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IPN Orsay. A historical overview of the first decades

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The numbers in red correspond to the slides

1 *Bonjour.*
Thank you Silvia for the invitation to present some aspects of the history of IPN Orsay.

2 *In the 1930s, nuclear physics was a young science born from radioactivity and the affirmation of atomism. In just a few decades, it has grown a lot with the discovery of the nucleus, and its constituents including the neutron in 1932.*

Many well-known physicists have participated in this research as shown, for example, in 1933 by the seventh Solvay Physics Council, the subject of which was ''Structure and properties of atomic nuclei'' . Like all the first "Conseils Solvay'', the proceedings were published in French.

It was also in the 1930s that the first accelerators appeared: electrostatic in England and cyclotron in the United States.

3 *But most of the experimental research was performed with radioactive sources as Frédéric Joliot wrote 25 years later: ''The artillery used to explore atomic nuclei could fit in a bottle of a few cubic centimeters. Those experiments which gave results of extreme importance required only a small space.''*

It was through radiochemistry methods that Otto Hahn and Fritz Strassmann made a surprising discovery in December 1938, a discovery immediately interpreted by Lise Meitner and Otto Frisch as the breakage of the uranium nucleus, the fission.

4 *This was not just a new phenomenon in physics, but it opened also the possible path to a considerable release of energy. In the summer of 1942, the United States set up the Manhattan Project, a vast organization of laboratories and industrial sites for the production of atomic bombs.*

5 *With Hiroshima on August 6, 1945 , the world discovered with astonishment the brutal applications of the atom. Nuclear physics and its applications will be of interest to the military and more generally to economics and politics.*

6 *In the United States, after the vote on the Atomic Energy Act and its signature by President Truman in August 1946, (1st) a commission responsible for nuclear power was created: the Atomic Energy Commission set up in January 1947. The United States was far ahead in the nuclear field, including in fundamental research.*

7 *In France, the ''Général de Gaulle'', head of the "Gouvernement provisoire de la République française" (until January 1946) was convinced of the need to found a national organization dedicated to nuclear energy. On October 1945, he signed the "Ordonnance", the order which marks the creation of the "Commissariat à l'Energie Atomique", the CEA.*

From January 46 (2nd), Frédéric Joliot will occupy the position of ''Haut Commissaire'', responsible for scientific and technical issues at the CEA. He will be revoked in 1950. Here, we see him during the inauguration of the first French atomic pile "Zoé" in December 48.

8 *In 1952, the "Centre d'Etudes Nucléaires" of the CEA was inaugurated on the Saclay plateau with the aim of combining fundamental and applied research.*

The following year, the CEA's first accelerator, a 5 MeV Van de Graaf, came into operation. A few years later it will be "Saturne", a 3 GeV proton synchrotron .

9 *Saturne will then be transformed into Saturne 2, the LNS, a national laboratory which will operate from 1978 to 1997. Pierre Radvanyi , one of the pioneers of IPN and very invested in hadronic physics, was its first deputy director.*

10 *A little flashback to the creation of another research organization, the CNRS , the "Centre National de la Recherche Scientifique" created under the impetus of Jean Perrin in October 1939, but the CNRS really started after the war with the appointment of Frédéric Joliot as director in August 1944 (20th). Joliot remained as the head until February 1946 (3rd).*

Unlike the CEA, research at the CNRS concerns all the fields of research. A biologist, Georges Tessier succeeded Frédéric Joliot as director and then a physicist, Gaston Dupouy in 1950.

11 *Imagined and discussed by a few visionary physicists, the official creation of a European organization began in December 1951. Two months later, eleven countries signed an agreement for the provisional creation of a ''Conseil Européén pour la Recherche Nucléaire''. The acronym CERN was born.*

In July 1953, the convention establishing the organization was signed and submitted for ratification to twelve states. On September 1954, the "European Organization for Nuclear Research" was officially created. It was an important event for French nuclear research, but insufficient, as Irène and Frédéric Joliot-Curie pointed out in public interventions. Without new accelerators, French physicists will be poorly trained to use CERN properly.

