J. Goulon

A. San Miguel ID24

T. Neisius

A. Koch

A. Fontaine

M. Renier

J. Röhler Belousov oscillator

H. Müller

U. Hatje Pt oscillations

H. Förster

T. Ressler Pd oscillations

W. Metz

Quick beam shifting for fast time-resolved XAFS and diffraction experiments

B.P.Tolochko, S.G.Nikitenko

Institute of Solid State Chemistry, Novosibirsk-90, Russia

A.N.Aleshaev, M.V.Fedotov, G.N.Kulipanov, S.I.Mishnev

Budker Institute of Nuclear Physics, Novosibirsk-90, Russia

We propose an combination of electron and X-ray optical scheme that allows to path bunches of electrons through the undulator along different trajectories at different times t_i. It causes the shift of SR generation point. So, a discrete-moving radiation source generating SR at t_i moments will be created.

These method can be used for XANES and diffractiom experiments.

XANES

Traditionally, the monochromator rotation is used for the energy scanning. In the new method, the position of the monochromator is fixed, but the position of the electron beam is changed by the magnetic field. As a result, the angle SR-beam/monochromator is changed thus changing the energy of the monochromatic beam. These scheme was realized at VEPP-3.

The reduction of silver from silver stearate AgSt +Red -> Ag + HSt was used as the process to be investigated. The reaction was conducted under isothermal conditions at various temperatures. Time dependences of the obtained spectra was received [1].

We proposed to use the new version of these scheme with using undulator with spread radiation spectrum. In this case, energy dispersive elements and linear detectors can be used to obtain XANES spectrum within one bunch. The basis of the proposal is the undulator with varied electron orbits where each bunch has its own trajectory. The SR beam from each bunch diffracts from energy-dispersive elements, passes through the sample and then is registered by its own linear detector (one detector for each bunch). Thus, the magnetic field scan in the correctors is at the same time the scan in time scale. Distance between bunches is the factor defining time resolution of the XANES registration. For example, if the time between two bunches is 5 ns, then time resolution is 5 ns for one spectrum.

DIFFRACTION

There are no position-sensitive detectors for diffraction experiments with nanosecond time resolution. So we propose to scan electron beam from one trajectory to another inside undulator. For each new trajectory of electrons (and therefore SR), a single-coordinate detector Di will be placed so that the radiation will fall on it from the sample at the moment when electrons pass the t_i trajectory.

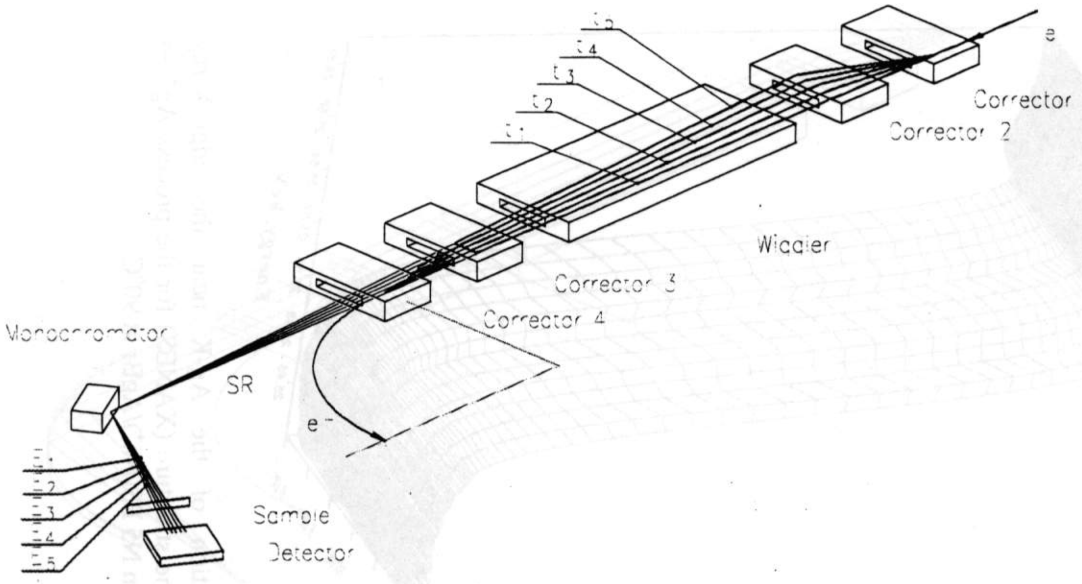
So, every new X-ray frame will be registered after some nanoseconds at an interval of t_i -1- t_i. The prototype of these scheme was realized at VEPP-3.

