

BRUNO TOUSCHEK AND THE FRASCATI STORY : THIRTY YEARS LATER



THANKS

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- Luisa Bonolis
- Orlando Ciaffoni
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- Claudio Federici
- Luigina Invidia

All the drawings are from Bruno Touschek

MAIN SOURCES

E. Amaldi,
The Bruno Touschek Legacy,
CERN 81-19, 23 Decembre 1981
and
L'eredita' di Bruno Touschek,
Quaderni del Nuovo Cimento, SIF,
Vol. V, 1982

- *Bruno Touschek and the art of physics*, by E. Agapito and L. Bonolis, 2004, English version 2005.

- *Le carte di Bruno Touschek*, ed. by G. Battimelli, M. ~De Maria and G. Paoloni, U.La Sapienza, Rome, 1989.

- *Bruno Touschek Memorial lectures 1987*, Frascati Physics series Vol. XXX, 2005

- *Via del Sincrotrone Km. 12*, by V. Valente, INFN 2007.



B. Touschek and E. Amaldi
in 1958

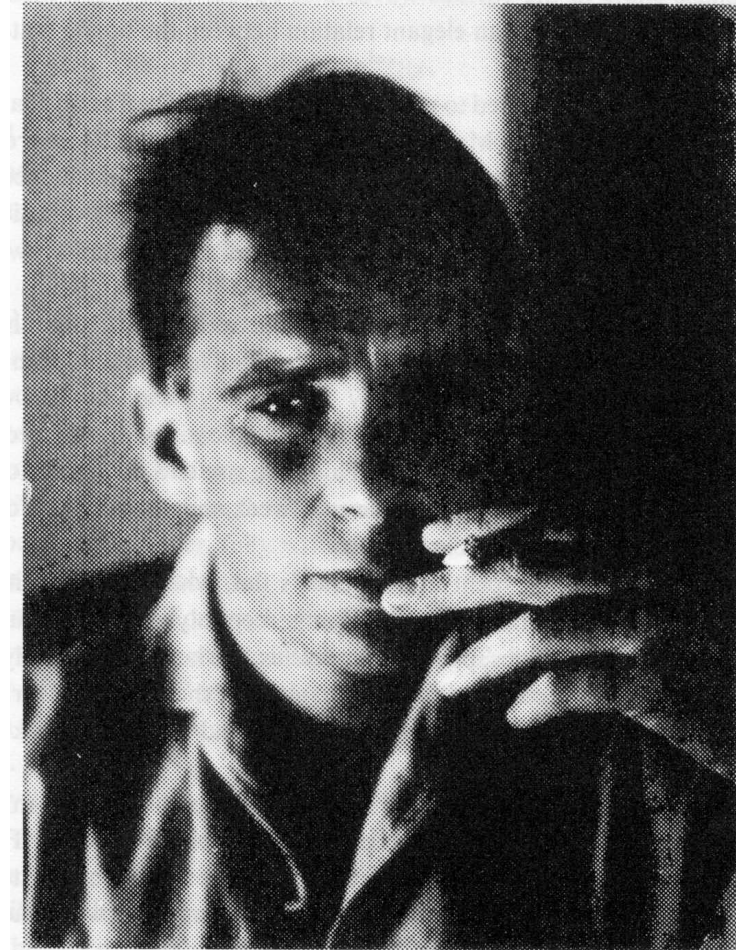
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OVERVIEW

- Bruno Touschek story
- How this Laboratory started
- The arrival of the theorists
- What ADONE did and short introduction to the movie to follow

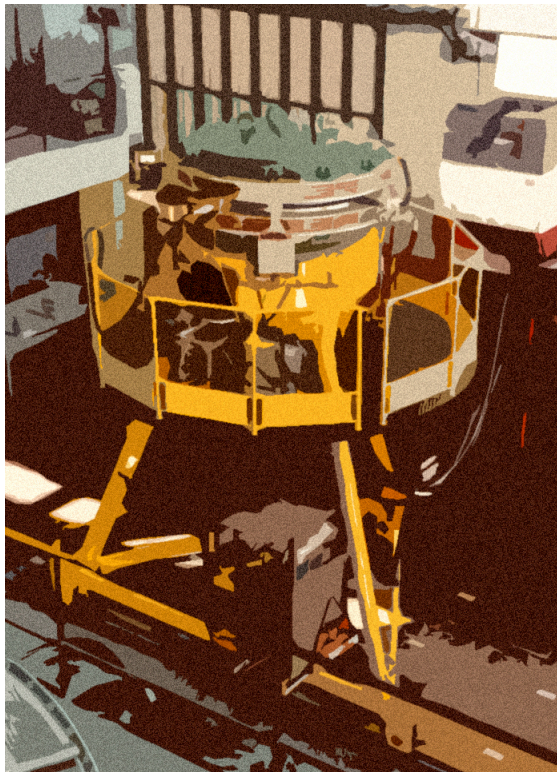
- In 1978, thirty year ago, on May 25th, Bruno Touschek died in Austria
- He had arrived there from Geneva, with a CERN car in early May
- In Geneva he had seen the beginning of the **LEP** adventure, the last and the biggest descendant of **AdA**, the machine he had built in Frascati in 1960.
- In Italy, he had settled in 1953 after an adventurous life which had gone through the war and across Europe

