JINR--94-1

Joint Institute for Nuclear Research
Laboratory of Nuclear Problems

Annual report 1993

Joint Institute for Nuclear Research
Laboratory of Nuclear Problems

Annual report 1993

Dubna 1994

INTRODUCTION

This book is a compilation of the short annual status reports on current experiments in which the physicists from the Laboratory of Nuclear Problems of JINR participate.

The experiments were briefly described (including a schematic layout of the apparatus, list of participants and institutions) in our previous issue entitled *"Current Experiments in Laboratory of Nuclear Problems of Joint Institute for Nuclear Research in 1992", Dubna, 1993, 93-186.*

In this book the status of the experiments (preparation/data-taking, etc) corresponds to the situation at the end of 1993.

It should be borne in mind that the above information is provided by the leaders of experimental teams and is given under their responsibility.

V.A.Bednyakov
LNP JINR Scientific Secretary

Current experiments listed in this book

Experiment	Title	Spokesman from JINR

Experiments on Intermediate Energy Physics

Phasotron Programme

LNP-1 ($M \to \bar{M}$)	**Experimental investigation of muonium - antimuonium conversion.**	O.V.Savchenko
LNP-2 (IKS)	**μ-Catalysed fusion reactions in a mixture of hydrogen isotopes.**	V.P.Dzhelepov, V.G.Zinov, V.V.Filchenkov
LNP-3 (YASNAPP-2)	**Effect of nuclear deformation on probabilities of α-, β- and γ-transitions in nuclei with $N \simeq 88$. Structure of nuclei in the transitional region ($N \simeq 88$).**	V.G.Kalinnikov
LNP-4	**Mass determination of unstable isotopes via measurements of β-decay energies.**	K.Ya.Gromov
LNP-5	**Study of α-decay in rare earth region.**	K.Ya.Gromov
LNP-6 (MUSPIN)	**The study of the condensed state of the matter by μSR technique.**	V.A.Zhukov
LNP-7	**Experimental studies for production of some medically important radionuclides: ruthenium-97, tungsten-178, actinium-225.**	V.A.Khalkin
LNP-8	**Investigation of spin-neutrino angular correlations in processes of capture of polarised muons by light nuclei.**	V.G.Egorov, I.A.Yutlandov
LNP-9	**Search for narrow dibaryon resonances in the proton-proton bremsstrahlung reaction at the energy below the pion threshold.**	A.S.Khrykin

LNP-10	**Low-temperature nuclear orientation of nuclei far from stability line.**	M.Finger

Experiments using external accelerators

LNP-11 (OBELIX)	**Study of antiproton and antineutron annihilations at LEAR with OBELIX detector.**	M.G.Sapozhnikov
LNP-12	**Search for muonium-antimuonium conversion $(\mu^+e^-) \rightarrow (\mu^-e^+)$.**	S.M.Korenchenko
LNP-13 (COSY-18) (COSY-20)	**Study of the cumulative fragmentation of the deuteron in the exclusive polarization approach and of the subthreshold kaon production at the synchrotron COSY.**	V.I.Komarov
LNP-14	**Precise measurement of the probability of the $\pi^+ \rightarrow \pi^o e^+ \nu_e$ decay.**	S.M.Korenchenko
LNP-15 (DISTO)	**Measurement of spin observables in $pp \rightarrow pK^+Y$.**	I.Falomkin
LNP-16	**Investigation of beta-neutrino angular correlation in super allowed beta-decay of short-lived nuclei.**	V.G.Egorov
LNP-17 (TGV, NEMO)	**Search for double beta-decay of ^{100}Mo.**	V.B.Brudanin
LNP-18	**Search for the decay $K^+ \rightarrow \pi^+\mu^+e^-$.**	B.Zh.Zalikhanov, S.M.Korenchenko
LNP-19	**Direct measurement of the branching ratio for the decay of the η-meson into two photons.**	L.Lytkin
LNP-20	**Study of subthreshold pions production and high energy light fragments emission in nucleus-nucleus collisions at heavy ion accelerators of the Laboratory of Nuclear Reaction of JINR.**	K.O.Oganesyan

LNP-21	**Study of low energy pion-nucleus interaction at LAMPF.**	K.O.Oganesyan
LNP-22 (E-225)	**Determination of NN-scattering amplitudes in the energy region from 1.1 to 2.7 GeV and Search for a structure around T_{kin}=2.1 GeV.**	B.M.Khachaturov
LNP-23	**The experimental study of the np elastic scattering amplitudes at 16 MeV.**	Yu.A.Usov
LNP-24	**Spin observables in neutron-proton elastic scattering.**	M.J.Finger

Experiments on High Energy Physics

Experiments at CERN

LNP-25 (DELPHI)	**The DELPHI Detector**	A.Olshevski
LNP-26 (WA-91)	**A search for centrally produced non-$q\bar{q}$ mesons in proton proton interactions at 450 GeV/c by using the CERN Ω Spectrometer.**	N.Russakovich
LNP-27 (WA-92)	**Measurement of beauty particle lifetimes and hadroproduction cross–section.**	N.Russakovich
LNP-28 (NOMAD) (WA-96)	**Search for the oscillation $\nu_\mu \leftrightarrow \nu_\tau$.**	S.Bunyatov
LNP-29	**Lifetime measurement of $(\pi^+\pi^-)$ atoms to test low energy QCD prediction.**	L.L.Nemenov

Experiments at Serpukhov accelerator

LNP-30 (HYPERON)	**Study of radiative K - decays with HYPERON spectrometer.**	V.B.Flyagin

LNP-31 (SERP-136)	Search for electron neutrino oscillations and investigation of neutrino-nucleon interactions at the accelerator U-70.	S.A.Bunyatov
LNP-39 (NEPTUN)	Study of spin effects at 400 to 3000 GeV using an internal jet target at UNK.	Yu.M.Kazarinov
LNP-40 (SERP-149)	Study of asymmetry in inclusive reactions $\pi^- p \to \pi^{\pm,0} X$ and $\pi^- p \to K_L X$ at 40 GeV/c and $pp \to \pi^o X$ at 70 GeV/c.	Yu.M.Kazarinov

Experiments at JINR synchrophasotron

LNP-32 (FAZA)	Investigation of the multifragmentation of target nuclei in nucleus-nucleus collisions at intermediate and high energies.	V.A.Karnaukhov

R&D and projects of new facilities

LNP-33 (SDC)	Solenoidal detector collaboration.	A.N.Sissakian
LNP-34 (ATLAS)	General-purpose pp experiment at the Large Hadron Collider at CERN.	N.A.Rusakovich
LNP-35 (TCF-A)	Tau-charm factory — accelerator studies.	E.A.Perelstein
LNP-36 (TCF-D)	Detector for C-tau factory of the JINR storage accelerator complex.	G.A.Chelkov
LNP-37 (MINGEN)	Deuteron cyclotron complex as a meson and neutron generator.	A.A.Glazov
LNP-38 (AEROGEL)	Development of technology for production of silicon aerogel and construction of cherenkov counters based on it.	A.I.Filippov

Experiments on Intermediate Energy Physics

Phasotron Programme

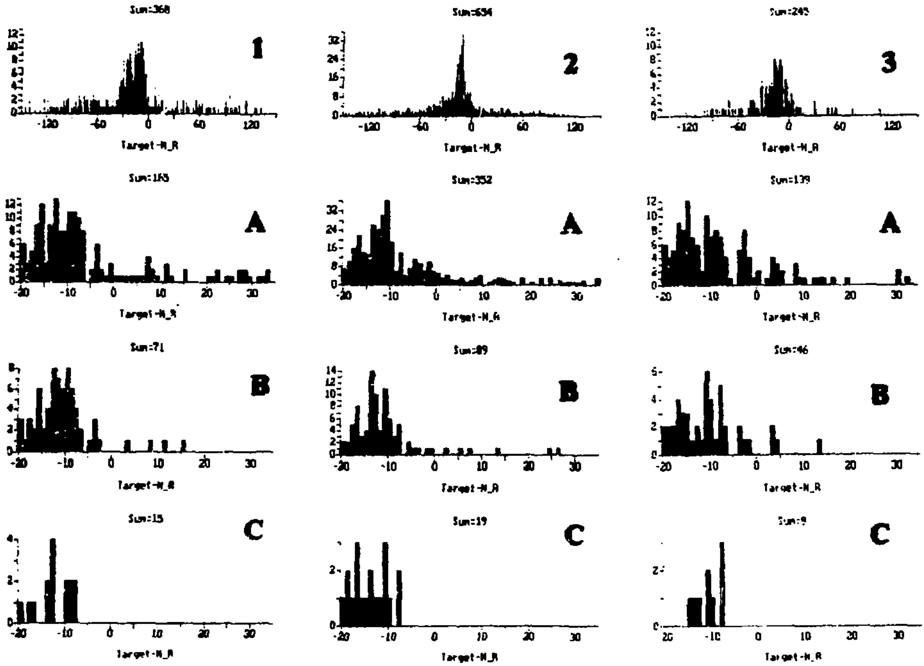


Fig. 1. Experimental spectra for distribution of registered electrons with respect to the normal to the SiO_2 target surface for three data sets (1 — $N_{\mu^+} = 4.5 \times 10^{10}$; 2 — $N_{\mu^+} = 7.0 \times 10^{10}$; 3 - $N_{\mu^+} = 2.7 \times 10^{10}$). A, B, C stand for the detailed distribution of the electron spectrum near the target surface: A is the primary spectrum, B is the electron spectrum with physical restrictions imposed on possible variation ranges of measured and calculated parameters over the whole energy spectrum width. C is the same in the energy range 46.5-53 MeV. The target centre co-ordinate is 11 mm. 0 is the vacuum chamber window centre. -6÷32 observation limits for muonium antimuonium conversion.

$M \to \bar{M}$	LNP-1
Status	Data-Taking

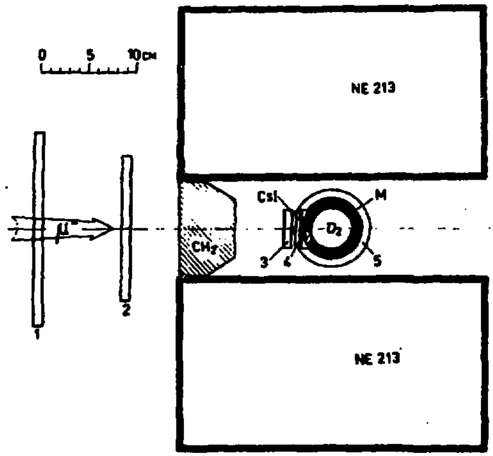
Experimental investigation of muonium–antimuonium conversion

LNP JINR, Dubna; St Petersburg Nuclear Physics Institute, Gatchina, Russia

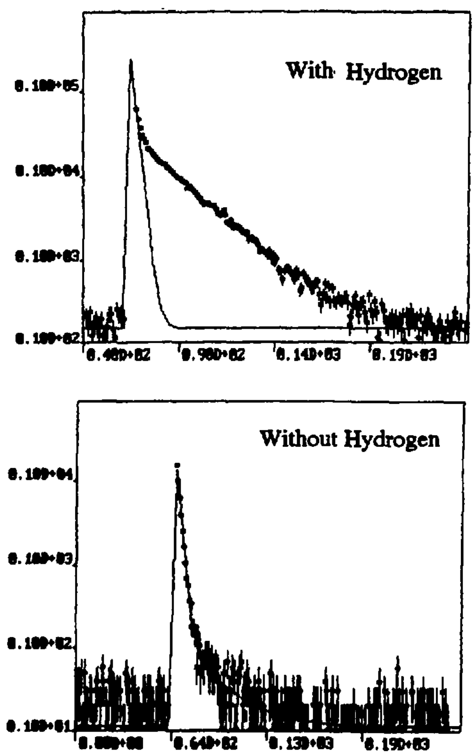
LNP, Dubna	V.M.Abazov, V.A.Baranov, A.N.Bragin, S.A.Gustov, A.P.Fursov, N.P.Kravchuk, T.N.Mamedov, I.V.Mirokhin, O.V.Savchenko
PINP, St Petersburg	N.P.Aleshin, N.F.Bondar, E.G.Drukarev, V.A.Gordeev, A.Yu.Kiselev, E.N.Komarov, A.G.Krivshich, O.V.Miklukho, Yu.G.Naryshkin, V.A.Sknar, V.V.Sulimov, I.I.Tkach

Spokesman from PINP: **V.A.Gordeev**
Spokesman from JINR: **O.V.Savchenko**

The processing of the data from the experiment on the search for muonium-antimuonium conversion has been completed. The experiment was carried out by the joint PINP-JINR group in 1991–1992 with a surface muon beam from the JINR phasotron. A total of 3.5×10^{11} muons passed through the target for all the conversion measurement time (about 640 hours of data acquisition). No events associated with the muonium–antimuonium conversion were observed. The conversion probability was found to be $W_{M\bar{M}} < 3.9 \times 10^{-7}$ (90% CL), which is 1.7 times better than the existing value (LAMPF, 1990: $W_{M\bar{M}} < 6.5 \times 10^{-7}$, 90% CL). A new value for the muonium–antimuonium conversion constant is $G_{M\bar{M}} < 0.13$ (90% CL). Tentative experimental data are published, a summing-up article is under preparation. Another series of the muonium–antimuonium conversion measurement is prepared. The conversion probability limit of 4×10^{-8} is expected to be achieved, which is below the theoretically possible minimum limit for observation of the conversion ($W_{M\bar{M}theor} < 6 \times 10^{-8}$). New electronic equipment for the experiment MAKS is being made at PINP, a new system of proportional chambers with co-ordinate read-out is being fabricated, a new target is being made. The meson separator of the magnetic system at the LNP JINR is being redesigned to increase the intensity of the separated beam of surface muons.



Layout of the experimental apparatus



Time spectrum of electrons from the decay of muons stopped in hydrogen
($25 cm^3$ LH)

IKS	LNP-2
Status	Data-Taking

μ-Catalysed fusion reactions in a mixture of hydrogen isotopes

LNP JINR, Dubna; PNC "Kurchatov Institute"; Russian Research Institute for Inorganic Materials, Russia

LNP, Dubna	V.G.Grebinnik, D.L.Demin, Yu.G.Zhestkov, A.D.Konin, V.S.Melezhik, A.I.Rudenko, V.I.Satarov, N.V.Sergeeva, V.T.Sidorov, A.P.Kustov, M.M.Petrovsky
RNCKI	L.I.Ponomarev, V.E.Markushin, M.P.Faifman
RNRIIM	V.K.Kapyshev, V.V.Gushchin, M.P.Malek, A.I.Meliantsev, L.A.Rivkis

Spokesmen: **V.P.Dzhelepov, V.G.Zinov, V.V.Filchenkov**

In 1993 an additional test of the experimental set-up was performed. The set-up consists of the liquid tritium target and the system of its gas filling, beam detectors, full absorption neutron detectors and the electronic circuits which: 1) separate the muon stops in the target, 2) register many-cycle events caused by the muon catalysis process (14 MeV neutrons), 3) provide the data handling. The appropriate set of the computer codes has been written, which provides the control of the data taking process.

Runs performed at the JINR phasotron with the target filled with protium and deuterium proved reliability of all systems of the experimental apparatus.

Profile and momentum optimization of the muon beam enable us to obtain up to 10 muon stops per second for the hydrogen volume. This intensity is sufficiently large to perform the accurate measurements. Excellent background/ effect (1/300) for electrons from decay of muons stopped in the target was observed. The test run with tritium was carried out. During the experiment it tu ned out that the tritium extraction from the standard storage beds after long keeping time and its subsequent purification at the level of 10^{-7} was a much more difficult process than it was assumed previously. This is due to high contamination with helium-3 produced from the tritium beta decay. A new tritium handling system is now developed together with the Experimental Physics Institute (Arzamas). The main problem is the financial support. We are searching for its sources now.

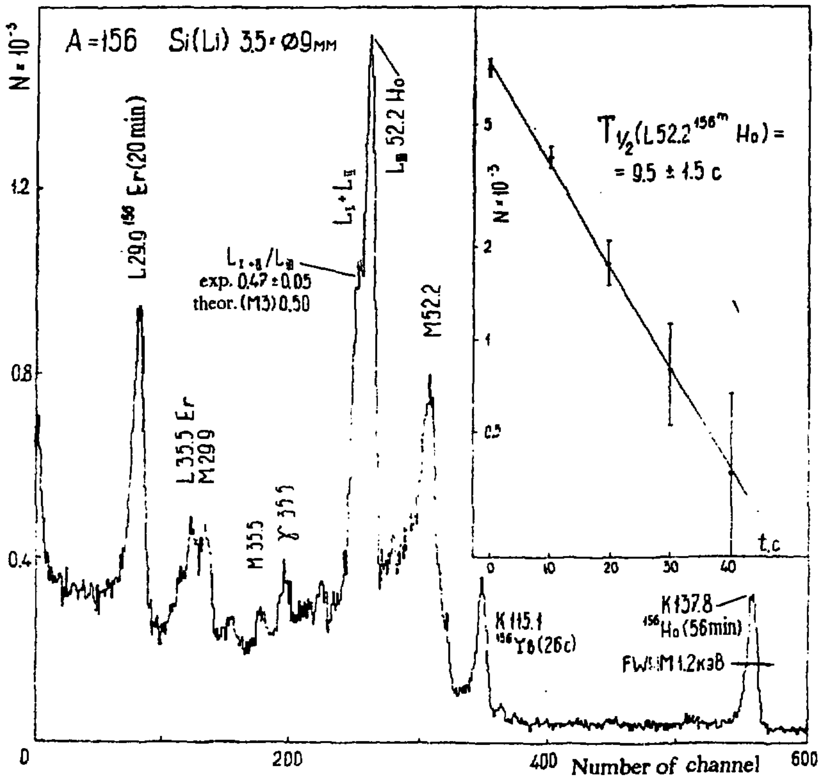


Fig.1. Internal conversion electron spectrum for short-lived A = 156 nuclides. The insertion shows time dependence of the decrease in the intensity of L52.2 lines (the contribution to the intensity from the decay of 20-minute ^{156}Er is subtracted).

YASNAPP-2	LNP-3
Status	Data-Taking

Effect of nuclear deformation on probabilities of α-, β- and γ-transitions in nuclei with N$\simeq$88. structure of nuclei in the transitional region (N$\simeq$88).

LNP, FLNR JINR, Dubna; PINP, St Petersburg; St Petersburg University; Russia Institute of Nuclear Physics, Rzez, Czech Republic; Institute of Nuclear Physics, Krakow; Krakow University; Lublin University, Poland; Institute of Nuclear Research and Nuclear Power, Sofia, Bulgaria; Ulan-Bator University, Mongolia

LNP, Dubna	I.Adam, N.A.Bonch-Osmolovskaya,V.M.Gorozhankin, V.G.Kalinnikov, N.A.Lebedev,V.A.Morozov, B.P.Osipenko, F.Prazak, V.I.Stegailov, A.A.Solnyshkin,P.Caloun
FLNR, Dubna	Yu.P.Gangrsky, B.N.Markov
PINP, St Petersburg	Yu.N.Novikov
Univ., St Petersburg	G.V.Veselov
INP, Rzez	D.Venos
INP, Krakow	A.V.Potempa
Univ., Krakow	G.Lizurej
Univ., Lublin	J.Wawryszczuk
INRNP, Sofia	M.Mikhailova
Univ., Ulan-Bator	N.Ganbaatar

Spokesman: **V.G.Kalinnikov**

To study the structure of excited nuclear states in a transition rare earth region (N = 88–90) and the nuclear deformation effect on transition probabilities, spectra of γ-rays, internal conversion electrons, fast and delayed $\gamma\gamma$ and $e\gamma$ coincidences for some short-lived nuclides were measured by means of spectrometers with semiconductor detectors.

Forty-four γ-transitions are reliably assigned to the decay of ^{157}Yb ($T_{1/2}$ = 36 s) [1]. Gamma-transitions of 69.5, 105.7, 242.1 and 341.9 keV were observed in the spectra of delayed coincidences. The ^{157}Yb decay scheme proposed for the first time involves several low-spin states of $^{157}_{69}$Tm$_{88}$, including head levels of some bands excited in the nucleus in reactions with heavy ions.

The decay scheme that we earlier proposed for ^{159}Yb (1.4 min) is substantially revised. Multipolarities of 13 γ-transitions are established, which allowed quantum characteristics of excited levels in $^{159}_{69}$Tm$_{90}$ to be determined less ambiguously [2].

Radioactive decay of A = 156 nuclei was investigated [3] to resolve the contradiction that concerns characteristics of ^{156}Ho isomers (see figure). The half-life of the isomeric transition $2^+ \to 5^+_g$ was measured by the decrease in intensity of L52.2 lines and found to be $T_{1/2} = 9.5 \pm 1.5$ s. A technique for determining nuclear moments of rare earth nuclides (about 10^9 atoms) with resonant laser fluorescence is under preparation. The technique will be used to measure spin of ^{156g}Ho.

Methodical work is done to prepare an experiment to find the 39.7-keV M3 isomeric transition between states of greatly different shape in ^{152}Eu. L and M conversion lines of this transition will be superposed on the Auger electron spectrum. Auger spectra of neighbouring rare earths will be systematically studied with an electrostatic beta-spectrometer [4].

[1] V.I.Stegailov et al. Abstr. Int.Conf. Nucl. Spectroscop. Nucl. Struct., 1994.
[2] I.Adam et al. JINR preprint D6-93-112, Dubna, 1993.
[3] V.G.Kalinnikov et al. Int.Conf. Nucl. Spectr. Nucl. Struct., St Petersburg, 1993, p.67.
[4] A.Kovalik and M.A.Mahmoud. J.Electr. Spectr. Rel.Phen., 61(1993), 326–336.

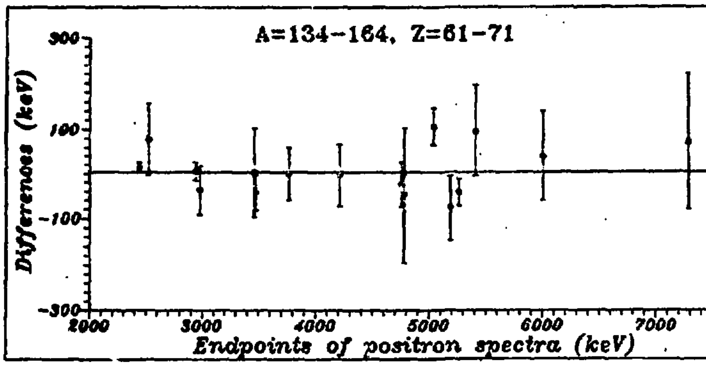


Figure 1. Comparison of the measured positron spectra end point energies with literature data

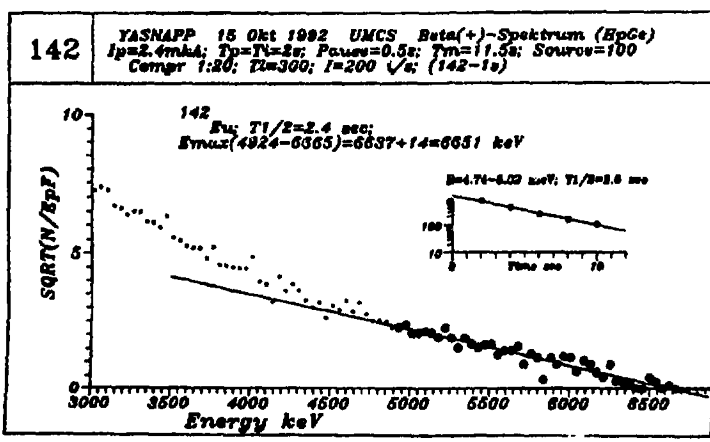


Figure 2. Curie plot positron spectrum of the ^{142}Eu, $T_{1/2}$=2.4 s.

LNP-4
Status Data-Taking

Mass determination of unstable isotopes via measurements of β-decay energies.

LNP JINR, Dubna; Physics Institute of St Petersburg University, Russia; Physics Institute of University Mary Sclodowski, Lublin, Poland; Nuclear Physics Institute, Krakow, Poland; Tashkent University, Uzbekistan

LNP, Dubna	Gromov K.Ya., Kalinnikov V.G., Fominykh V.I., Gorozhankin V.M., Yuldashev M.B., Sereteer D.
Univ., St Petersburg	Veselov G.V., Sergienko V.A.
PILU, Lublin	Wawryszczuk J.
NPI, Krakow	Potempa A.W.
Univ., Tashkent	Chalmatov A.H., Butabaev Yu.

