

Meeting Bruno Pontecorvo

BRUNO PONTECORVO 100

SYMPOSIUM IN HONOUR OF BRUNO PONTECORVO FOR THE CENTENNIAL OF THE BIRTH

PISA - 18-20 SEPTEMBER 2013

Meeting Bruno Pontecorvo

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(Giuseppe Fidecaro)



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Pisa, September 2013

**from Bruno's Recollections on the establishment of the weak
interaction notion:**

...since 1947 it had become one of my pet ideas...

**Following that thread I recall here a friendly meeting with Bruno in
Dubna, his visit to Italy in the late forties, the early work in the
Russian environment.**

**Thanks to the Organizers of the Pontecorvo100 Symposium:
an occasion to go back to
B. Pontecorvo's selected scientific works, 1997
and update my contribution there.**

Dubna, September 1989

- **How I happened to meet Bruno in the Hall of the Dubna Hotel, and to give him a reprint of a talk in Rome one year earlier.**
- **Would he find anything interesting there?**
- **Would he limit himself to polite thanks?**

The paper: *From Cosmic Rays to Physics with Accelerators.*

The venue: the International Conference on *The restructuring of physical sciences in Europe and the United States, 1945-1960*, Rome, September 1988.

What I recalled at the Rome Conference in 1988

- **1946, December, discovery of the Conversi-Pancini-Piccioni (CPP) effect.**
- **1947, March, Bruno draws attention on the possible equality of the coupling constants of electrons and mesons to nucleons.**
- **Thus, he essentially lays down the first two sides of the Puppi triangle, namely the nuclear β -decay process and the inverse meson capture process, leading from the (N,P) pair to the (e, ν) and (μ , ν) pairs respectively. (The triangle representation is J.Tiomno's idea in 1949.)**

Bruno's deep insight

Fermi, Teller and Weisskopf, Phys.Rev. 71 (1947) 314 (1 March issue), pointed out the existence of a $10^{10} - 10^{12}$ disagreement of the observed time of capture of mesons in carbon with respect to estimates.

Pontecorvo, in his paper, Phys. Rev. 72 (1947) 246 (received June 21), went into more detail in the analysis of the experiment and discussed features of weak interactions with deep insight.

Pontecorvo's idea developed in the following years through the work of other authors into the idea of a more general *Universal Fermi Interaction*: O. Klein (1948); G. Puppi (1948); J. Tiomno and J.A. Wheeler (1949); T.D. Lee, M. Rosenbluth, and C.N. Yang (1949); C.N. Yang and J. Tiomno (1950).

Bruno's reaction the day after our encounter

- **Next morning, Bruno looked for me. Warm reaction.**
- **Did my way to present the facts of 1947 acknowledge his *intuition*?**
- **Facts and anecdotes recalled. Also the relevance of the $\pi \rightarrow e\nu$ experiment at CERN.**
- **A visit to the horses of his son Tito**
- **The start of a friendship !**

Only much later I learned how Bruno pursued in Dubna in the years 1950 - 1955 his 1947 line of research .

Meeting Bruno Pontecorvo



**B. Pontecorvo, V.P. Dzhelepov, V.I. Lushchikov, Dzh. B. Pontekorvo,
Dubna, 1983**

The notion of Weak Interaction

from Bruno's 1985 recollections (published in 1989) :

I shall cover mainly some Dubna work on new particles, performed in 1951–1955, in the context of the notion of weak interaction, a notion which was certainly not taken as granted in the early 50's, but since 1947 had become one of my pet ideas.

... I shall limit myself to the evidence in favour of my 1947 idea, that the β -decay "is not alone". The processes, other than the β -decay, which pointed to some kind of universal behaviour concern first the muon and then strange particles. This story starts in 1947 and terminates in 1955.

Curious behaviour of new particles as seen at Dubna

New unstable particles are discovered in cosmic rays.

They are copiously produced and long living. That leads Bruno to:

- **suggest that the decay of hyperons and kaons is not due to the strong interaction that generates them**
- **extend the notion of weak interaction to new processes. an universal interaction at first seen between any group of four fermions.**
- **predict independently of Pais, the associated production of hyperons and kaons in strong interaction processes.**

Does Isospin matter?

- **Bruno builds a scheme based on the isotopic spin, conserved in the generation process, not conserved in the decay process.**
- **Searches for $N + N \rightarrow N + \Lambda^0$ and $N + N \rightarrow \Lambda^0 + \Lambda^0$, with an experiment at the Dubna synchrocyclotron (680 MeV).**
- **Concludes that Λ^0 are produced in neither of these two processes: the first would contradict the associated production with another of the new particles; the absence of the second is explained if the isotopic spin of Λ^0 and K^0 (produced together) are zero and 1/2 respectively.**

Bruno vs Murray

isospin vs strangeness

Gell-Mann's notion of strangeness turns out as a very powerful tool ...

Pisa 1955, Int Conf. on Elementary Particles:

Gell-Mann's talk finally sets the notion of weak interaction.