Reference:

[1] S.G. Nikitenko, B.P.Tolochko, et al - JOURNAL DE PHYSIQUE IV, (Supplement au Journal de Physique III, no.4), Volume 7, (1997), C2, pp 549-552.

Quick electron shifting for fast time-resolved XAFS and diffraction experiments

B.P.Tolochko, S.G.Nikitenko
Institute of Solid State Chemistry, Novosibirsk
A.N.Aleshaev, M.V.Fedotov, G.N.Kulipanov, S.I.Mishnev
Budker Institute of Nuclear Physics, Novosibirsk



XANES registration by electron beam position scanning at VEPP-3. Originally the monochromator is set up so that it received the photons from the undistorted orbit t_1. Then the orbit is deformed to the maximum of the deformed orbit t_5 and the scanning procedure begins: slow change of the orbit from t_5 to t_1. For each electron orbit t_1- t_5 corresponds the SR beam with energy E_1 -E_5.

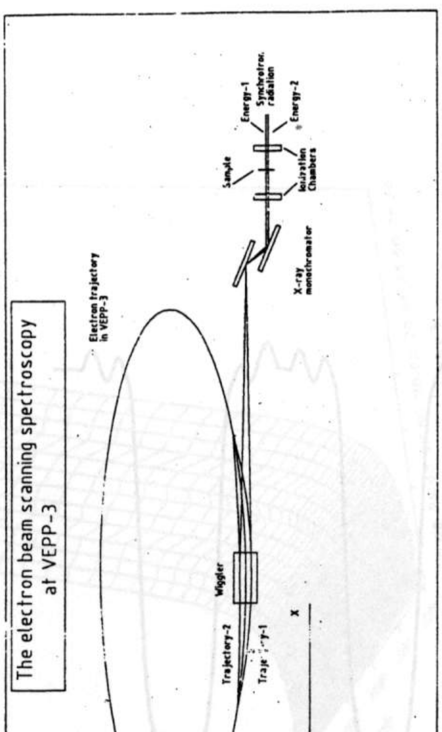
Дифракционный эксперимент с наносекундным временным разрешением. Проект для Accomulation Ring "Tristan" и тестирование прототипа на ВЭПП-3.

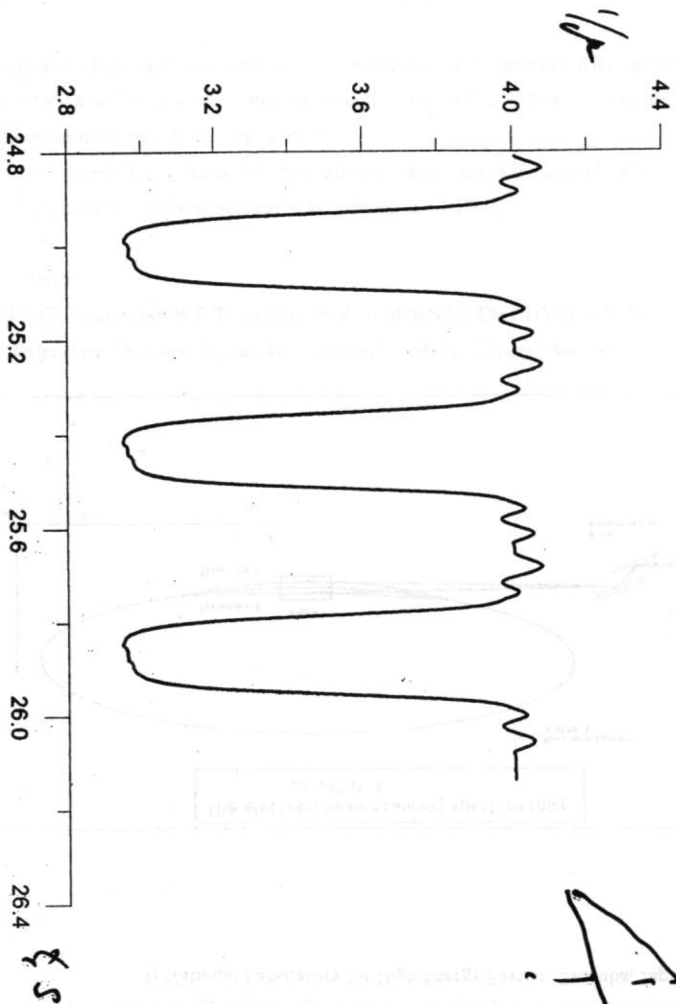
Б.П.Толочко[1], А.Н.Алешаев[2], В.Н.Корчуганов[2], Г.Н.Кулипанов[2], Е.Б.Левичев[2], Н.А.Мезенцев[2], С.И.Мишнев[2], В.Ф.Пиндюрин[2], М.В.Федотов[2], M.Ando[3]

