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75328
SOV/57-29-10-5/18

AUTHORS: Kel'man, V. M., Peregud, B. P., Skopina, V. I.

TITLE: A Short Magnetic Lens With a Distributed Winding

PERIODICAL: Zhurnal tekhnicheskoy fiziki, 1959, Vol 29, Nr 10, pp 1219-1224 (USSR)

ABSTRACT: The paper describes construction and design of short magnetic lenses with distributed windings, to be used with a β-spectrometer having an electro-optical circuit analogous to that of an optical prismatic spectrometer [Ref 1, 2]. Such lenses are considerably lighter than those having a standard winding, they use less power for their operation, and do not require any alignment with the axis of the vacuum tube. The nearer the center of the vacuum tube the coil is, the longer it is, the number of turns of each of the concentric windings increasing towards the transverse axis. The calculation of distribution of ampere-turns density may be made for any desired distribution of the magnetic field. To this purpose the equation given by Glaser [Ref 3] is used, the equation, written in terms of Hankel functions, representing an expression

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A Short Magnetic Lens With a Distributed Winding

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for the calculation of required ampere-turns in the coil winding. In line with the proposed design the authors designed and constructed three such lenses. These were tested in a spectrometer, and the data obtained by measurement are compared in curve form with the calculated values. The method of measurements made is not described, but it is stated that the accuracy obtained was ±0.3%. For the lenses tested the magnetic field leakage was 10 times smaller than in standard lenses; it may be reduced still further by proper screening. When screening of lenses with distributed winding was used, the vertical component of the earth magnetic field was reduced by a factor of 15. A table is given in which are shown the design data of the lenses discussed in the paper as well as those of a standard lens of equal magnification. The table shows that the number of turns of a lens with a distributed winding, the power it uses, and its weight are smaller than, and that the current density is greater than, those in a standard lens. There are 7 figures and 3 references, 2 Soviet, 1 British.

ASSOCIATION: Institute for Technical Physics, Academy of Sciences, USSR (Fiziko-tekhnicheskiy institut, AN SSSR).

SUBMITTED: April 7, 1959

21(1)

SOV/56-36-3-7/71

AUTHORS: Kel'man, V. M., Metskhvarishvili, R. Ya.

TITLE: Exact Measurement of the Ratios of the Internal Conversion Coefficients of γ-Quanta With Energies of 411.8 kev in Hg^{198} (Tochnoye izmereniye otnosheniy koeffitsiyentov vnutrenney konversii γ-kvantov s energiyey 411.8 keV v Hg^{198})

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 36, Nr 3, pp 694-696 (USSR)

ABSTRACT: In the presentpaper the authors publish the results obtained by measurements of the ratios of the internal conversion coefficients carried out by means of a γ-spectrometer with sufficient resolving power. As already shown (Refs 1-3), electric quadrupole radiation (E2) is concerned in the case of the 411.8 kev γ-quanta emitted by excited Hg^{198} nuclei. Figure 1 shows the inner conversion lines of γ-qunata on the L-subshells of Hg^{198}, figure 2 shows the same for the M, N and O shells, and figure 3 shows the conversion lines on K, L, M, N and O shells of Hg^{198}, recorded by means of a spectrometer with double focusing. Results: $K/L = 2.69 \pm 0.02$

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Exact Measurement of the Ratios of the Internal Conversion Coefficients of γ-Quanta With Energies of 411.8 kev in Hg^{198}

$$L_I : L_{II} : L_{III} = 1 : (1.05 \pm 0.02) : (0.45 \pm 0.01)$$

$$L : M : N : O = 1 : (0.252 \pm 0.004) : (0.077 \pm 0.004) : (0.018 \pm 0.002)$$

A table lists conversion coefficient ratios (E_γ = 411.8 in Hg^{198}) which are taken from references 1, 2, 3, 7, 8, 9 and from the present paper. There are 3 figures, 1 table, and 9 references, 5 of which are Soviet.

ASSOCIATION: Leningradskiy fiziko-tekhnicheskiy institut (Leningrad Physico-Technical Institute)

SUBMITTED: July 29, 1958

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21(7)

AUTHORS: Kel'man, V. M., Metskhvarishvili, R.Ya., Preobrazhenskiy, B. K., Romanov, V. A., Tuchkevich, V. V. SOV/56-37-3-8/62

TITLE: The Multipolarities of γ-Transitions in Tm^{169}

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 37, Nr 3(9), pp 639-642 (USSR)

ABSTRACT: The γ-spectrum and the spectrum of the conversion electrons of excited Tm^{169}-nuclei has already been investigated by several authors. In the present paper the level scheme of the considerably deformed Tm^{169}-nucleus and its particular characteristics are first discussed (Fig 1, Ref 4). In the following, the authors give several results obtained by measurements of the ratios of γ-conversion coefficients to the L-subshells of Tm^{169} (E_γ = 63, 94, 110, 130.5, 177, and 198 kev). Further, the multipolarities of the transitions were determined and for mixed radiations the percentage of the components was determined. The intensities of the conversion lines were measured by means of β-spectrometers. As a source a thin Yb^{169}-layer on an aluminum foil was used.

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The Multipolarities of γ-Transitions in Tm^{169} SOV/56-37-3-8/62

The production of this source is described in detail: A tantalum target was irradiated with 680 mev protons on the synchrocyclotron of the Ob"yedinennyy institut yadernykh issledovaniy (Joint Institute of Nuclear Research); The rare-earth elements produced were separated by ion exchange (using the cationite KU-2) and subjected to a process of preparation which is described. Finally, a Lu-fraction (Lu^{169}) was obtained on the aluminum foil, which goes over into Yb^{169} with a half life of ~2d. Figure 2 shows the conversion lines of 177 kev γ-quanta onto the L-subshells of Tm^{169}, and figure 3 shows the same for 198 kev γ-quanta. In both cases also the L_{II}- and L_{III}-maxima are distinctly marked beside the steep L_I-peak. The results obtained by these investigations are shown in a table. Thus, the following was e.g. obtained for the 177 kev transition:

$L_I:L_{II}:L_{III} = 1 : (0.24 \pm 0.01) : (0.137 \pm 0.006)$; L_{II}/L_I : 82% M1 + + 18% E2, L_{III}/L_I : the same mixture.

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The Multipolarities of γ-Transitions in Tm^{169} SOV/56-37-3-8/62

For the 198 kev transition the following is given: $L_I:L_{II}:L_{III} = 1:(0.135\pm0.002):(0.063\pm0.001)$; L_{II}/L_I: 93% M1 + + 7% E2, L_{III}/L_I: 90% M1 + 10% E2. There are 3 figures, 1 table, and 15 references, 8 of which are Soviet.

ASSOCIATION: Leningradskiy fiziko-tekhnicheskiy institut Akademii nauk SSSR (Leningrad Physico-technical Institute of the Academy of Sciences, USSR)

SUBMITTED: April 9, 1959

24.2000

77304
SOV/57-30-2-1/18

AUTHORS: Kel'man, V. M., Yavor, S. Ya., Fishkova, T. Ya.

TITLE: Achromatic Magnetic Mirrors

PERIODICAL: Zhurnal tekhnicheskoy fiziki, 1960, Vol 30, Nr 2, pp 129-137 (USSR)

ABSTRACT: To achieve a deflection or displacement of non-monochromatic beams of charged particles without separating them according to energy, Kel'man and Lyubimov (Izv. AN SSSR, ser. fiz., 18, 155, 1954) used a magnetic mirror whose magnetic field vector potential **A** satisfies the equation:

$$A_x = A(yz) = \mathrm{Re}\left[-\frac{H_0}{k}(y+iz)^k\right], \quad A_y = A_z = 0, \qquad (1)$$

where H_0 and k are constants. For a particular choice of k, one can find an angle α_0 for the incoming

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particles, such that all particles of various energies entering the field at that angle in the central plane describe similar trajectories and emerge out of the field at the point of entrance as a single beam (see Fig. 1).

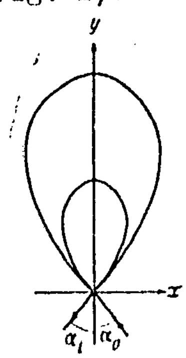

Fig. 1. Similar trajectories in an achromatic magnetic mirror. (α_0) angle of incidence; (α_1) angle of reflection.

