

MY LIFE WITH KACPER Z.*

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I met Kacper more than 60 years ago, a time so distant that one cannot expect my memory to reproduce the correct picture of these days. Also, as I am not a historian, I do not know how to search for relevant documents to make my story better grounded in facts. Therefore, you will hear only a strictly personal and, most likely, not very reliable account, based solely on my fragmented recollections. To some extent, I feel excused, however, as I am sure that some day, a competent historian will write a solemn biography of Professor Kacper Zalewski, one of the leading figures of the XX century Cracow physics.

We were both studying physics, Kacper one year ahead of me. I probably noticed him from a distance at times, but the first encounter imprinted in my memory happened when I was in the third year. That's when Kacper came to me and asked: how about playing chess? I said OK. Unfortunately, I do not remember where we played (most likely at the Palace "Pod Baranami" on the Main Square but I am not sure). What I do remember very well though, is the result: Kacper won three parties in the row. This has set our relationship forever: Since then, HE has been the master.

We met again sometime later at the theoretical physics seminar. At this point, a small explanation might be needed: after completing studies of physics, Kacper moved to the Institute of Chemistry to work under professor Gumiński (and actually completed also studies of chemistry). Nevertheless, he still considered himself a physicist and attended the theoretical physics seminar.

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Independently of this formal activity, we tried to learn something more “modern” and decided to form a small group to study the basics of quantum field theory, which — at that time — was not part of the standard student curriculum. Slowly, over time, attracting also younger colleagues, the group expanded, and more serious discussions about physics began.

This also led to a closer relationship. I became a frequent guest in his minuscule room at Krasiński Allee, and Kacper became part of our group of friends, mostly members of the Academic Sport Club. He was very well accepted, although it was not so obvious as you may think, because of one strange peculiarity: Kacper never touched any alcohol, in any form. As far as I can tell, he has been continuing this strange behavior until now. For all of us, this seemed almost inhuman. I was even spreading the gossip that — since no human being can survive without alcohol — he certainly must be drinking alone, when nobody watches. Strangely enough, this strict abstinence did not prevent Kacper from active participation in our foolish and sometimes crazy entertainments.

As anybody who happened to meet Kacper knows very well, he is an incredibly gifted man. He can learn anything in no time and his memory is legendary. I recall that one day, not long ago, he told me that when he reached the age of 40, he realized, to his great dismay, that after reading a page of a book he is not able to repeat it immediately by heart anymore! Let me remind you that at that time there was neither Google nor Wikipedia. You can understand that having Kacper around was really very, very handy.

Sometime in 1960, the announcement of the Les Houches Summer School appeared at the Institute. This was an entirely abstract dream for us but it gave us an idea. Although we certainly couldn’t go there, perhaps we could organize something like that ourselves. My wife, being earlier the treasurer of the university sport club, and thus having an experience with the central university administration, immediately realized that we might even obtain some support from the Rector. This was the beginning of Zakopane Summer Schools. The following year, ten youngsters, accompanied by Zygmunt Chyliński, our unforgettable, charismatic teacher, went to the mountain hut at Turbacz and spent more than a week lecturing and learning. Kacper was talking on the CBS theory of superconductivity. I was talking on cosmology. This shows that we were still very far apart in our physics.

Following year, Kacper went to Oxford to study theoretical chemistry under the supervision of the famous professor Coulson. That freezed our contacts for some time. I hope you realize that the Internet did not exist and that letters to and from Britain took at least two weeks one way, as the censors needed time to control the correspondence.

One important thing happened at this first Summer School. At some point, Zygmunt Chyliński suggested that we should get in contact with Professor Mięslowicz. At that time, I had hardly even heard anything about Mięslowicz or about his work and activities (he was a professor at AGH, I was employed at the university). It thus took some time before we decided to follow the advice of Zygmunt. The decision was taken during a short discussion at Kacper's place, after his return from Oxford. I remember very well that moment which turned crucial for our future lives.

We went to the Mięslowicz seminar and this indeed has changed everything. To make a long story short, let me just say that we got in contact with the exciting, first class physics *in statu nascendi*. At that time, the group was measuring the multi-particle production in nuclear emulsions and we immediately joined the everyday discussions of the emerging problems.

This, of course, made our relationship even closer although, as far as I remember, we still did not really work together. Kacper tried to approach the multi-particle processes from the point of view of statistical physics, which he knew very well. He actually published two papers on this subject. I was publishing some papers on general relativity but I was still unable to produce anything on high-energy physics. My only activity was talking, arguing and shouting at the seminar and at the coffee table in the basement of the AGH A0 building.