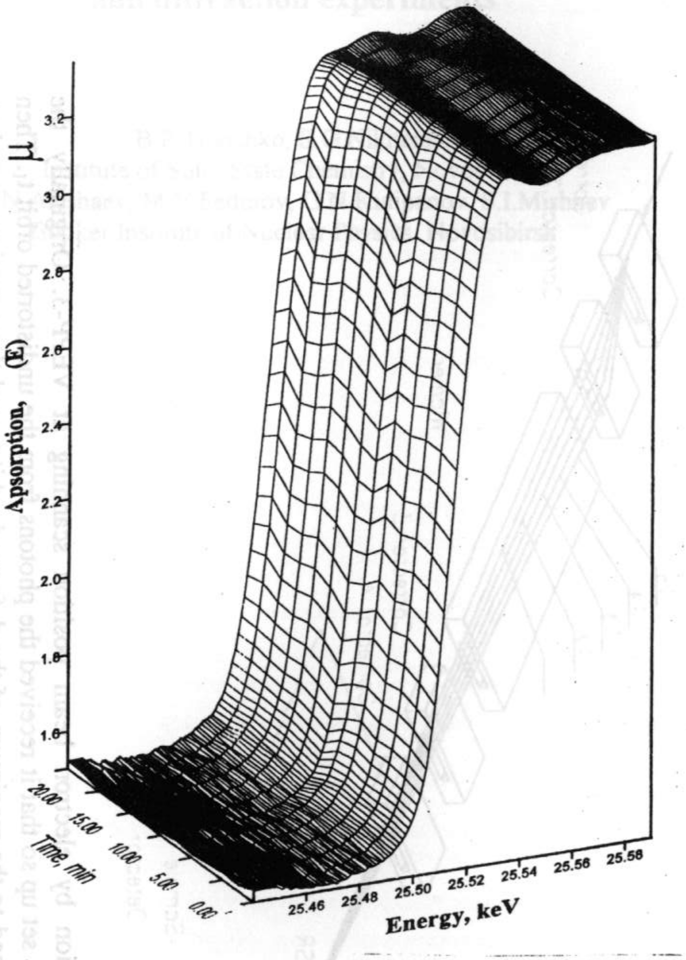
1) Институт химии твердого тела СО РАН, Новосибирск

