

Bruno Touschek and B.T. Memorial Lectures

Orsay, 13 September 2013

Mario Greco
University and INFN - Roma Tre

B.T. Biography

E. Amaldi, “The Bruno Touschek Legacy”, CERN 81-19, 1981.
Also in the Italian version in “Quaderni del Giornale di Fisica”

L. Bonolis and G. Pancheri, “Bruno Touschek: particle physicist and father of the e^+e^- collider”, Eur. Phys. J. H36 (2011)1.

Also in Rolf Wideroe’s autobiography, ed. By P. Waloshek,
DESY, 1994.

B.Touschek Archive, Physics Dep.t, Univ. La Sapienza, Rome

Touschek's Life

- B.T. was born in Vienna in 1921 from an officer of the Austrian army and a Jewish mother, belonging to an intellectual and artistic family. He died in Innsbruck in 1978.
 - Early years, before and at the start of World War II, mainly in Austria. P. Urban and A. Sommerfeld.
 - During the war he was mainly in Hamburg and Berlin. Period of clandestinity, prisoner, concentration camp, shot by SS guards. Collaboration with R. Wideroe.
 - After the war: Diploma in Göttingen on the theory of betatron. Moved to Glasgow and got his PhD.
- Final stay in Rome, theoretical activities and the start of AdA.
AdA in Orsay. Adone.

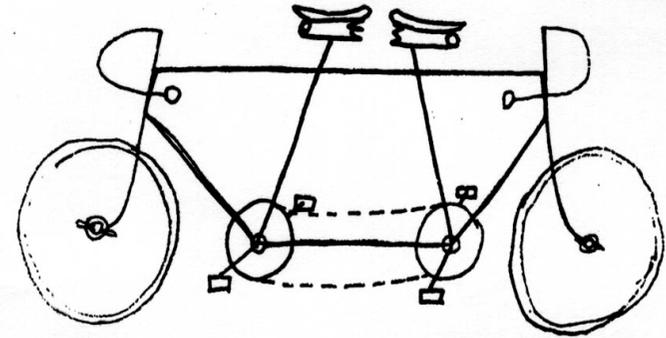


Early years

- In March 1938 Austria was annexed to Germany and according to the racial laws the “jewish” B.T. could not attend classes in the Gymnasium anymore. Got the final diploma as a private student.
- Visited his aunt Ada in Rome and started engineering fac. attending classes in Mathematics.
- September 1939: World War II started, B.T. back to Vienna, studying Physics and Mathematics, mostly at home. Friendship with Paul Urban, assistant prof. at the Univ.
- After found some small errors in A. Sommerfeld’s book on quantum theory and exchanged letters, A.S. suggested him to move to Germany and gave him help and support.

Clandestinity in Germany

- Helped by Sommerfeld B.T. moved to Hamburg, studied theoretical phys. and then to Berlin, working in a firm of electronic devices, but also continuing his studies.
- Collaboration and friendship with the norwegian Rolf Wideroe, who had started a project on the betatron. Also he had observed clouds colliding in the sky, and they first discussed the possibility of collisions of particles of opposite charges. B.T.'s contribution to the final betatron project.
- Heavy bombing in Hamburg and Berlin, but betatron was put in operation. Frenetic activity of B.T. Arrested for suspected espionage, was frequently visited by Wideroe.
- Transferred to a concentration camp, was shot by SS gards, survived by chance, went to hospital and again to prison. Finally he was free at the end of April '45, and in Goettingen he got his "Diploma Physiker" in '46 on the theory of the betatron.



PROBARE ET REPROBARE !

Glasgow

- B.T. settled in Glasgow in April '47, joining a team working at a 300 Mev synchrotron.
- Friendship and collaboration with Walter Thirring on electrodynamic processes. Later on the covariant formulation of the Bloch-Nordsieck method.
- Also many works on the production of mesons in fission processes. Correspondence with Heisenberg. In November '49 he got his PhD. with a thesis on "Collisions between electron and nuclei". Feeling himself unhappy in Glasgow he decided to leave and finally moved to Rome in late '52.