THIRTY LATER



BRUNO TOUSCHEK IS THE THEORIST WHO MADE POSSIBLE THE UNTHINKABLE IDEA OF ELECTRON-POSITRON COLLISIONS

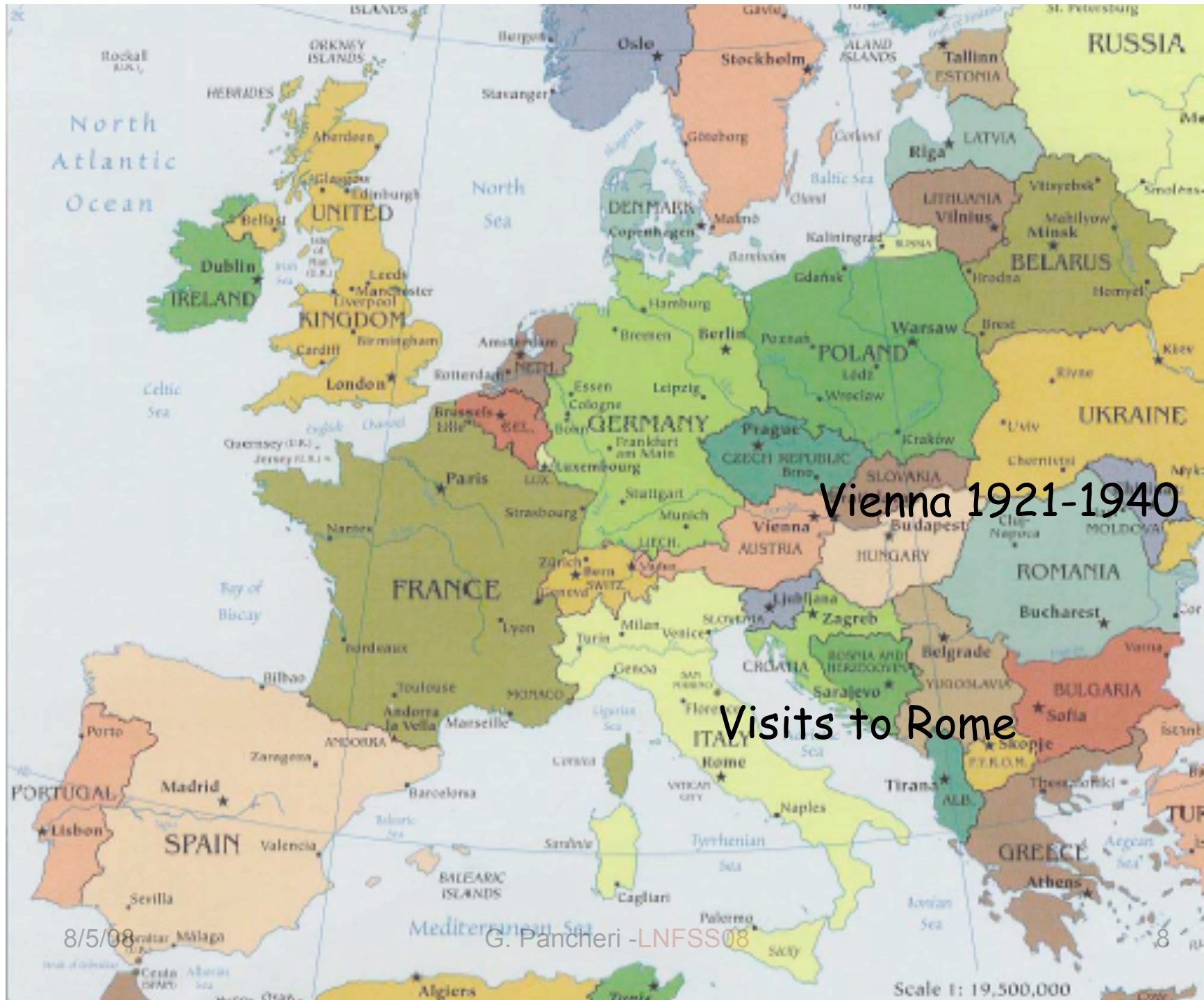
- **1960** The first electron-positron accelerator: **AdA** in Frascati ~5 meters around



2000 The last of the electron-Positron machines : **LEP** in Geneva 27 Km around



THE TOUSCHEK STORY



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FROM TOUSCHEK'S RECOLLECTIONS (E. AMALDI AND G. SACERDOTI)

When Austria was annexed to Germany in 1938, life became very difficult for the Jewish people in Vienna....

