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RESEARCH PROGRAMME AND MAIN RESULTS IN 2000 OF THE LABORATORY OF PARTICLE PHYSICS

Report to the 89th Session
of the JINR Scientific Council
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Dubna 2000

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The LPP programme involves:

- participation in on-going-experiments at CERN, DESY and IHEP (Protvino);
- detector R&D and preparation of new experiments at CERN, DESY, BNL and other centers;
- R&D of accelerator systems and methods.

These activities are well recognized by particle physics community and undoubtedly remain actual for the future.

The total number of the LPP projects is 14, including 10 particle physics experiments (COMPASS, HERMES, STAR, EXCHARM, NA48, H1, HERA-B, CMS, ATLAS, BOREXINO) and 4 accelerator projects (LHC, CLIC, TESLA and Electron Accelerator for Radiation Technologies). New results have been obtained recently in:

- hadron production (EXCHARM),
- CP violation and rare kaon decays (NA48),
- spin physics (HERMES),
- diffractive processes and photo-production reactions (H1).

Suggesting the programme of research, LPP has followed such principles as:

- concentration of resources in the most important projects;
- support of experimental study of the fundamental problems in which LPP has experience and reputation;
- support of R&D and construction of the most promising detectors in which LPP has a long standing tradition and internationally acknowledged experience;
- support of R&D of the subsystems for the modern accelerators and development of the promising accelerator technologies.

The particle physics at JINR is based mainly on the experiments at the external accelerators in the framework of international cooperation. The LPP programme takes into account the interests of the JINR Member States to be involved more actively through JINR in the most ambitious international programmes and to contribute with their resources more efficiently.

The activity of LPP in 2000 was concentrated on the current particle physics experiments and preparation of the new ones, R&D of the particle detectors and different acceleration systems.

1. CURRENT EXPERIMENTS

A study of charmed baryon production in neutron-nucleus interactions is continued in the **EXCHARM** experiment in the frame of the **OSCAR** theme. The EXCHARM experiment is an extension of the scientific programme being carried out at the U-70 accelerator in Protvino and aimed at:
- searching for exotic states in hadron reactions;
- studying of strange and charmed particle hadroproduction, including polarization phenomena;
- investigating of single and double ϕ–meson production and the OZI rule violation.

The relative intensity of the vector meson $K^*(892)^{\pm}$ production with zero Z-component of the spin (a spin density matrix element ρ_{00}) has been measured via the decays $K^*(892)^{\pm} \to K^0\pi^{\pm}$ in the transversity frame [1]. The obtained mean values of ρ_{00} are $0.393 \pm 0.011(\text{stat.}) \pm 0.018(\text{syst.})$ for $K^*(892)^+$, and $0.363 \pm 0.025(\text{stat.}) \pm 0.018(\text{syst.})$ for $K^*(892)^-$, respectively. A clear deviation of the obtained mean value of ρ_{00} from 1/3 for the leading meson $K^*(892)^+$ indicates the spin alignment. An indication the spin alignment for the non-leading meson $K^*(892)^-$ is present as well, but with lower statistical significance. Using a linear dependence: $\rho_{00}(P_T) = a + bP_T$, and fixing a-parameter at 1/3, the following slope parameters b have been obtained: $0.137 \pm 0.022(\text{stat.}) \pm 0.043(\text{syst.})$ for $K^*(892)^+$ and $0.085 \pm 0.059(\text{stat.}) \pm 0.039(\text{syst.})$ for $K^*(892)^-$ (both in $(\text{GeV/c})^{-1}$).

The following cross-sections of hyperon inclusive production in the neutron-carbon interactions have been measured: Λ^0 – $(3370 \pm 190)\mu$b/nucleon; Ξ^- – $(76 \pm 5)\mu$b/nucleon; $\Sigma(1385)^-$ – $(286 \pm 20)\mu$b/nucleon; $\Sigma(1385)^+$ – $(252 \pm 18)\mu$b/nucleon; $\Xi(1530)^0$ – $(13.5 \pm 1.4)\mu$b/nucleon [2]. Preliminary results of the anti-hyperon inclusive production cross-section measurement were obtained as well: $\overline{\Lambda}^0$ – $(175 \pm 10)\mu$b/nucleon and $\overline{\Xi}^+$ – $(6.5 \pm 0.5)\mu$b/nucleon. The studies of the associative $\phi - \Lambda$ and ϕ-kaons productions and production of $\Lambda(1520)^0$, all in the neutron-nucleus interactions, are in progress.