12 *In June 1954 (19th) in France, a government was formed chaired by Pierre Mendès France with Henri Longchambon , a scientist, as ''Secretary of State for scientific research and technical progress''. This was important because such a ministerial position had not existed since Irène Curie and Jean Perrin in the governments of Léon Blum before the war. The position disappeared in February 1955 (The 23rd) with the fall of the government, but Henri Longchambon continued to chair the "Conseil supérieur de la recherche scientifique" until 1958.*

Except for a month and a half in 1956, it was not until 1962 that we could find a ministry dedicated to research. Until 1969, it will be called ''Ministry of State responsible for Scientific Research and Atomic and Space Questions'' (April 15, 1962 to June 20, 1969)

13 *Let's go back to 1954 which was a favorable period for the equipment proposals.*

Irène Curie, director of the "Laboratoire Curie" at the ''Institut du Radium'' in Paris, proposed a proton synchrocyclotron project with the Dutch company Philips.

Yves Rocard, from the "Ecole Normale Supérieure" in Paris developed a project for a linear electron accelerator to be built by the French company CSF (Compagnie générale de télégraphie sans fil)

The two projects in collaboration with well-known companies were accepted, but It was obvious that space would have to be found outside Paris.

14 *This was done in 1955 with the acquisition of large plots of land in Orsay near the suburban train line, the "Ligne de Sceaux"'. It's a fairly complex story because the University which will own the place has not yet completed all the legal aspects associated with other lands located a little further away around the ''Chateau de Launay''. They were confiscated from their owner for acts of collaboration during the war.*

15 *Irène Curie was appointed director of the new "Laboratoire de physique nucléaire d'Orsay", but she died in March 1956 (17th) and Frédéric Joliot was appointed to the positions occupied by Irène and, in particular, to the management of the Orsay laboratory, a position he held until his death in August 58 (14th).*

16 *The construction of the laboratory began at the end of 1955 with a first phase of work decided in July. The winter was rainy and the conditions were difficult due to muddy terrain. Deeply driven concrete piles must be used.*

17 *The construction site was progressing quickly. In this photo from October 1956, we see the framework of the first building, today number 102.*

18 *In the spring of 1957, the Philips Company began the installation of the synchrocyclotron in collaboration with physicists and engineers from Parisian laboratories… and under the watchful eye of Frédéric Joliot who see here on the construction site in January 1957.*

19 *Here is the state of the laboratory in the summer of 1958 .*

In the foreground, from left to right, the first building, the physics laboratory. In the middle, the synchrocyclotron building which will also house the cyclotron of the Collège de France. Completely to the right, another building dedicated to alpha and beta spectrography. In the background, from left to right, the high voltage generator building. In the middle the water cooling tower of the synchrocyclotron and completely in the back, the heating plant of the buildings.

20 *This photograph is taken from an article by Frédéric Joliot-Curie in the magazine ''L'âge du nucléaire'', July – August 1958.*

In his paper, Joliot highlights ''The natural setting surrounded by greenery , where calm reigns, is favorable to fundamental research ''.

In the same journal, there are two other articles

21 *Jean Teillac develops the teaching aspects. They are still given in Paris but with interventions by researchers from the CNRS and the CEA. Teillac will succeed Joliot as director of the laboratory until 1966.*

The third article by Michel Riou focuses on equipment. Riou will also be director, but later, from 1974 to 1982.

22 *In his paper, Michel Riou mentions 6 accelerators from 300 keV to 160 MeV*

1)- The synchrocyclotron built by Philips and which has delivered the first internal beam since in June 58. An external proton beam of 156 MeV is hoped for the end of the year.

23 *2) The cyclotron of the Collège de France built under the direction of Frédéric Joliot in 1938 and which was transferred to Orsay in April 1958*

3) A variable energy cyclotron for heavy ions is currently being studied.

