

Gunnar Nordström, 1881 - 1923

Christofer Cronström
Division of Theoretical Physics, Department of Physical Sciences,
University of Helsinki, Helsinki, Finland

Abstract

A short biography of Gunnar Nordström, with comments on his principal scientific works is given in this article.

1 Biographical data

For my presentation of Nordström's biographical data I draw mainly on an article by H. Tallqvist [1], an article by E. Isaksson and R. Keskinen [2] and a paper by E. Isaksson [3]. This last reference also contains a list of publications by Nordström. For background material the book "Subtle is the Lord..." by A. Pais [4] has been invaluable.

Gunnar Nordström was born on March 12, 1881. Nordström's parents were professor Ernst Samuel Nordström and his wife Alina Sofia Hirn. In 1899 Nordström started to study mechanical engineering in the Polytechnical Institute (nowadays the Helsinki University of Technology) and obtained the degree of Master of Mechanical Engineering in 1903. He continued his studies immediately at the University of Helsinki, where he obtained the degree of Master of Science in 1905.

The next year 1906 - 1907 Nordström spent in Göttingen, aiming initially at specialising in physical chemistry. Apparently he was soon caught up in studying current issues in theoretical physics such as electromagnetism, since already in 1908 he defended his doctoral dissertation "Die Energiegleichung für das elektromagnetische Feld bewegter Körper" at the University of Helsinki. Among the references in this work one finds such names

as Lorentz, Abraham, Cohn and Minkowski but not yet Einstein. However, already next year Nordström published an account of Einstein's special theory of relativity using the four-dimensional formulation of Minkowski in the Proceedings of the Finnish Society of Sciences and Letters [5].

In 1910 Nordström became a docent in theoretical physics at the University of Helsinki; the first person to occupy such a position at the university. The summer of 1911 Nordström spent again in Göttingen. In the following years Nordström worked mainly on relativistic theories of gravitation obtaining an in many ways satisfactory scalar theory of gravitation, the first version of which was published in 1912 and 1913 [6], [7] to be followed by an improved version later in 1913 [8]. This work caught the interest of Einstein, who gave a full account of Nordström's theory at the meeting Naturforscher-Versammlung in Vienna in 1913 [9], in his plenary lecture on relativistic theories of gravitation. Nordström was present at this meeting, and became something of a celebrity as a result of Einstein's presentation. The rest of the summer Nordström spent in Zurich at the ETH. The meeting between Einstein and Nordström in Vienna led to a friendly and cordial relation between the two men¹, which lasted till the untimely death of Nordström in 1923.

The second major contribution of Gunnar Nordström concerns the unification of his scalar theory of gravitation with electromagnetism, which Nordström achieved by adding a fifth dimension to four-dimensional space-time and by requiring that the mass-distribution of matter be independent of the fifth coordinate [10]. This represents a genuine unification of gravitation and electromagnetism, and is a precursor to later works of Kaluza [11] and Klein [12], who considered a similar construct for the case of Einstein's tensor theory of gravitation. Nordström published two more papers [13], [14] on his unification scheme, but these were apparently not widely read. Anyway, Nordström's important contribution was not recognised at the time, and the unification based on introducing a fifth dimension has become known as the Kaluza-Klein mechanism. Only comparatively recently, in the monograph "Modern Kaluza-Klein Theories" [15], did Nordström's contribution get well-deserved recognition. This monograph contains a historical introduction to the subject and a reprint of Nordström's first article as well as a translation of that article into English.

¹I am indebted to Mrs. Saga Johansson, daughter of Gunnar Nordström, for a clarifying discussion on this point.

A comprehensive discussion of Nordström's scalar theory of gravitation as well as of his unification scheme is given also in the contribution by F. Ravndal in these Proceedings [16]. I will, therefore, refrain from a technical discussion of these items below, but will subsequently return to the question of possible reasons why Nordström's work on unification did not receive appropriate recognition at the time of its publication or shortly thereafter.

In the summer of 1914 Nordström was again in Vienna and later in Berlin, and managed in the nick of time just before the outbreak of World War I to travel to Leiden, where he spent the next few years. Nordström had a grant from the University of Helsinki, which was intended for three years abroad, which Nordström spent at Leiden in Holland during the years 1916 - 1919. The years in Leiden with Lorentz and Ehrenfest were apparently quite fruitful for Nordström, who also had occasion to meet with Einstein during his visits there. In Leiden Nordström met his future wife, Cornelia van Leeuwen, who was a student of Ehrenfest. They were married in 1917, and had three children, one daughter and two sons.

In Leiden Nordström mainly worked on questions related to Einstein's gravitation theory. The first paper, in 1916, appeared in Dutch and later in English under the title "Einstein's Theory of Gravitation and Herglotz's Mechanics of Continua" [17]. The most widely known paper from that period is undoubtedly Nordström's contribution [18] to the elucidation of the geometry of a spherically symmetric charged mass distribution, known under the name of the "Reissner-Nordström metric". This is nowadays interpreted as the space-time of a non-rotating charged black hole.