The polarization of Λ^0 hyperons produced inclusively in neutron-nucleus interactions at different energies and various production angles has been measured [3]. The dependence of the polarization P on the angle θ between the Λ^0-production plane and proton emission in the Λ rest system has been studied for various intervals of x_F. A method of apparatus function cancelation has been used to measure this polarization. The obtained result is one of the most precise measurements of the Λ^0-polarization and is in good agreement with the data obtained in proton beams. The obtained result enlarges the covered P_T region of the measured Λ^0-polarization.

The A-dependence of the Λ^0 and Ξ^- inclusive production cross-sections and the Bose-Einstein correlations for identical boson pairs (kaons) will be studied in 2001. The inclusive cross-sections of Ω^- and Ω^+ productions, as well as the polarization of Ξ^-, are planned to be measured.

The LPP physicists actively work in the **NA48** experiment at CERN devoted to the precision measurement of the ϵ'/ϵ ratio in CP violating decays of K^0-mesons into $\pi^+\pi^-$ and $\pi^0\pi^0$. A new preliminary result based on the 1998 run data has been

reported at the CERN seminar and presented at the ICHEP-2000 Conference in Osaka (Japan) [4]: $\text{Re}(\epsilon'/\epsilon) = (12.3 \pm 2.9(\text{stat.}) \pm 4.0(\text{syst.})) \times 10^{-4}$. The combined result of the 1997 and 1998 runs (taking into account the partially correlated systematic errors) is: $\text{Re}(\epsilon'/\epsilon) = (14.0 \pm 4.3) \times 10^{-4}$. This result, confirming a non-zero and positive value of $\text{Re}(\epsilon'/\epsilon)$, is at the top margin of the Standard Model (SM) predictions. Therefore, the further improvement of the experimental precision is very important to make the conclusion about the validity of the major models calculating the direct CP violation. New results of neutral kaon rare decays: $K_S^0 \to \gamma\gamma$, $K_S^0 \to \pi^0 e^+ e^-$, $K_S^0 \to \pi^+\pi^- e^+ e^-$, $K_L^0 \to \pi^0\gamma\gamma$, $K_L^0 \to e^+e^-e^+e^-$, $K_L^0 \to e^+e^-\mu^+\mu^-$ and $K_L^0 \to e^+e^-\gamma\gamma$, obtained in NA48 experiment, have been presented at the ICHEP-2000 Conference [5].

A new precision measurement of the Ξ^0 mass has been performed, which is $(1314.82 \pm 0.06(\text{stat.}) \pm 0.2(\text{syst.}))\text{MeV}/c^2$. The branching ratios of Ξ^0 radiative decays have been measured as: $\text{Br}(\Xi^0 \to \Lambda\gamma) = (1.90 \pm 0.34(\text{stat.}) \pm 0.19(\text{syst.})) \times 10^{-3}$ and $\text{Br}(\Xi^0 \to \Sigma^0\gamma) = (3.14 \pm 0.76(\text{stat.}) \pm 0.32(\text{syst.})) \times 10^{-3}$ [6].

The 2000 experimental run has been carried out with the active participation of the JINR group. Online physical data monitoring has been developed and maintained by the JINR group during this run. The mass-production of the NA48 overlayed Monte-Carlo is running at the LPP PC-farm. The JINR group is widely involved in the reparation of the NA48 spectrometer destroyed by the vacuum beam pipe implosion in 1999.

A new physics programme to investigate rare K_S and neutral hyperon decays using modified K_S beam in the NA48 experiment has been prepared. The first experimental run according to this programme has been carried out. A new physics programme for precision measurement of charged kaon decay parameters (including one related to the direct CP–violation) with an extended NA48 setup has been prepared. An experiment according to this programme is proposed to start in 2003.

The result of the ϵ'/ϵ measurement based on the data recorded in 1997-1999 and the systematic errors contributed to this measurement will be obtained in 2001.

The Dubna group has taken an active part in data taking, data analysis and technical maintenance of the system of mini-Drift Vertex Chambers of **HERMES** Spectrometer Front Tracking at the HERA, DESY, Hamburg. During 2000 the HERMES has collected about $6 \cdot 10^6$ deep inelastic scattering (DIS) events with polarized deuterium target and about $15 \cdot 10^6$ DIS events with unpolarized target with various types of the nucleus.