Cosmic rays in the late forties, Bruno's visits to Italy

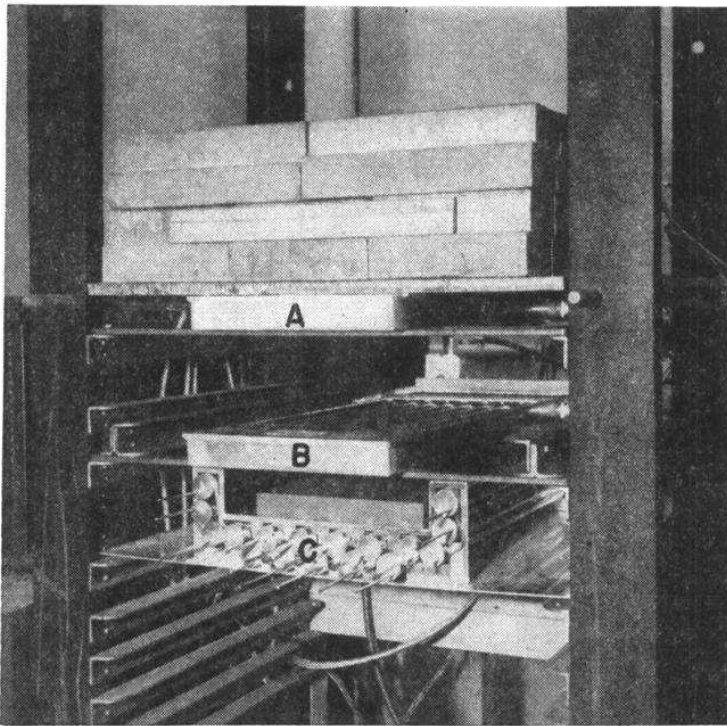


FIG. 2. Photograph of the counter assembly showing the graphite source between trays *B* and *C*. Absorbers are placed in the space between trays *A* and *B*.

1947-1950, cosmic rays exp.ts at Chalk-River, with E.J. Hincks.

(Figure from Phys. Rev. 77 (1950) 102.)

Rome, December 1947, seminar *Sulla Disintegrazione dei Mesoni ed i suoi Prodotti*.

1949, Basel and Como International Conference on cosmic rays, visit to the Olivetti factory in Ivrea and the cosmic-ray laboratory at Plateau Rosà, 3500 metres a.s.l.

Neutrinos on the forefront

Basel/Como: Bruno's radio-chemical method to detect neutrinos discussed with Fermi. Previously with Pauli, Zürich 1948.

Basel: Bruno discusses how gas amplification of proportional counters allows detection and measurement of a small ionization, Helv. Phys. Acta 23, Suppl. 3 (1950) 97, see Bruno's radio-chemical method above.

Rome, end August 1950

Mario Ageno and I met Bruno in Rome, at the Institute of Physics as reported elsewhere.

“On 1 September they (Bruno and his family) left by plane for Stockholm where they arrived before 9 p.m.. Next morning they proceeded to Helsinki, and then disappeared into thin air ...”

Bruno's new environment



1950, November 1, Pontecorvo joins the secret Hydro-Technical Laboratory of the USSR Academy of Sciences as Head of the Experimental Physics Division, at the Dubna future site.

B. Pontecorvo, and Irina G. Prokovskaya (1983).

The (top-secret) beginnings



**Dubna Synchro-cyclotron, initially
460 MeV, later 680 MeV**

**1946, August, USSR decision
to create a new laboratory
equipped with a powerful accel-
erator, on the bank of the Volga.**

**1947, starts the construction
of a synchro-cyclotron, the
largest accelerator in the world
(initially 460 MeV, 680 MeV
later).**

**1950, January, the synchro-
cyclotron becomes operational.**

1955-1956, the opening (I)

Around 1955, opening of the West-East relationships.

Bruno appears in public for the first time at a meeting for peace.

1955, August, Geneva, 1st Conference on Atoms for Peace, a delegation from USSR was present.

1956, the Joint Institute of Nuclear Research (JINR) is established (I.D. Blokhintsev first Director). It includes the “Laboratory of Nuclear Problems”, with Dzhelepov as Director until 1988, and the Veksler’s “Electro-Physical Laboratory”, already existing .

The original Volga settlement is named “Dubna’ – city of Sciences”.

CERN–JINR exchanges established

1955-1956, the opening (II)

June 1956, Geneva, CERN Symposium on High Energy Accelerators and Pion Physics. For the first time a large delegation of Soviet scientists working in particle physics takes part in a scientific conference in the Western World.

Work done at the synchro-cyclotron in the period 1950-1955, together with work done in other sectors of the Institute of Nuclear Problems and in other Russian laboratories, is reported by Meshcheryakov, Dzhelepov and others.

Bruno is not present in Geneva. However a paper in collaboration with Dzhelepov, Meshcheryakov, et al. *High-Energy particle beams from the 6 Metre Synchrocyclotron and Their Utilization* is presented by Dzhelepov.

Another paper, in collaboration with Mukhin et al., presented by Mukhin, *Positive Pion-Proton Scattering at the Energies 176, 200, 240, 270, 307 and 310 MeV.*

These results, and others on pion production, create some embarrassment to the physics community interested in similar experiments at the CERN SC (still at the construction stage).

Fortunately within few months the discovery of parity non-conservation displaces the center of interest of the SC community.

The work of Bruno in those years, and in the following ones, is summarized by Dzhelepov in the *Recollections*, 1997.

Keeping Bruno's memory alive

I happened to be in Protvino a few days before Bruno passed away, on September 24, 1993, and could give him a farewell.

Afterwards there have been a number of occasions to recall Bruno together with his Russian friends and collaborators. I think particularly of Venedikt Dzhelepov, Samoïl Bilenky, and Misha Sapozhnikov → “B. Pontecorvo Selected Scientific Works” collected and published on the initiative of Dzhelepov and Bilenky.

Bruno's scientific trajectory was fascinating, beyond and despite a certain sensational type of literature → I also met friends and collaborators of his golden years in Canada.

Much more is known today of Bruno. As to the old question, why did he *emigrate* to USSR, it remains open. Is that really important ?