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Technology and Instrumentation in Particle Physics

Remembering Georges Charpak, Friend, Advisor and Great Physicist

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In 1961 before I was born Georges Charpak was working on particle detectors for applications in Nuclear Science, this led him to the 1968 invention of the multi wire proportional chamber that eventually led to the discovery of the drift chamber. He was very proud of these achievements but unlike the Geiger Counter or the Winston Cone neither carry his name which he thought was a good thing. However, for me the story with George starts with my first meeting him on his visit to Argonne National Lab in 1983 where I was participating in what today we call the REU (Research Experience for Undergraduate) program for students. His inspiring talk and subsequent discussions led me to start a written communication with him, not a snappy e-mail like today's communications but a real exchange of letters with some ideas. The next summer while a graduate student working on my MS degree at Ohio State University as part of a 3-2 program with a liberal arts college called Mount Union College, George invited me to CERN as his summer student. Little did I know that his newest detector idea which was being tested in a Proton Synchrotron beam line in the East Hall would become the hardware development topic for my Ph.D. thesis for which George was Co-advisor of my studies, and only one month after I defended my Ph.D. thesis studying heavy ion interactions on the Sulfur on Sulfur target in the WA93 experiment at the CERN's West Hall off the SPS using a set of these devices, George got the exciting call announcing his winning of the Nobel Prize in Physics in 1992. The stories and memories of George did not stop there but continued on for many years afterwards, with our last face to face meeting being in

1999 on my visit to Paris and then a few e-mail exchanges a year up until his death in 2010. Many of the stories are personal, others are scientifically insightful while other will remain between us.

I arrived at CERN in June of 85 and went to the main EP secretary office and George came down to pick me up and help me settle in. The group at that time consisted of Fabio Sauli who I had heard of but never met and a young post-doc Masayo Suzuki. The device they were working on was named the “light chamber” and was only 10x10 cm² small. The concept was to have an avalanche wire chamber and read it out with an image intensified CCD camera so that higher multiplicity events could be recorded. Eventually by the end of my Ph.D. thesis we would build 4 of these detectors 2x1 m² imaged by eight specialty CCD cameras, and this device would find application in bio-medical imaging applications. As with all new ideas we were groping in the dark to try and find a way to make it work since it had never been done before and there were technical challenges to achieve the needed resolution for the intended applications of high density tracking in heavy ion collisions being planned for CERN SPS program. The detector was already built and ideas were being tested to try out ways to improve it or at least make it work more reliably. A beam line in the East Hall off the PS was set up with a dark box and imaged intensified camera. I recall that George was there at all hours to help and see if it could work. As can be seen in the few photos I have found of that time he was tired but always encouraging to all working to help. My role changed from just a helper to something more significant when Masayo was hospitalized after an auto accident. In the end we got lots of nice images and showed the basic idea could work, but since the CCD readout was not randomly triggerable but had a TV synchronized readout causing the background levels changed from event to event. This would eventually be solved but it would take the combined effort of the Univ. of Geneva electronics group and a supportive company interested in the idea of a triggerable CCD, which was done by EEV (English Electric Valve). During that summer a few other ideas were tried out on other detectors but it was this project that was intriguing and the application of searching for new physics of the Quark Gluon Plasma was exciting. I do remember during that summer that I mentioned to George that it was exciting studying these ideas of particle detectors, but George took off his glasses as he always did before getting ready to make some far insightful comment and replied that he thought I would only be truly satisfied if I was aiming to do physics with detector, and in the end he was very correct.



Figure 1: George Charpak working in the PS test beam of the West Hall at CERN with the imaging detector prototype in the summer of 1983.

I returned the next summer and participated again on several new ideas and improvements to the light chamber. This time George insisted I take the desk in his office across from him, which resulted in many chat sessions about politics, life, troubles and fun ideas. The opportunity came up to stay at CERN and work on my Ph.D. partially with him and Prof. M. Martin as a student at the Univ. of Geneva. Eventually the phase of the project turned away from a small new idea development to expand it in size and faster readout. We eventually built a full size detector and tested it and then went into mass production for the four readout planes in one arm and it was this that became the charged particle tracking system of the WA93 experiment. During the technical developments as the detector became bigger and the real life limitations were being encountered that would stop us from doing physics with the device, George became less and less interested. We eventually overcame them and when needed George was present to help talk us through ideas towards a solution. However, when data from the experiment with lovely images started coming out George was thrilled to be present and take some of the images away with him to show off to friends. The WA93 data set with these tracking chambers was taken in 1990-1991

and the data analysis of first physics results for my Ph.D. thesis defense occurred in Sept. of 1992 just a month before he got the phone call about him receiving the Nobel Prize in Physics.