The Gerasimov–Drell–Hearn (GDH) integral, one of the most fundamental sum rule in high energy spin physics, has been measured in resonance and DIS regions for the first time [7, 8]. It allows to extract the Q^2-dependence of GDH integral in the range of 1.2 $\text{GeV}^2 < Q^2 < 12\ \text{GeV}^2$. The contributions of the resonance and DIS regions to this integral have been evaluated separately. The latter has been found to dominate for $Q^2 > 3\ \text{GeV}^2$, while both contributions are important at low Q^2. The total integral shows no significant deviation from the $1/Q^2$ behaviour in the measured Q^2 range. There is no large effects due to either nucleon–resonance excitations or non–leading twist. The analysis of the HERMES experimental data taken with polarized deuterium target has been started to extract the Q^2 dependence of the GDH integral

for deutron and neutron.

Measurements of the cross section for exclusive photo-production of ρ^0 mesons from hydrogen are performed at HERMES [9, 10]. The main aims of these measurements were a study of the W-dependence of the cross section, decay angular distributions and the ratio $R = \sigma_L/\sigma_T$.

A study of the Deeply Virtual Compton Scattering (DVCS) [11] based on the HERMES data analysis in 2000 has started, which is one of the most interesting problems. The DVCS process can be studied through asymmetries which isolate the terms in the real photon leptoproduction cross section associated with the interference between the background. There are several asymmetries that can be studied. The initial one being investigated at HERMES is the single spin azimuthal angle asymmetry. It provides the unique possibility to get information on the skewed parton distributions related to the contribution of the total orbital momenta of quarks and gluons to the spin of the nucleon.

The HERMES JINR group has prepared the project which includes the proposal on the upgrade of the front part of the HERMES spectrometer with production and installation of the new set of mini-drift chambers and analysis of the future HERMES experimental data with aim to extract the new data on spin structure of the nucleon. This project was approved by the 13th session of PAC for Particle Physics (7-8 April, 2000).

The LPP participates in the **H1** detector upgrade to investigate deep inelastic scattering (DIS) processes at the $e - p$ collider HERA, DESY, specifically, in the software/hardware support of Forward Proton Spectrometer (FPS) [12] operation and in the upgrading of the hadron Plug calorimeter and Backward Proportional Chambers (BPC).

The JINR group has made a major contribution to the physics analysis of diffractive processes in DIS and photo-production reactions. The total cross sections for the semi-inclusive photo-production process with a leading proton in the final state has been measured in the kinematic range of fractional momentum of the leading proton: $0.66 < z < 0.90$ [13]. The measured cross sections are compared with semi-inclusive deep inelastic e^+p scattering data with the leading proton in the final state. The saturation model in which the proton structure is assumed to consist of two components: vector meson dominant F_2^{VDM} contributing at low values of photon virtuality and partonic structure function F_2^{QCD} governing the region $Q^2 > 1\text{GeV}^2$, was used to describe the photo-production and DIS data simultaneously. It is observed that the semi-inclusive photo-production cross section with the leading proton is suppressed more strongly with respect to the inclusive data than the semi-inclusive DIS cross section. Semi-inclusive structure function $F_2^{LP(3)}$ has been measured in DIS e^-p processes with the leading proton produced in the diffractive kinematic range ($z > 0.90$). Elastic ρ meson photo-production cross section and angular distributions have been measured in diffractive processes with leading proton: detected by the Horizontal Roman Pots of the FPS.

The H1 experiment has measured the cross section of the reaction $e^+p \to e^+X$ and compared to the neutral current (NC) expectations of the Standard Model (SM)

of strong and electroweak interactions for momentum transfer ranging between 200 and 30000 GeV [14]. The data have shown no significant deviation from the SM expectation.

The lower limit on the effective Planck scale M_s of 0.48 TeV and 0.72 TeV for positive and negative coupling, respectively, has been found in the search for possible effects of low scale quantum gravity with gravitons coupling to SM particles and propagating into extra spatial dimensions.

The inclusive e^-p and e^+p differential cross sections for NC and charged current (CC) processes have been measured in the range of Q^2 between 150 and 30000 GeV^2 and Bjorken x between 0.0032 and 0.65 [15, 16].

