Experiments in Laboratory of Nuclear Problems

of Joint Institute for Nuclear Research in 1994-1995

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Dubna 1994

INTRODUCTION

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

The experiments are briefly described including a schematic layout of the apparatus, list of participants and institutions.

In this book the status of the experiments (preparation/data-taking, etc) corresponds to the situation at the beginning of 1994.

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	Leaders from JINR

Experiments on Intermediate Energy Physics

Phasotron Programme

LNP-1 ($M \rightarrow \bar{M}$)	**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 and actinide regions**	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 of 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**	M.J.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 cumulative fragmentation of the deuteron in the exclusive polarization approach and of subthreshold kaon production at the synchrotron COSY**	V.I.Komarov
LNP-14	**Precise measurement of the probability of the** $\pi^+ \rightarrow \pi^0 e^+ \nu_e$ **decay**	S.M.Korenchenko
LNP-15 (DISTO)	**Measurement of spin observables in** $pp \rightarrow pK^+Y$	I.V.Falomkin
LNP-16	**Investigation of beta-neutrino angular correlation in superallowed beta-decay of short-lived nuclei**	V.G.Egorov
LNP-17 (TGV, NEMO)	**Search for double beta-decay**	V.B.Brudanin
LNP-18	**Search for the decay** $K^+ \rightarrow \pi^+\mu^+e^-$	B.Zh.Zalikhanov

LNP-19	**Direct measurement of the branching ratio for the decay of the η-meson into two photons**	L.K.Lytkin
LNP-20	**Production of subthreshold pions and high energy light fragments 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**	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 np elastic scattering amplitudes at 16 MeV**	Yu.A.Usov
LNP-24	**Measurement of 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.G.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.A.Russakovich
LNP-27 (WA-92)	**Measurement of beauty particle lifetimes and hadroproduction cross-section**	N.A.Russakovich
LNP-28 (NOMAD) (WA-96)	**Search for the oscillation $\nu_\mu \leftrightarrow \nu_\tau$**	S.A.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 muon neutrino-nucleon interactions at the IHEP–JINR Neutrino Detector**	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 (PROZA-M) (SERP-149)	**Measurement of single-spin asymmetry A_N in the reaction $pp_\uparrow \rightarrow \pi^0 X$ at 90° in the c.m.s at 70 GeV/c**	Yu.A.Usov
LNP-41 (ISTRA-M)	**Study of rare K^- - decays on ISTRA-M setup**	B.G.Zalikhanov, V.S.Kurbatov

Experiments at JINR synchrophasotron

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

Radiobiological researches

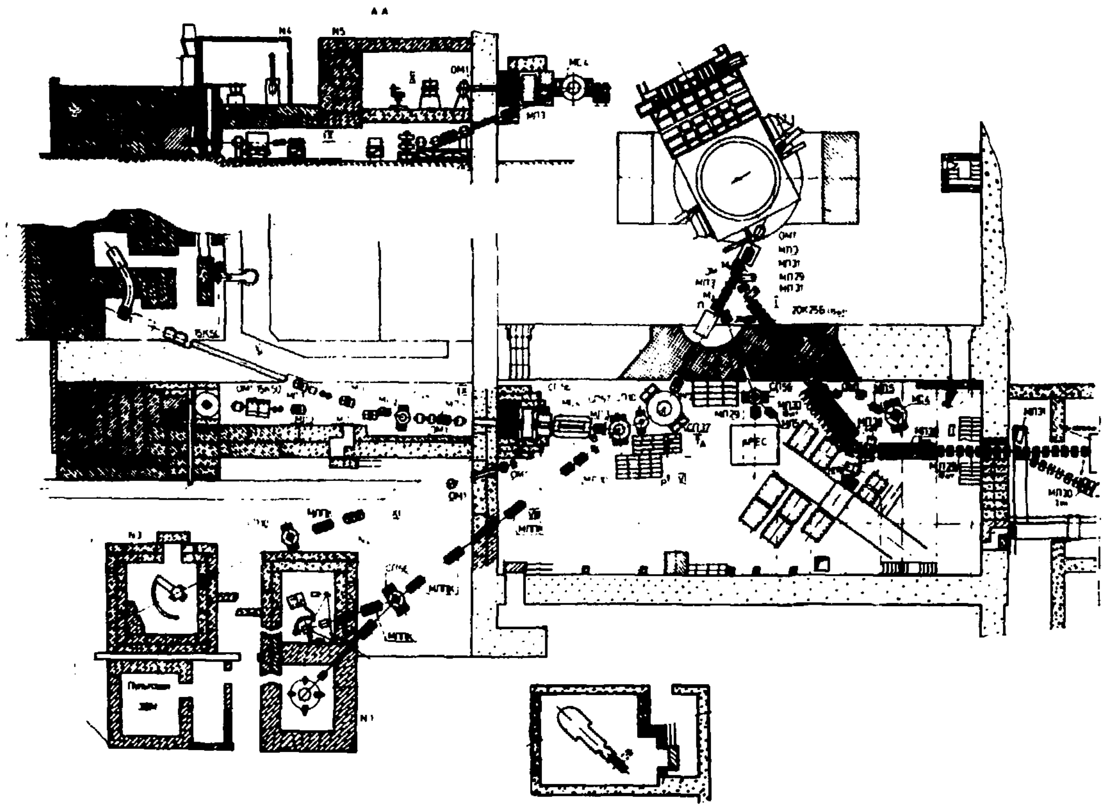
LNP-33 (MUTANT)	**Mutagenesis in cells by ionizing radiation with different LET**	E.A.Krasavin

R&D and projects of new facilities

LNP-34 (ATLAS)	**General-purpose pp experiment at the Large Hadron Collider at CERN**	N.A.Russakovich
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 designing of Cherenkov counters with radiators of this aerogel**	A.I.Filippov
LNP-42 (TDPAC)	**TDPAC - Measurements under high pressure and at high**	O.I.Kochetov

Experiments on Intermediate Energy Physics

Phasotron Programme



Layout of phasotron beam channels.
I, II, III ... XII—channel numbers; SP, OM—bending magnets;
ML, 15K, 20K—magnetic lenses.

Parameters of meson beams from the Phasotron per 1μA of the proton beam

Channel	Particle	Momentum, MeV/c	Particle flux, through area of 100 cm^2, s^{-1}	Spread, $\Delta p/p$	Polarisation	Impurity
I	μ^-	100	$4,5 \cdot 10^4$	10%	80%	8% e^-
I	μ^-	125	10^5	10%	80%	6%e^-; 2,4%π^-
I	μ^+	125	$3 \cdot 10^5$	10%	80%	3% e^+
I	π^-	220	10^6	10%		
I	π^+	220	$2,5 \cdot 10^6$	10%		
II	μ^-	90	$1,5 \cdot 10^4$	10%	75%	7% e^-
II	μ^-	125	$6 \cdot 10^4$	10%	75%	9%e^-; 0,4%π^-
II	μ^+	125	$2 \cdot 10^5$	10%	75%	3%e^+; 0,45%π^+
III	π^+	170	$1,5 \cdot 10^6$			
IX	π^+	76–165	$6,6 \cdot 10^7$ at 112 MeV/c	6%		24%e^+; 6%μ^+ at 112 MeV/c
IX	π^-	95–165	$2,6 \cdot 10^7$ at 123 MeV/c	6%		32%e^-; 35%μ^- at 123 MeV/c
IX	μ^+	26–30	$5,3 \cdot 10^5$ at 28 MeV/c	6%	>90%	N_{μ^+}/N_{e^+}=3,3% at 28 MeV/c

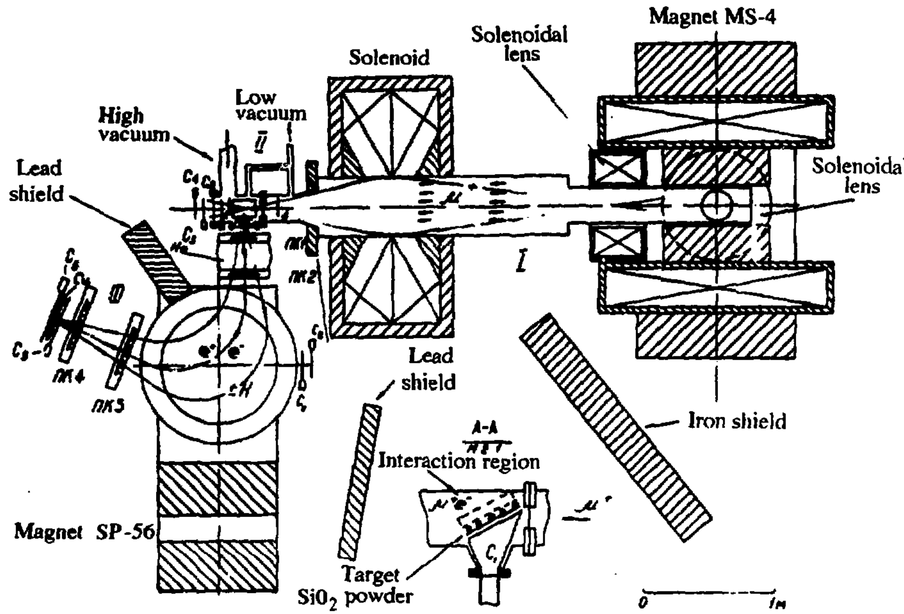


Figure 1. Layout of the experimental apparatus for searching for muonium to antimuonium conversion.

05-2-0987-92/96

$M \to \bar{M}$	. 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, 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

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

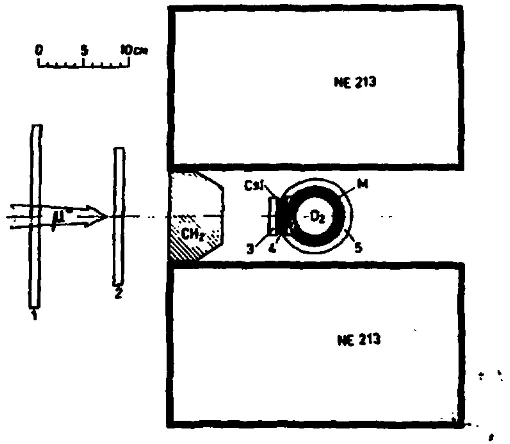
The experimental search for muonium-antimuonium conversion and analysis of its results were carried out in 1991–1993. The muonium-antimuonium conversion spectrometer MAKS (Figure 1) with the intense beam of surface muons from the JINR phasotron were used in the experiment. A new limit for the conversion probability was found (Table 1). In further investigations at the JINR phasotron it is possible to improve the muonium-antimuonium conversion probability by a factor of 8–10. To do this, one should change the target geometry at MAKS so as to use the full beam intensity (gain of 2), compensate the magnetic field around the target to below 20 mGs (gain of 2), increase the spectrometer aperture and beam intensity (gain of 2), increase data acquisition time (gain of 1.5). To improve selection of background events, an anticoincidence scintillation screen is supposed to be installed at the spectrometer input. Physically, this is an important step because the expected experimental conversion probability is already beyond the range where observation of the process is theoretically predicted ($W_{M\bar{M}^{theor}} < 6 \times 10^{-8}$).

The work to prepare a new series of measurements is going on at PINP and LNP JINR. The tentative date of beginning the first physical measurements in a new experiment is November 1994.

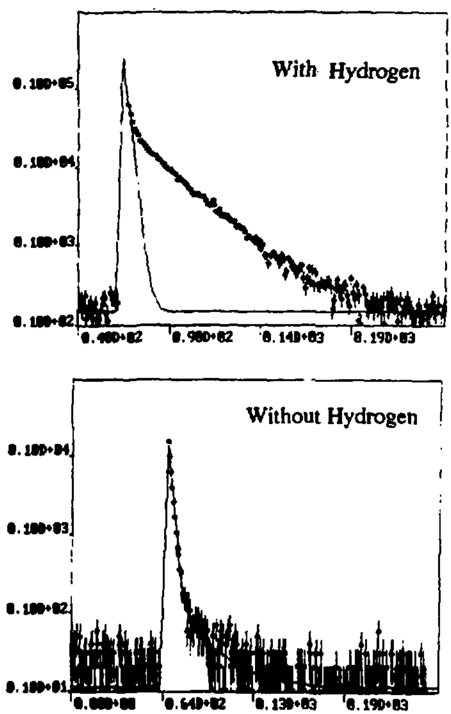
Table 1. Results from previous investigation of muonium-antimuonium conversion and results expected from the new PINP LNP JINR experiment.

Expt.	TRIUMF 1990	LAMPF 1991	PINP-LNP 1992	PINP-LNP (plan)
P	$1.7\cdot10^{-11}$	$2.8\cdot10^{-10}$	$1.0\cdot10^{-9}$	$2.0\cdot10^{-9}$
N	$2.3\cdot10^{12}$	$9.8\cdot10^{10}$	$3.5\cdot10^{11}$	$1.0\cdot10^{12}$
W_{MM}	$<2.1\cdot10^{-6}$	$<6.5\cdot10^{-7}$	$<5.1\cdot10^{-7}$	$<4.0\cdot10^{-8}$

Here "P" is the relative antimuonium registration probability; "N" is the number of incident muons on the target and W_{MM} is the muonium-antimuonium conversion probability.



Layout of the experimental apparatus



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

05-2-0987-92/96

IKS LNP-2
Status Data-Taking

μ-Catalysed fusion reactions in a mixture of hydrogen isotopes

LNP JINR, Dubna; RNC "Kurchatov Institute", Moscow; RFNC VSIIEP, Arzamas, RF

LNP, Dubna	D.L.Demin, V.P.Dzhelepov, V.V.Filchenkov, V.G.Grebinnik, A.D.Konin, V.S.Melezhik, A.I.Rudenko, V.I.Satarov, N.V.Sergeeva, V.T.Sidorov, Yu.G.Zhestkov, V.G.Zinov
RNCKI, Moscow	L.I.Ponomarev
RFNC VSIIEP, Arzamas	Yu.A.Khabarov

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

The goal of the experiment: a) direct measurement of the muon-to-helium sticking coefficient at high density of the deuterium- tritium mixture (liquid, 21 K) and at high concentration of tritium (25-75%); b) direct measurement of the neutron yield in a mixture of protium, deuterium, tritium (verification of the theory of hot atoms under real density and concentration conditions).

The methodical basis of the experiment comprises: a) a fundamentally new idea of performing measurement; b) a system for detection of muon stops in a target and of decay electrons, which is based on originally designed fast proportional chambers and is low-efficient with respect to neutrons (10^{-4}), c) high-efficient system of full absorption detectors (total volume 24 l) for detection of neutrons in 4π geometry, d) a small-size liquid tritium target with a liquid helium cooling system, e) an original high-efficient system for thorough (10^{-7}) purification of tritium in a large amount ($\sim 10^4$Ci), based on a palladium filter, f) a multichannel fast spectrometric system based on FADC, g) a system for collection, processing, monitoring, display and storage of experimental data based on PC and VAX, h) qualitative improvement of low-energy muon beam parameters. i) low neutron background, j) stable operation of the LNP phasotron.

Preliminary runs with a deuterium-filled target at the phasotron proved efficiency of all systems. The excellent background-to-effect ratio 1:300 was obtained for electrons.

A trial run with tritium was carried out. It showed that separation of tritium from standard isotope devices with a large shelf life and its purification to 10^{-7} is a more difficult task than we expected.

At present a new gas supply system is being worked out in co-operation with the RFNC VSIIEP (Arzamas-16).

Investigations will be continued to study spin dependence of the rate for ddμ molecular formation in solid deuterium in the temperature range (5–20) K. Earlier the measurements were carried out in a liquid. A solid deuterium target has been designed. A run with the target is scheduled for the end of the year.

ЭКСПЕРИМЕНТАЛЬНЫЙ КОМПЛЕКС **ЯСНАПП-2**

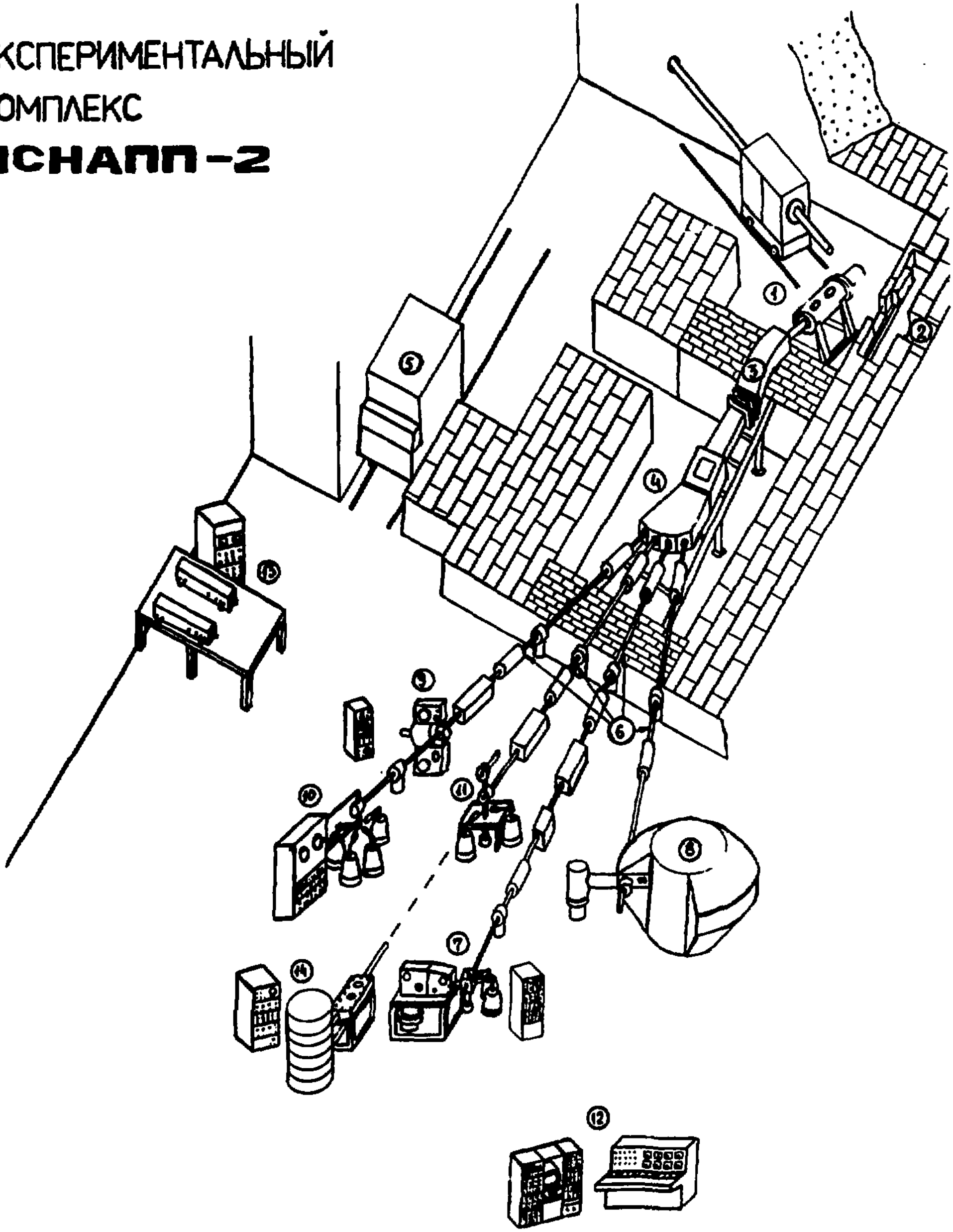


Figure: ISOL-complex YASNAPP-2: 1 ion source; 2 proton "stopper"; 3 mass separator magnet; 4 ion beam splitting system; 5 sliding door; 6 ion guides; *7,8,9,10,11 spectrometers ELGA, MATCh, magnetic lens, MUK and UMKS* respectively; 12 control panel of mass separator; 13 laser; 14 set up SPIN 2.

05-2-0986-92/96

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 RAS St Petersburg; St Petersburg University; 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

Leader: **V.G.Kalinnikov**

Specific structural features of nuclei of different shape and the effect of nuclear deformation on probabilities of α-, β- and γ-transitions are studied in experiments with short-lived nuclei of the transitional rare-earth region (N = 88). The experiments are carried out at the facility YASNAPP-2 on the extracted proton beam from the phasotron. To measure complex radiation spectra of nuclides from the given region and multidimensional coincidence spectra and lifetimes, spectrometric set-ups ELGA, UMKS, MUK, a magnetic lens spectrometer are used.

To study $M3$-isomerism in $^{156}_{67}Ho_{89}$ and $^{152}_{63}Eu_{89}$, laser spectroscopy methods and an electrostatic beta-spectrometer of high resolution will also be used.

In 1991 one and three-quasiparticle levels of odd nuclei with atomic weight $A \approx 157 - 167$ will be investigated to study the role of the Coriolis interaction and β - vibration in structure of excited nuclear states.