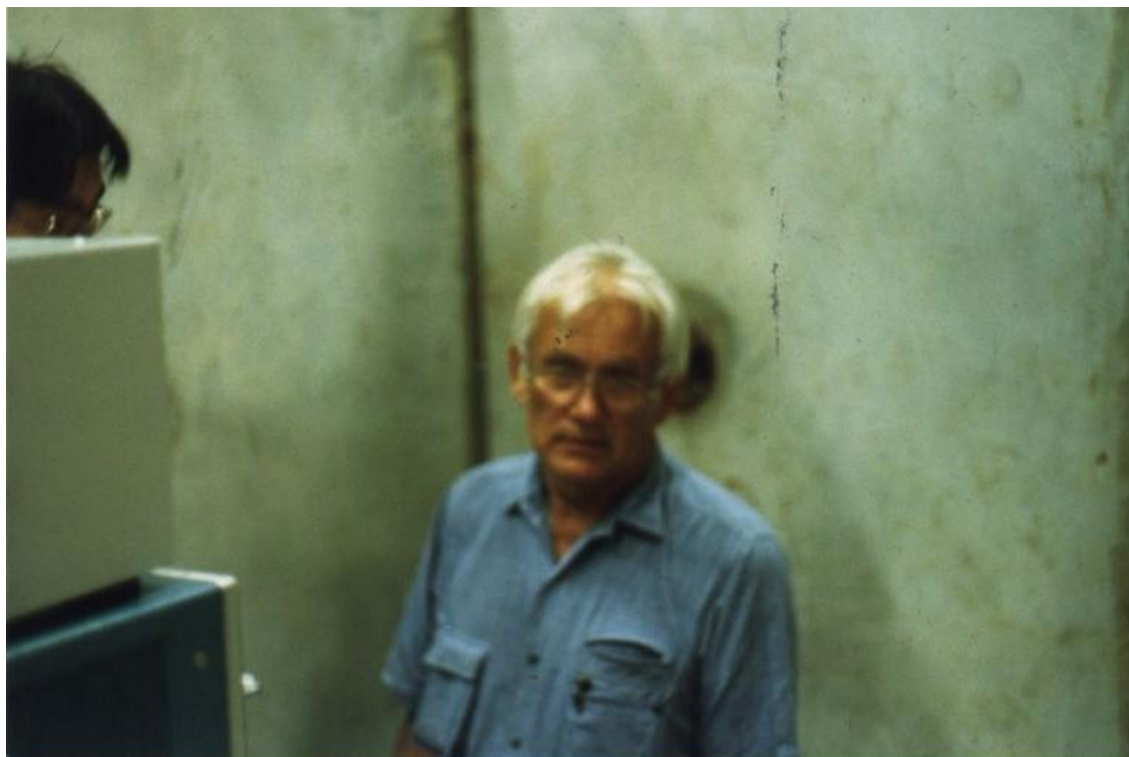


Figure 2: Georges Charpak in the early morning after an all night test beam run at the CERN PS T7 beam line of the West Hall at CERN, July 1983.

During this long time many other events occurred, wine shopping in Bourgone with George, the one year we waited in his office by the phone in October and the Nobel Prize committee did not call him and we went off to get a drink at the CERN bar, the phone call that came once from a New York reporter who accidentally phoned the wrong number 2330 instead of the Director General private number which was off by one number and this reporter expected to get the CERN director general, Carlo Rubbia, and George tried to pretend to be Carlo and also many other good memories. George also wanted to educate me about how Americans' see the world wrong, so he arranged that I would go to the Soviet Union and give a Physics seminar at 3 cities about the experiment being developed and the tracking chamber system. In his mind if more Americans became aware of the people within the Soviet Union there would be less chance for Nuclear war. We had constant visitors who needed help with their MWPC or Drift Chamber that would not work, and in the end the answer was always that the wire chamber had so many leaks that

air was getting in. One especially nice memory for me was George arranged that we would have lunch at the CERN main cafeteria with John Bell and talk some theoretical Physics, it was the shortest 2.5 hour lunch I ever had! The time flew by. Through George I met Tom Ypsilantis, Philippe Mine, David Anderson, Y. Giomataris, W. Dominik, D. Savage, D. Lamb, C. Rubbia, Abdus Salam, A. Breskin, P. Fonte, V. Peskov, L. Lederman and many more.

