ІЕФ

УЖГОРОД

# НАЦІОНАЛЬНА АКАДЕМІЯ НАУК УКРАЇНИ

# ІНСТИТУТ ЕЛЕКТРОННОЇ ФІЗИКИ

# INSTITUTE OF ELECTRON PHYSICS

# NATIONAL ACADEMY OF SCIENCES OF UKRAINE

Uzhgorod - 1997

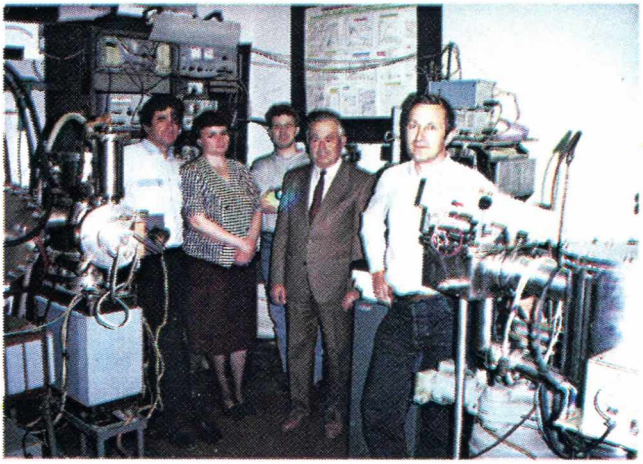
# *Welcome to the Institute of Electron Physics prof. O.Shpenik*


*Директор:* ***проф. О.Б.Шпеник***
*Заступник директора по науковій роботі:* ***А.М.Завілопуло***
*Учений секретар:* ***З.З.Торич***
*адреса:*
***294016, Україна, Ужгород, вул. Університетська, 21***

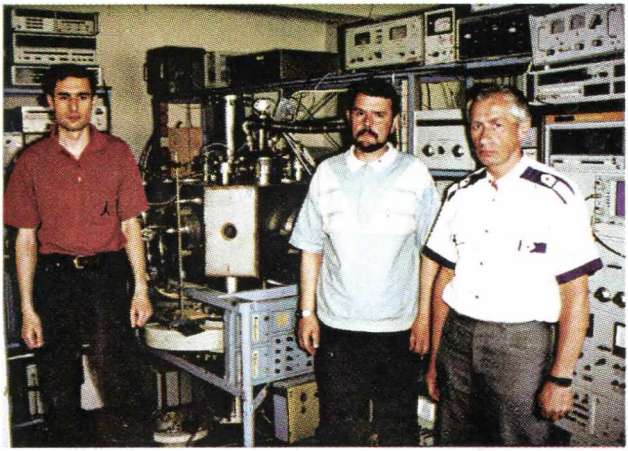
Director: **prof. O.B.Shpenik**
Vice-director in scientific work: **A.M.Zavilopulo**
Scientific secretary: **Z.Z.Torich**
adress:
**21 Universitetskaja, Uzhgorod, 294016, Ukraine**

**tel: +38 - (03122) - 43650; +38 - (03122) - 43524;**
**fax: +38 - (03122) - 43650; E-mail: iep@iep.uzhgorod.ua**
**http://www.iep.uzhgorod.ua**

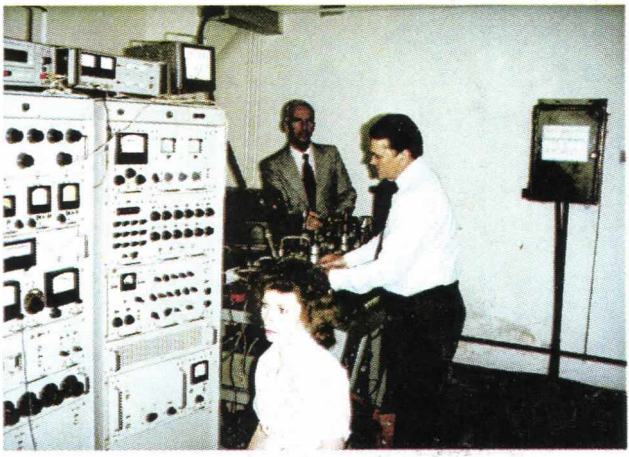
*Семінар відділу теорії елементарних взаємодій.*
Seminar of the Dpt. of Theory of Elementary Interactions.



