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**FIRST TEST MODEL
OF THE OPTICAL MICROSCOPE WHICH IMAGES
THE WHOLE VERTICAL PARTICLE TRACKS
WITHOUT ANY DEPTH SCANNING**

INTRODUCTION.

In the CHORUS and OPERA experiments in the neutrino physics the vertical particle tracks are detected in bilayer nuclear photoemulsion with central support [1, 2]. To construct the image of the whole vertical particle track a depth scanning operation must be accomplished at first and then the results of this scanning are sent into the computer.

In JINR there have been proposed principally new optical microscopes for selective detection of the vertical particle tracks without any depth scanning operation [3, 4]. In the paper [4] the experimental testing of the DArk-Field Scanning CONfocal (DAFISCON) optical microscope has been performed. It was shown that dark field images can be produced clearly at high density of the vertical particle tracks.

In the paper [5] there was explained the principle of new optical microscope which enable to form the image of the whole vertical particle track without any depth scanning. A new element, a spatial image transformer (or converter) is used in this microscope. Very high selectivity can be achieved by means of the meso-optical illuminating condenser.

In this paper we describe the first test model of this optical microscope which produces in focus image of the whole vertical particle track without any depth scanning.

TEST MODEL.

In Fig. 1 it is shown the top view of the first test model of this optical microscope. It consists of the light source LS, object O, the first imaging lens L_1 , image converter (transformer) IC, plane mirror M, second imaging lens L_2 and the image detector ID.

The object O consists of the linear array of the point like element S inclined at the angle $\sim 45^\circ$ with respect to the optical axis of the lens L_1 . The image of this object is located in the 3D space so that it cannot be detected by any plane detector due to very small grazing angles which produce the light rays. The image converter consists of some separated mirror elements (Fig. 2). The width of the lamellar mirror is equal to 3 mm. Each mirror element of the image converter IC is oriented in such a manner that the reflected rays are directed into the aperture of the second imaging lens L_2 , so that the whole image converter is oriented perpendicular to the reflected light rays. The second imaging lens L_2 produces the image of the image converter IC on the image detector ID.

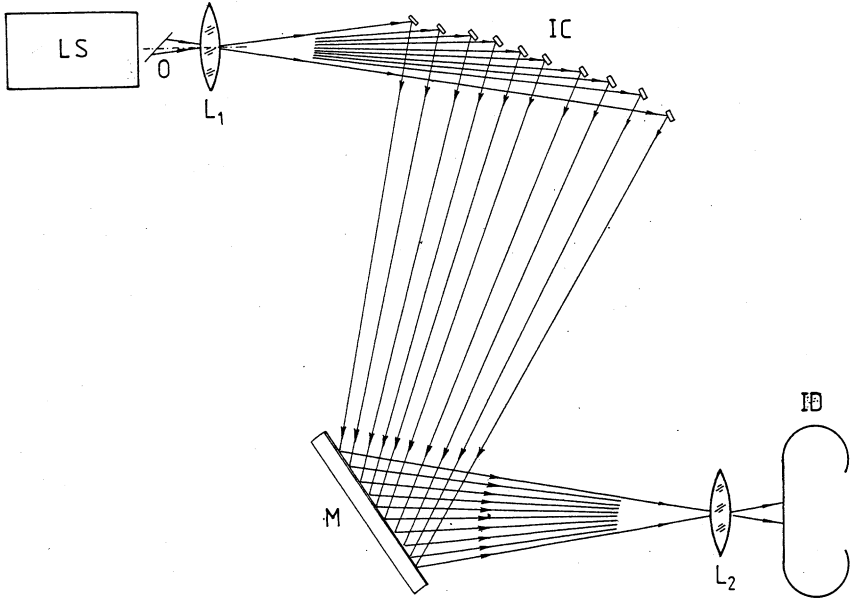


Fig. 1. The top view of the first model of the optical microscope which produces the image of the vertical particle track without any depth scanning: LS – light source, O – object in the form of the linear array of the point like elements inclined at the angle $\sim 45^\circ$ with respect to the optical axis, L_1 – the first imaging lens, IC – image converter, M – plane mirror, L_2 – the second imaging lens, ID – image detector.

