or in a free space, because the electromagnetic wave will be reflected from the ends of the cavity many times, and the rotation of the plane of polarization will be accumulated.

REFERENCES

1. *Simon P., Bassat G.M. et al.,* //Phys.Rev., B48. 1993. 4216.
2. *Ryzhov V.A., Zavatskii E.I. et al.,* //Zn.Tekh.Fiz., 65. 1995. 133.
3. *Isaev-Ivanov V.V., Fomichev V.N.* //Prib.Tekh.Eksp., N° 3. 1976. 172.

HYBRID PHOTODIODES

Yu. I. Gusev, V. V. Kuryatkov, T. I.Prokofieva, D. M. Seliverstov, O. I. Chernova[1)], E. E. Levina[1)], B. B. Loginov[1)], L. A. Maslennikov[1)]

[1)] *Central Scientific Research Institute "Electron", St.-Petersburg*

The Hybrid PhotoDiode (HPD) is a new kind of photodetectors, having the main advantages of photomultipliers and photodiodes. The interest to them is conditioned by the requirements of the modern high energy physics in high- speed detectors with good energy resolution and the linearity capable to work stablly in strong magnetic fields up to the 4 Tesla.

The HPD is a vacuum device, consisting from a photocathode (PC) and a silicon PIN diode. Photoelectrons emitted from the PC are accelerated by the voltage between the PC and the diode up to several keV. Penetrating through the thin input diode window, photoelectrons produce the electron-hole pairs, which are separated in a field of the reverse biased PIN diode and are collected on the electrodes. Due to the low energy of electron-hole pair in silicon (3,6 eV), the HPD has more than three order internal gain.

The idea of HPD creation was suggested by Abraham J.M. et al in 1966 [1]. However, due to the technological difficulties the first devices of HPD have been manufactured only in the 90th [2,3,4].

At present there are two main versions of HPD distinguished by the way of the photoelectron focusing on the PIN diode surface. In the the case of proximity HPD the photoelecrons from PC directly rich the close located (1–2 mm) PIN diode. In other version the electrons are electrostatically focused from the total surface of PC into the small area of the silicon detector improving the energy resolution but losing the independence on the magnetic field.

In this report the first results on measurements of proximity HPD parameters are presented. Such photodiodes are developed and produced by the PNPI - CSRI "Electron" collaboration.

The photo of HPD is shown in Fig.1. The body of the device is made from a metal and ceramics and represents a cylinder with a diameter of 50 mm and height of 15 mm. The internal structure of the HPD is schematically given in Fig.2.

We used the S-20 multialkali photocathode with a diameter of 23 mm, having the spectral sensitivity in the range of 350-750 nm with maximum sensitivity of 55 mA/ W at 500 nm (Fig.3).