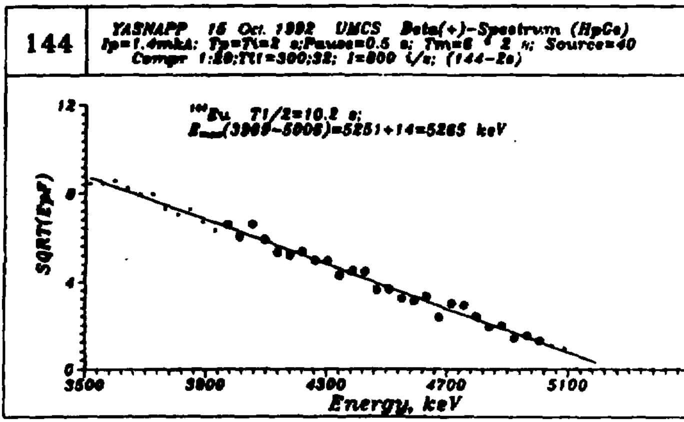


Figure 1. Curie plot of ^{144}Eu (10 s)

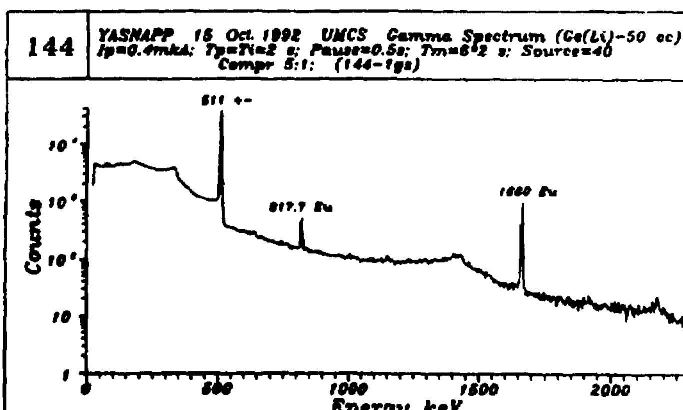


Figure 2. Gamma-spectrum of A=144 chain isotopes

05-2-0986-92/96

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; Nuclear Physics Institute, Krakow, Poland; Tashkent University, Uzbekistan

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

Leader: **K.Ya. Gromov**

The extension of systematic measurements of the nuclear mass far from the β stability line is of great interest in nuclear physics and astrophysics. The mass, or binding energy, is a fundamental gross property and a key input parameter for nuclear matter calculations. It is also a sensitive probe for collective and single-particle effects in nuclear structure.

Measurements of maximum β-decay energies using 9 mm thick HPGe-detectors give us mass differences of initial and final nuclei with an accuracy about 50 KeV. Mass separated ions of nuclei of interest are supplied by the on-line mass separator YASNAPP-2. There are possibilities of studying isotopes with half-lives down to $\simeq$ 1 sec. In necessary cases more detailed investigations of the β-decay are fulfilled.

The systematic measurements of maximum β^+-decay energies in the region A=131-165 are in progress. If this experiment has approximately five 30 hours' runs per year on the YASNAPP 2 facility there will be opportunity to measure 20–25 positron end point energies (β decay energy) during 3 years and to finish this programme within the limits of existing experimental possibilities.

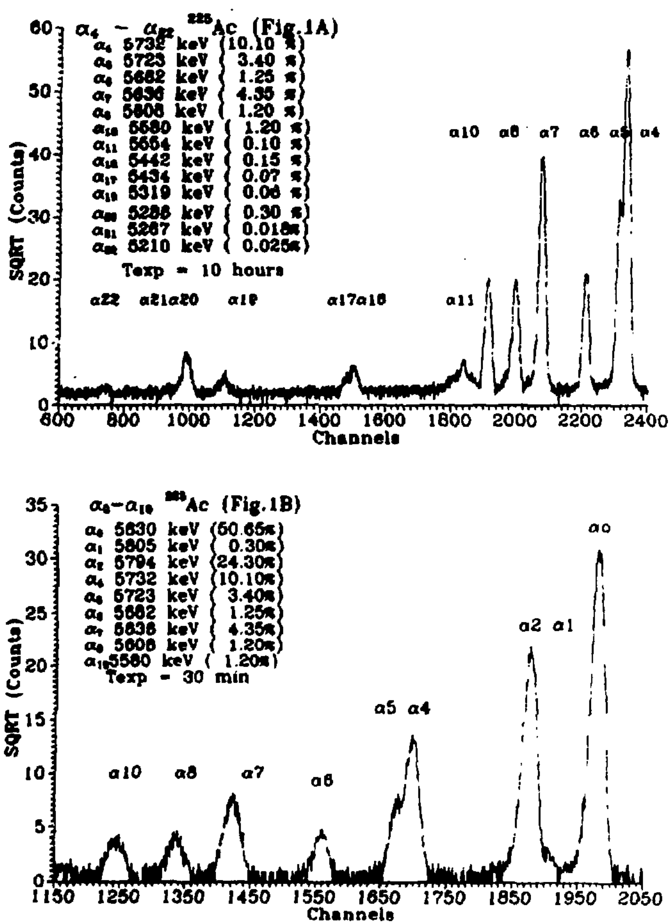


Figure: Alpha-spectrum ^{225}Ac ($T_{1/2}$=10 d) measured at a big magnetic double focusing α-spectrometer with a coordinate-sensitive detector.
(Resolution - 5 keV, transmission - 0.03% × 4π)
a) Fine structure in region E_α=5210-5730 keV;
b) Fine structure in region E_α=5580-5830 keV.

05-2-0986-92/96

LNP-5
Status Data-Taking

Study of α-decay in rare earth and actinide regions

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

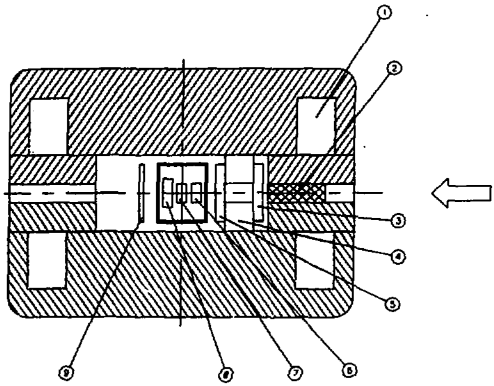
LNP, Dubna	V.G.Chumin, V.M.Gorozhankin, K.Ya.Gromov, V.I.Fominykh, S.S.Eliseev, M.B.Yuldashev, V.V.Tsupko-Sitnikov
Univ., Voronezh	S.G.Kadmenski, V.M.Vakhtel
PILU, Lublin	J.Wawryszczuk
Univ., Tashkent	A.H.Chalmatov, R.Niyazov
Univ., Samarkand	T.M.Muminov

Leader: **K.Ya. Gromov**

During the last two decades many new, mostly short-lived α-decaying nuclei have been discovered in the region of middle (A$\simeq$ 100-170) masses. But the accuracy of the known energies and probabilities (branching ratios) of the α-decay is relatively poor: 2-5 keV and $\geq$ 10%, respectively. At the same time systematic precise information on α-decay is very necessary for the complete analysis of the α-decay phenomenon -- for the study of the dependence of the probability of the α-decay on nuclear structure, on wave functions of initial and final states of nuclei. Precise values of α-decay energy allow us to obtain more correct data on nuclear masses.

For such purposes systematic *on – line* investigations of the α-decay of isotopes of rare earth elements are in progress at the experimental complex YASNAPP-2. Nuclei with half-lives down to $\simeq$ 1 s are accessible. To measure α-, γ- and β-spectra semiconductor detectors are used. In some cases of interest large precision $\pi\sqrt{2}$ α-spectrograph will be also used.

In the framework of this programme the investigations of the decay schemes of the nuclides in the ^{225}Ac ($T_{1/2}$=10 d.) decay chain started in 1993. Sources of ^{225}Ac are separated from ^{229}Th($7{\cdot}10^3$ y) by the procedure elaborated by Khalkin et al. (see Exp. LNP 7). During 1994-95 we intend to study the decay schemes of ^{225}Ac, ^{221}Fr and ^{217}At using semiconductor α- and β-spectrometers and the $\pi\sqrt{2}$ α spectrograph. We hope to obtain new data on parity doublet levels and consequently on octupole deformation of nuclei in this region.



Schematic view of the μSR setup with the iron core magnet. 1 –magnet coil, 2 – degrader, 3,5,6,8,9 -scintillator counters, 4 – collimator, 7 – sample.

The main properties of the beam and apparatus are:

Muon intensity .... $5 \cdot 10^5$ $\mu^+ s^{-1}$ (contamination 3% e^+)
$2 \cdot 10^5$ $\mu^- s^{-1}$ (contamination 6% e^-, 2.4% π^-)
Spot size .... 6 cm (FWHM) × 10 cm (FWHM)
Momentum .... 125 $MeVc^{-1}$
Polarization 80%
Spectrometer time resolution .... 1.2 ns
Achieved background to signal ratio .... $3 \cdot 10^{-4}$
Temperature range .... 1.3 – 300 K (accuracy 0.1 K)
Magnetic field .... 5 kG perpendicular
and 6 kG longitudinal to the initial beam polarization
Homogeneity of the magnetic field in the sample volume .... 10^{-4}

07-0-0857-88/95

MUSPIN	LNP-6
Status	Data-Taking

Study of the condensed state of matter by the μSR (Muon Spin Rotation) technique

LNP JINR, Dubna; RNC "Kurchatov Institute", Moscow; Institute of Theoretical and Experimental Physics, Moscow; Moscow Institute of Physics and Technology, Dolgoprudniy; Institute of Nuclear Research RAS, Moscow; Institute of Inorganic Chemistry RAS, Moscow; Kirenski Institute of Physics SB RAS, Krasnoyarsk; Moscow State University; St.-Petersburg Nuclear Physics Institute, Gatchina, Russia; Institute of Low Temperatures and Structural Studies, Wroclaw, Poland; Physical Institute, Prague, Czech Republic.

LNP, Dubna	Chaplygin I.L., Duginov V.N., Grebinnik V.G., Gritsaj K.I., Mamedov T.N., Olshevsky V.G., Pomjakushin V.Yu., Stoykov A.V, Zhukov V.A.
RNCKI, Moscow	Ponomarev A.N., Kirillov B.F.,Krasnoperov E.P., Meilikhov E.E., Nikolsky B.A., Suetin V.A.
ITEP, Moscow	Firsov V.G., Kudinov V.I., Obukhov Yu.V., Savelev G.N.
INR, Moscow	Eschenko D.G.
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.

Leader: **Zhukov V.A.**

The current and planned experiments using the spectrometer "MUSPIN" are:

1) Investigation of structure, dynamics and pinning of the magnetic vortex system in the High-T_c superconductors. Measurements of the magnetic penetration depth in copperless superconducting samples $BaBi_{1-x}Pb_xO_3$.

2) Study of the magnetic phase transitions in the High-T_c related compound Bi_2CuO_4.

3) Investigation of the properties of the systems with heavy fermions, the study of ferromagnetic state in $CeRuSi_2$.

4) Investigation of the hyperfine interactions of the acceptor centers in Si.

5) Study of the influence of electric fields on the muonium formation process in cryocrystals and cryoliquids.

The upgrading program of the spectrometer "MUSPIN" includes the mastering of the surface muon beam of LNP JINR phasotron. These muons open new oppotunities for the experiments with interesting new materials which are difficult to produce in large quantities and single crystals.

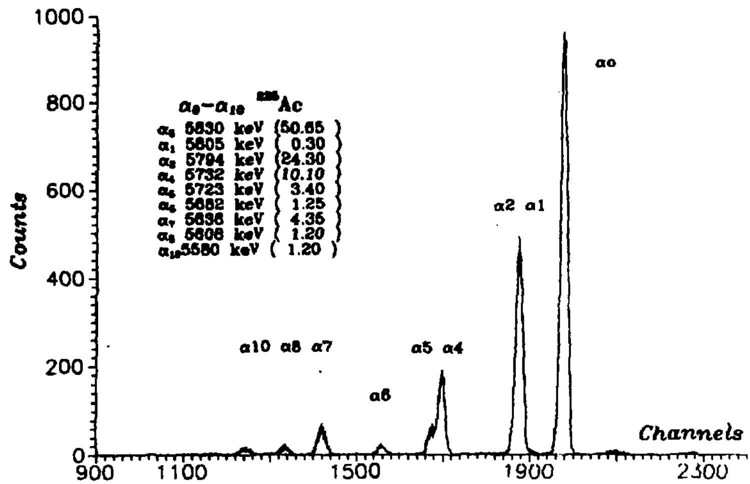


Figure 1: α-spectrum of ^{225}Ac. Magnetic double-focusing α-spectrometer. Resolution at $\alpha_0 < 6$ KeV.

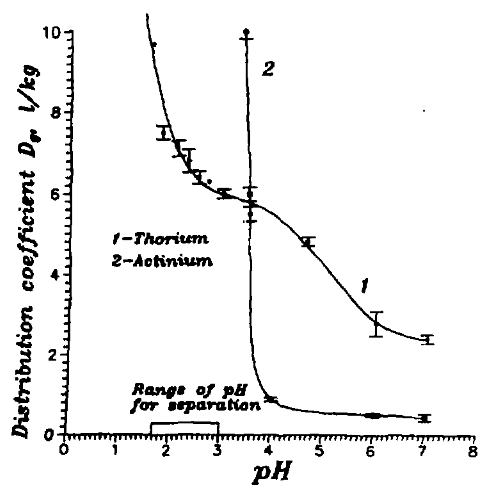


Figure 2: Dynamic distribution coefficients of Ac and Th between cation-exchange resin and ammonium citrate solution as a function of pH.

05-2-0986-92/96

LNP-7	
Status	Preparation

Experimental studies of 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[1]

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

Leader: **V.A. Khalkin**

The JINR is well able to produce many rare radionuclides that find wide application in science and technology, e.g ^{97}Ru, ^{178}W (^{178}Ta), ^{225}Ac for medical diagnosis and therapy. The aim of the present research is to study and choose optimum conditions for production of ^{97}Ru, ^{178}W at the JINR phasotron in nuclear reactions with protons ^{97}Tc(p,3n)^{97}Ru and ^{181}Ta(p,4n)^{178}W; investigation into chemical aspects of making pure ^{97}Ru and ^{178}W preparations in the form suitable for synthesis of radiopharmaceutical preparations and development of a generator system for production of ^{225}Ac on the basis of the radionuclide pair ^{229}Th/^{225}Ac. In 1994 particular emphasis will be placed on detailed study of chemical processes of separation, purification and concentration of these radioelements.

[1] There are protocols of intent signed by the JINR and 1) Institute for Nuclear Research, Chinese Academy of Sciences, Shanghai, China; 2) Institute for Atomic Physics, Bucharest, Rumania

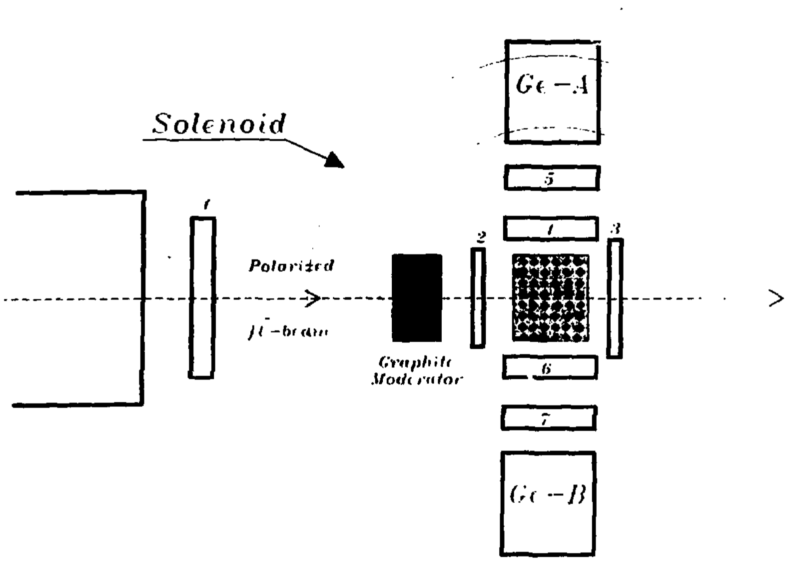


Figure : 1...7 Plastic scintillator counters.
Ge-A, Ge-B HP Ge γ-detectors of high volume (200 cm^3)

05-2-0986-92/96

LNP-8
Status Data-Taking

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

LNP JINR, Dubna; Catholic University, Louvain-la-Neuve, Belgium; Centre de Spectrométrie Nucleaire et de Spectrométrie de Masse, Orsay, France

LNP, Dubna	V.Brudanin, V.Egorov, A.Kachalkin, V.Kovalenko, A.Salamatin, Yu.Shitov, S.Vasiliev, V.Vorobel, I.Štekl, Ts.Vylov, I.Yutlandov, Sh.Zaparov
UCL, Louvain	J.Deutsch, R.Prieels, N.Severijns
CSNSM, Orsay	Ch. Briançon

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

The measurement of the angular correlation between the muon residual polarization ($\vec{P}$) and the momenta of the neutrino ($\vec{\nu}$) and γ-quantum ($\vec{k}$) in the $^{28}Si(\mu,\nu)^{28}Al^{*}$ process is carried out using the secondary μ^- beam of the JINR Phasotron. The value of $\vec{P}$ is measured with the μSR method, the value of $\vec{k}$ is determined by the set-up geometry, and the value of $(\vec{k}\cdot\vec{\nu})$ is 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 well 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 the correlation coefficients depending on the ratio of the *Induced Pseudoscalar* and *Axial* form factors g_P/g_A.

The results obtained in the former experiments[1,2] show the efficiency of the proposed method and indicate the quenching of g_P/g_A in hadronic medium in contradiction to *PCAC*-hypothesis. On the other hand, the presence of some unexpected background effects makes the above results not enough reliable and require additional measurements in order to confirm or refute this quenching.

1. V.Egorov *et al.*, Communication of JINR **P6-91-430** (1991).
2. V.Brudanin *et al.*, (submitted to Nucl. Phys. A).

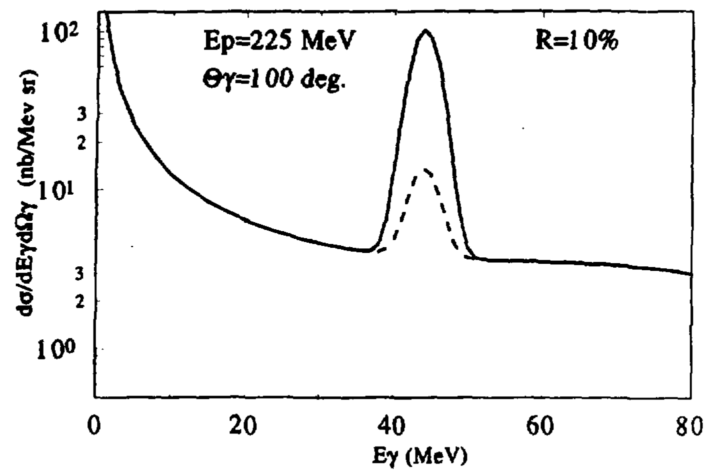


Figure 1: Differential cross section for the $pp \to \gamma X$ reaction. The solid curve corresponds to $\Gamma_{tot} = 1.0$ keV, the dashed curve to $\Gamma_{tot} = 0.1$ keV.

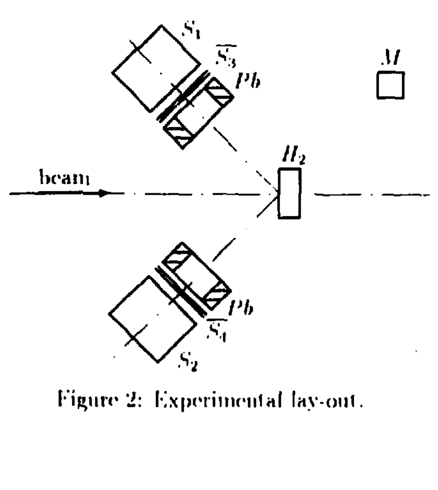


Figure 2: Experimental lay-out.

0'-...-C''' -92/96

LNP-9
Status Preparation

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

LNP, BLTP, FLNR JINR, Dubna

LNP, Dubna V.M.Abazov, Yu.K.Akimov, M.I.Gostkin, N.V.Khomytov, A.S.Khrykin, N.A.Kuchinsky, A.B.Lazarev, S.I.Merzlyakov, A.G.Molokanov, K.O.Oganesyan, E.A.Pasyuk, C.Yu.Porokhovoy, S.N.Shilov, V.A.Stolypin

BLTP, Dubna S.N.Ershov, S.B.Gerasimov

FLNR, Dubna Yu.G.Sobolev

Leader: **A.S.Khrykin**

The aim of the proposed experiment is the search for narrow, exotic dibaryon resonances (B^2's) with $M_B \leq 2m_p + m_\pi$ and the estimation of their width. Such six-quark states have been discussed over years within a number of QCD-motivated models but not yet verified definitely up to now. We propose a new method to search for very narrow, dominantly radiatively decaying dibaryons through the measurement of the photon energy distribution in the $pp \to \gamma B^2 \to pp\gamma\gamma$ reaction, detecting both photons in coincidence[1]. The narrow dibaryon should be seen as a sharp γ-lineover a smooth background with a good signal-to-background ratio. In order to illustrate the possibility of this method in Figure 1 the effective cross-sections of the explored reaction $\frac{d^2\sigma}{dE_\gamma d\Omega_\gamma}$ are shown. These cross sections were calculated for the possible candidate for the narrow dibaryon with mass M_B=1936 MeV. The gaussian form was assumed for the energy resolution function of the experimental set-up with the width R_γ=10%.

The experiment is planned to be performed at the JINR phasotron with the proton beam of energy from 200 to 250 MeV, intensity $\sim 5 \cdot 10^8$ protons/sec, and energy spread ~1%. The schematic of the experimental set-up is shown in Figure 2. The basic components of the set-up are the following: H_2 is the liquid hydrogen target, S_1 and S_2 are the detectors of the γ-quanta, $\overline{S_3}$ and $\overline{S_4}$ are the anticoincidence counters which shield the γ against charged particles, Pb's are the collimators and M is the monitor of the proton beam. The liquid hydrogen target is a vacuum insulated cylinder 4.5 cm in diameter, 0.3 g/cm^2 thick, with thin mylar windows of total thickness $\sim$ 100 μm. To reduce a large background of protons scattered by the target we are going to detect the backward-emitted photons. As γ-detectors, we assume to use two large scintillation counters. The planned exposure will permit us either to discover the specified dibaryons or to set an upper limit for its width, which is about two orders less than the one obtained in earlier experiments with the same aims.