2) Институт ядерной физики им. Г.И.Будкера СО РАН, Новосибирск

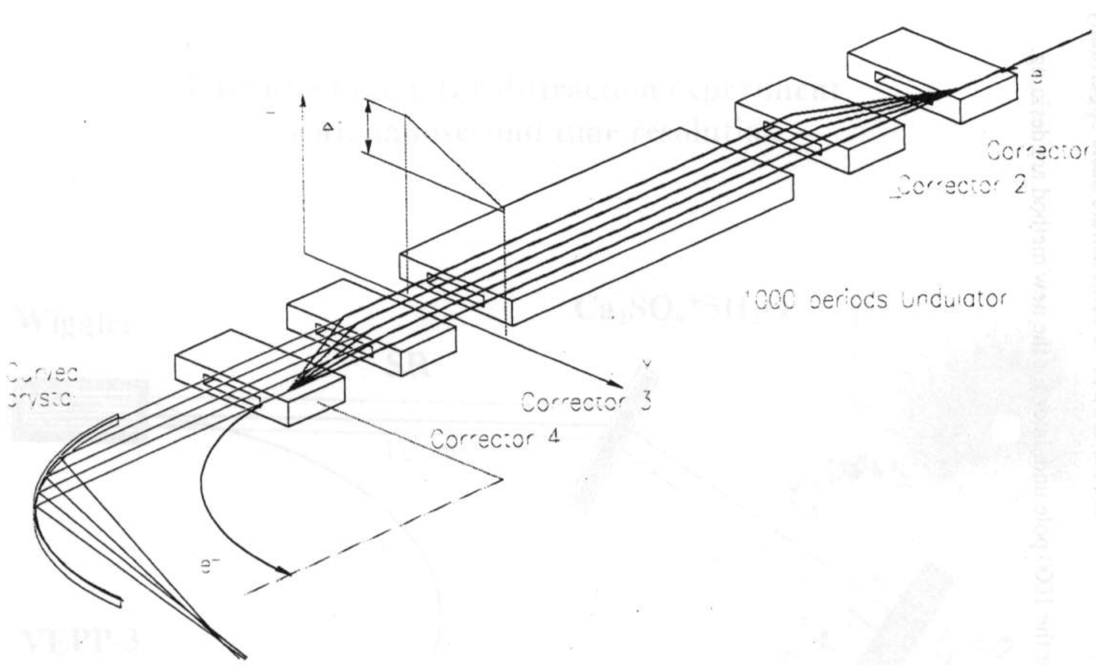
3) National Laboratory for High Energy Physics, Tsukuba, Japan