One should add that, although his main interests were now in high-energy physics, Kacper was still employed at the Institute of Physical Chemistry of Polish Academy of Science and thus, he felt obliged to produce something also in this area. He approached this problem in characteristic for him, simple and methodical way: He collected a list of interesting but not too difficult questions in the area of physical chemistry, put them in his notebook and was solving them regularly, at a constant rate, just enough to satisfy the requirements of the Institute bureaucracy.

In 1963, Professor Mięslowicz decided to send me to CERN. This was, of course, a great chance but also a great challenge for (at least) two reasons. First, my knowledge of high-energy physics was still very poor. Second and more important, my English was below any acceptable level. I could read physics, of course, but I was unable to communicate. Kacper came to the rescue: he gave me a series of lessons (being born in a good, traditional family, he learned French and English in his cradle and — remember — he also spent one year in Oxford). This really saved me, allowing to pass the exam in front of the ministerial commission in Warsaw and to start intensive work when I arrived at Geneva.

I stayed at CERN for two years and during that time we exchanged letters regularly. I still have carbon copies of all my letters to Kacper. I had to keep a copy of every letter because the answer was coming at best after one month, and my memory was simply not good enough.

I came back to Cracow and very soon Kacper went to CERN, so that our contacts remained restricted. I do not remember what he was doing during that time, as I myself was very busy in applying the quark model to the spin structure of the two-body processes. Together with Adam Guła and Bogdan Muryn we published calculations indicating that the quark structure of colliding particles may have something to do with the observed spin relations. The agreement with data was at best qualitative, however. Actually, soon after our paper appeared, a young physicist from Antwerp, Frans Verbeure (later a good friend of mine) published a well-documented paper, showing that the model apparently does not work, although the deviations were not dramatic. At that point, we were stuck and I started to look for some other problem to work on.

Fortunately, just about that time Kacper came back from CERN and took one more look at our calculations. He found a certain symmetry, which allowed select relations that were expected to work. I still do not understand how he was able to cook up this prescription but the result was spectacular: all available data agreed with this prediction. The result turned out important because it supported the idea of quarks, which, at that time, was far from generally accepted. I still remember the seminar given at CERN by Gell-Mann where he was emphasizing strongly that quarks are merely tools to simplify calculations but by no means should be treated as real objects. Therefore, our paper stirred some interest. But the real triumph came somewhat later at the European Conference in Lund (1968) when the rapporteur on this subject, David Jackson, himself the author of the dominating, absorption model for the two-body reactions, showed the brand-new, very precise data from Berkeley, the best in the world at that time, which followed exactly our predictions. That was really the great moment.

Of course, we continued working on the quark model. Our group published several papers and suggested also some experimental searches. I dare say that we became “famous”. Harry Lipkin even jokingly quoted our works as being done by a group from the JaGell-Mannian University at Quarkov. These were indeed the golden days.

At this point, I have to quit the description of the quiet life of two physicists because one great, although not entirely unexpected event changed dramatically the situation. One day in 1969, Kacper came to our apartment at Kremerowska and told us: Listen, I engaged. I must say that I almost fainted. My reaction was: Kacper it is almost unbelievable how precise you are: ten years ago, soon after my own marriage, you told me that, according to Plato, the best time for a man to marry is at 36! Kacper, always very exact, protested: I am only 35!

Let me add that for a long time we could not understand why Kacper was so immune to advances of all nice girls around. Our conclusion was that he apparently is not interested in anything but work. We were, of course, badly mistaken. All this time Kacper was simply searching for the best jewel. It took him some time to find Agnieszka, the real, true diamond.

These events had, of course, a great impact on our relationship. Fortunately, Ela and Agnieszka became friends and the necessary rearrangements went relatively smoothly. Our families became close and even related: Kacper is the godfather of our Wojtek and I am the godfather of their Andrzej.

As I already mentioned, we continued our studies of the quark model. Kacper moved to slightly more theoretical issues, working with Andrzej Kortański on the most convenient description of the spin properties of resonances. They were finally able to explain the physical origin of the symmetry discovered by Kacper (which made our relations work). He also worked with his students Adam Golemo and Paweł Gizbert-Studnicki on general formulation of the models for two-body processes.

Another change in Kacper's life took place in 1970. Professor Mięslowicz negotiated with Professor Kamiński the transfer of Kacper from the Institute of Physical Chemistry of the PAS to the Institute of Nuclear Research where the Mięslowicz group was located. Kacper could thus stop solving small chemical problems from his notebook.

