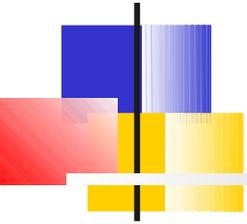
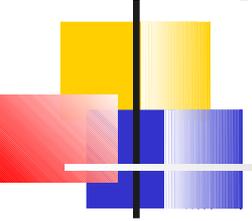


40 Years of the São Paulo Pelletron Accelerator

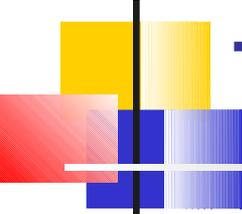


Roberto V. Ribas
Departamento de Física Nuclear
Instituto de Física - USP

Topics



- The origins of Nuclear Physics Research in Brasil.
- The Van de Graaff accelerator.
- The Pelletron Accelerator.
- Present & Future.
- I had a dream.



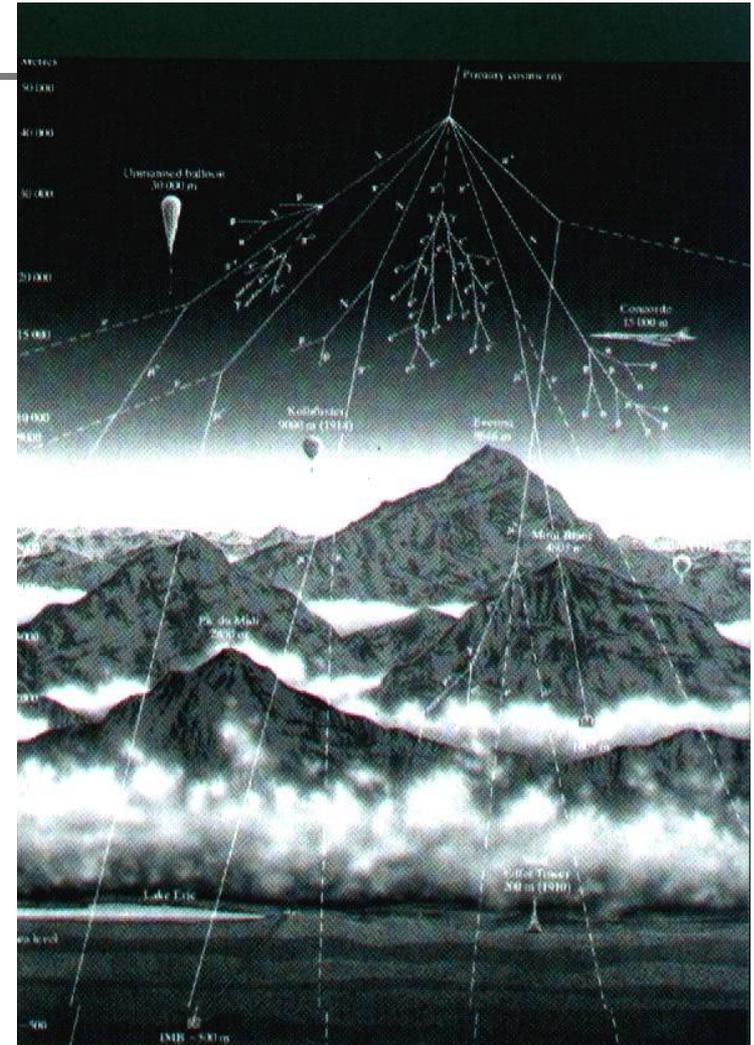
The beginning



- In 1934, with the foundation of USP, the Italian physicist *Gleb Wataghin*, was indicated by *Enrico Fermi* and came to *São Paulo* to start the Department of Physics, initiating researches in Physics in Brazil.

Penetrating Showers

- Few years after, the group led by Wataghin, with Marcelo Damy and Paulus Pompéia discovered the penetrating showers of cosmic rays (Phys. Rev. 57, p61, 1940)



The Pioneers



- Roberto Xavier, D. Maria, Occhialini, Marcello Damy, Seu José, Yolande Monteaux, Abraão de Morais, Mario Schenberg, Gleb Wataghin, Bentivoglio

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Cesare Giuseppe Mansueto Lattes



- Cesare Lattes initiated his under-graduated studies in physics in 1939. A few years after graduating he went to Bristol, where along with Powell e Occhialini, they discover the π meson in 1947.

The Great Discovery

Descobertas As 1947 e 1948

PUT IN PRODUCTION

Artificial Creation in Berkeley
Cosmic Beam Held Major
Key to Atom's Mysteries

TUESDAY, MARCH 9, 1948

First Meson Cosmic
In Laboratory Produced

[9-3-1948]

FOLHA DA MANHÃ

rio - As
e os Est

Atribui-se excepcional importancia à descoberta do meson
fisico brasileiro Cesare Lattes no dominio atomico

CONSIDERADA O MAIOR ACONTECIMENTO CIENTIFICO DOS ULTIMOS TEMPOS A PRODUÇÃO ARTIFICIAL DE "MESONS"

DECLARAÇÕES DOS PROFS. WATAGHIN E SOUSA SANTOS

[Folha da Manhã, 11-3-1948]

Antes de Co- te cientista pa oitem sua con rio do Ministei cisou esperar u is poltice a m que lá haviam clonava. Deves gente, as pesso linhas filitras p esforço incessa conferencia - ne absolutame Foi difícil ton obrigu a dno mais tarde

Antes, porém, de detalharmos a palestra que com ele tivemos, diga-mos que o sentido do trabalho de Eduarda Ribeiro, que bre um esca raio, esbarte Lattes. Se achamos meson, arti- pas fotogra- au acaso, co sil aprece: fessor Custi

Quando, mais tarde, nos encon- tramos com Cesar Lattes e com outro jovem fisico, o professor se sabe que o cicotron pode pro- duzir essa mesma atomica de fóton artificialmente, e sabe-se isto gra- as aos estudos de Cesar Lattes e

The new milestone in fundamen- tal nuclear research was reached by two young scientists working at

O jovem cientista brasileiro Cesar Lattes, em colaboração com outros pesquisadores da Universidade de California, e a quem se deve a des-

CESAR LATTES DE REGRESSO AO BRASIL

Esperado na segunda semana de dezembro o famoso cientista brasileiro

[A Manhã, 28-2-1948]

lugar ainda a sua cultura e seu preparo, os instrumentos inte-

nome foi mais tarde abreviado em

breve de (usa-á) ate 1948

mentous achievement at a conference in the presence of Dr. Watson

PROF. WATAGHIN

CESAR LATTES PRODUZIU O "MESON" ARTIFICIAL EM 9 DIAS DE TRABALHO

A Descoberta do Jovem Cientista Brasileiro Abriu o Caminho Para a Fisica Ultra-Nuclear — Uma Das Conquistas Mais Importantes da Ciencia Moderna — Perspectivas Ilimitadas — Fala ao DIARIO CARIOCA o Prof. Costa Ribeiro, Cate dratico da Nossa Escola de Filosofia

[A Manhã, 28-11-1948]

da E inec malde lha af nos fu lido desta redação, o Jor- a Robert Prescott, da ed "Fren" obtive da ata. l. e do: ocal: d resu d bert int: "a. "i. est: eru ligu: d ELE: l pi:

ações científicas ainda eram algo a

— "Quando Lattes me apresen- tou as duas chapas, existia das r

La Laboratory

O POVO E OS ESTUDANTES RECEBERAM COM VIVAS O DESCOBRIDOR DO MESON

Nenhum representante do governo ou do Ministerio da Educação no desembarque de Cesar Lattes — As primeiras declarações à reportagem — A ciencia a serviço da paz — Planos para o futuro