Bruno Touschek in Rome

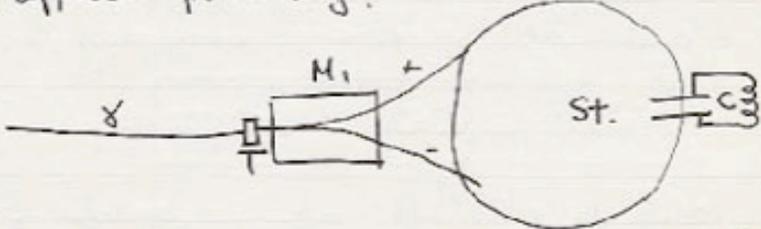
- In the fall of '52 B.T. was in Rome, and was offered a position by **Edoardo Amaldi**, director of the Physics institute G. Marconi.
- E. Amaldi, the youngest of the Fermi's collaborators, had a leading position in the Italian physics, and much contributed to the foundation of Cern in 1950.
- Also foundation of INFN and the project of 1.1Gev synchrotron at Frascati, under dir. of G. Salvini, completed in '59.
- At beginning B.T. worked with Radicati, Morpurgo, Cini on fundamental problems (CP, T, CPT invariance and weak interactions). Correspondence with W. Pauli and T.D. Lee. Nicola Cabibbo was a student of Touschek.



AdA

18.2.60.

State of affairs. Discussed plan with
Aligo. Decided for "outside" storage.
G. proposed use of γ -beam also
for electrons.
Typical possibility:

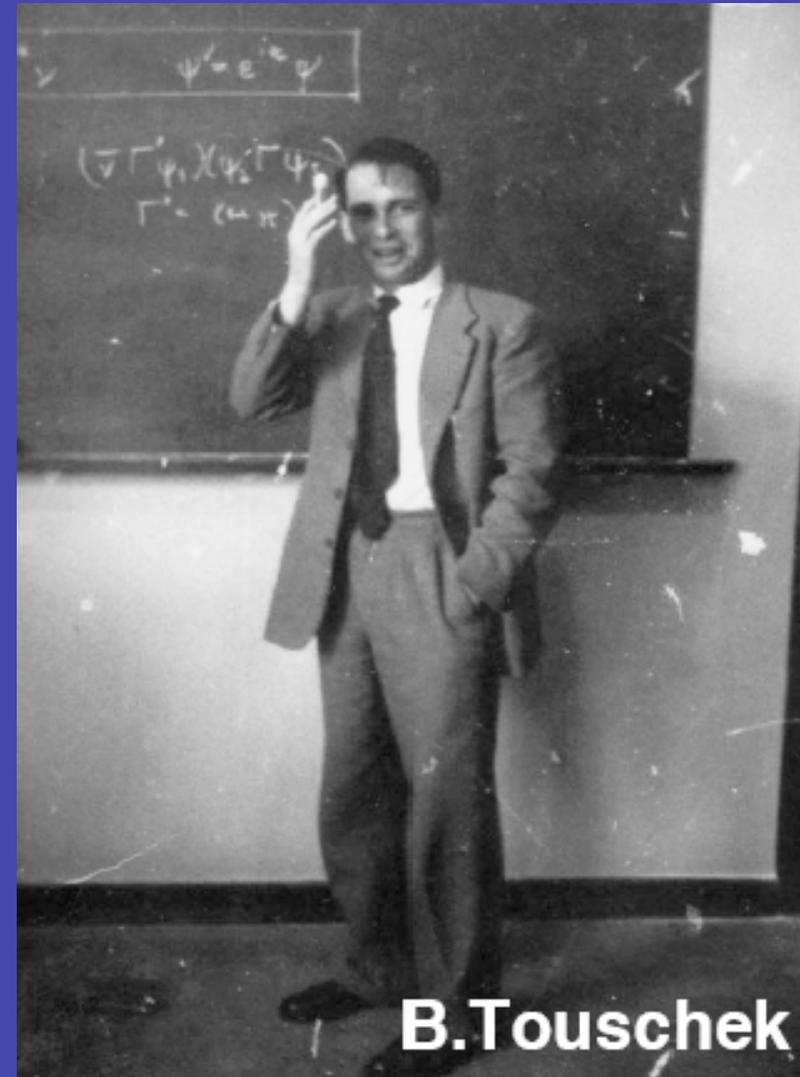


$\gamma = \gamma$ -beam, T = target, H₁ = separating
magnet, St. = Storage magnet, C = Arc.
circuit.