*Лабораторія електрон-іон і електрон-атомних зіткнень.*
Laboratory of Electron-Ion and Electron-Atom Collisions.

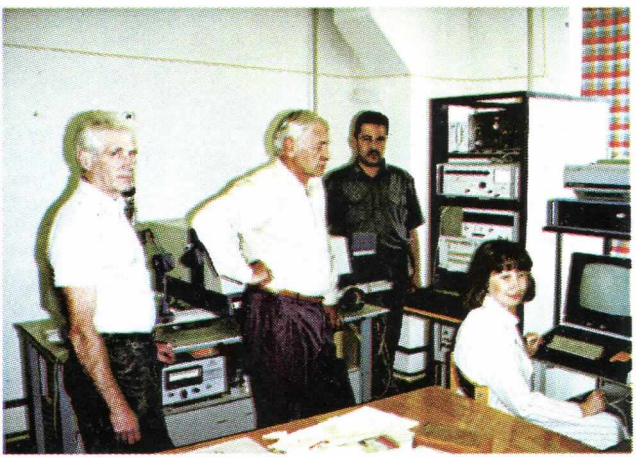


*Установка з газодинамічним джерелом молекулярного пучка.*
Gas Dynamical Molecular Beam Source.

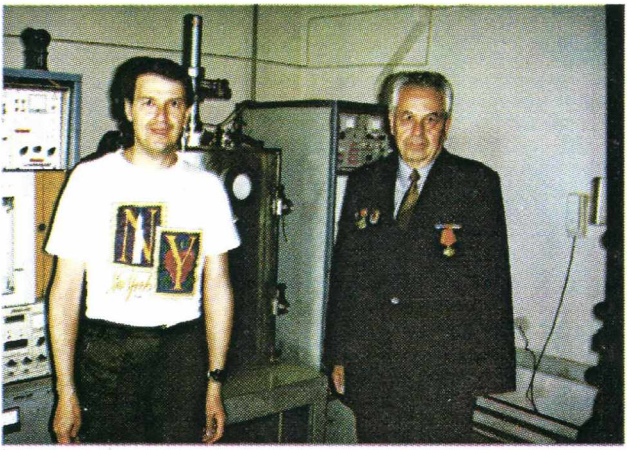


*Мас-спектрометрична лабораторія.*
Mass-Spectrometry Laboratory.

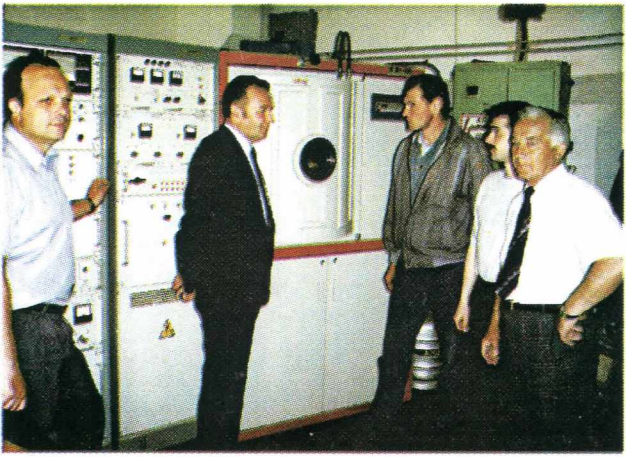
*Лабораторія багатофотонної іонізації.*
Multifoton Ionization Laboratory.