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In addition to checking the known values of α_0 for $k = 1$ and $k = 2$, the authors of this paper evaluated the necessary k's for angles $\alpha_0 = 30^\circ$ and $\alpha_0 = 45^\circ$. Mirrors with $\alpha_0 = 30^\circ$ angles arranged along sides of an equilateral triangle or mirrors with $\alpha_0 = 45^\circ$ forming a parallelogram could then be used to maintain closed trajectories of particles. The authors start from the solution ofthe differential equation of motion for charged particles in the central plane of a two-dimensional magnetic field, which for the initial conditions $x_0 = y_0 = 0$ has the form:

$$x = \int_0^y \frac{\frac{eH_0}{mcv}\frac{y^k}{k} - \sin\alpha_0}{\sqrt{1 - \left(\frac{eH_0}{mcv}\frac{y^k}{k} - \sin\alpha_0\right)^2}}\, dy. \qquad (5)$$

Here e, m, and v are charge, mass, and velocity, respectively, of the particle; c is velocity of light; $m = \frac{m_0}{\sqrt{1-v^2/c^2}}$, where m_0 is rest mass of the particle. In the central plane (z = 0) the field has the value:

$$H_x = H_y = 0, \quad H_z = H_0 y^{k-1}, \qquad (4)$$

where k can take integer and fractional values. Using the known values for k versus α_0: k = 1, $\alpha_0 = 90^\circ$; k = 2, $\alpha_0 = 40^\circ$; and k = 3, $\alpha_0 = 28^\circ$, the authors constructed an approximate curve k = k(α_0). Choosing approximate k values, they calculated curves by performing numerical integration of Eq. (5). Typical curves are presented on Fig. 3. From the form of the curve they could decide if k should be increased or decreased to obtain the desired correct curve.

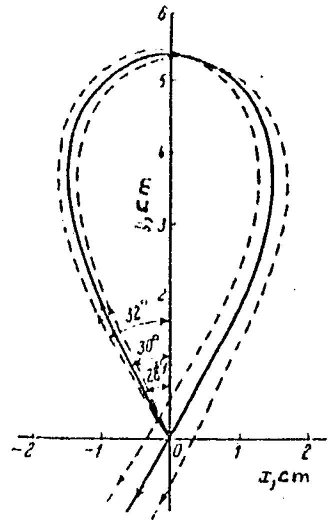

Fig. 3. Trajectory of charged particles in the central plane of the mirror, with k = 2.75 at incidence angles of 28, 30, and 32°.

The results of calculations are contained in Table A.

Table A. (a) Initial conditions; (b) data obtained by numerical integration of system of Eqs. (7); (c) data obtained by numerical integration of Khurgin's Eq. (10); (d) degrees.

k	a			b				c	
	α_0 degrees	γ_0 degrees	z_0 cm	α_l degrees	γ_l degrees	x_l cm	z_l cm	γ_l degrees	z_l cm
2	40.7	3	0	46.2	−7.4	−0.71	1.88	—	—
2	40.7	0	2.00	36.6	−2.6	0.76	−1.12	—	—
3	27.6	3	0	29.0	4.0	−0.61	1.67	—	—
3	27.6	0	1.00	28.0	−1.7	−1.18	1.90	—	—
1.81	45	3	0	51.7	−9.2	−0.81	2.01	−5.4	2.08
1.81	45	0	2.00	44.6	−0.4	0.70	−1.92	−2.6	−2.58
2.75	30	3	0	30.2	0.9	−0.67	1.68	8.2	1.82
2.75	30	0	0.50	28.5	2.4	−0.26	1.08	4.4	1.17
2.75	30	0	2.00	27.7	4.2	−0.58	−0.03	17.0	4.67

Achromatic Magnetic Mirrors

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This table contains also data about trajectories not lying in the central plane, obtained by two methods. One is by numerically integrating the exact system of equations of motion:

$$\left.\begin{aligned}
&\frac{dx}{ds} = C + \frac{eH_0}{mcv}\frac{(y^2+z^2)^{\frac{k}{2}}}{k}\cos\left(k\,\mathrm{arc\,tg}\,\frac{z}{y}\right),\\
&\frac{d^2y}{ds^2} = -\frac{eH_0}{mcv}(y^2+z^2)^{\frac{k}{2}-1}\left[y\cos\left(k\,\mathrm{arc\,tg}\,\frac{z}{y}\right) + z\sin\left(k\,\mathrm{arc\,tg}\,\frac{z}{y}\right)\right]\times\\
&\qquad\times\left[C + \frac{eH_0}{mcv}\frac{(y^2+z^2)^{\frac{k}{2}}}{k}\cos\left(k\,\mathrm{arc\,tg}\,\frac{z}{y}\right)\right],\\
&\frac{d^2z}{ds^2} = \frac{eH_0}{mcv}(y^2+z^2)^{\frac{k}{2}-1}\left[y\sin\left(k\,\mathrm{arc\,tg}\,\frac{z}{y}\right) - z\cos\left(k\,\mathrm{arc\,tg}\,\frac{z}{y}\right)\right]\times\\
&\qquad\times\left[C + \frac{eH_0}{mcv}\frac{(y^2+z^2)^{\frac{k}{2}}}{k}\cos\left(k\,\mathrm{arc\,tg}\,\frac{z}{y}\right)\right],
\end{aligned}\right\}\quad (7)$$

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where s is length of path traveled by the particle, C is a constant which is a function of initial conditions. The other is by integrating the approximate equation by Khurgin:

$$\frac{d^2z}{ds^2}=\left[\left(\frac{eH_0}{mcv}\right)^2\frac{k-1}{k}y^{2(k-1)}-\frac{eH_0}{mcv}(k-1)y^{k-2}\sin\alpha_0\right]z. \qquad (10)$$

γ_0 denotes the angle between the XY plane and initial particle direction for particles starting in the central plane (see Fig. 6); z_0 is the initial distance from the XY plane for particles entering the field parallel to the XY plane; γ_1 is the angle between direction of the exit of the particle and the central plane; α_1 is the angle between the projection of that direction in the XY plane and the negative Y axis direction. In all cases the quantity $\frac{eH_0}{mcv}$ was equal to 0.04 per cm^k.

Achromatic Magnetic Mirrors

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Figure 6 represents an interesting case where a particle entering the field parallel to the central plane comes out again parallel to that plane (curve 2). A field with such a special k value can then be used for displacement of parallel beams of particles with various energies.

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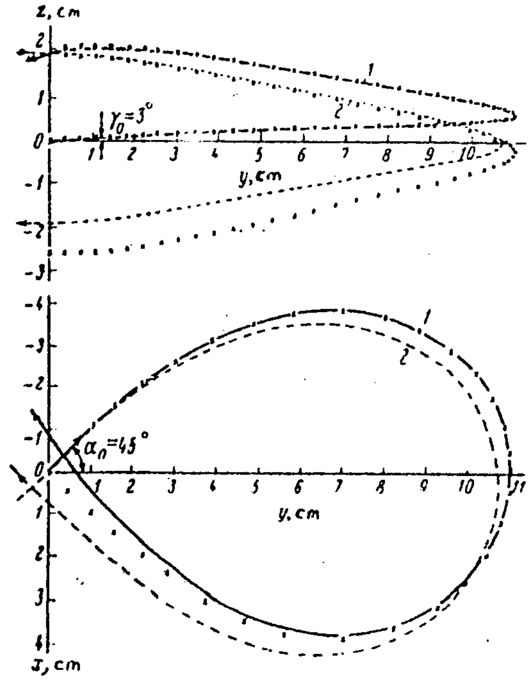

Fig. 6
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Caption to Fig. 6.

Fig. 6. Projections on YZ and XY planes of two space trajectories in a field with k = 1.81. Initial conditions: trajectory (1): $x_o = y_o = z_o = 0$, $\alpha_o = 45^o$, $\gamma_o = 3^o$; trajectory (2): $x_o = y_o = 0$, $z_o = 2$ cm, $\alpha_o = 45^o$, $\gamma_o = 0$. Crosses indicate trajectories with the same initial conditions, but computed using the method of Khurgin.

Using a method described by Kel'man and Lyubimov, the authors constructed a field for k = 1.81, and its values agreed fairly well with Eq. (4). Further improvements were obtained by means of additional windings on the shielding and the magnet laminas. The authors point out that one can obtain the desired result,

i. e., the deflection or displacement of a nonmonochromatic charged particle beam by utilizing two mirrors with a lateral displacement of particles of different energies in the manner indicated on Fig. 10.

