BRUNO TOUSCHEK MEMORIAL LECTURES.

Giorgio Salvini : How it all started. Where is it going ?

December 9 , 2009 .

§1. **A change in the title.**

These memorial lectures point to the past. But it is important what Bruno Touschek could teach us even today in his tremendous capacity of looking forward. So I take the freedom to change the title of my little talk : it becomes "How all this started . Where is it going ?

I am indebted like you toward Bruno for the push he gave to Frascati , to us , to the world

§2. **After the war.**

I shall start from the years after the war , let' say from 1945 on. I was in Milan, coming back after three years of military service in our incredible war. Milan, when I arrived on September 8 1943 , was half destroyed . It is there that we learnt in 1945 of the nuclear bombs over Japan and the atomic energy development, as an important by product. Italy was divided in at least two parts, : Rome was less touched by the bombs , and was proceeding in physics . It is a great merit of the romans to have obtained remarkable results in neutron collisions and having obtained cosmic ray results, which at the end arrived to the historical Conversi Pancini Piccioni experiment (1947) . We in Milan started with CISE , a merit of Bolla, Salvetti, Salvini, Silvestri , with the ambitious idea to establish in Italy an atomic pile like Fermi did in the United States

You know the story : in a few years cosmic ray research and theoretical physics flourished , and the collaboration between all Italian centers and the universities brought our defeated country at a good level in physics research –

The fact I must underline is that we (I should mention many Italian physicists, but let me recall Gilberto Benardini, Edoardo Amaldi , Giuseppe Bolla and Giovanni Polvani) in Milan started to collect the best young scientists. We did not care of their actual preparation in science , but of their real capacity and decision and curiosity toward physics . This was not a difficult aim : it was a common thought that physicists and physis had win and closed the war, and scientists could now run the world.

So, physics and nuclear energy were the whip and lash to awake the country. Our attention concentrated on the new accelerating machines . We collected all our Italian possibilities in order to realize a nuclear machine which could compare with the similar initiatives already started in the victorious countries , France, England , United States . I think it was a rather magic moment: we had from all universities the best . In them there was a treasure of best people of potential value . We plundered the best with the help of intelligent teachers and generous altruistic chairmen. The war was out, and we did not pay much attention to the nationality and language .

§ 3. The arrival of Bruno Toushek.

It is during this period and these occasions that Bruno Touschek arrived to Rome (1952) . He was already known for his work in realising a betatron of 15 MeV with Wideroe (an original far sighted physicist that we should always remember) and for his intense direct interest in various problems of theoretical quantum physics . At his arrival at Gottingen (1946) , after dangerous years which included his serious danger to be killed by a Nazi soldier , he could diascuss and make programs with the best scientists, , including W. Heisenberg , .Becker , Von Weitzsacher. ,F.G. Houtermann .

In Rome he discussed general questions of quantum mechanics , but he was also attracted by the problems of the new accelerating machines. His first work in Rome was in collaboration with M. Sands , a visitor from the California Institute of Tecnology . This work is " Allignement errors in the strong focusing in synchrotrons (Nuovo Cimento , 1953) I quote it to underline that Bruno could alternate his capacity as a theoretical machine builder , and a physicist deep and critical in general problems of quantum mechanics . In 1952- 1954 he published papers with W.K. Burton, Chrisholms , Morpurgo , Cini, Radicati on Tao mesons and time reversal in quantized theories. It was a clear suggestion of Edoardo Amaldi and myself to arise in Frascati a real center of theoretical physics When the Frascati machine was near to be finished, we definitely prepared rooms for theoretical research

First we had Giacomo Morpurgo and Raoul Gatto , and very soon Touschek arrived with his first Laureandi , who were Nicola Cabibbo and Francesco Calogero . The theoretical group was definitely established in Frascati in the sixties, and we recall the great results which were obtained in the following years , to start from the "Bible" of Cabibbo and Gatto , and the work of Guido Altarelli , Mario Greco , Etim Etim, Giulia Pancheri (that we consider the Frascati theoretical Lady in these last thirty years) , and many others. One may have a better idea of these developments from the pages written by Vincenzo Valente , and from the comments of the coming speakers.

The school was very active and curious , and the problem " What next ?" became immediately very lively after the national success of the Frascati machine. We had intense discussions regarding our future and all ideas were accepted with interest. I must recall the very intense days when Touschek, with Calogero and others, underlined the tremendous interest of electron positron physics . It was a rather magic moment . It was decided (a merit of Giorgio Ghigo in particular) to make another small synchrotron (ADA) to study the annihilation processes .

Bruno was really excited. He first proposed to inject positrons in the synchrotron , and make of it the first e e ring.. The miracle of ADA shall be described to day by Carlo Bernardini , who can be considered one of the physicists which opened with ADA a new way to physics.

§ 4The successes in other places.

The merits of Toushek were largely appreciated, but he could not enjoy in Frascati the results from his brilliant anticipations . After the first success with ADA , Frascati was not ready to grasp the first results of $e^+ e^-$ rings , and we learnt from others (France, Russia) the immediate reality and importance of the vector mesons.

Touschek was very interested in general in matter – anti matter collisions, but I must say that his major interest was for e^+ e- collisions. The interactions of baryon were in his opinion more complicated and still rather obscure.

The Success of ADA produced the construction and use of ADONE. He dedicated himself to the problems (the teething problems) of Adone, and Amman has given us a good record of his contributes . But now I jump to his work in Geneva, at Cern, in the seventies.