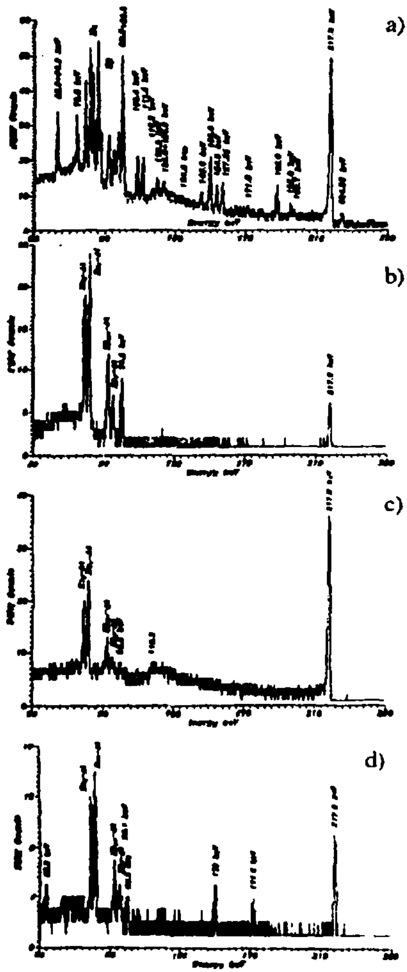
Spokesman: **K.Ya.Gromov**

The procedure for correction of the positron spectra measured on HPGe-spectrometer have been elaborated. Effects of summing of positron and annihilation γ-quanta pulses and positron back- and side-scattering have been taken into consideration. Curie plot analysis of corrected positron spectra is used for obtaining the spectrum end point energies. The comparison of the measured positron spectra end point energies for some nuclides with early known beta decay energies (Fig. 1) shows that our systematic errors are not more than 30-50 keV at the end point energies up to ~7.0 MeV.

Positron spectrum end points for 24 nuclides were measured, fourteen of them for first time. Curie plot of the ^{142}Eu, 2.4 sec positron spectrum is shown in Fig. 2 for example. Taking into account decay schemes of these isotopes we determined beta decay energy differences. The results are submitted for publication.

1. G.V.Veselov, K.Ya.Gromov, S.V.Evtisov et al. Beta-decay energy determinations for neutron deficient rare earth nuclides, A=134-164. "Izvestiya RAN, ser.fiz.", v.58, No.1, 1994.

2. G.V.Veselov, K.Ya.Gromov, A.V.Potempa et al. Method of determination of end point energy for positron spectra measured by HPGe-detector. Submitted to the Book of Abstracts of Int.Conf. on Nucl.Spectroscopy and Nucl.Structure, Kharkov, 19-22 April 1994.



Spectra of γ-ray coincidented with fine structure α-lines of ^{221}Fr

a) Single γ-spectrum of ^{225}Ac and ^{221}Fr;

b) γ-spectrum in the E_{α}= 6.244 MeV window (population of the 99.5 keV level);

c) γ-spectrum in the E_{α}= 6.127 MeV window (population of the 217.6 keV level);

d) γ-spectrum in the E_{α}= 5.982 MeV window (population of the 367.5 keV level).

LNP-5	
Status	Data-Taking

Study of α-decay in rare earth region.

LNP JINR, Dubna; Voronezh University, Russia; Physics Institute of Mary Curie-Sklodowskie University, Lublin, Poland; Tashkent University; Samarkand University, Uzbekistan

LNP, Dubna	Chumin V.G., Gorozhankin V.M., Gromov K.Ya., Fominykh V.I., Kalinnikov V.G., Yuldashev M.B., Sereteer D.
Univ., Voronezh	Kadmenski S.G., Vakhtel V.M.
PILU, Lublin	Wawryszczuk J.
Univ., Tashkent	Chalmatov A.H., Niyazov R.
Univ., Samarkand	Muminov T.M.

Spokesman: **K.Ya.Gromov**

For lack of money to pay for runs on JINR phasotron the on-line α-experiments on the YASNAPP-2 Isol facility were not carried out in 1993.

In framework of the program of this experiment the α-decay line investigations of ^{225}Ac ($T_{1/2}$ = 10 d) and its daughter nuclei ^{221}Fr (4.8 min) and ^{217}At (32 ms) have started. ^{225}Ac sources were separated from ^{229}Th ($7\cdot10^3$ y) by the procedure elaborated by V.A.Khalkin et al. (see Exp. LNP-7). On the basis of studies of γ-spectra coinciding with ^{225}Ac and ^{221}Fr fine structure α lines the level schemes of ^{221}Fr and ^{217}At are constructed. 43 γ-transitions are placed between ^{221}Fr levels with energies: 26,0; 36,0; 38,5; 99,6; 99,8; 100,8; 108,3; 150,1; 195,7; 224,6; 234,5; 393,3 and 404.4 keV. Seven γ-transitions are placed between ^{217}At levels: 99,5; 217,9; 271,4 and 367,6 keV. Investigations of $\gamma-\gamma$-coincidences in the ^{225}Ac and ^{221}Fr decays and of α-spectra of ^{225}Ac decay chain on a large magnetic α-spectrograph are in progress.

1. K.Ya.Gromov, M.Ya.Kuznetzova, Yu.V.Norseev et al. ^{225}Ac($\alpha-\gamma$)-Coincidences in the ^{225}Ac decay. Preprint JINR P6-93-233, "Izvestiya RAN, ser. fiz.", v.58, 1, 1994.
2. Yu.S.Butabaev, R.A.Niyazov, A.Kh.Kholmatov et al. ($\alpha-\gamma$)-Coincidences in the ^{221}Fr decay. Submitted to the Book of Abstracts of Int. Conf. on Nucl. Spectroscopy and Nucl. Structure, Kharkov, 19-22 April 1994.
3. R.A.Niyazov, Yu.S.Butabaev, A.Kh.Kholmatov et al. ($\gamma-\gamma$)-Coincidences in the ^{225}Ac and ^{221}Fr decays. Submitted to the same conference.

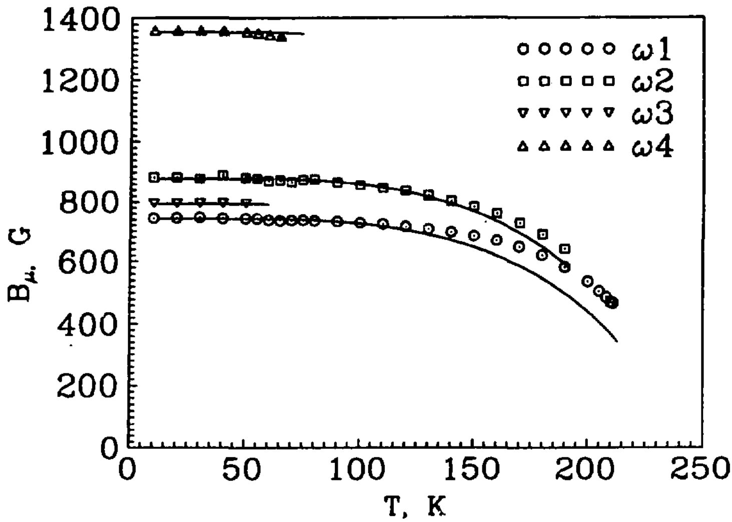


Figure 1: Temperature dependence of muon spin precesion frequencies in CuO (Solid line is the Brillouin function S=1/2).

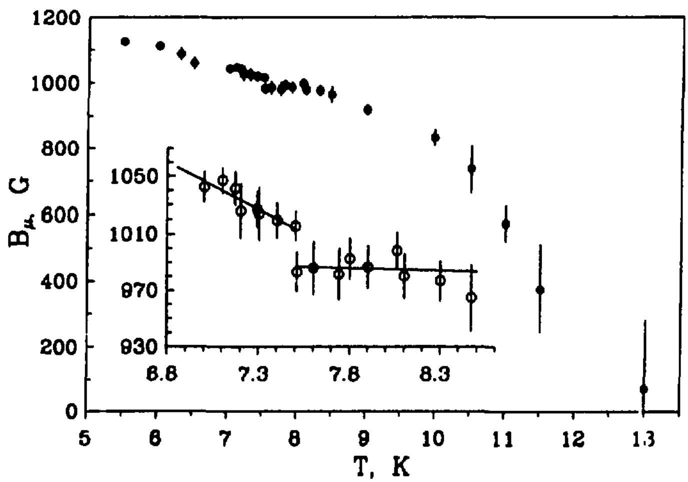


Figure 2: Local magnetic field on the muon in $Y_2Cu_2O_5$ measured in ZF-μSR experiment.

MUSPIN	LNP-6
Status	Data-Taking

The study of the condensed state of matter by μSR (Muon Spin Rotation) technique.

LNP JINR, Dubna; RSC "Kurchatov Institute", Moscow; ITEP, Moscow; Inst. of Structural Macrokinetics, Chernogolovka; Moscow Inst. of Physics and Technology, Moscow Region; Inst. of Inorganic Chemistry, Moscow; Moscow State University; St Petersburg Nuclear Physics Inst., Russia; Inst. of Low Temperatures and Structural Studies, Wroclaw, Poland; Physical Inst., Praha, Czech Republic .

LNP, Dubna	Chaplygin I.L., Duginov V.N., Grebinnik V.G., Gritsaj K.I., Lazarev A.B., Mamedov T.N., Olshevsky V.G., Pomjakushin V.Yu., Shilov S.N, Zhukov V.A.
RSCKI, Moscow	Nikolsky B.A., Ponomarev A.N., Kirillov B.F., Pirogov A.V., Suetin V.A.
ITEP, Moscow	Firsov V.G., Kudinov V.I., Obukhov Yu.V., Savelev G.N.
ISM, Chernogol.	Kotov N.M.
IIC, Moscow	Kravchenko E.A.
MSU, Moscow	Nikiforov V.N.
ILTSS, Wroclaw	Klamut J., Zaleski A.J., Gorin R.
PI, Praha	Kapusta S., Sebek J., Kovacek V.

Spokesman: **V.A. Zhukov**

In 1993 the following results were obtained:

1. Transverse field and zero field cooling measurements were performed with the high-purity CuO powder in the temperature range 10–240 K. The magnetic phase transitions were detected at 227 K and 213 K. Four Larmor precession signals were observed in the commensurate phase below 55 K, but with temperature increasing above 190 K, the precession became having only one component (Fig.1). In the incommensurate phase (213 K$< T <$237 K) the Larmor precession was not observed because of too large damping.

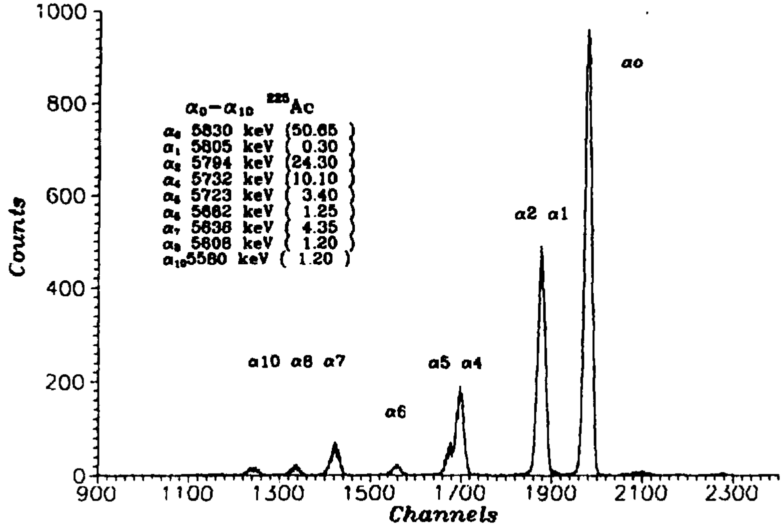
2. Compound $Y_2Cu_2O_5$ was investigated in the temperature range 4.2 K–30 K. Apart from the known magnetic phase transition at 13 K we observed a peculiarity in the temperature dependence of the local magnetic field on the muon near the temperature 7.5 K, which can be interpreted as an additional magnetic phase transition caused by a change in the magnetic ordering of the copper subsystem (Fig.2).

3. Experiments with antiferromagnetic ceramic samples $La_{2-x}Sr_xCuO_4$ have been performed in the temperature range 10–300 K. The zero field muon spin polarization function obtained below the Neel temperature clearly shows a nonzero initial precession phase $\phi \approx -0.35$ rad. We propose an explanation based on existence of the dynamical magnetic fields on the muon.

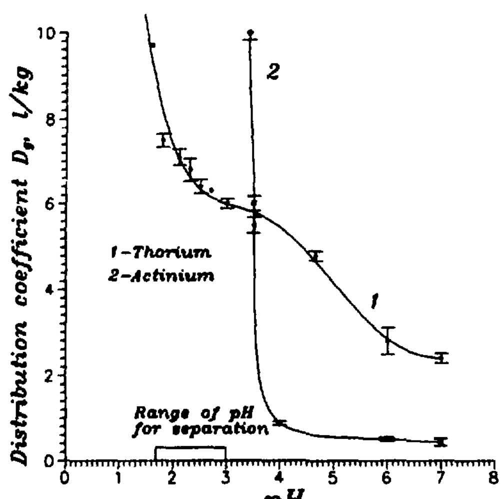
4. The residual polarization of negative muons in p-type Si has been investigated. Muon spin relaxation was observed at temperatures below 30 K. The relaxation rate at T=30 K is equal to 0.18(8) μs^{-1}. The relaxation rate grows with the decrease in temperature and at 4.2 K exceeds 30 μs^{-1}. In the region T< 30 K the data on the relaxation rate are well described as $\Lambda = BT^{-q}$, where q=2.75. Power dependence of Λ may evidence the essential role of the phonon mechanism in the relaxation of the electron momentum of the acceptor center.

5. The muon polarization is measured for its reactions with molecules having the biological value, as protecting living organisms against the radiation. The reactiveness of these reactions is defined.

6. Processes of muon and muonium interaction with microadmixtures of inorganic ions and radiative defects are investigated in α-quartz monocrystalls. A picture of muonium reactions with the replacement ions is developed. Constants of the chemical reaction rate between muonium and the series of ions are defined.



α-spectrum of ^{225}Ac.
Magnetic double-focusing α-spectrometer;
Resolution at $\alpha_o \leq 6$ keV.



Dependence of dynamic distribution coefficients of Ac and Th between cation-exchange resin and ammonium citrate solution.

Experimental studies for production of some medically important radionuclides: ruthenium-97, tungsten-178, actinium-225.

LNP, JINR, Dubna; Institute for Physical Chemistry, Moscow; Institute for Diagnostic Systems, Department of World Laboratory, Moscow; Institute of Biophysics, Ministry of Health, Moscow, Russia

LNP, Dubna	Khalkin V.A., Norseev V.A., Stregailov V.I., Tsupko-Sitnikov V.V., Zaizeva N.G.
IPC, Moscow	Peretruchin V.F.
IB, Moscow	Korsunsky V.N.
IDS, Moscow	Marchenkov N.S.

Spokesman: **V.A. Khalkin**

Technetium and tantalum target have been designed. They allow up to 80% of internal proton beam from the JINR phasotron to be "captured" and heating of the metals to their melting point to be avoided at heat release of 3-4 kW cm^{-2}. The mean amounts of desired radionuclides produced in nuclear reactions $^{99}Tc(p,3n)^{97}Ru$, $E_p = 48$ MeV, and $^{181}Ta(p,4n)^{178}W$ were found to be 50 mCi/h (±15%) for ^{97}Ru and 4.5 mC/h (±15%) for ^{178}W.

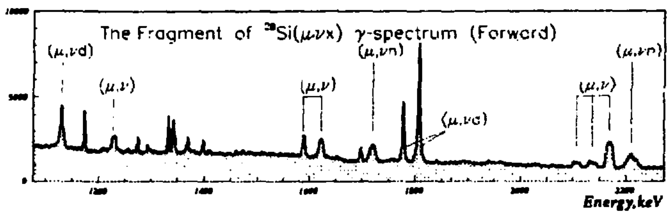
The first successful experiments on distillation of ruthenium tetra-oxide from solution with high concentrations of technetium acid have been carried out. Multiple ion-exchange separation of ^{225}Ac and 5-10 mg of ^{229}Th in citrate solution without losses of parent radionuclide is proved to be possible (actinium generator).

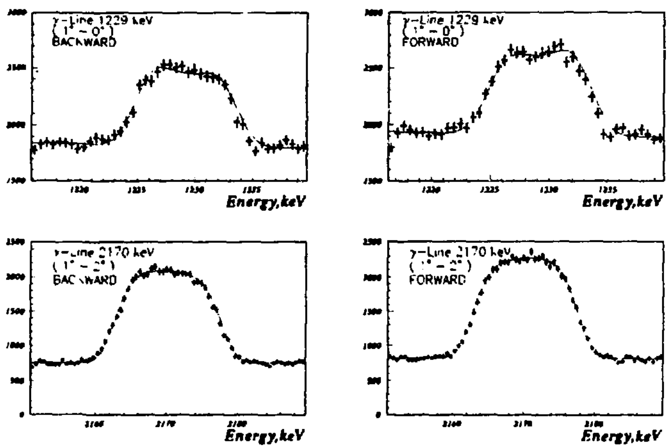
A method to produce "thin" α-radiation sources of ^{225}Ac and its decay products is developed for precision α-spectrometry with FWHM $\simeq$ 5 keV on the ^{225}Ac 5830-keV line.

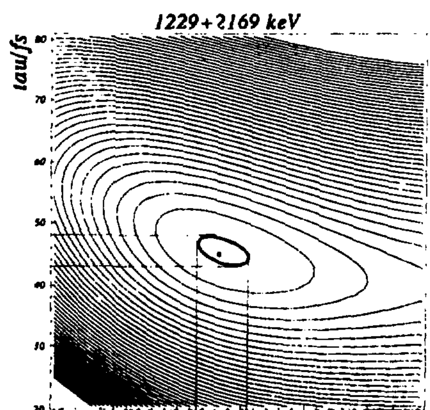
Papers:

1. Zaizeva N.G., Khalkin V.A. et al. Targetry for the Ruthenium-97 and Tungsten-178 (tantalum-178) production on the phasotron of JINR. 5th Int. Workshop on Targetry and Target Chemistry (19-23 Sept. 1993, BNL, N.Y., USA).

2. Gromov K.Ya., Kuznetsova M.Ya., Norseev Yu.V., Tsupko-Sitnikov V.V. et al. Investigation of $(\alpha-\gamma)$ coincidences in the ^{225}Ac decay. JINR, R6-93-233, 1993.







χ^2 versus 2 parameters:

X -axis:
$M_1(+2)/M_1(-1)$ depending on the g_P/g_A ratio

Y -axis:
life time τ of the excited level in recoil nucleus

LNP-8	
Status	Data-Taking

Investigation of spin-neutrino angular correlations in processes of capture of polarised muons by light nuclei.

LNP, JINR, Dubna; Catholic University, Louvain-la-Neuve, Belgium; Nuclear Physics Institute of Academy of Sciences, Řež, Czech Republic; Centre de Spectrométrie Nucleaire et de Spectrométrie de Masse, Orsay, France

LNP, Dubna	V.Brudanin, V.Egorov, A.Kachalkin, V.Kovalenko, A.Salamatin, S.Vassiliev, V.Vorobel, I.Štekl, I.Yutlandov, Sh.Zaparov
UCL, Louvain	J.Deutsch, R.Prieels, L.Grenacs
IPN, Řež	J.Rak
CSNSM, Orsay	Ch. Briançon

Spokesmen: **V.Egorov, I.Yutlandov**

The measurement of angular correlation between muon residual polarization ($\vec{p}$) and the momenta of neutrino ($\vec{\nu}$) and γ-quantum ($\vec{k}$) in the $^{28}Si(\mu,\nu)^{28}Al^*$ process is proposed to be carried out using the secondary μ^- beam of JINR Phasotron. The value of $\vec{p}$ should be measured with μSR method, the value of $\vec{k}$ is determined by the set-up geometry, and the direction of neutrino emission $\vec{\nu}$ should be deduced from the Doppler shift of the subsequent γ-quanta energy. This shift is caused by the recoil after emission of the muonic neutrino at relatively high energy (about 100 MeV) and depends very much on its direction, as far as on the recoil slowing-down process. As a result, the Doppler - broadened lines in γ-spectra have a specific shape which is determined by the set of correlation coefficients depending on the ratio of induced pseudoscalar and axial form factors g_P/g_A.

In 1993 the first experiment[1] was carried out using two HP Ge detectors which could measure the Doppler shift of γ-quanta emitted at 60° and 120° with respect to the muon polarization axis ("Forward" and "Backward" detector position). Analysis of 1129 and 2171keV γ-lines provided the following values of parameters fitted:

$$\begin{aligned} x &= +0.264 \pm 0.046, \\ \tau &= 45 \pm 5 fs, \\ \delta &= +0.46 \pm 0.29 \end{aligned}$$

The ratio of q_p/g_a within the FPA, PSA-I and PSA-II models is obtained to be $+8.1 \pm 1.6, +6.6 \pm 2.0 and + 2.3 \pm 2.1$, respectively.

[1] V.Brudanin, V.Egorov, A.Kachalkin et al., "Measurement of the Induced Pseudoscalar Form Factor in the Capture of Polarized Muons by Si Nuclei". Submitted to Nucl.Phys.A.

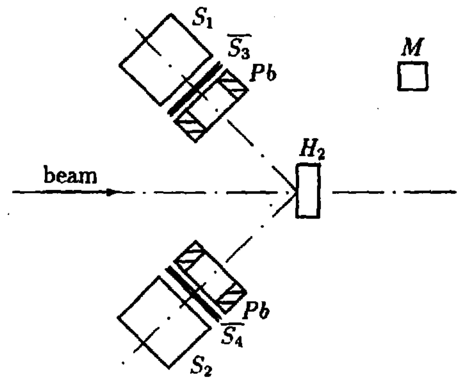


Figure 1: Experimental lay-out.

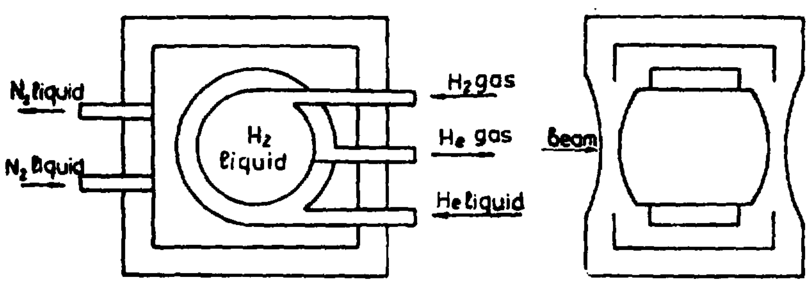


Figure 2. Schematic view of liquid hydrogen target

LNP-9	
Status	Preparation

Search for narrow dibaryon resonances in the proton-proton bremsstrahlung reaction at the energy below the pion threshold.

JINR, Laboratory of Nuclear Problems, Dubna

LNP, Dubna A.S.Khrykin, A.B.Lazarev, S.N.Shilov, V.A.Stolypin

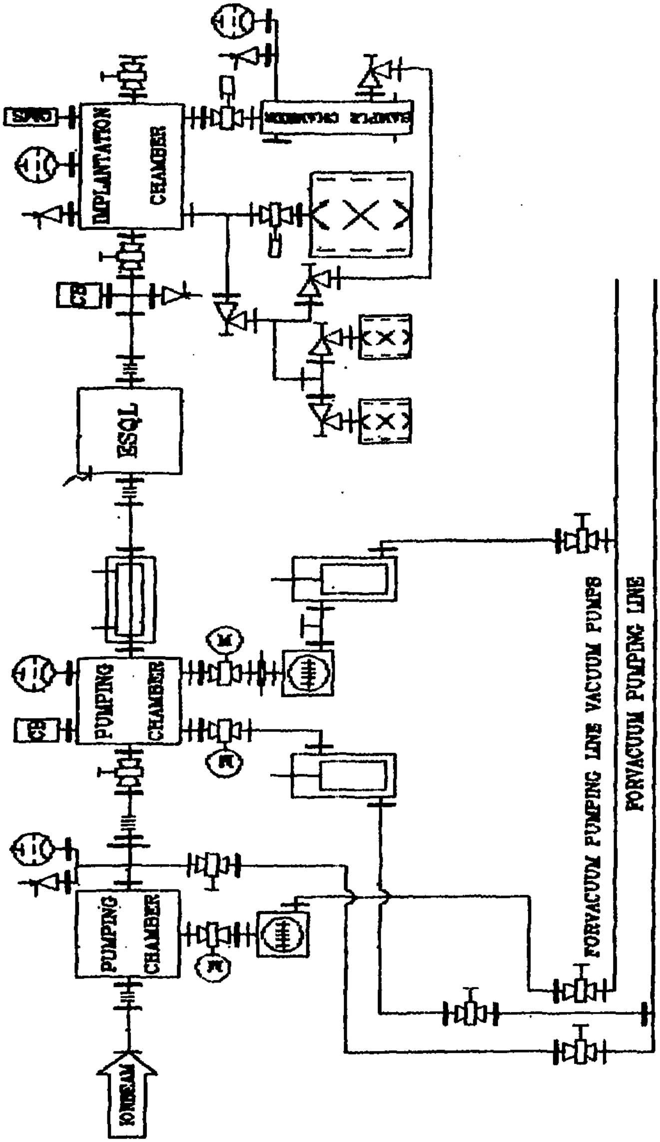
Spokesman: **A.S.Khrykin**

For the experiments on the search for narrow dibaryons in the $pp \rightarrow pp\gamma\gamma$ reaction a liquid hydrogen target is needed (Fig.1), which has to meet the following reqiurements:

- energy loss for 200-250 MeV incident protons must not exceed $\sim$ (3-5)% to provide good energy resolution of the experimental set-up;
- thickness of the windows must be as low as possible to avoid background due to the interaction of incident protons with nuclei of the windows;
- density of nuclei per cm^2 of the target must be sufficiently large to provide large enough luminosity of the experimental set-up.