Basic formulae

$$q = N^2 (v\tau)^2 \frac{\sigma}{q} \cdot \frac{c}{\pi R}$$

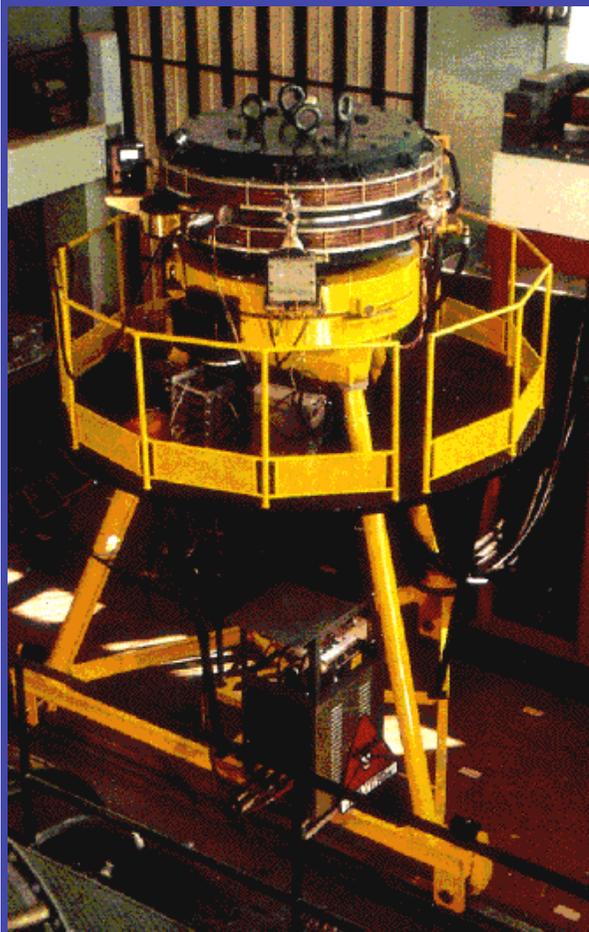
N = number of particles accepted per pulse
v = repetition rate of the Synch (v = 20)



B. Touschek

- Seminar in Rome by P. Panofsky on the Stanford e- e- collider in the fall of 1959 (two tangent rings).
- Immediately after B.T. started speculating about a single ring where e- and e+ could collide (as discussed earlier with Wideroe) and explore the properties of the vacuum.
- Seminar in Frascati in Febr. 1960. In his notebook he started exploring the physics of e+e- processes. The reaction e-e+ → 2 photons as luminosity monitor. Also he suggested to convert the new synchrotron in an e+e-collider .
- Final project (AdA) with 250 Mev beams.
- Paper of N. Cabibbo and R. Gatto, PRL 1960 and PR 1961

AdA (Anello di Accumulazione) 1960



The Frascati Storage Ring.

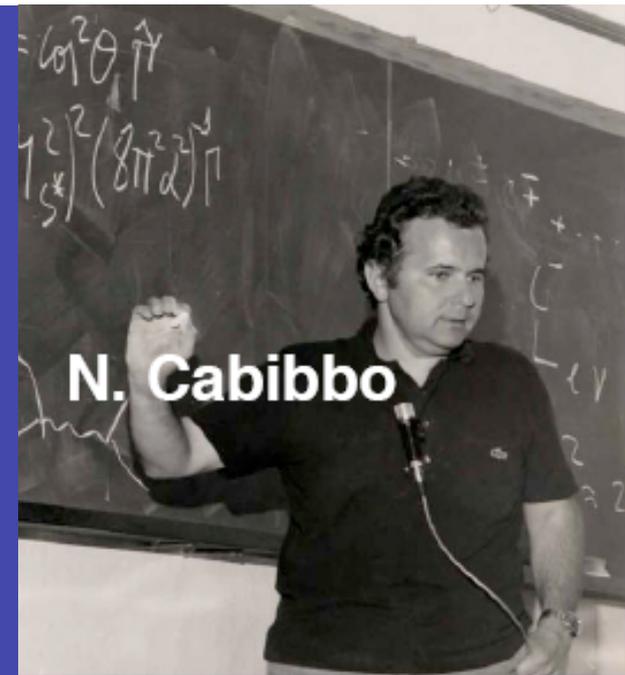
C. BERNARDINI, G. F. CORAZZA, G. GHIGO
Laboratori Nazionali del CNEN - Frascati

R. TOSCHEK

Istituto di Fisica dell'Università - Roma
Istituto Nazionale di Fisica Nucleare - Sezione di Roma

(ricevuto il 7 Novembre 1960)

Other actors in AdA



- AdA was built in one year, but difficulties with injection to get full luminosity.
- Visit to Frascati by P. Marin, a collaboration started and the decision was taken to use the Orsay Linac as injector and to transfer AdA. Problems in crossing the french-italian border which needed diplomatic interventions.
- Final collisions at LAL. “Touschek effect” (beam-beam interactions limiting the beam life time).
- Adone project.