The NC e^-p measurement of $d\sigma/dQ^2$ shows a clear increase with respect to the positron cross section at high Q^2, which is consistent with the SM expectation of the contribution of parity violating Z^0 exchange. As a result the parity violating structure function xF_3 is extracted. The CC cross section is observed to be larger for electron scattering than for positron scattering by up to a factor of ten at high Q^2, because of W-boson coupling to different quark flavours. The NC cross section at low Q^2 is about 1000 times larger than the CC cross section, since the CC cross section is suppressed due to the propagator term dependence on M_W^2. At the highest values of $Q^2 \sim M_Z^2, M_W^2$, the NC and CC cross sections are of similar size as expected from the SM (electro-weak unification).

The expected results in 2001 are:

- The final analysis of semi-inclusive diffractive structure functions $F_2^D(3)$ as well as vector meson diffractive photo-production cross section measurement on the basis of the experimental data collected in 1999 and 2000, will be completed.

- Upgrade of the FPS (new radiation hard fiber detectors and new position-sensitive photo-multipliers) will be performed.

- Final test of the new hardware/software for the Plug detector and BPS, study of their operation within the framework of the H1 experiment after HERA-2000 upgrade, will be carried out.

2. PREPARATION OF NEW EXPERIMENTS

The Common Muon and Proton Apparatus for Structure and Spectroscopy, **COMPASS (NA58)**, has been proposed to perform a series of experiments with the high energy muon and hadron beams at CERN. The LPP has constructed and assembled the Hadron Calorimeter 1 (HCAL1) consisting of 480 modules for the COMPASS initial set up in 2000. 160 modules have been fully equipped and used in the trigger studies during the technical run in May-September 2000. The LPP has participated also in the construction of the Large Area Straw Chamber Tracking Station. A specialized assembly area has been prepared and the first chambers have been constructed and delivered to CERN. The COMPASS is planning to start data taking in 2001.

The LPP participates in the construction of the Liquid Argon Hadronic End-cap Calorimeter and subsystems connected to it, according to the JINR obligations in the **ATLAS** experiment which is under preparation at CERN. The absorber structure and stainless steel pieces for four serial HEC module assembly were produced at the JINR main workshop and one absorber has been sent to Minsk. Four serial modules were assembled and checked at the CERN SPS test beam with pions, electrons and muons and without particle beam in the cold conditions. The analysis of the experimental data shows good performance of the modules. Pollution of the liquid argon due to the irradiation of materials used in all ATLAS liquid argon calorimeters has been measured with the specially built up apparatus in the neutron fluency up to $1.5 \cdot 10^{16} n/\mathrm{cm}^2$ at the IBR-2 reactor. It was shown at numerous runs that liquid argon pollution is less than 2 ppm. The preshapers, as part of the readout electronic chain, have been designed and produced. Their performance has been studied at the SPS test beam. It was shown that design and production of the preshapers were successful. About 500 temperature probes for ATLAS liquid argon calorimetry were calibrated with precision of few mK. Up to the end of this year the amount of calibrated probes will reach 700.

The main activity of LPP within Compact Muon Solenoid Project, **CMS**, was concentrated on the study, design, integration, and production of the CMS Endcap detectors, where JINR takes a full responsibility in the frame of the Russia and Dubna Member States (RDMS) of the CMS Collaboration. This year opened the mass-production phase for the Endcap hadron calorimeter (HE) and the first forward muon station (ME1/1) in accordance with the CMS construction schedule.

JINR coordinates the RDMS CMS Collaboration activity on the design and construction of the HE calorimeter and is responsible for the HE absorber. The scintillator tile production for HE-1 will be completed by the end of February 2001. A full-scale pre-production prototype of the HE calorimeter sector, PPP2, [19] is upgraded with new 36 megatiles and ready for test at CERN next year.

The ME1/1 chamber production in Dubna has been split in two parts due to funding profile and other reasons. The chamber assembly will start in the second half of 2001. This year CSC panel production has started. Full production rate of 10 panels per week has been achieved in July. Analysis of the experimental data taken with the P4 ME1/1 CSC prototype [20], instrumented with front-end electronics based on the Minsk ASICs, confirmed that the performance of baseline CSC meets the CMS requirements. Because of severe constrains of space available the integration of ME1/1 zone was a subject of thorough study. A full-scale mock-up of ME1/1 zone has been built to confirm that this layout is realistic.