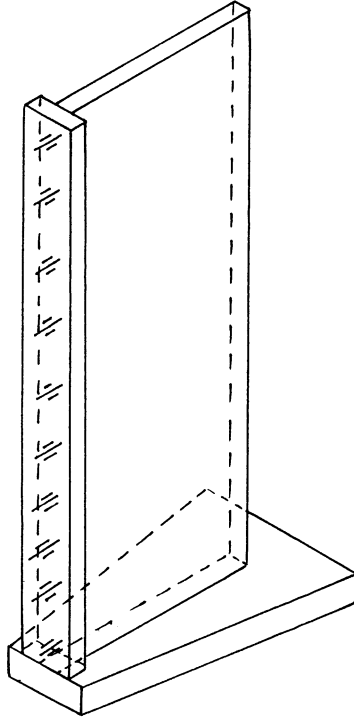


Fig. 2. The construction of one mirror element in the image converter IC. The width of the working lamellar mirror is equal to 3 mm.

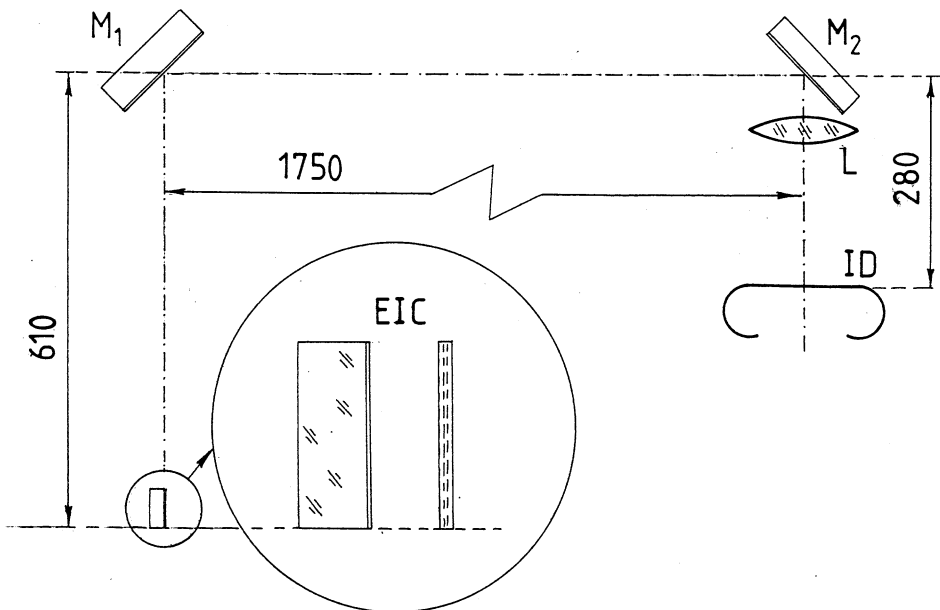


Fig. 3. The optical system by which the top image of the image converter has been obtained: EIC – one element of the image converter, M_1 – the first plane mirror, M_2 – the second plane mirror, L – the imaging objective, ID – image detector.

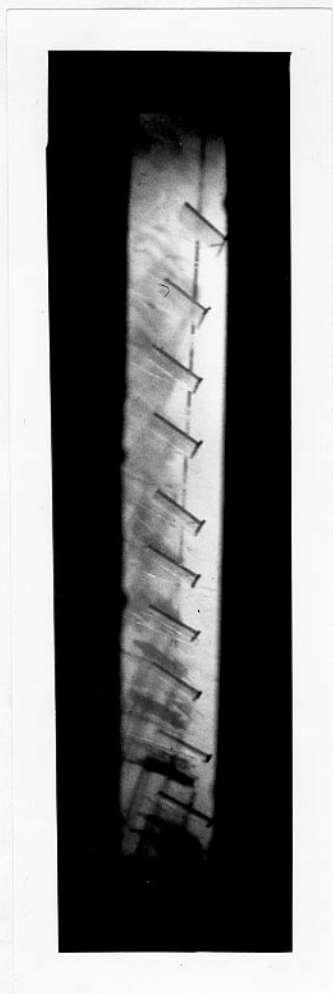


Fig. 4. The top view of 10 mirror elements of the image converter IC.