We have developed a liquid hydrogen target which is a reasonable compromise to meet these requirements. Figure 2 shows a schematic view of this target. The liquid hydrogen target is within a horizontal cylindrical brass flask 4.5 cm in diameter and 4.5 cm in length so that its thickness is 0.3 g/cm^2. On both sides of this cylinder there are thin mylar windows with a total thickness of 200 μm. The outside of the target flask has a liquid nitrogen shield. The target flask is mounted inside a vacuum can which has two mylar windows 200 μm thick and 85 mm in diameter. The target vessel is connected with a cistern containing gaseous hydrogen. Cooling and temperature stabilization of the target is effected by liquid helium with the help of a tubular heat exchanger. Condensing gaseous hydrogen into the target vessel takes up about two hours. The flow rate of liquid helium at the temperature of the target 20^0 K is about 2.5 litres/h. The flow rate of liquid nitrogen is about 0.5 litres/h.

With this costruction of the target we are going to decrease the total thickness of the windows of the target by a factor of 2.



The implantation arrangement of SPIN facility

LNP-10	
Status	Preparation

Low-temperature nuclear orientation of nuclei far from stability line

LNP, JINR, Dubna; NPRI BSU, Minsk, Belarus; NPRI MSU, Moscow; NRI, Moscow; KAEI, Moscow, Russia; RICM, Zhilina; ELTECO, Zhilina, Slovakia; Charles Univ., Prague, Czech Technical Univ. Prague; RICM, Prague; TESLA VT, Prague; TESLA, Premysleni; ISI CAS, Brno, Czech Republic; Sussex Univ., Great Britain; Braunschweig Univ., BRD; Leuven Univ., Belgium; Univ. of Novi Sad; Univ. of Beograd, Yugoslavia

LNP, Dubna R.Drevenak, M.Finger, M.Finger,Jr., Yu.M.Kazarinov, T.I. Kracikova, A.Janata, N.A.Lebedev, V.N.Pavlov, M.Slunecka, L.N.Somov, A.D.Stepanov, V.Streit, Yu.V.Yushkevich, Yu.Zafar

Spokesman: **M.Finger**

The influence of a Coriolis interaction on the properties of the deformed nuclei has been investigated. From the low-temperature nuclear orientation studies of ^{167,169,171,173}Lu in *Gd* the anisotropies of γ-rays in the odd-A ^{167,169,171,173}Yb isotopes have been obtained. The $\delta(E2/M1)$ and $\delta(M2/E1)$ multipole mixing ratios and a $q(E0/E2)$ ratio for β - vibrational transition in ^{169}Yb were deduced and unambiguous spin-parity assignment was made for many levels in odd-A $^{167-173}$Yb. The energy and structure of individual levels, reduced $B(E2)$ and $B(M1)$ transition probabilities and $\delta(E2/M1)$ mixing ratios have been calculated using the quasiparticle-phonon model with the Coriolis mixing included (the same parameters of the Saxon-Woods potential for the whole region of deformed nuclei were used). The attempt was made to draw some general conclusions based on the comparison and analysis of our experimental and theoretical results and all data available in the literature.

In general the Coriolis interaction is very important for nuclei studied. The excellent agreement (better than 2%) was obtained between the calculated and experimental level energies. The comparison of the experimental and calculated values of reduced $B(E2)$ and $B(M1)$ transition probabilities and mixing ratios $\delta(E2/M1)$ shows that there is quite good agrement between the experimental and calculated values of $B(E2)$ and $\delta(E2/M1)$, while agreement of these values for $B(M1)$ is much worse. The most interesting experimental result, obtained for the first time by us [1], is the observation of the sign and magnitude of multipole mixing ratio change when going from ^{169}Yb to ^{171}Yb where the filling of the shell (transition from the particle to hole states) takes place. The nuclear orientation measurements of ^{166}Tm ($T_{1/2}$= 7.7 h) in *Gd*, were carried out with the aim to study the properties of even-even Er nuclei (NO of ^{168}Tm is in progress). The work on the preparation of samples for nuclear orientation studies of Tb, Hf, Re, etc have been performed.

Low temperature nuclear orientation studies of the local magnetization of Co and Mn impurities in the reentrant spin glass AuFe above and below the percolation threshold have been performed. The results obtained with samples ^{60}Co (Au18at%Fe), ^{54}Mn(Au14at%Fe) and ^{54}Mn (Au18at%Fe) show that the Co and Mn magnetic moments in the same matrix AuFe possess different behaviour. This is probably due to different behaviour of Mn-Fe and Co-Fe interactions at short distances. From Mössbauer measurements of ^{57}Fe in Au14at%Fe the temperature of the transition to spin glass state was estimated to be T~ 55 K.[2]

[1] Davaa S. et al., 1984, JINR Comm. R6-84-556, Dubna

[2] Gurevich G.M. et al., Programme and abstracts of the NSI-HFI-5, Russia, Dubna, September 22-24, 1993, p.33

Experiments Using External Accelerators

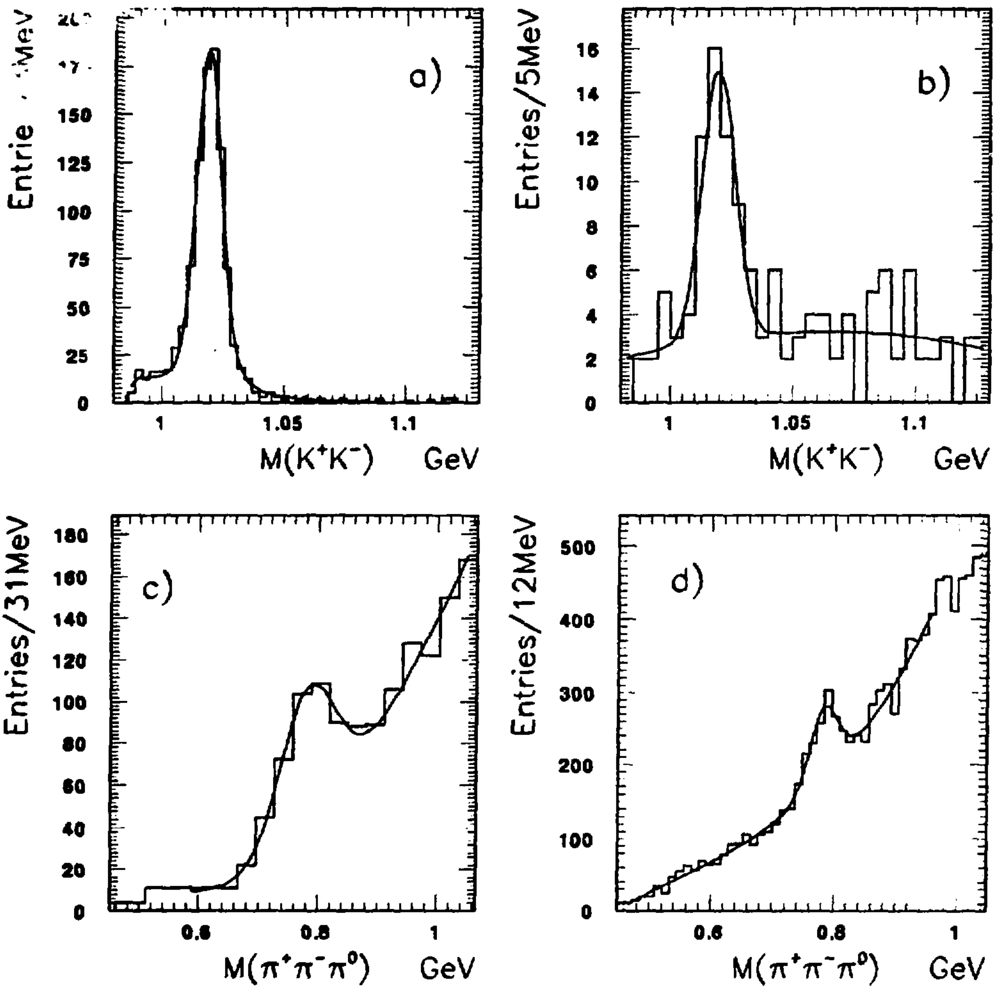


Fig.1. Invariant mass spectra of 2K (a, b) and 3 π (c, d) for events with proton momentum $p < 200$ MeV/c (a, c) and $p > 400$ MeV/c (b, d). Solid line is the result of fit of experimental spectra by resonance curve and smooth background.

OBELIX	LNP-11
Status	Data-Taking

Study of antiproton and antineutron annihilations at LEAR with OBELIX detector

LNP JINR Dubna; Bologna Univ./INFN; Brescia Univ./INFN; Cagliari Univ./INFN; Frascati Nat.Lab. INFN; Legnaro Nat.Lab. INFN; Padova Univ./INFN; Pavia Univ./INFN; Trieste Univ./INFN; Turin Univ./INFN; Turin Polytechnic/INFN; Udine Univ./INFN

LNP, Dubna	V.G.Ableev, O.Yu.Denisov, O.E.Gorchakov, I.V Falomkin, G.B.Pontecorvo, S.N.Prakhov, A.M.Rozhdestvensky, M.G.Sapozhnikov
Bologna Univ./INFN	A.Bertin, M.Bruschi, M.Capponi, I.D'Antone, S.De Castro, D.Galli, U.Marconi, I.Massa, M.Morganti, M.Piccinini, M.Poli, N.Semprini-Cesari, S.Vecchi, M.Villa, A.Vitale, G.Zavattini, A.Zoccoli
Brescia Univ./INFN	G.Belli, M.Corradini, E.Lodi Rizzini, L.Venturelli
Cagliari Univ./INFN	A.Adamo, C.Cicalo, A.Lai, A.Masoni, G.Puddu, P.Temnikov, S.Serci, G.L.Usai
Frascati Nat.Lab. INFN	C.De Leo, C.Guaraldo, A.Lanaro, V.Lucherini, F.Nichitiu
Legnaro Nat.Lab. INFN	P.Boccaccio, U.Gastaldi, M.Lombardi, G.Maron, R.A.Ricci, L.Vannucci, G.Vedovato
Padova Univ./INFN	A.Andrighetto, M.Morando
Pavia Univ./INFN	G.Bendiscioli, V.Filippini, C.Marciano, P.Montagna, A.Rotondi, P.Salvini, V.I.Tretyak, A.Zenoni
Trieste Univ./INFN	G.V.Margagliotti, G.Pauli, S.Tessaro, E.Zavattini
Turin Univ./INFN	F.Balestra, G.C.Bonazzola, T.Bressani, M.P.Bussa, L.Busso, D.Calvo, P.Cerello, S.Costa, D.D'Isep, L.Fava, A.Feliciello, L.Ferrero, A.Filippi, R.Garfagnini, P.Gianotti, A.Grasso, A.Maggiora, S.Marcello, D.Panzieri, G.Piragino, E.Rossetto, F.Tosello, G.Zosi
Turin Polytechnic/INFN	M.Agnello, F.Iazzi, B.Minetti
Udine Univ./INFN	L.Santi

Spokesmen: T.Bressani, C.Guaraldo — From JINR: **M.G.Sapozhnikov**

The main aim of the group working in the PS201 experiment (OBELIX) at CERN in 1993 was the study of the OZI rule violation in antiproton annihilation in deuterium. With the statistics of 1.1 million events the branching ratios of two reactions were measured:

$$\bar{p}+d \longrightarrow \pi^- + \Phi + p \quad \text{and} \quad p+d \longrightarrow \pi^- + \omega + p$$

for annihilation of antiprotons at rest (see Fig.1). The branching ratios were evaluated for two ranges of proton momentum: for proton spectator region p < 200 MeV/c and for protons with momenta p > 400 MeV/c. It was found that the ratio of these branchings is

$$R\,(\Phi\pi^-/\omega\pi^-) = \begin{array}{ll} (133 \pm 33)\cdot 10^{-3} & p < 200\ \mathrm{MeV}/c \\ (113 \pm 40)\cdot 10^{-3} & p > 400\ \mathrm{MeV}/c \end{array}$$

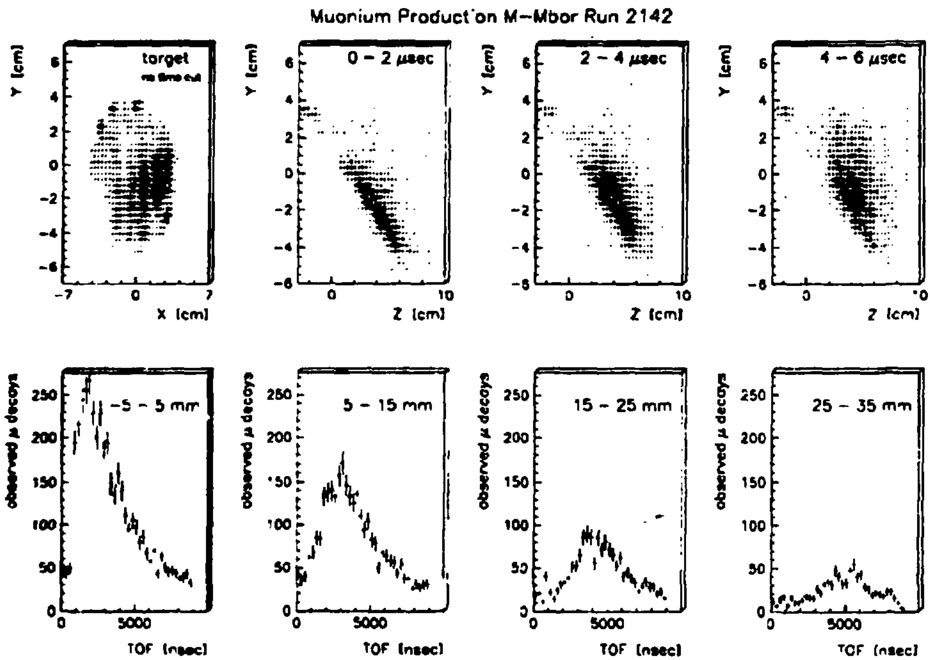
It is considerably higher than predicted by the OZI-rule on the basis of the assumption that Φ meson production is going on due to small admixtures of light quarks in the Φ wave function. Then the ratio R should be $R = (0.16 - 4.2)\cdot 10^{-3}$.

What is remarkable is that the degree of the OZI-violation in the antiproton annihilation is much higher than that observed in the experiments on πp or pp- scattering. Typically, the ratio $R(\Phi X/\omega X)$ found in these experiments reaches at most $R = (20 - 30)\cdot 10^{-3}$

These observations are rather non-trivial because among the reasons for the OZI violation the substantial admixture of the strange quarks in the nucleon wave function has been discussed. So the experimental information on Φ-meson production in the antiproton annihilation could be connected with very general aspects of the proton structure.

Among the other results obtained by the group one may underline the following:

1. The rare reactions of subthreshold Λ production in $\bar{p}d$ annihilation at rest $\bar{p} + d \rightarrow \Lambda + X$ were studied. The branching ratios of different exclusive channels have been determined and the mechanism of the Λ formation was evaluated.
2. A promising result was obtained in the analysis of the reaction $p + d \longrightarrow 3\pi^- + 2\pi^+ + p$. The effective mass distribution of 4 pions demonstrate the same broad enhancement as that earlier attributed to the $\xi(1480)$ state. After subtraction of the combinatorial background the parameters of the peak fitted by the gaussian are: $M = 1.487 \pm 0.002\mathrm{GeV}/c^2$, $\sigma = 0.090.0 \pm 0.002\mathrm{GeV}/c^2$.
3. The properties of the reaction $\bar{p} + d \longrightarrow 2\pi^- + \pi^+ + p$ have been evaluated for the high momentum range of the proton: p > 400 MeV/c. The detailed investigation of this reaction in the region of high momenta was performed for the first time.



Figures. Distributions of muonium outside the target

LNP-12
Status Data-Taking

Search for muonium-antimuonium conversion $(\mu^+e^-) \rightarrow (\mu^-e^+)$

LNP JINR, Dubna; Physikalisches Institut, Universität Heidelberg; III Physikalisches Institut, RWTH Aachen, Germany; Yale University, New Haven Ct., USA; Physik-Institut der Universität Zürich; Paul Scherrer Institut, Villigen, Switzerland; Institute of Nuclear Studies, Swierk, Poland; Institute of High Energy Physics, Tbilisi State University, Tbilisi, Georgia

LNP, Dubna N.A.Kuchinsky, V.V.Karpukhin, I.V.Kisel, N.P.Kravchuk, A.S.Korenchenko, N.V.Khomutov, V.A.Baranov.

Spokesman from JINR: **S.M.Korenchenko**

At the beginning of 1993 a new readout system was developed to read out a signal from wires of cylindrical proportional chambers of $M\bar{M}$ - setup.

The main features of the system are:

- High density, 700 recording channels in a crate, 10000 a in branch.
- Fast readout, (100 ns/hit on external bus), only valid data are transmitted to the computer.
- Small dead time, 25μs for a typical $M\bar{M}$ - event.
- Digital delay (up to 5.12μs), multihit capability.
- Reread capability, any hits which were recorded during the last writing cycle (5.12μs) can be read out.
- Data pipeline, new data writing cycle can be done during acquisition of subsequent events. High frequency of memory samples, 50 MHz.

The readout system includes up to 16 dedicated CAMAC crates daisy-chained by an external data bus, which is attached to the CAMAC interface of the readout system. Delay/receiver units, a bus terminator/fanout and a readout controller are housed in each crate.

During 1993 this system was developed, produced and tested. In the last summer run it was successfully used in the $M\bar{M}$ - experiment for data taking.

During the two runs on the beam (3 and 4 weeks long) about 10^{12} muons were stopped in the SiO_2 powder target. The measured experimental data were stored on approximately 100 EXABYTE tapes (2.5 Gigabytes each). These data will be used for the detector calibration, for calculation of an efficiency of the separate parts of the detector and for estimating of the muonium-antimuonium conversion probability.

Effective event selection software based on the cellular automata was developed in Dubna.

The most pessimistic estimate for a number of the registered muonium decays in vacuum per muon stop is not less than 10^4. So the measured data will allow one to estimate an upper limit on the muonium to antimuonium spontaneous conversion probability about 10^{-8}, which means an improvement by a factor of about 100 as compared with previous experiments.

The corresponding limit on the coupling constant for the muonium-antimuonium conversion is $G_{M\bar{M}} < 0.01G_F$, where G_F is the Fermi coupling constant. The observed distributions of muoniums in vacuum outside the target are shown in the figures.

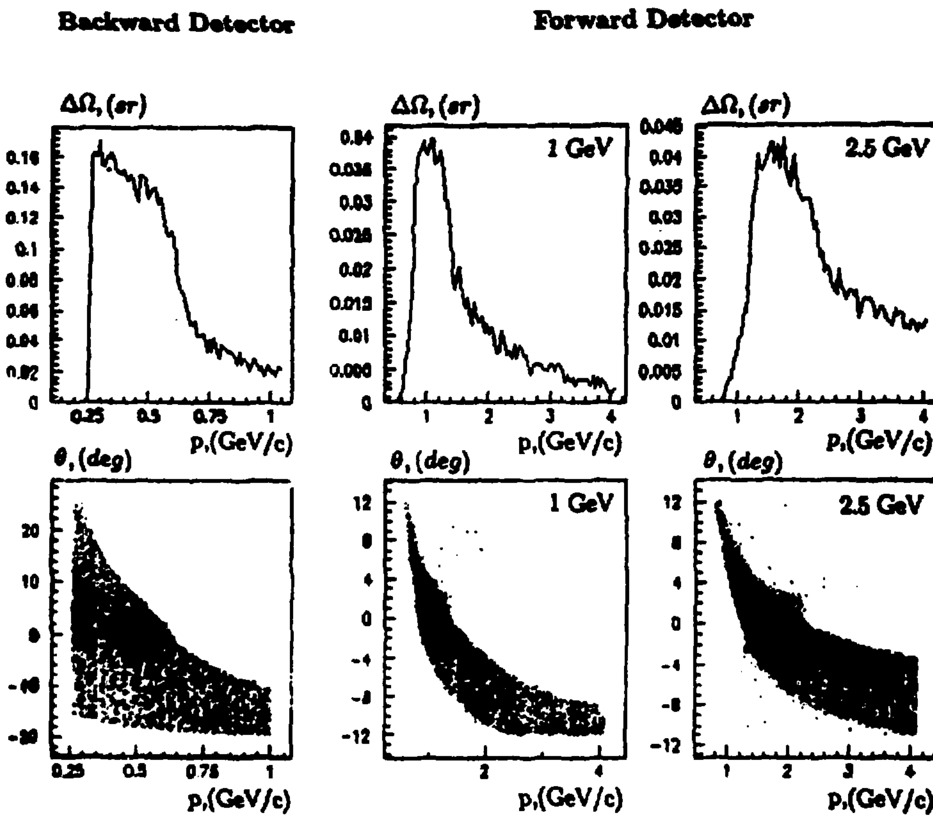


Fig.1. Extended angular-momentum acceptance of the Forward Detector and Backward Detector of the set-up Zero Degree Facility.

COSY 18:20	LNP-13
Status	Preparation

Study of the cumulative fragmentation of the deuteron in the exclusive polarization approach and of the subthreshold kaon production at the synchrotron COSY.

LNP, LCTA JINR, Dubna; INP of Moscow State Univ.; SPINP, Gatchina; ITEP, Moscow, Russia; Inst. für Kernphysik Forschungszentrum Jülich; Inst. für Kern und Hadronenphysik Forschungszentrum Rossendorf; Univ. Köln; Univ. Münster, BRD; Jagellonian Univ. Cracow, Poland; HEPI, Tbilisi, Georgia; Kaz. State Univ., Alma-Ata, Kazakhstan; Univ. Komenskogo, Bratislava, Slovakia

LNP, Dubna	V.I.Komarov, B.Zh.Zalikhanov, Yu.K.Akimov, V.P.Zrelov, V.M.Grebenyuk, N.I.Zhuravlev, M.A.Ivanov, E.V.Komissarov, V.V.Karpukhin, V.V.Kruglov, V.S.Kurbatov, N.A.Kutchinskyi, S.I.Merzlyakov, A.Yu.Petrus, A.I.Pusynin, V.Z.Serdyuk, V.V.Sidorkin, A.I.Filippov, A.S.Khrykin
LCTA, Dubna	V.V.Ivanov, P.G.Akishin, P.V.Zrelov
INP Univ., Moscow	A.V.Kulikov, V.P.Kurotchkin, S.V.Trusov
SPINP, Gatchina	S.L.Belostotsky, V.P.Koptev, V.A.Grebenyuk et al.
ITEP, Moscow	V.P.Tchernyshev
IKP KFA, Jülich	O.B.Schult, K.Sistemich, W.Borgs, M.Buescher, D.Gotta, D.Grzonka, H.R.Koch, W.Oelert, H.Ohm, H.Seyfarth, K.H.Watzlowik et al.
IKHF, Rossendorf	H.Mueller, S.Dienel, S.V.Dshemuchadze, K.W.Leege, Chr.Schneidereit et al.
Univ., Köln	H.Paetz gen. Schieck
Univ., Münster	H.Dombrovski, R.Santo
Univ., Cracow	A.Strzalkowski, L.Jarczyk, B.Kamys et al.
HEPI, Tbilisi	M.Nioradze, L.Glonti.
Univ., Alma-Ata	Yu.N.Uzikov
Univ., Bratislava	V.Finer, P.Pavlovitch, J.Ruzhitchka et al.

Spokesman from JINR **V.I.Komarov**

LNP JINR is responsible for elaboration and preparation of two groups of detectors among three main groups of detectors of the set-up: "forward detector"(FD) and "backward detector"(BD).

Main results of 1993:

Backward detector. Computer simulation of the detector and determination of its expected parameters was performed[1]. Technical assignment of the scintillation hodoscope was prepared and designing of the hodoscope and the support was started. Hodoscope scintillators, a test module of the hodoscope and the equipment for control and tuning of the drift chamber were produced. About 30% of work on drift chamber production was done. The equipment for testing the drift chamber module was prepared in Jülich. The module was installed at the COSY ring and its testing with operating accelerator was started.

Forward detector. The scheme of the forward detector was proposed and the first stage of computer simulation was performed. The main expected performance parameters was found. As a multiwire chamber, the new type of a fast proportional chamber suggested by B.Zalikhanov was accepted. Characteristics of the chamber found in the test of the experimental module meet the requirements of the set-up. Two versions of the readout system for multiwire chambers were proposed for considering by the collaboration. A block-diagram of the trigger electronics was suggested and some CAMAC modules were produced. Possibility of the luminosity monitoring and the control of position of the beam-target interaction region was analyzed. Status of the project preparation was reported at the international conferences[2,3,4].