Then came the tragic year of 1971. Two leading figures of the Polish experimental high-energy physics, Leszek Michejda from Warsaw and Oleg Czyżewski from Cracow suddenly died. Both at the age around 40. A terrible blow indeed. One should realize that the Cracow bubble chamber group was constructed and later fully relaying on the fantastic leadership of Oleg Czyżewski, incredibly gifted man in many respects. Kacper and myself, we were in shock. Perhaps I should add that we were discussing physics with Oleg almost daily, and he was at the origin of several papers we published together. Kacper, asked by Professor Mięslowicz, had to take responsibility for the group. To be the successor of such a great man as Oleg Czyżewski, was a real challenge. It must have been also a terrible burden, I imagine.

At about that time, we both became deeply impressed by the famous Feynman paper about partons, which gave a new life to the so-called inclusive reactions. Consequently, we started to look again more closely into multi-particle processes. At some point, we realized that multiplicity distribution encodes information about the multi-particle correlations. This led us to several investigations “translating” the traditional presentations of the multi-particle data into correlation parameters, and eventually allowed to prove that the dominant source of the observed positive correlations is the presence of the diffractive component of the spectra. This result, published together with Krzysztof Fiałkowski, allowed Krzysztof to later develop (together with Hannu Miettinen) the well-known two-component model that dominated the description of these phenomena for more than a decade.

Having a close relationship with the Mięslowicz group, we were naturally interested and puzzled by the idea of “fireballs”, the hypothetical objects characterized by isotropic decay into groups of particles. I remember very well that for some time, we have helplessly tried to find a way to look experimentally for the presence of such objects. We came one day to Professor Mięslowicz and told him about our problem. His immediate answer was: you should look into correlations. Indeed, based on this hint, we produced the relevant paper next day. Unfortunately, Professor Mięslowicz refused to sign the paper and thus we missed the opportunity to have a common paper with this great man.

Kacper, being now the leader of the experimental group, had to spend much time on organization of work, participating in experiments and also editing papers produced by the group. A look into SPIRES shows many papers of which I know very little and thus shall not bother you with. Let me just mention his interest in a fascinating problem of the space-time structure of the high-energy processes which he studied using data collected in experiments on the deuterium target.

For several years, our roads in physics became separated. Discovery of QCD allowed a more theoretical approach to the description of strong interactions and Kacper moved in this direction. This led him to study the physics of heavy quarks, the related sum rules and, naturally, the spin structure of these phenomena. He also studied the MIT bag model, in particular its chiral version. I was not able to follow this trend and thus I cannot say very much about Kacper’s activities at that time. Looking at SPIRES, I found, to my surprise, that he even published papers on strings! It documents his incredible abilities to learn new things and new ideas.

I should stress, however, that although we were not working on the same problems, I always treated Kacper as my mentor (remember the three chess parties which I lost on our first encounter) and thus I tried to consult with him any new idea coming to my mind. Kacper, being a very polite man,

never refused to listen, and only very rarely allowed himself to tell me that my idea is plainly stupid. The normal reaction was: “I am not sure I understand what you mean”. This way his sober mind saved me from many awful blunders.

The issue that gave us a chance to work together again was intermittency. This was theoretical enough for Kacper and thus he contributed several new ideas to this very strange phenomenon, which, for some time, dominated the studies of multi-particle processes.

In the mid-nineties, our friend Wit Busza from MIT got the idea of constructing a small, cheap experiment at Brookhaven, which would quickly measure the basic features of particle production in collisions at the highest available energy. Since the Cracow emulsion group was also involved in this experiment, we joined them in preparation of the letter of intent, with the idea that such measurements will be useful to test “intermittency”. I am not sure if our argument really did matter, but anyway, the experiment was accepted and actually turned out to be very successful. In result, we are both proud authors of the first paper produced by the PHOBOS Collaboration.

In the meantime, another issue took our attention. We started to look into the so-called HBT correlations exploring the effects of quantum statistics in the particle spectra. The measurements of these effects allow, as we all know, to study the space-time structure of the multi-particle system. Kacper provided a very elegant statistical interpretation of these observations and we used it for the search of possible phase transitions in the system. We continued the discussions of this subject for several years. Let me mention only one (last) result of our work. We showed that the available multi-particle data provide the experimental proof that, as expected, hadrons very close together in space do indeed melt into quarks.

This finally brings the story of my life with Kacper to the twenty first century. I think, I better stop here because my scientific activity slowed down considerably and I am not able to follow the work of Kacper closely enough. We rarely discuss physics now. But I would not like to leave you with the impression that intensity of my life with Kacper diminished in any way. On the contrary, I am now a frequent visitor at their home at Przegorzały, profiting from the well-known, excellent cuisine of Agnieszka and enjoying achievements of their children and grandchildren. In short, I am again receiving invaluable help and support from this wonderful family, which they were able to build over the years.

Let me finish by expressing my most sincere thanks to Agnieszka and Kacper for the long friendship, which — I do not hesitate to say — has shaped and continues to shape my life.