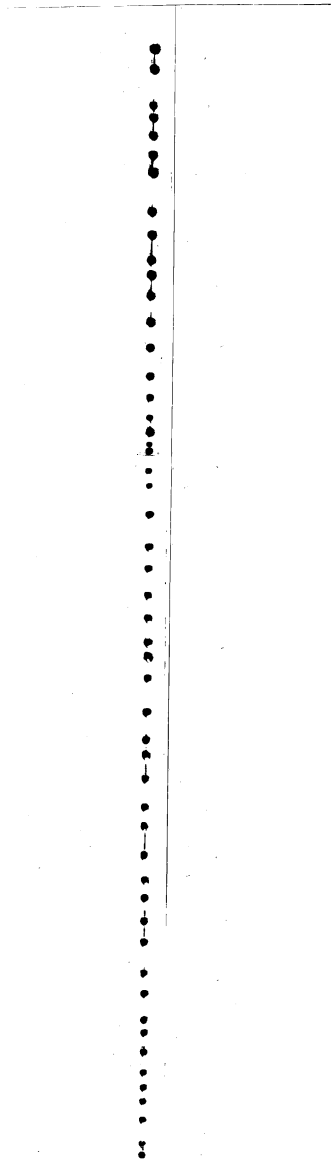


Fig. 5. The structure of the object O: the linear array of the pine holes of the diameter ~ 0.3 mm in the Al foil.

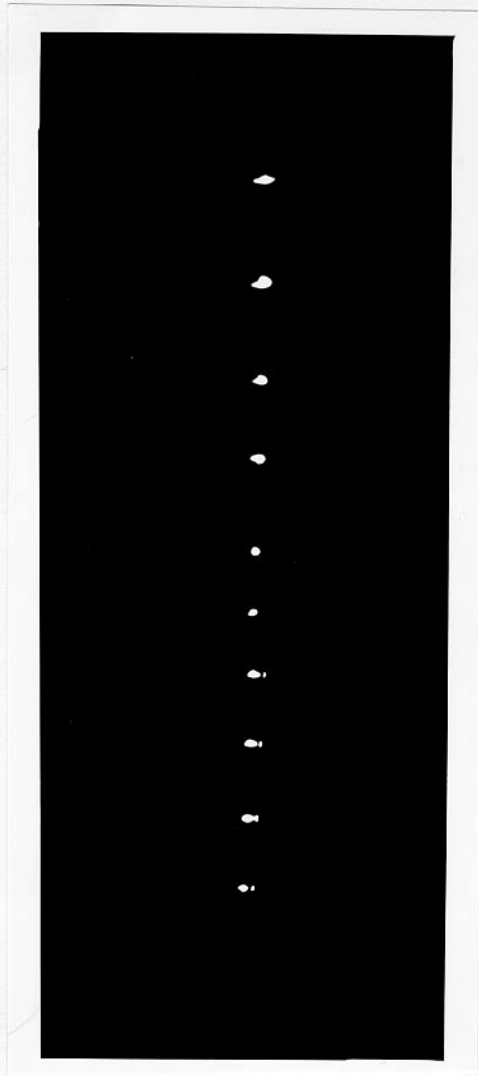


Fig. 6. The in focus photo of the object O which has been obtained by means of the test model shown in Fig. 1.