When things became very difficult, Paul Urban, then a young Assistant Professor, himself in a precarious position, helped Bruno meet Arnold Sommerfeld in Munich and through him continue his studies with Paul Harteck's help in Berlin.





IN GERMANY, DURING WWII, IN HAMBURG AND BERLIN, AT THE END IN PRISON, TOUSCHEK STARTED TO WORK ON PARTICLE ACCELERATORS

There had been a project to built a betatron
and put it on an airplane and from it
shoot a beam of electrons to destroy
enemy's planes

To do this, the Germans had called the
norwegian physicist **Rolf Wideroe**

Wideroe would go to and talk physics with
Touschek while Touschek was in prison
and would bring him cigarettes and wine,
while discussing in English Heitler's
"Radiation Theory"



Rolf Wideroe a 18 anni

FROM TOUSCHEK'S NOTEBOOK

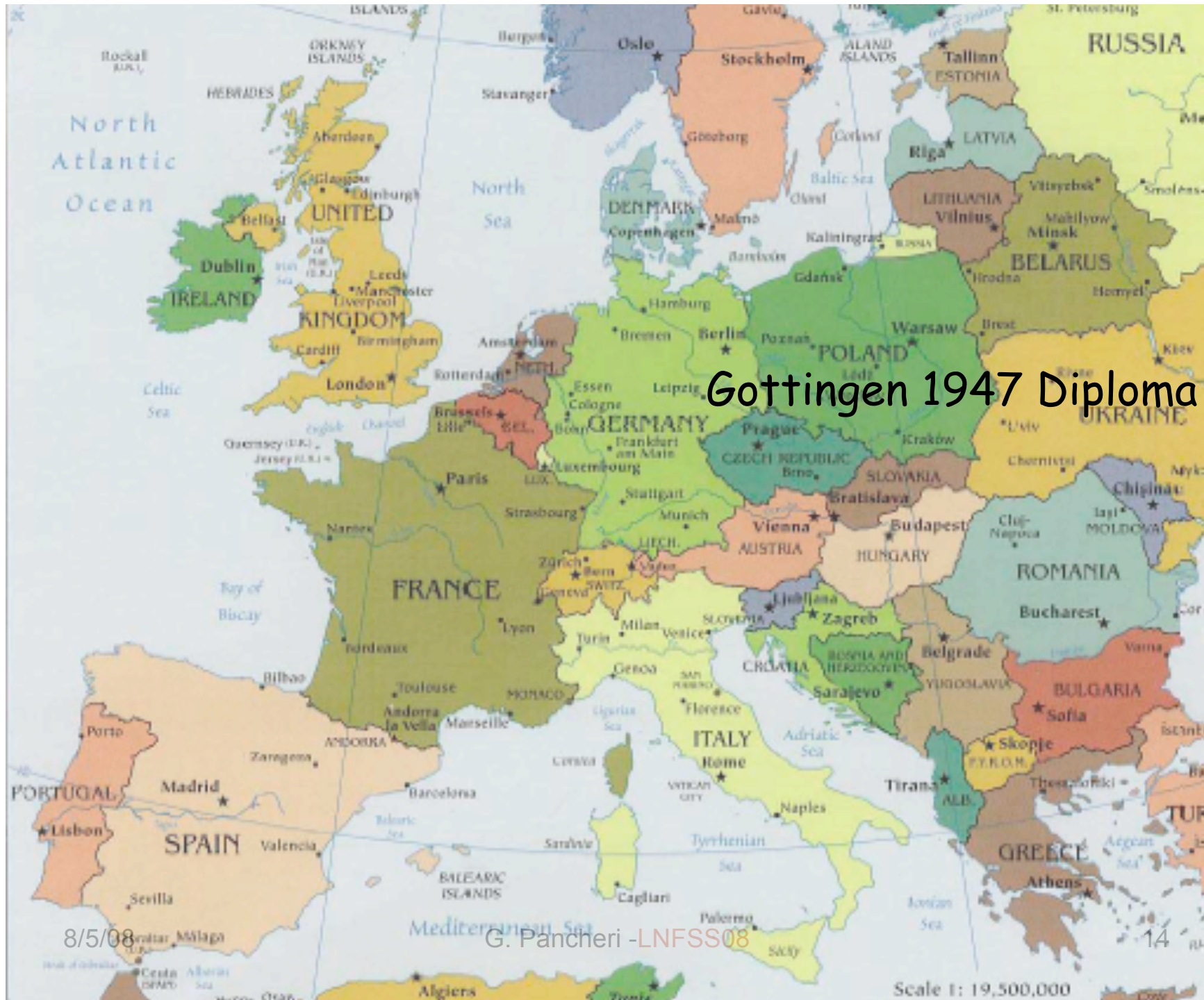
Let me first explain why a storage ring is an important instrument, particularly when fed with electrons and positrons. The first suggestions to use crossed beams I have heard during the war from Widerøe, the obvious reason for thinking about this being, that one ~~wastes~~ a considerable amount of energy by using 'stopping' targets - most of the energy being wasted to pay for the motion of the centre of mass. If one wants to study electrodynamics one should try to use particles, which interact weakly except electromagnetically. This automatically cuts one down to electrons (and positrons) since μ -mesons are hard to come by in large numbers. To use a crossed beam consisting of electrons and positrons has the further advantage that in all interesting processes the particles of the initial state (i.e. the electrons and the positrons) disappear. Experiments made in this way can only depend on two parameters (the energy and the angle, the first being given by the machine). This means that much more information can be gained by much fewer events.