[Acervo Folha de São Paulo, 10-12-1948]

Dr. dr. Cesar Mansueto Lattes, que descobriu a

veio então o cientista brasileiro para a California, a fim de con-

dise: — "Da proxima vez trar-lhe-er

Whereas Dr. Lattes said that

PUT IN PRODUCTION

Artificial Creation in Berkeley
of Cosmic Beam Held Major
Key to Atom's Mysteries

2 YOUNG SCIENTISTS' WORK

Research Means Determining
of the Ultimate Particles of
Matter, Why They Exist

[11-3-1948]

Revelações sobre
descoberta de

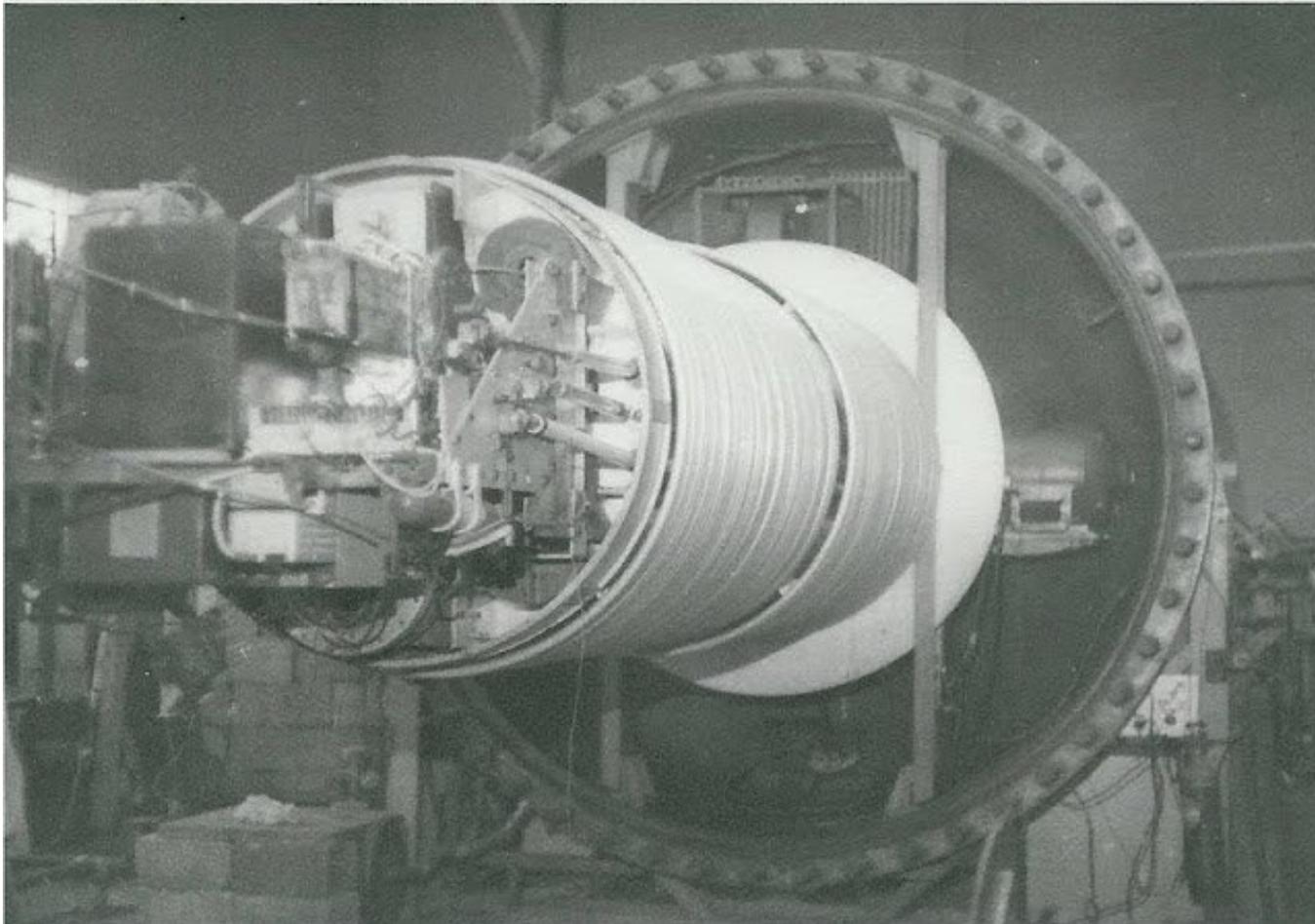
[O Estado de São Paulo, 24-3-1948] in the radiation labors other veteran staff men ously gave the spotlig Gardner and Lattes at

Progresses in the 1950's



- Soon after the WW-2, Marcelo Damy installs the Betatron and Oscar Sala initiate the construction of the Van de Graaff, both at the USP (in the new and actual main Campus).

The Van de Graaff



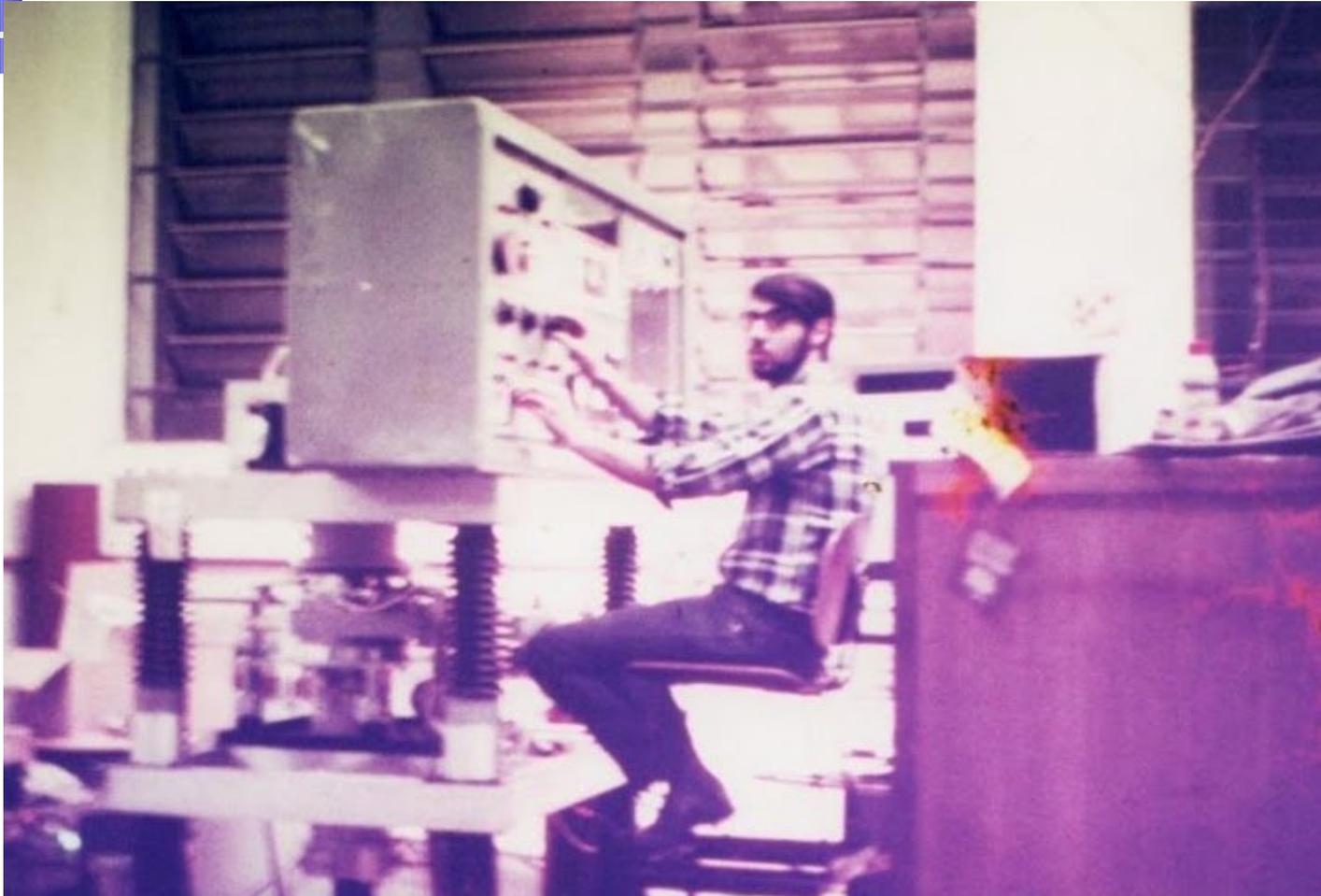
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Control Room