Fig.1. Photo of the proximity Hybrid PhotoDiode

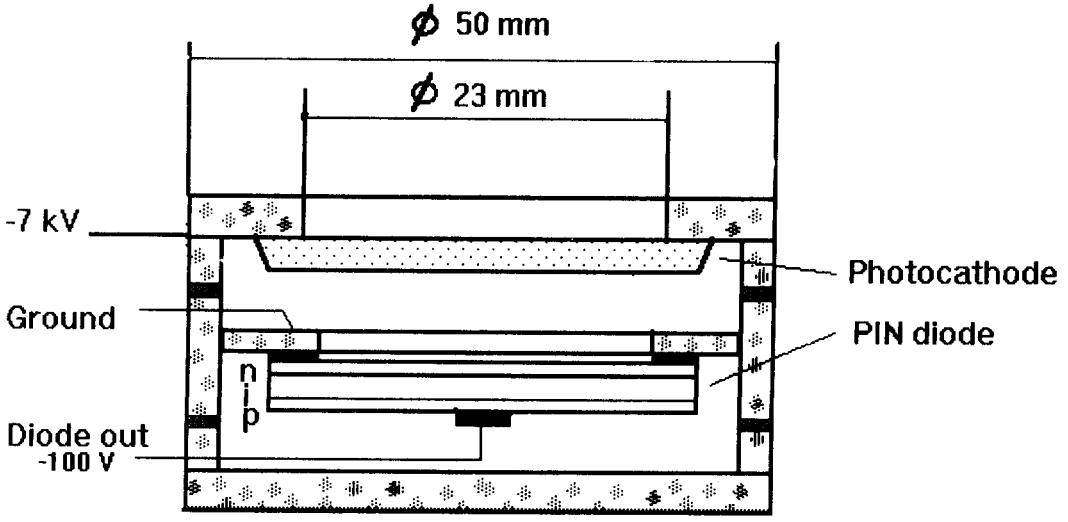

Fig.2. The schematic cross section of the HPD

The PIN diode is produced from the high-resistance n-Si with a diameter of the active area of 12 mm and a thickness of 350 micron. The voltage dependence of the diode current and capacitance are presented in Fig.4 and 5. With bias voltage more than 70 V the diode has a full depletion at the capacity and the current of 40 pF and 5 nA correspondently. Only the small increase of the leakage current up to 7 nA is observed at a double increase of the reverse voltage. The photoelectrons bombard the Si diode through the thin n(+)- implanted contact layer flying in the accelerating field the distance of 2 mm between PC and the diode.

