**Universities - partners:**

- ✓ University of Rome (Faculty of Mathematics)
- ✓ University of Salemmo (Faculty of Informatics and Mathematics)
- ✓ University of Naples (Faculty of Engineering)
- ✓ Bologna University (Faculty of Mathematics)
- ✓ University of Toronto
- ✓ University of Lisbon
- ✓ University of Barcelona
- ✓ University of New York

Over the past years, the Faculty of Physics and Mathematics has been implementing joint work with the Los Alamos National Laboratory (LANL). This laboratory was founded in 1943 for the implementation of the Manhattan Project on the Establishment of Nuclear Weapons.

At present, LANL conducts fundamental research in many fields of physics involving scientists from around the world. The series of works performed with the direct participation of the representative of NTUU "KPI named after Igor Sikorsky" by Professor V. Gorshkov was completed by the publication of the book "Magnetis Reconance and microscope and a single spin measurement", World Scientific, 2006. It

Devoted to the technique of registering in the solid state of individual electron spins, which provides a unique tool for research in physics, chemistry, biology and medicine.

Distribution of an initially coherent laser beam in a turbulent atmosphere. A sample of numerical simulation demonstrating both fragmentation and wandering.

The cooperation of the NTUU "KPI Igor Sikorsky" and LANL in the field of optical communications, carried out with the help of a laser beam (Prof. V. Gorshkov, post-graduate student S. Torous) is carried out efficiently. A connection of this kind will be characterized by high communicability, secrecy and high density of transmitted information.

An essential factor that holds back the implementation of major technical solutions is

An atmosphere that is virtually turbulent in all weather conditions. Even small spatial variations of the refractive index lead to a distortion of the laser beam. In the process of propagation, the beam is fragmented (splits into separate rays) and deviates from the original direction. The received signal level becomes random, which increases the probability of errors in decoding information. Studies conducted at the Physics and Mathematics Department are devoted to the development of methods for suppressing the detector signal fluctuations. Widespread use of mathematical modeling in the study of the distribution in the turbulent atmosphere of so-called particle-coherent beams (including optical Vortices), allowed to achieve a decrease in the level of fluctuations of the signal 20 times. Such an indicator is the record in the world today. The results of the joint work published in the JOURNAL OF PHYSICS B: ATOMIC, MOLECULAR AND OPTICAL FISCIS (2009), are highly praised at the annual Photonics West-San Francisco-2009 conference and included in the 2009 list of the highest achievements of LANL.

Alamos National Laboratory and National Tequencal University of Ukraine "KPI".

It is supposed to perform joint work in the

- area theory and modeling of propagation of light through the turbulent atmosphere; Theory and modeling of sensors and imgers;

- Modulation of the dynamics of quantum systems interacting with the environment;
- Modulation of electromagnetic radiation scattering and absorption by NSS;
- Study of surface-enhanced Raman scattering (SERS) and fluorescence of molecules adsorbing on the NSS interfaces and are micro-resonators;
- Modeling of controlled growth of nano-particles.

Over the last three years, active collaboration, enshrined in the relevant agreement, with the Center for Advanced Materials in Materials Science (Clarkson University, NY) is underway.

Works devoted to physics of nanosystems. It is known that the properties of one and the same substance placed in a particle with dimensions up to 100-200nm differ significantly from the physical and chemical properties of particles of micron (and higher) scales. Nanoparticles are widely used in medicine, microelectronics and even in rural households. The method of obtaining nanoparticles should ensure their monodispersity (uniformity of size) and controllability of the form, from which strongly

Depend on the physical and chemical properties of the particles. Often, depending on the modes of formation, the shape of the particles is different for one and the same source material.

In addition, cooperation with foreign scientific and educational institutions is carried out at all departments of the faculty.