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Life on Risk?



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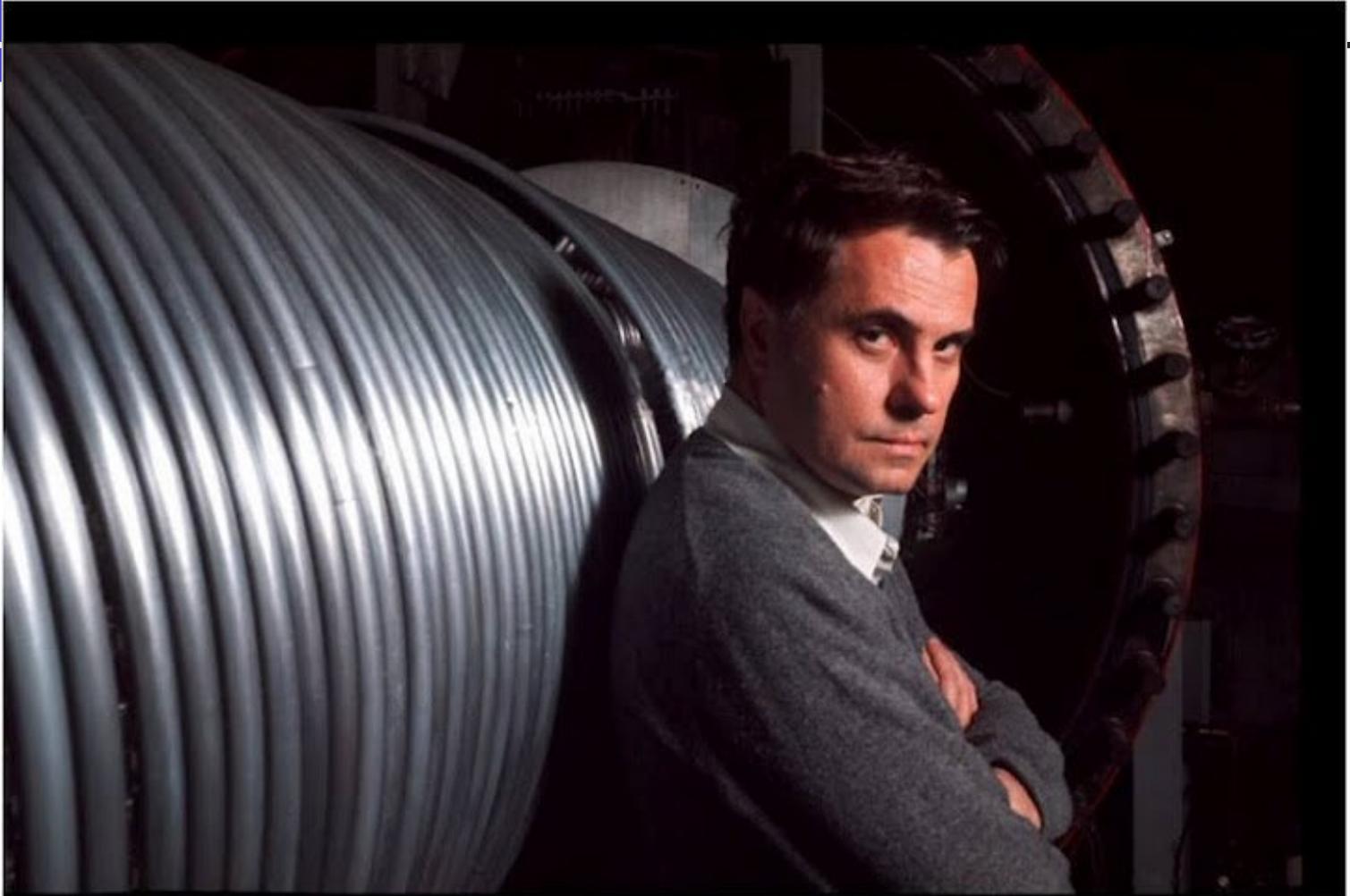
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Family Album



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The Famous Hollywood Actor



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The Limousine



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Yong Trentino Polga

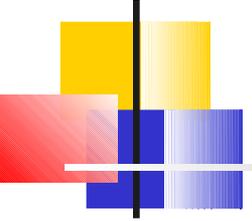


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The Van de Graaff Building



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Raymond Herb - NEC

- In 1965 NEC – National Electrostatic Corporation was founded.
- The project of an Electrostatic Accelerator, incorporating the new metal pellets charging chain, invented by A. Ferry and Ray Herb and an unique all metal and ceramic accelerating tube was starting.