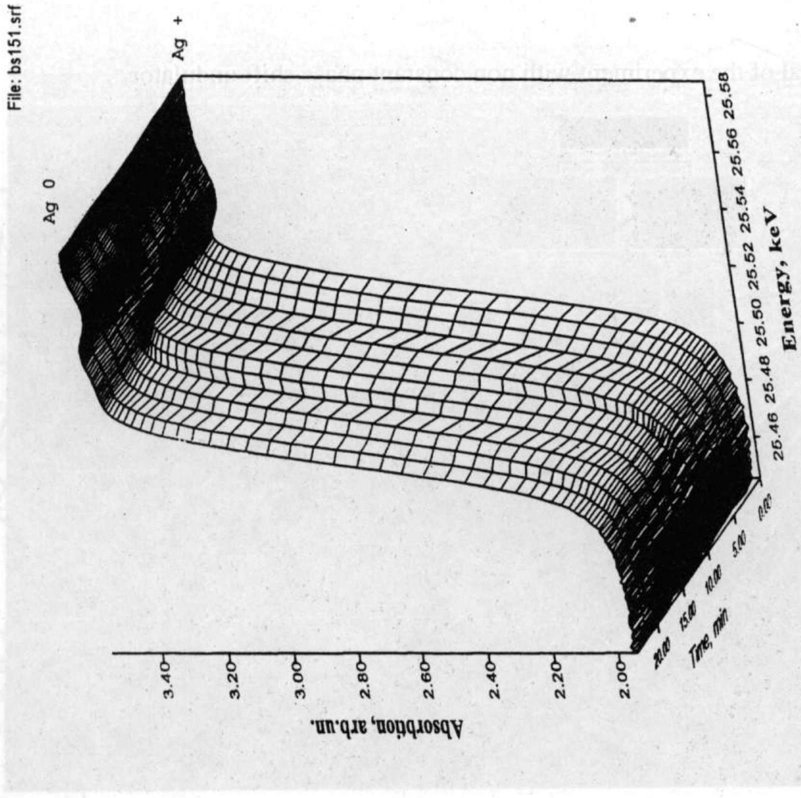




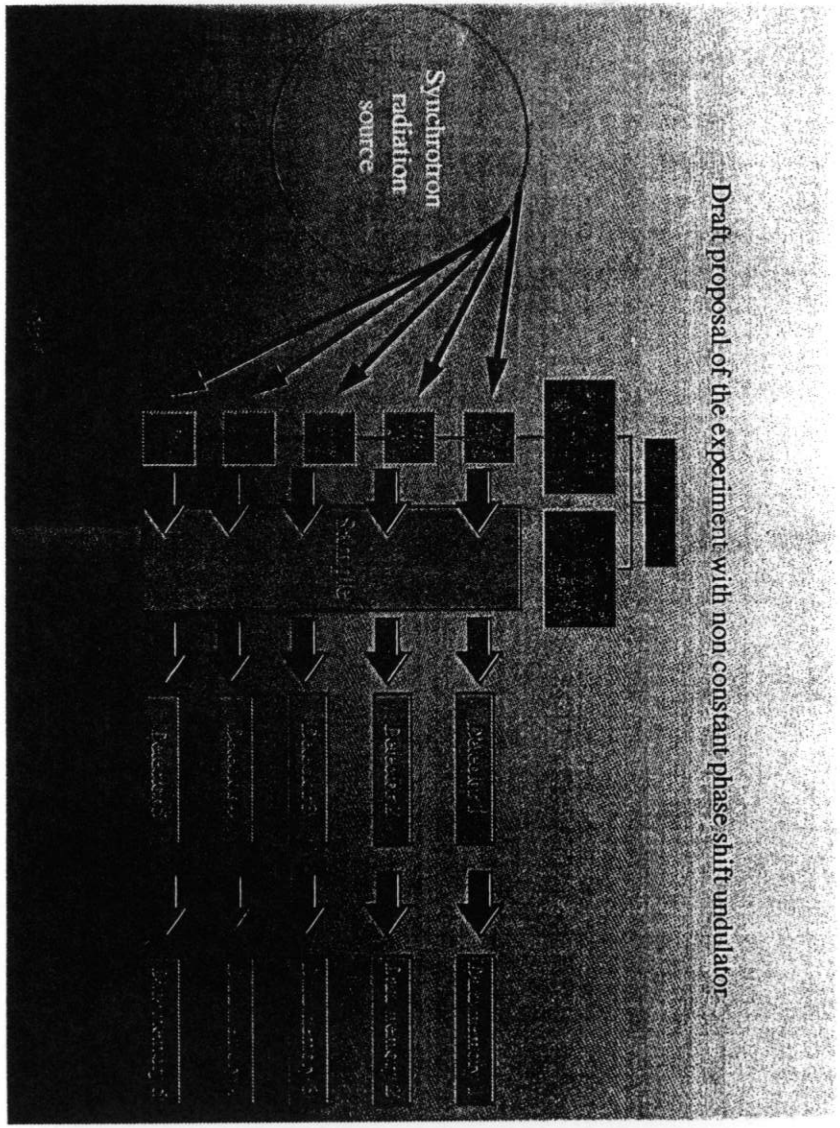
The evolution of the Ag-K near the edge-X-ray absorption fine structure (XANES) for the process $Ag^{+} \rightarrow Ag^{o}$ in the film N5 $FS(Na^{+})/AgBr$ at 90°C.



The proposal scheme for the XANES registration by electron beam position scanning at 1000 pole undulator with a variable field, the gradient of which is directed to perpendicular to the trajectory of the electrons. For each electron orbit corresponded the SR beam with different energy.



