O-21 **Friday, 17.06., 12^{40} - 13^{00}**

Commissioning of ARPES beamline at the Polish National Synchrotron Solaris

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Keywords: synchrotron radiation, Photoelectron spectroscopy

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Ultra high resolution Angle-Resolved Photoelectron Spectroscopy (UARPES) beamline has been constructed at the III generation synchrotron SOLARIS in Cracow, Poland.

The length of the UARPES beamline from source to the sample position is 28.5 m. The source of photon is 2.8–m-long, 120–mm period, quasi-periodic elliptically polarizing undulator (EPU) of Apple II type. The undulator with minimum gap of 20 mm, enables variable polarization (linear of any orientation, circular, and elliptical). The maximal radiative power of the undulator is 600 W. The UARPES EPU is the first undulator installed at 1.5 GeV SOLARIS storage ring of the Polish National Synchrotron Radiation Centre SOLARIS. The UARPES beamline is designed to cover the UV photon energy range from 8 eV to 100 eV. High resolving power of 20 000 over the whole energy range is achieved with the state-of-art monochromator combining NIM and PGM geometry in a single design. The beamline control system is integrated with SOLARIS machine using TANGO software. Each of the beamline devices is navigated with a dedicated device server. PLC system monitors all beamline's critical parameters and sends status information to the Graphical Users Interface (GUI). Beamline motors and encoders are controlled with state-of-art ICEPAP controllers. The ARPES beamline has been designed safe for users. The first beamline mirror is enclosed inside a safety hutch having 5 mm shielding lead wall. Much attention is paid to monitoring of the radiation level during operations.

The Endstation includes two separated chambers: the sample preparation chamber equipped with devices for surfaces cleaning and surface diagnostic as well as the analysis chamber including state-of-the-art energy spectrometer DA-30 L from VG-Scienta, Sweden. The spectrometer facilitates measurements within the solid angle of 30° without sample rotation. The system is equipped with a cryogenic 5- axis manipulator including LHe flow type cryostat, stabilizing the sample temperature within the range 10 K to 500 K.

The SOLARIS synchrotron is a newcomer to the synchrotron world, and the ARPES beamline is the first beamline to be commissioned at SOLARIS. This situation is obviously a challenge for the SOLARIS team. Fortunately there are experts from other, well established synchrotron centers assisting with their advices. At the beginning the beamline is configured for the linearly (horizontally) polarized light and monochromator working in the PGM mode. The photon beam geometry along the beamline is monitored using currents intercepted by collimating baffles and photodiodes, as well as using beam images on the YAG screens.

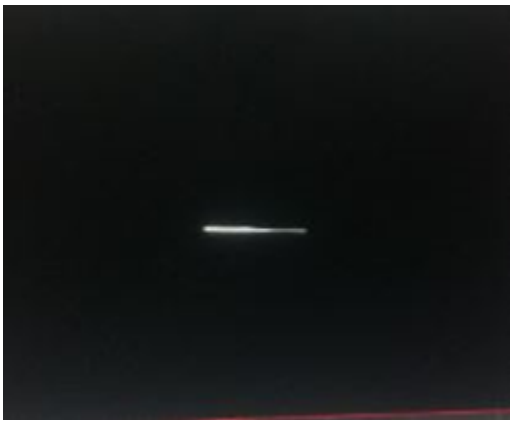

Figure 1. An image from YAG screen - first photons at the ARPES beamline. The acquisition was performed for electron beam values: energy 1.5 GeV and current 10 mA. The undulator gap equals to 100 mm.

The success of guiding the light from the source up to the Endstation to a large extent depends on fiducialisation and carefull metrology of the beamline component. The used metrology procedures (a so-called blue lining) has allowed to transmit the photon beam along the beamline using only minimal corrections. The carefully performed checking of numerical models by SOLARIS alignment group has been crucial for correct placement of the beamline elements.

Acknowledgments: This work was supported by European Regional Development Funds.