravitating Bose-Einstein Condensates. In: Calmet, X., Ed., *Quantum Aspects of Black Holes. Fundamental Theories of Physics*, Springer Nature, Cham, Switzerland, Vol. 178, 151-194.
https://doi.org/10.1007/978-3-319-10852-0_6

[12] Sivaram, C. and Arun, K. (2012) Primordial Rotation of the Universe, Hydrodynamics, Vortices and Angular Momenta of Celestial Objects. *The Open Astronomy Journal*, **5**, 7-11. https://doi.org/10.2174/1874381101205010007

[13] Sivaram, C. and Arun, K. (2012) On a Minimum Column Density for Massive Star Formation. https://arxiv.org/ftp/arxiv/papers/1205/1205.4623.pdf

[14] Sivaram, C. and Arun, K. (2009) A Brief History of Dark Energy. *Astrophysics and Space Science*, **319**, 3-4. https://arxiv.org/abs/0809.3364
https://doi.org/10.1007/s10509-008-9952-y