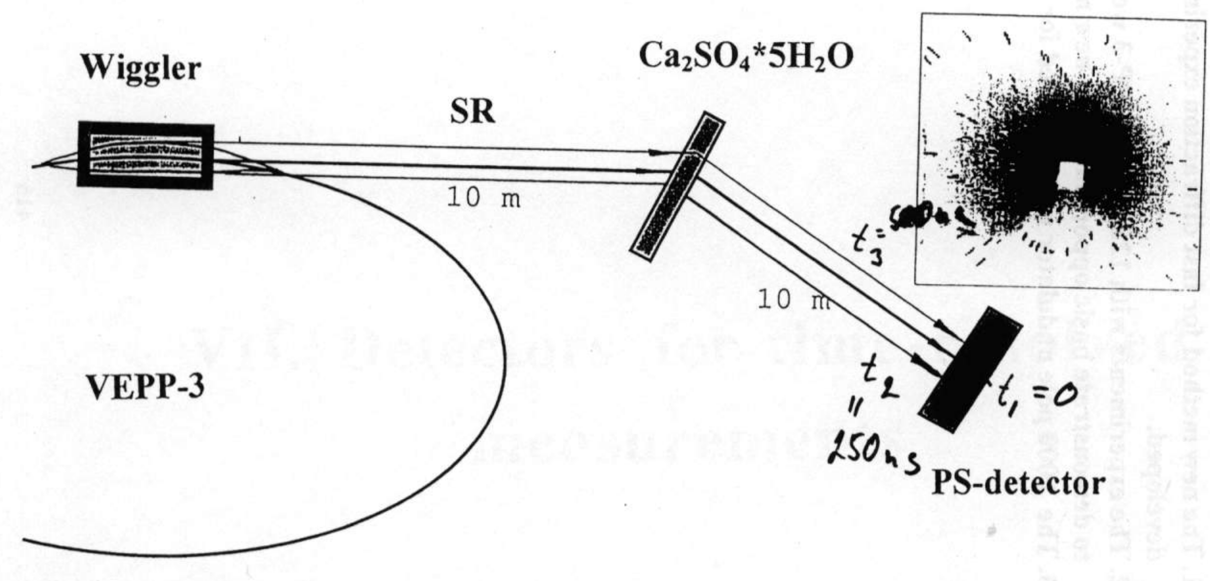
The evolution of the Ag-K near the edge-X-ray absorption fine structure (XANES) for the process $Ag^+ \rightarrow Ag^o$ in the film N7 FS(K^+)/AgBr at 90°C.

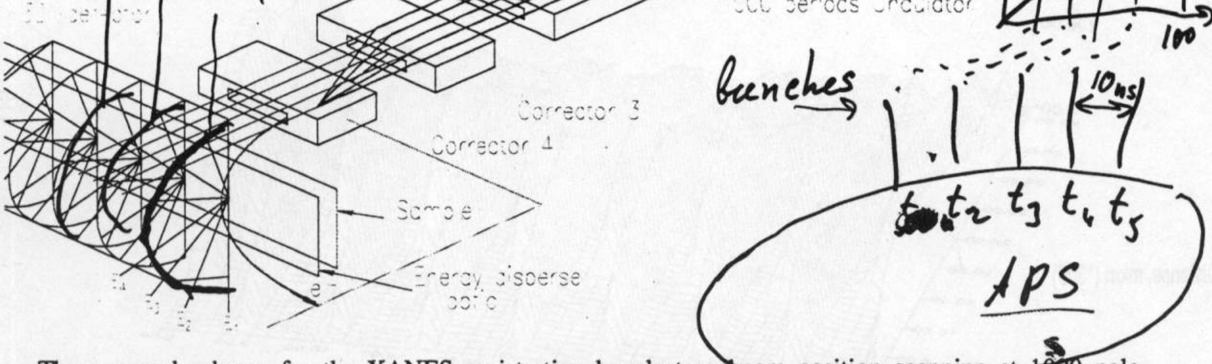


Conclusion

1. The new method for fast XANES was developed.
2.The experiments on VEPP-3 were carried out to demonstrate basic opportunity of a new method.
3. The proposals for the 1000 pole undulator for the new method are desining.