1. Akishin P.G. et al. Preprint E13-93-339, Dubna, 1993.
2. Komarov V.I. et al. *Int. sem. "Hadr. Proc. at Small Angles at Storage Rings"*. Bad Honnef, 1993.
3. Dshemuchadse S. et al. *Proc. of the Int. Work.: Dubna Deuteron-93*,
4. M.Büscher et al. *Phys. Scripta*, **48**, (1993), p.50

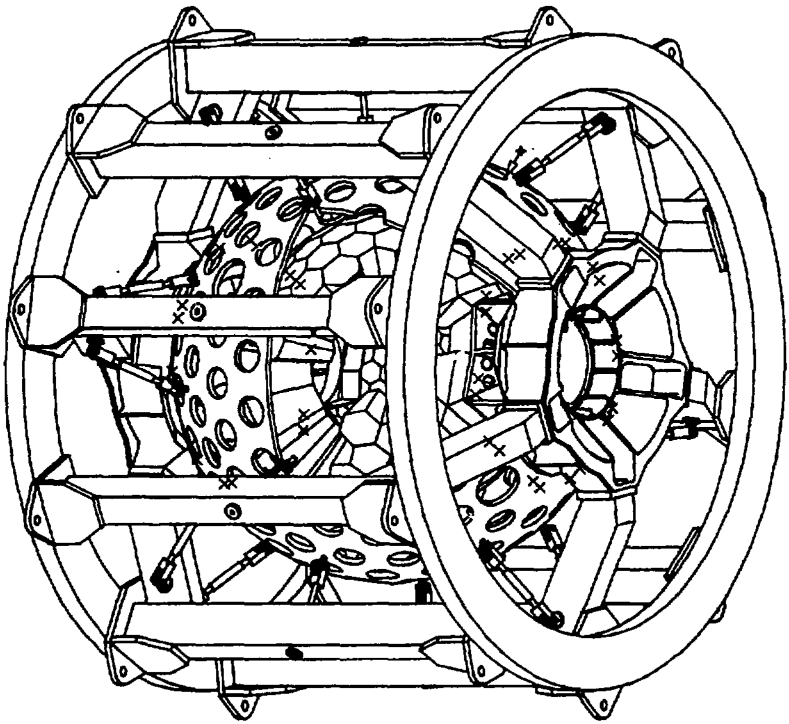


Figure Mechanical part of the spectrometer for precise measurement of the probability of the $\pi^+ \rightarrow \pi^0 e^+ \nu_e$ decay

LNP-14
Status Preparation

Precise measurement of the probability of the $\pi^+ \to \pi^o e^+ \nu_e$ decay

LNP JINR, Dubna; PSI, Paul-Scherrer-Institut, CH-5234 Villigen, Switzerland; University of Virginia; Arizona State University, USA; Tbilisi State University, Tbilisi, Georgia; Institute of Physics, Minsk, Belarus

LNP, Dubna N.A.Kuchinsky, V.V.Karpukhin, S.M.Korenchenko, N.P.Kravchuk, A.S.Korenchenko, N.V.Khomutov, V.A.Baranov, A.S.Moiseenko, V.V.Smirnov, S.I.Yakovlev

Spokesman from JINR: **S.M.Korenchenko**

The goal of the experiment is to measure the probability of the pion β-decay $\pi^+ \to \pi^o e^+ \nu_e$ precisely and to improve the accuracy from 4% to 0.5% at the first stage and further to 0.2÷0.3%.

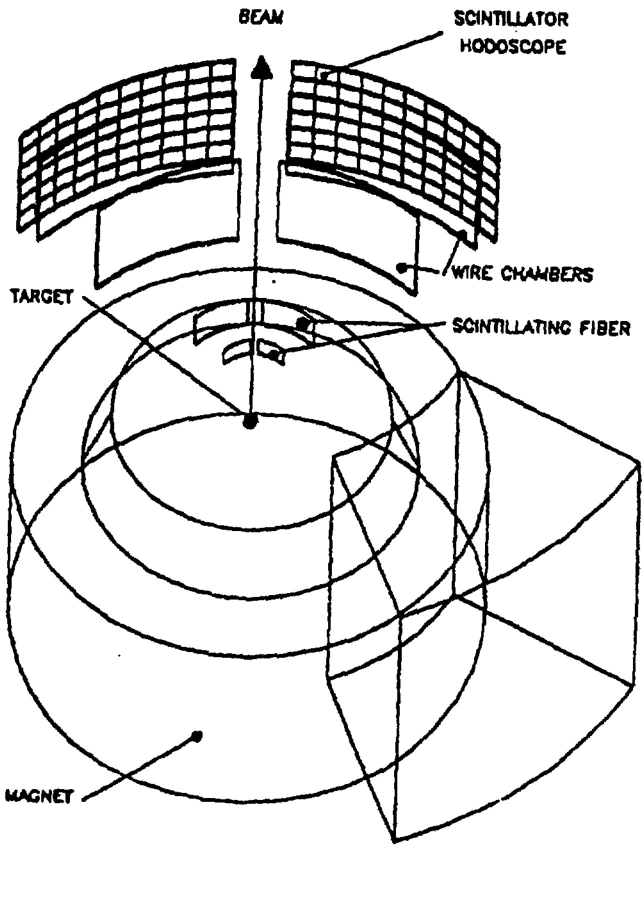
In 1993 the work on the project was done in two directions:

1. The MWPC chambers.
   All main parts of thin wall self supporting chamber #1 are produced. The main parameters of the chamber are:

• anode wire layer diameter	120 mm
• active length	350 mm
• number of wires	192
• number of outer/inner strips	$64 \times 2/64 \times 2$
• wire spacing	2 mm
• half gas gap	2.5 mm

   The thickness of the entire MWPC assembly to γ rays is ~ 0.003 radiation length.

2. Development of electronics.
   (a) A charge sensitive amplifier for cathode readout.
   Now a prototype amplifier has been developed and tested. A charge gain is 500 and equivalent noise charge is 2500 e^- (RMS). The amplifier has both input and output impedance of 50 Ohm. This allows a coaxial cable to be used for connections.
   (b) Anode readout.
   In order to have a high density, low power and fast readout electronics we intend to use a RAL ASIC chip set fc· multiwire chambers. Now the most difficult problem is availability of the set.



Layout of the experimental apparatus

DISTO	LNP-15
Status	Preparation

Measurement of spin observables in $pp \to pK^+Y$

LNP JINR, Dubna; Indiana University, USA; Istituto di Fisica and I.N.F.N., Torino, Italy; Laboratoire National Saturne, Saclay, France.

LNP, Dubna	I.V.Falomkin, V.V.Ivanov, V.I.Lyashenko, G.B.Pontecorvo, V.I.Travkin, A.D.Volkov, B.Zh.Zalikhanov
IF INFN, Torino	F.Balestra, S.Bossolasco, M.P.Bussa, S.Costa, L.Fava, L.Ferrero, R.Garfagnini, A.Grasso, A.Maggiora, D.Panzieri, G.Piragino, E.Rossetto, F.Tosello, G.Zosi
Saturne, Saclay	J.Arvieux, R.Bertini
IUCF, Indiana	L.C.Bland, W.W.Jacobs, S.E.Vigdor

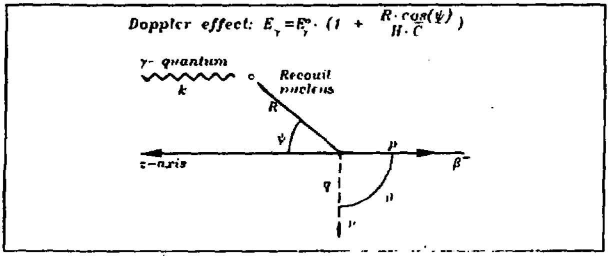
Spokesman: R.Bertini   Spokesman from JINR: **I.Falomkin**

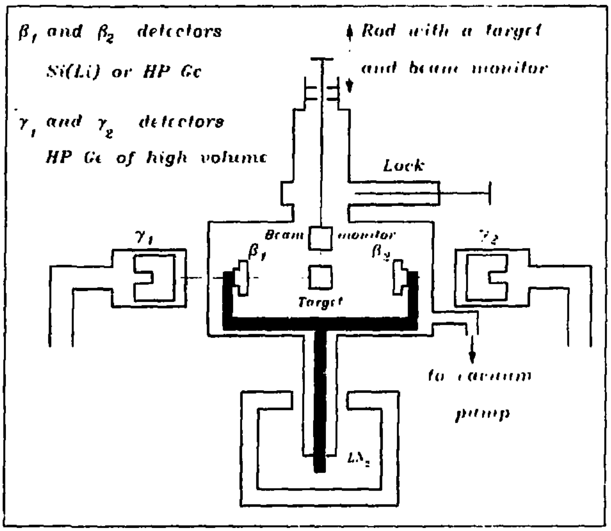
The project DISTO is aimed at studying polarization phenomena in proton–proton collisions with production of strange particles at the SATURNE accelerator. In 1993 it was supposed to fabricate elements of proportional chambers and to adjust and test them in Saclay.

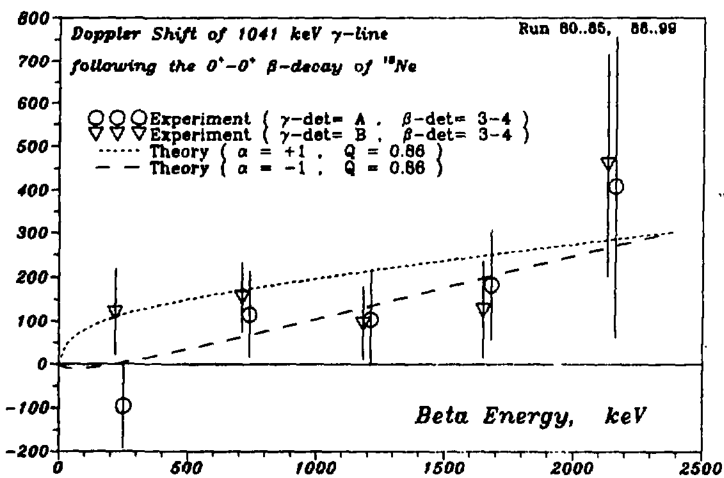
Each chamber will consist of two modules. Each module consists of two cylindrical surfaces with anode wires (surfaces X and Y) and two strip surfaces (surfaces U and V). Strips make an angle of $\pm 18°$ with the vertical. The chamber, which is over 2 m long, ensures the desired resolution in space and time and covers the required solid angle. Now there are surfaces X and U in the first module and Y and V in the second module of the chamber. The chamber was assembled in Dubna is now in Saclay. A large part of electronic equipment is already installed. Signals from wires and strips were observed.

This year we were also developing software for the experiment. A two-level trigger system will be used for real-time selection of events associated with production of λ- and σ-particles in the experiment DISTO. The first-level trigger is to select events for multiplicity, only four-prong events being selected. The second-level trigger is based on four RISC processors for geometrical reconstruction of each analysed event so as to look for primary and secondary vertices.

With specific features of production and decay kinematics of unstable λ- and σ-particles in view, the coordinate of the intersection point of a straight line (coinciding with the particle track) and the primary beam axis and the coordinate of the angle of the track with the beam direction were proposed to be used as parameters for revealing the presence of a secondary vertex in an event under consideration. They do not require full geometrical reconstruction of the event. The neutron net employed for classification of events in the space of new variables ensures practically unambiguous identification of signal and background events.


Doppler effect: $E_\gamma = E^o_\gamma \cdot (1 + \frac{R \cdot \cos(\psi)}{M \cdot C})$
γ- quantum
k
Recoil nucleus
R
ψ
z-axis
p
β⁻
q
ν


β₁ and β₂ detectors
Si(Li) or HP Ge
γ₁ and γ₂ detectors
HP Ge of high volume
Rod with a target
and beam monitor
Lock
γ₁
γ₂
Beam monitor
β₁
β₂
Target
to vacuum
pump
LN₂


Doppler Shift of 1041 keV γ-line
following the 0⁺-0⁺ β-decay of ¹⁸Ne
Run 60..65, 68..99
Experiment (γ-det= A , β-det= 3-4)
Experiment (γ-det= B , β-det= 3-4)
Theory (α = +1 , Q = 0.86)
Theory (α = -1 , Q = 0.86)
Beta Energy, keV
800
700
600
500
400
300
200
100
0
-100
-200
0
500
1000
1500
2000
2500

LNP-16	
Status	Preparation

Investigation of beta-neutrino angular correlation in super allowed beta-decay of short-lived nuclei

JINR, Dubna; CSNSM, Orsay, France, UCL, Louvain, Belgium

JINR, Dubna	C.Belikov, V.Brudanin, V.Egorov, V.Kovalenko, I.Štekl, A.Salamatin, V.Vorobel, Ts.Vylov, S.Vasiliev, Sh.Zaparov, V.Tsupko-Sitnikov
CSNSM, Orsay	Ch.Briancon, Ch.Vieu, J.Dionisio
UCL, Louvain	J.Deutsch, R.Prieels, N.Severijns

Spokesman: **V.Egorov**

According to the Standard Model, the nuclear super-allowed β-decay is caused by the only two types of weak interaction, namely $V-$ and $A-$ interaction, another two types ($S-$ and $T-$) are assumed to be absent at all. On the other hand, the existing experimental upper limits for the presence of these interactions are not better than 9% for $T-$interaction and 23% for S-interaction (at 95% CL). The goal of the present experiment is to reduce the last of the above limits down to 5..10%.

The idea of the experiment is the investigation of $(\beta - \nu)$ angular correlation based on the precise measurement of the γ-ray Doppler shift caused by recoil of the daughter nucleus after (β, ν) emission.

After the preliminary *off-line* experiment with a long-lived ^{24}Na source, in 1993 the first on-line test using the ^{3}He-beam of the Tandem accelerator (IPN, Orsay, France) was carried-out in order to optimise the experimental set-up and the measurement conditions. The (^{3}He,n)-reaction on the C, $(CH_2)_n$, B_2O_3 and SiO_2 targets was used in order to produce short-lived ^{14}O, ^{18}Ne and ^{30}S nuclei. For the detection of β and γ several types of Si(Li) and HPGe detectors were tested. The PC-based acquisition system connected with SUN-computer was tested as well.

As a result, the Doppler shift of 1041 keV γ-line following the $(0^+ - 0^+)$ β-decay of ^{18}Ne has been observed and the numerous recommendations on the further improvement of the solid-target set-up as well as on the development of the gas-target set-up have been obtained.

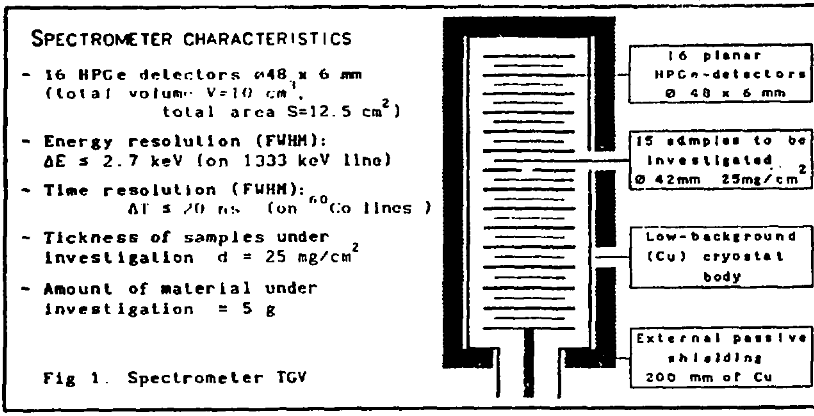


Fig 1. Spectrometer TGV

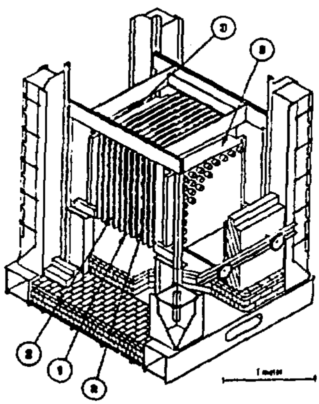


Figure 2 : The NEMO 2 prototype (1) Central frame with the metallic foil, (2) Tracking device of 10 frames with 2 x 32 Geiger cells each, (3) Scintillator walls of 8 x 8 counters. The sheilding is not shown.

decay	2β0ν ground state	2β (0ν,χ)	2β0ν; excited state 2_1^+	2β0ν; excited state 0_1^+
energy window(E_1, E_2) MeV	(2.5 , 3.0)	(2.0 3.0)	(2.0 , 2.5)	(1.4 , 1.8)
N_{exp}	0	13	13	98
$N_{Backgr.}$ 2β2ν + external back.	0.	14.	14.	116.
ε (%)	4.5	1.8	3.5	2.9
$T_{1/2}$ years (90 % CL)	>3.8 10^{21}	>5.0 10^{20}	>9.7 10^{20}	>5.1 10^{20}

Table 1 : Half-life limits for ββ decays of ^{100}Mo to ground and excited states of ^{100}Ru.

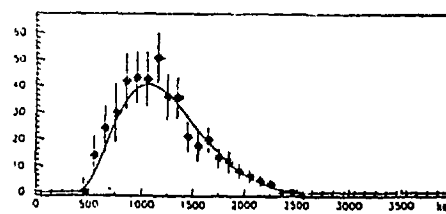
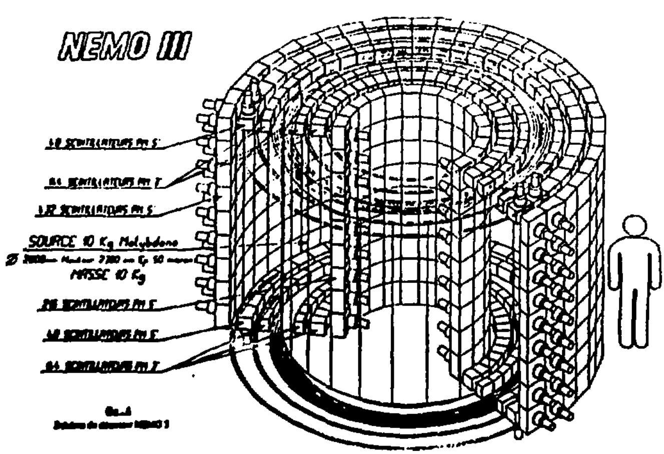


Figure 3 : Total energy spectrum fit for e-e events in ^{100}Mo (4** events, background subtracted, 2485 h.). Solid line shows the 2β2ν simulated spectrum fitted to the experimental data.



TGV, NEMO	LNP-17
Status	Data-Taking

Search for double beta-decay of ^{100}Mo.

LNP JINR, Dubna; CSNSM, Orsay; NEMO Collaboration, Modane UG Laboratory, France

LNP, Dubna	Ts.Vylov, V.Brudanin, N.Rukhadze, V.Egorov, V.Kovalenko, O.Kochetov, I.Štekl, Sh.Zaparov, A.Salamatin, Yu.Shitov
CSNSM, Orsay	Ch.Briancon
NEMO Coll.	Bordeaux, Caen, Dubna, Kiev, Moscow, Orsay, Strasburg

Spokesman of TGV experiment: **V.Brudanin**
Spokesman of NEMO experiment: S.Jullian from JINR:**V.Brudanin**

The goal of TGV- and NEMO- collaborations is to study $2\beta2\nu$ and $2\beta0\nu$ decay of ^{100}Mo and other nuclei to probe the effective Majorana neutrino mass down to 0.1 eV. For four years the TGV- and NEMO- collaborations have built prototype spectrometers TGV-1, NEMO-1 and NEMO-2 in order to measure the experimental $e-e$ background in the 4 MeV region (Q_{ee} =3.03 MeV for the 2β-decay of ^{100}Mo). The spectrometers are installed in the Frejus Underground Laboratory (Modane, France) and thus are shielded with 4800 m of water equivalent.

The TGV-1 spectrometer consists of 16 planar HP Ge detectors (Fig.1) and has high efficiency, as well as good energy and time resolution. In 1993 the background characteristics of the spectrometer with 20 cm high purity copper shielding were measured under ordinary laboratory conditions in Dubna and since December 1993 - under underground conditions. The main goal of TGV-1 is: 1) the measurement of radioactive impurities in ^{100}Mo foils which will be used in NEMO-3 set-up; 2) the measurement of $2\beta2\nu$ decay of ^{100}6Mo (supplementary to NEMO measurement); 3) the investigation of 2β decay of other isotopes which are available in very small amount insufficient to be investigated with NEMO spectrometer (^{48}Ca, etc.).

The NEMO-2 spectrometer (Fig.2) consists of 1 m^3 tracking volume formed by 640 Geiger cells and of two 1x1 m^2 scintillator walls, each formed by 64 phoswich counters. The spectrometer is in operation since August 1991. In 1993 it was used for 2485 hours to investige 2β decay of enriched ^{100}Mo (172g, 95%) (Fig.3). As a result, the value of $T_{1/2}(2\beta2\nu)$ was measured: $T_{1/2}(2\beta2\nu) = 1.0 \pm 0.08(stat.) \pm 0.2(syst.) \cdot 10^{19}$ years. The lower half-life limits for other 2β decay modes were also obtained (Table 1[/1/]).

The NEMO-2 is the prototype of the large NEMO-3 spectrometer[/2/] which was designed in 1993 (Fig.4) for the investigation of 10 kg of enriched ^{100}Mo. The Laboratory of Nuclear Problems is charged to produce 1200 plastic scintillator detectors (20x20x10 cm^3) for this set-up. In 1993 the energy and time characteristics of such detectors equipped with XP4312B and XP4512B was measured[/3/].

1. R.Arnold, A.Barabash, A.Blinov et al., Proc. Int. Europhysics Conf. on High Energy Physics, Marseille, July 22-28, 1993.
2. "NEMO. Proposal of the experiment on double beta-decay to probe the effective Majorana neutrino mass down to 0.1 eV". NEMO collaboration, LAL, Orsay, France, 07.10.1993.
3. V.Brudanin, V.Egorov, Sh.Zaparov et al., (submitted to NIM).

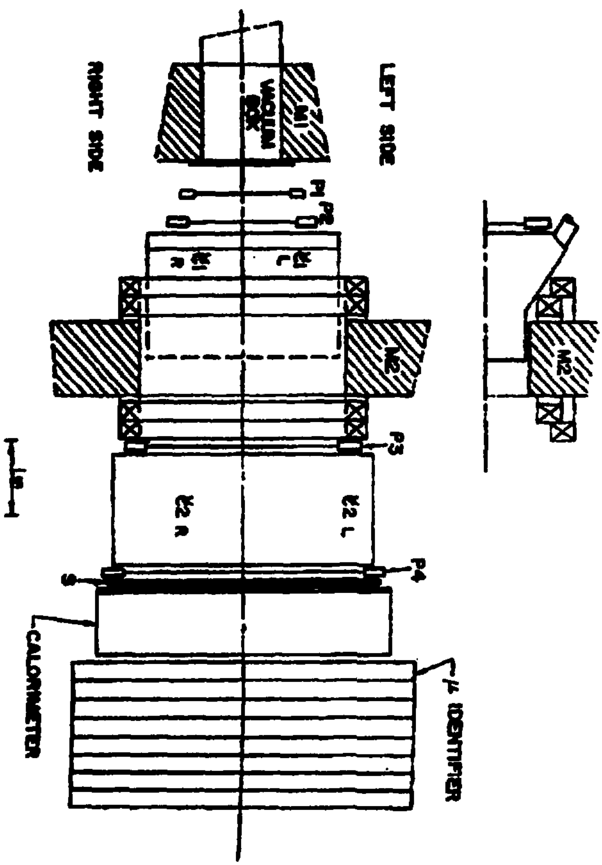


Figure: Experimental lay-out to search for $K^+ \to \pi^+\mu^+e^-$

LNP-18
Status Preparation

Search for the decay $K^+ \rightarrow \pi^+\mu^+e^-$

LNP JINR, Dubna; Paul Scherrer Institut, Villigen, Switzerland; Brookhaven National Laboratory, Upton, New York; University of Washington, Seatle, Washington; Yale University, New Haven Ct., USA; Institute for Nuclear Research, RAS Moscow, Russia; Institute of High Energy Physics, Tbilisi State University, Tbilisi, Georgia.

LNP, Dubna B.Zh.Zalikhanov, A.I.Rudenko, N.A.Lebedev, V.S.Kurbatov E.V.Komossarov, V.M. Artemov, C.V.Yashenko, S.M.Korenchenko, N.P.Kravchuk, A.S.Korenchenko

Spokesmen from JINR: **B.Zh.Zalikhanov, S.M.Korenchenko**

The search for the decay $K^+ \rightarrow \pi^+\mu^+e^-$ is planned to be carried out on the kaon beam from the accelerator AGS at the Brookhaven National Laboratory in order to improve the present estimate of the upper limit of this decay probability ($R < 2.1 \cdot 10^{-10}$) by a factor of ~ 70.

In 1993 the work on the experiment was done in two directions:

The track beam part: The prototype proportional chamber is developed. The properties of the chamber are:

— geometrical dimensions 600×600 mm^2
— sensitive area 300×300 mm^2
— gap 1 mm, wire pitch 1 mm
— every chamber measures two coordinates.

The chamber electronics is developed with the rate capability up to 10 MHz.

The proportional chamber and electronics were tested with a powerful source under the conditions close to future working ones ($\sim$ 100 MHz per chamber). The total number of channels to be used is 2000.