It throws away

GIANCARLO SACERDOTI REMEMBERS HIS CONVERSATIONS WITH BT IN 1960 WHILE GOING FROM ROME TO TERNI TO GET THE MAGNETS FOR ADA

- Wideroe's betatron was finished 1944, but the allied troops were soon arriving and BT was to be transferred from prison to the Kiel concentration camp
- Along the way, weakened by fever and slowed down by the heavy books he was always carrying with himself, he fell to the ground
- A soldier shot him to the head and left him for dead on the road side and the other prisoners and the soldiers moved away
- But it was only a superficial wound and he was able to get up and walk to a hospital, saving his life



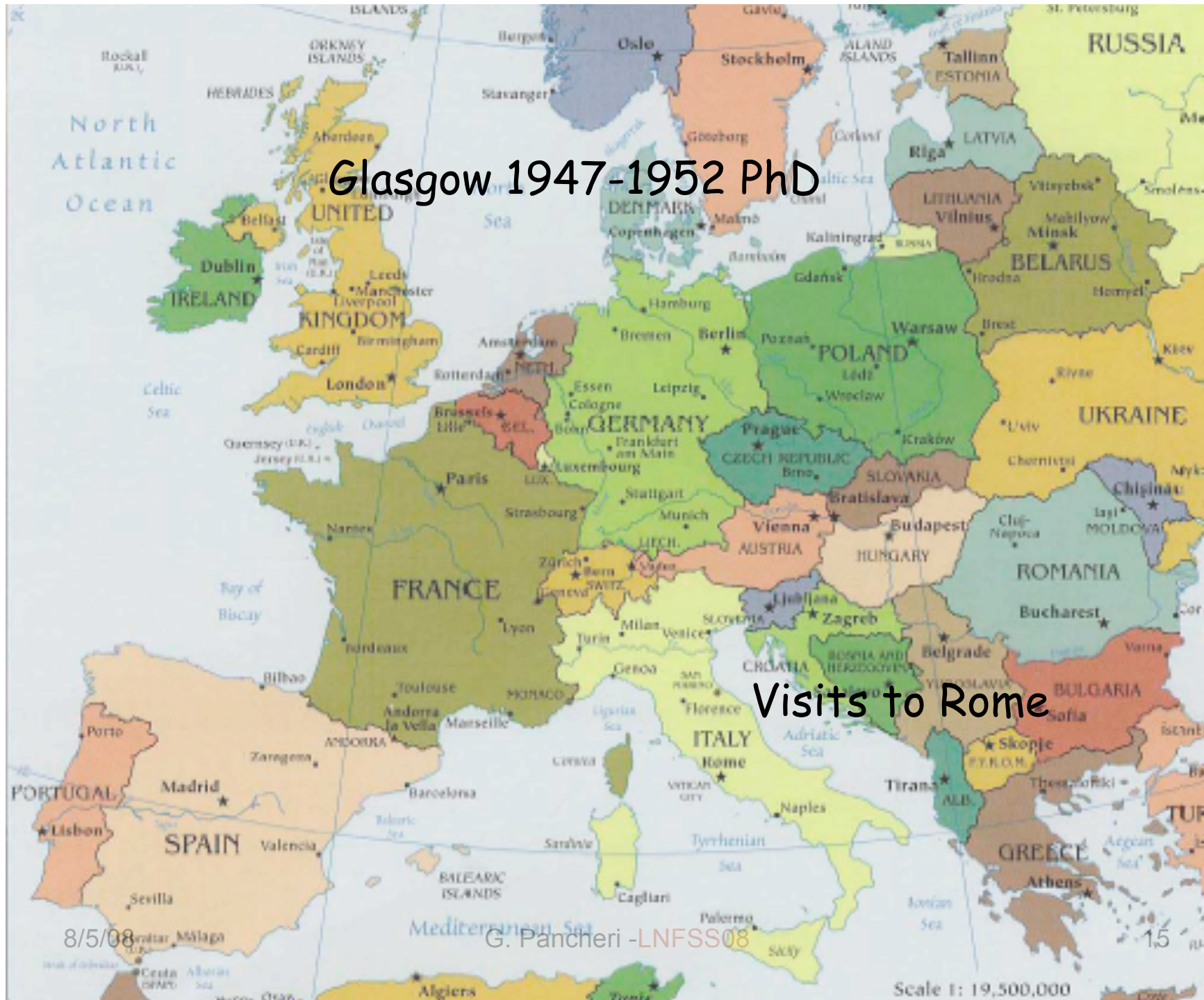


Gottingen 1947 Diploma

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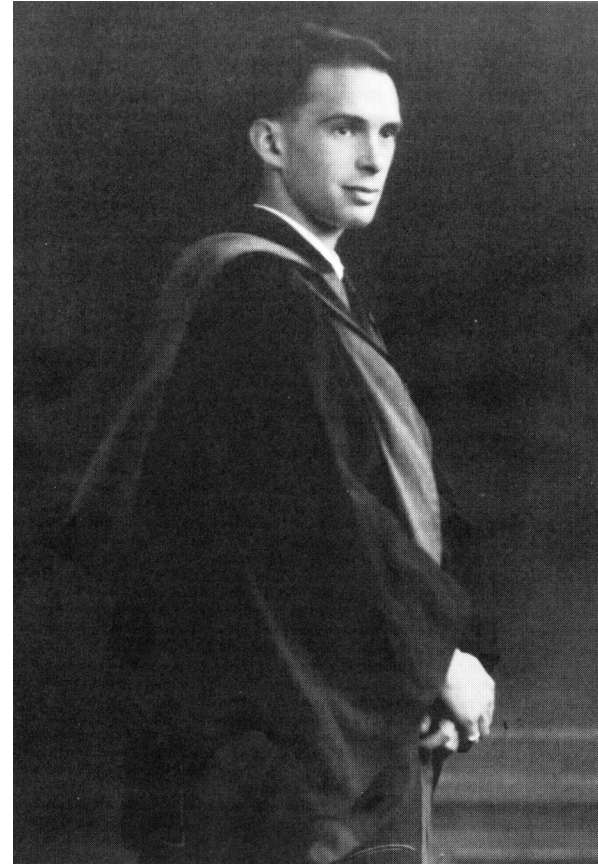
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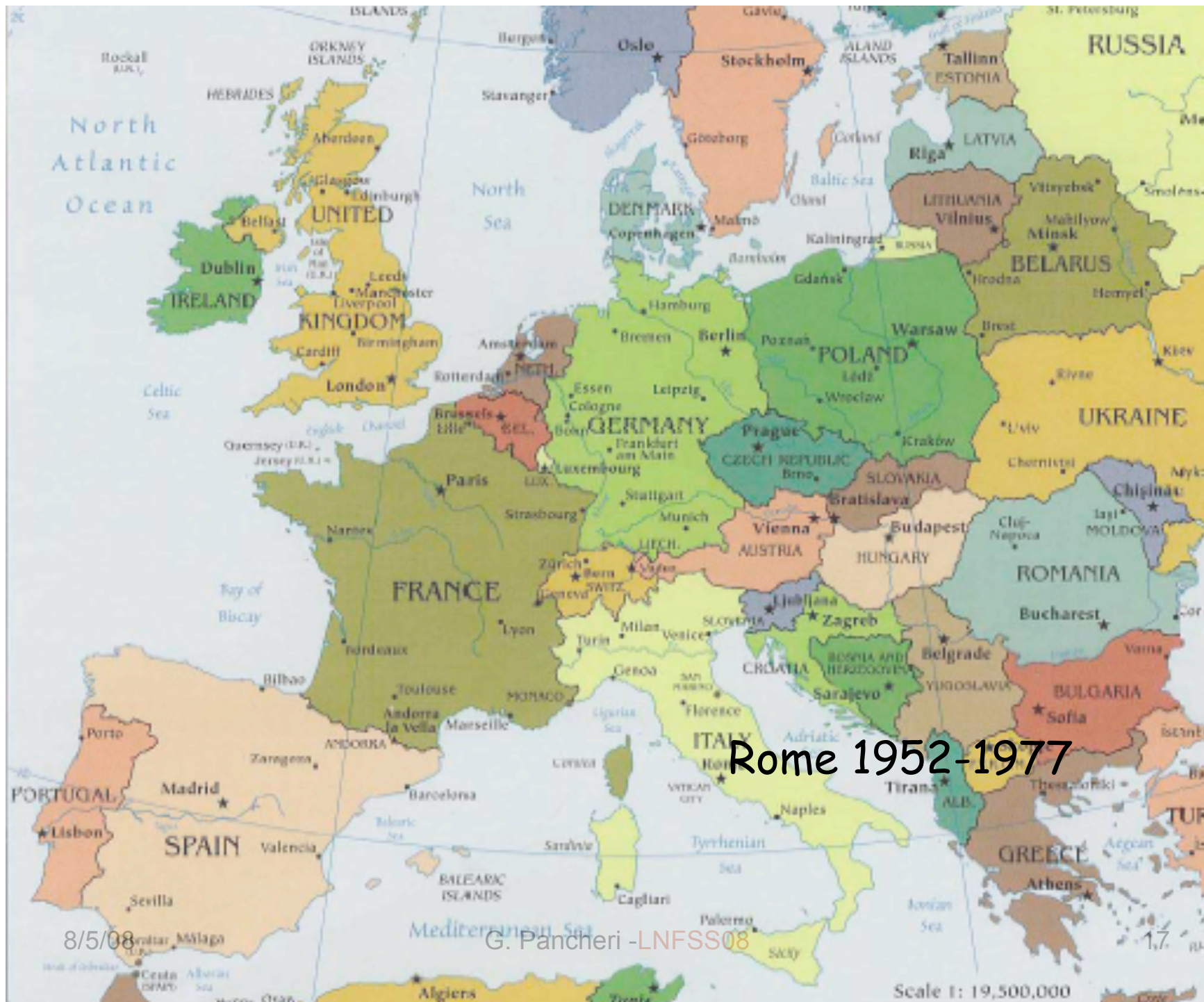
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TOUSCHEK IN GLASGOW