JINR and other Dubna Member States institutes participate in Preshower sub-project. Recent results in 2000 are design of final specs for Si mass-production and design of the final technology for mass production of the Preshower silicon detector at RIMST, Zelenograd. 165 silicon detectors corresponding to 0.4 square meters were produced. Two Preshower ladders (2×8 Si-detectors) are fabricated within required mechanical characteristics. Radiation study of the Si-strip detectors is continued.

JINR physicists participate in the RDMS CMS task force on development of SW and simulation of physics processes with emphasis to Endcap and forward region [21].

The CMSIM and ORCA programmes were tested and modified for muon tracks reconstruction in the Endcap muon system. Computing group participates in the design of a concept of regional distributed centres. Simulation of heavy ion collisions in the CMS detector and the trigger option are in the progress.

According to the JINR commitments, LPP participates in the construction of the Outer Tracker (OTR) of the **HERA-B** detector designed to search for CP-violation in exclusive B-decays, mainly, in the "gold plated" decay mode $B^0 \to J/\Psi K^0_S$. The Dubna group played a major role in the preparation and installation of the OTR superlayers accomplished by the end of 1999. The LPP physicists participated in the commissioning of the OTR superlayers and detector running, control of data quality and online monitoring, cross-check of geometry, cabling and alignment using the real data, in 2000. Dubna group has contributed to the development of ARTE (general software package for HERA-B), readout system and the OTR data quality packages. A special programme has been introduced into ARTE for selecting events without coasting beam interaction at HERA-B target wires.

The following Dubna group activity is planned in 2001: systematic study of the OTR performance using real data taken in 2000, autocalibration of the OTR drift chambers, alignment development, improvement of track reconstruction in the OTR and participation in J/ψ analysis.

The LPP takes part in the design and construction of the End-cap Electro- Magnetic Calorimeter (EEMC) for the 4π-detector **STAR** for the collider RHIC at the Brookhaven National Laboratory. The experimental runs were started in 2000 with the participation of LPP physicists. The manufacturing of the full scale prototype of the 30° EEMC module was constructed and started at JINR Workshop. The photo-multiplier tube (PMT) box was developed and tested in cooperation with WSU STAR group at Detroit. The manufacturing of 16 PMT boxes to provide the 16 modules of the STAR BEMC has been started at the JINR workshop.

The LPP specialists participate in construction of the low-noise neutrino detector **BOREXINO** located at the underground laboratory in Gran Sasso (Italy). The responsibilities shared by the JINR group are mainly related to the DAQ system, detector calibration, testing, cleaning and mounting of PMT.

3. ACCELERATION TECHNIQUES

In according to the schedule of operations for the project **LHC Damper** the 2000 activities were focused on the creation and testing of a prototype system. In the course of this activity, JINR has manufactured a deflector and a wide-band amplifier for the LHC Damper. Testing of the assembled system was carried out on a special bench LPP by JINR specialists together with colleagues from CERN. Afterwards, the prototype was transported to CERN for continued testing according to standards received for the LHC project, and also to study the stability of the kicker on possible thermal loads. As a whole, the characteristics of the prototype system were shown to meet the

requirements of the project. Now the preparation for the following stage of operations – pre-production of devices – has started.

Activities within this theme continue to be focused at the creation of a technical and research basis to develop the technology for model superconducting cavities, with special emphasis towards optimizing their electrophysical parameters. A model of the cylindrical magnetron sputtering configuration based upon permanent magnets with an Nb target has been designed, manufactured, and probed. The magnetron operation is stable utilizing argon at a working gas pressure in the range from $6 \cdot 10^{-4}$ up to $5 \cdot 10^{-2}$ Torr, and with a cathode voltage at -700 V up to -300 V. The size of the magnetron allows to operate the cavities of frequency 3GHz. Theoretical investigations of the amplitude dependence on the surface resistance, SCC, of type Nb/Cu are going on. It has been shown that the limit of non-quadratic losses which appear in Nb/Cu type cavities may be shifted substantially by means of decreasing the working layer roughness until the layer can be considered smooth. The analysis of quantum fluxon behavior near the superconducting smooth surface is carried out. It has been shown that this surface creates a barrier for fluxon penetration into the superconductor which exceeds the first critical field by a factor of 2 to 3. The obtained results are in agreement with the known experiments on magnetization of smooth superconducting samples.

