

## Bruno Touschek

### WHO WAS BRUNO TOUSCHEK?

Bruno Touschek was one of the great physicists of the second half of the twentieth century. He used his understanding of theoretical physics and his experience gained in Germany with Wideroe to invent, propose, and construct the first matter-antimatter accelerator, opening the door to a deeper understanding of the world in which we live.



Touschek was born in Vienna in 1921. Although a brilliant student, during his last year of secondary school, he was forced to abandon his studies because his mother was Jewish. This obstacle notwithstanding, he managed to graduate and enroll for university studies, which he was again forced to abandon in short order for racial reasons. With the help of friends, he continued his studies in Hamburg, where no one knew his origins, taking on various jobs simultaneously in order to make a living.

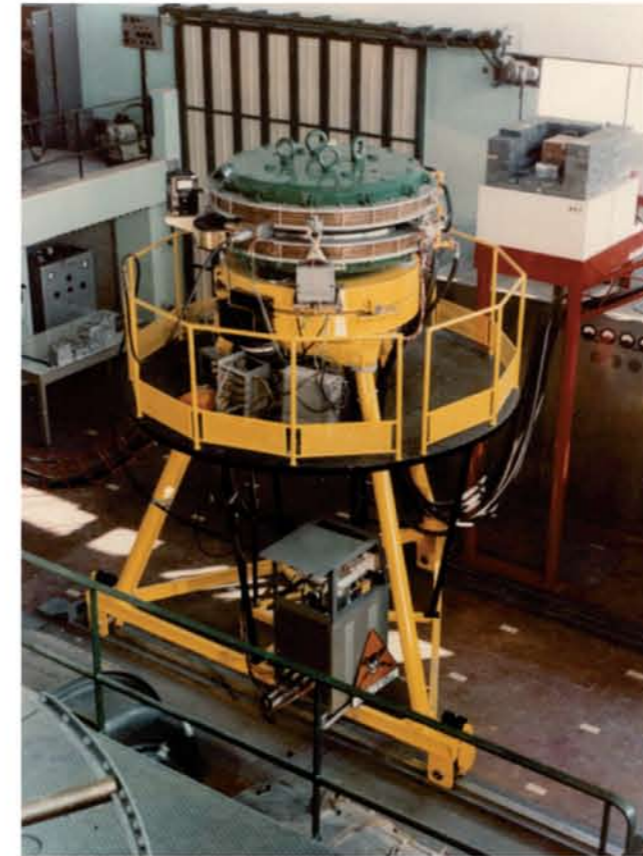
In 1943, he was invited by Rolf Wideroe to participate in the construction of the betatron. When the Gestapo arrested Touschek in 1945, Wideroe visited him in prison, and during these visits, Touschek conceived of and developed important theories concerning the physics of particle accelerators.

After his release from the concentration camp, in 1946, Touschek graduated from the University of Göttingen and began working at the Max Planck Institut. In February 1947, he moved to Glasgow, where he obtained a fellowship at the Department of Scientific and Industrial Research, working with P. Dee, another renowned expert on accelerating machines. Thereafter, Touschek was nominated Official Lecturer in Natural Philosophy at the University of Glasgow, a post that he held until 1952, when he moved to Rome, where he had an aunt, Ada. He began to spend time in scientific circles in Rome, and, when he obtained a position as a research scientist at the INFN, he decided to remain in Italy permanently. Three years later, he returned to Glasgow to marry the daughter of a noted zoology professor at the University, Elspeth Yonge, with whom he had two children.

On March 7, 1960, Touschek held a seminar at the Frascati National Laboratories to demonstrate the importance of systematic studies of electron-positron collisions and to illustrate that such collisions could be achieved by constructing a single magnetic ring inside which bunches of electrons and positrons would circulate in opposite directions at the same energy. In head-on collisions, particle and antiparticle would annihilate each other, giving rise to a total transformation of matter into energy.

In less than a year and with the collaboration of Carlo Bernardini, Gianfranco Corazza, and Giorgio Ghigo, Touschek built the prototype of the matter-antimatter collider he named AdA (Anello di Accumulazione). By happy coincidence, the name of the machine was

the same as that of his aunt, who was very close to him, especially after his move to Italy.



### WHAT WAS TOUSCHEK'S IDEA?

Bruno Touschek's ingenious idea was to accelerate particles as both probes and targets and to make them collide in flight. The advantage of this technique is to make available the sum of the energies of the two beams, which, annihilating each other, give up all of their energy to the creation of new particles. In addition, if one of the two colliding beams consists of particles of matter, and the other consists of particles of antimatter, both can be accelerated in opposite directions within the same magnetic ring.

The history of subnuclear physics from the 1960s onward clearly demonstrates that the study of electron-positron collisions at high energy provided the principal means for studying the tiniest details of the structure of matter, confirming Touschek's predictions concerning the richness of the electron-positron interaction process in every new energy domain explored.

AdA, although simply a prototype, remains a milestone in the history of science, marking the origin

of the most profitable experimental technique ever used to conquer the frontier of the infinitesimal.

After the commissioning of AdA, Touschek followed the design and construction phases of ADONE (1965-1967) with great interest, dedicating himself in particular to the physics of the beams.

Through his excellent drawings, Touschek was able to depict the academic world with extreme irony. "Bruno possessed a natural gift for creating caricatures, which he would draw with a pen on the first piece of paper he found, during exam sessions at the University or during meetings or working groups—caricatures pertaining to the activity at the Institute or at the Frascati Laboratories." (E. Amaldi)