- In 1947, after obtaining his diploma from Gottingen, Bruno Touschek went to Glasgow where with a fellowship and started being interested in the construction of the 350 MeV synchrotron under the direction of P.I. Dee
- He was awarded his PhD in 1947, his internal rapporteur was J.Gunn and the external one Rudolph Peierls
- In 1950 Walter Thirring came to Glasgow as a Nuffield fellow and they worked on the covariant formulation of the Bloch-Nordsieck method in electrodynamics with external currents





IN THE '50

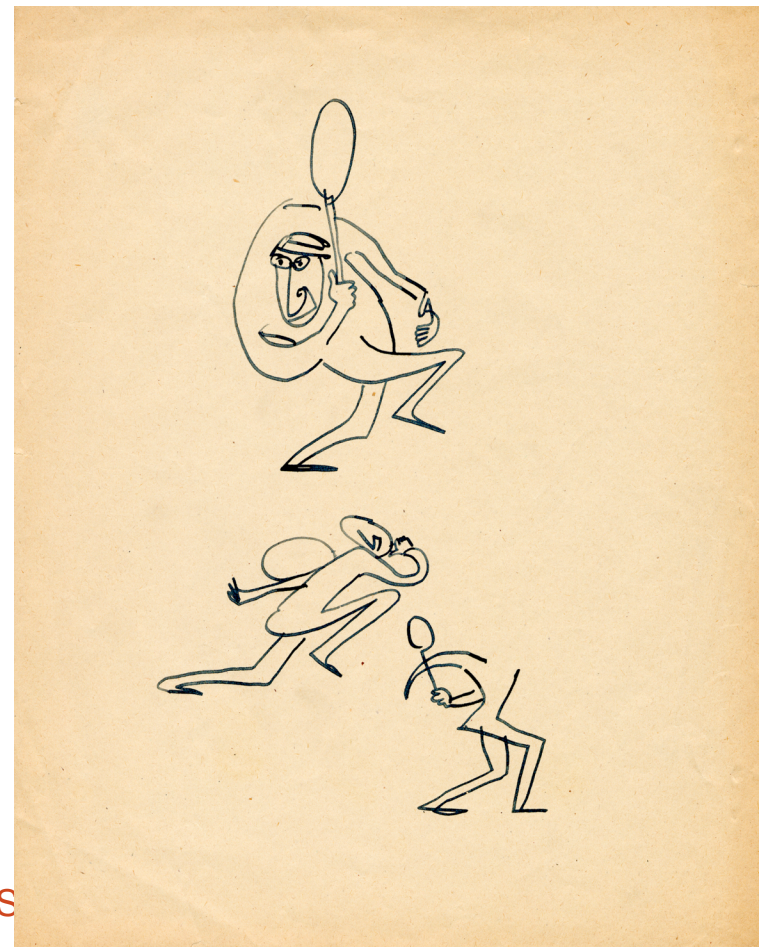
BT had an aunt leaving near Rome and started going to the Physics Department and discuss physics: he was offered a position by E. Amaldi e decided to come and live in Rome