24 *4) The other three are not yet accelerators . These are high voltage generators, more precisely: a small Cockroft -Walton type generator of 150 increased to 300 kilovolts and another of 600 kV built by Sames in Grenoble and finally a 4 megavolts generator currently being studied by the Swiss company Haefely .*

25 *Experimental setups are also presented, such as this isotope separator built by the Gamma-Industries Company and delivered in 1957 or devices already used for nuclear spectroscopy. They were transferred from the "Institut du Radium" and the "Collège de France".*

26 *What was the status of the Orsay laboratory at its beginnings? This appears clearly in this "Annuaire'', i. e. the activity report of the "Institut du Radium" at the Paris University for the period 1958 – 1959.*

In Orsay, the laboratory took the name "Laboratoire Joliot-Curie"

27 *In 1966, on January 22, an "Institut de physique nucléaire" was created and common to the "Faculté des sciences" of Paris and Orsay, including the Curie and Joliot-Curie laboratories.*

28 *In fact, this Institute brings together four centers :*

- The Joliot-Curie laboratory, here in Orsay

- The Curie laboratory in Paris

- the IPN of the Faculty of Sciences in Paris which is a high energy laboratory using bubble chambers

- A chemistry laboratory in Arcueil

29 *In 1971, there was only one Institute of Nuclear Physics left, here in Orsay, and dependent on the "Université de Paris Sud".*

What happened ?

A decree of March 1970 (21st) abolished the University of Paris and split it into thirteen universities spread across the capital and its inner suburbs.

The IPN laboratory in Paris became the LPNHE, "Laboratoire de physique nucléaire des hautes énergies" which still exists today under this name.

The year 1971 was marked by another event in April : the creation by a decree of IN2P3 the "Institut de physique nucléaire et de physique des particules", a public establishment created within the CNRS but with significant autonomy which would gradually decrease. In July 1984, IN2P3 became a scientific department of the CNRS.

IN2P3 is important not only for the centralization and discussion of budgets, but also for the hiring of technical staff with, at least for some time, the confirmation of the TPN the "Titulaires de Physique Nucléaire", an advantageous status, initially copied from the CEA.

30 *In his preface to the 1971 Activity report, the director, Maurice Jean, gives some information on the laboratory staff: "A community of around 200 researchers and some 450 technical and administrative collaborators who assist them in the exploitation of important common research resources and in particular the three accelerators:*

- The 160 MeV Proton Synchrocylotron

- The Heavy Ion Variable Energy Cyclotron

- The Van de Graaff tandem MP which replaces the 4 MeV Van de Graaff stopped at the end of 1971".

The cyclotron transferred from the Collège de France no longer appears because it was shut down on November 25, 1966 after having provided nearly 1500 hours for physics that year (In 1966: beam 1480 h and maintenance 150 h).

Now, some information on the three accelerators and their evolution.

31 *The synchrocyclotron works well as shown by the distribution of operating hours in 1966 with a large emphasis on physics but also irradiations for radiochemistry.*

32 *A major renovation project was accepted at the end of 1972. It will focus on the magnet, the high frequency system and the beam extraction. The energy will also be increased to 200 Mev for protons.*

The accelerator was stopped in May 75 (17th). Its operation for physics gradually restarted in 1978 and 1979.

33 *At the beginning of the 1990s, the synchrocyclotron was transferred to nuclear medicine for proton therapy treatments. The CPO, the"Centre de protonthérapie d'Orsay" was created in a part of the IPN buildings with a transfer to the "Institut Curie" in July 1990. Today, the CPO is the most important center for protontherapy in France with a new cyclotron and a new building.*

34 *In the 1960s there were still very few heavy ion accelerators in the world. The CEA cyclotron at Saclay had been in operation since 1956.*

At Orsay, studies of a dedicated cyclotron were launched since the beginning of the laboratory and an order for the magnet placed in 1957. (It will be delivered in 1959), but it will

take six years to complete the construction carried out by teams from IPN under the scientific coordination of Marc Lefort. An internal beam was obtained in April 65 and the physics experiments could start in the fall of 1966.