Muon identifier: 250 drift chambers are made. All the chambers are shipped to BNL and checked. The dimensions of the chamber are 2000×600 mm^2. The total number of channels is about 15000.

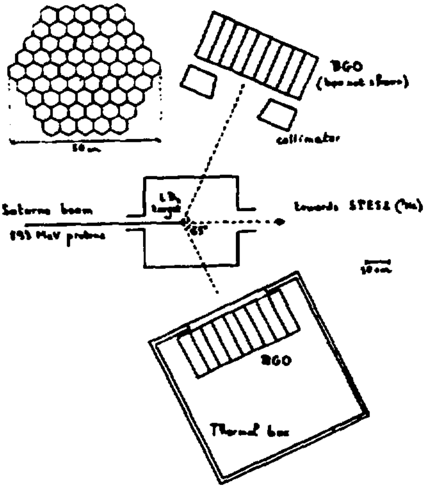


Fig. 1. Schematic view of the array of 61 BGO counters and of the experimental set-up.

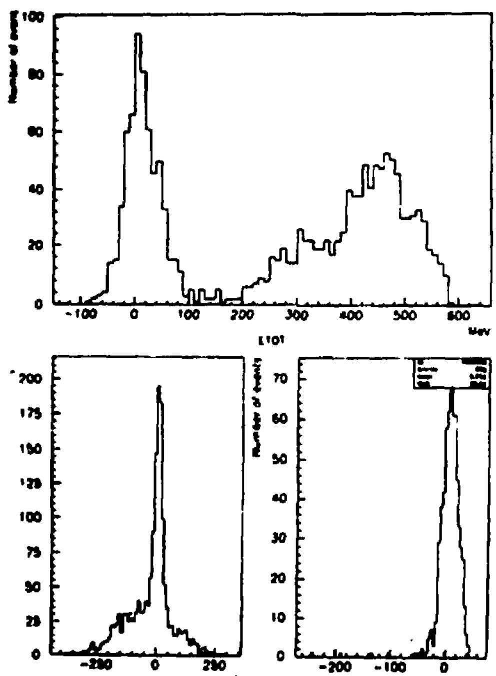


Fig. 2. Photon spectra obtained

LNP-19
Status Data-Taking

Direct measurement of the branching ratio for the decay of the η-meson into two photons.

LNP, Dubna	A.Efendiev, L. Lytkin
SPhN Saclay	A.Boudard, B.Fabbro, M.Garson, B.Mayer
LNS Saclay	J.Saudinos, E.Tomasi-Gustafsson
UCLA	M.Cojus, B.Nefkens, J.Price, B.Tippens, M.J.Wang, D.White
PSI	R.Abela
TRIUMF	R.Abegg, W.van Oers, P.Fuchs
GMU	W.Briscoe, J.Connelly, W.Dodge
SPNPI	V.Nikuline.

Spokesperson: M.Garcon, M.Clajus from JINR: **L.Lytkin**

During 1993 the two-arm BGO γ (Fig.1) calorimeter was mounted and tested. By means of LED influence of the magnetic field on the detectors was measured and the additional shielding was made.

In front of the right arm γ calorimeter the passive and active collimator was placed. The active collimator was calibrated with a radioactive source amd cosmic rays.

The on-line program for the reconstruction of γ events was written. In a 10-day testing run we investigated the behaviour of the BGO detectors within a burst time and run time. We got the calibration data, selection criteria.

6 million triggers were recorded in the data taking run with and without the active collimator.

Preliminary results show that the background outside the $\eta \to 2\gamma$ peak is less than 1% (see Fig.2). The maximal systematic uncertainty is given by an uncertainty in the acceptance and will be evaluated from the data to be taken with the active collimator.

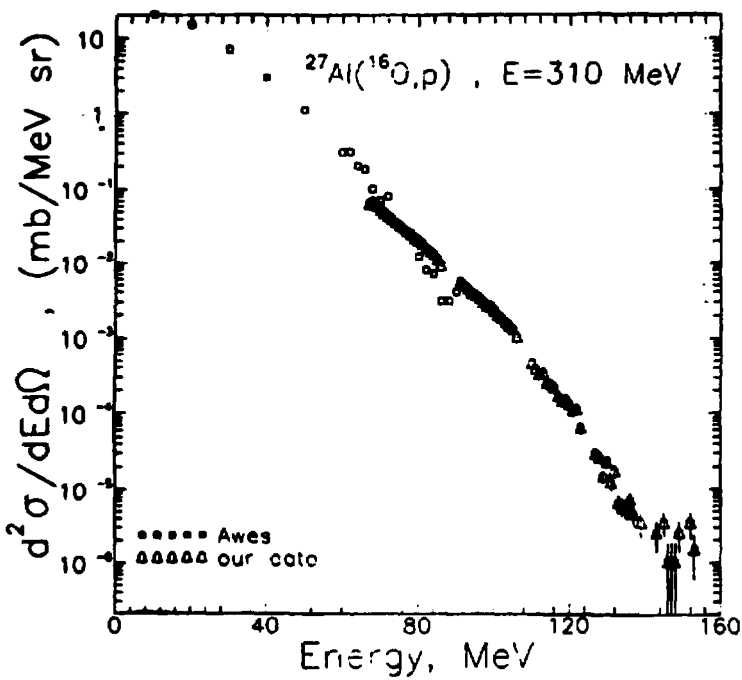

$^{27}Al(^{16}O,p)$, E=310 MeV
●●●●● Awes
ΔΔΔΔΔ our calc
$d^2\sigma/dEd\Omega$, (mb/MeV sr)
Energy, MeV
10
1
10⁻¹
10⁻²
10⁻³
10⁻⁴
10⁻⁵
10⁻⁶
0
40
80
120
160

Figure 1.

LNP-20
Status: Data-Taking

Study of Subthreshold Pion Production and High Energy Light Fragments Emission in Nucleus-Nucleus Collisions at Heavy Ion Accelerators of the Laboratory of Nuclear Reaction of JINR.

LNP JINR, Dubna; FLNR JINR, Dubna; Moscow Physical Engineering Institute; Institute of Nuclear Research, Moscow, Russia; Los Alamos National Laboratory; Arizona State University, USA

LNP, Dubna	K.O. Oganesyan, E.A. Pasyuk, V.Yu. Alexakhin S.I. Gogolev, M.I. Gostkin, S.I. Merzlyakov, S.Yu. Porokhovoy, N. Scintee
FRNR Dubna	Yu.E. Penionzhkevich
MEPI, Moscow	M.G. Gornov
INR, Moscow	R.A. Eramzhyan, A.B. Kurepin
LANL, Los Alamos	C. Morris
ASU, Tempe	B. Ritchie

Spokesman from LNP JINR: **K.O. Oganesyan**

The preparation of the experiment on subthreshold pion production and light charged particle emission in heavy ion collision at energies below 60 MeV per nucleon was underway. The experiment will be done at the U400M cyclotron. The multilayer scintillation and semiconductor telescopes and the 4π detector BGO ball from LAMPF will be used. In 1993 the collaboration was working on design and construction of beam line, scattering chambers, electronics for data acquisition. As the first stage of the experimental program and feasibility test the light particle (p, d, t) spectra from the collision of ^{16}O nuclei with Al and Au for two incident energies 210 and 310 MeV were measured at the U400 cyclotron. Figure shows the measured proton spectrum from the reaction $^{16}O + ^{27}Al$ at $\theta_{lab} = 30°$ for incident energy of 310 MeV. These first measurements demonstrate that we can see protons with energy up to 150 MeV. The prior measurements of the proton spectrum for the same reactions were extended only to 90 MeV. We advanced about 3-4 orders of magnitude in the level of measurable cross section. It became possible due to an appropriate combination of a high intensity beam of the U400 cyclotron and the technique of multilayer telescopes, which is not traditional for the experiments with heavy ions. The preliminary results were presented at the International School-Seminar on Heavy Ion Physics, May 10-15, 1993, Dubna (E7-93-274).

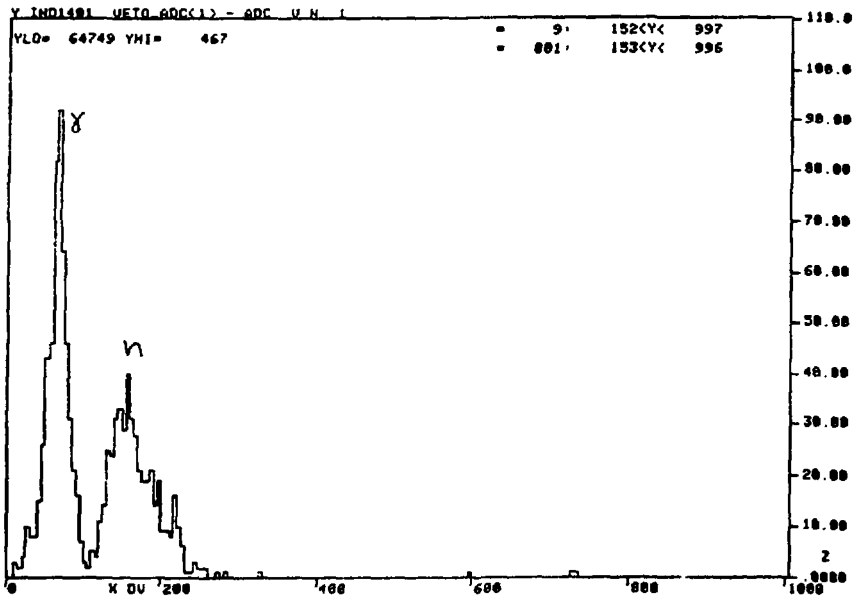

Y IND1401 VETO ADC(1) - ADC V N 1
YLO= 64749 YHI= 467
= 9 152<Y< 997
= 001 153<Y< 996
γ
n
X DV
200
400
600
800
1000
110.0
100.0
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
.0000

Figure 1.

LNP-21	
Status:	Data-Taking Data Analysis

Study of Low Energy Pion-Nucleus Interaction at LAMPF

LNP JINR, Dubna; Institute for Nucleor Research, Troitsk, Russia; Los Alamos National Laboratory; Arisona State University, Arizona; Rutgers University, USA

LNP, Dubna	K. Oganesyan, E. Pasyuk, V.Yu. Alexakhin, S.I. Gogolev
INR, Troitsk	A. Kurepin
LAMPF, Los Alamos	C. Morris
ASU, Arizona	B. Ritchie
RU, USA	R. Ransome

Spokesman from JINR: **K. Oganesyan**

The data were obtained at the LAMPF LEP channel with the 4π BGO ball detector in following experiments.

1. E1275 "Study of $\pi^+d \to 2p$ reaction at pion energies 20 - 50 MeV". The high accuracy measurements of differential and total cross section of pion absorption on deuterium and carbon were done with a minimal step in incident energy. The analysis of data will be completed next year. The data obtained will allow one to verify an indication of resonance–like behavior of the cross section in this energy range.

2. E1227 "Two pion component of pion absorption at low energies". The most complete data set on energy and mass dependence of the two-proton component of pion absorption cross section below the Δ-resonance was obtained. The preliminary data was presented on the Annual meeting of APS.

3. E1239 "The feasibility test of direct pionic atom production". The data obtained will allow one to estimate probability of direct production of low-lying states of pionic atom.

In August 1993 experiment E1282 "Measurement of neutron-neutron scattering length and effective range in reaction $d(\pi^-, nn)\gamma$" was carried out. The experimental setup included a liquid scintillator neutron detector array and one arm of a new NMS spectrometer for γ detection. The measurements were performed in full kinematics. Figure shows the efficiency of $n - \gamma$ discrimination.

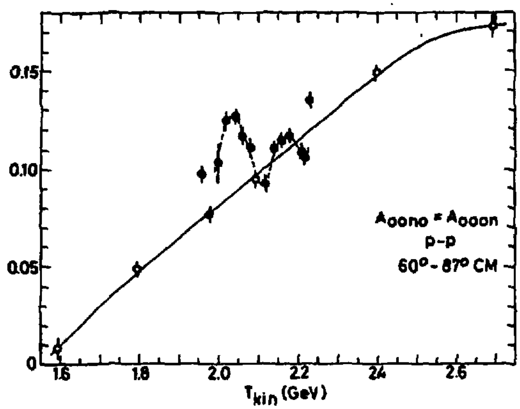


Figure 1.

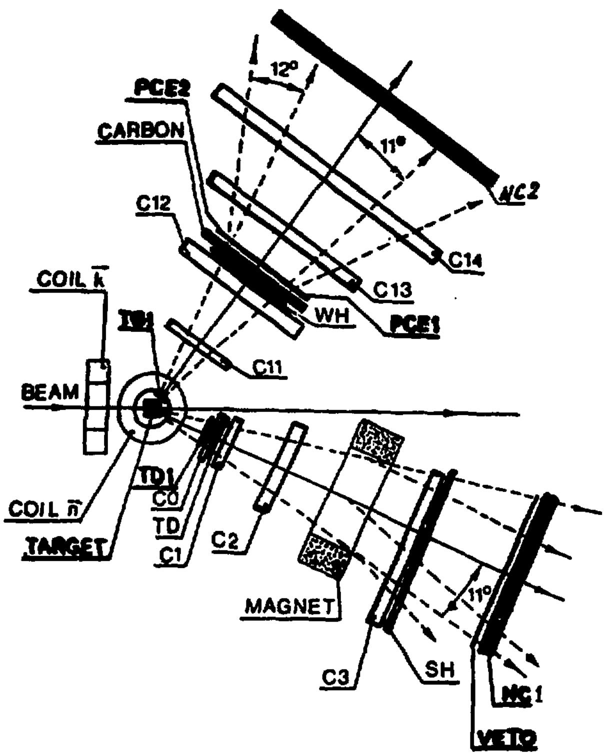


Figure 2.

E-225, Saclay	LNP-22
Status	Data-Taking

Determination of NN-Scattering Amplitudes in the Energy Region from 1.1 to 2.7 GeV and Search for a Structure around T_{kin}=2.1 GeV.

LNP JINR, Dubna, Russia; Laboratoire National SATURNE, Saclay; DAPNIA, Saclay, France; DPNC, Universite de Geneve, Suisse; ANL-HEP, Illinois, USA

LNP, Dubna	L.Barabash, Z.Janout, V.Kalinnikov, Yu.M.Kazarinov, B.Khachaturov, V.Matafonov, I.Pisarev, A.Popov, Yu.Usov
LNS, Saclay	J.Ball, J.M.Fontaine et al.
ANL-HEP, Illinois	H.Spinka et al.
DPNC Univ., Geneve	R.Hess et al.

JINR Spokesman: **B. Khachaturov**

The proposal of experiment EXP-225 concerns the verification of a possible structure in *pp* elastic scattering around 2.1 GeV (Fig.1) and the complete experiment in the pn quasielastic scattering between 1.1 and 2.7 GeV.

Two runs were performed for *pn* scattering, one at 1.1 GeV, the second one at 1.6, 1.8, 2.04, 2.10 and 2.4 GeV. The aim of the first run (November 1992) was comparison of *np* and *pp* elastic data, and *pn* and *pp* quasielastic data at the same energy. We observe very good agreement of *pp* elastic and quasielastic data. But the *pn* analyzing power and spin correlation quasielastic data are smaller than those for elastic *np* scattering. We concluded that a second neutron counter (NC2) (Fig.2) hodoscope is needed. This NC2 was installed in October 1993 including its electronics. NC2 may considerably improve the results and their normalization in the overlapping angular region. Two targets in the same refrigerator were polarized simultaneously. This was the first test of new materials ^{6}LiD and ^{6}LiH. We saw a considerable difference between these two targets, allowing the contribution of the polarized deuterons in ^{6}Li and D nuclei to be estimated.

In the second run (April 1993), the acquisition by the SUN-computer was performed, and the ANL proportional chamber gave full satisfaction. The same targets with new irradiated materials were used. The target polarization was roughly the same as for the first run. We have tested a new system for spin precession into the longitudinal direction. This system contains 3 dipoles and two solenoids. Results obtained with the "anti-polarimeter" show that the new array worked correctly.

As a conclusion from these two runs, the unique, but crucial part of the apparatus, the target, needs a development. New irradiation and new target polarization measurements are necessary and need considerable effort and manpower.. After new measurements giving the target polarization more than 10%, we estimate that the target for *pn* experiment may be ready only in 1994.

For this reason we decided to finish the first part of our program, namely accurate checks of the structure in *pp* scattering around 2.1 GeV. For this part we need the pentanol polarized target which works perfectly.

Our direct amplitude reconstruction at 2.10 GeV and neighbouring energies resulted in two types of solutions, one with a positive and the other with a negative relative phase of the amplitude *a*. The choice of the one or the other solutions at different energies was the first indication of the structure discussed above. The new spin precession system installed on our beam line allows an s-type beam and measurement of observables N_{ossn} and N_{onsk} (simultaneously with D_{onon}, K_{osso}, A_{oosk}, D_{osok}). The values of N_{ossn}, N_{onsk} and K_{osso} are large and of different signs for both types of solutions. The measurement is expected to distinguish between the two solutions and to improve considerably the accuracy of the amplitude reconstruction.

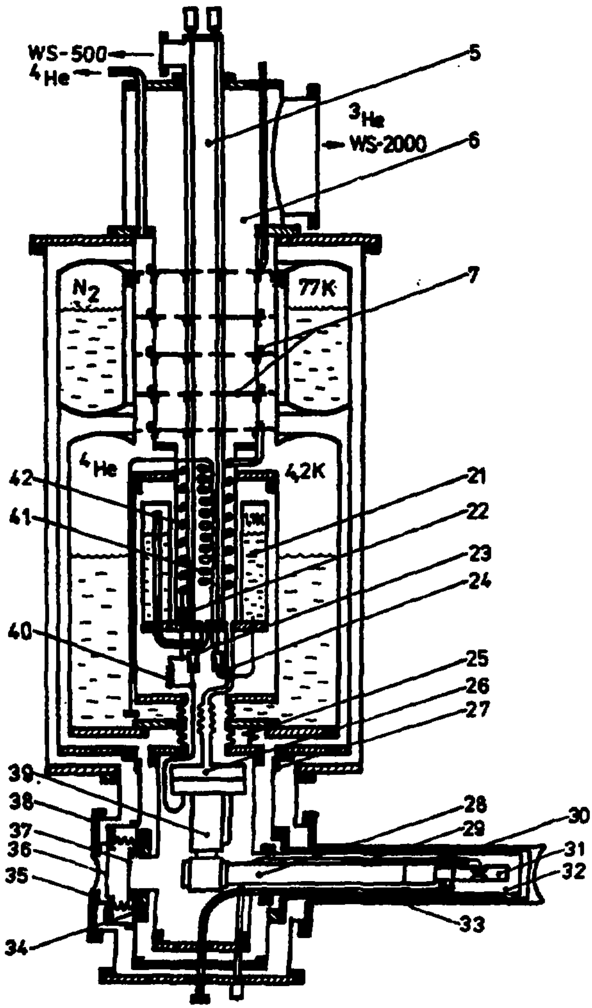


Figure 1.
Schematic view of the vertical cryoctat of $^3He/^4He$ dilution refrigerator.
(22 - condenser; 23,24 - needle valves; 26 - ^3He still; 28 - main heat exchanger; 29 - NMR cable; 30 - microwave choke; 31 - mixing chamber (target); 32 - microwave covity; 35,36,37 - covers; 39 - preliminary heat exchanger.)

LNP-23
Status Data-Taking

The experimental study of np elastic scattering amplitudes at 16 MeV.

LNP JINR, Dubna; INR, Moscow; KHIPT, Kharkov, Russia; Nuclear Center Charles University, Praha, Czech Republic

LNP, Dubna	N.S.Borisov, E.I.Bunyatova, V.F.Burinov, O.N.Chevelev, Yu.M.Kazarinov, B.A.Khachaturov, V.G.Kolomietc, E.S.Kuzmin, V.N.Matafonov, A.B.Neganov, I.L.Pisarev, Yu.A.Plis, Yu.A.Usov
INR, Moscow	G.M.Gurevich at al.
KHIPT, Kharkov	A.A.Lukhanin at al.
Charles Univ.	I.Wilhelm, Z.Dolezal at al.

JINR Spokesman: **Yu.A.Usov**

The study of spin dependence of $n-p$ scattering amplitudes represents an interesting problem concerning NN interaction. Two different concepts of interaction potentials exist at present time (usually called Paris and Bonn potentials) for describing the process in the frame of phase-shift analysis. With respect to the fact that the spin dependence substantially differs in these two models, it is necessary to complete the experimental data. Now establishment of spin dependent quantities arises much interest but the experimental values are missing in the energy region below 50 MeV at present.

For this reason the proposal for experimental research of the elastic scattering of the polarized neutrons by polarized protons was specified. A polarized neutron beam is based on Van de Graff accelerator of Charles University Nuclear Centre (Prague) using $^3H + d \rightarrow {}^4He + n$ producing reaction at deuteron energy about 2 MeV. The transverse polarization of the neutron beam at $\theta_{lab} \simeq 60°$ consists of about 18% with energy of neutrons about 16 MeV.

The polarized sample* is of cylindrical form 20 mm in diameter and 60 mm long. The maximum degree of polarization obtained with dynamic method is $\simeq 95 \pm 3\%$. It is maintained at temperature about 20 mK in holding magnetic field of 0.37 T with a big aperture for scattering particles. Under these conditions the relaxation time is about 1000 hours.

At the first stage of the experiment the measurements of the difference of total cross sections in pure spin states are supposed: $\Delta\sigma_t$ and $\Delta\sigma_l$. In 1993 (May, November) two runs were realized in order to measure $\Delta\sigma_t$, at present the experimental data are processed.

In accordance with results obtained after processing the program of the further research will be specified. In 1994 there are plans to begin the measurements of the parameter $\Delta\sigma_l$ at E_n=16.3 MeV. For this aim in 1993 the permanent magnet was made in CU in order to turn the neutron spin receiving the longitudinal polarization of neutron beam.

* N.S. Borisov at al. Target with a frozen nuclear polarization for experiments at low energies. Submitted to Nucl. Instr. and Methods.

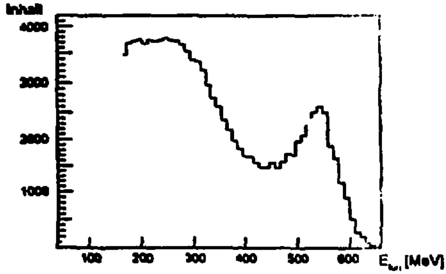


Figure 1: Energy spectrum of the 0° neutron beam in the NA2 area. As compared to the 'old' 3.4° spectra from the nE1 beam, the quasielastic peak is reduced due to Pauli blocking.

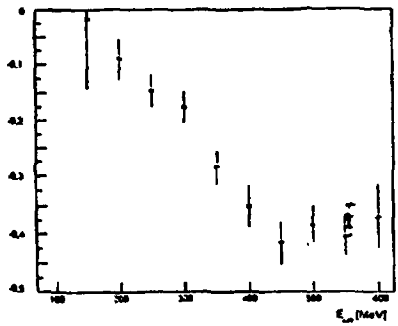


Figure 2: Neutron polarization as a function of the energy. The agreement with our previous result is excellent, if the present proton polarization of 0.75 is taken into account.

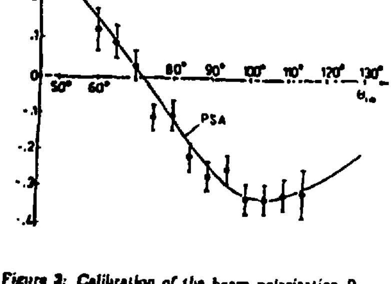


Figure 3: Calibration of the beam polarization P_b at ≈ 540 MeV and measurement of the analyzing power A_{nmo} using the setup at experiment I and a CH_2 target. The parameter $P_b = 0.30 \pm 0.02$ was found by normalizing these data to the PSA. The angular dependence is in good agreement with the PSA predictions.

PSI Exp R-87-12	LNP-24
Status	Data-Taking

Spin observables in neutron-proton elastic scattering.

LNP JINR, Dubna; University of Freiburg, Br; DPNC University of Geneva; PSI, Villigen; Charles University, Praha; DAPNIA CEN, Saclay, France.

LNP, Dubna	R. Drevenak, M.Finger, M.Finger,Jr., Yu.M.Kazarinov, M.Slunecka
Univ., Freiburg	H. Schmitt et al.
DPNC, Univ., Geneva	R. Hess et al.
PSI, Villigen	M. Daum, S. Mango et al.
DAPNIA CEN, Saclay	F. Lehar

Spokesman from JINR: **M.Finger**

A new very intense polarized neutron beam line NA2 created by the charge exchange reaction $C(\vec{p},\vec{n})X$ at 0° was successfully set up at the accelerator complex of the Paul Scherrer Institute. This polarized neutron beam with two specialized spectrometers equipped with frozen spin polarized proton and LH_2 targets respectively is used to perform extensive programme aimed at the study of spin observables in neutron-proton elastic scattering between 300 MeV and 580 MeV. Average polarization 35% - 45% with all possible orientations $(\vec{s},\vec{n},\vec{k})$ and intensity $5\times10^6\vec{n}\ s^{-1}cm^{-2}$ at 12 m from the production target of the neutron beam was obtained for neutrons with energy between 250 MeV - 580 MeV. The energy of incoming neutron was measured by time-of-flight between the signal of one of the start counters (recoil proton) and the RF-signal of the accelerator, which was operated in the 50 MHz ($20ns$) mode. The neutron beam polarization was measured with the symmetric two arm time-of-flight spectrometer.