In 1917 Nordström was invited to become "Professor Extraordinarius" in Berlin. This shows that Nordström was highly esteemed by his contemporary scientists; it is for instance hardly possible that such an offer could have been made without the knowledge and consent of Einstein. However Nordström declined this offer, and the extraordinary professorship was eventually offered to, and accepted by Max Born. In connection with a correspondence with Einstein in the summer of 1918 related to a trip by Nordström and his wife to Finland [19] Born comments on this in the following words "*I only found out later that he [Nordström] had been my strongest competitor for the Berlin Extraordinary Professorship*". The relevant passage of one of the letters in this matter from Einstein also deserves to be quoted:

“Dear Born.

It is very kind of you to look after the Nordströms. Just write to the general Staff that Nordström has already been granted a permit for the outward journey, at Haber’s request [which Einstein had earlier secured from Haber]. Then the return journey will be readily allowed. As I wrote to you before, he has to be back at the beginning of August”.

At that time Finland was a Grand Duchy in the Russian Empire, and Nordström travelled with a Russian passport, which created bureaucratic difficulties in wartime Europe. In 1918 Nordström was appointed professor of physics at the Polytechnic Institute in Helsinki (later the Helsinki University of Technology), a professorship which he in 1920 exchanged for a professorship in mechanics at the same institute.

In Finland Nordström continued to publish both textbooks and popular articles as well as scientific papers; his last major paper related to general relativity was entitled “Über das Prinzip von Hamilton für materielle Körper in der allgemeine Relativitätstheorie” [20]. In 1922 Nordström was elected member of the Finnish Society of Sciences and Letters but his time in the Society became rather short. Gunnar Nordström died after a lengthy period of illness in December 1923.

2 Epilogue on the 5th dimension

It has been clear, at least since the publication of the monograph “Modern Kaluza-Klein theories” [15], that Gunnar Nordström’s paper [10] on the unification of his scalar theory of gravitation with electromagnetism has not received the recognition it deserves in the scientific literature. Such things happen, and were it not for the fact that a somewhat obscure reason for this has been put forward as a (partial) explanation of this circumstance in [15] it would perhaps be unnecessary to dwell on this matter further. I refer to Ref. [10] in the monograph [15], which is a private communication by S. Chandrasekhar indicating that a reason for the lack of recognition of Nordström’s unification paper might have been a lack of cordiality between him and Einstein. Even if there would have been such a lack of cordiality, it is hard to believe that Einstein would have suppressed Nordström’s work on unification for such reasons. Such a behaviour is simply not compatible with existing testimonies of Einstein’s character. The “lack of cordiality”

referred to is in fact not substantiated². On the contrary, there is evidence that the relation between Einstein and Nordström was indeed most cordial. Just to mention a few documented facts: Nordström would hardly have been invited to become “Professor Extraordinarius” in Berlin in 1917, if Einstein had not held him in high esteem. Furthermore, the concern that Einstein expressed for Nordström’s travel difficulties in 1918, which have been detailed above, and documented in [19], also speak of cordiality and not the lack thereof.

The simplest explanation is frequently the most appropriate. Nordström’s paper “Über die Möglichkeit, das elektromagnetische Feld und das Gravitationsfeld zu vereinigen” [10] was published just at the outbreak of World War I, and may for this reason alone not have received full attention. His further communications on the unification [13] and [14] were published in Finland in 1915 and may also have had little impact. It is known that Einstein was intensely interested in the unification issues already at the time of Nordström’s first paper. It is also known that Einstein (for good reasons) at the same time was intensely occupied with developing the tensor theory of gravitation, which he completed at the end of November 1915 [21]. Under these circumstances he apparently did not pay much attention to Nordström’s unification which involved the *scalar* theory of gravitation. When Kaluza in 1919 proposed a unification of electromagnetism with Einstein’s tensor theory of gravitation, the manuscript was forwarded to Einstein for refereeing. Einstein’s reaction to Kaluza’s manuscript, which was published in 1921 [11], is on the record. The following is a quote from the letter in question from Einstein to Kaluza [22]: “*The idea of achieving [a unified theory] by means of a five-dimensional cylinder world never dawned on me. ... At first glance I like your idea enormously*”.

“Never dawned on me...” This means that the idea of unification by means of a fifth dimension was a complete surprise and novelty to Einstein in 1919. He was simply not aware of the precursor to unification by means of an extra fifth dimension which Nordström had published already in 1914. Subsequent workers in the field took up the thread from Kaluza’s paper, and did not search the literature for earlier work. Such things happen. Lack of awareness of Nordström’s work (for understandable reasons), rather than any “lack of cordiality”, thus provides the most likely explanation of why Nordström did not receive the recognition at the appropriate time for his work on unification that he undoubtedly deserved.

²I am indebted to Professor P. G. O. Freund for a clarifying discussion on this point.

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