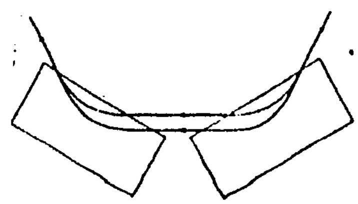

Fig. 10. Deflection of a nonmonochromatic beam by means of two mirrors with noncompensated displacements.

Achromatic Magnetic Mirrors

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There are 10 figures; 1 table; and 6 references, 5 Soviet, 1 U.S. The U.S. reference is: W. K. H. Panofsky, J. A. McIntyre, Rev. Sci. Instr., 25, 287, 1954.

ASSOCIATION: Physico-technical Institute AS USSR, Leningrad (Fiziko-tekhnicheskiy institut AN SSSR, Leningrad)

SUBMITTED: July 6, 1959

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77307
SOV/57-30-2-4/18

AUTHORS: Kel'man, V. M., Peregud, B. P., Dolmatova, K. A., Luzyanin, I. D.

TITLE: Vertical Focusing of an Electron Beam Using Cylindrical Magnetic Lenses in an Axially Symmetrical Radially Increasing Magnetic Field

PERIODICAL: Zhurnal tekhnicheskoy fiziki, 1960, Vol 30, Nr 2, pp 153-158 (USSR)

ABSTRACT: Kel'man and others (ZhTF, XXVIII, 1056, 1958) and Vandakurova (ZhTF, XXVIII, 1065, 1958) showed that radially arranged magnetic lenses may produce a vertical focusing of electrons moving in nearly circular, or spiral, orbits. The present paper describes experimental investigation of an electron motion in a radially increasing magnetic field whose defocusing effects are compensated by means of cylindrical magnetic lenses. Two equal ring-shaped flat coils (1) are producing the required field (see Fig. 1).

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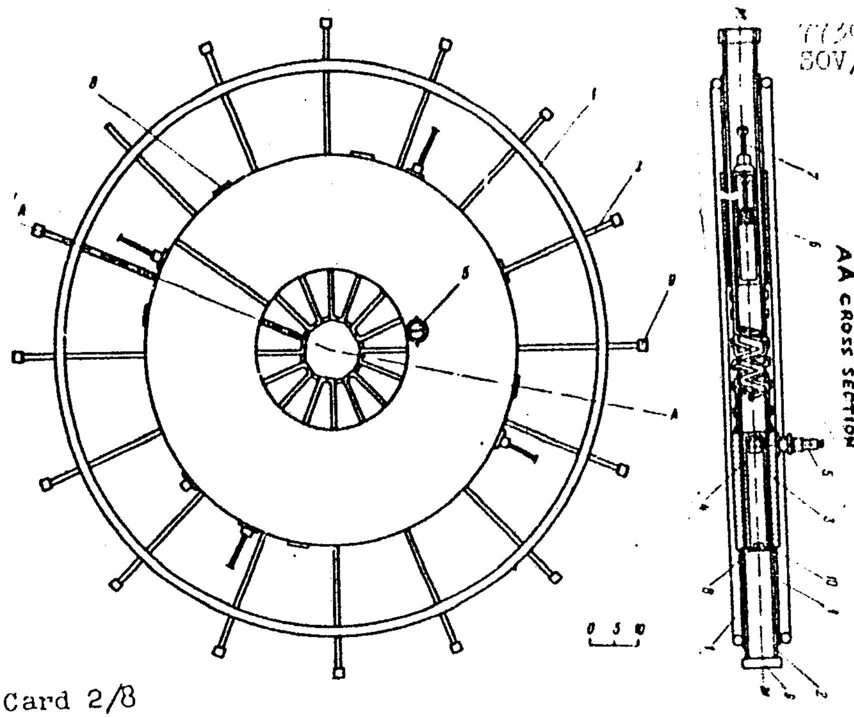

Fig. 1
(Caption on Card 3/8)

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Vertical Focusing of an Electron Beam Using Cylindrical Magnetic Lenses in an Axially Symmetrical Radially Increasing Magnetic Field

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Fig. 1. Diagram of experimental setup. (1) Coils of guiding field; (2) focusing systems; (3) holders; (4) chamber; (5) injector; (6) screen; (7) rod; (8) window; (9) jumper; (10) insulation.

Experiments were performed with two pairs of coils with a mean radius of 55 and 35 cm. The spacial arrangement of the focusing system (2) is shown on Fig. 4.

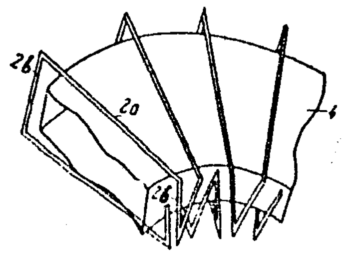

Fig. 4. Focusing system (schematic diagram). (2a) Copper rod; (2b) vertical jumper; (4) chamber.

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Vertical Focusing of an Electron Beam Using Cylindrical Magnetic Lenses in an Axially Symmetrical Radially Increasing Magnetic Field

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As seen, the entire system is a continuous circuit. The direction of horizontal field components of adjacent magnetic lenses is opposite. The vacuum chamber (4) has an inner radius of 17 cm and an outer of 35 cm. It is 2 cm high. The betatron injector 5 is of standard type with deflector 18 cm from the axis of the system. It could be rotated in the horizontal and vertical plane. The angle of divergence of the beam is 5°. The path of the beam was observed by means of willemite covered screens, while for intensity measurements the screens were replaced by copper plates, and the resulting inhibiting radiation was measured by means of Geiger counters through thin windows covered with thin organic glass (see Fig. 5. The injection was continuous by means of a constant 4 to 8 kv potential. In the case of the 35 cm coil of the guiding field with 8 kev electrons and 1,400

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Vertical Focusing of an Electron Beam Using Cylindrical Magnetic Lenses in an Axially Symmetrical Radially Increasing Magnetic Field

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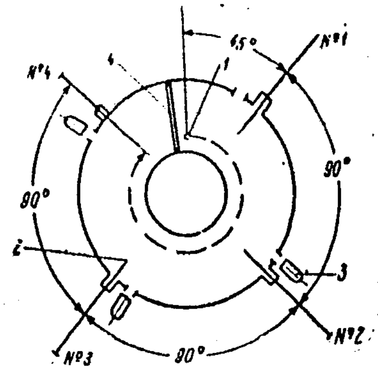

Fig. 5. Diagram of the distribution of screens and end-counters: (1) injector; (2) screen; (3) counter; (4) plate shielding the scattered X-ray radiation.

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Vertical Focusing of an Electron Beam Using Cylindrical Magnetic Lenses in an Axially Symmetrical Radially Increasing Magnetic Field

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ampere-turns on the coils, the authors found on the screen Nr 4 the beam to be well focused in the radial direction but completely out of focus in the vertical direction. A 300 a current in the focusing device reduced the beam to an approximate circle of 3 mm diam. The screen was at a distance of 24 cm from the axis of symmetry. The authors used the 55 cm coil to measure the average intensity at a fixed equilibrium orbit. The results are on Figs. 8 and 9. On Fig. 9, N_2 and N_4 are the counting rate intensities from the radiations originating at the screens Nr 2 and Nr 4. One sees that while without focusing the intensity after one half of a turn drops more than 13 times; for currents of more than 300 a the ratio is of the order of unity. There are 9 figures; and 2 Soviet references.

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Vertical Focusing of an Electron Beam Using Cylindrical Magnetic Lenses in an Axially Symmetrical Radially Increasing Magnetic Field

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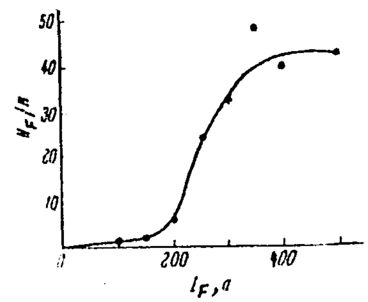

Fig. 8. Beam intensity versus current intensity in the focusing system at an angular distance of 135° from the injector. N_F = intensity of counting rate at a current I_F; N = intensity of counting rate at $I_F = 0$.