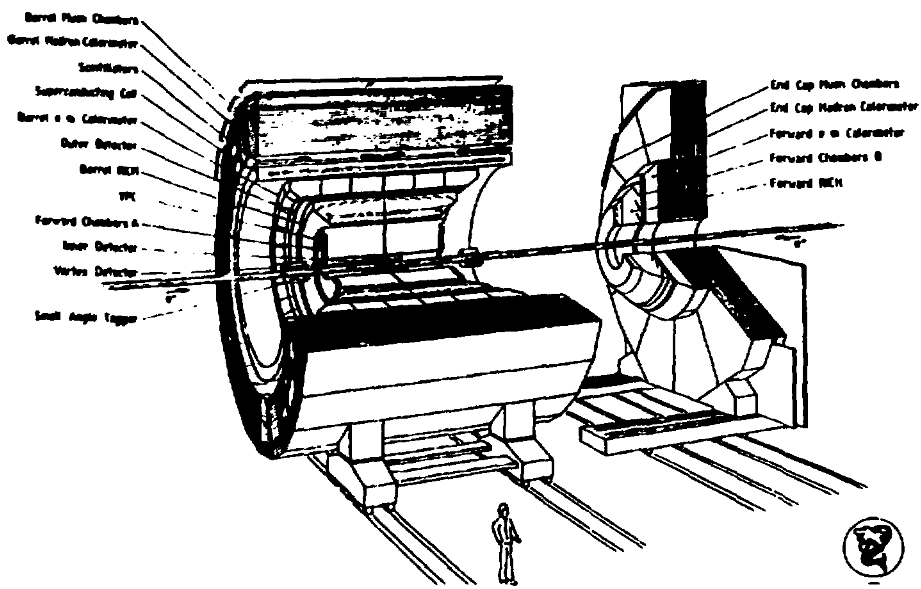
At the first experimental target station the frozen spin polarized proton target was used. The target has a volume $4\times4\times4$ cm^3 and the orientation $\vec{n}$ and $\vec{k}$ of the polarization are possible. The change in the orientation was performed in less than 1 hour. The target system has a built-in dummy target for the background measurements. For some experiments CH_2 and C targets were used at this position. The scattered neutrons were detected by the hodoscope of 11 plastic scintillation bars of $8\times20\times130$ cm^3. The polarization of scattered proton was measured in a polarimeter using multiwire chambers. About 15×10^6 double scattering raw np-events were registered during March to measure parameters A_{oono}, A_{onon} and K_{onno}. Part of the March run was used for setting up the new beam line. About 30×10^6 single scattering raw np-events in July to measure spin correlation parameters A_{oonn}, A_{onkk} and A_{oosk}, and 30×10^6 double scattering np-events in October to measure parameters A_{oono}, A_{onoo}, K_{onno}, K_{osso} and K_{osko} were registered.

At the second experimental target station an LH_2 target was installed to observe new spin parameters where the longitudinal polarization of recoil protons is analyzed. Due to the spin rotation caused by the special magnet used at this spectrometer longitudinal polarization of the protons may also be analyzed. The spectrometer was set at about 8°, and no neutron detector was used for this small proton angle. Data for the measurement of K_{onno} and K_{okko} are taken.

[1] A.Ahmidouch et al., PSI Newsletter Nucl.Part.Phys.(1991)43

[2] A.Ahmidouch et al., PSI Newsletter Nucl.Part.Phys.(1992)33

Experiments on High Energy Physics



The DELPHI Detector

DELPHI	LNP-25
Status	Data-Taking

The DELPHI Detector (Detector with Lepton Photon and Hadron Identification)

Amsterdam NIKHEF, Antwerp Univ., Athens Demokritos/NCSR, Athens Univ., Athens Nat.Tech.Univ., Bologna Univ./INFN, Brussels IIHE, CERN, Copenhagen Niels Bohr Inst., Cracow Inst.Nucl.Phys., Dubna JINR, Genoa Univ./INFN, Grenoble ISN, Helsinki Univ., Iowa State Univ. Ames, Karlsruhe IEKP, Lisbon LIP, Liverpool Univ., Lund Univ., Univ. of Lyon I (IPNL), Milan Univ./INFN, Mons Univ., Orsay LAL, Oslo Univ., Oxford Univ., Padua Univ./INFN, Paris College de France, Paris LPNHE - P.et M.Curie Univ., Univ. Fed. Rio de Janeiro, Rome Sanita/INFN, Rome Univ.II/ INFN, Rutherford Appleton Lab., Saclay CEN DPhPE, Santander Univ., Serpukhov IHEP, Stockholm Univ., Strasbourg Univ., Trieste Univ./ INFN, Turin Univ./ INFN, Udine Univ./INFN, Uppsala Univ., Valencia Univ., Oester. Akad. Wissensch. Vienna, Warsaw Univ., Wuppertal Univ.

LNP, Dubna Alekseev G., Bilenky M., Chelkov G., Khovansky N., Kouznetsov O., Krumstein Z., Malyshev V., Nozdrin A., Olshevski A., Potashnikova I., Pukhaeva N., Rudenko T., Sedykh Yu., Tkatchev L., Tokmenin V., Vertogradov L.

Spokesman from JINR: **A.Olshevski**

DELPHI is a general purpose detector for physics at LEP on and above the Z^0-boson, offering three-dimensional information on curvature and energy deposition with fine spatial granularity as well as identification of leptons and hadrons over most of the solid angle. The JINR (Dubna) had contributed to the construction of DELPHI and is involved now in running the DELPHI detector, in physics analysis and in the upgrading program.

About 20000 streamer tubes were produced at JINR for DELPHI Hadron Calorimeter and at present Dubna is maintaining this detector hardware and software.

1993: In the area of physics analysis the JINR group works on:
- Global electroweak analysis and Standard Model tests.
- Studies of b - lifetime, branching ratios and decay modes using the J/ψ tagging.
- QCD physics; in particular, measurements of the fragmentation functions, determination of the strong coupling constant and search for quark polarization phenomena.
- Two-photon physics, measurements of the photon structure function.
- Development of LEP200 physics program.

In the framework of the DELPHI upgrading program the JINR group is participating in the construction of the Surround Muon Chambers. Dubna contributes to this project with the production of the detectors and electronics design.

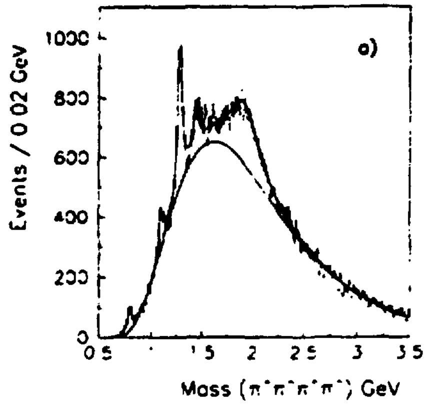


Figure 1

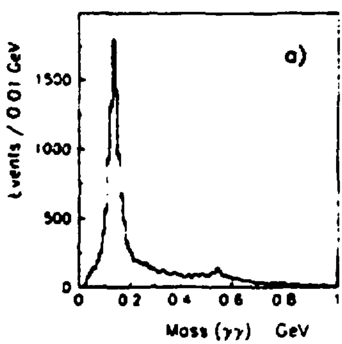


Figure 2

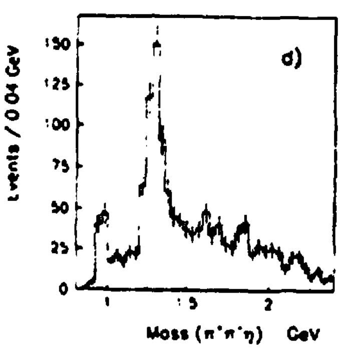


Figure 3

WA91	LNP-26
Status	Data-Taking

A search for centrally produced non–$q\bar{q}$ mesons in proton proton interactions at 450 GeV/c by using the CERN Ω Spectrometer

LNP JINR, Dubna; Athens University; Bari Univiversity/INFN; Birmingham University; CERN, Geneva; Paris College de France

LNP, Dubna	Maljukov S., Minashvili I., Romanovsky V., Russakovich N., Semenov A., Solovjev A., Tchlatchidze G.
Athens Univ.	Abatzis S., Vassiliadis G.
Bari Univ.	Di Bari D., Fini R., Ghidini B., Girone M., Lenti V., Loconsole A., Manzari V., Navach F.
Birmingham Univ.	Barnes R.P., Bayes A.X., Carney J.N., Clewer S., Dodenhoff C.J., Kinson J.B., Villalobos Baillie O., Votruba M.F.
CERN	Beusch W., Evans D., French B.R., Jacholkowski A., Knudson K., Kirk A., Lassalle J.C., Quercigh E.
College de France	Sene M., Sene R.

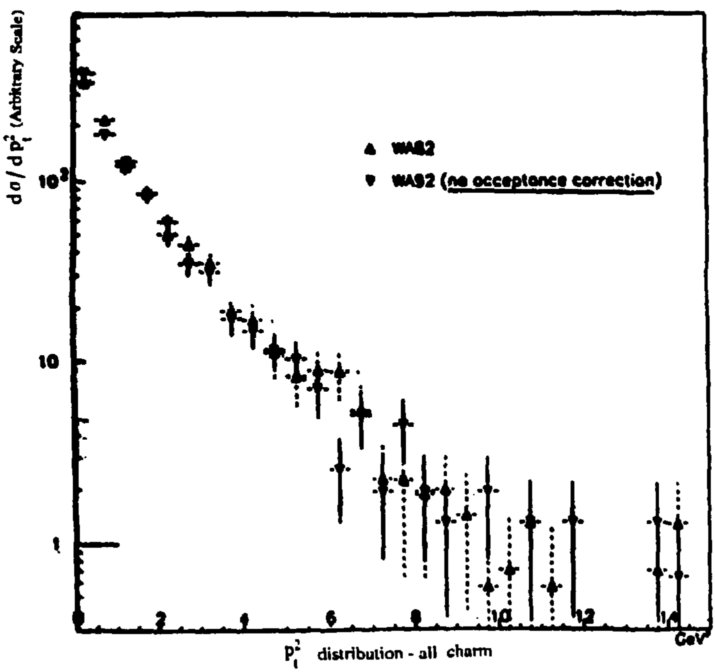
Spokesman: A.Kirk   from JINR: **Russakovich N.**

Experiment WA91 was motivated by the interesting signals observed by the WA76 experiment in central production at 85 and 300 GeV. The first results from experiment WA91 with 40% of statistics recorded during its 1992 data taking were obtained. In particular, the X(1450) and X(1900) observed for the first time in the $\pi^+\pi^-\pi^+\pi^-$ channel of the WA76 experiment at 300 GeV/c are confirmed by the WA91 data (Fig. 1).

The Dubna group responsibility was mainly refurbishing and maintaining the OLGA lead glass calorimeter, appropriate trigger electronics and algorithm of electromagnetic shower reconstructions. As an example of calorimeter performance $\gamma\gamma$- and $\pi^+\pi^-\eta$-effective mass spectra are shown in Fig.2,3. Peaks from π°, η and $f(1285)$ are clearly seen.

The next data-taking runs with new layout of the detectors in the WA91 experiment are planned. It was proposed that a combined electromagnetic calorimeter (GAMS+OLGA) should be used behind two Cerenkov counters. This setup will improve the acceptance of OLGA.

1 F.Antinori et al. "First results from experiment WA91 at the CERN Omega Spectrometer" CERN/PPE 93-133, CERN, 1993.



dσ / d p_t^2 (Arbitrary Scale)
WA82
WA82 (no acceptance correction)
10²
10
1
0
2
4
6
8
10
12
14
GeV
p_t^2 distribution - all charm

Figure 1

WA92	LNP-27
Status	Data-Analysis

Measurement of beauty particle lifetimes and hadroproduction cross–section

Bologna University/INFN; CERN, Geneva; JINR, Dubna; Genoa University/INFN; London ICL; Moscow Lebedev Phys.Inst., Russia; Pisa University/INFN; Rome University/INFN; Rome University II/INFN; Southampton University

LNP, Dubna	Maljukov S., Minashvili I., Romanovsky V., Russakovich N., Semenov A., Solovjev A., Tchlatchidze G.
Bologna Univ.	Forino A., Geessaroli R., Malferrari L., Mazzanti P., Guareni A.
CERN	Antinori F., Beush W., Dufey J.P., Evans D., Fabre J.P., Farthouat Ph., Frenh B.R., Kirk A., Lassalle J.., Passaseo M., Ryzhov V., Shuler G.
Genoa Univ.	Adinolfi M., Barberis D., Casanova V., Dameri M., Darbo G., Hurst R., Martinengo P., Osculati B., Rossi L., Salvo C.
London ICL	Duane A., Websdale D.M.
Moscow LPI.	Adamovich M., Alexandrov Y., Kharlamov S., Nechaeva P., Zavertyaev M.
Pisa Univ.	Angelini C., Cardini A., Flaminio V., Lazzeroni C., Roda C.
Rome Univ.	Bacci C., Ceradini F., Ciapetti G., Frenkel A., Harrison K., Lacava F., Martellotti G., Nisati A., Orestano D., Penzo G., Petrolo E., Pontecorvo L., Torelli M., Veneziano S., Verzocchi M., Zanello L.
Rome Univ.II	Cardarelli R., Di Ciaccio A., Santonio R.
Southampton Un.	McEwen J.G.

Spokesman from JINR: **Russakovich N.**

The 1993 data-taking run has finished. We have taken about 60 million events of several signatures enriched by D- and B- mesons. Especially for this experiment the Dubna designed and produced an electronic trigger system for OLGA calorimeter. This system with associated on-line software was used during 1993 data-taking for triggering on high P_t electrons and γ-quanta.

The data processing, investigation of selection criteria and acceptance calculations are now under way. Some preliminary results are already available. As an example, the p_t^2-distributions of D-mesons registered through their decays to $K\pi$, $K\pi\pi$ and $K\pi\pi\pi$ is shown in the Figure.

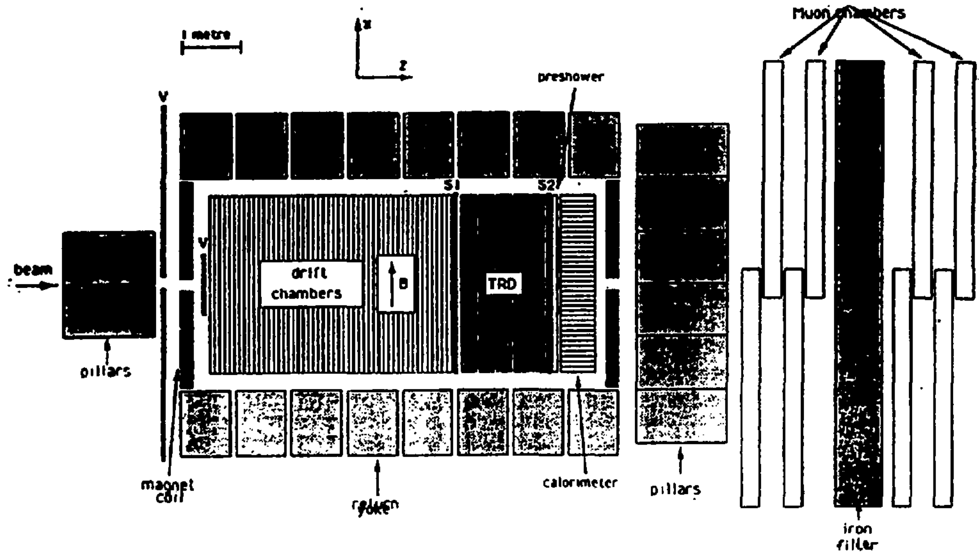


Fig.1. The schematic view of NOMAD detector.

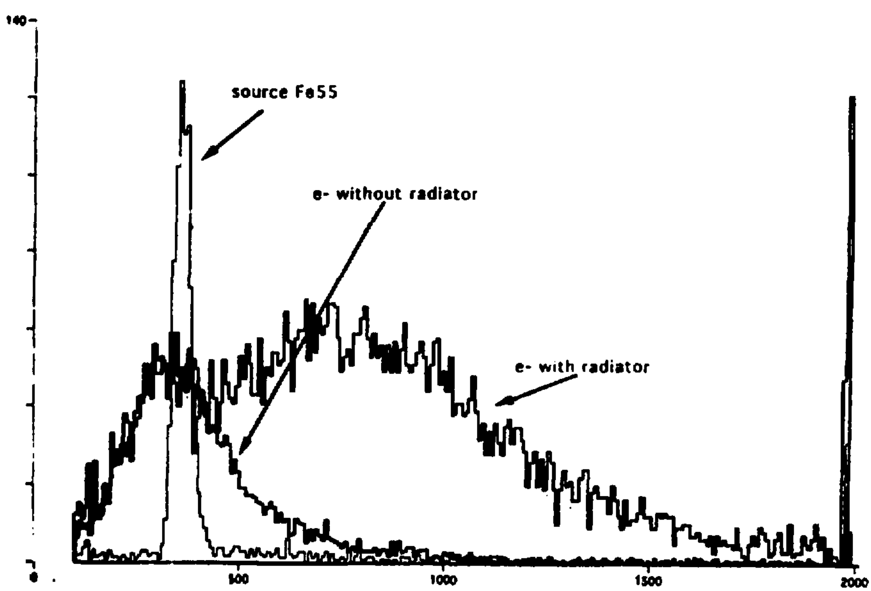


Fig.2. Amplitude distribution from TRD test module obtained with 10 GeV electrons at CERN SPS.

NOMAD WA-96	LNP-28
Status	Preparation

Search for the oscillation $\nu_\mu \leftrightarrow \nu_\tau$

LNP JINR, Dubna; Annecy LAPP; Calabria University; CERN; Dortmund University; Johns Hopkins University; Lausanne University; Melbourne University; University of Michigan; Moscow INR; Padova University/INFN; Paris VI and VII University; Pavia University/INFN; Pisa University/INFN; Saclay CE DPhPE; University of Sydney; Zagreb Rudjer Boskovic Institute

LNP Dubna Batusov Y., Bunyatov S., Klimov O., Kuznetsov V., Lyukov V., Nefedov Y., Petrovichev O., Popov B., Snyatkov V., Tereshchenko V., Valuev V.

Spokesman: Vannucci F. from JINR: **S. Bunyatov**

The experiment was improved on September 18, 1991. The NOMAD setup is shown in Fig.1. The work for the creation of detectors and software development continued during 1993. The results obtained by the JINR group are as follows:

The off-line program preparation. The new set of kinematic criteria was offered in order to improve the reconstruction efficiencies for hadronic decay channels of τ-lepton [1]. As a result, the sensitivity of experiment to $\nu_\mu \leftrightarrow \nu_\tau$ oscillation was increased by 20%. A new procedure of ν_τ / ν_μ ratio calculation was proposed.

The upper limit of the ν_τ / ν_μ ratio was decreased from $3.0 \cdot 10^{-4}$ to $2.5 \cdot 10^{-4}$.

The effect of a possible hadron calorimeter addition was considered. It was shown that addition of a hadron calorimeter to the original setup of NOMAD detector would increase the reconstruction efficiencies of hadronic τ^--decay channels by $\sim 5\%$ [2].

TRD simulation package was created [3,4]. A full GEANT TRD Monte-Carlo simulation program (GENOMTRD) was developed.

On-line development. The testing equipment for the prototype of mylar tubes was created. The preparation of ^{55}Fe-montoring program for TRD-detector was started.

Testing accelerator run for TRD-detector. The physicists from JINR were taking part in the first TRD module testing accelerator run at CERN in October-November 1993. The 10 GeV electron test beam from SPS was used. The TRD-detector consisted of 16 adjacent aluminized mylar straw tubes, each 3 m long and 16 mm diameter, filled with a mixture of Xe (65%) and CH_4 (35%).

Good separation of signals from ionisation losses and transition radiation was obtained (Fig.2). 1.5 m^3 of Xe gas for TR detectors tests were supplied. The part of the detector will be ready to accelerator run in the middle of 1994. The all NOMAD detector components will be installed at the end of 1994.

1. S. Bunyatov, O. Klimov, V. Lyukov, Y. Nefedov, B. Popov, V. Valuev. "New analysis of kinematical cuts to reduce background from ν_μ and $\bar{\nu}_\mu$ interactions to hadronic decays of τ-leptons in NOMAD experiment" NOMAD MEMO #30, 1993.

2. B. Popov. "Addendum to the NOMAD MEMO #30", September 1993.

3. V. Valuev. "The implementation of TRD code into the NOMAD library", NOMAD MEMO, 1993.

4. T. Fasio, P. Nedelec, V. Valuev. "TRD simulation package" NOMAD Software Note, October 1993.

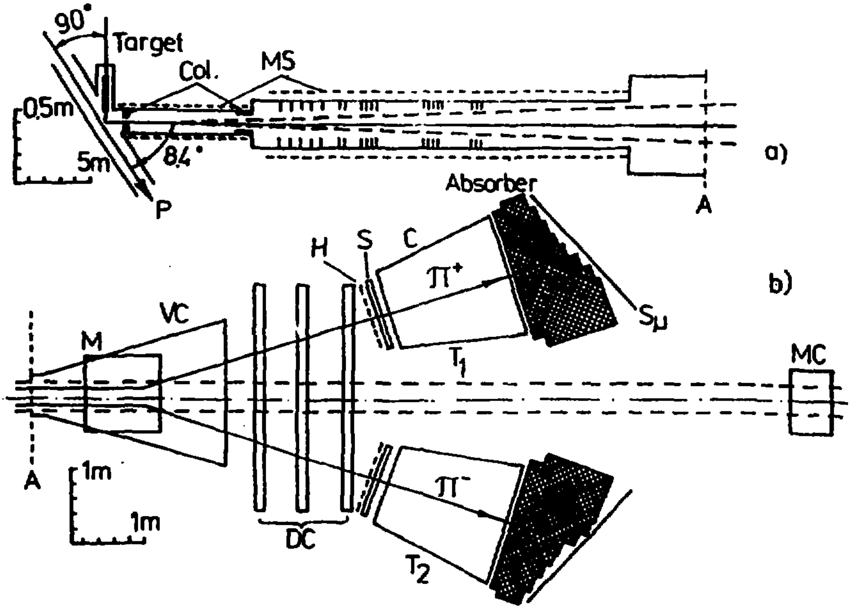


Fig. 1. Experimental setup.
(a) channel scheme: *p* — internal proton beam, *Target* — target mechanism, *Col* — collimator, *MS* — magnetic shield;
(b) magnet and detectors: *M* — poles of spectrometer magnet, *VC* — vacuum chamber, *DC* — drift chambers, *H* — scintillation hodoscopes, S_μ — scintillation counters, *C* — gas Cherenkov counters, *Absorber* — cost-iron absorber, *MC* — monitor counters.

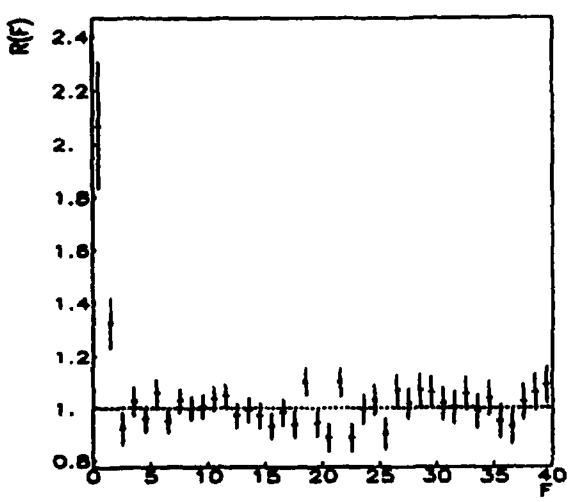


Fig. 2. The ratio of the experimental distribution of $\pi^+\pi^-$-pairs on relative momentum to the approximating distribution. The deviation of the ratio from unity in the two first bins is due to extra pairs originating from break-up of $A_{2\pi}$ in the target matter.

LNP-29
Status Preparation

Lifetime measurement of $(\pi^+\pi^-)$ atoms to test low energy QCD prediction

LNP JINR, Dubna; Institute for Nuclear Physics, Dubna Branch, Moscow State University, Russia; CERN, Geneva; University of Bern, Switzerland

LNP, Dubna	L.G. Afanasyev, O.E. Gorchakov, M.A. Ivanov, V.V. Karpukhin, V.I. Komarov, V.V. Kruglov, A.V. Kuptsov, L.L. Nemenov, M.V. Nikitin, Zh.P. Pustylnik
LCTA, Dubna	A.S. Chvyrov, A.V. Kolomyichenko
INP, MSU	A.V. Kulikov, S.V. Trusov, V.V. Yazkov
CERN, Geneva	L. Montanet
Univ., Bern	G. Czapek, F. Dittus, D.Frei, K. Pretzl, U. Moser, J. Schacher

Spokesman: **L.L.Nemenov**

In 1993 we observed 272 ± 49 atoms consisting of π^+ and π^--mesons [1,2] and obtained an estimation of the $\pi^+\pi^-$-atom lifetime in the ground state: $\tau = (2.9^{+\infty}_{-2.1})\cdot 10^{-15}$ s or $\tau > 0.3\cdot 10^{-15}$ s with probability of 98%. The atoms were produced in a Ta target by 70 GeV internal beam at U-70 Proton Syncrotron (Protvino). The pairs of π^+ and π^--mesons were detected from the atom break-up in the same target. The experimental setup and results obtained are shown in Fig.1 and Fig.2.