Layout of the Laue diffraction experiment with nanosecond time resolution



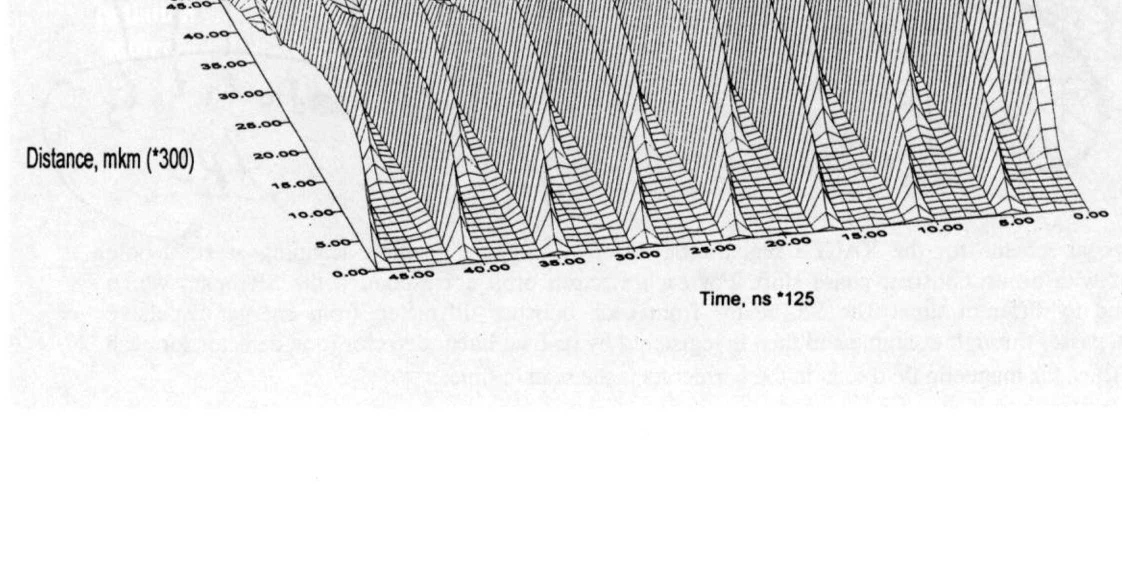


The proposal scheme for the XANES registration by electron beam position scanning at 1000 pole undulator with a non constant phase shift. For each electron orbit corresponded the SR beam which correspond to different time. The SR beams from each bunches diffracted from energy dispersive elements, passes through a sample and then is registered by its own linear detector (one detector for each bunch). Thus, the magnetic field scan in the correctors is the scan in time.

Conclusion

1. The new method for fast diffraction experiment was developed.
2. The experiments with 125 ns on VEPP-3 were carried out to demonstrate basic opportunity of a new method.
3. The 1000 pole undulator was proposed for new method

The SR beam behaviour after magnet switch on



Time-Resolved X-ray Diffration in the Study of the Solid-Solid Phase Transition of Even n-Alkane.

Md. Forhad Mina, Tsutomu Asano, Hiroshi Takahashi[1], Ichiro Hatta[1], Kazuki Ito[2] and Yoshiyuki Amemiya[3]

Department of Physics, Faculty of Science, Shizuoka Univ., Shizuoka 422, Jappan

[1]Department of Applied Physics, Faculty of Engineering, Nagoya Univ., Nagoya 464-01, Japan

[2]The Graduate Univ. for Advanced Studies, 1-1 Oho, Tsukuba, Ibaraki 305, Japan

[3]Engineering Research Institute, Faculty of Engineering, Tokyo Univ., Tokyo 113, Japan

The solid-solid phase transition of even n-alkane (hexatriacontane) was performed by simultaneous measurments with DSC, time-resolved WAXS using the X-ray television (TV) detector and SAXS using the PSPC. The structural changes during the transition from the low-temperature monoclinic form (ML) to the high-temperature monoclinic form (MH) are observed to undergo through the two processes. One shows a direct transition from ML to MH by twin formation without passing any activated state. The other exhibits a two-step transition from ML to MH passing through an orthorhombic state (O), where the molecules become upright from the ML state. The direct ML to MH transition was observed by the X-ray TV method at low temperature during the phase transition. This shows that the twin formation requires lower energy than the two-step process. On the other hand, the continuous change of the diffraction patterns observed by the X-ray TV mesurement exhibits that the ML to MH transition is accompanied by the coherent motion of the molecules. The change of the lamellar thickness observed by the time-resolved SAXS measurements also indicates the latter transition is consistent with the results obtained by WAXS and DSC.