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Vertical Focusing of an Electron Beam Using Cylindrical Magnetic Lenses in an Axially Symmetrical Radially Increasing Magnetic Field

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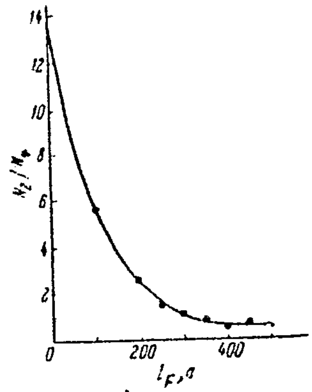

Fig. 9. N_2/N_4 ratio versus focusing current intensity I_F.

ASSOCIATION: Physico-Technical Institute AS USSR Leningrad (Fiziko-tekhnicheskiy institut AN SSSR Leningrad)

SUBMITTED: August 27, 1959

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AUTHORS: Kel'man, V. M., Knyaz'kov, L. G., and Vasil'yeva, Ye. K.

TITLE: A Magnetic System With Double Deflection Used in Mass Spectrometers With Strong Dispersion

PERIODICAL: Zhurnal tekhnicheskoy fiziki, 1960, Vol. 30, No. 10, pp. 1193 - 1198

TEXT: Two schemes of mass spectrometers with double focusing are described, for which a magnetic system consisting of two oppositely directed magnetic fields generated by round poles is used. The basic scheme of one of these spectrometers is shown in Fig. 1. It is shown that the dispersion of this spectrometer may be increased arbitrarily by enlarging the distances l_1' and l_2''. The optical magnification of the spectrometer remains equal to unity. The second scheme is shown in Fig. 2. For the purpose of repeated acceleration of the ion beam, this spectrometer is complemented by a telescopic system shown in Fig. 3, which consists of two immersion lenses. The formulas derived indicate that also the

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A Magnetic System With Double Deflection Used in Mass Spectrometers With Strong Dispersion

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dispersion of this spectrometer may be increased arbitrarily. However, to prevent an excessive increase, it is necessary to use a large cylindrical capacitor. A spectrometer designed according to the first scheme is now being adjusted at the Fiziko-tekhnicheskiy institut (Institute of Physics and Technology). There are 3 figures and 2 references: 1 Soviet.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN SSSR, Leningrad (Institute of Physics and Technology AS USSR, Leningrad)

SUBMITTED: March 14, 1960

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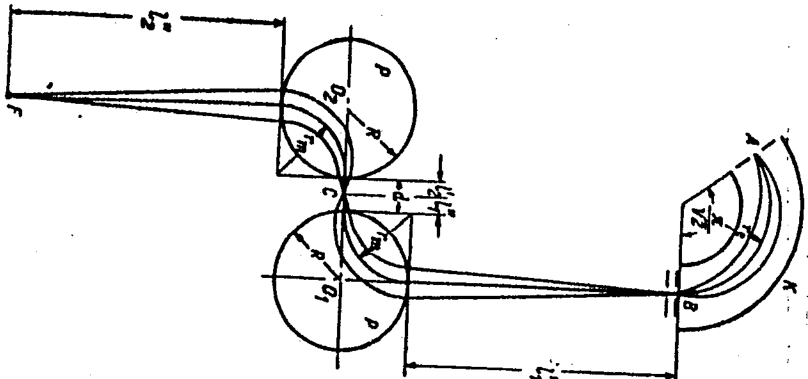

Рис. 1.

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KEL'MAN, V.M.; PEREGUD, B.P.; SKOPINA, V.I.

Universal precision β-spectrometer. Atom.energ. 10 no.5:534-536 My '61. (MIRA 14:5)

(Spectrometer)

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AUTHORS: Kel'man, V. M., and Gall', L. N.

TITLE: Mass spectrometers with two-dimensional magnetic prism

PERIODICAL: Zhurnal tekhnicheskoy fiziki, v. 31, no. 9, 1961, 1083-1091

TEXT: The production of mass spectrometers built in exact analogy to light-optical spectrometers is prevented by the absence of magnetic systems fulfilling the same task as optical prisms. Such magnetic systems are used in β-spectrometry, and the authors think it possible to use them also in mass spectrometers. A magnetic prism (Fig. 1) consists of a deflecting magnet whose poles are symmetric with respect to the plane PP (plane of field antisymmetry) and whose field is two-dimensional. The magnetic field strength must not change in a shift along the x-axis. The angles α and β must be chosen so that with a certain ion pulse both cylindrical magnetic lenses which focus the ion beams form a cylindrical telescopic system. The authors study the conditions to be fulfilled by the angles α and β in order that the focuses of the cylindrical lenses coincide. They obtain the two conditions $1/\tan\alpha + 1/\tan\beta = \alpha + B$ and $\sin\alpha + \sin\beta = d/Q$, where d

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Mass spectrometers with two- ...

is the width of the pole shoes, and ϱ the radius of curvature of the ion path in the magnetic field. If the gap width is not small with respect to ϱ, the equations of motion of the ions in the magnetic field must be integrated numerically. Further, the authors discuss various constructions of mass spectrometers with magnetic prisms. First, they deal with a mass spectrometer whose construction is equal to that of an optical spectrometer (without energy focusing), taking account of the angular dispersion of particles caused by mass differences. Finally, they mention four variants of mass spectrometers with magnetic prisms in which the energy is focused by cylindrical or spherical condensers. Fig. 4 shows a mass spectrometer with energy focusing consisting of a plane magnetic prism and a cylindrical condenser. Ya. L. Khurgin (ZhETF, 9, 824, 1939) is mentioned. There are 7 figures and 6 references: 3 Soviet and 3 non-Soviet. The two references to English-language publications read as follows: E. M. Purcell, Phys. Rev., 54, 818, 1938; C. P. Browne et al., Rev. sci. Instr., 22, 952, 1951.

ASSOCIATION: Fiziko-tekhnicheskiy institut im. A. F. Ioffe AN SSSR Leningrad (Physicotechnical Institute imeni A. F. Ioffe of the AS USSR, Leningrad)

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31719
S/057/61/031/012/005/013
B108/B138

26.2322

AUTHORS: Kel'man, V. M., and Yavor, S. Ya.

TITLE: Achromatic four-pole electron lenses

PERIODICAL: Zhurnal tekhnicheskoy fiziki, v. 31, no. 12, 1961, 1439-1442

TEXT: Achromatic lenses for electron microscopes are studied. This kind of achromatic lens can be an assembly of two four-pole lenses - one electrostatic and one magnetic. The symmetry plane of the electric field will coincide with the plane of antisymmetry of the magnetic field. The electrical and magnetic forces acting upon the charged particles have to point in opposite directions. The authors only considered the case in which the electrostatic and magnetic fields are superimposed. The advantage of this design is that in paraxial approximation all particle trajectories may be considered achromatic. The relativistic equations for the trajectories of the charged particles in the lens are

$$x'' - xf(z)Q(v) = 0$$

$$y'' + yf(z)Q(v) = 0$$

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B108/B138

Achromatic four-pole electron lenses

where $Q(v) = \frac{eH_o}{mcv} - \frac{eE_o}{mv^2}$. f(z) determines the dependence of the electrical and magnetic scalar potentials on the z coordinate. m = relativistic mass. A possible design is shown in Fig. 1. Another design could be with hyperbolic poles and electrodes, with or without laminated electrodes between the main ones. G. A. Grinberg (Izbrannyye voprosy matematicheskoy teorii elektricheskikh i magnitnykh yavleniy, M.-L., 1948) is mentioned. There are 3 figures and 4 references: 1 Soviet and 3 non-Soviet. The 2 references to English-language publications read as follows: P. Grivet, A. Septier. Nucl. Instr. Meth., 6, 126, 243, 1960; M. Y. Bernard. C. R., 236, 185, 1953.

ASSOCIATION: Fiziko-tekhnicheskiy institut im. A. F. Ioffe AN SSSR Leningrad (Institute of Physics and Technology imeni A. F. Ioffe AS USSR, Leningrad)

SUBMITTED: January 26, 1961

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31943
S/057/62/032/001/003/018
B104/B138

24.2500

AUTHORS: Ankudinov, V. A., Kel'man, V. M., Kresin, O. M., and Sysoyeva, L. N.