B. Touschek's legacy

- Particle-antiparticle collisions (AdA -> LHC). Many fundamental discoveries.
- Machine's theory and developments.
- Large impact on theoretical physics at Frascati and Rome:
 - Radiative corrections (QED, J/Psi and Z prod.)
 - Exponentiation in QED and QCD (ex. W/Z Pt-distributions.)
 - Weak interactions.

BRUNO TOUSCHEK MEMORIAL LECTURES

INFN - Laboratori Nazionali di Frascati

Frascati 11-15 May, 1987

The exact principles of Quantum Mechanics

By

JOHN S. BELL

CERN, Geneva, Switzerland

The Frascati National Laboratories of the Italian Institute for Nuclear Physics (INFN) are instituting a yearly Memorial Lecture to honour BRUNO TOUSCHEK. The inauguration of the series, by Nicola Cabibbo, the President of INFN, will take place in Frascati on 11th May, 1987.

Inauguration Day

E. Amaldi Bruno Touschek - The legacy of the man and the physicist

Open Session: Remembering Bruno Touschek

J. Bell The exact principles of Quantum Mechanics

B. Richter e^+e^- -colliding beam physics - Status and future prospects

Organizers:

E. Etim
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G. Pancheri

Secretaries:

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F. Scacchi

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INFN - Laboratori Nazionali di Frascati P.O. Box 13 - 00044 Frascati, Italy

M.G., G. Pancheri,
BTML, Frascati
Phys. Series XXXIII,
2005



BTML 1987



BTML 1987



BTML 1987



BTML 1987



BTML 1987



BTML 1987



BTML 1987



BTML 1987



BTML 1987

Recent editions of BTML

- BTML stopped after a few years.
- 2009 N. Cabibbo: Chiral Symmetry and Particle Physics. Also C. Pellegrini and E. Picasso



BTML 2009



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- 2010 BTML hold together LC2010

BRUNO TOUSCHEK

memorial lectures

INFN - Laboratori Nazionali di Frascati

November 30th, 2010 - 10:30 a.m.

**To be held together with LC10 Workshop:
New Physics: complementarities between
direct and indirect searches**

Speakers

- **Giorgio Bellettini**
(Pisa Univ., Fermilab)
- **Mario Calvetti**
(Firenze Univ., LNF)
- **Jean-Pierre Delahaye**
(CERN)
- **John Ellis**
(CERN)
- **Lyn Evans**
(CERN)
- **Mario Greco**
(Roma Tre Univ.)
- **François Richard**
(LAL)

Advisory Committee

C. Bernardini

M. Calvetti

M. Greco

G. Salvini

Organizing Committee

D. Babusci

H. Bilokon

L. Bonolis

G. Pancheri

http://www.lnf.infn.it/conference/btml2010/Memorial_Lecture/Welcome.html

Secretariat:

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- 2011 From AdA to SuperB (1961-2011)
Scientific twinning between Frascati and Orsay.



AdA the first electron-positron storage ring

1961-2011 from AdA to SuperB



Scientific twinning Frascati-Orsay



Speakers

- C. Bernardini Univ. Sapienza, Roma
- J. Haïssinski LAL, Orsay
- G. Panzeri LNF, Frascati
- R. Petronzio Univ. Tor Vergata, Roma
- P. Raimondi LNF, Frascati
- G. Salvini Univ. Sapienza, Roma
- A. Skrinsky BINP, Novosibirsk
- A. Stocchi LAL, Orsay

Thursday December 1st, 2011
10:00 a.m.
Bruno Touschek auditorium

Advisory Committee

- C. Bernardini Univ. Sapienza, Roma
- U. Dosselli LNF, Frascati
- M. Greco Univ. Roma Tre, Roma
- G. Salvini Univ. Sapienza, Roma
- A. Stocchi LAL, Orsay

Organizing Committee

- N. Arnaud
- D. Babusci
- R. Bassoli
- H. Bilokon (chair)