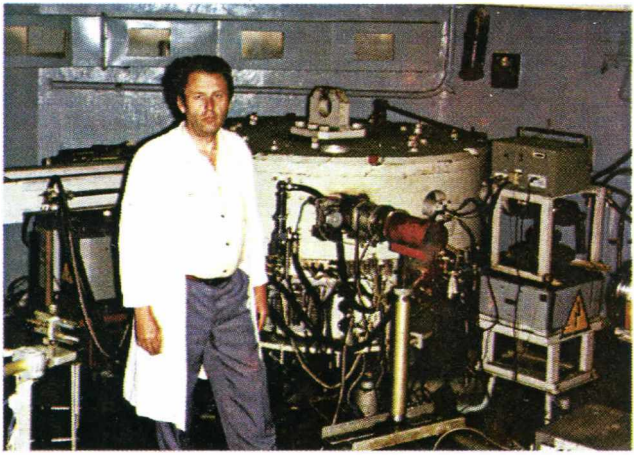
*Лабораторія ІЧ-спектроскопії..*
IR-Spectroscopy Laboratory.



*Лабораторія по росту кристалів.*
Crystal Growth Laboratory.



*Лабораторія тонкоплівкової технології.*
The Laboratory of Thin Layers Technology.



*Прискорювач електронів - мікротрон М30.*
Electron Accelerator - Microtron M30.

**Institute of Electron Physics** – the first institute of Ukrainian National Academy of Sciences, located in Transcarpathia – was founded in 1992 on the base of Uzhgorod Department of the Institute for Nuclear Researches, Ukrainian Academy of Sciences. The department having been organized and headed until 1988 by Prof. I.P.Zapesochny. This is the only institute in Ukraine, carrying out scientific research on the urgent problems of atomic physics, physics of electronic and atomic collisions, low-energy nuclear physics, physics of metal vapour lasers, construction of optical and laser devices. The foundation of the institute was the result of the efforts of numerous researchers headed by such known scientists and leaders of scientific groups in Uzhgorod as I.P.Zapesochny, V.O.Shkoda-Ulyanov, Yu.M.Lomsadze, D.V.Chepur, M.I.Holovey. The important role in the organizing and development of scientific researches in Uzhgorod was played by Acad. M.V.Keldysh, Acad. B.Ye.Paton, Acad. L.A.Artsimovich, Acad. O.F.Nemets, Acad. V.G.Baryakhtar, Acad. M.S.Brodyn, Acad. I.R.Yukhnovsky, Acad. S.V.Svechnykov, Acad. M.V.Pasichnyk, Acad. I.M.Vyshnevsky, Acad. B.I.Verkin.

**The main directions of the scientific activity of the institute consist in:**

- studies of elementary processes and phenomena stimulated by interaction of low and intermediate energy electron, ion, atomic and molecular beams with each other and with condensed matter;
- studies of elementary processes and mechanisms of lasing excitation in gas lasers; development and creation of new lasers, optical materials and devices for quantum electronics.

The institute comprises 7 scientific departments (where over 100 researchers, among them 12 Doctors of Science (Dr.Sc.) and 32 Candidates of Science (Ph.D.) as well as post-graduates work) with its own scientific library, Scientific Council, maintenance group and experimental workshops. The institute possesses modern facilities, original equipment including the electron accelerator up to 30 MeV (M-30 microtron),

superhigh vacuum setups ($p = 10^{-10}$Torr) for surface studies and for investigation of electron excitation of ions, a gas dynamical molecular beam source, mass-spectrometers, electron guns, electron monochromators and analysers, dye lasers, setups for crystal growth and film deposition, modern computers.