[1] S.B.Gerasimov and A.S.Khrykin, Mod.Phys.Lett. **A8**, 2457(1993).

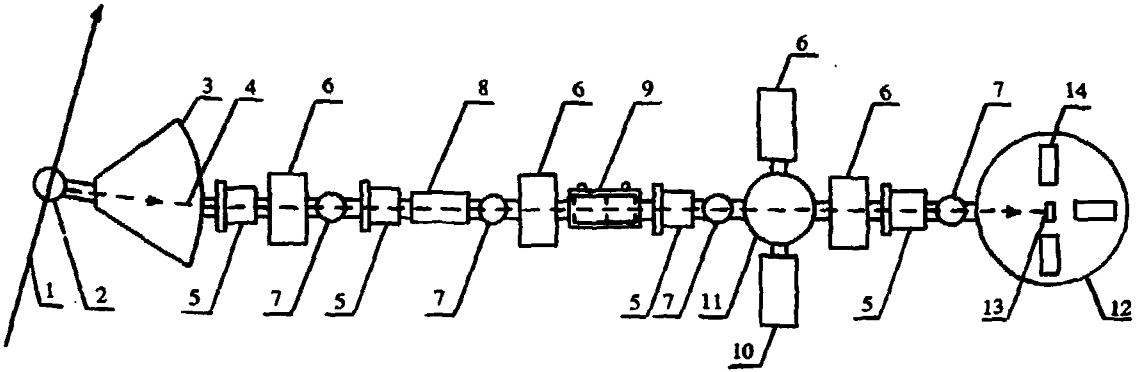


Figure: **The on-line SPIN Facility:** 1. proton beam (660 MeV), 2. target, 3. mass separator, 4. ion beam, 5. electrostatic quadrupole lens, 6. high-vacuum pumps, 7. ion beam detectors, 8. ion beam lock, 9. liquid-nitrogen trap, 10. quadrupole mass spectrometer, 11. implantation chamber (off-line experiments), 12. dilution refrigerator (^3He-^4He) with magnet orientation system, 13. cold implantation matrix (on line experiments), 14. γ, β, α detectors

SPIN	LNP-10
Status	Data-Taking

Low-temperature nuclear orientation of nuclei far from stability line

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

LNP, Dubna	R.Drevenak, M.Finger, M.Finger,Jr., A.Janata, Yu.M.Kazarinov, T.I.Kracikova, N.A.Lebedev, M.V.Lyablin, A.F.Pisarev, D.E.Shabalin, M.Slunecka, L.N.Somov, A.D.Stepanov, Yu.V.Yushkevich
NPRI BSU, Minsk	V.G.Baryshevski et al.
NPRI MSU, Moscow	V.P.Parfenova et al.
NRI, Moscow	G.M.Gurevich et al.
RNCKI, Moscow	L.I.Menshikov et al.
RICM, Zhilina	P.Wiesenganger
ELTECO, Zhilina	J.Prochazka et al.
CU, Prague	B.Sedlak et al.
CTU, Prague	J.John, J.Konicek et al.
VACUUM, Prague	P.Hedbavny et al.
TESLA, Premysleni	J.Kula et al.
ISI, Brno	J.Dupak et al.
Sussex Univ.	W.D.Hamilton et al.
Braunswieg Univ.	U.Keiser et al.
Leuven Univ.	L.Vanneste
Novi Sad Univ.	M.Veskovich et al.
Beograd Univ.	I.Anicin et al.

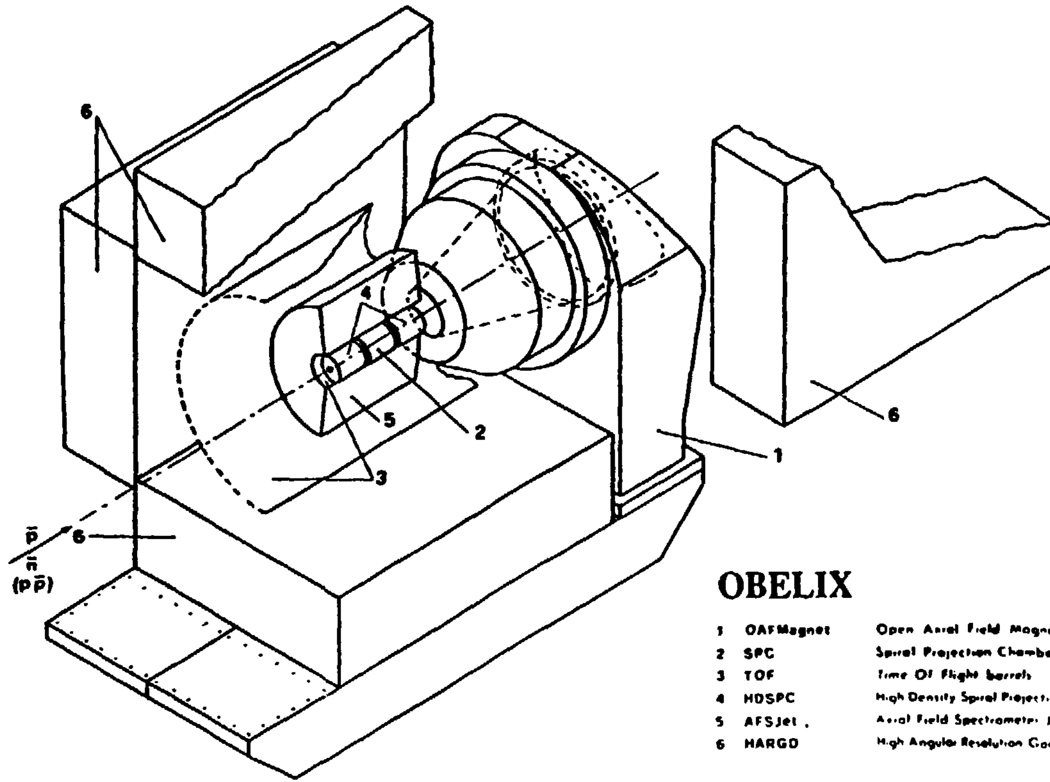
Leader: **M.Finger**

The experimental facility for the study of the spin effects in the decay of oriented nuclei in a broad range of atomic and mass numbers and half-lives based on hyperfine interactions at ultra-low temperatures - the SPIN Facility - has been constructed at the LNP JINR.

High cooling power top loading ^{3}He-^{4}He dilution refrigerator of the system is capable of fast cooling the sample inserted into the mixing chamber to the base temperature of 10 mK for about 1 h. The time for changing sample is about 10 min. A pair of superconducting coils can provide an external polarizing magnetic field on the sample in the horizontal plane up to 2 T. A detection system is designed for the study of angular distribution and temperature dependence of the anisotropy of gamma rays, linear polarization of gamma rays and nuclear magnetic resonance of thermally oriented radioactive nuclei detected via the effect of the resonance upon the angular distribution of nuclear radiation (NMR/ON technique). Wide variety of sample preparation techniques based on nuclear chemistry and mass separation, ion implantation, temperature treatment, melting and diffusion can be used. High intensity beams of the Dubna 600 MeV proton phasotron, 10 GeV synchrophasotron, heavy ion cyclotrons or Dubna reactor neutron beams are used for production of radioactive isotopes. A special radioactive ion beam line of the ISOL Facility (YASNAPP-2 Facility at the LNP JINR) for on-line ion implantation is under construction.

Using the basic SPIN Facility wide range of experiments in nuclear and solid state physics will be preformed. The main research programme in the field of nuclear structure studies is devoted to the properties of rare earth nuclei and heavy elements. Research in the field of solid state physics includes hyperfine interactions, NMR/ON and spin lattice relaxation studies.

Experiments Using External Accelerators



OBELIX

1 OAFMagnet — Open Axial Field Magnet
2 SPC — Spiral Projection Chamber
3 TOF — Time Of Flight barrels
4 HDSPC — High Density Spiral Projection Chamber
5 AFSJet — Axial Field Spectrometer Jet Chamber
6 HARGD — High Angular Resolution Gamma Detector

05-2-0987-92/96

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, F.Nichitiu, G.B.Pontecorvo, S.N.Prakhov, A.M.Rozhdestvensky, M.G.Sapozhnikov, V.I.Tretyak
Bologna Univ.	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.	G.Belli, M.Corradini, E.Lodi Rizzini, L.Venturelli
Cagliari Univ.	A.Adamo, C.Cicalo, A.Lai, A.Masoni, G.Puddu, P.Temnikov, S.Serci, G.L.Usai
Frascati Nat.Lab.	C.De Leo, C.Guaraldo, A.Lanaro, V.Lucherini
Legnaro Nat.Lab.	P.Boccaccio, U.Gastaldi, M.Lombardi, G.Maron, R.A.Ricci, L.Vannucci, G.Vedovato
Padova Univ.	A.Andrighetto, M.Morando
Pavia Univ.	G.Bendiscioli, V.Filippini, C.Marciano, P.Montagna, A.Rotondi, P.Salvini, A.Zenoni
Trieste Univ.	G.V.Margagliotti, G.Pauli, S.Tessaro, E.Zavattini
Turin Univ.	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	M.Agnello, F.Iazzi, B.Minetti
Udine Univ.	L.Santi

Leaders: **T.Bressani, C.Guaraldo** *Leader from* JINR: **M.G.Sapozhnikov**

The OBELIX detector is designed for studying exclusive final states of antiproton and antineutron annihilation at low energies with protons and nuclei. The measurements of charged and neutral particles is possible in practically 4π-geometry. Gas targets were foreseen to provide the measurements of P-wave annihilation. A special care was ability to detect low-energy proton-spectators or a residual nucleus in the case of $\bar{p}A$ annihilation.

In the Figure one can see the assembly of OBELIX detectors. A gas target (hydrogen, deuterium or other heavier gases) is surrounded by a Spiral Projection Chamber (SPC). The SPC is used as a vertex detector for measurements of protonium X-rays and of nuclear fragments after $\bar{p}A$ annihilation. The magnet and the jet drift chamber of the Open Axial Field Spectrometer (AFS) are used for charged particle momentum and dE/dx measurements. Two concentric arrays of plastic scintillators allow a time-of-flight (TOF) system to identify and trigger on charged particles. The gammas are detected by 4 supermodules of the high angular resolution gamma detector (HARGD) that surrounds the apparatus.

The physical program of the OBELIX experiment includes the search for glueballs, hybrids and other exotic states by comparison of the same decay modes occurring from initial states of annihilation with different isospins or angular momenta, search for multiquark and exotic resonances in nuclear matter, search for rare $\bar{p}A$-reactions forbidden on a free nucleon (Pontecorvo reactions), the systematic study of $\bar{N}N$ interaction with antineutrons, the strangeness production in $\bar{p}A$ annihilation etc.

Plans of the JINR group for 1995 are the following: 1. To start the investigation of the reason for the strong OZI violation studying Φ production in $\bar{p}p$ annihilation at rest at different gas pressures. 2. To finish the investigation of the general features of $\bar{p}d$ annihilation. 3. To continue increasing the statistics on $\bar{p}d$ annihilation at rest.

a) Detection principle:

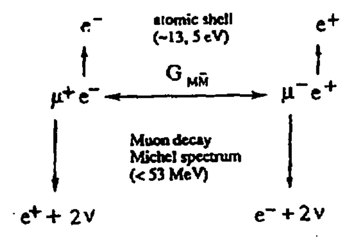


Figure 1: Principle of the experiment.
The conversion of a muonium atom into an antimuonium atom ($\bar{M}$) with a coupling strength $G_{\bar{M}M}$ leaves a bound state of a μ^- and an e^+. The muon decay liberates an energetic electron with the typical Michel distribution and an atomic positron with an average energy of 13.5 eV.

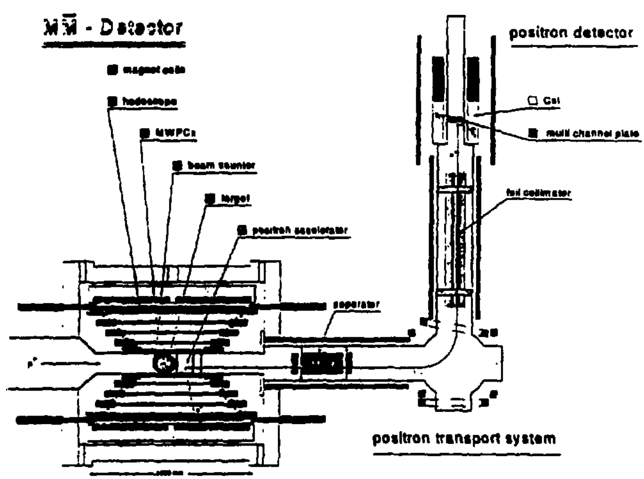


Figure 2: Schematic view from above of the apparatus for the new search for muonium to antimuonium conversion now underway at PSI.

05-2-0987-92/96

R 89-06.1 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, V.A. Baranov

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

The experiment is to be carried out on the beam of "surface" $\pi E3$ muons from the meson factory PSI (Switzerland), $p_\mu \approx 20$ MeV/c, intensity $\approx (2 \div 5) \cdot 10^6 s^{-1}$.

The goal is to search for muonium-antimuonium conversion ($M \rightarrow \bar{M}$) with a probability $\approx (10^{-10} - 10^{-11})$. The probability achieved so far is $\approx 0.4 \cdot 10^{-6}$. The research has been given the highest priority at PSI.

Formation of an antimuonium atom ($\mu^- e^+$) in the experiment is established by detecting both the energetic electron ($E_{e^-} \leq 53$ MeV), resulting from the decay of the negative muon, and the remaining positron ($E_{e^+} \approx 13$ MeV) (See Figure 1). The experimental layout is shown in Figure 2.

The magnetic spectrometer SINDRUM is used to detect the energetic electron. It consists of 5 cylindrical proportional chambers with the total number of anode wires ≈ 3000 and a scintillation hodoscope of 64 counters viewed by photomultipliers on both sides. In the centre of the spectrometer there is a target of very fine quartz powder (SiO_2). Muons stop in the powder and form muonium atoms, which then go out into vacuum space around the target.

To be detected, the low-energy positron is first accelerated to 10 keV in a special system placed in a magnetic field, then it is deviated by 90^0 in a specially formed magnetic field, passes through a collimating device, stops, and is registered by a position-sensitive detector made from microchannel plates. All positron path is within high vacuum of $\approx 10^{-9}$ millibar. Gamma quanta arising from annihilation of positron in matter are registered by a hodoscope of 12 full absorption CsJ counters.

In 1993 statistics based on 10^{12} stopped muons was obtained. It gives the possibility to estimate the ($M \rightarrow \bar{M}$) conversion probability at the $\approx 10^{-8}$ level.

It is planned to increase the antimuonium detector efficiency by a factor of 2-5 in 1994 and to take data in 4 weeks' run.

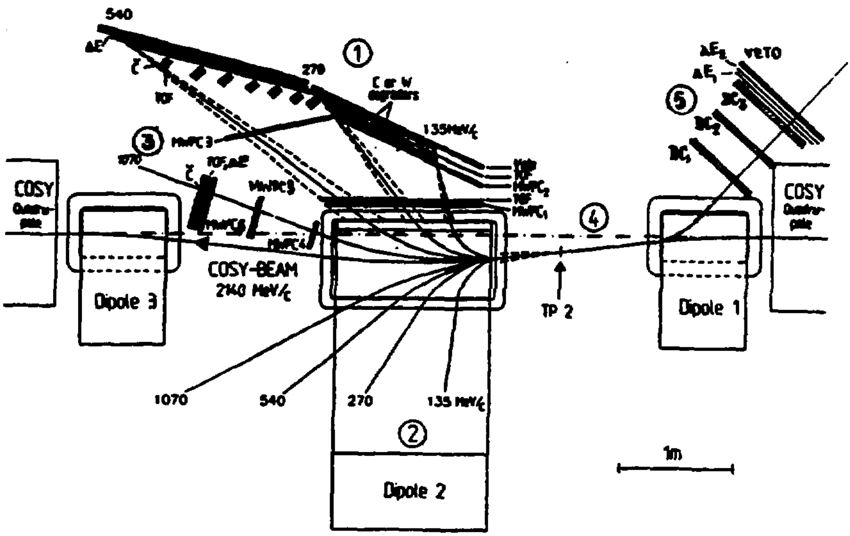


Figure 1: Layout of the 0° Facility (ZDF) at COSY.
Tracks of particles and detector groups are shown for the experiment on the subthreshold K^+-production. 1 - Side Detector, 3 - Forward Detector, 5 - Backward Detector.

05-2-0987-92/96

COSY 18-20	LNP-13
Status	Preparation

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

LNP, LCTA JINR; INP of Moscow State Univ.; SPINP, Gatchina; ITEP, Moscow, Russia; Institut für Kernphysik Forschungszentrum Jülich; Institut für Kern und Hadronenphysik Forschungszentrum Rossendorf; Univ. zu 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, D.Dedovich, D.N.Zavarykin, V.P.Zrelov, V.M.Grebenyuk, N.I.Zhuravlev, E.V.Komissarov, V.V.Karpukhin, V.V.Kruglov, A.Yu.Petrus, I.N.Potrap, A.I.Puzynin, A.I.Rudenko, A.V.Selikov, V.V.Sidorkin, W.T.Sidorov
LCTA, Dubna	V.V.Ivanov et al.
INP Univ., Moscow	A.V.Kulikov, S.G.Abdulasisov, S.V.Trusov
SPINP, Gatchina	S.L.Belostotsky, V.P.Koptev, O.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.Watzlawik et al.
IKHF FZR, Rossendorf	H.Mueller, S.Dienel, K.W.Leege, Chr.Schneidereit et al.
Univ., Köln	H.Paetz gen. Schieck
Univ., Muenster	H.Dombrovski, R.Santo
Univ., Cracow	A.Strzalkowski, L.Jarczyk, B.Kamys et al.
HEPI, Tbilisi	N.S.Amaglobely, M.S.Nioradze, L.Glonti et al.
Univ., Alma-Ata	Yu.N.Uzikov
Univ., Bratislava	V.Finer, P.Pavlovitch, J.Ruzhitchka et al.

Leader COSY-18: **K.Sistemich** Leader COSY-20: **V.I.Komarov**

Behaviour of few-nucleon systems at high momentum-energy transfers is planned to be studied with a zero degree facility -- a magnetic spectrometer to be installed on the cooled beam of the proton synchrotron COSY (Jülich, BRD). The "elementary" cumulative process deuteron fragmentation by protons will be investigated at 1-2.5 GeV energy in the kinematics far from the quasielastic scattering on a single nucleon. A systematic measurement is proposed in the exclusive approach using the polarized beam and the polarized target for the differential cross sections, vector and tenzor analyzing power, spin-spin-correlation asymmetry. Secondary protons will be detected in a collinear geometry at the angles close to 0^0 and 180^0 in coincidence. Few-nucleon systems in heavier nuclei will be investigated in the cumulative process of subthreshold kaon production with the same spectrometer. Double differential cross sections of kaon emission and correlation of kaons with light nuclear fragments can be investigated. Commissioning of COSY was performed in 1993. The main aims of the JINR in the program are development and manufacturing of the Forward and Backward Detector groups, participation in the development of the side Detector, data acquisition system, measurements and data handling, computer simulation. Design and partial production of the BD and FD equipment is the main goal of the project in 1994.

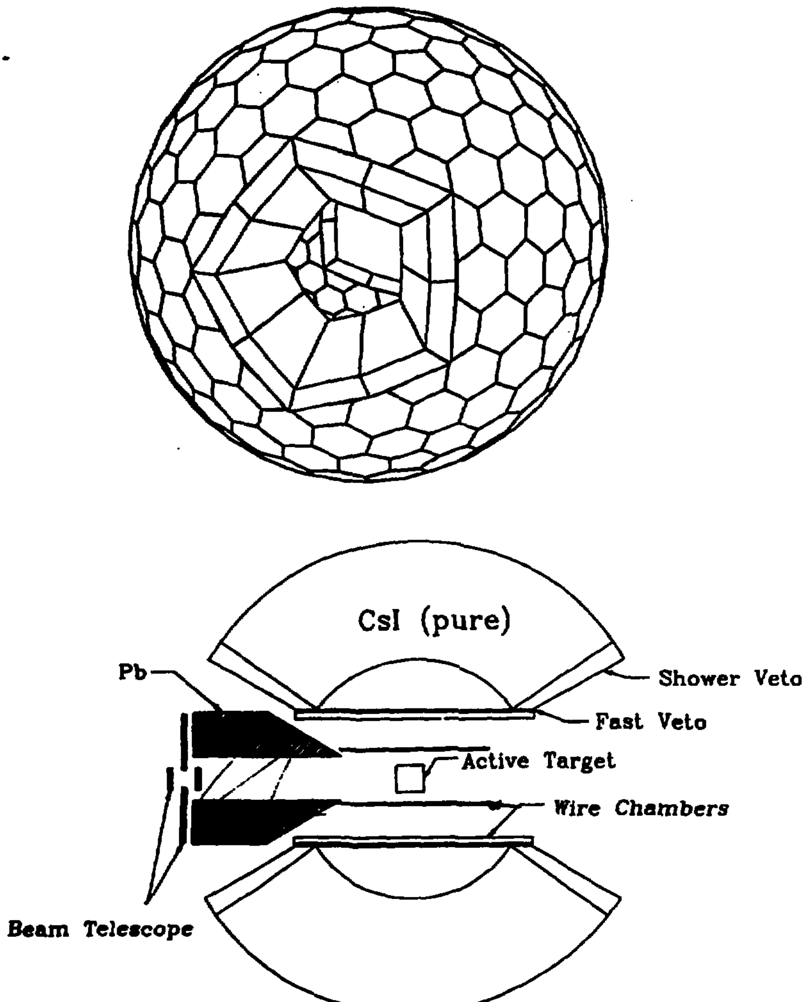


Figure: Top: a view of the 240-element pure CsI calorimeter. Bottom: schematic cross section through the $\pi\beta$ apparatus showing approximate locations of major components.