TITLE: Motion of charged particles in a uniform magnetic field the strength of which is linearly dependent on time

PERIODICAL: Zhurnal tekhnicheskoy fiziki, v. 32, no. 1, 1962, 22-29

TEXT: The motion of charged particles of mass m and charge e was studied in a uniform magnetic field $H_z = H_0 t + H_1$. H_0 and H_1 are constant. The electric field created by the variation in magnetic field strength is shown as $E_\varphi = -H_0 r/2c$. The equations of motion for a charged particle in nonrelativistic approximation read:

$$m(\ddot{r}-r\dot{\varphi}^2) = \frac{e}{c} r\dot{\varphi}(H_0 t + H_1),\ \frac{m}{r}\frac{d}{dt}(r^2\dot{\varphi}) = -\frac{eH_0 r}{2c} - \frac{e}{c}\dot{r}(H_0 t + H_1),\ m\ddot{z} = 0.$$

From the latter equation it follows that $z = \dot{z}_0 t + z_0$ (3), where $\dot{z}_0$ and z_0 are constant. Thus, the particles travel in an $r-\varphi$ plane moving along the z-axis at constant velocity. By substituting

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Motion of charged particles ...

$$\omega_0 = \frac{eH_0}{2mc}, \quad \omega_1 = \frac{eH_1}{2mc}, \qquad (A)$$

in the equations of motion, one obtains

$$\ddot{r} - r\dot{\varphi}^2 = 2r\dot{\varphi}(\omega_0 t + \omega_1),$$
$$\frac{d}{dt}(r^2\dot{\varphi}) = -\omega_0 r^2 - 2r\dot{r}(\omega_0 t + \omega_1). \qquad (4)-(5).$$

Using the complex function $U = r\exp\left\{i(\varphi + \omega_0 t^2/2 + \omega_1 t)\right\}$, this system can be represented in the form $\ddot{U} + (\omega_0 t + \omega_1)^2 U = 0$ (7).

$$U = \sqrt{t + \frac{\omega_1}{\omega_0}}\left\{C_1 J_{1/4}\left[\frac{(\omega_0 t + \omega_1)^2}{2\omega_0}\right] + C_2 J_{-1/4}\left[\frac{(\omega_0 t + \omega_1)^2}{2\omega_0}\right]\right\}. \qquad (8)$$

is a solution of (7), J_n being the Bessel function. The constants in (8) are determined with the aid of an initial value problem, and

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$$U=\frac{\pi}{2}\sqrt[4]{\frac{x_0x}{\omega_0^2}}\{\omega_1 r_0[J_{1/4}(x_0)J_{1/4}(x)+J_{-1/4}(x_0)J_{-1/4}(x)]+$$
$$+[\dot{r}_0+ir_0(\dot{\varphi}_0+\omega_1)][J_{-1/4}(x_0)J_{1/4}(x)-J_{1/4}(x_0)J_{-1/4}(x)]\}, \qquad (13)$$

$$x=\frac{(\omega_0 t+\omega_1)^2}{2\omega_0}, \text{ a } x_0=\frac{\omega_1^2}{2\omega_0}.$$

is obtained as solution. Since r is the amount of the complex function U, one has

$$r=\sqrt{UU^*}=\frac{\pi}{2}\sqrt[4]{\frac{x_0x}{\omega_0^2}}\{r_0^2(\dot{\varphi}_0+\omega_1)^2[J_{-1/4}(x_0)J_{1/4}(x)-J_{1/4}(x_0)J_{-1/4}(x)]^2+$$
$$+[\omega_1 r_0(J_{1/4}(x_0)J_{1/4}(x)+J_{-1/4}(x_0)J_{-1/4}(x))+\dot{r}_0(J_{-1/4}(x_0)J_{1/4}(x)-$$
$$-J_{1/4}(x_0)J_{-1/4}(x))]^2\}^{1/2} \qquad (14)$$

(14)-(15).

$$\varphi=x_0-x+\operatorname{arc\,tg}\frac{r_0(\dot{\varphi}_0+\omega_1)}{\dot{r}_0+\omega_1 r_0\dfrac{J_{1/4}(x_0)J_{1/4}(x)+J_{-1/4}(x_0)J_{-1/4}(x)}{J_{-1/4}(x_0)J_{1/4}(x)-J_{1/4}(x_0)J_{-1/4}(x)}}. \qquad (15)$$

(3), (14), and (15) fully describe the motion of a charged particle in the given magnetic field. A thorough study shows that if a particle moves long enough its kinetic energy is almost linearly time-dependent. The results are applied to a number of special cases. There are 9 figures and 2 non-Soviet references. The two references to English-language publications read as follows: Gordon, Charged-Particle Orbits in Varying Magnetic Fields, J. of Appl. Phys., 31, no. 7, 1187 (1960); C. S. Gardner, Particle trajectories in homogeneous magnetic field with linear time dependence, University of California, Lawrence Radiation Laboratory, Berkeley, California, Rept. 4563 (Aug. 1955).

ASSOCIATION: Fiziko-tekhnicheskiy institut AN SSSR im. A. F. Ioffe, g. Leningrad (Physicotechnical Institute AS USSR imeni A. F. Ioffe, Leningrad)

SUBMITTED: March 27, 1961

35356

9.6150

S/057/62/032/003/002/019
B154/B102

AUTHORS: Kel'man, V. M., and Rodnikova, I. V.

TITLE: New systems for mass-spectrometers

PERIODICAL: Zhurnal tekhnicheskoy fiziki, v. 32, no. 3, 1962, 269 - 278

TEXT: The use of an electrostatic prism and a cylindrical telescope system instead of deflecting condensers is studied for electron-optical mass-spectrometers: (a) with a plane magnetic prism and a cylindrical telescope system (Fig. 1); (b) with a plane magnetic prism and an electrostatic prism; (c) with an intermediate image, a plane magnetic prism and a telescope system of immersion lenses serving as electrostatic deflecting element (Fig. 5); (d) with an intermediate image and a plane magnetic prism and an electrostatic prism as first deflecting element. If in Figs. 1 and 5 the telescope system is replaced by an electrostatic prism, then the systems (b) and (d) are obtained. Δl; M_{Γ}; M_{B} for the telescope of cylindrical lenses are determined by the following equations:

$$\Delta l = \frac{\sin\alpha + \sin\beta}{2\cos\beta} \sqrt{\frac{V_2}{V_{\kappa}}} F_2 \frac{\Delta m}{m}. \quad (10)$$

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$$M_{г.} = -\frac{\cos\theta_1}{\cos\theta_2}\frac{\cos\alpha}{\cos\beta}\sqrt{\frac{V_{о.}}{V_{и.}}}\frac{F_2}{F_1}. \quad (17)$$

$$M_{в.} = -\frac{f_{э.1}}{f_{э.2}}\frac{f_{м.1}}{f_{м.2}}\frac{F_2}{F_1}\sqrt{\frac{V_{о.}}{V_{и.}}}. \quad (21)$$

where $\alpha = \beta$; $F_1 = F_2$; $V_0 = V_1$; $V_2 = V_И$; $f_{э.1} = f_{э.2}$. Δl; $M_Г$; $M_В$ for the electrostatic prism are determined by the following equations:

$$M_{г.} = -\frac{\cos\alpha}{\cos\beta}\frac{F_2}{F_1}\sqrt{\frac{V_{о.}}{V_{и.}}} \quad (25)$$

$$\Delta l = \frac{\sin\alpha + \sin\beta}{2\cos\beta} \times \sqrt{\frac{V_{м.}}{V_{и.}}}F_2\frac{\Delta m}{m}. \quad (27)$$

$$M_{в.} = \frac{f_{м.1}}{f_{м.2}}\cdot\frac{F_2}{F_1}\sqrt{\frac{V_{о.}}{V_{и.}}}. \quad (26)$$

with $\alpha = \beta$; $F_1 = F_2$; $V_o = V_И = V_M$. Δl - distance between two lines in the focal plane corresponding to the difference of ion mass Δm; $M_Г$ - increase of horizontal plane; $M_В$ - increase of vertical plane. The systems (a) and

