Electron Source and Free Electron Laser Laboratory

The project consists of three stages, each could be financed by the offset funds:

- Lab for development of electron source cathodes (5 M$)
- Lab for development and test of superconductive electron guns (30 M$)
- UV free electron laser POLFEL (200 M$)

The Andrzej Soltan Institute for Nuclear Studies (IPJ) already collaborates with The Thomas Jefferson National Accelerator Facility (TJNAF) in research and development studies on the superconducting electron injector furnished with the superconducting thin film lead photocathode. Such injectors are dedicated to the continuous wave operated linacs, most of all, for those feeding free electron lasers (FEL). The lead film having the thickness of a few hundreds of angstrom is deposited with the UHV cathodic arc - a method which has been specifically established at IPJ.

A quantum efficiency (QE) and rf resonant quality (Q) measurements are performed at cryogenic test facility at TJNAF. A hitherto results show satisfying QE values, significantly higher than those achieved for the photocathodes obtained with other deposition techniques. Observed resonant quality strongly depends on the deposition process and is a main subject of currently undertaken efforts.

In general, from the gained experience, we conclude that arc based deposition is well suited to the Pb photocathode preparation. Up to our knowledge, the performed studies are the unique worldwide. Due to the rising interest in constructing high average power FEL in Europe and America, we plan to extend our activity by setting new deposition stages.

The extension includes a construction of 2 deposition stands: spherical chambers with cathode bloc and knee-type filter. Both equipped with an in situ diagnostics instruments: electron, x-rays and ultraviolet spectrometers. The laboratory will be upgraded to enable a dust-free chemical processing. That will be accomplished with a new experimental infrastructure including a hall with a clean room area for the work and inspections of the open cavities, and workshop containing glove-box and laminar flow chamber. The implementation is expected in 2 years and involves 16 man-years.

The next step is the lab for development and test of superconductive electron guns. It requires a dedicated building equipped with RF power supply, cryogenics, RF cavities with control system and diagnostics.

The final stage of the program is a complete free electron laser. It consists of an electron gun, 600 MeV linear accelerator, ondulators and optical beams. It needs 400m long tunnel and experimental hall. Once built, it will be the largest and most advanced research device in Central-Eastern Europe. With 0.2 GW power pulses as short as 100 femtoseconds it will give unprecedented possibilities:

- condensed matter studies with a special focus on electronic properties of molecules,
- three-dimensional analysis of molecular structures,
- analysis of physical, chemical and biological processes in femtosecond and atomic scale.

Its applications ranges from physics and chemistry through material engineering to biology and medicine.

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