35 *In order to go further in ion range and energy, an innovative solution was adopted : pre-acceleration of low-charge ions in a small linear accelerator before injection into the cyclotron after stripping in a thin carbon sheet. The project was finalized in 1966.*

The first krypton beam available for physics was delivered in March 1970, a world first. During two years, intense research activity for superheavy nuclei reigned without success, but other important results will contribute to the validation of the principle of double acceleration for the development of new accelerators dedicated to heavy ions.

In 1985, the CEV – ALICE was shut down and the installation dismantled.

36 *The other type of accelerator requires significant high voltages , devices known before the war in the "Laboratoire de synthèse atomique d'Ivry", a laboratory directed by Frédéric Joliot.*

Arriving in Orsay in 1957 , Michel Langevin, who had worked in Ivry, coordinated the construction of electrostatic accelerators, firstly with a 4 MeV Van de Graaf which came into operation in 1962.

37 *Since 1966, Michel Langevin also played an important role in the establishment , operation and evolution of a Van de Graaff Tandem accelerator. The Tandem will come into operation at the end of 1972 with a voltage reduced to 8 MV and increased to 13 MV in 1975 and then to 15 MV. It still works today but in a different context.*

38 *In June 1980, a group of engineers and physicists proposed an extension project with the construction of an isochronous cyclotron with superconducting coils associated with the Tandem. The project will not happen... But*

39 *A cryogenic cyclotron will be built in Orsay from 1986 to 1994, and then transferred to the KVI laboratory in Groningen, Netherlands. This was the AGOR project.*

40 *In the twenty first century, a linear electron accelerator will be associated with the Tandem to form the ALTO Platform.*

41 *The development of accelerators and associated research was an important dimension of the Institute, but it was not the only one. Nearly from the beginning, the research was structured around four "Divisions" as indicated here for the year 1975. In the activity report, you can find the nominative list of permanent researchers from the CNRS and the University. I simply indicate the number by department to which should be added a few foreign visitors.*

The year 1975 was also marked by several important decisions which would concern IPN.

42 *The high energy department , which wanted to move closer to CERN, left the laboratory to participate in the creation in January 1976 of the ''Laboratoire d'Annecy de physique des particules'' (LAPP)*

43 *In September 1975, as part of the public investment of the seventh plan, the government decided to construct and establish in Caen the "Grand Accélérateur National d'Ions Lourds", GANIL, a joint project of the CEA and IN2P3. IPN engineers played an important role in the design and construction of GANIL. Several will go to Caen for the construction.*

Marc Lefort will be the first director and Claude Detraz, also from IPN, the second.

44 *IPN played also an important role in the creation and equipment of other laboratories.*

Already in 1962, a team from IPN around René Bernas had created, with another team from the CNRS of Meudon, the CSNSM, the "Centre de Spectrométrie Nucléaire et de Spectrométrie de Masse" in the building 104 of IPN.

Later, in the 1980s, a small IPN team around Luc Valentin initiated interdisciplinary collaborations with biologists, first by building instruments for in vivo imaging of small animals and clinical imaging. More fundamental research in biology has been developed, and in 2006 the IMNC"'Imagerie et Modélisation en Neurobiologie et Cancérologie" was created as a unit of the CNRS.

45 *In the 1980s, research at IPN was grouped into 2 "Divisions": experiments and theory. In the experimental research department, the substructure in groups still retains, with some refinement, the organization around accelerators and chemistry, but with a strong increase of experiments performed outside the laboratory and particularly on national accelerators as highlighted by the director, Xavier Tarrago in the 1984 annual report.*

46 *At the end of the 1980s and in the 1990s, IPN will undergo a significant change with not only a different organization of research, but also with new fields. Here is the organization of the research department into groups in 1999 after the recent integration of theoretical physics. Without going into details, one can note a thematic organization with some new research topics.*

47 *I will now present the evolution of experimental setups with three examples chosen from heavy ion physics where scientists from IPN were deeply invested.*

At the beginning of the 1970s, deep inelastic reactions were discovered in experiments at CEV. They required fine identification of the nuclei in charge and mass which could have been made thanks to electronics studied and manufactured in the laboratory.