Upon finishing my Ph.D. degree George and I kept in touch, sometimes often and sometimes not with cycles but always at least twice a year by e-mails. I went off to the Univ. of Chicago to work on the gaseous Transition Radiation Detectors for KTeV, but also helped with the CsI calorimeter and debugging the tracking chambers; but I am most proud of the Hyperon system that I put together for KTeV which even N. Cabibbo took note of. I was the post-doc of Roland Winston of the Winston cone fame and this helped me feel comfortable at the Univ. of Chicago because Roland Winston was of an identical character and brilliance as George. Plus I even got to contribute to five papers on solar energy research with Roland's other none high energy physics efforts. I learned fast upon my arrival at the University of Chicago that there were people there who disliked George and had conflicts with him in the past, Bruce Winstein was very proud that he had asked George if he was ever going to do Physics (note not to be read is Bruce was aware that I was going to say this since I had written this after Georges death but before Bruce died). Looking back at George's career I would go as far as to say that George was a physicist, he worked on the CERN g-2 experiment, he used his new wire chamber and drift chamber to participate in experiments of rare K0 decays and the study of CP violation which resulted in a CERN yellow report in the 60s about Physics results from this experiment. When I first arrived at CERN George was always interested in what experiments needed, finding a way to help but was excited about the Physics itself. I remember when the cold fusion talk came to CERN, the room was full and all members of George's group showed up; right after the talk we all met in the hallway and discussed how the Physics seemed wrong by utilizing what physics they had presented during their seminar.

I went on to write a popular book that came out of my public lectures when I was Compton Lecturer of Physics at the University of Chicago. Many people helped me during the research for this book and George went out of his way when I needed to contact someone about certain timeframe material. George willing wrote a blurb for the back cover along with John Bahcall about how great the book "The Elusive Neutrino" was. Likewise when George was writing books in his retirement we often had discussions on some points he wanted to bounce off of someone. He arranged that I give the summary talk at the 2001

Vienna wire chamber conference, which was an honor for me to deliver since I knew George, thought that conference was the best one that reflected what he perceived to be his field of research expertise.

We had a few fights, the one that comes to mind was when I was the Physics Section Chair for arXiv.org and insisted that articles on detectors belonged in the Instrumentation and Detector section and not the hep-ex category, this was not a statement against him but solely a statement that Library science states that an article should be in the category which it belongs for organizational purposes. Also George was a strong advocate for Nuclear Energy and I was not because my own history is I grew up in Western Pennsylvania in the shadow of 3-mile Island when the crisis there unfolded when I was in high-school. However, I do have a suggestion that I think George would like if anyone from DOE is listening: In the 1940s President Roosevelt and Einstein proposed at the prodding of Fermi to start a crazy almost impossible project to build the nuclear bomb, and in May of 1961 50-years ago President Kennedy made a similar challenge that everyone thought impossible to put a man on the moon by the end of the decade; I propose to DOE to take a city of half-million people and by the end of the decade make it completely run off of renewable energy, capable of surviving without the grid electricity, no natural gas service and most cars running on renewable fuels. A lot of components to do this for electricity and heating exist but a lot would have to be invented to make it work, while other components for energy storage would have to be developed with intense R&D. Once we can demonstrate a city like this then man on this planet would be ready to face the real challenge of saving the planet, and this would be a dramatic step forward that we need to do, and that I feel is possible to do by 2020!

George and I last met face-to-face in 1999 when I was in Paris. I came to his condo near Notre Dame on the Seine river. We had a pleasant afternoon discussion and remembered the past. At that time he was well and still enjoying life. I will always remember him as a kind good man, great scientist and a true physicist.