05-2-0987-92/96

R 89-01.1	LNP-14
Status	Preparation

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

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

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

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

The goal of the experiment is to improve the accuracy of the pion β-decay ($\pi^+ \to \pi^o e^+ \nu_e$) rate ($R \sim 10^{-8}$) from 4% to 0.5% at the first stage. These measurements will be relative. Normalization will be done by means of the decay $\pi^+ \to e^+ \nu_e$, which is registered in the same exposure.

The experiment will be carried out at the PSI on the beam of π^+-mesons with $p_\pi \sim 100$ MeV/c and intensity up to $5 \cdot 10^6 \pi$/s.

Precise measurement of the probability of the pion β-decay allows a severe test of charged quark-lepton current universality and Cabbibo-Kobayashi-Maskawa mixing matrix unitarity.

Detailed substantiation and description of this experiment are given in the *Proposal for an Experiment at PSI* R 89-01.1. The proposal for the experiment was approved by the Commission on New Experiments of the PSI in 1992 and was given the highest priority.

The experimental lay-out is shown in the Figure. Pions pass through beam counters, stop in the target and decay. Gamma quanta resulting from the decay of a π^o-meson, which arise from the β-decay, are registered by a shower detector consisting of 225 CsI counter modules, each counter being 12 radiation lengths long. The total solid angle of the facility is $\sim 0.77 \cdot 4\pi$ steradian. The total volume of CsI crystals is 0.346 m^3.

Charged particle trajectories are determined by means of cylindrical proportional chambers, which must ensure the co-ordinate determination accuracy ≤ 1 mm and a high degree of suppression of accident coincidences of muon decay positrons. A high time resolution will be determined by a cylindrical hodoscope of scintillation counters. The whole facility is surrounded by counters to suppress the cosmic ray background.

Two cylindrical proportional chambers and their electronic equipment are manufacturing at Dubna. The outer diameter of the chambers is ~ 160 and 260 mm, the length is ~ 350 and 540 mm, the total number of wires is ~ 700, the number of strips is ~ 800.

In 1994 chamber 1 and electronics for 128 channels will be installed in the PSI for testing on the beam.

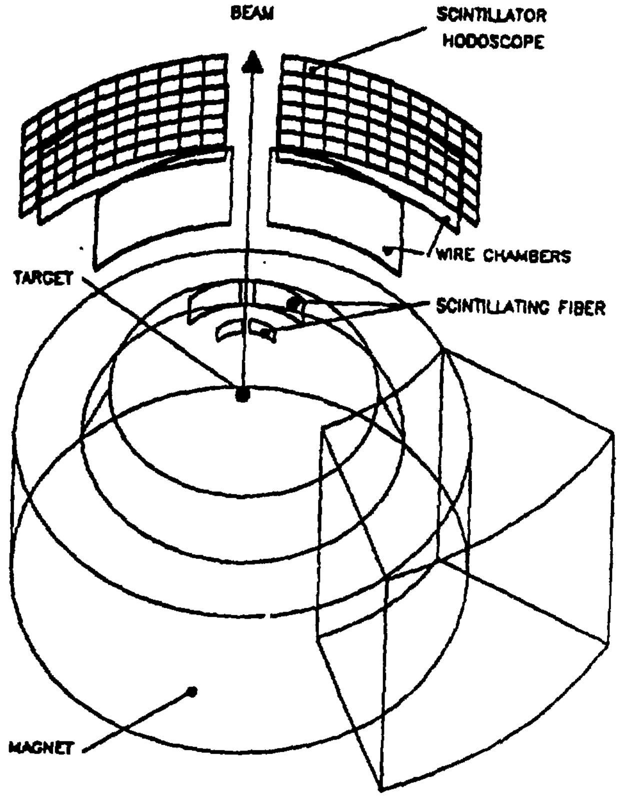


Figure: Layout of the experimental apparatus

05-2-0987-92/96

DISTO	LNP-15
Status	Preparation
	Data-Taking

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

LNP JINR, Dubna, Russia Indiana University, USA; Istituto di Fisica/INFN, Torino, Italy; Laboratoire National Saturne, Saclay, France

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

Leader: **R.Bertini** Leader from JINR: **I.V.Falomkin**

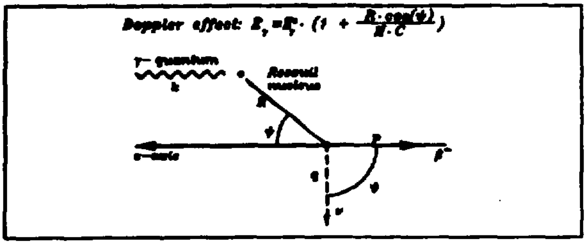
The purpose of the experiment is to measure the differential cross sections, as well as the spin observables P_Λ, P_{Σ^0}, A_Y and D_{YY}, for the reactions $pp \to pK^+\Lambda$ and $pp \to pK^+\Sigma^0$ at energies between the reaction thresholds and the maximum attainable energy at Saturne (about 2.9 GeV). The correlation between these observables and the N^* and Y^* resonances will also be determined.

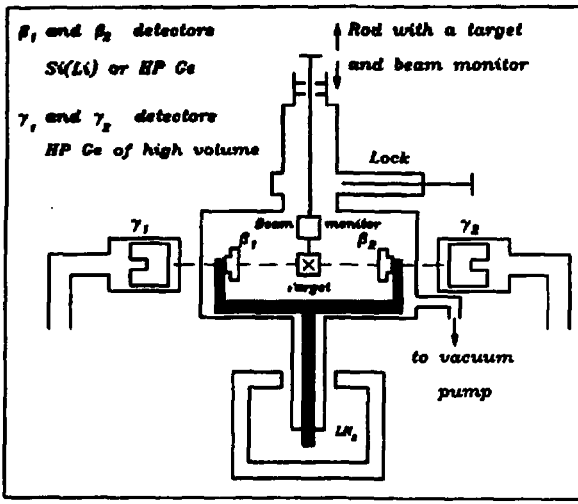
Some theoretical attempts [J.M.Laget, DPHN Saclay 90-31 (1991)] have been made to explain the reaction mechanism by applying the one-boson-exchange models. Measurement of spin observables at Saturne would provide a way to investigate the relationship between the fundamental QCD approach and the boson-exchange theories.

The experiment would also provide data needed to assess the feasibility of producing "tagged" (via pK^+) polarized Λ^0 "beams", which might eventually be used to study ΛN-interactions directly.

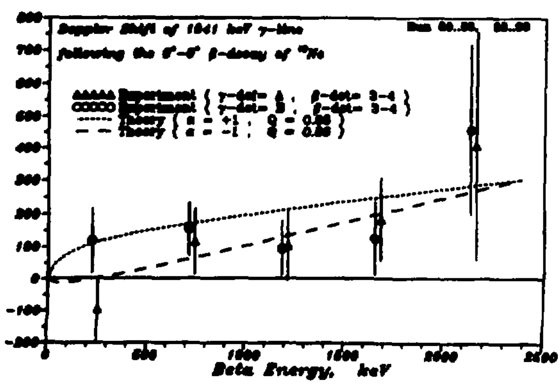
The experimental apparatus consists of ten detectors, symmetrically placed on opposite sides of the beam, including 4 MWPCs of cylindrical shape (constructed at JINR). Detectors cover an azimuthal scattering angle of 45^0 and a dip angle of $\pm 15.5^0$.

In 1994 the DISTO installation will be assembled in the experimental hall at Saturne and the first runs with the proton beam will be carried out.





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



0
500
1000
1500
2000
2500
Beta Energy, keV

05-2-0986-92/96

LNP-16
Status Preparation

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

LNP JINR, Dubna; Catholic University, Louvain-la-Neuve, Belgium; Centre de Spectrométrie Nucleaire et de Spectrométrie de Masse, Orsay, France

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

Leader: **V.Egorov**

According to the Standard Model (SM), the nuclear superallowed 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 latter 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.

The experimental set-up and the measurement conditions were optimized in the preliminary *off-line* experiment with the long-lived ^{24}Na source, as well as in the *on-line* test with ^{14}O, ^{18}Ne and ^{30}S short-lived nuclei obtained in the $(^3He, n)$-reaction using the C, $(CH_2)_n$, B_2O_3 and SiO_2 solid targets irradiated with the ^3He-beam of the Tandem accelerator (IPN, Orsay, France). The detection of β-particles and γ-quanta was done by means of Si(Li) and HPGe detectors of several types. The PC-based acquisition system connected with a SUN-computer was tested as well.

Taking into account the results of the tests, the improved experimental set-up is being developed now in order to measure the Doppler shift of the 1041 keV γ-line following the $(0^+ \rightarrow 0^+)$ β-decay of ^{18}Ne nuclei. The set-up is equipped with the target transport system and contains 14 Si(Li) β- and 2 HP Ge γ-detectors. Further development of the set-up using a gas target (in order to investigate the decay of ^{14}O) is also planned to be continued.

Spectrometer characteristics:

- 16 HP Ge detectors ø48 × 6 mm (total volume $V = 10\,cm^3$, total area $S = 12.5\,cm^2$)
- Energy resolution (FWHM): $\Delta E \le 2.7$ keV (on 1333 keV line)
- Time resolution (FWHM): $\Delta t \le 20$ ns (on ^{60}Co line)
- Thickness of samples under investigation: $d = 25$ mg/cm^2
- Amount of material under investigation ≈ 5 g

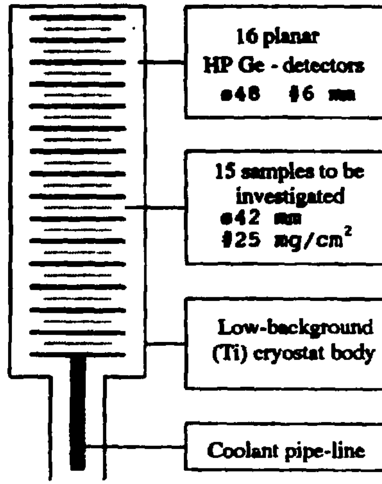


Figure 1: Spectrometer TGV

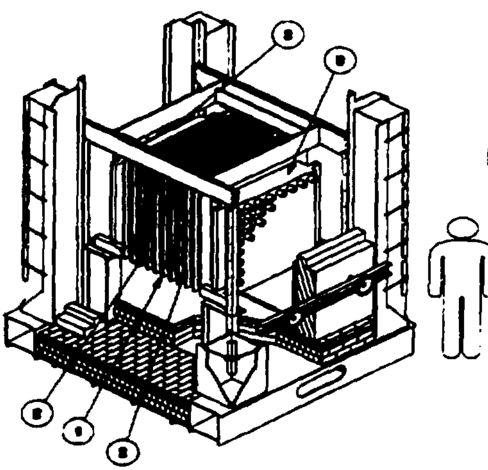


Figure 2: The NEMO-2 Detector
(1) Central frame with the metallic foil.
(2) tracking device of 10 frames with 2×32 Geiger cell each.
(3) Scintillator walls of 8×8 counters.

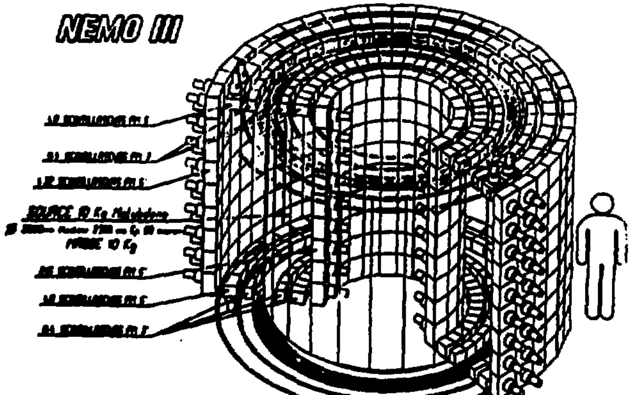


Figure 3: The NEMO-3 Detector

05-2-0986-92/96

TGV, NEMO	LNP-17
Status	Data-Taking

Search for double beta-decay

JINR, Dubna; CSNSM, Orsay, France; 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, V.Timkin
CSNSM, Orsay	Ch.Briancon
NEMO Collaboration	

Leader of TGV experiment: **V.Brudanin**
Leader 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. Since four years the TGV- and NEMO- collaborations have built prototype spectrometers TGV, NEMO-1 and NEMO-2 in order to measure the experimental $e-e$ background in the 4 MeV region. Spectrometers are installed in the Frejus Underground Laboratory (Modane, France) and thus are shielded with 4800 m of water equivalent.

The TGV spectrometer consists of 16 planar HP Ge detectors (Figure 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 in ordinary laboratory conditions in Dubna and since December 1993 - in underground conditions. The main goal of TGV 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 ^{48}Ca and some other nuclei.

The NEMO-2 spectrometer (Figure 2) consists of 1 m^3 tracking volume formed by 640 Geiger cells and of two 1×1 m^2 scintillator walls, each formed by 64 phoswich counters. The spectrometer is in operation since August 1991. In 1993 it was used during 2485 hours for the investigation of 2β decay of enriched ^{100}Mo (172g, 95%). In 1994-1995 this spectrometer will be used for the investigation of ^{96}Zr and ^{106}Cd.

The NEMO-2 is the prototype of the large NEMO-3 spectrometer which has been designed in 1993 (Figure 3) for the investigation of 10 kg of enriched ^{100}Mo. The Laboratory of Nuclear problems is charged to produce 1200 plastic scintillator detectors ($20\times20\times10$ cm^3) and the spectrometer frame of high-purity copper for this set-up. The spectrometer is planned to start its operation in 1996 in order to probe the effective Majorana neutrino mass down to 0.1 eV.

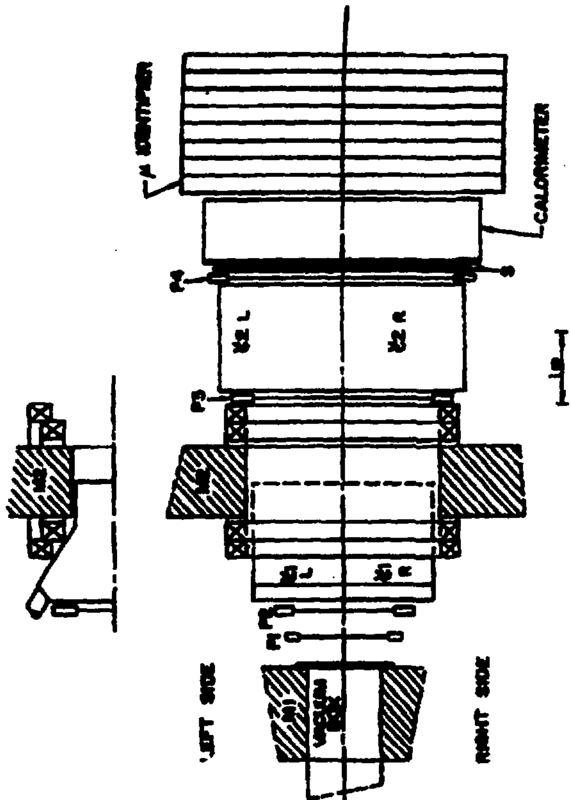


Figure: Experimental lay-out to search for $K^+ \to \pi^+\mu^+e^-$

05-2-0987-92/96

E-856	LNP-18
Status	Preparation

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

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

LNP, Dubna V.M.Artemov, D.V.Dedovich, E.V.Komissarov, V.S.Kurbatov, V.Z.Serdiuk, S.V.Yaschenko, B.Zh.Zalikhanov, A.I.Rudenko, S.M.Korenchenko, N.P.Kravchuk, A.S.Korenchenko

Leader:**M.Zeller** Leader from JINR: **B.Zh.Zalikhanov**

The search for the decay $K^+ \to \pi^+\mu^+e^-$ 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 ($R < 2.1^{-10}$) by a factor of ~ 70. Observation of this decay, which violates the lepton number conservation law, would indicate the presence of "new" physics beyond the standard model. The new value of the upper limit of the $K^+ \to \pi^+\mu^+e^-$ probability is planned to be achieved by a 7-fold increase in the kaon beam intensity, a 3-fold increase in the facility acceptance, a 2.3 times longer exposure, a 1.5 times better efficiency of hardware and software. In searching for the decay $K^+ \to \pi^+\mu^+e^-$ one will obtain about 50000 $K^+ \to \pi^+e^+e^-$ events, experimental data to measure the CP-violating component of μ^+ polarization in the decay $K^+ \to \pi^+\mu^+\mu^-$ at the magnitude level $\sim 10\%$, and the data to measure asymmetry related to CP violation in the decay $K^+ \to \pi^+\pi^+\pi^-$ to statistical accuracy of $\sim 10^{-5}$. The experiment is described in detail in the *Proposal to Perform an Improved Search for the Decay* $K^+ \to \pi^+\mu^+e^-$. The experimental lay-out is shown in the Figure. The upper level to be obtained for the relative probability of the decay $K^+ \to \pi^+\mu^+e^-$ is expected to be $\sim 3 \times 10^{-12}$ at the 90% confidence level.

The main contribution of the JINR is the creation of superfast wire chambers which are able to work with beam intensity $\simeq 2 \times 10^8 s^{-1}$ and have time resolution $\leq 5ns$. By including these chambers in the experiment we are sure to increase its selectivity considerably and to rise its information capability. During 1993 two prototypes of fast narrow gap chambers and 64 channels of special chamber electronics were developed and tested at PSI. The geometrical parameters of these chambers: wire pitch is 1mm, anode-cathode gap is $1mm$, sensitive area is $170 \times 280mm^2$, entry window area is $500 \times 500mm^2$, outer dimensions are $600 \times 650mm^2$.

Using intensive radioactive source Sr^{90} the rate capability 1.3×10^4 sec^{-1} mm^{-2} was obtained under gas amplification 5×10^4. Such a rate capability is not maximal because electrons from the source produce 2-3 times more ionization than minimal ionizing particles. The chamber efficiency under these conditions was 98%, time resolution 5 ns (FWHM) and 10 ns (FW0.1M). Front end electronics has the sensitivity 2×10^4 electrons at the registration threshold 50 mV and the capability of separating the signals piled up within the time interval 8 - 10 ns.

In 1994 two four-coordinate chambers and 256 channels of front electronics will be made. Both the chambers and the electronics will be tested in an intense beam of the PSI accelerator in October. In 1995 2000 channels of electronics and 5 stations-repeaters of signals should be made. They are intended for transmitting short signals (8 – 10) ns at a distance of 110 m and restoring their shapes. At the end of the year all the apparatus should be installed at the BNL accelerator.

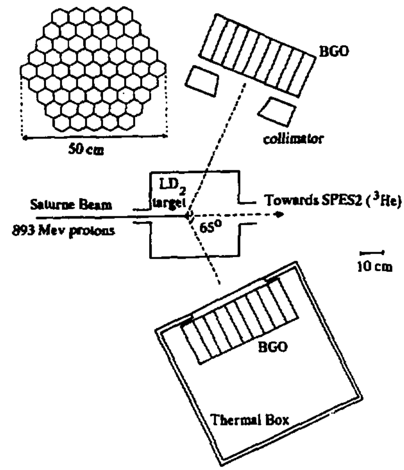


Figure 1: Schematic view of the array of 61 BGO counters and of the experimental set-up.

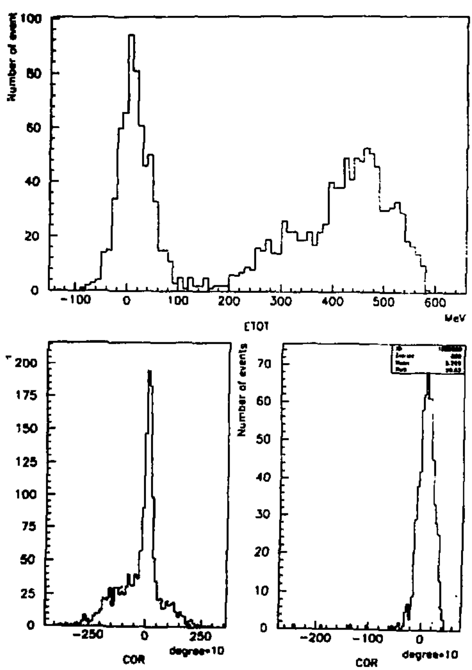


Figure 2: Photon spectra obtained

05-2-0987-92/96

E-258, Saclay	LNP-19
Status	Data-Analysis

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

LNP JINR, Dubna; SPhN, Saclay; LNS Saclay; UCLA; France; PSI, Switzerland; TRIUNF, Canada; George Washington University, USA; PNPI, St Peterburg, Russia

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.

Leaders: **M.Garcon, M.Clajus** Leader from JINR: **L.Lytkin**

The data were obtained at LNS Saclay in experiment 258 (see Figure 1). 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 Figure 2).

The maximal systematic uncertainty is given by an uncertainty in the acceptance for the gammas and will be evaluated from the data to be taken with the active collimator.

The variations of acceptance with beam parameters are:
- with beam energy and beam spread $< 0,1\%/100$ keV,
- with horizontal beam position and angle $< 0,2\%/mm$ and $0,1\%$/mrad.

The uncertainty in the electronics efficiency is:
trigger efficiency: 0,9998±0,00015,
- invalid bit patterns $< 0,002$ – systematic uncertainty in BR,
- missing TDC or low ADC $< 0,003$ – systematic uncertainty in BR.