(b) do not include an additional diaphragm for retaining ions with an energy considerably different from the given energy. Thus only ion sources provided for beams with small dispersion of velocity can be used. To avoid this disadvantage an intermediate image is introduced as shown in the systems (c) and (d). In these systems Δl, M_{Γ}, M_{B} are given by the following equations:

$$\Delta l = \frac{\sin\alpha + \sin\beta}{2\cos\beta}\sqrt{\frac{V_{\text{м.}}}{V_{\text{м.н.}}}}F_{\text{м.2}}\frac{\Delta m}{m}. \quad (43)$$

$$M_{\text{г.}} = M_{\text{э.г.}}M_{\text{м.г.}} = \frac{\cos\alpha}{\cos\beta}\frac{F_{\text{э.2}}}{F_{\text{э.1}}}\frac{F_{\text{м.2}}}{F_{\text{м.1}}}\sqrt{\frac{V_{\text{э.о.}}V_{\text{м.о.}}}{V_{\text{э.н.}}V_{\text{м.н.}}}} \quad (41)$$

$$M_{\text{в.}} = M_{\text{э.в.}}M_{\text{м.в.}} = -\frac{F_{\text{э.2}}}{F_{\text{э.1}}}\frac{F_{\text{м.2}}}{F_{\text{м.1}}}\frac{f_{\text{м.1}}}{f_{\text{м.2}}}\sqrt{\frac{V_{\text{э.о.}}V_{\text{м.о.}}}{V_{\text{э.н.}}V_{\text{м.н.}}}}. \quad (42)$$

where $\vartheta_1 = \vartheta_2$ and

$$M_{\text{M.Г.}} = -\frac{\cos\alpha}{\cos\beta}\sqrt{\frac{V_{\text{M.O.}}}{V_{\text{M.И.}}}}\frac{F_{\text{M.2}}}{F_{\text{M.1}}} \quad (31)$$

$$M_{м.н.} = \frac{F_{м.2}}{F_{м.1}} \frac{f_{м.1}}{f_{м.2}} \sqrt{\frac{V_{м.о.}}{V_{м.н.}}}. \quad (36)$$

$$M_{э.г.} = M_{э.в.} = -\frac{F_{э.2}}{F_{э.1}} \sqrt{\frac{V_{э.о.}}{V_{э.н.}}}, \quad (40)$$

If $V_2 > V_1$ (system c) or $V_s > V_1$ (system d), then $tg\,\vartheta_1 = tg\,\vartheta_2 > 0$. If $V_2 > V_1$ (system c) or $V_s > V_1$ (system d), then $tg\,\vartheta_1 = tg\,\vartheta_2 < 0$. There are 6 figures, 2 tables, and 5 Soviet references.

ASSOCIATION: Fiziko-tekhnicheskiy institut im. A. F. Ioffe AN SSSR Leningrad (Physicotechnical Institute imeni A. F. Ioffe AN USSR Leningrad)

SUBMITTED: July 31, 1961

Fig. 1. Electron optic scheme of mass-spectrometer with plane magnetic prism and cylindrical system for $V_2 > V_1$. 1 - plane magnetic prism;

2 - telescopic system of cylindrical lenses (represented schematically in the form of an equivalent double layer); 3 - electron collimator lens; 4 - focussing electron lens. A - object; C - image.
Fig. 5. Electron optical scheme of mass-spectrometer with an intermediate image in which the telescopic system of immersion lenses serves as electrostatic diffraction element $(V_2 > V_1)$. 1 - plane magnetic prism;

2 - telescopic system of immersion lenses; 3 - collimator lens of the electrostatic analysator; 4 - focussing lens of the electrostatic analysator; 5 - collimator lens of the magnetic spectrometer; 7 - intermediate immersion lens; 8 - diaphragm; A - object; B - intermediate image; C - final image.

KEL'MAN, V.M.; RODNIKOVA, I.V.

Electrostatic prismatic analyser of the energy of charged particles. Zhur.tekh.fiz. 32 no.3:279-286 Mr '62. (MIRA 15:4)

1. Fiziko-tekhnicheskiy institut imeni A.F.Ioffe AN SSSR, Leningrad.
(Particles (Nuclear physics)) (Nuclear physics--Instruments)

44212

S/057/62/032/012/007/017
B104/B186

AUTHORS: Kel'man, V. M., Peregud, B. P., and Skopina, V. I.

TITLE: A precision prismatic spectrometer I. Electron-optical scheme and design

PERIODICAL: Zhurnal tekhnicheskoy fiziki, v. 32, no. 12, 1962, 1446-1464

TEXT: A magnetic beta spectrometer developed in the FTI imeni A.F.Ioffe AS USSR is described which makes it possible to investigate the electron spectrum of radioactive isotopes both with great resolving power and with great aperture ratio, also determining the electron energy with great accuracy. The electron-optical system (Fig. 1) resembles that of an optical spectrometer. It is distinguished from other electron-optical systems in that focusing and energy separation of particles are effected by different units. This enables great resolving power to be combined with comparatively large solid angle, large area of source and great aperture ratio. In the gap of the deflecting magnet (Fig. 4) the field can be stabilized by a tight coupling between field strength and coil current, accurately to within 0.003%. The field strength of the magnet lenses can

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be varied over a range corresponding to electron energies from 30 to 2800 kev. The vacuum system comprises a vacuum chamber for the source, two tubelike vacuum chambers for the collimator lens and the focusing lens, a chamber for the deflecting magnet and another for the counters. Within an accuracy of 0.01%, a stabilizer keeps the current constant in a range from 0.02 to 3 a for 20 minutes. The electrons passing through the slit can be registered either by two G.M. counters working in coincidence or by counters placed at a distance of 750 mm from the slit. An automatic system controls the spectrometer according to a fixed program and records the results on a paper tape. There are 11 figures.

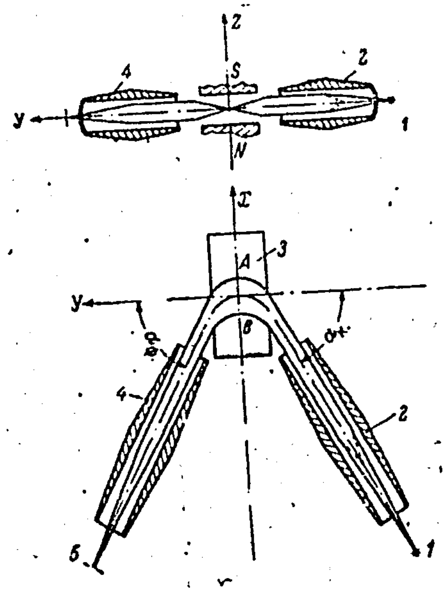
ASSOCIATION: Fiziko-tekhnicheskiy institut im. A. F. Ioffe AN SSSR, Leningrad (Physicotechnical Institute imeni A. F. Ioffe AS USSR, Leningrad)

SUBMITTED: July 18, 1962

A precision prismatic spectrometer...

Fig. 1. Electron-optical system.

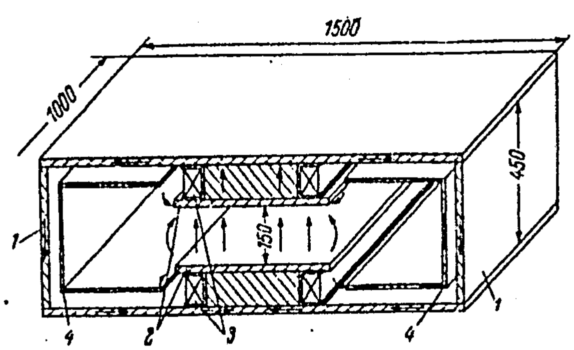
Legend: (1) radioactive source, (2) collimator lens, (3) deflecting magnet, (4) focusing magnet, (5) slot



A precision prismatic spectrometer...

Fig. 4. Cross section of a deflecting magnet.

Legend: (1) yoke of the magnet, (2) pole shoes, (3) coil, (4) shield.



44213

S/057/62/032/012/008/017
B104/B186

24.6750

AUTHORS: Kel'man, V. M., Peregud, B. P., and Skopina, V. I.