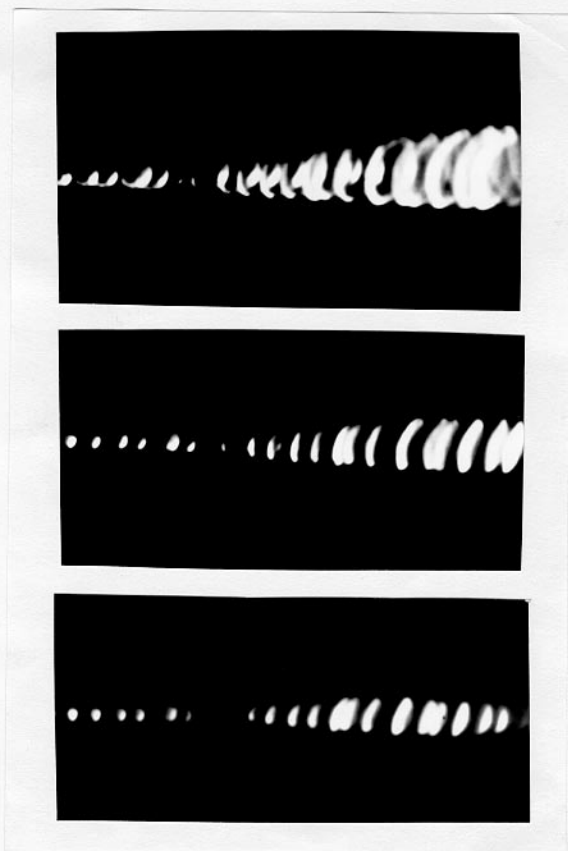


Fig. 7. The primary out of focus images of the object O produced by the lens L_1 on the photofilm oriented perpendicular to the optical axis of the lens L_1 at three different stops.

Thus the problem of the depth defocusing is eliminated in this microscope.

To obtain the image of all mirror elements of the image converter IC an optical system shown in Fig. 3 has been ring up. The imaging objective L was a teleobjective with focus length 200 mm. The top view of 10 mirror elements of the image converter produced by the system in Fig. 3 is shown in Fig. 4.

In Fig. 5 the structure of the object O is shown. Each pin hole in aluminum foil is of the diameter ~ 0.3 mm.

RESULTS.

The in focus photo of the object O, obtained by our test model, is shown in Fig. 6.

The primary out of focus images of the same object O produced by the first imaging lens L_1 on the photodetector oriented perpendicularly to the optical axis of the lens L_1 are shown in Fig. 7 at three different stops.

CONCLUSIONS.

For the first time in the history of the optical microscopy the image of the linear object oriented at the large angle ($\sim 45^\circ$) with respect to the axis of the microscope has been produced without any depth scanning at large angular aperture of the microscopic objective.

REFERENCES

1. E.Eskut et al. (CHORUS coll.), Nucl. Instr. And Meth. A401 (1997) 7.
2. CERN, SPSC 2000-028, M.Guler et al., Experimental Proposal: OPERA.
3. L.M.Soroko, Commun. JINR, E13-99-342, 1999, Dubna.
4. A.Ya.Astakhov et al., Commun. JINR, E13-99-342, 1999, Dubna.
5. L.M.Soroko, Commun. JINR, E13-2001-88, 2001, Dubna.

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Сороко Л.М.

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Первая испытательная модель оптического микроскопа, который дает изображение всего вертикального следа частицы без какого-либо сканирования по глубине

Дается описание первой испытательной модели оптического микроскопа, который формирует изображение всего вертикального следа частицы в фокусе без сканирования по глубине. Было получено в фокусе изображение объекта, состоящего из линейного массива точечноподобных элементов. Проведено сравнение с первичным (не в фокусе) изображением указанного объекта.

Работа выполнена в Лаборатории ядерных проблем им. В.П.Джелепова ОИЯИ.

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First Test Model of the Optical Microscope which Images the Whole Vertical Particle Tracks without Any Depth Scanning

The first test model of the optical microscope which produces the in focus image of the whole vertical particle track without depth scanning is described. The in focus image of the object consisting of the linear array of the point-like elements was obtained. The comparison with primary out of focus image of such object has been made.

The investigation has been performed at the Dzhelapov Laboratory of Nuclear Problems, JINR.

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