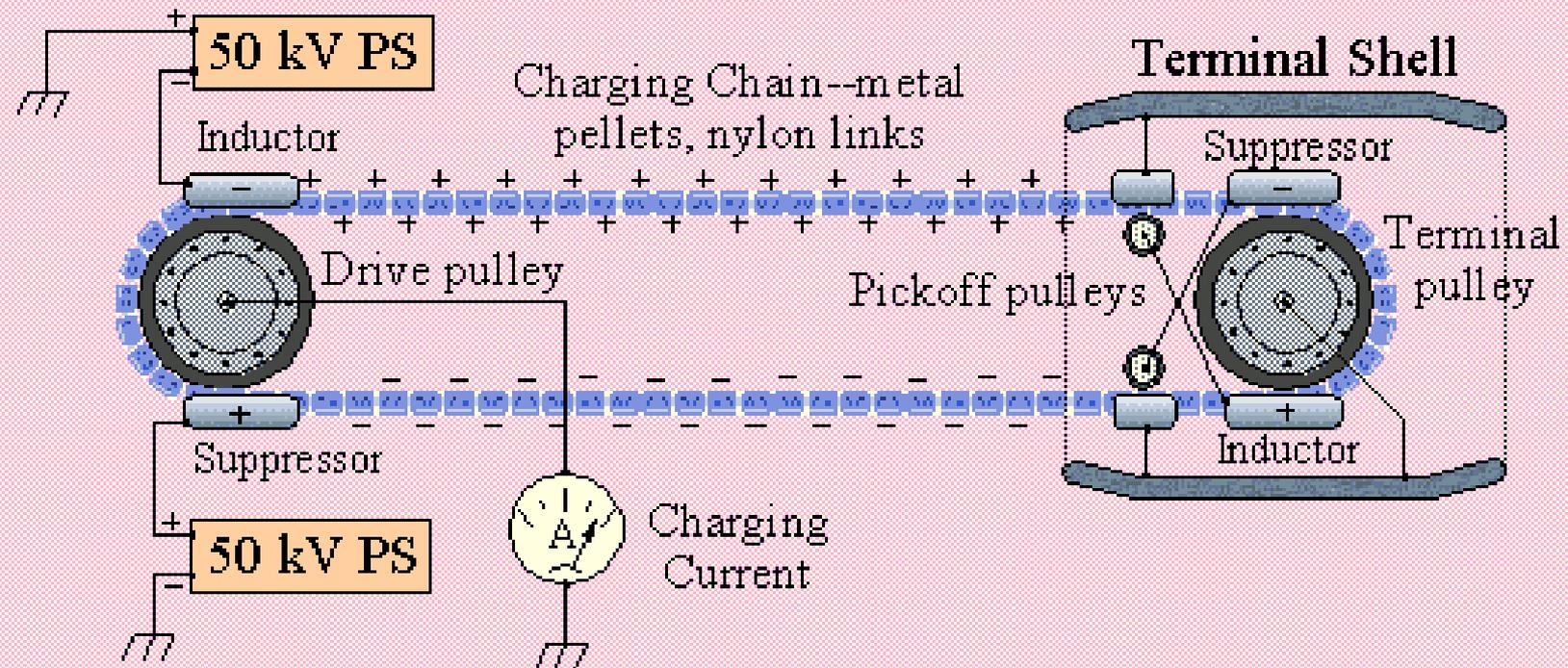
Accelerating Tube



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Pelletron Charging Chain

Pelletron Charging System
(Positive configuration shown)



The Building of the Tower



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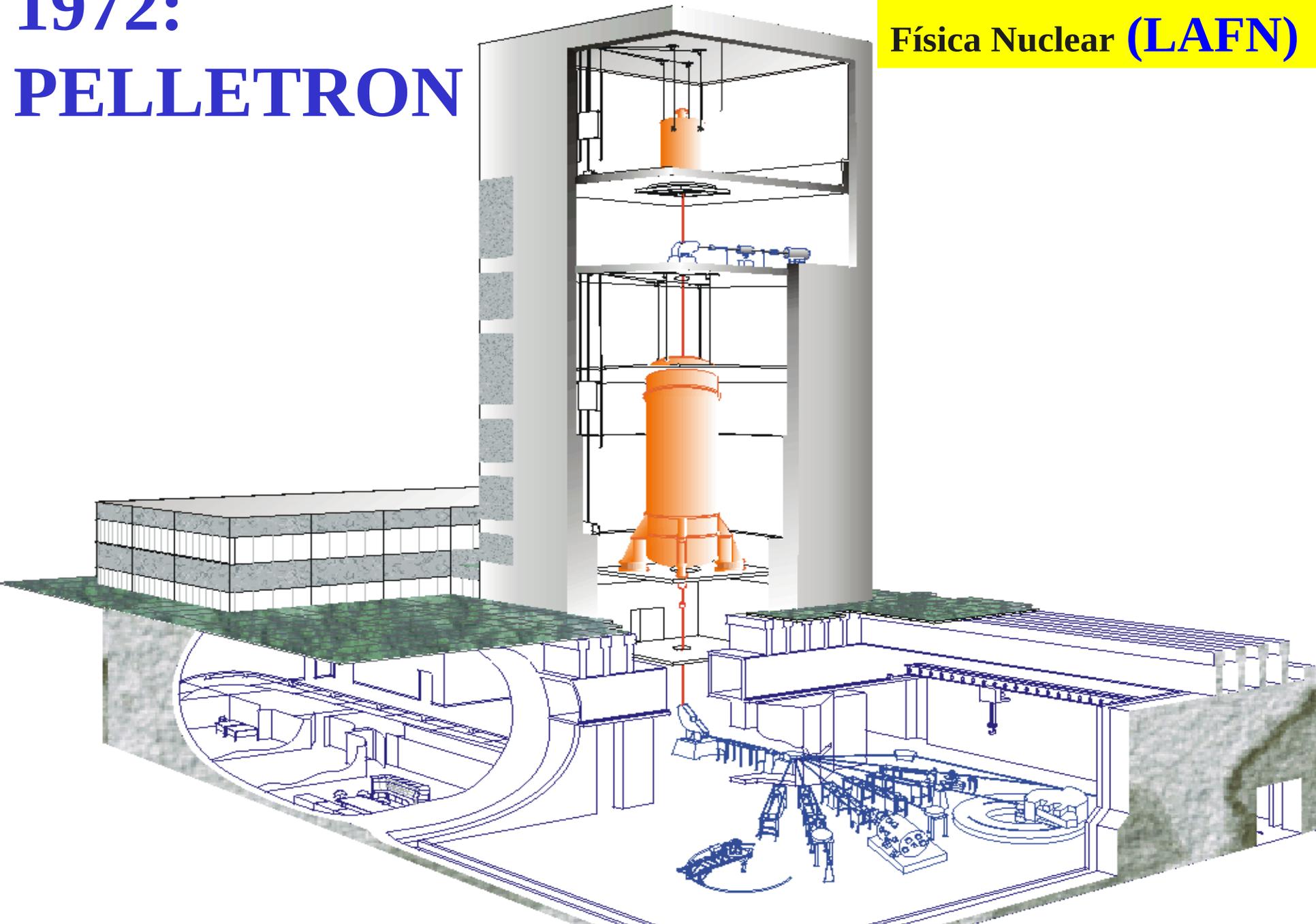
Construction Site



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1972:
PELLETRON

Laboratório Aberto de
Física Nuclear (LAFN)