The institute maintains scientific contacts with many research institutes of Ukraine, Russia, Hungary, the Czech Republic, Germany, France, Great Britain and other countries. International conferences, scientific forums are regularly held in the institute. One of the achievements of the scientists of the institute was the Sinelnikov Prize of Ukrainian National Academy of Sciences awarded in 1994 to I.P.Zapesochny, V.A.Kelman and Yu.O.Shpenik for their investigation "Physical processes and mechanisms of excitation in bismuth vapour lasers with electron and optical pumping", as well as the State Prize of Ukraine in science and engineering awarded in 1995 to I.P.Zapesochny, O.B.Shpenik. A.I.Imre, A.M.Zavilopulo, O.M.Sabad together with the scholars of Uzhhorod State University V.I.Lendyel, L.L.Shimon, I.S.Aleksakhin for the series of studies "Elementary processes and resonance phenomena in pair collisions of electrons, atoms and ions". Through the recent 4 years the researchers of the institute have accomplished 3 Dr.Sc. and 5 Ph.D. degrees, published 4 books and over 150 papers.

Along with the fundamental studies the institute carries out applied research to satisfy the requirements of the national economy. A number of techniques and devices were worked out and applied in production and medicine: digital weightometers for weighting the mixture, weightometers for overhead travelling cranes, hygrometers of layered materials, thickness gauges for three-layer structures, argentometers for determining silver concentration in the photography waste solutions. Laser devices for intravascular irradiation of blood, acupuncture, physiotherapy, have been created, techniques of vacuum annealing of step-motor driver elements, spectral and mass analysis of ceramics composition by laser excitation have been worked out.

**Department of Theory of Elementary Interactions** (Prof. I.Yu.Krivsky – Head; Prof. M.I.Haysak, Dr. O.I.Sabad, Dr. O.I.Zatsarinny, Dr. Ye.Yu.Remeta, Dr. V.I.Kelemen, Dr. L.O.Bandurina, Dr. Z.Z.Torich, Dr. V.M.Simulik). The efforts of the department are mainly concentrated on the development of methods for solution of few- and multi-particle problems of atomic physics (methods of hyperspherical coordinates, density functional, optical potential, diagonalization), studies of interaction of electrons and photons with atoms and ions, strong electromagnetic field, investigation of relationship between the Dirac equation for spinor field and the Maxwell equations, searching for the conservation laws for these fields. The resonances in electron-atom and electron-ion collisions are studied, energies, wave functions and widths of the autoionizing states of He, Be, Mg, Ca, Li, Na, K, Rb, Cs atoms are obtained, the resonance structure of the effective cross-sections of electron scattering by various atoms and ions is described, the cross-sections of dielectronic recombination of electron at He ion, Ca atom ionization and ionization of sodium-like Mg, Al, Si, Fe ions are calculated.

**Department of Photonuclear Processes** (Prof. V.T.Maslyuk – Head; Prof. D.I.Sikora, Prof. V.I.Mazur, Dr. P.P.Hanych, Dr. A.I.Lengyel, Dr. O.O.Parlag).The investigations, performed at the department on the base of M-30 electron accelerator, are aimed at studying photonuclear reactions in the range of E1 giant resonance and at the studies of radiation strength of new materials and devices, carrying out activation analysis. The systematic studies of efficiencies and effective cross-sections of the photocreated delayed neutrons at the heavy nuclei decay have been performed, the original model for the calculation of the absolute efficiencies of the delayed neutrons has been worked out, new nuclear data on the efficiencies and effective cross-sections of isomeric states formation at the inelastic scattering of gamma-photons by selenium, bromine, silver, hafnium and tungsten isotopes have been obtained.