During 2000 the Free Electron Laser (FEL) group carried out investigations on microwave generation utilizing the FEL and traveling wave tube (TWT) for the project **CLIC** at CERN. In accordance with the long term plan of the PPL, the following tasks have been resolved by investigations using the LIA-3000 accelerator: registration of the electron beam bunching at the base frequency of 30 GHz, and the experimental observation of smooth frequency tuning in the FEL scheme [22]. The electron beam bunching was registered in experiments with the FEL oscillator where for the first time a Bragg resonator of a new type was used in the feedback circuit. The generation of microwave radiation in the mode H_{11} at a frequency of 30.7 GHz with very high efficiency (greater than 30%) was realized in this scheme of the FEL oscillator. The electron beam bunching was registered at this frequency. In addition, electron beam bunching was registered in these experiments in the mode E_{01}, with a frequency of 36.4 GHz.

Year 2000 saw the completion of the **TESLA** Technical Design Report, which provides the technical basis for a future collider. The employees of LPP designed and manufactured the equipment of the Regenerative FEL (so-called RAFEL), which should increase the power and narrow the band of radiation in the X-ray and VUV spectra [23]. Now, the equipment of RAFEL is installed on the TESLA Test Facility (TTF), and preparation for experiments with RAFEL at the TTF are continued. TTF is scheduled to run in December of 2000 and March of 2001 for final adjustments.

A novel variant of an RF sensor with a round cross-section and inner diameter of 72 mm has been produced. This is a sensor with a highly uniform electric field within the measuring volume. The sensor and measuring system have been designed, manufactured, tested, and calibrated, and are intended for the TTL. This is the only system to measure a void fraction of the two-phase superfluid helium flow. The design,

manufacturing, and certification devices, and the metrological systems to control the thermodynamic state of two- and single-phase cryogens have been finished. These systems, and the developed methodology, provide an accuracy of calibration of not more than ± 5 mK for resistive temperature sensors in the range from 1.5 K to 300 K and ± 1.5% or less for radio frequency void fraction sensors intended for helium, hydrogen, nitrogen, and others. The total rate of the system to calibrate temperature sensors is about 100 pieces per month, and can be increased by 75% if necessary.

Within the framework of the TESLA collaboration, commercially available cryogenic temperature sensors were irradiated by a Cs γ-source up to an enormous total dose of 1 MGy ($E_\gamma \approx 0.661$ MeV) at 77.3 K and 293 K. Afterwards, the post-radiation behavior of the sensors was estimated. The platinum, PRT, and carbon resistive temperature sensors have demonstrated high radiation resistance. In accordance with the agreement between DESY and JINR, 50 TVO temperature sensors were delivered to DESY to be used in the TTF. There were continued investigations of the TVO temperature sensors under magnetic fields in the temperature range from 1.6 K to 4.2 K, and up to 9 T.

A new, non-traditional direction in technique of the **electron accelerators for radiation technologies** is performed at LPP. To verify new technical solutions a scaled model of the accelerator has been manufactured. Parameters of the model are as follows: electron beam energy – 200 keV, beam peak current – 1 A, pulse duration – 10 μs, repetition rate of the current pulses – 18 kHz, average beam power – 20 kW. The experimental experience obtained with the accelerator model was used as the basis to construct a full scale multi-beam accelerator with energy 500-700 keV and output power 25-35 kW at an extremely low cost. Electron beam parameters of the accelerator are the following: total peak beam current – 0.5 A, pulse duration – 10-20 μs, repetition rate – 10-20 kHz. At present the development of the design of the accelerating voltage source – the vacuum spiral coaxial resonator – is completed and its manufacture has been started.

A work has been done to study a possibility of increasing the efficiency of the radiation technology by means of using secondary electrons to excite molecules of the gaseous mixture. At the accelerators developed at LPP the pulsed electron beam current is generated by RF electric field. An average ratio of the repetition period to the pulse duration is equal to 10, so the possibility to apply the DC electric field appears to accelerate the secondary particles. At 10 μs pulse duration and 100 μs repetition period the electrical discharge cannot evolve and the electric field strength can be increased up to the value enough to excite molecules. The obtained tentative results have shown that there is a principal possibility of enhancing significantly the efficiency of the molecule excitation by the electron beam and an output power of the radiation stimulated processes on the harmful admixture removal from flue gasses.

References

[1] A.N. Aleev et al. Phys. Lett., Vol. B485, 2000, p. 334.