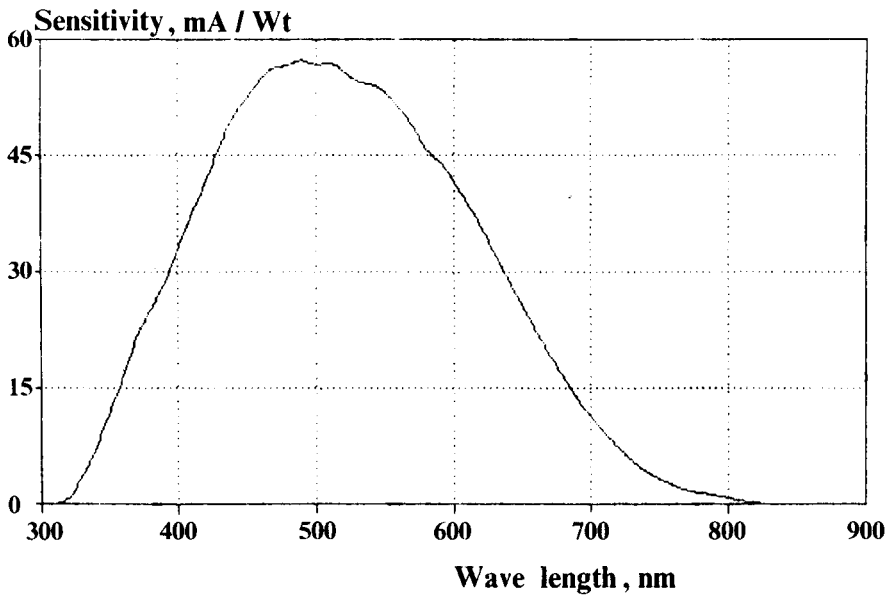

Fig.3. The photocathode sensitivity of HPD

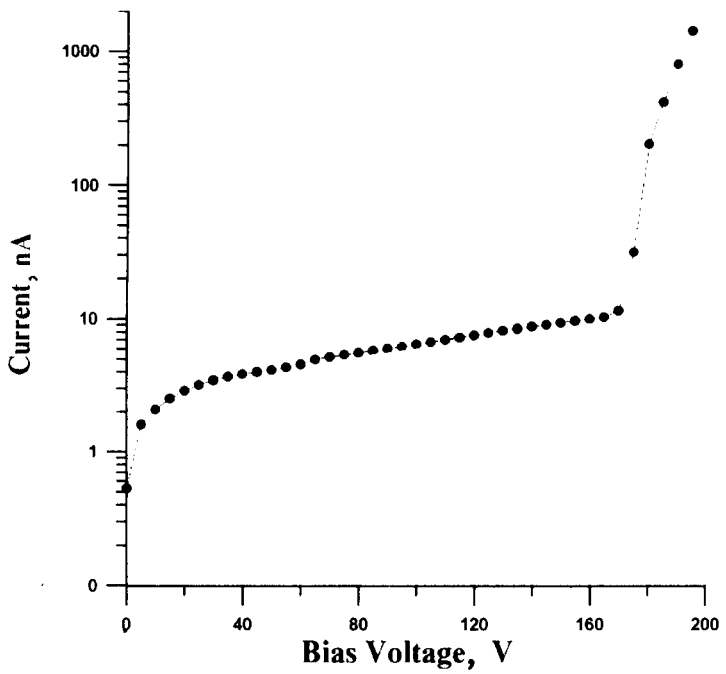

Fig.4. The voltage-current characteristic of the HPD PIN diode

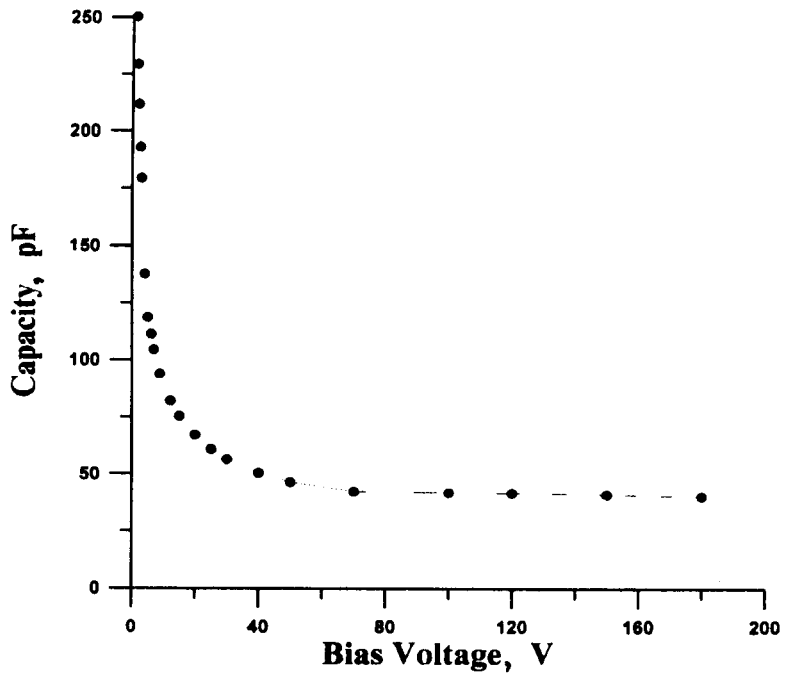

Fig.5. The voltage-capacity characteristic of the HPD PIN diode

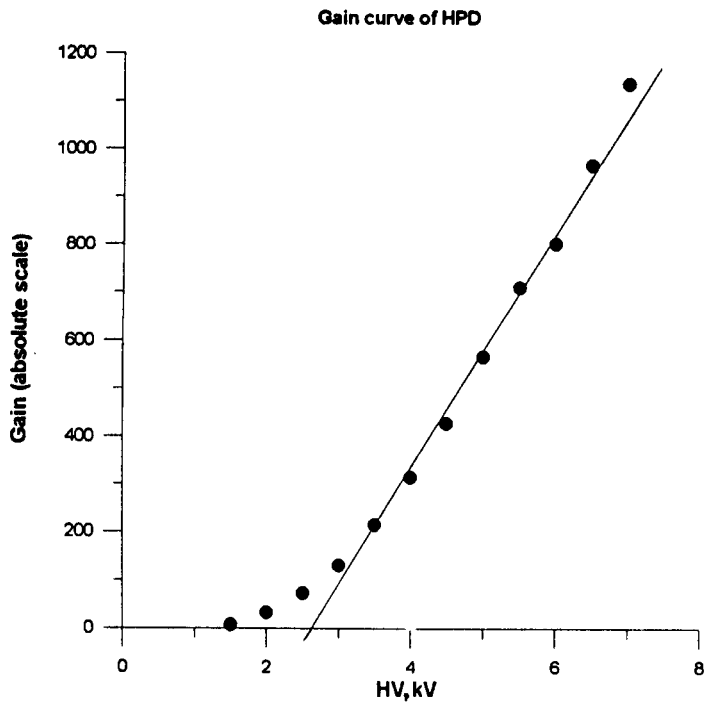

Fig.6. HPD gain versus acceleration voltage.The linear fit over the high points of the dependence determines the gain threshold of 2,7 kV

The Fig.6 shows the dependence of the HPD gain on the accelerating voltage. The threshold sensitivity of photoelectron energy prove to be of 2,7 keV, that is in accordence with the calculation indicated the thickness of the "dead" surface diode layer of 190 (±5) nm [4].

Measurements of the energy and the time resolution of HPD now is in a progress.

REFERENCES

1. *Abraham J.M., Wolfgang L.G., Inskeep C.N.* //Adv. EEP 22B. 1966. P.671.
2. *Van Geest L.K., Stoop K.W.J.* //NIM A310. 1991. P.261.
3. *Johansen G.A., Johnson C.B.* //NIM A326. 1993. P.295.
4. *Arnaudon H., Benetti P., Boskma L., Burger P., Confin A., RDeSalvo R., Paolucci S., Rossella M., Schomaker R.* //NIM A342.1994. P.558.

HOMOCLINIC POINTS ARE GENERITY

D. W. Serow

Homoclinic points are nature phenomenon in the same meaning word to word. A. Poincaré [1] discovered the homoclinic points in the time of research *three body problem* in celestial mechanics and named these points.

This phenomenon independently from Poincaré, self that not distrusting, observed J. Hadamard [2] in the time of geodesic flows on a twodimensional manifolds with negative Gaussian curvature research (setting of problem directly goes back to research of charged particle motion in the electromagnetic field). This wonderful paper writing at the very end of XIX century on the many anticipated ideas of XX century.