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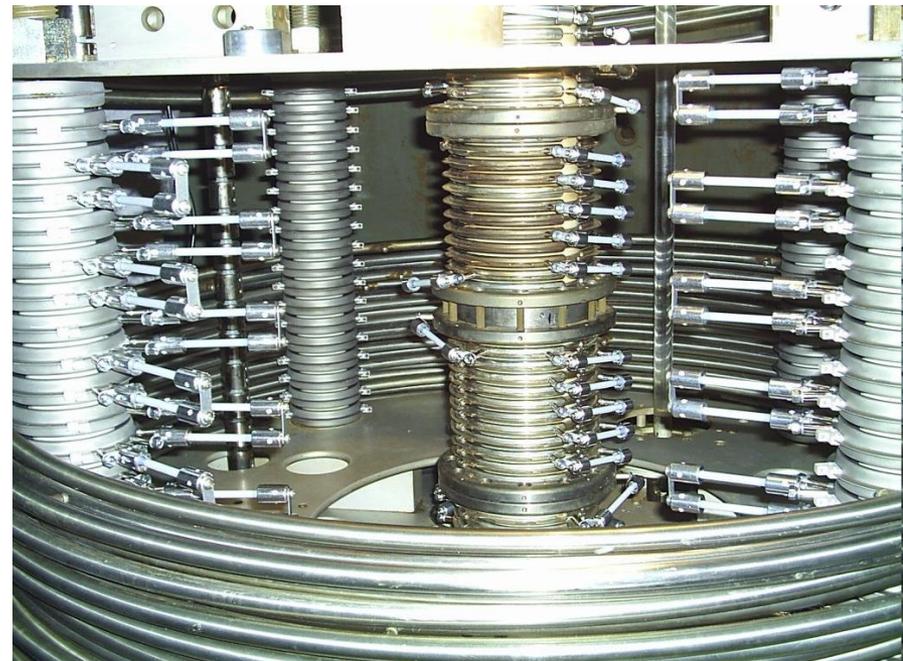
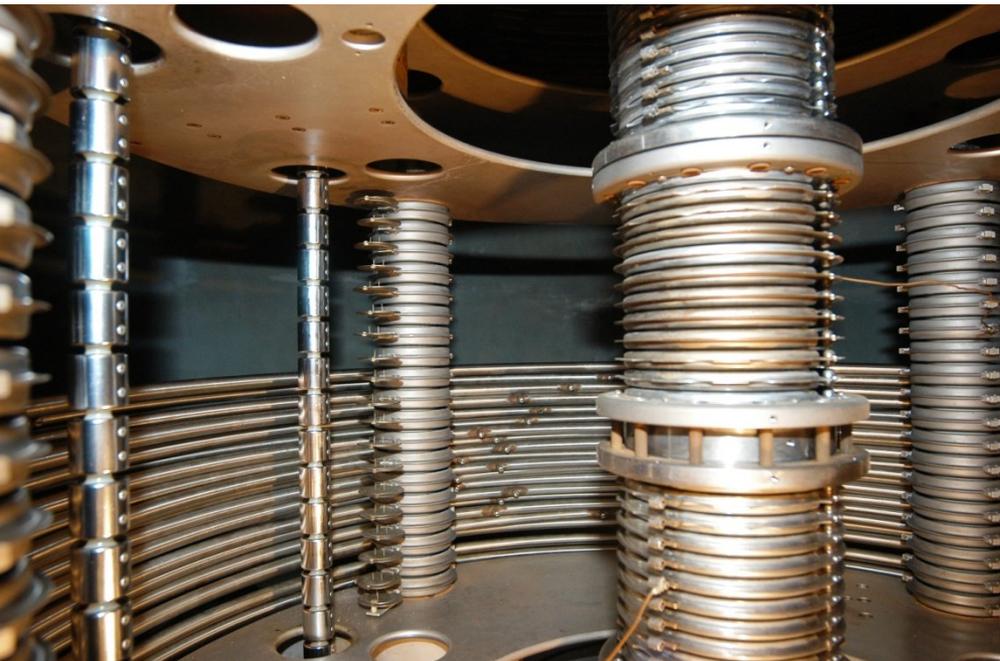


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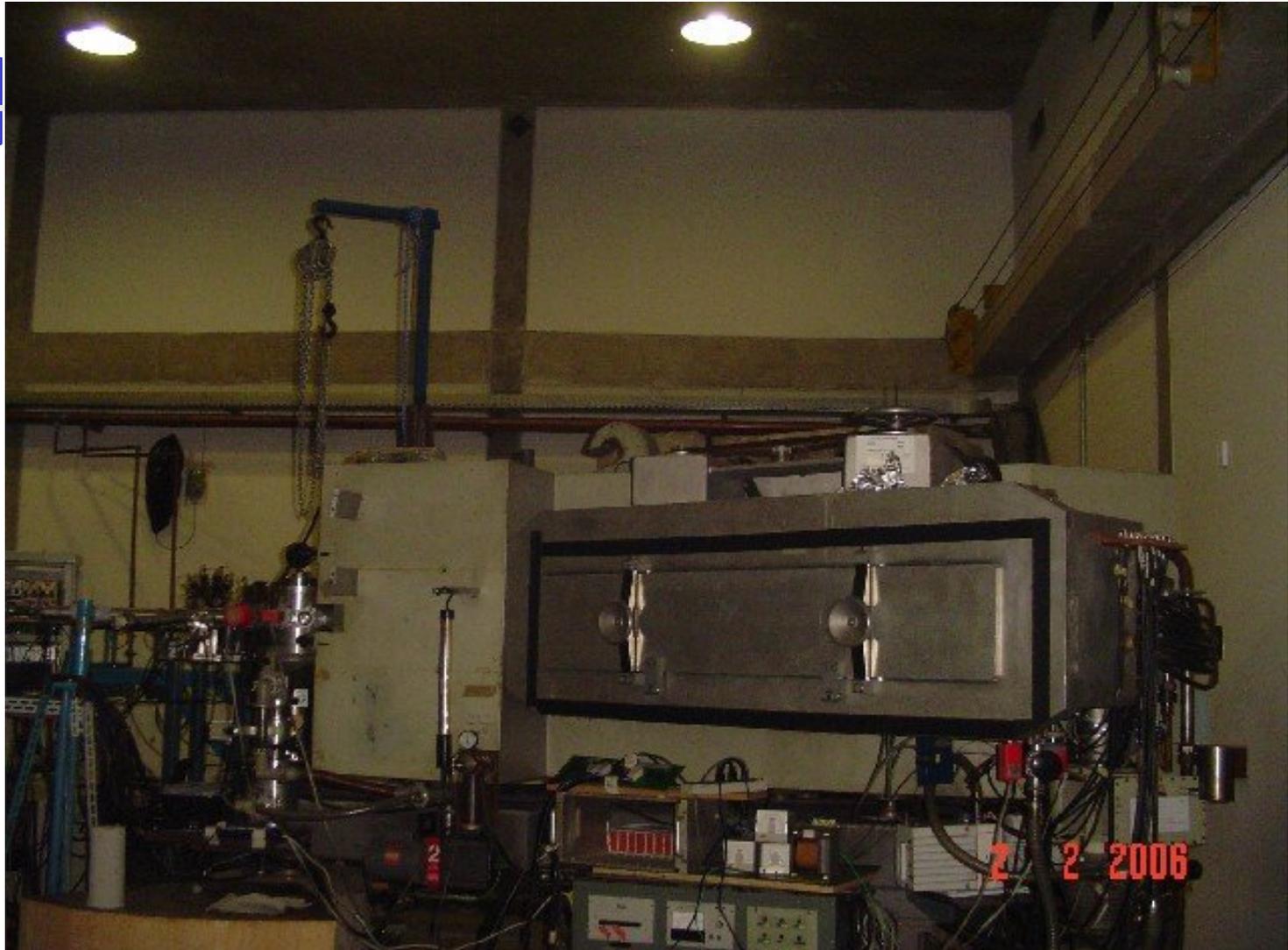
Many Problems in the Early Days...