**Department of Ionic Processes** (Prof. O.B.Shpenik – Head; Prof. A.N.Zavilopulo, Dr. J.E.Kontros, Dr. M.M.Erdevdi, Dr. A.V.Snegursky, Dr. I.V.Chernyshova, Dr. T.Yu.Popik). The field of scientific research includes the studies of elementary processes and phenomena, stimulated by interaction of low-energy electron, ion, atomic and molecular beams with each other and with condensed matter. Using the crossed-beam technique and methods of photon, electron threshold, metastable and mass spectromerty, the systematized data for elastic and inelastic (excitation, ionization) scattering of electrons by atoms of the first, second and eighth groups of the Periodic Table and a number of molecules ($H_2O$, $N_2$, $CO_2$, $SF_6$) have been obtained. Detailed studies of cascade transitions, resonance processes, post-collisional interaction of the scattered and autoionizing electrons, kinematic effects have been performed. A wide spectrum of investigations of interference effects at slow ion-atomic collisions and the interaction of monoenergetic electrons with solid surface have been carried out.

**Department of Crystal Physics** (Dr. D.B.Goyer – Head; Dr. A.V.Gomonnai, Dr. Yu.M.Azhniuk, Dr. Yu.O.Xavery, Dr. V.M.Holovey, Dr. L.G.Romanova). The main efforts of the department are aimed at studying variation of electrical and optical properties of $A^{III}B^{V}$ and $A^{II}B^{VI}$ semiconductors under irradiation of MeV-electrons and the investigations of the mechanisms of formation and annealing of radiation defects, as well as at studying the technological and external effects upon the optical and electrical properties of crystals being used in acoustooptics and nonlinear optics. The effect of impurities (S, Te, Se, Fe) upon the optical absorption and photoluminescence spectra of electron-irradiated gallium phosphide was studied, the new stages of low-temperature annealing of the radiation defects having been revealed.

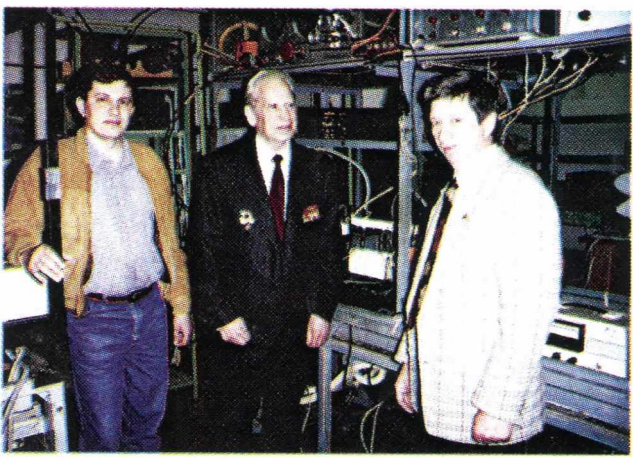
**Department of Electron Processes** (Prof. A.I.Imre – Head; Dr. V.S.Vukstich, Dr. G.G.Bogachov, Dr. O.O.Borovik, Dr. H.M.Gomonai). The experimental studies of the processes and

phenomena in the inner electron shells of atoms and ions at pair collisions of electrons with the atoms and ions are carried out in four major directions: (i) optical spectroscopy of atoms and ions in the vacuum ultraviolet (VUV) range; (ii) X-ray spectroscopy of free atoms at their collisions with electrons of keV-energies; (iii) visible and VUV optical spectroscopy of ions at their collisions with electrons; (iv) electron spectroscopy of atoms at their excitation by monoenergetic electrons. The researchers have studied in detail the processes of Tl, Cd, Zn, Mg, Ca, Sr, Ba ions excitation, electron and optical spectra of alkali and alkaline-earth autoionizing states decay, formation of vacancies in the inner shells of alkali metal atoms.