The test experiments with a fast one coordinate position sensitive x-ray detector OD-3.2 at the beam line BL-15A at Photon Factory

Y.Amemiya[1], K.Ito[1], H.Okuda[2], N.Yagi[3]

[1]Photon Factory, KEK, Japan, [2]Kyoto University, Japan [3]Tohoku University, Japan

V.M.Aulchenko, M.A.Bukin, I.V.Gaponenko, M.S.Dubrovin, V.M.Titov

Budker Institute of Nuclear Physics, Novosibirsk, Russia

Yu.A.Gaponov, B.P.Tolochko

Institute of Solid State Chemistry, Novosibirsk, Russia

The detecting part of OD-3.2 is a proportional chamber with a drift gap. Electrons that appear due to the photo effect drift through the field-shaping wire grid cathode towards the anode wires where an avalanche amplification occurs. The avalanche coordinate along the anode is measured from the distribution of induced charge over the cathode strips that serve as the second chamber cathode. In order to provide a maximum counting rate with high coordinate resolution, a specialized processor was used to realize the algorithm of coordinate reconstruction for the simultaneous and independent registration of many events.

The first version of the parallax-free single-coordinate OD-3 detector (model OD-3.1) was developed in the BINP in 1995 [1]. It was installed at the beam line BL-5-b of the Siberian Synchrotron Radiation Center and used in time-resolved experiments on powder diffraction with microsecond time resolution.

The second version of the OD-3 (OD-3.2) with the focal length of 1500 mm was designed and manufactured for PF-KEK. The data acquisition and on-line visualization system is based on the Sun SPARC station.

During these experiments, coordinate and time resolution, parallax, counting rate and other parameters were measured. 0.1 mm SR beam was used for the test of coordinate resolution. The parallax-free test has been carried out in Novosibirsk using a special device that allowed to emulate the rotation around the 1.5 m focal point.

Two experiments have been made to carry out the counting rate test. A narrow SR beam was used in the first experiment, while scattering from an aerosil sample was used in the second one.

The time resolution test experiment was carried out with the use of the radiation of the SR beam. The whole time scale of OD-3.2 from 1 microsecond up to 10 min. was tested successfully in a frame-by-frame mode. The experiment on the frog muscle contraction was also used to test time resolution of the detector.

Detectors parameters:

Detector name	Focal length (mm)	Channel size (mm)	Space resolution FWHM (mm)	Number of channels	Count rate(MHz)
OD-3.1	350	0.07	0.18	3328	10
OD-3.2	1500	0.07	0.15	3328	10

Reference

1. V.M.Aulchenko, et al. Nuclear Instr. and Meth. in Phys. Res. A367(1995) 79-82.

Tense friction wave transmission, high precision rotation stage with tunable angular step from 0.04" to 0.2"

N.G.Gavrilov, A.N.Kosarev, M.A.Kholopov
Institute of nuclear physics, Novosibirsk-90, Russia
O.V.Evdokov, E.A.Kuzminykh, B.P.Tolochko
Institute of solid state chemistry, Novosibirsk-128, Russia

There are many problems connected with using precise device for linear and angular translation in synchrotron radiation beam lines. New experiments need more high precision technic.

The most using gear transmission mechanism has essential defect - the inconstant instantaneous transmission ratio. This defect is especially strong during rotation at small angles (in range of 0.1 - 0.2 degree of arc) and can reach 3"-10" in this region. Therefore we used absolutely different principle of transmission of rotation which has not such failing. This defect was overcome in rotation stage developed in BINP and ISSC, in which rotating mechanism made on basis of tense friction wave transmission (TFWT). In the report will be shows how this and same type mechanism works.

The kinematics of the TFWT is similar to that of the friction wave transmission (FWT). Because of this, the tense transmission is based on the principle of the transmission and transformation of movement by means of wave tense deformation of one or more links of the mechanism. The main difference of the TFWT, compared to the FWT, is that the transmission ration is mainly dependent on the deformation value, and the flexibility of the immobile wheel has also an impact on the transmission ratio.

Possible applications

1. Precise angular transposition in a wide range (360 degree), compared to the piezoceramic drive. The transmission allows to rotate sample at any angle with a very small pitch.
2. Precise linear transposition with a small pitch over large distance (for example with stroke 0.2 mm and pitch 0.01 micron).
3. The transmission of precise rotation and linear movement in vacuum.

Reference:

1. N.G.Gavrilov, B.P.Tolochko. Tense friction transmission and the using it in precise mechanism. Preprint 96-29 (1996). Budker Institute of Nuclear Physics, Novosibirsk.