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He was very interested on the possibility to transform the 300 GeV proton synchrotron of CERN in a proton-antiproton cumulative ring , and encouraged the studies of Altarelli and Carlo Rubbia since the beginning . This possibility was considered almost desperate by many persons. But it is remarkable that Bruno did encourage , at the end successfully , many audacious enterprises in physics. He encouraged us to establish the existence of W, Z bosons , and I think that with Glashow and T.D. Lee he had a first idea of what in the eightees (after his death) shall be called the Standard Model

§ 5. The activity in Geneva

When he came to Cern, in 1977, his health was not good . Still he started to work on the problem of preparing and maintaining in the best way the antiproton beam . Before reaching Geneva , Bruno had completed a paper (January 1978) He intended to compare it with the ideas of Van der Meer anf others; but this was not possible , due to his physical conditions . His last notes were not published in time . What remains is a posthumous publication " An analysis of stochastic cooling , Nota Interna LNF 79/6 R.

I think that the success in observing W , Z° can be in part dedicated to him . Of course, he could not see the decisive precise results of LEP, which came after his death. Picasso will recall the bridge from ADA to LEP with his beloved positrons. I am sorry he cannot be with us to day and any more. Please notice that he was one year younger than me.

We really would like to discuss with him to day the fundamental unresolved problems in front of us: what would he say of dark matter and the problem of the gravitational waves , still unobserved in our Earth ? And which experiment should we plan to help the problem of the origin and extension of the Universe ?

At this point, please allow me five minutes of free fantasy , as sometimes I dared , in my talks with him. After these five minutes I shall be back to this room , and become serious again.

§ 6 Five minutes of dream.

We are now in the year 2430 . We are more than 300 years far from our 2009 , as we are far three centuries now, from the time of Galileo Galilei, and his trial .

The XXII century (2100 – 2200) has been rather atrocious. . A good part of the atomic bombs accumulated by too many countries did explode, and many millions of men (Billions) have been killed . But since then until now immense progresses have come , and some new kind of wisdom started among the men of our planet. It seems that altruism and generosity is spreading, even without the necessity of a specific religion.

We can say that the need for energy is finished : we know now how to milk energy from the Sun and other stars. The cold nuclear fusion has arrived to a final success , and we are confident in controlling it. .

Our curiosity for the world and its laws made enormous progress. We remember the questions of the gravitational waves, which were so uncertain in 2000 , and now we have reached a larger view

of the forces in the Universe. Our progress in the analysis of the past and the present ,and our definition of time , made in this century tremendous progress , and we are still working on it.

-Now we know that there is life every where in the universe , and perhaps the word life to define the recent discoveries is inadequate . We visited other planets , and we know how to live on them, and the transferred new inhabitants seem to be happy . Still we do not know enough of other intelligences in the Universe . The research of "men type" animals continues , and we are far from general conclusions .
_ Our progress in biology and medecin has been immense in the last centuries . We almost control the length of our life. . The spontaneous desire to close after a while our Ego is increasing, as well as our sympathy for other men and wimen, who shall inherit our ideas and researches. .-The idea of progress in in life without killing each other is becoming dominant , and the auspices for peace on the Earth and outside are now very intense

We can say that the questions regarding the nature of our Universe made tremendous progress, as well as the relations and understanding between men and other animals . Still we look to the future with the hope to understand better what all this is.

Now I come back , and I close here the ridicolous anticipations that I invented. In this paragraph.

§ 7**. A note on the present situation.**

Considering the present time, December 2009, heavy problems are in front of us, even with the pleasure of their uncertainty. LHC is progressing together with the future of our researches, in Italy and elsewhere.No one, I say no one, knows where we shall be ten years from now Our miracle of knowing more and more is progressing . We are already working with enthusiasm to the idea of a new electron linear collider, which will work to analyse in full detaiks the obscure indications of LHC. .Do we need other Touschek ? . My opinion is " Yes " ; perhaps they already exist.

Let me consider our world, and let's remain in the region of science and experimental verification . I consider Bruno Touschek a prophet. Please, don't jump on the chair . He is not a prophet of God . He is a prophet of science , , and gives us the idea that our adventure in science is just at the beginning : we must be conscious of what we do not know yet . The sharp attitude and the irony of prophets like Bruno are necessary. I suggest you to follow what is coming out in Internet and in the best newspapers in the world, and in the prophecies of the more advanced scientists, Nobel prize or not. Bruno was able to understand and drive and at the same time to compassionate our intentions.

In this sense, I bow his genius , for what I understand from him , in the past and even now ; I invite you to meditate his difficult life, his discoveries and his will of never surrendering. .

§ 8. **What must be added . His drawings.**

The drawings of Bruno Touschek are a document which at the same time reveal the opening of his mind, his subtle culture of Europe , and in particular the capacity of his country (Austria) in art and particularly in drawings. . We must be grateful to Edoardo Amaldi for having presented them in his Bruno Touschek's Legacy ,with some detail.

His drawings have a proper personal style . They resemble the main lines of the artists in Europe, , and at the same time cover with full irony the ambitions and ways of life of the man in the XXth

century . As Amaldi notices , one basic leitmotive is the self injury ,from which the whole of our society , and each of us individually, suffers

But it is not only that . The years in Italy of our bloodless revolution in the sixties are represented by Bruno with a mixture of compassion and irony. They are only occasional pieces of paper that he did not care to save , but they are more than that : they invite human mind to think . They do not suggest, like Macbeth in Shakespear , that " Life is a walking shadow …,it is a tale ……significant nothing."

No. His drawings indicate that there is something beyond our irony which is correct to follow and search. . Something expresses in his drawings the subtle mistery of his personality : a mind of high quality , almost aristocratic and even ashamed of this . These dramatic oscillations are concealed in each of us , but in the case of Bruno were to the highest level . He is here, with his images, inviting us to be honest , not to "pretend to know ", and to understand our limitations.