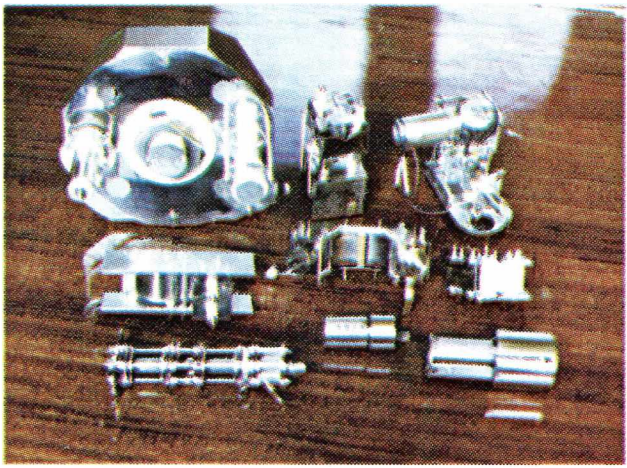
**Department of Quantum Electronics** (Prof. V.A.Kelman – Head; Prof. I.P.Zapesochny, Dr. V.P.Starodub, Dr. Yu.V.Zhmenyak, Dr. O.I.Gomonai, Dr. Yu.O.Shpenik). The investigations at this department concern studying mechanisms of formation of inverse population and lasing excitation in metal-vapour lasers, compound-vapour lasers, plasma dynamic and excimer lasers as well as nonlinear effects at the interaction of powerful laser radiation with free atoms. The lasing action of bismuth- and copper-vapour lasers was thoroughly examined and improved, the scientists of the department being the first to obtain lasing at photodissociative excitation of bismuth dimers. At present time a quasicontinuous plasma dynamic laser, based on the mixture of a plasma jet and a halogen agent, and a powerful excimer laser with X-ray preionization are being constructed. In the field of nonlinear studies at the interaction of coherent adiation with free atoms the specific features of multiphoton ionization and resonance interaction of sodium and ytterbium atoms are investigated.

**Department of Optical Materials for Quantum Electronics** (Prof. P.P.Puga – Head; Prof. M.I.Holovey, Dr. A.V.Lada, Dr. S.S.Krafchik, Dr. A.M.Solomon, Dr. V.Yu.Loya). The main efforts of the department are concentrated on studying and elaborating the physical and chemical fundamentals

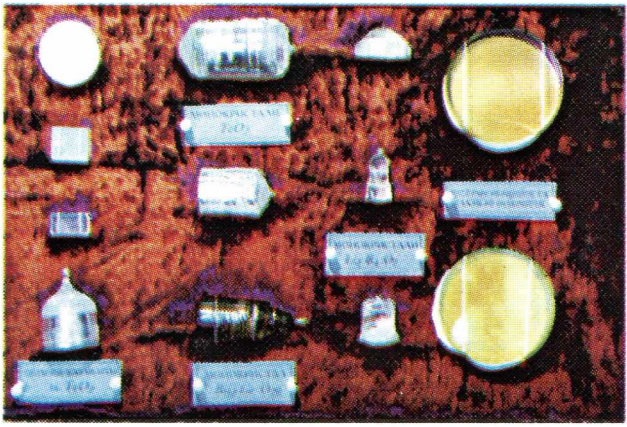
and techniques of obtaining single crystals, films, glasses of the materials promising for nonlinear optics, acoustooptics, optoelectronics, laser optics. High- quality enlarged paratellurite single crystals as well as the single crystals of some borate compounds have been obtained. Besides, the techniques for obtaining protective and anti-reflective coatings for optical devices of KDP ($KH_2PO_4$), DKDP ($KD_2PO_4$), CDA ($CsH_2AsO_4$), DCDA($CsD_2AsO_4$) and lithium iodate single crystals as well as light-dividing coatings for the elements of power optics for powerful technological lasers have been worked out.



*Лабораторія лазерів на парах металів.*
Metal Vapour Lasers Laboratory.



*Джерела електронних, атомних та іонних пучків та електронні спектрометри.*
Electrons, Atoms and Ions Beams Sources and Electron Spectrometers.



*Елементи оптичних матеріалів.*
Parts of Optical Materials.

*Відповідальний за випуск: О.Б.Шпеник*
*Редактор: А.М.Завілопуло*
*Фото: М.М.Ердевді*

Віддруковано в Ужгородській міській друкарні.
Замовлення № 1293. Тираж 350 пр.