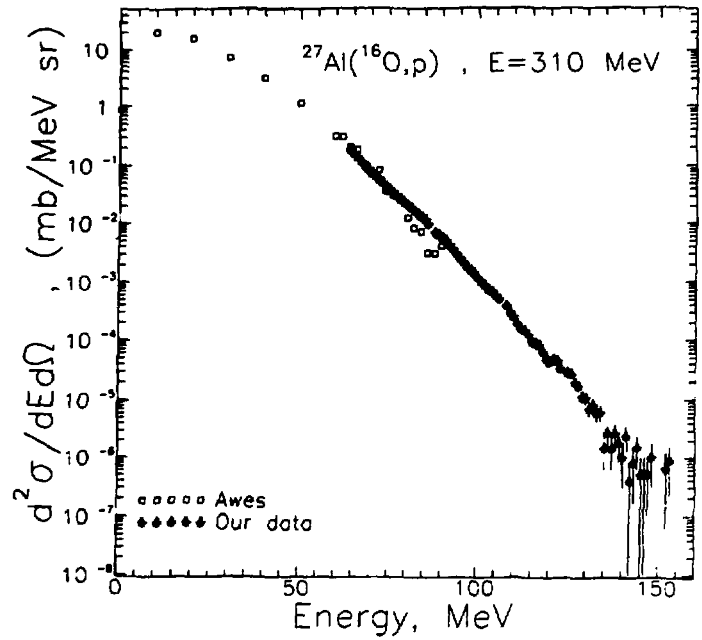


Figure 1: Measured proton spectrum from the reaction $^{27}Al(^{16}O,p)$ at $\theta_{lab} = 30°$ and incident energy of 310 MeV compared with the data from T.C.Awes et al. Phys.Rev. C25 (1982) 2361.

05-2-0987-92/96

LNP-20
Status Data-Taking

Production of subthreshold pions and high energy light fragments in nucleus-nucleus collisions at heavy ion accelerators of the Laboratory of Nuclear Reaction of JINR

LNP, 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
FLNR, 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

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

The investigation of pion production in nucleus-nucleus collisions at deeply subthreshold energies of a few tens of MeV per nucleon and the problem of high-energy light particle emission in nucleus-nucleus collisions at low energies are of significant interest. The data to be obtained will allow an advance in understanding dynamics of these processes, the role of coherent and incoherent mechanisms and the role of multinucleon correlations in nuclei.

Operation of a new heavy ion cyclotron U400M at the Flerov Laboratory of Nuclear Reactions provide a good opportunity to study subthreshold pion production and emission of high-energy light particles.

For effective utilization of accelerator capabilities a multipurpose installation based on a multilayer semiconductor and a scintillation telescope spectrometer will be used. For the correlation measurements we are planning to use the 4π spectrometer BGO ball from LAMPF.

In 1993 preparation of the magnetic channel, scattering chambers for telescopes and BGO ball, electronics for scintillation and semiconductor spectrometers was underway.

As the first stage of the experimental program and feasibility test the light particle spectra from the $^{16}O + ^{27}Al$ collision at two incident energies 210 and 310 MeV have been measured. The Figure shows measured proton spectrum at $\theta_{lab} = 30°$ for incident energy of 310 MeV. These first measurements demonstrate that we can see protons up to 150 MeV. The previous measurements of the proton spectrum for the same reactions extended only to 90 MeV.

In 1994 pion production and light particle emission will be measured with the BGO ball and scintillation telescope. The semiconductor telescope construction will be continued.

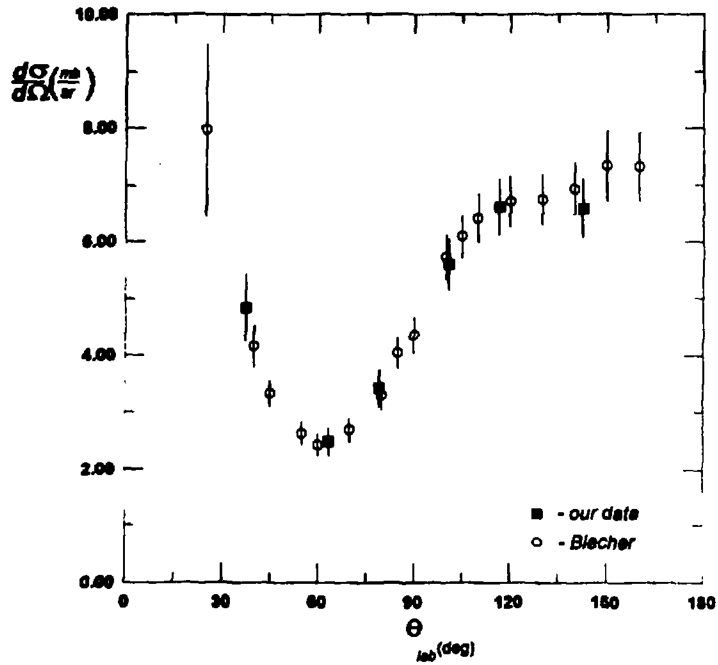


Figure 1: Measured angular distribution for $\pi^{+}C$ elastic scattering for pion energy of 40 MeV compared with the data from M.Blecher et al. Phys.Rev. C20 (1979) 1884.

05-2-0987-92/96

LNP-21
Status Data Analysis Preparation

Study of low energy pion-nucleus interaction

LNP JINR, Dubna; Moscow Physical Engineering Institute; Institute for Nuclear Research, Troitsk, Russia; Los Alamos National Laboratory; Arisona State University, Arizona; Rutgers 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
MEPI, Moscow	M.Gornov
INR, Troitsk	A.Kurepin
LAMPF, Los Alamos	C.Morris
ASU, Arizona	B.Ritchie
Rutgers Univ.	R.Ransome

Leader from JINR: **K. Oganesyan**

Program includes study of low energy pion absorption, pion production by pions, pionic charge exchange reactions and pion-nucleus elastic scattering at LAMPF. The program is important because non-nucleonic degrees of freedom in nuclei may manifest themselves in these processes.

The data were obtained at the LAMPF LEP channel in the following experiments.

1. E1275 "Study of $\pi^+ d \rightarrow 2p$ reaction at pion energies 20 - 50 MeV". The high accuracy measurements of differential and total cross sections of pion absorption on deuterium and carbon has been done with a minimal step in incident energy. Cross sections of π^+ elastic scattering on d and ^{12}C have been measured simultaneously. The Figure illustrates the data obtained.

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

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 the pionic atom.

4. E1282 "Measurement of neutron-neutron scattering length and effective range in reaction $d(\pi^-, nn)\gamma$". The experimental setup included a liquid scintillator neutron detector array and one arm of the new NMS spectrometer for γ detection.

The preparation of experiment E1284 "Study of the reaction $\pi^{\pm} + ^4He \rightarrow \pi^{\mp} + 4p(n)$ at pion energies 60 - 120 MeV" is underway.

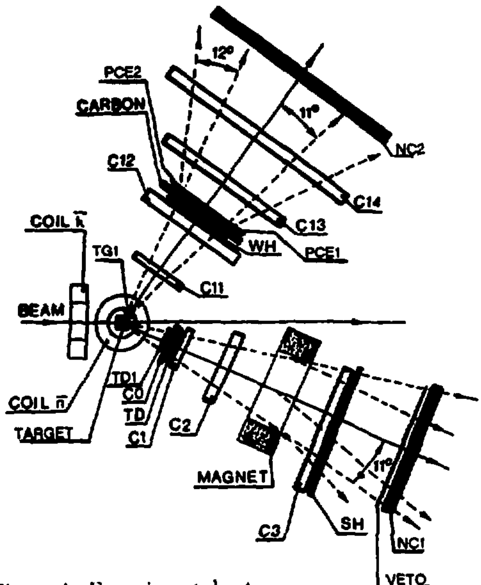
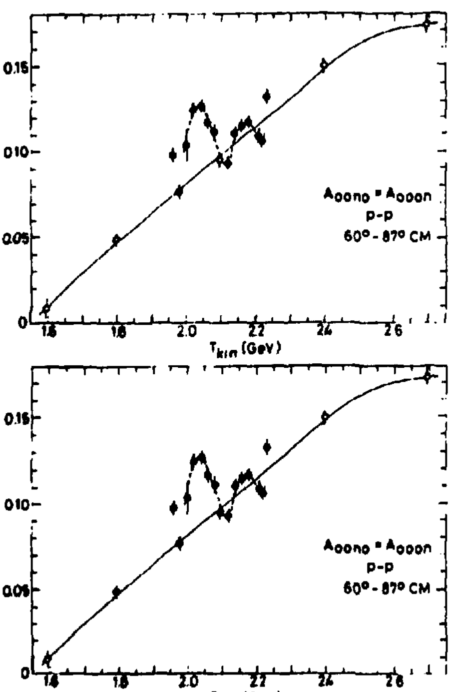


Figure 1: Experimental set up



Figures 2: The energy dependence of A_{oono}(pp) at angels of 60°-87° and 90° in c.m.s

02-2-0982-92/96

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, CE Saclay; DAPNIA, CE 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, Ilinois	H.Spinka et al.
DPNC Univ., Geneve	R.Hess et al.

Leader: **J. Ball** Leader from JINR: **B. Khachaturov**

The *Nucleon-Nucleon program performed on the SATURN II polarized beam includes* measurements of observables allowing the direct reconstruction of elastic scattering matrix elements. This matrix determines the transition from the initial to final state as a function of energies and scattering angles for all initial and final spin states. The first part of the program was dedicated to pp elastic scattering between 0.83 and 2.7 GeV, the second one to np elastic scattering below 1.1 GeV. The third part, started in 1992, concerns pn scattering between 1.1 and 2.7 GeV. It uses a polarized deuteron target which is considered as a neutron and a proton targets. This part also includes a check of evidence for a possible structure, observed in the final analysis of the first part of the program. The experimental set up is shown in Figure 1.

The first runs were used to search for a structure around T_{kin}=2.1 GeV. The measurement of spin dependent observables in pp-elastic scattering (analyzing power A_{oono} = A_{ooon}, spin correlation observable A_{oonn}, depolarization D_{onon}, and polarization transfer K_{onno}) were made in the angular region from 58° to 97° at 14 energies.

The results obtained for pp-elastic scattering analyzing power show strong energy dependent behaviour around T_{kin}= 2.1 GeV. The energy dependence of A_{oono}(pp) at fixed angles in c.m.s has two narrow maxima on either side of 2.11 GeV (Figure 2, for example).

The energy dependence of spin correlation parameter $A_{oonn}(90°)$ shows rapid decrease in the energy interval from 2.06 up to 2.16 GeV. All measured observables are in excellent agreement with the previous SATURN II data.

The observed narrow structure in the energy dependence of analyzing powers and spin correlation are an experimental indication of a possible narrow resonance in pp-interaction.

However, additional measurements are still needed to remeasure the A_{oono}, A_{ooon} and A_{oonn} data around 1.80 2.04, 2.10, 2.20, 2.24 and to perform new measurements at 2.35, 2.55 and 2.60 GeV, to use the new neutron counter hodoscope on the left-hand arm of our array, to use the fast fiber hodoscope acquisition (UCLA group) during a part of the time, if the corresponding hodoscopes are correctly tested in November 1993 and if they are compatible with the experimental set-up. The measurements proposed above would add new important evidence to our previous observations.

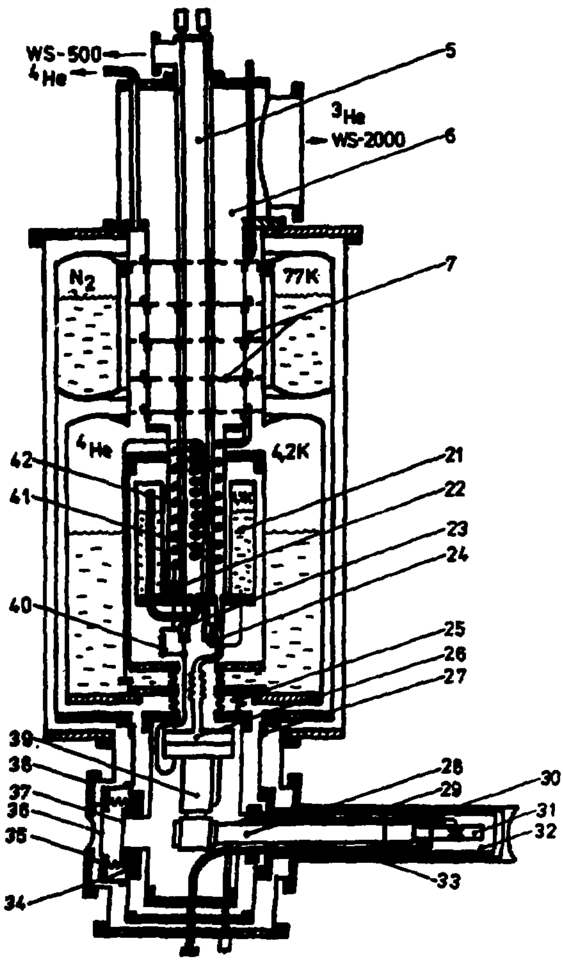


Figure 1.
Schematic view of the vertical cryoctat of $^3He/^4He$ dilution refrigerator. (22 - condenser; 23,24 - needle valves; 26 - ^3He still; 28 - main heat exchanger; 29 - NMR cable; 30 - microwave choke; 31 - mixing chamber (target); 32 - microwave covity; 35,36,37 - covers; 39 - preliminary heat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

02-2-0982-92/96

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
KHIPT, Kharkov	A.A.Lukhanin
Charles Univ., Prague	I.Wilhelm, Z.Dolezal at al.

Leader from JINR: **Yu.A.Usov**

The study of spin dependence of *np* scattering amplitudes represents an interesting problem concerning NN interaction. Two different models of interaction potentials exist at present time (usually called Paris and Bonn potentials) for describing the process in the frame of the phase - shift analysis. With respect to the fact that the spin dependence substantially differs in these two models, it is necessary to complement the experimental data. For this reason the proposal for experimental research of elastic scattering of polarized neutrons from polarized protons was specified. A polarized neutron beam is based on Van de Graaff accelerator of the Nuclear Centre Charles University (Prague) using $d + {}^3H \rightarrow {}^4He + n$ reaction at deuteron energy about 2 MeV. The transverse polarization of the neutron beam at $\theta_{lab} \simeq 60°$ is about 18% at energy of neutrons about 16 MeV.

The polarized sample is a cylinder volume of 60 mm long and 20 mm in diameter. The maximum degree of polarization obtained with the dynamic method is $\simeq 95 \pm 3\%$. It is maintained at temperature about 20 mK in 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 $\Delta\sigma_l$, at present the experimental data are processed.

In accordance with results obtained after processing, the program of further research will be specified. In 1994 there are plans to begin the measurements of the parameter $\Delta\sigma_t$ at E_n=16,3 MeV.

Target orientation	$\hat{k}$	$\hat{s}$	$\hat{s}$	$\hat{n}$	$\hat{n}$	$\hat{n}$	o	o	o
Beam orientation	$\hat{k}$	$\hat{k}$	$\hat{s}$	$\hat{s}$	$\hat{n}$	$\hat{k}$	$\hat{s}$	$\hat{n}$	$\hat{k}$
No re-scattering	A_{ookk}	A_{ooks}	A_{ooss}		A_{oonn}			A_{oono}	
With re-scattering of recoil proton in the polarimeter				K_{osso} K_{ossn}	K_{onno} D_{onon} $P(\equiv A)$	K_{osko} N_{oskn}	K_{osso} K_{okso}	K_{onno} $P(\equiv A)$	K_{osko} K_{okko}

Table 1: **List of spin observables to measure.** We used a four index notation, X_{drfc}, which refers to scattered (d), recoil (r), beam (f) and target (c) spin orientations. Each index can take either value k, n, s or o according to the particle polarization orientation. The direction $\hat{k}$ is defined as being along the particle trajectory, $\hat{n}$ along the normal to the scattering plane, and $\hat{s}$ orthogonal to the other two axes ($\hat{n} \times \hat{k}$). o means either unpolarized or the particle polarization is not observed.

03-0-0941-91/95

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

Measurement of spin observables in neutron-proton elastic scattering

LNP JINR, Dubna; University of Freiburg/Br; DPNC University of Geneva; PSI, Villigen; Charles University, Prague; DAPNIA CEN, Saclay

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

Leader from JINR: **M. Finger**

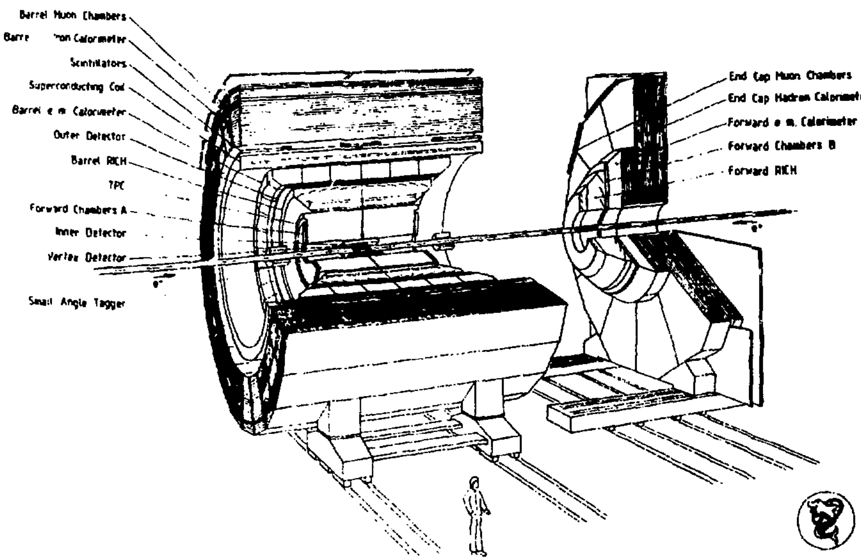
The experimental programme to measure spin observables in neutron-proton elastic scattering between 250 MeV- 580 MeV was proposed and approved to be realized at the accelerator complex of the Paul Sherrer Institute - PSI experiment R-87-12.

The new NA2 polarized neutron beam line was successfully set up at PSI. This very intense polarized neutron beam, created by the charge ex change reaction $C(\vec{p},\vec{n})X$ at O°, has unique features: (1) continuous energy between 250 MeV - 580 MeV; (2) average polarization 35% - 45% with all possible orientations $(\hat{s},\hat{n},\hat{k})$; (3) intensity $\sim 5\times10^6$ $\vec{n}/s.cm^2$ at 12m from the production target using accelerated polarized proton beam of very high intensity $\sim 10\ \mu A$. The energy of the incoming polarized neutrons is measured by time-of-flight between the start signal in one of the recoil proton counters and the rf-signal of the accelerator operated in the 17 MHz and 50MHz mode.

The experimental layout has two target stations working simultaneously. The first one is equipped with a frozen spin polarized proton target, volume $4\times4\times4$ cm^3, operated at 2.5 T polarizing and 0.5 T - 0.8 T holding magnetic field, and temperature ~ 50 mK obtained by the ^3He - ^4He dilution refrigerator. An average polarization is 80% - 90%. The orientations $\hat{n}$ and $\hat{k}$ of the target proton polarization are possible. Unpolarized CH_2 and C targets are also used this position. The scattered neutrons are detected by a hodoscope, the polarization of the recoil protons is measured in a polarimeter involving an array of Charpak chambers. The second experimental target set-up has LH_2 target and is used to observe new spin parameters where the longitudinal polarization of recoil protons is analyzed.

The spin observables shown in the Table are expected to be measured in elastic np scattering between 250 MeV - 580 MeV, ranging from 90° to 160°. This will allow one to reconstruct 5 complex amplitudes of the nucleon - nucleon system with isospin T = 0.

Experiments on High Energy Physics



The DELPHI Detector

02-0-0907-91/95

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 INP, 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.

Leader: **J.-E.Augustin** Leader from JINR: **A.Olshevski**

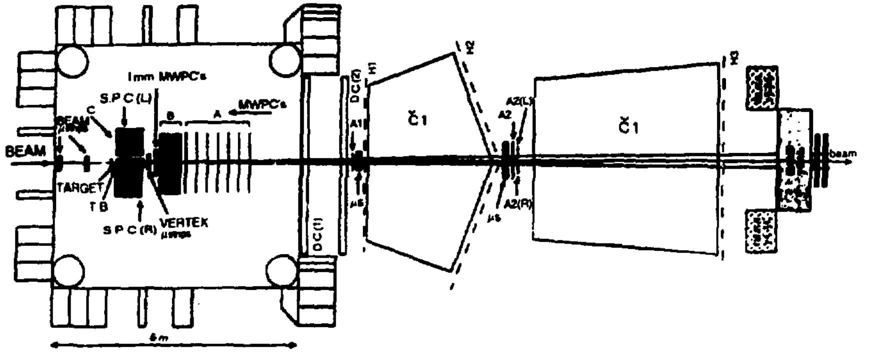
DELPHI is a general-purpose detector for physics at LEP on and above the Z^0, offering three-dimensional information on curvature and energy deposition with fine spatial granularity as well as identification of leptons and hadrons over most of the solid angle. A superconducting coil provides a 1.2 T solenoidal field of high uniformity. Tracking relies on the inner detector, the Time Projection Chamber (TPC), the outer detector and forward drift chambers. Electromagnetic showers are measured in a barrel with high granularity by the High Density Projection Chamber (HPC) and in endcaps by 1° × 1° projective towers composed of lead glass as active material and photodiode read-out. Hadron identification is provided mainly by liquid and gas Ring Imaging Cherenkov Counters (RICH). The segmented magnet yoke serves for hadron calorimetry and as a filter for muons, which are identified in two drift chamber layers. In addition, scintillator systems are implemented in the barrel and forward regions, as well as a Small Angle Tagger (SAT) for luminosity determination and a 3-layer micro vertex silicon detector for high precision vertex and lifetime measurements.

During the three years of LEP operation the DELPHI detector has been running under stable conditions providing the data for precise Z-boson physics. For the moment a number of important results concerning the electroweak theory, QCD studies, b-quark physics as well as some others have been obtained by the DELPHI collaboration. JINR has made a significant contribution to the construction and maintaining of the DELPHI hadron calorimeter, the development of the DELPHI software and on both experimental and theoretical aspects of the physics analysis. About 20000 streamer tubes were produced at the JINR for DELPHI Hadron Calorimeter and at present Dubna is maintaining hardware and software of this detector.

