Nuclear Microprobe and the Single Ion Facility
at the Institute of Nuclear Physics PAN Krakow

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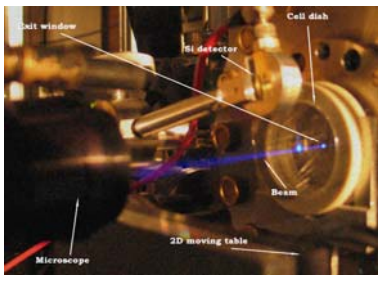
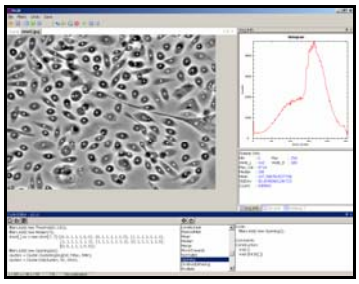
The Institute of Nuclear Physics (IFJ PAN) in Krakow is a governmental research institute established in 1955. It employs almost 500 persons, including 66 professors and assistant professors. Part of the Institute was distinguished as the center of excellence ADREM, encompassing the Department of Applied Spectroscopy. The Department is applying nuclear spectroscopy methods to other branches of science, mainly medicine and biology, nanotechnology, and materials research. The bulk part of results has been obtained with home facilities. From numerous experimental setups of the Department, the main research tool is the HVEC KN-3000 type Van de Graaff accelerator, equipped with proton microprobe, delivering proton beam focused down to a spot of 7 μm in vacuum or 15 μm in air. The facility is supported by the dedicated biology and sample preparation laboratories.

Main field of the "standard" ion beam applications are studies of trace elements content and surface and depth distribution of elements with the use of PIXE, STIM, and RBS techniques. From recent research, two programs should particularly be mentioned:
- studies of the possibility of TiO_2 nanocrystals penetration through human skin (recently closed EU project NANODERM, 8 EU institutions, coordination Prof. T.Butz, Leipzig),
- determination of the geological age of rocks, carried out by measurements of U, Th, and Pb content in monazite crystals (collaboration with the Institute of Geology PAN).

In another area, the single ion facility has been put into routine operation. It allows targeted external irradiations with the control of ions number down to a single proton. Parallel with irradiation setup, a sophisticated software system has been developed, enabling on–line cell recognition and automatic positioning. The research was focused on living fibroblast cells irradiations carried out with the external proton beam. This task has been realized in frames of the 6th UE network CELLION, "Studies on cellular response to targeted single ions using nanotechnology" (2004–8, 10 EU institutions, coordination J.Lekki, IFJ).

(a) 

(b) 

(a) External proton beam in the microprobe single ion hit facility
(b) Interface of the automatic cell recognition and the beam control code.

To enhance the experimental basis with complementary techniques, the most recent project realised in the Department is the construction of an X-ray microprobe based on a microfocus X-ray tube Hamamatsu L9191, with the expected X-ray beam diameter of 1 μm. Researchers and students participate also in complementary experiments performed with SRIXE, XANES, EXAFS, FTIR or micro-Raman spectroscopy methods using facilities in the collaborating institutes, mainly Frascati, Hamburg, and Brookhaven.