E. Amaldi's remembers :

Shortly after his arrival, we started playing tennis together...

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THE FRASCATI STORY

Strada del Sincrotrone Km. 12 by V. Valente, 2007





Touschek with Amaldi and other physicists near Tuscolo in mid 50's

- In 1953 INFN had decided to built an electrosynchrotron and soon it was decided that it should be built in Frascati

1956: THE SYNCHROTRON WAS UNDER WAY



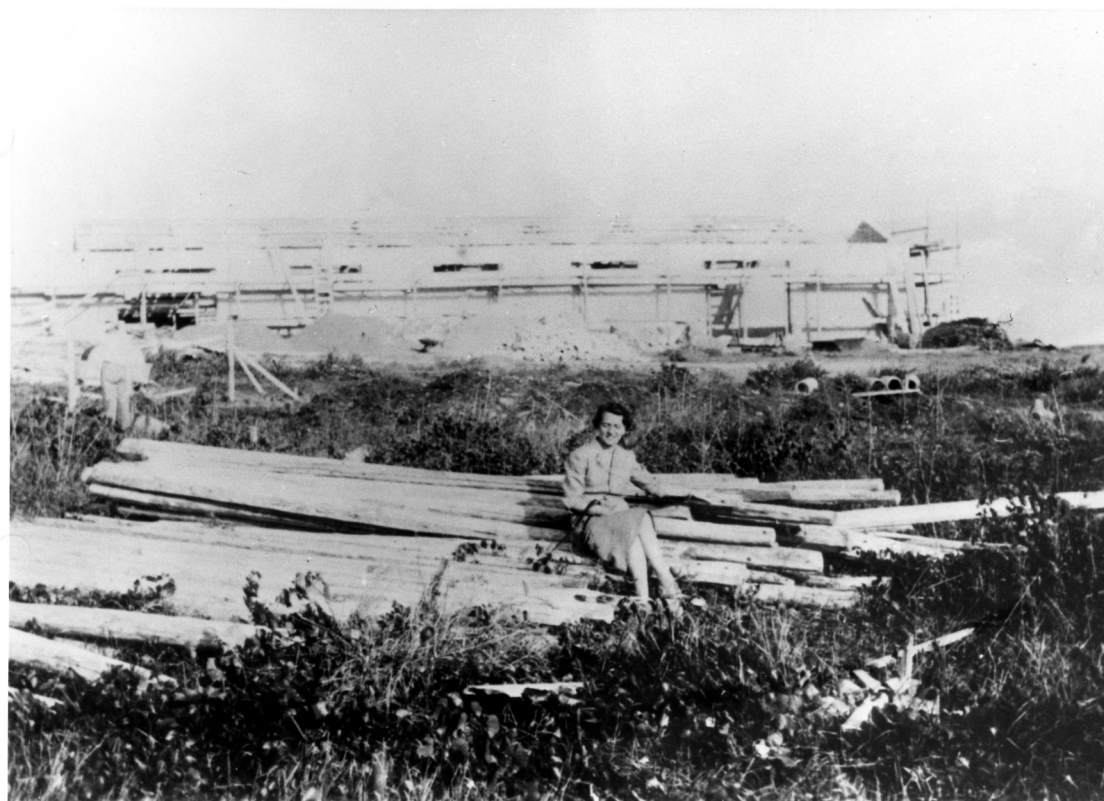
BUILDINGS WERE COMING UP



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THE LABORATORY IN 1959



Now we are here

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E/3 Vista Aerea dei Laboratori. 6.11.1959 (Fotocielo 11/157)

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THE LABORATORY AND THE SYNCHROTRON WERE READY



THE SYNCHROTRON WAS READY



B/49 - EDIFICIO SINCROTRONE - 24.10.1957. (AGENZIA. ITALIA 7783)