In 1993 the area of physics analysis the JINR group works on involves 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, the measurements of the photon structure function and 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.

Ω LAYOUT FOR WA91 (1994 RUN)



Ω LAYOUT FOR WA91 (1995)

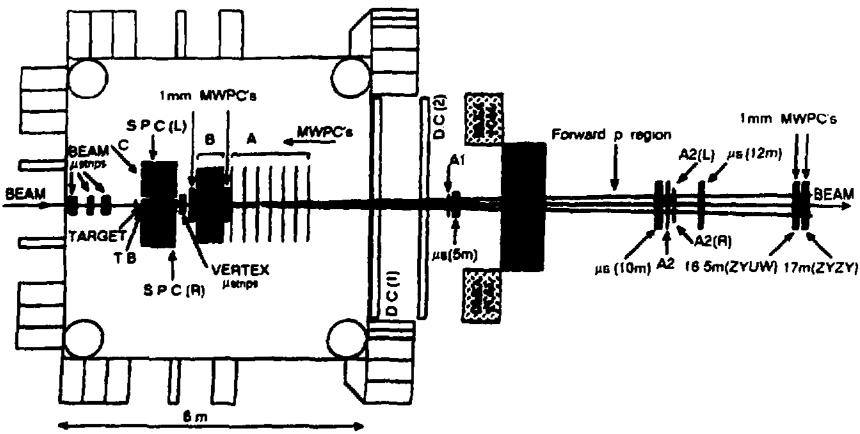


Figure: Proposed layout for 1994 and 1995

02-2-0982-92/96

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

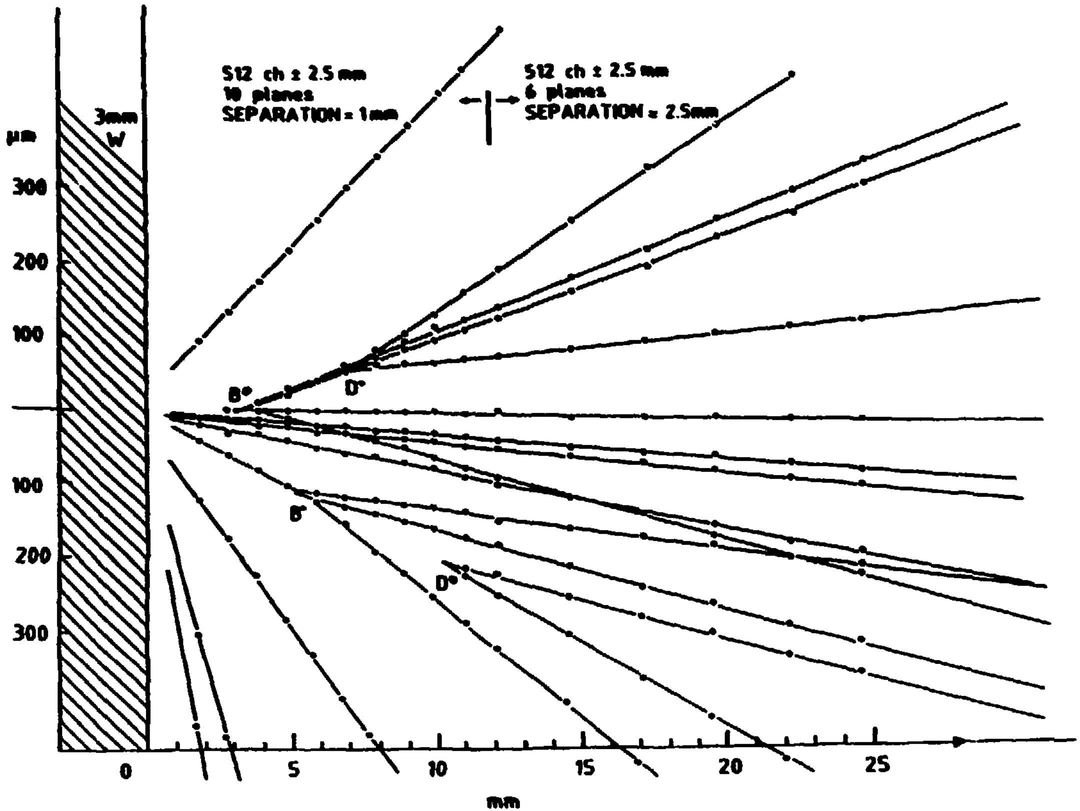
LNP JINR, Dubna; Athens University; Bari University/INFN; Birmingham University; CERN, Geneva; Paris College de France

LNP, Dubna	Kulchitsky Yu., 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.

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

The aim of this experiment is to search for non–$q\bar{q}$ mesons produced in the central region in the reaction $pp \to p_f(X^\circ)p_s$ at 450 GeV/c, where the subscripts f and s indicate the fastest and slowest particles in the laboratory respectively and X° represents the central system that is presumed to be produced by double exchange processes. The state X° will be studied in many decay modes, e.g. $\pi^+\pi^-$, $\pi^+\pi^-\pi^\circ$, $2\pi^+2\pi^-$, $2\pi^+2\pi^-\pi^\circ$, $\eta\pi^+\pi^-$, $\omega\pi^+\pi^-$, K^+K^-, $K^+K^-\pi^\circ$, $K^\circ_sK^+\pi^-$, $K^+K^-\pi^+\pi^-$, $2K^+2K^-$, $K^\circ_sK^\circ_s$, $K^\circ_sK^\circ_s\pi^\circ$, $\eta\eta$, etc. in two runs. The first run was optimised for the detection of states decaying to charged particles and neutrals with no charged particle identification and the second one with two Cherenkov counters included. The aim is to collect at least 10 times the statistics of the previous WA76 experiment which should allow us to confirm the states observed in the lower energy runs of the WA76 experiment and to search for new states. Data taking will be completed in 1994.

The experiment uses the Omega Spectrometer facility with a trigger designed to enhance central meson production over diffractive reactions. The momentum of the fast particle with $x_F > 0.9$ is measured by a system of μ-strip detectors, and the γ's are detected using the OLGA lead glass calorimeter.



Experiment WA92: Measurement of Beauty Particle Lifetimes and Hadroproduction Cross-Section

02-2-0982-92/96

WA92 LNP-27
Status Data-Analysis

Measurement of beauty particle lifetimes and hadroproduction cross-section

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

LNP, Dubna	Kulchitsky Yu., 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., French 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., Nisatti 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 Univ.	McEwen J.G.

Leader: **Rossi L.** Leader from JINR: **Russakovich N.**

WA92 is for the experimental search for beauty particles produced in fixed target hadronic interactions. The essential feature of the proposed experimental technique is the use of two specially designed pieces of hardware a high precision "decay detector" and a fast secondary vertex trigger processor. If these devices come up to our expectations, we should be able to obtain a sufficient data sample to address several important physics issues, including measurements of the lifetime of charged and neutral B mesons, the B hadroproduction cross section, and possibly $B^{\circ} - \bar{B}^{\circ}$ mixing.

The first results will be presented at the 27th International Conference on High Energy Physics in Glasgow (July 1994).

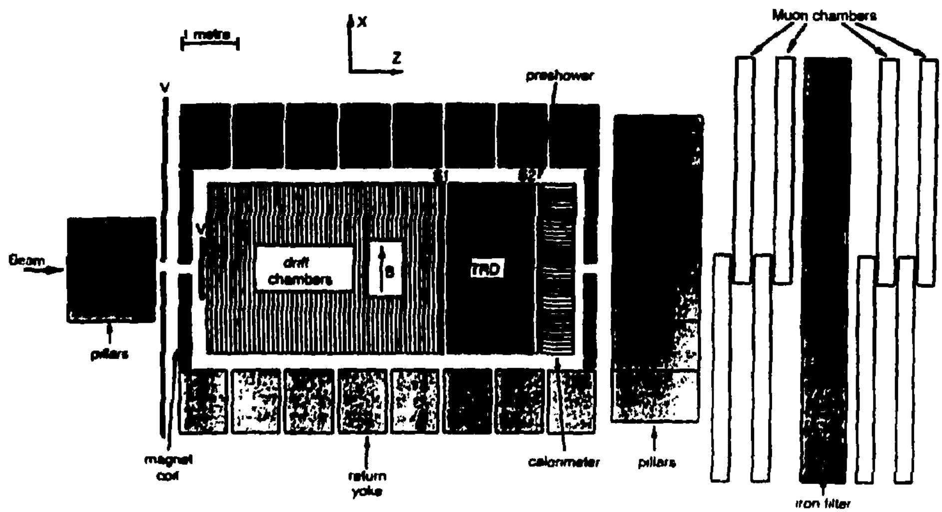


Figure: The schematic view of NOMAD detector

02-2-0982-92/96

NOMAD, WA-96	LNP-28
Status	Data-Taking

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

LNP JINR Dubna; Annecy LAPP; Calabria Univ.; CERN; Dortmund Univ.; Florence Univ./INFN; Harvard Univ.; Johns Hopkins Univ.; Lausanne Univ.; Melbourne Univ.; Univ. of Michigan; Moscow INR; Padova Univ./INFN; Paris VI and VII Univ.; Pavia Univ./INFN; Pisa Univ./INFN; Saclay CEN DPhPE; Univ. of Sydney; Zagreb Rudjer Boskovic Inst.

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

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

The experiment searches for the oscillation $\nu_\mu \leftrightarrow \nu_\tau$ in the CERN wide-band neutrino beam. It aims at detecting ν_τ charged current interactions by observing the production of the τ lepton through its various decay modes by means of kinematical criteria. A sensitivity of $\sin^2 2\theta < 3.8 \times 10^{-4}$ at the 90% confidence level can be achieved with exposure of the target with 2.4×10^{19} protons of the wide band neutrino beam of the SPS.

The detector reconstructs the event kinematics and identifies electrons, muons and photons. It uses the UA1 magnet. The target consists of 145 drift chambers, each 2.2 X thick, with a total mass of 2.9 tons over a fiducial volume of 2.6×2.6 m^2. It is followed by transition radiation detectors and an electromagnetic calorimeter which includes a preshower detector. The muons are identified after the return-yoke of the magnet.

The JINR will take part in off-line and on-line programs, in testing the experimental set-up, participate in accelerator runs, in data handling and physical analysis of the data; supply the xenon gas of high purity for the TRD detectors for a total amount of 10 m^3.

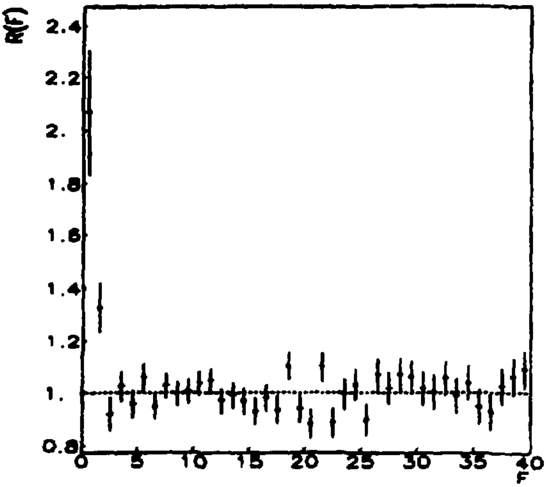


Figure 1. The ratio of the experimental distribution of $\pi^+\pi^-$ pairs to the approximating distribution versus $F = \sqrt{\left(\frac{Q_x}{\sigma_x}\right)^2 + \left(\frac{Q_y}{\sigma_y}\right)^2 + \left(\frac{Q_z}{\sigma_z}\right)^2}$. Here Q_x, Q_y and Q_z are components of the relative momentum of pions and σ_x, σ_y and σ_z are values of experimental precision of the respective components.

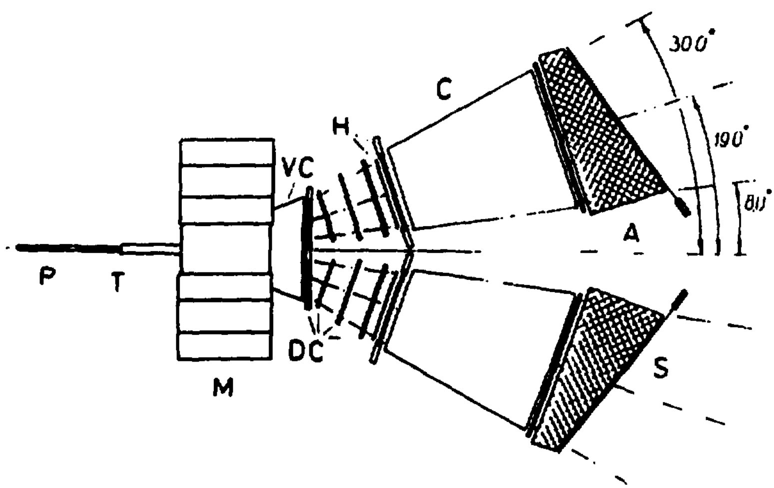


Figure 2. The setup of the experiment planned at PS CERN: P - proton beam, T - target, M - spectrometer magnet, VC - vacuum chamber, DC - drift chambers, H - scintillation hodoscopes, C - Cherenkov gas counters, A - cast-iron absorber, S - scintillation counters.

02-2-0982-92/96

LNP-29
Status Proposal

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

LNP JINR, Dubna; Institute for Nuclear Physics, Moscow State University, Russia; CERN, Geneva; College de France, Paris; IN2P3, Grenoble, France; INFN, Frascati, Italy; University of Bern, Switzerland

LNP, Dubna	L.G.Afanasyev, O.E.Gorchakov, V.V.Karpukhin, V.I.Komarov, V.V.Kruglov, A.V.Kuptsov, L.L.Nemenov, M.V.Nikitin, V.G.Olshevski, Zh.P.Pustylnik, A.V.Selikov, A.V.Tarasov
LCTA, Dubna	P.G.Akishin, A.S.Chvyrov, L.Yu.Kruglova, P.V.Zrelov
INP, MSU	N.A.Kalinina, A.V.Kulikov, S.V.Trusov, V.V.Yazkov
College de France	M.Benayoun, J.L.Narjoux, Ph.Leruste, M.Sene, R.Sene
CERN, Geneva	M.Doser, L.Montanet
IN2P3, Grenoble	M.Ray-Compagnolle
INFN, Frascati	P.Gianotti, C.Guaraldo, A.Lanaro, V.Lucherini
Univ., Bern	G.Czapek, F.Dittus, D.Frei, K.Pretzl, U.Moser, J.Schacher

Leader: **L.L.Nemenov**

In the experiment at Serpukhov 272 ± 49 atoms consisting of π^+ and π^- mesons were observed. The atoms were produced in a Ta target by 70 GeV protons and $\pi^+\pi^-$ pairs were detected from the atom break-up in the same target. The ratio of the experimental distribution of $\pi^+\pi^-$-pairs in relative momentum to the approximating distribution is shown in Figure 1. The deviation of the ratio from unity in the first two bins is due to extra pairs originating from ionization of $(\pi^+\pi^-)$ atoms in the target material.

The results obtained justify plans for an experiment to measure the $(\pi^+\pi^-)$ atom lifetime that makes it possible to determine $\pi\pi$ scattering lengths with precision of 5% and so to test crucially chiral symmetry breaking.

In March 1993 the CERN SPSLC approved the Letter of Intent. In the first half of 1994 we will finish preparation of a Proposal for the experiment on an external proton beam at the PS CERN and by June 1994 it will be submitted to the SPSLC. The setup of the experiment planned is shown in Figure 2. The project of the beam line, the experimental area and the beam dump is already designed by PS Division.

The pairs from $(\pi^+\pi^-)$ atom break-up will be detected against a background of free $\pi^+\pi^-$ pairs strongly affected by Coulomb interaction in the final state. The yield of the "atomic" pairs depends on the $(\pi^+\pi^-)$ atom lifetime.

Analysis of the Coulomb interaction effect in a $\pi^+\pi^-$ system will also allow obtaining the relative number of $\pi^+\pi^-$ pairs from short-lived $(\rho, \omega, \phi \ldots)$ and long-lived sources $(\eta, K^0_s \ldots)$.

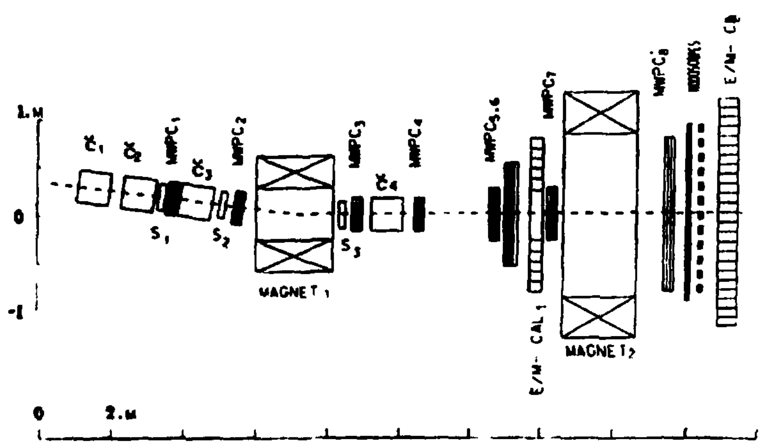


Figure: The layout of detector "Hyperon" at Serpukhov accelerator U-70

02-2-0982-92/96

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, Pavia, Italy; University, Sofia Bulgaria; IEF, Koshice; University, Koshice; IP, Bratislava, Slovakia; IP, Minsk; NC PPHE at Minsk University; University, Gomel, Belarus

LNP, Dubna	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, V.S.Rumyantsev, 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., Pavia	S.Ratti, G.Introzzi
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
Univ., Minsk	N.M.Shumeiko
IP, Minsk	Yu.A.Kulchicky, A.S.Kurilin
Univ., Gomel	G.A.Ivanov

Leader :**V.B. Flyagin**

The main goal of the experiment (it is performed on secondary beam of U-70 accelerator, IHEP) is a search for and study of the structure-dependent part of γ-radiation in K^+ semi-leptonic and non-leptonic decays such as

$$K^+ \to \pi^+\pi^0\gamma, \quad 3\pi\gamma, \quad \pi^0 e^+\nu\gamma.$$

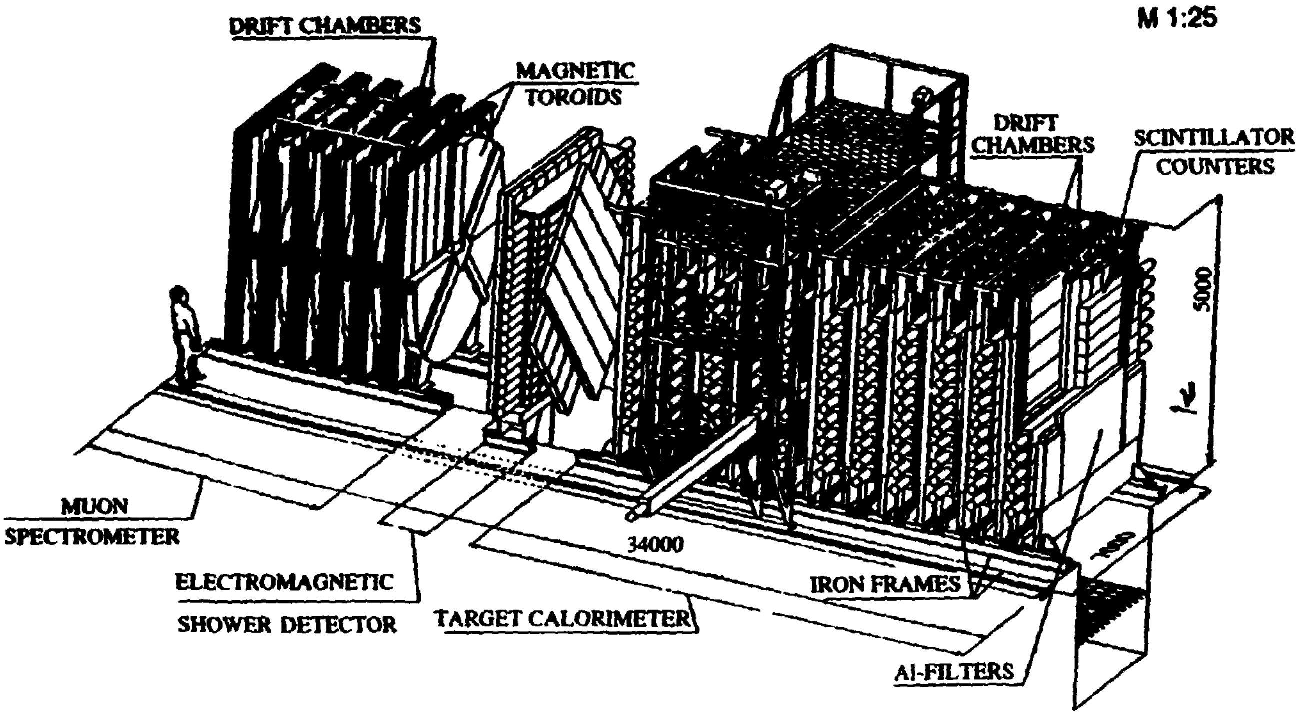
The direct emission part of γ-rays is of special interest; it contains information on internal dynamics and particle structure.

Within the same data taking K_{e4}-form factors and $K^+ \to 3\pi$ decays, which are also of interest, will be studied.

Our precise data on K_{e3}- form factors are already published in the Review of Particle Properties 1992.

Additional possibility provided by the same set-up is studying rare K^0- decays. In 1993 we published the best estimation of the limit on $Br(K_s^0 \to e^+e^-)$. In 1994 the matrix elements for $K^+ \to \pi^+\pi^0\pi^0$ decay, in which new theoretical interest has arisen recently, will be evaluated.