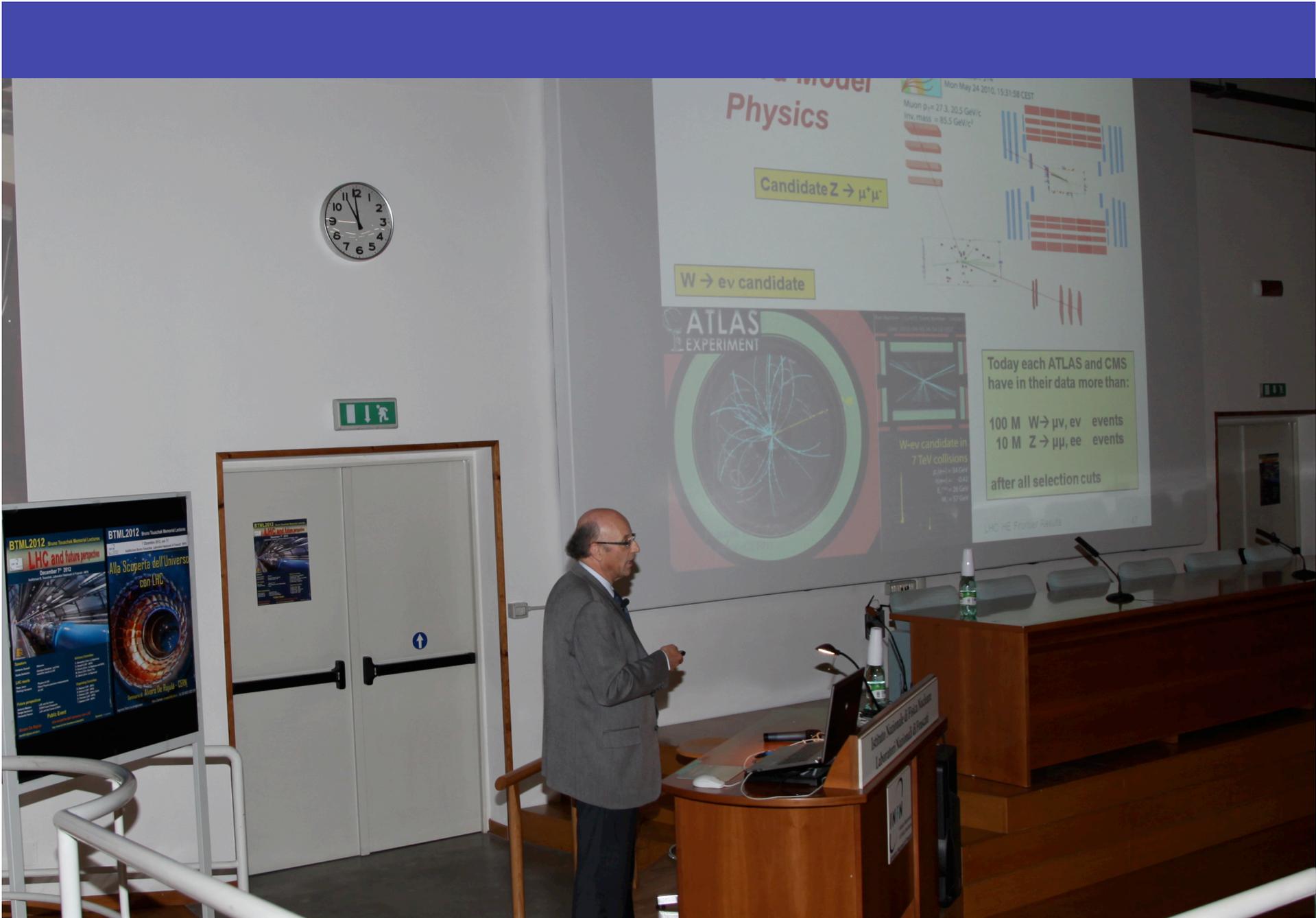






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Scientific twinning between Frascati and Orsay.
- 2012 High Energy Frontier at the LHC :
P. Jenni, G. Campana, S. Bertolucci, A. de Rujula



BTML 2012





Two posters for the BTML2012 Bruno Touschek Memorial Lectures are displayed on a screen. The left poster is titled "LHC and future perspectives" and is dated December 7th, 2012. It features a photograph of the LHC tunnel and lists speakers, an advisory committee, and future perspectives. The right poster is titled "Alla Scoperta dell'Universo con LHC" and is dated December 17, 2012. It features a photograph of the LHC detector and lists the seminar by Alvaro De Rujula at CERN. Both posters include contact information for the event.



THANK YOU