And the guests started to arrive



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ADΛ AND ADONE

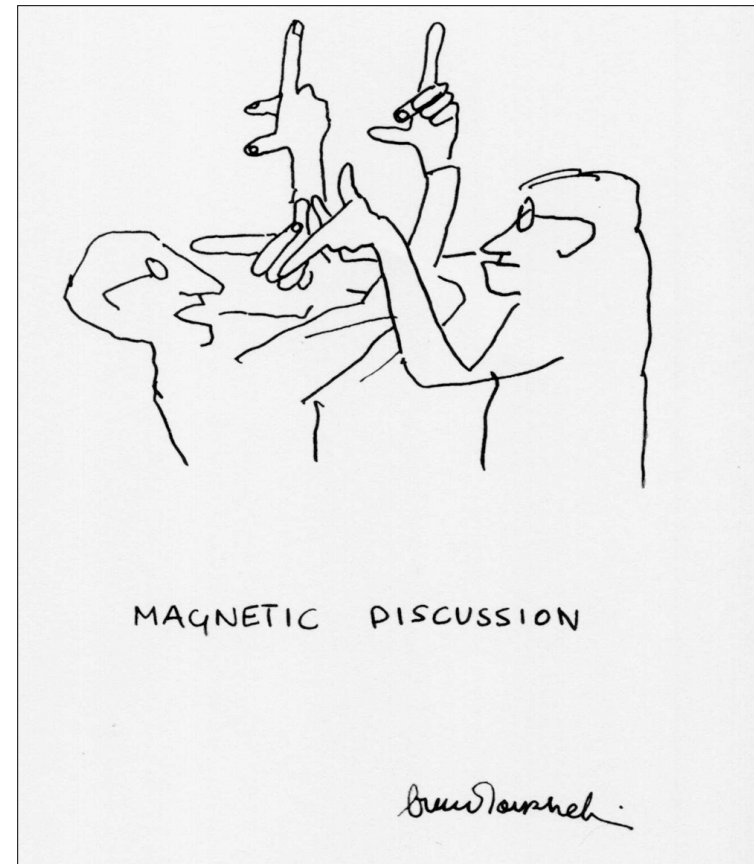
- It is at this point, as the synchrotron was starting, that Touschek proposed to build AdA: a revolutionary new idea which was soon followed by the construction of the first

e+e- collider

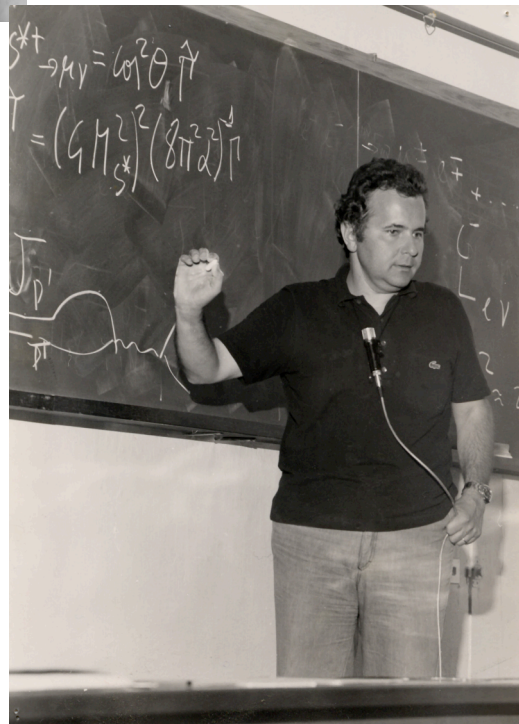
- And within the next twelve month Touschek with Gatto and other Frascati physicists proposed to build ADONE

ADONE

- At the end of 1960 Touschek proposed to build a more powerful machine, ADONE
- ADONE was built between 1965 e il 1968 in the building now housing the phi-factory DAFNE



THE THEORISTS WHO BUILT FRASCATI



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PHYSICS FROM FRASCATI AND ADONE (FROM LONG AGO)

Experimental

- The discovery of multihadronic production 1971
- Limit on the mass of heavy lepton 1973
- The discovery of the J/Ψ (short movie later)

Theoretical

- QED processes in e^+e^-
- QED Radiative corrections
 - One photon
 - Two photon
 - Infinite no.s Bloch-Nordsieck method
- QCD including
 - Soft gluon resummation

TOUSCHEK'S LIFE SPANS EUROPE IN SPACE AND TIME

- 1921 BT was born in Vienna, **Austria**
- 1921-1940 in Austria (with periodic visits to Italy)
- 1940-1947 in Berlin, Hamburg and Gottingen, **Germany**
- 1947-52 in **Scotland** (with occasional visits to Italy)
- 1952-1977 in Rome, **Italy** (with an important travel to France)
- 1978 in Geneva, **Switzerland** with LEP
- May 1978, BT dies in Innsbruck, **Austria**