NEUTRINO DETECTOR



02-2-0982-92/96

SERP-136	LNP-31
Status	Data-Taking

Search for electron neutrino oscillations and investigation of muon neutrino-nucleon interactions at the IHEP–JINR Neutrino Detector

JINR, Dubna; IHEP, Serpukhov, Russia

LNP, Dubna	L.Barabash, Yu.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

Leader from JINR: **S. Bunyatov** Leader from IHEP: **A. Vovenko**

The new $\nu_e \rightarrow \nu_x$ 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 this beam. According to the proposal, the possibility of $\nu_e \rightarrow \nu_x$ 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 till March 6 1993 the first accelerator run was carried out. The total number of protons on the target was $1.4 \cdot 10^{18}$. The DST tape was prepared. The events corresponding to $\tilde{\nu}_e + N \rightarrow e^{\pm} + X$ reactions were reconstructed. The experimental data are analyzed with the aim to search for $\nu_e \rightarrow \nu_x$ oscillation. At the same time the data analysis of $\nu_\mu + N \rightarrow \mu^- + X$ and $\tilde{\nu}_\mu + N \rightarrow \mu^+ + X$ interactions for the $\sigma(\tilde{\nu}_\mu)\,/\,\sigma(\nu_\mu)$ ratio determination in the energy range 2–30 GeV will be carried out.

Two additional month's runs of the accelerator are necessary in 1994.

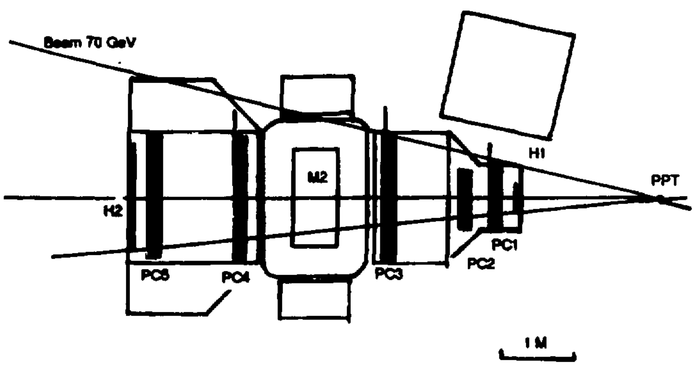


Figure: Set-up RPS NEPTUN at 70 GeV proton beam U-70.

02-2-0982-92/96

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; Moscow State University, 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.

Leader from LNP 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-hydrogen 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 a 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:

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

In 1993 the following results were obtained:

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

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

Photomultipliers PTM-85 were bought to construct RICH.

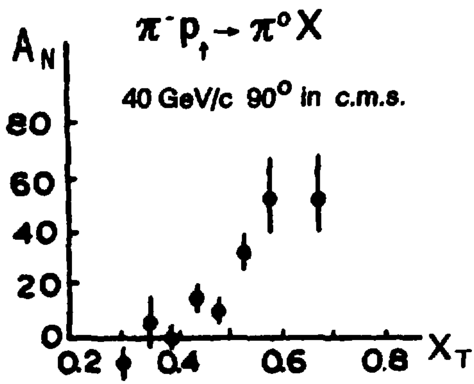


Figure 1: Single-spin asymmetry A_N in the reaction $\pi^- p_\uparrow \to \pi^0 X$ at 90°

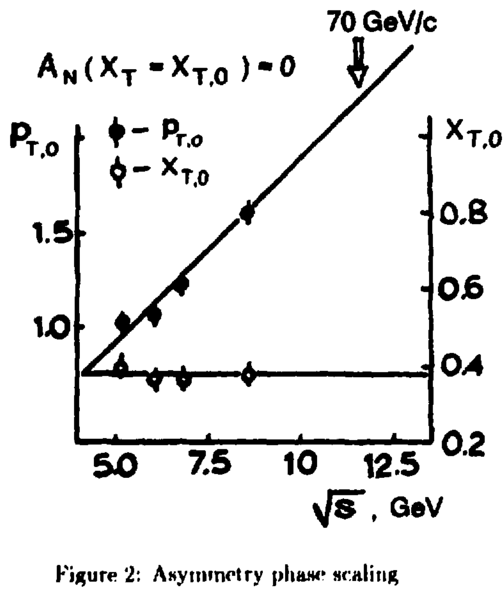


Figure 2: Asymmetry phase scaling

02-2-0982-92/96

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

Measurement of single-spin asymmetry A_N in the reaction $pp_\uparrow \to \pi^0 X$ at 90° in the c.m.s at 70 GeV/c

LNP JINR, Dubna; IHEP, Protvino, Russia

LNP, Dubna N.Borisov, E.Bunyatova, Yu.Kazarinov, B.Khachaturov, M.Liburg, V.Matafonov, A.Neganov, I.Pisarev, Yu.Plis, O.Schevelev, Yu.Usov

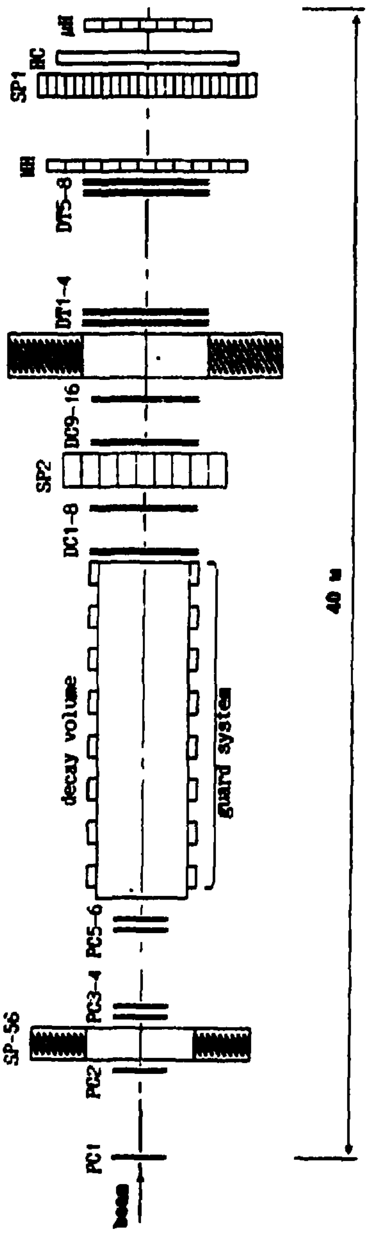
IHEP, Protvino V.Apokin, Yu.Arestov, N.Belikov, O.Bujanov, B.Chujko, A.Davidenko, A.Derevschikov, O.Grachev, V.Grishin, Yu.Kharlov, I.Kotov, Yu.Matulenko, V.Medvedev, A.Meschanin, V.Mochalov, A.Mysnick, S.Nurushev, D.Patalakha, A.Polyarush, A.Prudkoglyad, V.Rykov, V.Sergeev, K.Shestermanov, V.Solovianov, L.Soloviev, A.Ufimtsev, A.Vasiliev

Leader: **A.Vasiliev** Leader from JINR: **Yu. Usov**

Recently single-spin asymmetry A_N has been measured in the reaction $\pi^- p_\uparrow \to \pi^0 X$ at 90° in the c.m.s at 40 GeV/c (see Figure 1). On the basis of the low energy data it was supposed that single-spin asymmetries at different energies exhibit similar behaviour as a function of $x_T = 2p_T/\sqrt{s}$ (see Figure 2). This phenomenon was called the *Asymmetry phase scaling*. But the energy range was too narrow (between 13 and 40 GeV) to make a firm conclusion about the existence of this effect.

The current experiment presents a unique opportunity to increase almost twice the energy range of the phenomenon described above. We intend to measure single-spin asymmetry in inclusive π^0-production at large transverse momenta in the central region of interactions of 70 GeV protons on transversely polarized protons. We plan to carry out this experiment at the 70-GeV Protvino accelerator. A beam will be extracted from the accelerator by means of a bent crystal installed into the vacuum tube of the U-70. A frozen propane-diol polarized target will be used. Energies and coordinates of showers from π^0-meson decays will be measured by two identical lead glass calorimeters. The first accelerator run was carried out in February 1993. The second and third runs are expected to be in 1994 and 1995 years.

The Layout of ISTRA-M setup



05-2-0987-92/96

ISTRA-M	LNP-41
Status	Data-Taking

Study of rare K^- - decays on ISTRA-M setup

LNP, LCTA JINR, Dubna; INR RAS, Troizk, Russia; Yerevan Physical Institute, Yerevan, Armenia

LNP, Dubna	V.M.Artemov, E.M.Komissarov, V.S.Kurbatov, V.Z.Serdiuk, V.V.Sidorkin, A.D.Volkov, S.V.Yaschenko, B.G.Zalikhanov
LCTA, Dubna	G.A.Emel'yanenko, I.N.Silin
INR, Troizk	V.M.Bolotov,V.V.Isakov, E.Gushin, V.N.Marin, Yu.Musienko, A.A.Poblaguev,Postoev V.E.
YerPI, Yerevan	A.V.Voskanian, A.O.Gasparian, A.G.Ketikian

Leader: **B.G.Zalikhanov, V.S. Kurbatov**

The main goal of the experiment :

1. The measurement of structure-dependent radiation in the $K^- \to \ell\nu\gamma$ ($\ell = e, \mu$) decay.
2. The study of rare radiative K^- - meson decays at a new qualitative level and with higher statistics.
3. The search for new K^- - decays (for example $K^- \to \pi^-\gamma\gamma$).

The experiment will be performed at the experimental set-up ISTRA-M (see Figure 1) which is thoroughly tested and ready for mass data taking. It contains a magnetic beam spectrometer, a magnetic spectrometer of decay products, a guard system surrounding decay volume, two electromagnetic calorimeters, a hadronic calorimeter, a muon identifier. The data processing system is already in proper shape.

The tasks to be solved during 1994:

- first half of the year: data processing of $\sim 10^7$ events
- second half: $1 \div 2$ months of data taking on beam with selective trigger

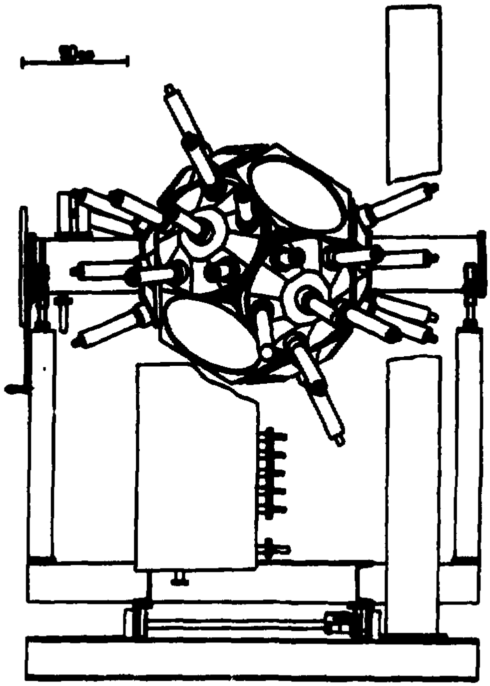


Figure 1: The layout of the experimental apparatus FASA.

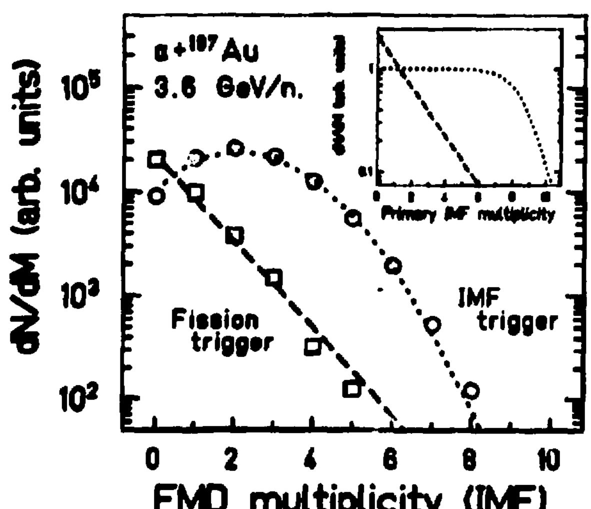


Figure 2: Multiplicity distributions of the intermediate mass fragment ($3 \leq Z \leq 20$), measured by FASA for two classes of events: multifragmentation (circles) and fission (boxes). They are fitted with Fermi (dotted line) and exponential (dashed line) distributions, folded with the experimental filter. The insert gives the corresponding primary distributions.

03-1-0983-92/96

FASA	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 Institute, 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, V.K. Rodionov, N.I.Zhuravlev, V.M.Sidorov
KIAE, Moscow	G.B.Yankov, O.V. Bochkarev, E.A. Kuzmin, L.V. Chulkov
INP, Krakow	W. Karcz
ZFK, Rossendorf	W. Neubert
INP, Darmstadt	H. Oeschler, V. Lips, R. Barth, J.Theobald
Univ., Iowa City	E. Norbeck

Leader: **V.A. Karnaukhov**

The project is aimed at the investigation of the mechanism of multiproduction of fragments with intermediate masses ($2 < Z_f < 20$) from the target spectator in nucleus-nucleus interactions. The installation "FASA" consists of a multiplicity detector DMF (64 scintillator counters with CsJ(Tl) 25 mg/cm^2 thick) and 5 spectrometer telescopes for TC fragments - ($\Delta E_1 \times \Delta E_2 \cdot E$: proportional counter $\times$ ionization chamber $\times$ semiconductor detector). Every TC serves as a trigger of the system. The TCs identify the charge and measure the energy of the fragments. The DMF determines the multiplicity and the direction of the particles. All channels of the DMF are provided with amplitude analyses. The solid angle of the system is $\sim 3.6\ \pi$sr.

Two runs at the JINR synchrophasotron with the FASA setup are planned during 1991 by using relativistic proton and helium beams and an Au target. Data concerning the fragment energy and mass distributions, multiplicity of fragments, angular correlations will be obtained. The data will be analyzed according to different models of multifragmentation, with account of a possible connection with phase transitions in nuclear matter ("cracking", "liquid gas")

Radiobiological Researches

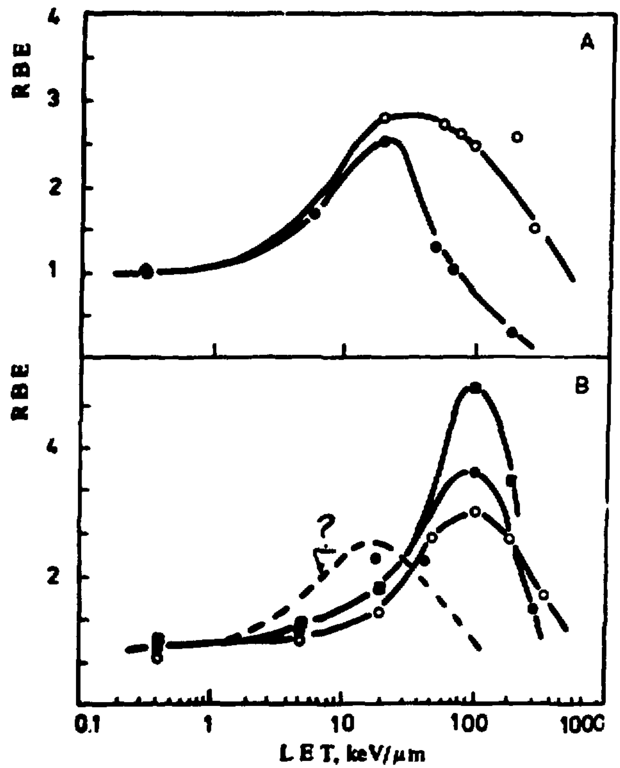


Figure 1: Relative biological effectiveness (RBE) as a function of linear energy transfer (LET) for bacteria (A) and mammalian cells (B).

A: o lethal effect; • - induction of point mutation;

B: o - lethal effect; • induction of 6-thioguanine resistance mutants; filled squares - induction of chromosomal aberrations; dashed line point mutation ?

08-2-0980-92/96

MUTANT-2	LNP-33
Status	Data-Taking

Mutagenesis in cells by ionizing radiation with different LET

LNP JINR, Dubna; IBPH CzAN, Brno; DLR, Koln; GSI, Darmstadt, Germany; VONC RAMN, Moscow; IOG RAN Moscow; IMG RAMN, Moscow, Russia

LNP, Dubna	I.D.Alexandrov, M.V Alexandrova, A.V.Boreyko, A.P.Cherevatenko, R.D Govorun, N.A.Koltovaya, O.V.Komova, V.I.Korogodin, V.L.Korogodina, E.A.Krasavin, I.L.Lapidus, E.A.Nasonova, T.E.Phomenkova, N.L.Shmakova, N.V.Shvaneva
IBPH, Brno	S.Kozubek
DLR, Koln	G.Horneck
GSI, Darmstadt	G.Kraft
VONC, Moscow	A.A.Vainson
IOG, Moscow	V.A.Tarasov
IMG, Moscow	V.A.Gvozdev

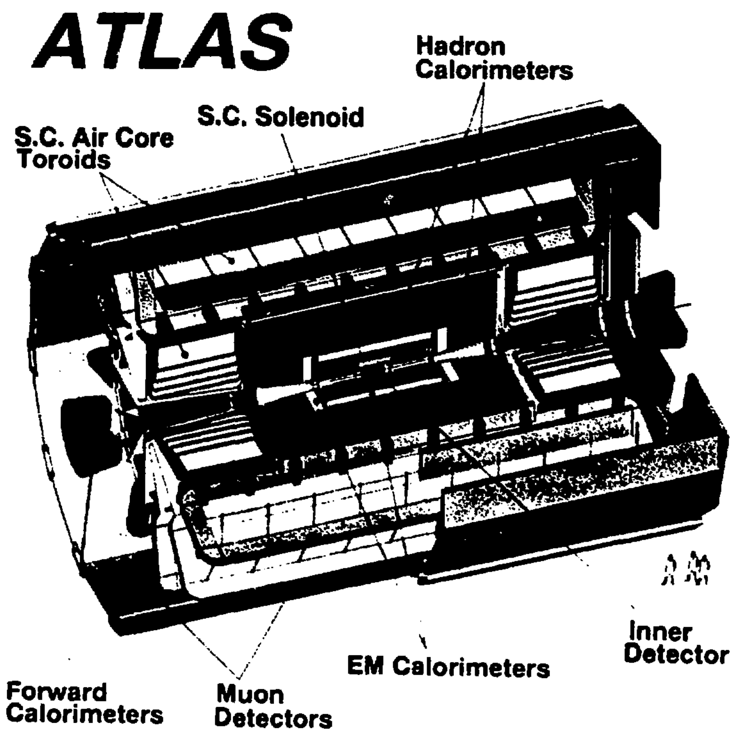
Leader from JINR: **E.A.Krasavin**

Gene mutations are an important determinant of the natural and artificial (in particular radiation-induced) genetic variation in both germinal and somatic cells. Therefore, one of the main problems of the low-dose radiation effect induced by different types of ionizing radiation seems to be the investigation of the nature of gene mutations and the mechanism of mutation induction. According to the accumulated data, all spontaneous and radiation induced gene mutations may be divided into two principal groups, namely point mutations, which include nucleotide substitutions, and structural mutations of chromosomes such as deletions, translocations etc. Some of the latter are fundamentally the same as microscopically detectable aberrations.

In experiments with bacteria it was shown (Figure A) that maximum in the dependence of relative biological effectiveness (RBE) as function of the linear energy transfer (LET) on the mutagenic assay is shifted to the region of low LET in comparison with the lethal assay. This fact reflects the differences in molecular events which determine induction of point and lethal (chromosomal) mutations. The dependence of RBE(LET) on the induction of point and structural mutations for eukaryotic cells is now unknown (Figure B).

Induction of point and structural mutations in bacteria, yeast, eukaryotic germinal and somatic (mammalian and human) cells by ionizing radiation with different LET will be studied. Dose response curves for point vs. structural gene mutations will be obtained.

R&D and Projects of New Facilities



The ATLAS detector

ATLAS	LNP-34
Status	R&D

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

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

Leader from JINR: **N.A.Russakovich**

The ATLAS Collaboration proposes a general-purpose pp experiment which would be operational at the startup of the Large Hadron Collider (LHC) in order to exploit its full discovery potential. The LHC offers a large range of physics opportunities, among which the origin of mass at the electroweak scale is a major focus of interest. The detector optimization is therefore guided by physics issues such as sensitivity to the largest possible Higgs mass range, but also for example by detailed studies of top quark decays, Supersymmetry searches, and sensitivity to large compositeness scales. The ability to cope with a broad variety of expected physics processes also demonstrates most importantly the detector's potential for unexpected new physics.

Many of the interesting physics questions at the LHC require high luminosity, and so the primary goal of the experiment is to operate at the standard high luminosity for LHC of $1.7 \cdot 10^{34}\ cm^{-2}s^{-1}$ with a detector that provides as many signatures as possible of new physics using electron, gamma, muon, jet, and missing transverse energy measurements.

Emphasis is also put on the performance necessary for physics accessible during the initial lower luminosity running. The experiment will address more complex signatures including tau detection and heavy flavour tags to as high a luminosity as practicable.

Finally, for a restricted set of signatures, the detector is conceived for safe performance even at the highest possible luminosities which could be delivered by the LHC.

The Technical Design Report of the ATLAS detector has to be prepared by the end of 1994. JINR's physicists (LNP, LSHE, LCTA, FLNP) intend to participate in designing, manufacturing and maintenance of the muon spectrometer, hadron calorimeters, inner tracker, trigger and software.