TITLE: A precision prismatic spectrometer. II. Resolving power, aperture ratio, accuracy of measuring energy and relative intensities

PERIODICAL: Zhurnal tekhnicheskoy fiziki, v.32, no. 12, 1962, 1465-1476

TEXT: The properties of a prismatic beta-spectrometer designed in the FTI imeni A. F. Ioffe AS USSR (Zhurnal tekhnicheskoy fiziki, v. 32, no. 12, 1962, 1446-1464) are described. The instrument is adjusted by means of the Ir^{192} conversion spectrum and an RdTh deposit, the rectangular source (1.5·15 mm) and rectangular slit (1.5·25 mm) being arranged symmetrically. The optimal instrument half-width is δ = 0.027% if source and slit are 1 mm wide, the resolving power is 0.036%, if the stated above adjustment is used. Characteristics are given in Table 1. The design of the vacuum system and of the source attachment makes it possible to vary the distance between the source and the center of the collimator lens from 121 cm down to 5 cm, thereby decreasing the focal length from 127 to 28 cm. If the

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aperture diaphragm is opened 9.9 cm the solid angle varies between 0.004 and 0.8% of 4π. If the source is brought closer to the lens, the lens current I_K and the angle φ_M through which the source must be turned in order to compensate for the rotation of the image by the magnet lenses both have to be altered (Fig. 3). In a range between 132 and 807 kev the mean line-width of the conversion spectrum lay between 0.15 and 0.21% if the source dimension was 0.6·15 mm, the source thickness 0.5 mg/cm^2 and the slit 2.5·40 mm. The aperture ratio was 0.4% of 4π in these measurements. The probable deviation ϱ of the line-width lay between 1.7 and 15%. The electron momentum was calculated from the formula

$$H\rho = k\left(I_T + \frac{b}{k}\right) = k(I_T + I_0) = (3670 \pm 2)(I_T - 0.0025 \pm 0.0006),$$

where H_ϱ is given in oersteds·cm and I_T in amperes. The error of the

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relative intensities of the conversion lines lies between 0.01 and 0.8%. There are 5 figures and 6 tables.

ASSOCIATION: Fiziko-tekhnicheskiy institut im. A. F. Ioffe AN SSSR, Leningrad (Physicotechnical Institute imeni A. F. Ioffe AS USSR, Leningrad)

SUBMITTED: July 18, 1962

Fig. 3. I_K/I_o and φ_M as function of the distance $\xi\phi$ between source and center of lens. Legend: (1) I_K/I_o, (2) φ_M.

Table 1. (a) symmetrical variant, (b) great aperture ratio, (1) focal length in cm, (2) dimensions of the aperture diaphragm in cm^2, (3) Ω in % of 4π, (4) source dimensions in mm, (6) aperture ratio, cm^2, (7) $\delta=\Delta(H\varrho)/(H\varrho)$,%.

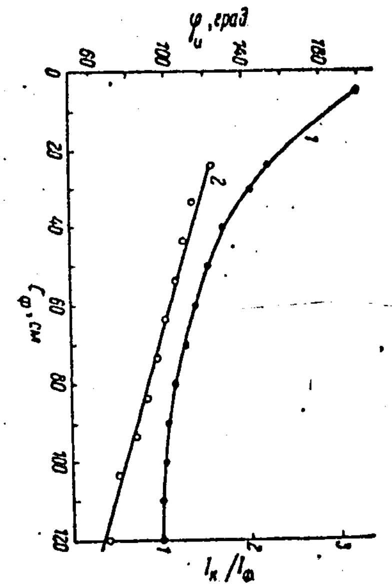

Fig. 3

Table 1

(1)	Размеры апертурной диафрагмы, см² (2)	Ω, % от 4π (3)	Размеры источника, мм² (4)	Ширина приемной щели, мм (5)	Светосила (произвед. Ω на площадь ист.), см² (6)	$\delta = \Delta(H\rho)/(H\rho)$, % (7)
(a) 127	3 × 3	0.0045	0.4 × 15	0.4	$3 \cdot 10^{-6}$	0.014
127	5 × 5	0.012	0.4 × 15	0.4	$7 \cdot 10^{-6}$	0.022
127	9 × 9	0.04	1.0 × 15	1.0	$6 \cdot 10^{-5}$	0.036
73	9 × 9	0.12	2.0 × 15	2.5	$3 \cdot 10^{-4}$	0.10
(b) 42	9 × 9	0.37	1.5 × 15	2.5	$8 \cdot 10^{-4}$	0.14
28.5	9 × 9	0.79	1.0 × 15	2.5	$12 \cdot 10^{-4}$	0.20

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KEL'MAN, Veniamin Moiseyevich; YAVOR, Stella Yakovlevna; ARTSIMOVICH, L.A., akademik, otv. red.; GOL'SHTEYN, G.A., red.izd-va; AREF'YEVA, G.P., tekhn. red.

[Electron optics] Elektronnaia optika. Izd.2., perer. i dop. Moskva, Izd-vo Akad. nauk SSSR, 1963. 362 p. (MIRA 16:6)
(Electron optics)

S/057/63/033/003/018/021
B104/B180

AUTHORS: Kel'man, V. M., and Yavor, S. Ya.

TITLE: A quadrupole lens with negative chromatic aberration

PERIODICAL: Zhurnal tekhnicheskoy fiziki, v. 33, no. 3, 1963, 368-370

TEXT: Quadrupole lenses may have negative chromatic aberration if the ratio between magnetic and electric fields has a certain value. It is assumed that the electrostatic and magnetic fields are superposed in such a way that the symmetry plane of the former coincides with the antisymmetry plane of the latter. Besides this, the electric and magnetic field forces acting on the charged particle are counter to one another. Under these assumptions φ the electrostatic and the magnetic field will be described by $\varphi = \frac{E_0}{2} f(z)(x^2-y^2)$ and $\psi = H_0 f(z)xy$, where $f(z)$ gives the field distribution along z and E_0 and H_0 are constants. In the relativistic case the paraxial trajectories have the form

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$$x'' - xf(z)\left(\frac{eH_0}{mcv} - \frac{eE_0}{mv^2}\right) = 0,$$

$$y'' + yf(z)\left(\frac{eH_0}{mcv} - \frac{eE_0}{mv^2}\right) = 0.$$

... of the lense is defined by

$$Q = \frac{eH_0}{mcv} - \frac{eE_0}{mv^2} = \frac{e}{m_0 v}\sqrt{1 - \frac{v^2}{c^2}}\left(\frac{H_0}{c} - \frac{E_0}{v}\right),$$

Studying these equations the condition

$$E_0 \frac{c}{v_2} < H_0 < E_0 \frac{2c^2 - v_2^2}{cv_2},$$

... negative chromatic aberration is derived in the relativistic, and

$$E_0 \frac{c}{v_z} < H_0 < 2E_0 \frac{c}{v_z}.$$

in the non-relativistic case. If H_0 satisfies these conditions a ... quadrupole lens will have negative chromatic aberration. There ... figure.

...ON: Fiziko-tekhnicheskiy institut im. A. F. Ioffe AN SSSR, Leningrad
(Physicotechnical Institute imeni A. F. Ioffe AS USSR, Leningrad)

SUBMITTED: April 2, 1962

S/057/63/033/004/003/021
B187/B102

AUTHORS: ~~Kel'man, V. M.,~~ and Rodnikova, I. V.

TITLE: Mass spectrometers with two-dimensional electric and magnetic fields

PERIODICAL: Zhurnal tekhnicheskoy fiziki, v. 33, no. 4, 1963, 387 - 392

TEXT: In the previous paper of the authors (ZhTF, 32, no. 3, 1962, 269) mass spectrometers with very small aberration are described, the deflecting system of which consists of two-dimensional magnetic and electrostatic fields which are arranged separately in a series. The ion beam before entering and after leaving the fields is parallel. The postulation that the entire system must be achromatic determines the mutual position of the magnetic and the electric part of the apparatus. The entire system as a whole could not be two-dimensional. In the present paper the electron-optical properties of such a system are studied for the case that the entire system remains two-dimensional. The formulas are established for the general relativistic case and then simplified for the nonrelativistic case (low particle velocity) frequently occurring in practice. The angular

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B187/B102

Mass spectrometers with...

magnification of the system is $M_{\vartheta} = \sqrt{\frac{V_{p1}}{V_{p2}}}\frac{\cos \vartheta_{1m}}{\cos \vartheta_{2m}}$, where ϑ is the angle of deflection, V the electric potential, $V_p = V(1 - \frac{eV}{2mc^2})$, m is the rest mass of the particle. The indices 1 and 2 denote the values before and after the passage through the corresponding fields; the index m signifies that the particle shall move in the central plane. The condition for achromatism is $\frac{\sin \vartheta_{2m}}{\sin \vartheta_{1m}} = \sqrt{\frac{V_2}{V_1}}$. Three schemes of the arrangement for mass spectroscopes are described, which when the direction of motion of the particles is reversed, yield three further schemes. The following formulas are valid for these schemes (for nonrelativistic approximation). The horizontal magnification of the instrument is $M_{Hor} = M_{\vartheta}\frac{F_2}{F_1}\sqrt{\frac{V_o}{V_B}\frac{V_2}{V_1}} = -\frac{\cos \vartheta_{1m}}{\cos \vartheta_{2m}}\frac{F_2}{F_1}\sqrt{\frac{V_o}{V_B}}$. F_1 and F_2 denote the focal widths of the collimator and the focusing lens, V_o is the potential in the object space of the collimator lens and V_B is

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the potential in the image space of the focusing lens. Furthermore formulas are derived for the image line and the radius of curvature of the image. $\frac{dl}{dm} = -\frac{F_2}{2m}\sqrt{\frac{V_2}{V_B}}\, tg\, \vartheta_{2m} \left(1 - \frac{V_1}{V_2}\right)$ is valid for the linear dispersion of the apparatus, m is the particle mass. The design of the three apparatus described in the present paper is simpler than that suggested by the author in his previous paper since simple electrostatic slit lenses are used and not telescopic systems of such lenses as before. Since the deflection angle in the magnetic field is limited with 90° the dispersion is lower. There are 3 figures.