Present



Espectrógrafo Magnético



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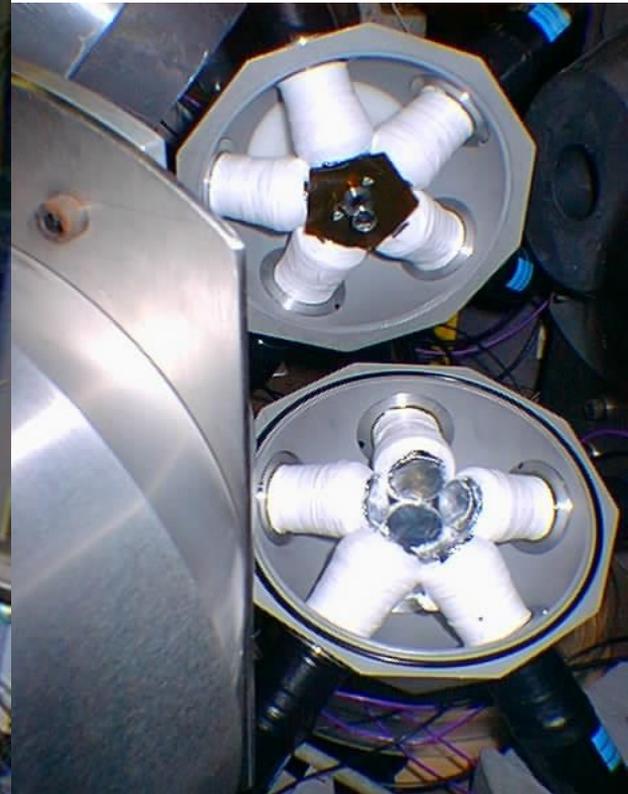
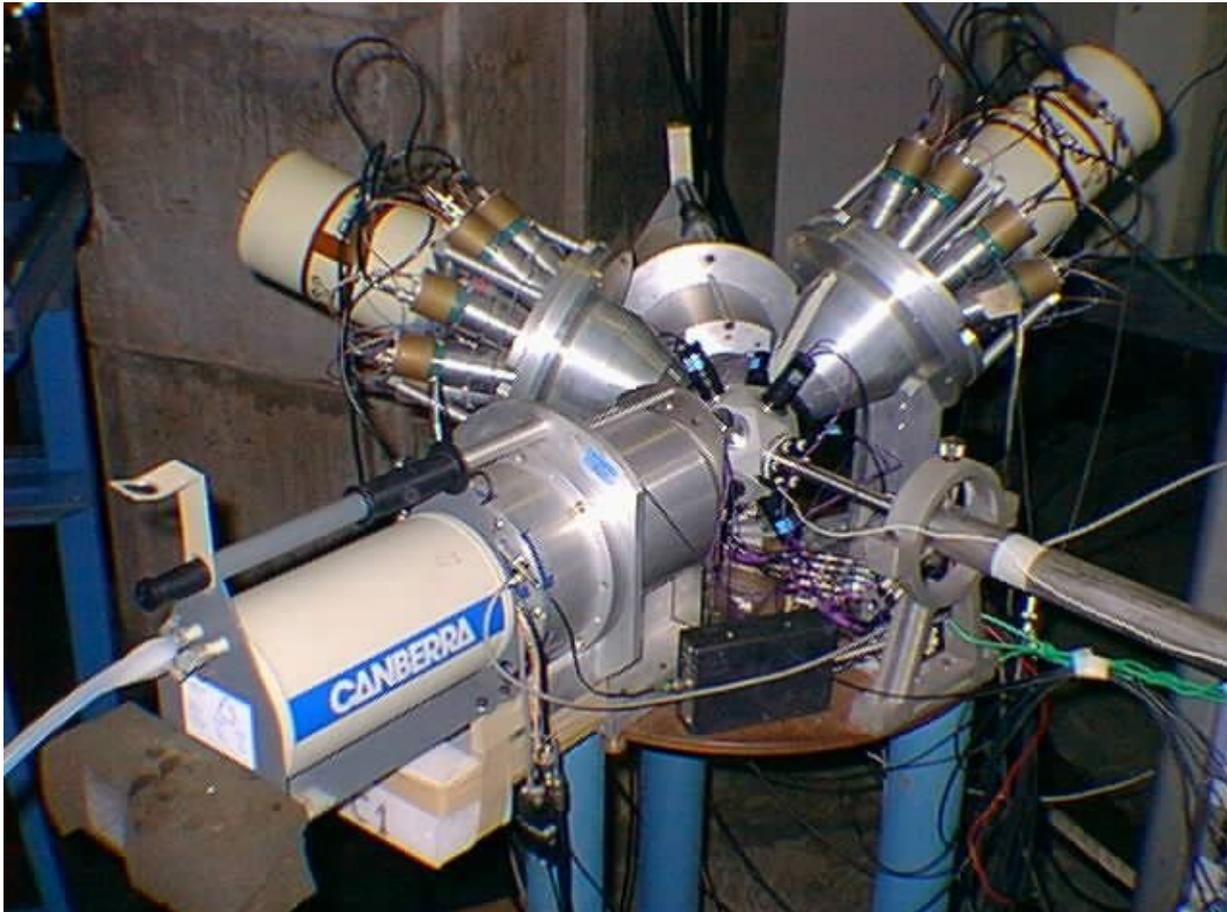
Espectrômetro Saci - Pererê

Pererê: 4 Detectores HPGe com supressores Compton

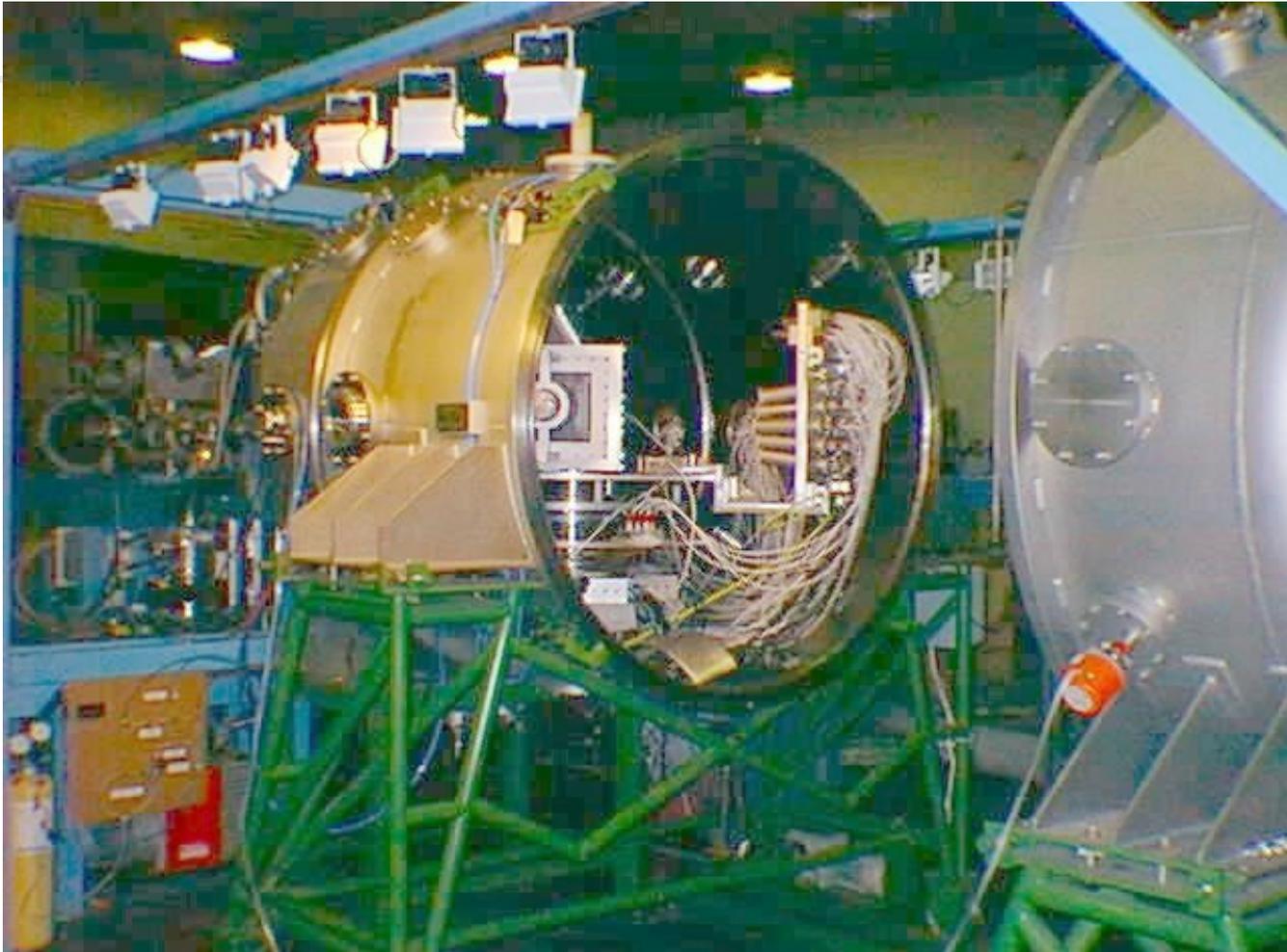
Pequeno Espectrômetro de Radiação Eletromagnética com Rejeição de Espalhamento

Saci: 11 telescópios $\Delta E-E$ compostos por cintiladores plásticos.