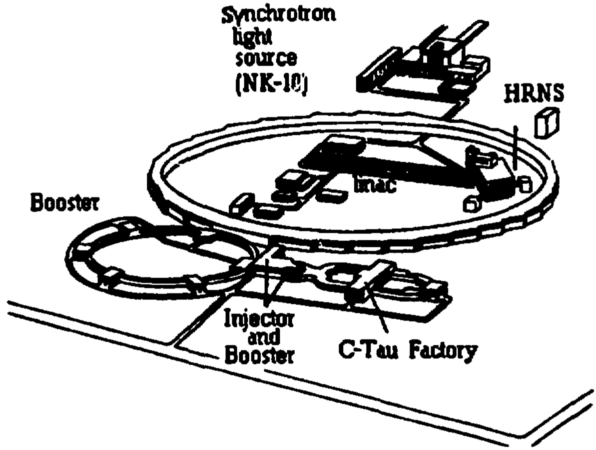


Figure 1: Layout of the JINR storage ring complex.

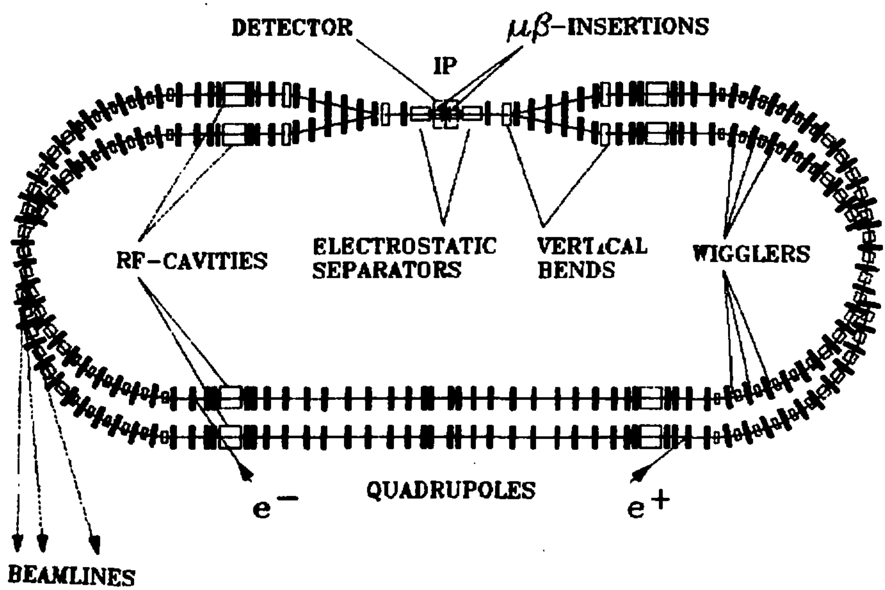


Figure 2: Tau-Charm Factory

05-2-0993-92/96

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, Ukraine; IP, Yerevan, Armenia

LNP, Dubna	V.Alexandrov, V.Anosov, V.Antropov, O.Arkhipov, P.Beloshitsky, L.Bobyleva, P.Chernov, A.Eljov, V.Kazacha, 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.
IP, Yerevan	E. Laziev et al.

Leader from LNP JINR: **E.A.Perelstein**

High luminosity collider-tau-charm factory studied at the 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 maxinum luminosity at 2 GeV.

In 1993 the engineering proposal for the JINR Tau Charm Factory was worked out including electromagnetic systems, injection systems, power supply, a vacuum system. Variants of an RF power supply were also proposed and studied.

As a result of the international collaboration, a versatile Tau- Charm Factory scheme, within which one can begin from the conventional scheme have the possibility of realizing the crab-crossing to reach a luminosity about $5 \cdot 10^{33}$, and the monochromatization scheme were proposed.

To be continued in 1994 are the machine study and the magnetic lattice study in the cooperation with LAL to obtain higher luminosities with the conventional devices and beam parameters, and the JINR - Cornell research and development program directed at high luminosity of electron-positron storage rings (Upgraded CESR - Tau Charm Factory). These studies are connected with the CESR linac optics and positron converter improvements.

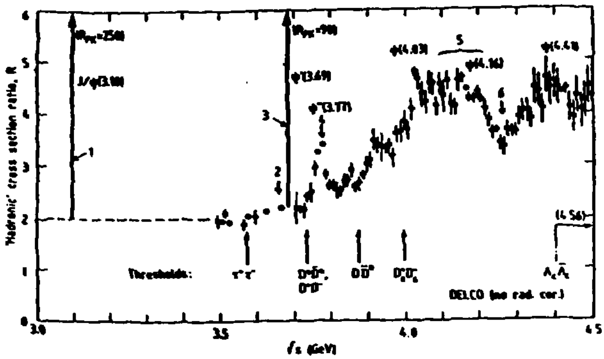


Figure 1.

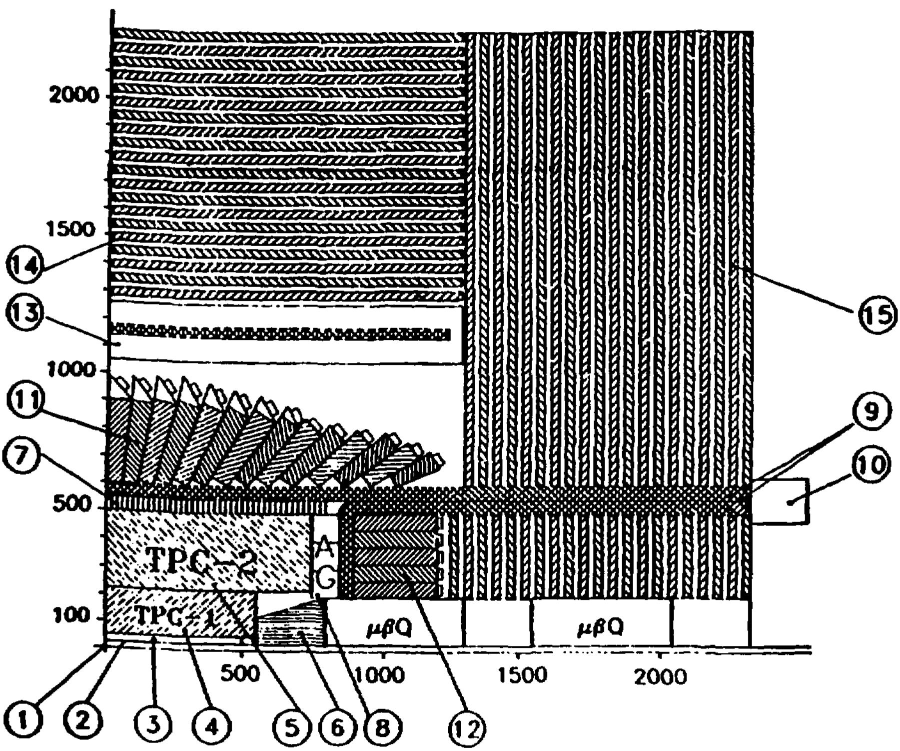


Figure 2: Universal detector. 1 - beam collision point; 2- vacuum chamber of accelerator; 3,4,5 - track system detectors (TPC-1, TPC-2); 6 - luminosity monitor and front calorimeter; 7,8,9,10 - detectors of particle identification system; 11,12 - γ-calorimeter; 13 - superconducting solenoid; 14,15 - path system; $\mu\beta Q$ - micro-beta insertions.

05-2-0993-92/96

TCF-D Status | LNP-36 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.

Leader: **G.Chelkov**

Now a storage accelerator project is being studied at the JINR. This complex is expected to allow promising investigations in the Institute's traditional fields of elementary particles physics, nuclear physics, condensed matter physics, as well as applied investigations. The new complex is supposed to be attractive for wide international co-operation. The project discussed involves a $c\tau$-factory with the total energy of colliding particles up to 5 GeV.

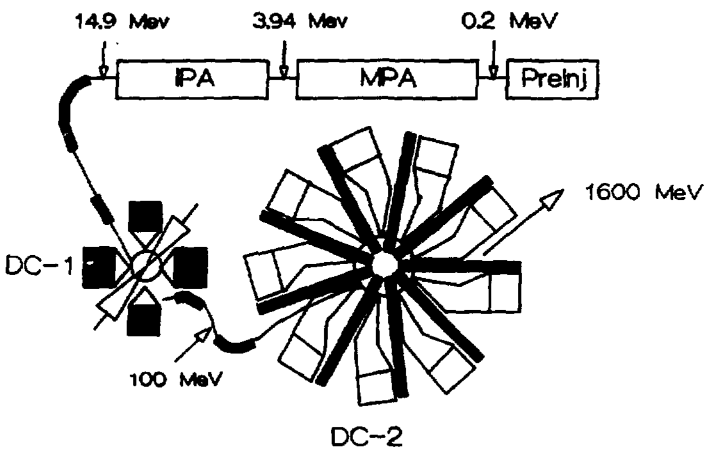
The core of the experimental programme for $c\tau$-factories must be the study of properties of the second-generation quarks and the third-generation leptons through investigations in τ-lepton physics; charmed meson physics; charmonium physics; charmed baryon physics.

Figure 1 shows the hadron production cross section as a function of the energies available at $c\tau$-factories. In the Table there are the assumed production rates of events that can be studied at $c\tau$-factories.

Production Rates of Events at $c\tau$-Factory

Type of PARTICLE	E_{cm} GeV	Production frequency 1/s	Events per year (10^7 s)
J/Ψ	3.10	1000	10^{10}
Ψ'	3.69	600	$6 \cdot 10^9$
$\tau^+\tau^-$	3.57	0.4	$4 \cdot 10^6$
$\tau^+\tau^-$	3.67	2	$2 \cdot 10^7$
$\tau^+\tau^-$	4.25	4	$4 \cdot 10^7$
D^+D^-	$\Psi''(3.77)$	2	$2 \cdot 10^7$
$D^0\bar{D}^0$	$\Psi''(3.77)$	3	$3 \cdot 10^7$
$D_s^+D_s^-$	4.03	0.7	$7 \cdot 10^6$
$D_sD_s^*$	4.14	1	10^7
$L = 10^{33} cm^{-2}s^{-1}$; $E_{cm} = 4$ GeV			

To solve the above-mentioned problems one needs a universal 4π-detector. At present there are both operating installations and projects of universal 4π-detectors for colliding e^+e^- beams in close energy regions. As mentioned above, the $c\tau$-factory investigations involve mainly precision experiments, which demands that the detector performance should satisfy strict requirements: a) precise ($\Delta P/P \simeq 0.5\%$) measurement of momenta of charged particles and a possibility of reconstructing coordinates of secondary vertices of decays of charmed particles and τ-leptons with an accuracy of $\approx 10 \mu m$; b) possibility of identifying e, μ, π, K, p with energies to ≈ 2 GeV/c; c) precise energy measurements for electrons and γ-quanta of the lowest possible energies in a calorimeter with a space resolution good enough for effective identification of π^0-mesons; d) maximum tightness of the detector. A schematic view of the detector proposed at the JINR is shown in Figure 2.



Accelerator Layout

09-2-0981-92/96

MINGEN	LNP-37
Status	Preparation

Deuteron cyclotron complex as a meson and neutron generator

JINR, Dubna IHEP, Protvino, Russia

LNP, Dubna Vorozhtsov S.B., Alenitsky Yu.G., Glazov A.A., Denisov Yu.N., Dzhelepov V.P., Dmitrievsky V.P., Zaplatin N.L., Kalinichenko V.V., Onischenko L.M., Belyaev A.L., Ivashkevich S.A., Novikov D.L., Novikov A.V., Pryanichnikov V.I., Samsonov E.V., Savaneev V.P., Semenov M.M., Chesnov A.F.

IHEP, Protvino Mal'tsev A.P., Teplyakov V.A.

Leader: **Glazov A.A.**

One of the most important current problems is nuclear power engineering safety. For several years specialists have been discussing the possibility of using high-current accelerators with energy about 1 GeV per nucleon to fulfil the following tasks:

1. Power generation together with a subcritical reactor.
2. Prolongation of the fuel element campaign.
3. Transmutation of highly active nuclear power plant waists.

In 1993 the interest in the problem increased as there appeared new proposals to employ high-current accelerators for transmutation of NPP waists (Los Alamos) and to create safe nuclear power plants (C.Rubbia, CERN).

One of the most important issues in practical realization of the proposals is to develop adequate accelerating facilities that would provide beams with the necessary parameters at minimum construction and power consumption costs and maximum efficiency. Investigations of μ-catalysis and neutron generation by relativistic nuclei carried out at the JINR have shown a possibility of increasing the neutron yield per accelerated ion and thus decreasing the critical intensity of the accelerator, which makes it easier to implement the idea.

An isochronous cyclotron is the simplest, most compact and economical intermediate-energy ion accelerator adequate to the above tasks. It is reasonable to accelerate particles with $Z/A = 1/2$, which allows acceleration of deuterons for μ-catalysis and heavier nuclei.

Current achievements in obtaining high magnetostatic fields of about 10–12 T in superconducting magnets open up an opportunity to build cyclotrons of relatively small size for high energy particle acceleration. Strong magnetic focusing ensures transverse stability of the beam in the course of acceleration to about 100 mA.

The final goal of the project is to create a Deuteron Cyclotron Complex with final energy about 1 GeV/nucleon and mean beam intensity in the 10 milliampere range. The complex will consist of an RFQ linac and two superconducting sector cyclotrons (Figure).

Parameters of the accelerators are chosen such that the size of the complex and the radiofrequency losses are as small as possible at the given maximum energy per nucleon of accelerated particles. As a result, the maximum radii of final cyclotron orbits are 1.11 m and 3.33 m.

Following the schedule, we have already built full-scale prototypes of one of four superconducting sector magnets for the cyclotron DC-1 and one of two accelerating cavities for the cyclotron.

In 1994 it is planned to assemble a magnet with trial coils, to cool it to the nitrogen temperature, and to fabricate all superconducting coils. The operating accelerating voltage is planned to be obtained at the delta-cavity in the pulsed mode.

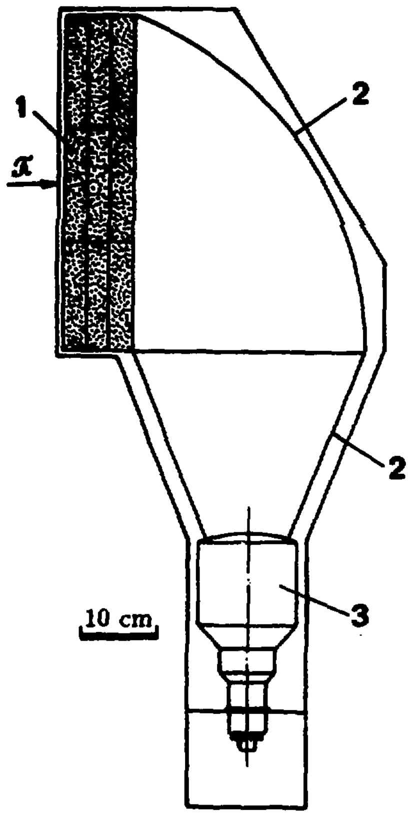


Figure 1. A module of the aerogel Cherenkov counter.
1 aerogel radiator assembly with n = 1.1
(volume 500×500×90 mm^3). 2 reflector (Al).
3 photomultiplier XP2040.

05-2-0987-92/96

Aerogel	LNP-38
Status	R&D

Development of technology for production of silicon aerogel and designing of Cherenkov counters with radiators of this aerogel

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

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Leader: **A.I.Filippov**

The research is aimed at developing and improving the technology for production of silicon dioxide aerogel, creating on its basis general-purpose Cherenkov counters to be used in intermediate and high energy physics, and providing conditions for production the aerogel in large amounts.

The importance of the task is proved by the fact than in 1990 the *Science* classified aerogels among ten most promising lines of scientific and technological investigations carried out in the USA (Science, 250, 1640 (1990)).

In 1994 it is planned to put into operation a 1-litre autoclave for drying gels based on tetramethyloxilane and tetraethyloxilane and to develop technology for making silicon dioxide aerogel samples $60 \times 60 \times 30$ mm^3 in size. The autoclave is to be equipped with automatic programmed devices to control temperature and pressure in the course of the drying process (about 2 days). Simulation, designing and fabrication of a prototype Cherenkov counter module with a $180 \times 180 \times 90$ mm^3 aerogel radiator of $n \simeq 1.1$ ($P^{\pi}_{thresh} = 300$ MeV/c) and study of its characteristics will be carried out.

An 30-litre autoclave is supposed to be installed at VNIISIMS (Aleksandrov) to make aerogel samples $200 \times 200 \times 30$ mm^3 in size. On their basis a module of the Cherenkov counter (with a $500 \times 500 \times 90$ mm^3 radiator) will be fabricated for the project COSY (Jülich–Dubna) aimed at studying subthreshold production of K^+ in the $p + {}^{12}C \rightarrow K^+ + X$ at proton energy (0.8 1) GeV.

The final goal of the project is to make a full-size Cherenkov aerogel counter with a radiator about $1000 \times 1000 \times 90$ mm^3 in size consisting of four individual modules.

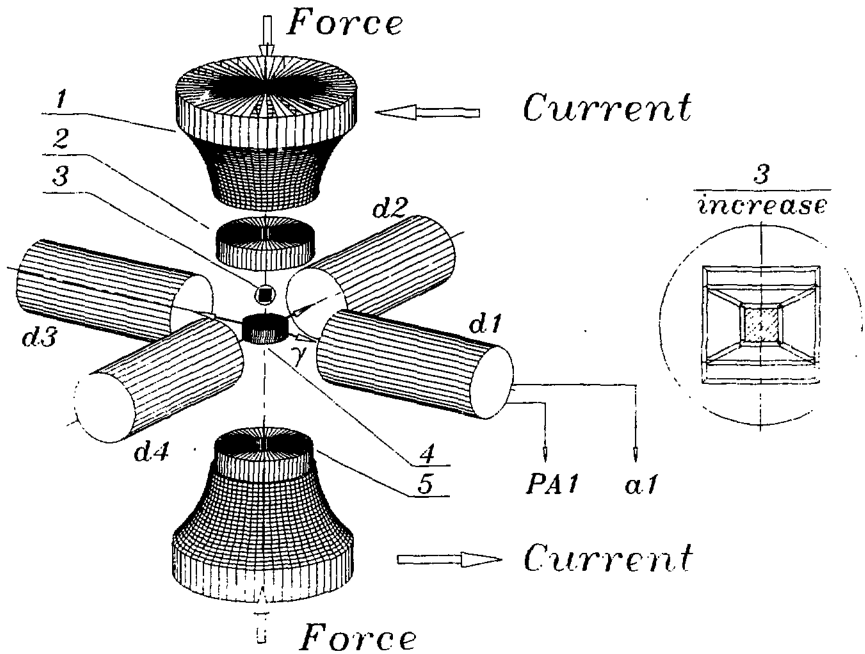

Figure 1: Schematic view of the TDPAC set-up under high pressure and high temperatures. (1) rings giving press and leading current for heating to the double-stage of the high pressure apparatus, (2) first stage of high pressure system, (3) second stage of high pressure system and sample, (4) catlinite cell, (5) sintered diamond anvils of first stage.

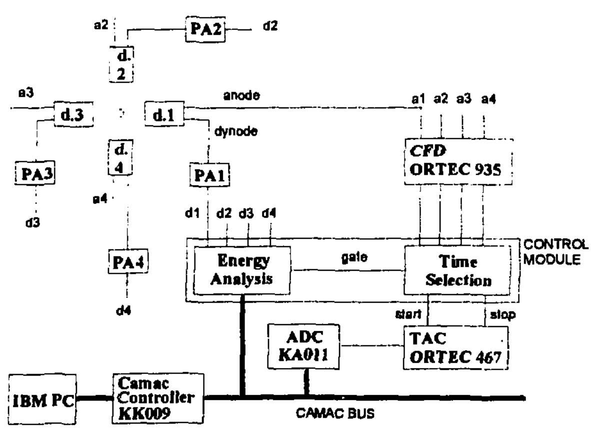

Figure 2: Schematic diagram of the complete TDPAC spectrometer.

05-2-0986-92/96

TDPAC	LNP-42
Status	Preparation

TDPAC - Measurements under high pressure and at high temperatures

LNP JINR, Dubna; Institute of Nuclear Physics, Moscow State University; High Pressure Physics Institute, Troitsk, Russia; Faculty of Nuclear Sciences and Physical Engineering, Prague, Czech Republic; Institute of Physics, M.Curie-Sklodowska University, Lublin, Poland

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The anomalous rare earth metals (Ce, Sm, Eu, Tm, Yb etc.) show different electron properties depending on another constituent in the rare compounds and alloys, as well as on external pressure and temperature. The electron instability of 3d-transition elements has not been adequately studied. The coupling of the nuclear spin system with magnetic and/or electric hyperfine fields can provide specific information about static and dynamic properties of the local probe environment. In consequence, the method of time differential perturbed angular correlation (TDPAC) of γ-rays can be applied to the studies of 4f-to-5d and 3d-to-4s electron transitions, since it is sensitive to electron structure in the valence band.

The TDPAC spectrometer (Figure 1) has been constructed for operation under different conditions (temperature and pressure). The measurements with samples under high pressure (up to 30GPa) and in the temperature range from 20°C up to 1500°C are prepared. Hardware and software means of the TDPAC spectrometer (Figure 2) provide very good energy and time resolution together with the maximal efficiency. The detector system is composed of 4 BaF_2 detectors (Ø40x40mm) coupled to the UV-transparent quartz window of photomultipliers XP2020Q. Our BaF_2 detectors provide energy resolution of $\sim$ 10% for the 662keV γ-quanta of ^{137}Cs. The time resolution $\sim$500 ps (FWHM) for γ-γ coincidences 133keV - 482keV of ^{181}Ta and $\sim$200 ps for coincidences 1173keV - 1332keV of ^{60}Co was reached.

The research program includes the study of the magnetic systems with electron instability - RT_2 (where R are the rare elements and T = Mn, Fe, Ni, Co) and $_{1-x}Yb_x$ compounds.

94-165

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