[2] A.I. Zinchenko talk at IV Int. Conf. "Hyperons, Charm and Beauty Hadrons", June 27-30, 2000, Valencia, Spain.

[3] A.N. Aleev et al. Eur. Phys. J., Vol. C13, 2000, p. 427.

[4] NA48 collaboration: "New measurement of Direct CP Violation in Two Pion Decays of Neutral Kaons be Experiment NA48 at CERN", talk presented by A.Ceccucci at CERN Particle Physics Seminar, February 29, 2000.
NA48 collaboration: "New results on Direct CP Violation" talk presented by B.Gorini at the ICHEP-2000, Osaka, Japan, July 2000.

[5] NA48 collaboration: "New Results on the Neutral Kaon Rare Decays, Obtained in the NA48 experiment", talk presented by V.D.Kekelidze at the ICHEP-2000, Osaka, Japan, July, 2000.

[6] V. Fanti et al., Eur. Phys. J., Vol. C12, 2000, p. 69.

[7] N. Akopov, A. Nagaitsev. HERMES internal Note 00-033, DESY, Hamburg, September 2000.

[8] A. Airapetian et al, Eur. Phys. Jour. C (in press); Eprint numbers: hep-ex/0008037 and DESY-00-096.

[9] A. Airapetian et al, Eur. Phys. Jour. C (in press); Eprint numbers: hep-ex/0004023 and DESY-00-058.

[10] K. Ackerstaff et al, submitted to Eur. Phys. Jour. C; Eprint numbers: hep-ex/0002016 and DESY-99-199.

[11] M. Amarian, A. Nagaitsev. HERMES internal Note 00-006, DESY, Hamburg, January 2000.

[12] P.van Esch et al. Nucl. Instrum. and Meth., Vol. A446, 2000, p. 409.

[13] H1 collaboration: "Measurement of the Photoproduction Cross-Section with a Leading Proton at HERA", talk at ICHEP-2000, Osaka, Japan, July 2000.

[14] C. Adloff et al. Phys. Lett., Vol. B479, 2000, p. 358.

[15] H1 collaboration: "Measurement of Neutral and Charged Current Cross Sections in Electron-Proton Collisions at high Q^2 at HERA", talk at ICHEP-2000, Osaka, Japan, July 2000.

[16] H1 collaboration: "Inclusive Measurement of Deep Inelastic Scattering at high Q^2 in Positron-Proton Collisions at HERA", talk at ICHEP-2000, Osaka, Japan, July 2000.

[17] A. Zarubin et al. HE Engineering and Safety Note 2000-007, CMS Document, CERN, February 23, 2000.

[18] V. Kudinov et al. HE Installation. Engineering and Safety Note 2000-045, CMS Document, CERN, October 4, 2000.

[19] V.V. Abramov et al. CMS-NOTE-2000-03, July, 2000; Eprint number hep-ex/0007045.

[20] Y. Erchov et al. Preprint JINR E13-2000-26, Dubna, 2000.
S. Movchan et al. Preprint JINR P10-2000-108, Dubna, 2000.

[21] I. Golutvin et al. Comput. Phys. Comm., Vol. 126, 2000, p. 72.
I. Golutvin et al. in Proc. of CHEP200, p.128, 2000, Padova, Italy.

[22] S.V. Filin et al. Nucl. Instrum. and Meth., Vol. A445, 2000, p. 25.
N.S. Ginzburg et al. Nucl. Instrum. and Meth., Vol. A445, 2000, p.253.
C.A. Goldenberg et al. Nucl. Instrum. and Meth., Vol A445, 2000, p. 257.
N.S. Ginzburg et al. Phys. Rev. Lett., Vol 84, 2000, p. 3574.

[23] E.L. Saldin, E.A. Schneidmiller and M.V. Yurkov. Nucl. Instrum. and Meth., Vol. A445, 2000, p. 40; p. 178.; p. 320; E.L. Saldin, E.A. Schneidmiller and M.V. Yurkov. Preprint TESLA-FEL 2000-02, Hamburg, DESY, 2000.
C. Pagani et al. Preprints DESY 00-015 and 00-115, DESY, Hamburg, 2000.
J. Andruszkow et al. Preprint DESY 00-66, DESY, Hamburg, 2000.
B. Faatz et al. Preprints DESY 00-94 and 00-95, Hamburg, 2000.

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