Preprint: 2022 IOP JPCS - The Vigier Centenary Third Regime Natural Science Toward a Physics tf The Observer
12th International Symposium Honoring Noted Mathematical Physicist Jean-Pierre Vigier

Relativistic theory of gravity with variable gravitational constant (*Relativistische Gravitationstheorie mit variabler Gravitationskonstante*[1])

Pascual Jordan[2]

University of Göttingen[3]

Richard L. Amoroso (Trans)[4]

Noetic Advanced Studies Institute
Escalante Desert Research Station
Beryl, UT 84714 USA

amoroso@noeticadvancedstudies.us

Abstract. Dirac's idea, that the gravitational constant is in fact not constant, but subject to slow changes during cosmological evolution is explored. The task is to generalize Einstein's general theory of relativity in such a way that, *K* is no longer a constant, but is treated as an additional (scalar) field quantity. The 5D or projective theory of relativity, founded by Kaluza and others, is recognized as a suitable basis.

Translators Forward. This issue of IOP JPCS provides the 1st English translations of the three 1946, 1947, 1948 Jordan papers important in development of Field equations for the Kaluza hypothesis. Pascual Jordan was a well-known German theoretical physicist who is one of the founders of quantum mechanics and quantum field theory. Together with Max Born and Werner Heisenberg, Jordan coauthored an important series of papers on quantum mechanics [1,2]. He went on to pioneer early quantum field theory. In 1933 Jordan joined the Nazi party, if he had not done so; it is likely he would have won a Nobel Prize in Physics for his work with Max Born, who in 1954 with Walther Bothe.

Relativistic theory of gravity with variable gravitational constant
As is well known, Dirac has brought forth the idea, that the gravitational constant[5]

---

[1] Jordan P 1946 *Relativistische Gravitationstheorie mit variabler Gravitationskonstante*, *Naturwissenschaften* **33,** 250–251; https://doi.org/10.1007/BF01204481
[2] Pascual Jordan 18 October 1902 – 31 July 1980
[3] University of Göttingen (*Georg-August-Universität Göttingen*) Jordan earned his doctorate studying under Max Born.
[4] This work of translation generally adheres to literal meaning as stated by the author.
[5] In contrast to Einstein's constant, $\kappa = 8\pi G / c^2$.

$$K = \frac{8\pi f}{c^2} \tag{1}$$

is in fact not constant, but subject to slow changes during cosmological evolution. If you take those thoughts seriously, the task arises, to generalize Einstein's general theory of relativity in such a way that, K is no longer a constant, but is treated as an additional (scalar) field quantity. I tackled this task in an investigation carried out in 1944 [3]. The 5D or projective theory of relativity, founded by Kaluza and further worked on by Veblen and many other authors, was recognized as a suitable basis.

In the previous theory of the vacuum field, we have 14 field elements, namely 10 gravitational potentials g_{kl} and 4 electromagnetic potentials Φ_k. So now we are looking for a theory with 15 instead of 14 field elements, and the projective relativity theory yields 15 field elements of itself, namely 15 components of a metric

$$g_{\mu\nu} = g_{\nu\mu} \tag{2}$$

with $\mu, \nu = 1, 2..., 5.$ One could therefore only succeed through this use of $K = \text{const}$ for the previous theory, that in an artificial, unnatural way the constancy of one of the $g_{\mu\nu}$ and the projective coordinates X^μ formed scalar quantities

$$j = g_{\mu\nu} X^\mu X^\nu \tag{3}$$

as a secondary condition independently of the field equations. If one drops this additional requirement, one automatically gets a theory with variable

$$K = \tfrac{1}{2} J c^2. \tag{4}$$

In the meantime, these investigations have been pursued further. Together with C. Müller, the new field equations were discussed and applied to cosmological models [4]. The result is that the cosmological ideas were developed by me from completely different points of view [5]. The mathematics for the projective relativity theory extended by $J \neq \text{const}$ has been further investigated. Original evidence of the main formalism was based on a generalization presented by Pauli [6] for the special case $J =$ const; some of which were very complicated and cumbersome. Very simple proofs have been found by G. Ludwig, who was able to completely extend the relationship between the 5D and 4D curvature tensor developed by Pauli for $J =$ const to $J \neq$ const. (My own investigation was limited to the tapered curvature tensor) I have just found a different surprisingly simple demonstration.

Hopefully, parts of this investigation can be published soon [7]. A coherent overall presentation in book form is in preparation. The relationship between the theory and the detailed affine field theory carried out by Schrödinger in recent years will also be discussed.

Göttingen, Pasquale Jordan.
Received: November 15, 1946.

References and notes

[1] Born M Jordan P 1925 Zur Quantenmechanik *Zeitschrift für Physik A Hadrons and Nuclei* **34** 1
[2] Born M Heisenberg W Jordan P 1926 Zur Quantenmechanik. II *Zeitschrift für Physik A Hadrons and Nuclei* **35** 8-9, 557–615; https://doi.org/10.1007/BF01379806
[3] Jordan P 1945 Gravitationstheorie mit veränderlicher Gravitationszahl *Physik Zeitschr* (proofs); Gravitation theory with variable gravitational constant

[4] Interessante Hinweise betreffs der Folgerungen aus den neuen Feldgleichungen verdanke ich ferner Herrn Heckmann; Interesting note regarding the implications of the new ones, I also owe thanks for field equations to Prof. Heckmann.
[5] 1944 *Physikalische Zeitschrift* **45** 183 45.
[6] Pauli W 1933 *Ann. d Phys.18, 305, 337*; Google Scholar
[7] Eine gruppentheoretische Aufklärung über den Sinn der projektiven Relativitätstheorie erschien Göttinger Nachr 1945, Seite 74. A group theoretical explanation of the sense of the projective Relativity theory appeared in G6ttlnger Nachr. 1945, page 74.