Sistema Ancilar de Cintiladores



Large Scattering Chamber



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Large Scattering Chamber



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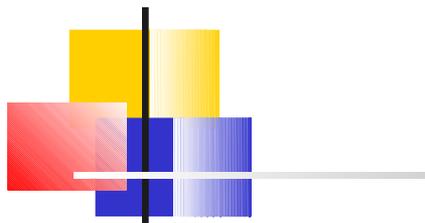
Position sensitive neutron detector



RIBRAS



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Exper.	Título	Responsável	Solic.	Conc. 1	Conc. 2
E15-c	Measurements using ERDA technique in Pelletron Laboratory	Nemitala Added	6	4	
E23-c	External PIXE and PIGE measurements in Pelletron Laboratory	Nemitala Added	6	4	
E43-c	Irradiation with ion beams	Nemitala Added	7	6	
E75-b	Revisitando a reação $6\text{He} + 27\text{Al}$	Leandro Gasques	7	4	
E76-b	Medidas da reação $12\text{C}(8\text{Li},4\text{He})16\text{N}$	Alinka Lepine	12	6	6
E77-b	Determinação do fator $S(E)$ astrofísico para a reação $16\text{O}+16\text{O}$	Leandro Gasques/ José R. B. Oliveira	12	9	3
E79b	Medida da distribuição de barreiras quase-elásticas do sistema $6\text{He} + 120\text{Sn}$	Adriana Barioni	15	12	
E81-b	Medidas de processos inelásticos e fusão incompleta com núcleos fracamente ligados estáveis pela técnica de coincidências gama-partícula	José Roberto B. Oliveira/ Leandro Gasques	18	12	6
E83-b	Investigação de reações de espalhamento elástico com feixes radioativos e alvo gasoso	Valdir Guimarães/ Valdir Scarduelli	6	6	
E84-b	Desenvolvimento de feixes radioativos com o sistema RIBRAS	Valdir Guimarães	6	5	
E86-b	Medidas de espalhamento elástico de $8\text{Li}+p$	Alinka Lepine	18	12	
E88-b	Excitação Colombiana do 8Li	Marlete Pereira Meira de Assunção	15	12	
E91-b	Procura de estados isoméricos	Nilberto H. Medina	10	10	
E93-b	Estudo da colisão do núcleo 6He com alvos leves em baixas energias	Rubens Lichtenthaler Filho	12	6	6
E94-b	Estudo da Reação de Transferência Alfa $12\text{C}(7\text{Be},3\text{He})16\text{O}$	Maria Carmen Morais	10	6	
E95-b	Medidas do espalhamento $6\text{He}+p$ e da reação $p(6\text{He},\text{alfa})t$	Rubén P. Condori/ Rubens Lich. Filho	14	10	
E96-b	Medidas de seções de choque de fusão de núcleos radioativos através do método de detecção de raios X-K	Viviane Morcelle	15	9	
E97-b	Assessing Collective Properties in Transitional Nuclei	Thereza Borello-Lewin	10	6	
E98-b	Alpha cluster states in light nuclei populated through the $(6\text{Li},d)$ reaction	Marcia R. D. Rodrigues	10	10	
E100-b	PRÉ ARCO-ÍRIS NUCLEAR NO SISTEMA $10\text{B} + 27\text{AL}$	José Roberto B. Oliveira/ D. Pereira	6	6	
E101-b	Estudo da reação $12\text{C}+12\text{C}$ em energias de interesse astrofísico utilizando o Método do Cavalo de Tróia	Alejandro Szanto de Toledo	18	9	
E102-b	Medidas do processos inelásticos e as fusões completa e incompleta para o sistema $6\text{Li} + 154\text{Sm}$.	José Roberto B. Oliveira/ D. Pereira	6	6	
E103	Medidas do retro-espalhamento de 8Li em 208Pb	Ernesto S. Rossi Jr/ Valdir Guimarães	6	6	
E104	Espalhamento elástico de núcleos radioativos leves ricos em neutrons	Valdir Guimarães	13	9	
E105	Experimental investigation of inelastic and alpha transfer channels on the $16\text{O} + 60\text{Ni}$ reaction at barrier energies	José Roberto B. Oliveira/ D. Pereira	6	6	



PELLETRON-LINAC



- The LINAC is a booster to the Pelletron beams, under construction. A project that had many problems, (mainly budget) but now we can see light at the end of the tunnel...

LAFN

Laboratório Aberto de Física Nuclear



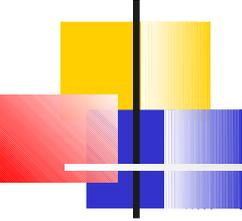
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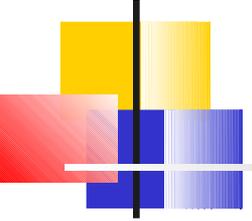


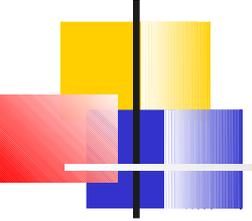
Visiting the Past

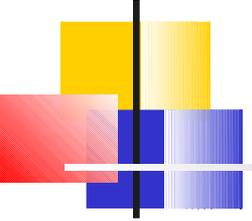
(A Midsummer Night's Dream)

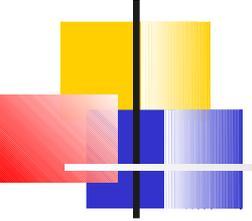
- Just before the dawn of Saturday, January 21, this year, I had a very interesting dream. I woke soon after and could spend about five minutes reminiscing about the details of the dream, before they escaped me. Following, I report what I could remember.

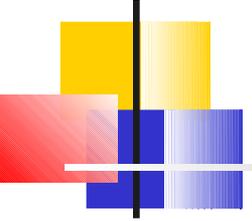
- 
- We were in the Pelletron Laboratory, with several people working on some installation or fixing something. Several technicians and students were fixing small pieces on the floor, along a wide corridor (the Lab of the dream was very different from the real one, as is usual in dreams). At one moment, someone handed me a small transparent plastic envelope with one of these 35mm slides, containing, what I thought, was a photo of the location at the time of its construction. Apparently I should look at this photo to see where we could put things, etc...