In March 1993 SPSLC CERN approved Letter of Intent I 191 to measure the $\pi^+\pi^-$-atom lifetime with precision better than 10% for checking precise predictions of QCD at low energy. In accordance with SPSLC recommendations a full Proposal of the experiment at PS CERN is being prepared by physicists of JINR, INP MSU Dubna Branch, CERN and of scientific centres of West Europe. The Proposal preparation will be finished in June 1994. Project of the beam line, the experimental area and the beam dump is already designed by PS Division.

In 1993 in the Proposal framework there the detailed calculations of the yields and momentum distributions of $\pi^+\pi^-$-atoms at PS CERN were fulfilled, dynamics of the $\pi^+\pi^-$-atom interactions with matter and manufactured frames and highvoltage electrodes of 34 drift chambers were studied.

Preliminary data on study of the Coulomb correlations were reported at Marseilles Conference. Results of the observation of the $\pi^+\pi^-$-atoms and prospects of their investigation at PS CERN were reported at the seminars in 10 scientific centres of the West Europe.

1. Afanasyev L.G., et al. Phys. Lett., 308B (1993) 200.
2. CERN Courier, October, 1993, p. 8.

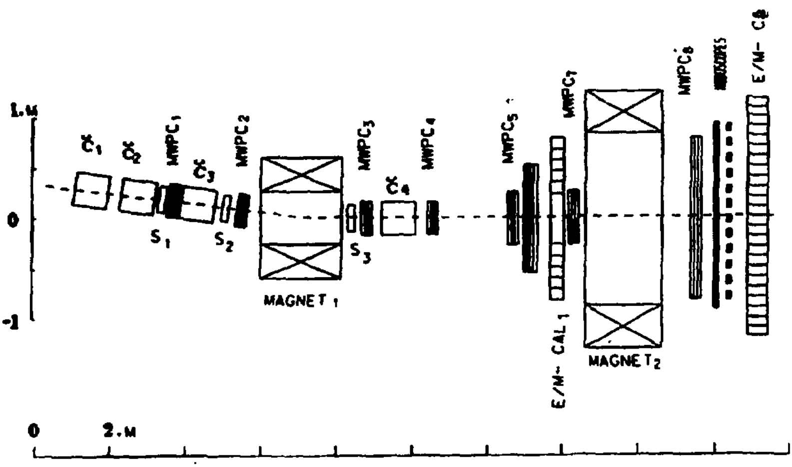


Fig.1. The layout of detector "Hyperon" at Serpukhov accelerator U-70

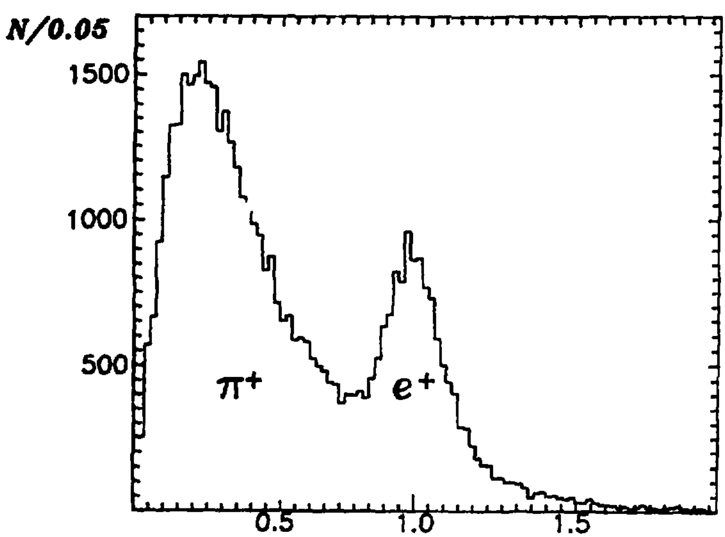


Fig.2. N-events number as a function of ratio energy mesuared in e/m-calorimeter to momentum measured in magnetic field

Hyperon	LNP-30
Status	Data-Taking

Study of radiative K - decays with HYPERON spectrometer

LNP JINR, Dubna; IHEP, Protvino, Russia; IFAN, Baku, Azerbaidzhan; IAF, Bucharest, Romania; IHEP, Tbilisi, Georgia; University, Sofia; IEF, Koshice; University, Koshice, Bulgaria; IP, Bratislava, Slovakia; IP, Minsk; Universiry, Gomel, Belarussia

LNP Dubna	A.G.Asmolov, Yu.A.Budagov, I.E.Chirikov-Zorin, Yu.I.Davydov, V.P.Dzhelepov, V.B.Flyagin, V.V.Glagolev, A.V.Kolomyichenko, I.P.Liba, Yu.F.Lomakin, S.N.Malyukov, A.A.Oleinik, O.E.Pukhov, V.I.Romanovsky, N.A.Russakovich, N.L.Russakovich, A.A.Semenov, A.N.Shalyugin, A.S.Soloviev, V.B.Vinogradov, A.G.Volodko
IHEP, Protvino	A.M.Blick, V.N.Kolosov, V.M.Kutjin
IFAN, Baku	O.Abdinov, V.Maniev
IAF, Bucharest	D.Pantea, F.Kotorabai
IHEP, Tbilisi	N.S.Amaglobeli, B.G.Chiladze, G.A.Chlachidze, D.G.Dzhincharadze, D.I.Khubua, I.A.Minashvili, R.G.Salukvadze
Univ., Sofia	A.Jordanov, L.Litov, G.Velev, R.Tsenov
IEF, Koshice	L.Shandor, J.Shpalek
Univ., Koshice	G.Martinska
IP, Bratislava	S.Tokar, B.Sitar, P.Strmen
IP, Minsk	Yu.A.Kulchicky, A.S.Kurilin, V.S.Rumjantcev
Univ., Gomel	G.A.Ivanov

Spokesman: **V.B.Flyagin**

The following scientific investigations of K-meson decays were made using "Hyperon" set up (Fig.1).

- 2.5×10^6 triggers with K^+ and K^0 decays were written on tapes during the run in the unseparated beam of IHEP 10 Gev/c.
- On the basis of our recent K_{e3} - decay data we calculated a value of CKM - matrix element $|V_{us}| = 0.2226 \pm 0.0024$, which confirms the best early estimations (DPG 1992): $|V_{us}| = 0.2196 \pm 0.0023$ (Prepr. JINR E1-93-305.)
- As a result of partial processing of statistical data we calculated a preliminary value of the "g"-coefficient of $K^+ \to \pi^+\pi^o\pi^o$ decay matrix element $g = 0.67 \pm 0.04$, which is agrees with the world average $g = 0.594 \pm 0.019$.
- Having processed events with K_s^0 - decays we estimated a new limit on the decay into e^+e^- pairs : $Br(K_s^0 \to e^+e^-) < 2.8 \times 10^{-6}$. It is the best world result up to date (compared with $Br < 10^{-5}$ DPG). (Preprint IHEP 93 - 87 DEP).
- Using our experimental data on inclusive K_s^0 - meson production in π^+A- and K^+p- interactions we finalized this investigation at 11 GeV/c (Nucl. Phys. A 56, 83, 1993)
- The group also made $R\&D$ of detectors for high energy physics. In particular, detailed investigations of "Hyperon" e/m-calorimeters stability were done using $K^+ \to \pi^+\pi^0$ events observed i the experiment. That helped us significantly improve identification of positrons on the large π^+- background. The result is shown by the histogram (Fig.2).

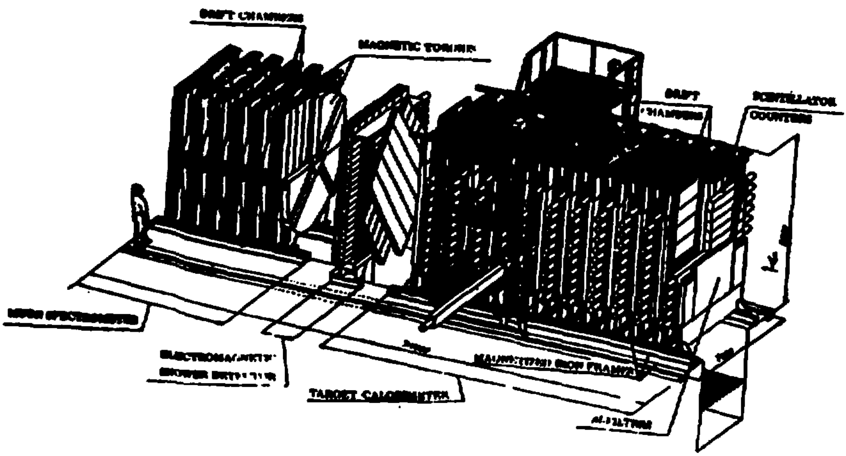


Fig.1. Neutrino Detector IHEP JINR.

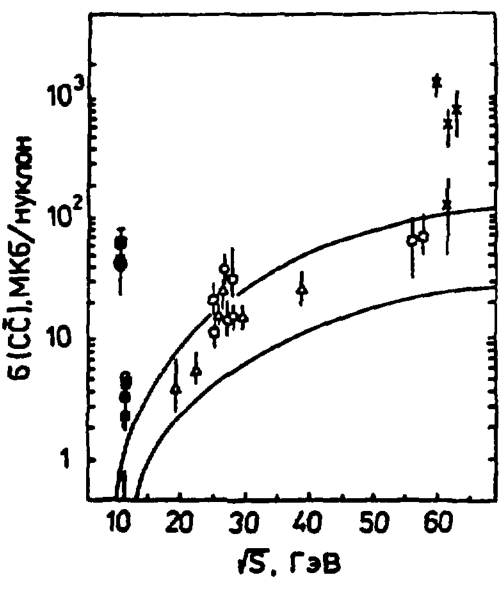


Fig.2. Nucleon-nucleon charm particle prodaction total cross section. Data and QCD - model predictions. □ - data from paper [1].

SERP-136	LNP-31
Status	Data-Taking

Search for electron neutrino oscillations and investigation of neutrino-nucleon interactions at the accelerator U-70

JINR, Dubna; IHEP, Serpukhov, Russia

JINR, LNP, Dubna L.Barabash, Y.Batusov, S.Bunyatov, A.Karev, M.Kazarinov, O.Klimov, V.Kuznetsov, E.Ladygin, V.Lyukov, Y.Nefedov, O.Petrovichev, B.Popov, V.Snyatkov, V.Tereshchenko, V.Valuev

IHEP, Serpukhov A.Borisov, N.Bozhko, S.Chernichenko, G.Chukin, V.Goryachev, M.Kirsanov, A. Kononov, A.Kozhin, V.Kravtsov, A.Kulikov, A.Mukhin, Y.Salomatin, V.Sytnik, V.Tumakov, A.Vovenko

Spokesman from JINR: **S. Bunyatov**

The data processing of beam dump experiment at IHEP-JINR Neutrino detector (Fig.1) was completed in 1993 years. In the latest paper [1] the total cross section of charm particle production in pN interactions at energy 70 GeV ($\sqrt{s}$ = 11.46 GeV) was determined using analysis of equilibrium positive muons, produced in the $\nu_\mu N$-interactions in iron filter, placed in front of the Neutrino detector.

The upper limit for total cross section of charm particle production at 70 GeV pN interactions has been obtained: $\sigma_{c\bar{c}} < 1.7$ μb/nucleon (90% C.L.).

The upper limit for the charm production cross section is in agreement with theoretical calculations based on QCD (Fig.2). Therefore, the mistake of statement about the anomalous intensification of charm production cross section near the threshold is proved

The new $\nu_e \rightarrow \nu_\tau$ oscillation experiment was started at the IHEP-JINR Neutrino Detector in 1993. The principal difference of the proposed experiment from all experiments carried out earlier on accelerators is the specially constructed *neutrino channel* with a short decay base of 12.6 m (instead of 100-400 M) and without a focusing system. The *relative admixture of electron neutrinos* to muon neutrinos increases up to 4% instead of 0.8% in such a beam. According to the proposal, the possibility of $\nu_e \rightarrow \nu_\tau$ oscillation in the range of Δm_{12} (the mass square difference of two neutrino types) from 20 to 500 eV^2 will be investigated

From February 6 to March 6 1993 the first accelerator run was carried out. The total number of protons of target was $1.1 \cdot 10^{18}$. The DST tape was prepared. The events corresponding to $\bar{\nu}_e + N \rightarrow e^{\pm} + X$ reactions were reconstructed. The experimental data is analysed with the aim to search for $\nu_e \rightarrow \nu_\tau$ oscillation. At the same time the data analysis of $\nu_\mu + N \rightarrow \mu^- + X$ and $\bar{\nu}_\mu + N \rightarrow \mu^+ + X$ interactions for the $\sigma(\bar{\nu}_\mu)/\sigma(\nu_\mu)$ ratio determination in the energy range 2–30 GeV will be carried out.

Two additional month runs of accelerator are necessary in 1994.

[1] L.Barabash et al. Preprint JINR P1-93-327, Dubna, 1993.

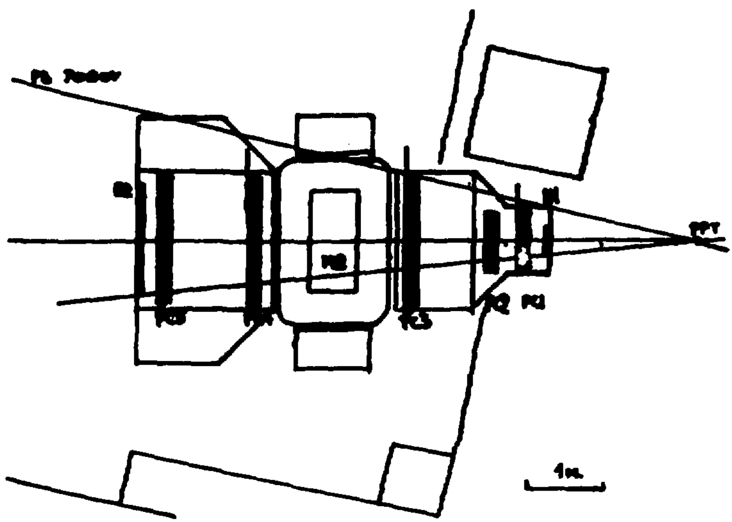


Figure 1. Set-up RPS NEPTUN at 70 GeV proton beam U-70.

NEPTUN	LNP-39
Status	Preparation

Study of spin effects at 400 to 3000 GeV using an internal jet target at UNK.

LNP JINR, Dubna; IHEP, Serpukhov; University, Moscow, Russia; University, Tbilisi, Georgia; University, Michigan; BNL, Bruchaven; MIT, USA

LNP, Dubna	L.S.Barabash, S.I.Bilenkaja, N.S.Borisov, M.Finger, V.A.Kalinnikov, Y.M.Kazarinov, B.A.Khachaturov, B.Z.Kopeliovich, M.Y.Liburg, V.N.Matafonov, I.L.Pisarev, Y.A.Pliss, A.A.Popov, I.K.Potashnikova, V.I.Snjatkov, Yu.A.Usov
IHEP, Serpukhov	G.A.Alekseev,V.D.Apokin et al.
Univ., Tbilisi	N.S.Amaglobeli et al.
Univ,, Mocsow	L.I.Belzer et al.
Univ., Michigan	V.A.Anferov, A.D.Krish et al.
BNL, Bruchaven	L.G.Ratner.
MIT	G.R.Court et al.

Spokesman from JINR: **Yu.M.Kazarinov**

The goal of the experiment is to study the spin effects when the 400 Gev and then 3 Tev protons in UNK rings collide with a spin polarized ultra-cold atomic hidrogen internal jet target. Five different spectrometers will observe spin phenomena in various hadron-hadron reactions at small, medium and large transverse momenta.

LNP JINR costructed a recoil particle spectrometer (RPS) to detect recoil particles in the interval $0.5 < t < 2$ Gev$^2/c^2$.

RPS consists of the spectrometer magnet, wire proportional chambers (10^4 channels) with electronics, scintillation counters with trigger electronics. At present all equipment of RPS has been constructed and tested in Dubna.

Reactions to study:

$pp \to pp$	$pp \to \gamma X$	$pp \to e^+e^-X$	$pp \to \mu^+\mu^-$
$pp \to \pi X$	$pp \to K^+K^-X$	$pp \to \eta X$	$pp \to \eta' X$
$pp \to \omega X$	$pp \to f_2(1270)X$	$pp \to jet\ X$	$pp \to \gamma\ jet\ X$
$pp \to \Lambda X$	$pp \to \Lambda X$	$pp \to pX$	$pp \to pX$
$pp \to \Sigma^+X$	$pp \to \Sigma^-X$	$pp \to \Xi^-X$	$pp \to \Lambda_c^+X$

In 1993 the following results were obtained:

Transportation of RPS equipment in IHEP (Serpukhov) was finished and its assembling at 70 GeV proton beam began to make common test and the measurement of its characteristics (Fig.1);

The project of the Ring Image Cherenkov Spectrometer (RICH) designed for particles in RPS;

Photomultipliers PTM-85 were bought to construct RICH.

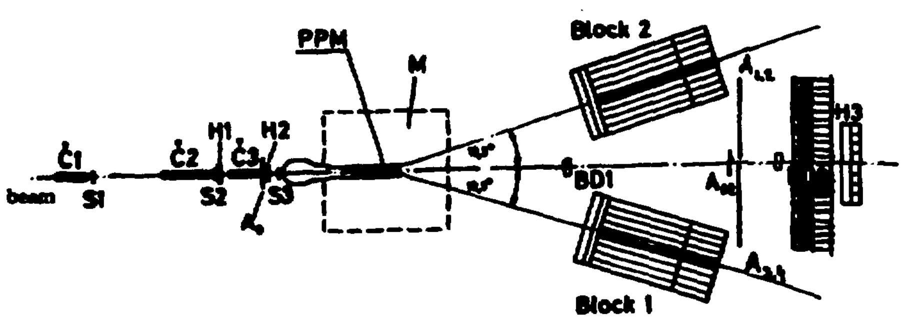


Figure 1. Lay-out of the Proza-M detector.

PROZA-M, SERP-149	LNP-40
Status	Data-Taking

Study of asymmetry in inclusive reactions $\pi^- p \to \pi^{\pm,0} X$ and $\pi^- p \to K_L X$ at 40 GeV/c and $pp \to \pi^o X$ at 70 GeV/c.

LNP JINR, Dubna; IHEP, Serpukhov; University, Tbilisi, Georgia; University, Michigan, Ann-Arbor, USA

LNP, Dubna	N.S.Borisov, E.I.Bunjatova, Y.M.Kazarinov, B.A.Khachaturov, M.Y.Liburg, V.N.Matafonov, A.B.Neganov, Yu.A.Usov
IHEP, Serpukhov	V.D.Apokin et al.
Univ., Tbilisi	N.S.Amaglobeli et al.
Univ., Michigan	C.M.Chu et al.

Spokesman from JINR: **Yu.M.Kazarinov**

The goal of the experiment is investigation of hadron spin structure in inclusive reactions with polarized proton (deuteron) targets.

The accelerator is U-70 in Serpukhov.

The Detector is the Cherenkov counter hodoscope PROZA-M. (Fig.1).

Reactions studied at 40 GeV/c:

$$\pi^- p \to \pi^- X \quad \pi^- p \to \pi^0 X \quad \pi^- p \to \eta X \quad \pi^- p \to \pi^+ X$$
$$\pi^- p \to K_L X \quad \pi^- d \to \pi^0 X \quad \pi^- d \to \eta X \quad K^- p \to \pi^0 X$$

Reactiones studied at 70 GeV/c:

$$pp \to \pi^- X \quad pp \to \pi^0 X \quad pp \to \eta X \quad pp \to \pi^+ X$$
$$pp \to K_L X \quad pp \to \eta X \quad pd \to \pi^0 X \quad pd \to \eta X$$

In 1993 processing of the data obtained earlier in the experimental measurement of analyzing power in reaction $pp \to \pi^o X$ at 70 GeV was performed. The processing is not finished.

The investigation of the reaction $\pi^o d \to \pi^o X$ planned for 1993 has not begun because no accelerator time was given.

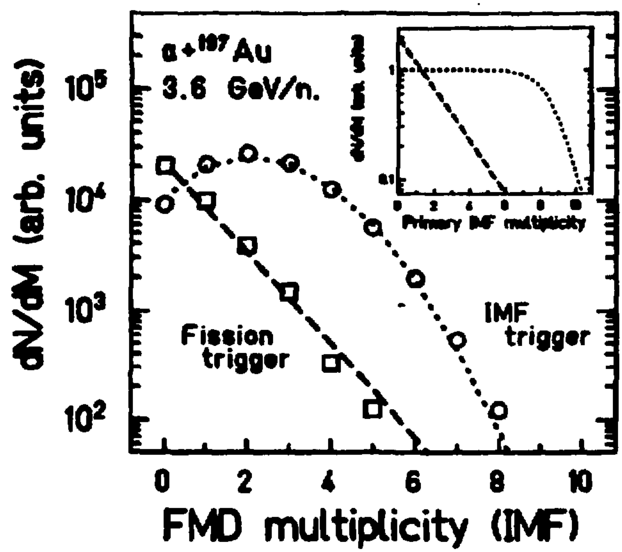


Fig. 1. Multiplicity distributions of the intermediate mass fragment ($3 \leq Z \leq 20$), measured by FASA setup for two classes of the events: multifragmentation (circles) and fission (boxes). They are fitted with Fermi *(dotted line)* and exponential *(dashed line)* distributions, folded with the experimental filter. The insert gives the corresponding primary distributions.

FAZA	LNP-32
Status	Data-Taking

Investigation of the multifragmentation of target nuclei in nucleus-nucleus collisions at intermediate and high energies

LNP JINR Dubna; Kurchatov Inst. of Atomic Energy, Moscow, Russia; Institute of Nuclear Physics, Krakow, Poland; ZFK, Rossendorf; Institute of Nuclear Physics, Techn. University, Darmstadt, FRG; University of Iowa, Iowa City, USA

LNP, Dubna	V.A.Karnaukhov, L.A.Petrov, V.D.Kuznetsov, S.P.Avdeev
KIAE, Moscow	G.B.Yankov, O.V.Bochkarev, E.A.Kuzmin, L.V.Tchulkov
INP, Krakow	W. Karcz
ZFK, Rossendorf	W. Neubert
INP, Darmstadt	H. Oeschler, V. Lips, R. Barth
Univ., Iowa City	E. Norbeck

Spokesman: **V.A. Karnaukhov**

The investigations are performed using a new 4π-setup FASA, installed at the beam of relativistic light nuclei of the JINR synchrophasotron. The setup FASA consists of a fragment multiplicity detector (64 scintillator counters with thin CsI(Tl)) and 5 telescopes (ΔE — ionization chamber × E-semiconductor detector), serving as a trigger of the system. The main idea of this project is that the use of light projectiles at relativistic energies gives a complementary information to that obtained from heavy ion collisions. In our case dynamic effects are reduced and decay of excited target spectator proceeds in apparently statistical manner ("thermal multifragmentation").

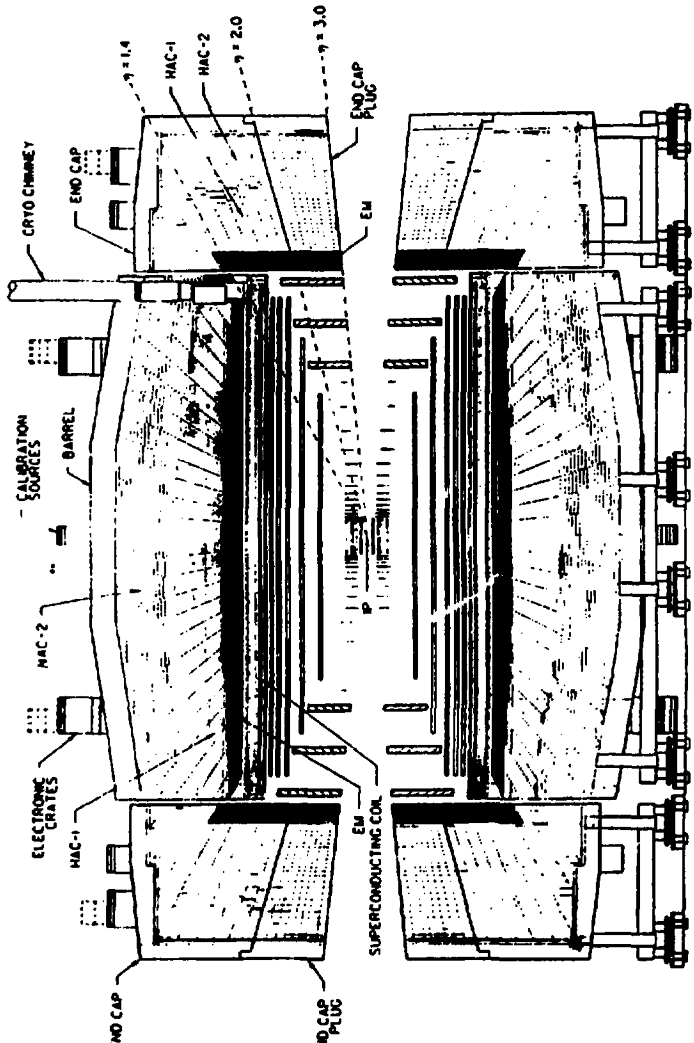
The study of a target multifragmentation for the collision

$$^4He\ (14.6\ GeV) + Au$$

gives the following conclusions:

- The mean multiplicity of the intermediate mass fragments is equal to 5.1 ± 0.8, which means that the excitation energies reached are higher than 1000 MeV.
- The mass-spectrum of IMF is fitted well by power low distribution $A^{-\tau}$. Parameter τ shows "critical behaviour" predicted by some models, assuming a liquid-gas phase transition in nuclear matter.
- The break up density is (5-8) times lower than the normal one.
- The mean life-time of the excited target spectator does not exceed 10^{-21} s.