48 *Second example with the renewal of setups at GANIL at the end of the 1980s. The INDRA detector decided in 1989 and completed at the end of 1992 was constructed by four laboratories. IPN engineers played a very important role, particularly for electronics with the introduction of the new VXI standard.*

49 *Third example: the contribution of IPN to the ALICE detector of the LHC at CERN . Physicists and engineers from IPN deeply contributed to the conception of the "Dimuon Forward Spectrometer", un Addendum in 1996 to the ALICE Technical proposal. The important technical contributions from IPN focused on the tracking chambers and associated reading electronics. The collaboration ALICE published the first of the LHC physics papers with thousand signatures.*

50 *I will end my presentation with a very important dimension of IPN: technical activities and associated staff.*

At the beginning, people came from the laboratories directed by the Joliot Curie to which was added recruitment within the framework of the CNRS.

Growth was rapid with around 450 people including almost 70 engineers with a significant number of TPNs, a specific status which allowed high-level recruitment. A nominative list, only for engineers, appeared each year in the activity reports.

51 *The technical organization was established logically around the accelerators but with also other groups specialized in mechanics, electronics, cryogenics as well as administrative services.*

52 *At that time, many elements of accelerators or experimental setups were designed but could also be produced on site.*

53 *Some details on the IPN staff as it was presented in May 1977 in the laboratory's newsletter, an internal document regularly published since 1970 with its hundredth issue in 1992. These documents constitute a kind of chronicles about life at IPN.*

The number of researchers was 144 with a little bit more from CNRS (58 %).

444 technical and administrative employees, 56% of whom have TPN status. If we compare to today's laboratories, the number is impressive with a little more than 3 times the number of researchers. Many constructions could be carried out in the laboratory thanks to a large number, 70, of preparers and workers, categories of employees which have disappeared.

54 *As I have already pointed out, research will undergo profound transformations which will gradually be reflected in the organization of the technical supports as we can see here in 1999. Besides groups in traditional technical fields, thematic groups have been created: R&D accelerators with 2 groups and a group of R&D detectors which brings together different technologies in the same place.*

This development will be marked the following year by the creation of the "Division Accélérateurs" in the spirit of the project groups set up for the transformation of the synchrocyclotron in the 1970s and the construction of AGOR in the 1980s.

55 *IPN Orsay has just been declared a historic site by EPS*

History is built mainly on preserved documents and objects: the archives.

From the end of the 1970s, the direction of IPN asked the various scientific, technical and administrative groups to keep documents. It was done gradually with storage in different rooms in the laboratory. From the 1990s, a small group coordinated by Hélène Langevin began the identification of these documents and their classification, a delicate and necessary operation, sometimes interrupted due to lack of dedicated staff. This long and meticulous work has restarted within the framework of IJCLab.

I would like to thank Elisabeth Seibert for sending me digitized documents.

For a long period, two full-time photographers were part of the IPN staff and a large photo collection was gradually built up. My thanks to Luc Petizon for sending me photos.

A few objects have also been preserved. The most spectacular one of is the 10 meters linear accelerator which can be seen outside right next to this amphitheater.

56 *I will not conclude this historical overview focused on the first years, but, I will end with a quote from Fréderic Joliot-Curie taken from his 1958 paper*

''Nearly twenty-five years ago, so in the 1930s, fundamental research had, to a certain extent, the artisanal character so favorable to the development of the personality.

The need to explore matter more and more deeply has led to the invention of increasingly powerful technical means, many of which are large and complex. Quickly the artillery launching the projectiles: high voltages, cyclotron, betatron , synchrocyclotron, synchrotron, large and heavy setups, took place in the laboratories. A large technical staff became essential to ensure their operation. (...)

In this transition from the artisanal scale to the industrial scale , it seems essential to me to be aware of these dangers and to find the conditions of use of the equipment which will not suffocate the researcher. We cannot create original work by working like on assembly lines.

57 *I don't know what Joliot's opinion would be today, but I believe that beyond the scientific successes, he would not have been disappointed with the inventiveness and ultimately with life, or rather with the many scientific and technical lives that met at the ‘’Institut de physique nucléaire d'Orsay’’*

Thank you for your attention.