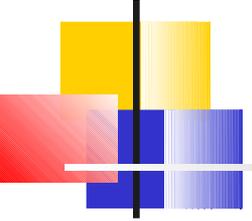
- 
- I thought it would be useless – where would I get a slide projector these days? Anyway, I put the slide, still within the envelope up to the light and near my eyes. To my surprise, it was not what I was thinking, but a fantastic hologram, which had been made at the time of the inauguration of the Laboratory. If I looked at a particular part of the Laboratory with the hologram, what I would see was that part, just like it was at the time when the hologram was built! A kind of *Google Streets*, but with a much more interesting technology, as you will notice.

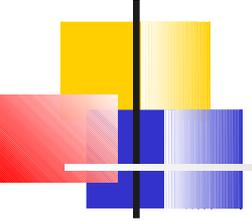
- 
- I first looked at the door of a bathroom, next to where I was, and I could see an old lady, looking as she were over 90 years old, coming out of the toilet. I removed the slide from my eyes and the reality showed that there was nobody there. I looked again and realized that moving a little bit the hologram, I could still see the old lady taking a step forward, leaving the bathroom. I concluded that the hologram had had a relatively large exposure to the point of registering some movement. I was fascinated and went looking elsewhere in the laboratory.

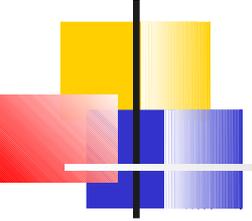
- 
- In the next scene I remember, I was inside an office room, brand new, all very white walls, with a few desks. On these desks, there were small lamps, and, as I do not remember them, I took one in my hand to see better. They seemed very fragile and I concluded that they did not last long, as I do not remember them. Then I went to a large hall, where the *Laboratory Inauguration Ceremony* was taking place. Then, I no longer needed the hologram, and walked through the people at the event. I do not think there were any sounds, nor that the people were aware of my presence.

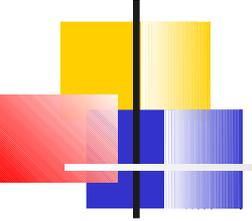
- 
- Then I saw a boy, who seemed to me about 13-14 years old and was standing on a stool or box; the only child within the much older adults. I asked him - and who are you? To my surprise, he answered me, seriously - I'm *Professor Victor!* (he was the only person to say something to me). I asked him: *Victor Rotberg?* and he said yes. So I gave him a big hug and said - *Victor,* how long it has been, since we met! (*Victor Rotberg* was a young assistant professor at that time, and years after he left our University and is now at the *University of Michigan, USA*).

- 
- Then I started walking around, looking for people who I might know. It took a while to find *Nobuko* and *Kasuo Ueta* (a couple of professors, now retired but still active at the Department). I also gave a big hug on them, demonstrating enthusiastically the joy of finding them still very young. They smiled, probably without understanding what was happening, but there was no dialogue. The detail is that *Kasuo* wore a dark gray suit, and *Nobuko* was dressed with a suit of the same tone, I think it was the same fabric...

- 
- I continued my search for acquaintances and then saw *Alex* (my colleague in the Department), much taller than he really is, wearing one of these gabardine raincoats, down to his feet. I also hugged and greeted him, receiving only just that same smile in response. So, I thought - and what about my colleagues, fellows of IC at the time, are they here? I started to look for them. I saw someone who could be *Marcão* (*Marcos Nogueira Martins*, also my colleague at IFUSP), but I got closer and saw it was not.

- 
- I knew I would not be there, since I only come to the *Department of Nuclear Physics* about a month after the Inauguration, i.e., in February 1972. Then I went down to the lower floor and saw a lady down on her knees, taking care of two small children. It seemed to be *Violeta Porto* (a professor at the time, now retired), but at the moment I could not remember her name and I didn't ask her. I helped her a bit with the kids and...

- 
- I woke up! I returned to the present and into the real world. About a hour after, I got up, took breakfast and went for a walk with my dog *Lola*. We took the way toward the IFUSP, not so far from my home. I got into the Lab and went directly to the ground floor, where the plaque celebrating the Inauguration is located. I looked at the date: January 26, 1972! I thought that it might be the exact date, but the dream anticipated by a few days the 40th anniversary of the Pelletron Laboratory!

- 
- I still remember very well my arrival at the *Department of Nuclear Physics*, in February 1972, to begin my *Undergraduate Research Program* (Scientific Initiation). I went to the main office and asked for *Prof. Pentino*, that would be my advisor. *Pentino?* - It would not be *Trentino*? So I went to *Trentino Polga's* office, we talked about what I would do, and I'm there until today.
 - (translation of an e-mail message sent to my family and the people involved in the dream, in January 23, 2012)

The Inaugural Plaque



The Inauguration Ceremony



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Rua Maria Antonia, 1968



The Military at the Campus



Oscar Sala & Dirceu Pereira

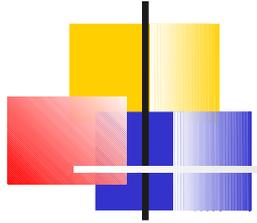


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Wayne Seale



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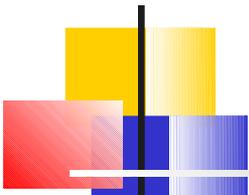
Thank for your attention.



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Simultaneous Penetrating Particles in the Cosmic Radiation

Some experiments were made to examine whether showers with two or more penetrating particles could be found in cosmic radiation.

The apparatus used has been described in a previous paper.¹ It consisted of a fourfold coincidence set provided with a Neher-Harper circuit; its coincidence time was of 7×10^{-7} min. The counters used were of 100 cm² area and were filled with hydrogen and argon at a total pressure of 15 mm of mercury. Their efficiency, measured according to the method of Street and Woodward, was 100 percent.

The arrangement of the counters consisted of two sets of telescopes in coincidence (Fig. 1), each counting only rays which produce coincidences through a layer of lead 16 cm thick.

The results of the measurements (made at an altitude of 800 m above sea level), are given in Table I. The observed average frequency of the showers was 15 times greater than

Souza Santos have independently discussed the absorption processes of the mesotron producing radiation in the high atmosphere and have pointed out that in order to explain the high absorption of this radiation in the upper region of the atmosphere and the penetrating power of the mesons, it is necessary to assume that at least two mesotrons are simultaneously created (which makes improbable the inverse process.)

A further report of these measurements will be published elsewhere.

G. WATAGHIN
M. D. DE SOUZA SANTOS
P. A. POMPEIA

Department of Physics,
São Paulo University,
São Paulo, Brazil,
December 8, 1939.

¹ Annaes da Academia Brasileira de Ciencias. T. XI, p. 1.

² La Ricerca Scient., in the press.

³ Annaes da Academia Brasileira de Ciencias, in the press.

Grupos de pesquisa

Física Nuclear Experimental

Espectroscopia de Raios Gama - Gama

Reações com Íons Pesados - GRIP

Dinâmica de Reações Nucleares com Íons Pesados-Leves - IPL

Reações Diretas e de Núcleos Exóticos - Exóticos

Fusão de Núcleos Pesados - FNP

Íons Pesados Relativísticos - IPR

Física Aplicada

Laboratório de Dosimetria da Radiação - Dosimetria

Laboratório de Cristais Iônicos, Filmes Finos e Datação - Lacifid

Física Aplicada com Aceleradores - GFAA

Biofísica Molecular com Aceleradores - BMA

Física Teórica

Física de Hádrons - Grhafite

Teoria Quântica Relativística - Quanta

Ensino

Ensino de Física - GEF

Laboratório de Análise Materiais com Feixes Iônicos