R&D and Projects of New Facilities



SDC central calorimeter

SDC	LNP-33
Status	R&D

Solenoidal detector collaboration

Participants: *Armenia, Belarus, Brazil, Bulgaria, Canada, Czech Republic, Slovakia, France, Georgia, Israel, Italy, Japan, Peoples Republic of China, Romania, Russia, United Kingdom, United States of America, Uzbekistan*

LNP Dubna Y.A.Budagov, I.E.Chirikov-Zorin, I.N.Churin, F.Cotorobai, Yu.I.Davydov, V.B.Flyagin, S.B.Gerasimov, Vl.V.Glagolev, D.M.Khazins, A.I.Lebedev, Yu.F.Lomakin, S.M.Malyukov, I.V.Puzynin, V.M.Romanov, N.A.Russakovich, A.A.Semenov, A.N.Sissakian, V.I.Snyatkov, S.Tokar, V.A.Utkin, G.V.Velev, V.B.Vinogradov, A.G.Volod'ko

Spokesman from JINR: **A.N.Sissakian**

1993 is very sad year for the worldwide high energy physics: the U.S. Congress terminated (closed the financial funds) the largest complex for the Superhigh Energy Physics - SSC. However, the results obtained at the treatment of the killed project can be used to create other large setups for the next generation of SuperColliders.

In the 1993 the following results were obtained:

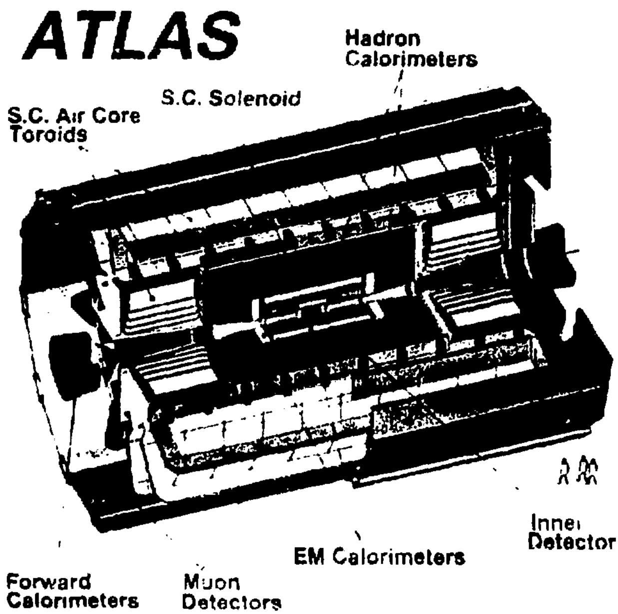
1. With direct participation of the JINR Group two full scale prototype blocks (the weight of each is 90 t) of the SDC Muon Barrel Toroid (MBT) were manufactured at PO "ATOMMASH". The blocks were tested for the tolerance and quality by the JINR, ATOMMASH and SSCL specialists. The manufacture quality met the necessary requirements. The both blocks were tested for deformation and stability. The results of this testing also met the appropriate requirements.

2. The groups of the JINR specialists organized the calculation of the magnetic field in the iron of MBT and the measurements of the magnetic permeability in the samples, prepared from the steel slabs selected for the MBT block production.

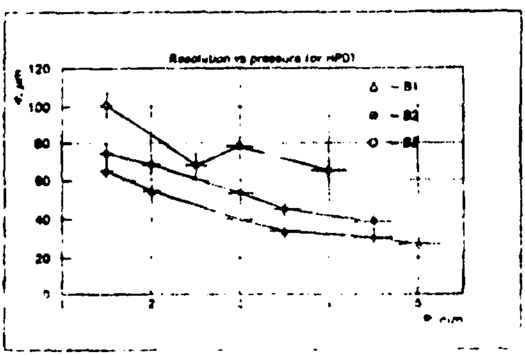
3. The group of the JINR specialists took active part in the designing of the Hadron Central Calorimeter Absorber (the Barrel and Endcaps one, and Supports, and Picnic Table) for the SDC in the SDC Department at Fermilab (Batavia, USA). The design of this project was practically ended.

4. The group of the NEOMAP (LNP) specialists in co-operation with Pisa and Kharkov takes part in the development of the scintillator counters ("tiles" with fibre read out of information from the rad.hard scintillator for the calorimeter and the large scale muon counters) for SDC.

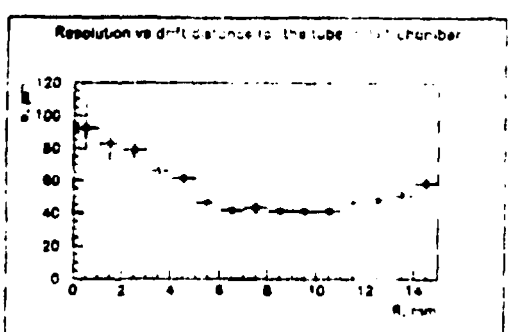
5. The group of the NEOMAP (LNP) specialists took part in the simulations of the physical processes and trigger for the SSCL and in the development of RPC method of the Muon Trigger System (Pisa) and in the production of the MWPC and the calorimeter towns and their testing with the help of the cosmic muons at the SSCL (Dallas, USA).



BEAM TEST RESULTS



single tubes



[illegible] m² prototype

ATLAS	LNP-34
Status	R&D

General-purpose pp experiment at the Large Hadron Collider at CERN

Participants: *Australia, Austria, Canada, CERN, Czechoslovakia, Denmark, Finland, France, Germany, Greece, Hungary, Israel, Italy, Japan, JINR, Kazakhstan, The Netherlands, Norway, Poland, Portugal, Russia, Spain, Sweden, Switzerland, United Kingdom.*

Spokesmen from JINR: **N.Rusakovich**

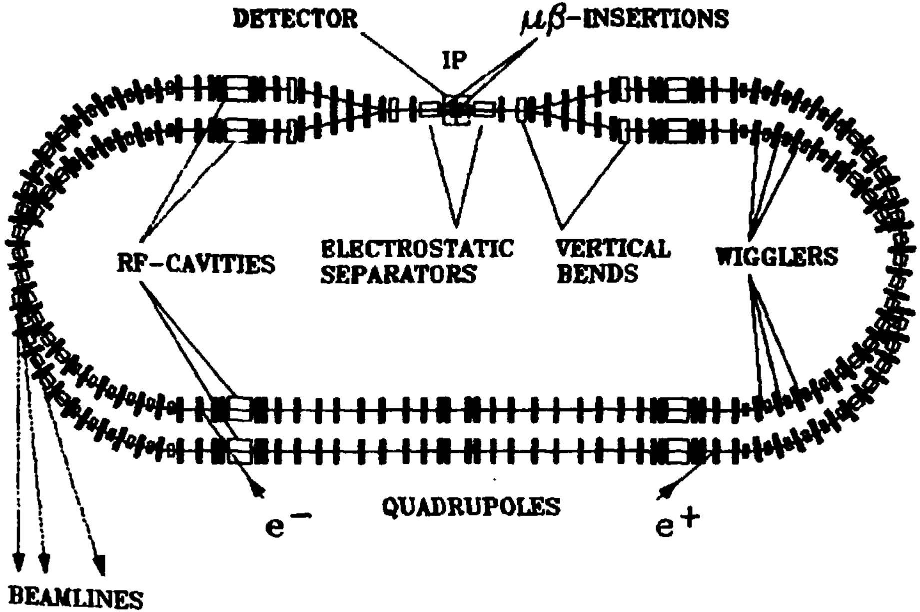
The ATLAS Collaboration proposes a general-purpose pp experiment which would be operational at the startup of the Large Hadron Collider (LHC/CERN) in order to exploit its full discovery potential.

The ATLAS collaboration consists of 91 institutes bringing together a total of 850 members - 194 from Russia (and States of former USSR) - coming from 11 institutes. The JINR Dubna group (more than 50 members) as a whole actively participates in the ATLAS collaboration for LHC. This work started in December 1991 within the framework of the Memorandum of Understanding concluded between JINR (LNP) and the Max Planck Institute of Munich. The main object of our common R&D effort in 1993 was a muon system, which includes detector for precision coordinate measurement (presently high pressure drift tubes-HPDT), front-end electronics, fast triggering on systolic processors, modelling architecture of pipe-processing and evaluation possibility of using EPLDs for that (together with LCTA JINR), and optical alignment system (together with St.Peterburg Insitute of Fine Mechanic and Optic).

In 1993 the beam test set up at CERN was used for tests and data taking from Dubna prototypes, MPI 1×1 meter and 2×2 meter prototype as well as other detectors for muon system of ATLAS. Special type front-end electronics (around 700 channels) for MPI prototypes was designed and constructed in Dubna. The first results are quite interesting and promising: for 1×1 meter prototype pilot results indicate spatial resolution within the range 50-60 microns (Fig.1). Using a neutron beam from the JINR pulse neutron source IBR-30, the efficiency of PDT for detection of neutrons was investigated. JINR physicists have taken part in software activities of the ATLAS muon rate calculations. On the basis of this calculation new alignment method for muon chambers was proposed.

Together with IFMO (St.Peterburg) the first prototype elements of the ATLAS optical alignment system was designed and constructed in Russia and was tested in MPI.

In 1994 JINR in close cooperation with CERN, MPI, Munich and Freiburg Universities, IFMO St.Peterburg and Erevan Institute of Physics plans to increase participation in all these activities (muon system, optical alignment system, TGT and Tile calorimeters) along with preparation of the Technical Proposal.


DETECTOR
$\mu\beta$-INSERTIONS
IP
RF-CAVITIES
ELECTROSTATIC SEPARATORS
VERTICAL BENDS
WIGGLERS
e^-
QUADRUPOLES
e^+
BEAMLINES

TCF-A	LNP-35
Status	Preparation

Tau-Charm Factory — accelerator studies

LNP JINR, Dubna; LAL, Orsay, France; Cornell University, Ithaca, USA; BINP, Novosibirsk; Research Institute of Electrophysical Apparatus, St Petersburg; Russian Institute of Powerfull Radioconstruction, St Petersburg; MIPhI, Moscow, Russia; Kharkov Institute of Physics and Technology, Kharkov, Ukraina.

LNP, Dubna	V.Alexandrov, V.Anosov, V.Antropov, O.Arkhipov, P.Beloshitsky, L Bobyleva, P.Chernov, A.Eljov, V.Kazacha, D.Kaltchev, N.Kazarinov, V.Mironov, L.Onischenko, E.Perelstein, M.Sazonov, Yu.Smirnov, A.Vasilenko
JINR, Dubna	A.Sissakian, Ts. Vylov
LAL, Orsay	J. Le Duff et al.
Univ. Cornell	M. Tigner et al.
BINP, Novosibirsk	N.S.Dikansky et al.
RIEA, St Petersburg	Yu.P.Severgin al.
RIPR, St Petersburg	E.A.Petrov et al.
KhIPT, Kharkov	A.N.Dovbnja al.
MIPhI, Moscow	E.S.Masunov et al.

Spokesman: **E.A.Perelstein**

High luminosity collider tau-charm factory studied at JINR must provide the luminosity about $10^{33}cm^{-2}s^{-1}$ in the energy range of colliding particles 1.5-2.5 GeV with the maximum luminosity at 2 GeV.

The main results of the machine study are reported at the Second Workshop on JINR Tau Charm Factory, April 27-29, 1993, Dubna; the Third Workshop on the Tau Charm Factory, June 1-6, 1993, Marbella, Spain; Particle Accelerator Conference, May 17-20, 1993, Washington.

In 1993 the engineering proposal for the JINR tau-charm factory was worked out including electromagnetic systems, injection systems, power supply, vacuum system. The variants of the RF power supply were been proposed and studied. RF-transmission lines, amplifiers, etc. were examined and a variant based on a klystron amplifier with power about 80 kW was chosen for the future designing.

As a consequence of the international collaboration the versatile τ-charm factory scheme allowing to begin from conventional scheme and to have the possibility of the realization of the crab - crossing as well as the monochromatization one was proposed.

In 1994 the machine study and the magnetic lattice study will be continued to obtain higher luminosities with the proved devices and beam parameters.

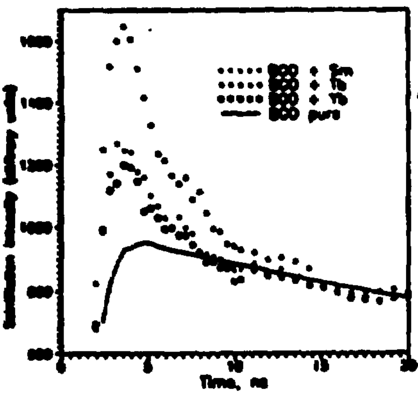


Fig.1 Time spectra of BGO crystals

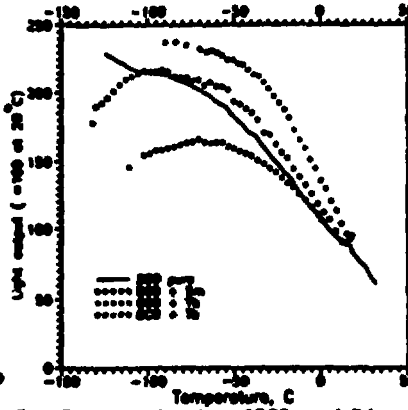


Fig.2 Temperature dependence of BGO crystals light output

Table 1.

BGO crystal	Relative light output	Slow component decay time,ns	Fast component decay time,ns	Fast component percentage
Pure	100	338±10		
Yb 0.001%	75	311±22	5.0±0.9	1.7
Yb 0.2%	66	313±6	3.9±0.4	1.3
Yb 1%	55	328±25	5.1±0.3	1.9
Sm 0.1%	48	303±12	4.2±0.6	1.7
Tb 0.1%	21	274±20	3.9±0.2	3.4

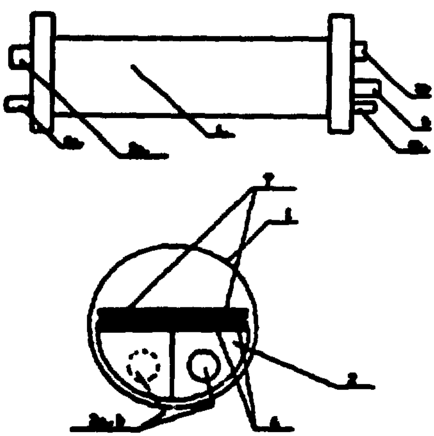


Fig. 3a The overall and cross-sectional views of the Spark Counter.

1. Counter body
2. Support
3a,b. Gas input and output
4a,b Signal outputs
5. High voltage
6. Glass Electrode
7. Two lines of pins

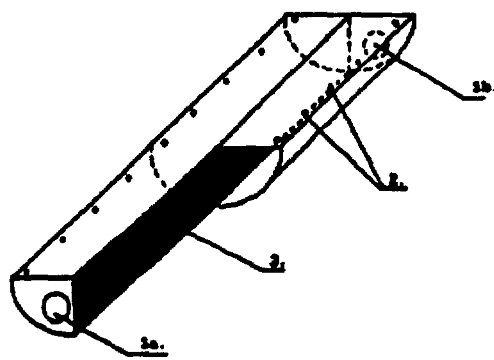


Fig. 3b Plexiglass support for gas circulation.

1a,b Gas input and output
2. Holes for gas circulation
3. Separation wall

TCF-D	LNP-36
Status	Preparation

Detector for C-tau factory of the JINR storage accelerator complex

LNP JINR, Dubna; Cornell University (CESR), USA; LAL, Orsay, France

LNP Dubna Azhgirei L., Bannikov A., Barabash L., Baranov S., Boyko I., Chelkov G., Churin I., Danilets P., Dodonov V., Zhuravlev N., Ignatenko M., Kopeliovich B., Kotova T., Khachaturov B., Khovansky N., Kodes P., Kovalenko S., Kouznetsov O., Krumstein Z., Merzljakov S., Nikolenko M., Osipov A., Olshevski A., Sedykh Yu., Stoletov G., Tkatchev L., Tokmenin V., Vertogradov L., Yatsunenko Yu., Zhmyrov V.

Spokesman from JINR: G.Chelkov

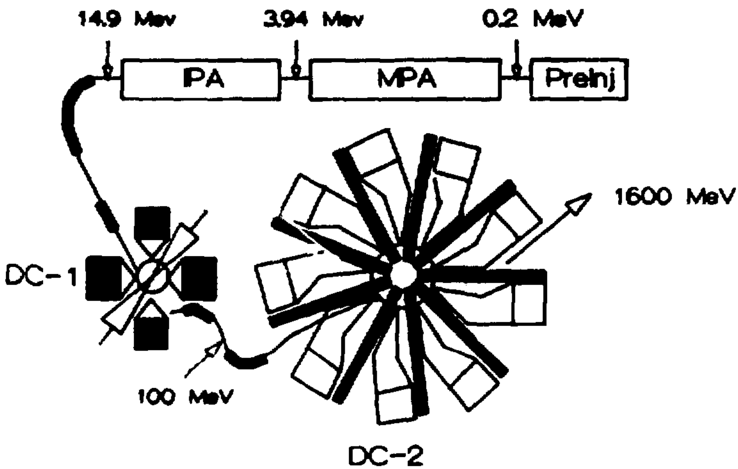
Now a storage accelerator project is being studied at the JINR. This complex is expected to allow promising investigation in the Institute's traditional fields of elementary particle physics, nuclear physics, condensed matter physics as well as applied investigations. The project discussed involves a C-Tau factory with the total energy of colliding particles up to 5 GeV.

A compact electromagnetic calorimeter with high energy resolution based on nonorganic scintillators is one of the most favorable variants of a luminosity monitor for the $c-\tau$ factory detector. But the most convenient and easily producible scintillators (NaI, CsI, BGO) have significant disadvantages: low radiation hardness and long decay time. It was recently discovered that doping of BGO crystals with ytterbium causes an increase in their radiation hardness and a decrease in the decay time constant.

We have carried out measurements of light output and time spectra of BGO crystals doped with ytterbium, terbium and samarium. All the crystals were made at the Research Institute for Synthetic Materials (in Alexandrov, Russia). Time spectra of the investigated crystals are presented in Fig.1. All spectra of doped crystals contain a "fast" component with decay time within the range of $4 \div 5$ ns. Parameters of the time spectra fitting as well as relative light outputs of scintillators are presented in table 1.

It is well known, that the light output of BGO crystals strongly depends on temperature. This effect must be taken into account in real experiments. In Fig.2 the measured light output of new crystals versus the temperature is presented.

The most promising way of developing the Time of Flight System (TOF) is to employ spark counters with localized discharge (Pestov counters). With time resolution about 30 ps, they provide a 3-fold increase in the maximum momentum for particle identification. A prototype spark counter 0.5 m long was made at BINP, Novosibirsk, in 1990. The task of joint JINR/BINP R&D is to design a spark counter suitable for mass-production. In 1993 such a counter was designed (Fig.3) at JINR (in close cooperation with BINP, Novosibirsk). All mechanical elements for the first five counters were produced in Dubna.



Accelerator Layout

MINGEN	LNP-37
Status	Preparation

Deuteron cyclotron complex as a meson and neutron generator

LNP JINR, Dubna; High Energy Physics Institute, Serpukhov, Russia

LNP JINR, Dubna Ju.G.Alenitsky, A.A.Glazov, Ju.N.Denisov, V.P.Dzhelepov, V.P.Dmitrievsky, N.L.Zaplatin, V.V.Kalinichenko, L.M.Onischenko, S.B.Vorozhtsov

HEPI, Serpukhov A.P.Maltsev, V.A.Tepljakov

Spokesman: **A.A. Glazov**

The work on the project of creation of a Deuteron Cyclotron Complex (Fig.1.) began with constructing the full-size prototype sector of the superconducting sector magnet and prototype accelerating cavity for the cyclotron DC-1.

In 1993 after the test assembly of the superconducting magnet some of its elements, namely the central column, the nitrogen screen, the suspension and adjustment systems, were de-bugged.

The diagnostics system for helium flows in the cryogenic system is put into operation.

After adjustment of equipment at the special work bay for superconducting coil winding two test sections of the electromagnet coil were wound. A contract for their compounding is concluded with the Research Institute for Electric Machine Engineering (St Petersburg).

An automatic nuclear magnetometer is developed to measure high magnetic fields (up to 6 T) typical of superconducting magnets. A pilot lot is produced.

After testing in the accelerating cavity of the cyclotron the vacuum evacuation system is updated by changing for turbomolecular pumps VMN-500.

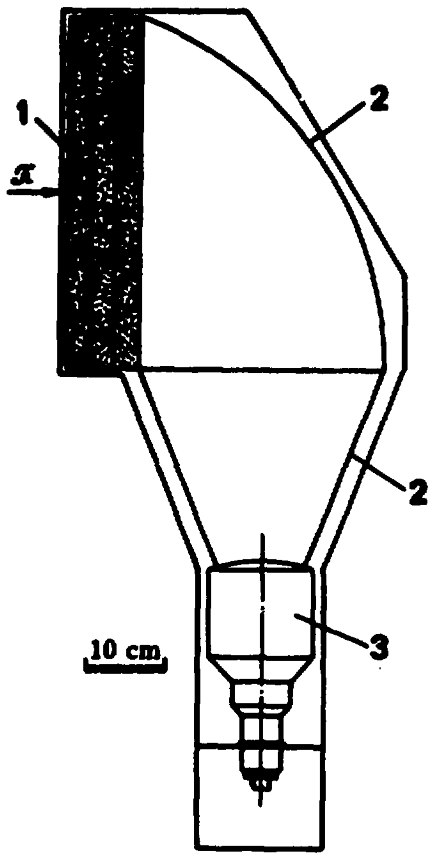


Figure 1. A module of the aerogel Cherenkov counter.
1 aerogel radiator assembly with n = 1.1
(volume 450x450x90 mm^3). 2- reflector (Al).
3 photomultiplier XP2040.

Aerogel	LNP-38
Status	Preparation

Development of technology for production of silicon aerogel and construction of Cherenkov counters based on it

LNP JINR, Dubna; Komensky University, Bratislava, Slovakia; VNIISIMS, Aleksandrov, Russia

LNP, Dubna	Yu.K.Akimov, V.P.Zrelov, V.I.Komarov, N.A.Kutchinskyi, S.I.Merzlyakov, A.I.Filippov, S.V.Filin, A.P.Fursov, N.V.Khomutov, S.I.Yakovlev
Komensky Univ., Bratislava	J.Ruzhitchka, P.Pavlovitch, D.Kollar, S.Sharo, V.Finer, L.Kuchta
VNIISIMS, Aleksandrov	E.V.Polyansky, V.E.Khadzhi

Spokesman: **A.I.Filippov.**

In 1993 the efforts were mainly concentrated on making a laboratory and equipment for production of silicon oxide aerogel.

Rooms for a chemical laboratory and a silicon alcogel drying laboratory were prepared; a 1-litre alcogel drying autoclave was designed, its fabrication in the Laboratory machine shop being almost finished. Development of the procedure for purification of initial materials and for production of silicon oxide gels from tetraethyloxylane and tetramethyloxylane are going on at the chemical laboratory. The factors affecting the quality of gels (gel formation temperature, catalysts) are studied.

Comparative study of experience accumulated in major laboratories of the world (Germany, Sweden, Japan, USA. France) for production of silicon oxide aerogels and its use in aerogel Cherenkov counters is carried out. Equipment and preparation of the 1-litre gel drying autoclave and its control systems for tests continues (a gel drying cycle is about 2 days long).

94-1

Монтаж Н.А.Киселевой.

Рукопись поступила 04.1.94. Подписано в печать 4.1.94
Формат 60x84/8. Офсетная печать. Уч.-изд. листов 8,79
Тираж 250. Заказ 46902. Цена 1580 руб.

Издательский отдел Объединенного института ядерных исследований
Дубна Московской области