In Memoriam — Ignjat Nikolić

Dear colleagues, dear guests,

Today, at this ceremonial meeting of the Institute of Physics, we have gathered to recall the memory of our colleague, researcher, and dear friend Dr. Ignjat Nikolić. These memories help us not only to see more clearly who Ignjat was and how he lived and worked, but also to reflect once more on our own community, on ourselves, on where our lives are going, and on how we can influence them.

I first met Ignjat in the late 1970s, when he was working on his diploma thesis in physics under the supervision of the late Professor Djordje Živanović, who at that time was teaching the course *Gravitation* at the Department of Physics, Faculty of Science and Mathematics, University of Belgrade. The topic of that thesis was whether gravitation could be constructed as a field theory in flat spacetime, as is the case with the other fundamental physical interactions (weak, electromagnetic, and strong).

Relying on the ideas presented in the works of S. Deser (1970) and R. Feynman (1960/61), Ignjat showed that gravitation is essentially different from the other fundamental interactions: any attempt to formulate it in flat spacetime leads to an inconsistent theory, one that produces an error of about 30% in predicting the perihelion shift of Mercury. Even more interesting was his further analysis, which showed that the source of this inconsistency lies in the nonlinearity of the gravitational interaction—that is, in the fact that the gravitational field generates itself (unlike, for example, the electromagnetic field). Ignjat then demonstrated how this theory could be corrected by taking its nonlinearity into account. The result of this analysis led to a somewhat unexpected conclusion—a theory coinciding with Einstein's theory of gravitation. Thus, at the very beginning of his research career, Ignjat achieved a deep understanding of the nature of the gravitational interaction, entering this fascinating field fully prepared for the challenges that awaited him.

At that time, research in gravitation within our community was at a kind of turning point. Already in the late 1960s, gravitation had found a place here through the interest of individual researchers (Djordje Živanović, Zvonko Marić) in the fundamental questions of constructing a consistent classical and quantum theory of gravitation. In the mid-1970s, a regular course in the theory of gravitation was introduced into the physics curriculum, another serious step toward reviving research in this area. Yet, it still took another five or six years for these activities to reach the next level—research closely linked with contemporary developments worldwide. From the very beginning, Ignjat was part of this process. He became a member of a group of researchers (Djordje Živanović, Dragan Popović, Ignjat Nikolić, and myself) that spontaneously formed in the late 1970s with the goal of engaging actively in the study of gravitation. Every Friday we held joint seminars, attempting to grasp the modern problems of gravitation. Out of these seminars came our first joint paper, published in 1981. Based on his contribution to that work, Ignjat defended his master's thesis. A new scientific discipline was thus born in our community, and Ignjat played a significant role in that process.

These events were also very important to me personally. Like Ignjat, I had developed a strong interest in gravitation during my studies. My diploma thesis, defended under Marko Leko, professor of gravitation in the Department of Mechanics in the late 1960s, dealt with relativistic cosmology. But to truly enter the field of gravitation, I had to wait about ten years. When it finally happened, in 1981, the next step was quite natural: Ignjat continued working on his doctoral dissertation under my mentorship, which suited both his and my interest in advancing our studies of gravitation.

Our further research was devoted to the so-called Poincaré gauge theory of gravitation, which originated in the 1960s and developed significantly over the following two decades. This line of research arose from attempts to construct an alternative theory of gravitation, in the hope that it might overcome some of the weaknesses of Einstein's theory (the existence of singularities and the

impossibility of quantization). After several joint papers, which further strengthened our research confidence, Ignjat came very close to fulfilling the requirements for his doctoral defense. At that time, he tackled a problem that crowned his research efforts of that period: the problem of formulating a local theory of gravitation so that its geometric structure would come fully to light. He began this work in Belgrade, completed it during his stay in Princeton, and published it in the well-known journal *Physical Review D* (1984). The preprint version had about 50 pages, and Ignjat was very proud of it, as he had done it independently, later receiving significant recognition and citations for it.

Ignjat continued his research in gravitation for another two or three years, publishing several papers, but afterward his activity shifted to other pursuits. Like many of us, he became engaged in applied research in order to earn the means to buy a home for himself and his family. He took this obligation more seriously than many of us, because he had lived with an illness since high school. He knew he had to secure basic living conditions for his family in time, before the illness prevented him from doing so. Fortunately, he succeeded.

In the late 1980s and early 1990s, Ignjat returned to research in gravitation, publishing several excellent papers on his own. These works are of even greater value from a human perspective, once we realize they were achieved under the heavy burden of illness. By the mid-1990s his illness had become more pronounced, preventing him from doing the work he loved and knew best. In 1998 I spent a short time in Cologne, Germany, with Professor Friedrich Hehl (who knew Ignjat). In our conversations I learned that there was a problem in the teleparallel theory of gravitation that had remained unsolved since 1981. With considerable experience in gravitation, it seemed to me that, with the methods we in Belgrade were familiar with, the problem could be solved. It was a problem too difficult to tackle alone, and the methods required were exactly those in which Ignjat was an expert. So I thought it would be good to work on it together. But he was seriously ill, and I wondered whether, under those circumstances, he still cared about gravitation at all, and whether it made sense to propose it to him. It turned out I was wrong. He accepted the suggestion with pleasure, and together we completed the work, publishing it in *Physical Review D* (2000). That was our last joint paper.

When we think about those who are no longer with us, we become more aware of the human and professional roles they played in our lives. Behind such reflections there usually lies the thought of the inevitability of human mortality, and this thought helps us to face our daily lives sincerely and openly—to think about ourselves, our community, and our profession, and to make decisions about our future. In this way, those who are no longer with us continue to live in our memories, as in the novels of the Irish writer James Joyce: they influence us, transform our relationship to the world in which we live and work, and help us to grasp more deeply the mystery of life.

Milutin Blagojević, Belgrade, June 2001