But unfortunately neither Poincaré nor Hadamard did not realize the discovering phenomenon degree (in the negative case the natural science development should be elapsed in some other waterway). Nevertheless Hadamard experienced unusuality of situation, he wrote: "The method being used by me be simple but results obtained, on the contrary, are composite or, at least, very different from those we customized to occur". When concluding the paper Hadamard sets the question: "Have not anything analogous in the problems of dynamics and, in particle, in celestial mechanics? If as for like this, then *all setting of problem about stability of planet systems is needed on the radical revision*" (my italics — D. S.).

Poincaré expressed the emotional estimate to homoclinic situation by the following words: "It is surprised to composite of this figure I am not even trying to portray" (loc. cit. [1] p. 399).

At first sight may to show off that the question are exotic situations, however it is not quite the case.

Let M be Reeman C^r-manifold. This one to one map $f: M \to M$ are sad to be C^r-*diffeomorphism*, if f and $f^{-1}: M \to M$ are maps of C^r class. $\mathrm{Diff}^r(M)$ be C^r-diffeomorphisms $f: M \to M$ group. *Differentiable dynamical systems* on the manifold M or, that the same, differentiable integer numbers group $\mathbb{Z}$ on M action, the action, being the homomorphism $\mathbb{Z} \to \mathrm{Diff}^r(M)$ such, that induced $\mathbb{Z} \times \mathrm{Diff}^r(M) \to \mathrm{Diff}^r(M)$ map be differentiable.