ASSOCIATION: Fiziko-tekhnicheskiy institut im. A. F. Ioffe AN SSSR, Leningrad (Physicotechnical Institute imeni A. F. Ioffe AS USSR, Leningrad)

SUBMITTED: April 2, 1962

KEL'MAN, V.M.; YAVOR, S.Ya.; DYMNIKOV, A.D.; OVSYANNIKOVA, L.P.

Achromatic quadrupole lenses. Izv. AN SSSR. Ser. fiz. 27 no.9: 1135-1138 S '63. (MIRA 16:9)

1. Fiziko-tekhnicheskiy institut im. A.F.Ioffe AN SSSR.
(Electron optics)

ANKUDINOV, V.A.; KEL'MAN, V.M.; SISOYEVA, L.N.

Acceleration of charged particles by periodically varying magnetic fields. Zhur.tekh.fiz. 33 no.1:19-27 Ja '63. (MIRA 16:2)

1. Fiziko-tekhnicheskiy institut imeni A.F.Ioffe AN SSSR, Leningrad.
(Particles (Nuclear physics)) (Magnetic fields)

KEL'MAN, V.M.; YAVOR, S.Ya.

Quadrupole lens with negative chromatic aberration. Zhur. tekh. fiz. 33 no.3:368-370 Mr '63. (MIRA 16:5)

1. Fiziko-tekhnicheskiy institut imeni A.F.Ioffe AN SSSR, Leningrad.
(Lenses) (Achromatism)

KEL'MAN, V.M.; RODNIKOVA, I.V.

Mass spectrometers with two-dimensional electric and magnetic fields. Zhur. tekh. fiz. 33 no.4:387-392 Ap '63. (MIRA 16:9)

1. Fiziko-tekhnicheskiy institut imeni A.F.Ioffe AN SSSR, Leningrad.
(Mass spectrometry) (Electric fields) (Magnetic fields)

BORYKIN, B. V.; KEL'MAN, V. M.; MEDNIKOVA, L. S.

"Dispersion Properties of a Prismatic Electrostatic Beta Spectrometer."

report submitted for All-Union Conf on Nuclear Spectroscopy, Tbilisi, 14-22 Feb 64.

FTI (Physico Technical Inst)

S/0057/64/034/002/0321/0325

ACCESSION NR: AP4013421

AUTHOR: Kel'man, V.M.; Levchenko, S.I.; Luzyanin, I.D.; Peregud, B.P.

TITLE: Vertical focusing of an electron beam in an axially symmetric radially increasing magnetic field by cylindrical magnetic lenses

SOURCE: Zhurnal tekhn.fiz., v.34, no.2, 1964, 321-325

TOPIC TAGS: electron beam, electron beam focusing, magnetic lens, cylindrical magnetic lens, vertical beam focusing, vertical cyclotron beam focusing, cyclotron, accelerator, continuous injection accelerator

ABSTRACT: This paper is the most recent of a series (V.M.Kel'man, B.P.Peregud, K.A.Domatova, ZhTF 28,No.5,1055-1060,1958; Yu.V.Vandadurov,Ibid.28,No.5,1065-1076, 1958; V.M.Kel'man, B.P.Peregud,K.A.Dolmatova,I.D.Luzyanin,Ibid.30,No.2,153-158,1960) devoted to discussion of a system for vertical focusing of the beam in a cyclotron or similar device. The focusing system is described in earlier papers of the series. The focusing system consists of a number of cylindrical magnetic lenses located on equally spaced radii of the acceleration chamber. The present paper reports an experimental investigation of the effectiveness of the focusing system by means of

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ACCESSION NR: AP4013421

probe measurements of beam intensity under various conditions. The apparatus (except for the probe, which presents no novel features) was described in an earlier paper. The chamber was 4 cm high and somewhat more than 32 cm in radius. A 5 keV electron beam was employed. The beam current was measured at 135° from the injection point as a function of the current in the focusing lenses. Appropriate excitation of the lenses increased the beam current by a factor of 100. The beam current was measured as a function of the radius with the lenses excited. Six peaks could be distinguished which, by their relative heights, could be correlated with the first six revolutions of the beam. The positions of the beam after each of its first five revolutions were calculated by a method developed in a previous paper. The calculated beam positions agreed very well with the locations of the five highest peaks on the current versus radius curve. The position of the beam after the sixth revolution is not discussed. The following conclusions are drawn: 1) The proposed system assures effective vertical focusing of an electron beam in a radially increasing magnetic field. 2) Formulas developed in an earlier paper can be employed to calculate the behavior of the system. 3) The system can be recommended for use with cyclotrons to increase the beam energy, and for the development of new types of continuous injection accelerators. "The authors express their gratitude to Yu.

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ACCESSION NR: AP4013421

V.Vandakurov and Yu.S.Korobochka for the interesting and valuable discussions that occurred during the course of the work." Orig.art.has: 4 formulas, 5 figures and 1 table.

ASSOCIATION: Fiziki-tekhnicheskiy institut im. A.F.Ioffe AN SSSR, Leningrad (Physical-Technical Institute, AN SSSR)

SUBMITTED: 26Dec62 DATE ACQ: 26Feb64 ENCL: 00

SUB CODE: PH, SD NR SOV REF: 004 OTHER: 000

Card 3/3

ANKUDINOV, V.A.; KEL'MAN, V.M.; SYSOYEVA, L.N.

Acceleration of charged particles by variable magnetic fields. Zhur. tekh. fiz. 39 no.1:23-33 Ja '64. (MIRA 17:1)

1. Fiziko-tekhnicheskiy institut imeni A.F.Ioffe AN SSSR, Leningrad.

KEL'MAN, V.M.; KNYAZ'KOV, L.G.; KRASNOVA, Ye.K.

High-dispersion mass spectrometer with a double magnetic system. Zhur. tekh. fiz. 34 no.9:1688-1693 S '64. (MIRA 17:10)

1. Fiziko-tekhnicheskiy institut imeni Ioffe AN SSSR, Leningrad.

ENCL: 00 SUB CODE: GP, EC

ACCESSION NR: AP5013996

GLIKMAN, L.G.; KEL'MAN, V.M.; YAKUSHEV, Ye.M.

Electromagnetic mechanism of the acceleration of cosmic rays.
Izv. AN SSSR.Ser.fiz. 29 no.10:1865-1869 O '65.

(MIRA 18:10)

1. Institut yadernoy fiziki AN KazSSR.

L 2194-66 EWT(1) IJP(c)

ACCESSION NR: AP5019234 UR/0056/65/049/001/0210/0213

AUTHOR: Glikman, L. G.; Kel'man, V. M.; Yakushev, Ye. M.

TITLE: Exact integration of the equations of motion of relativistic charged particles for a certain class of variable electromagnetic fields

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 49, no. 1, 1965, 210-213

TOPIC TAGS: motion equation, nonlinear differential equation, partial differential equation, first order differential equation, charged particle, relativistic particle

ABSTRACT: The authors obtain an exact solution for the equations of motion of relativistic charged particles in a variable electromagnetic field having rotational symmetry, in which there is a median plane that is perpendicular to the symmetry axis and is a plane of antisymmetry for the magnetic field and a plane of symmetry for the electric field. The motion of the particles in this plane is treated. It is assumed in addition that the charges produce no electric field and that the electrostatic potential is zero. The magnetic component of the field has only an azimuthal component in the median plane. The equations of motion are derived from the relativistic Hamiltonian-Jacobi equation and reduced to a first-order partial

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L 2194-66
ACCESSION NR: AP5019234

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differential equation, which is integrated by the Lagrange-Charpit method. Orig. art. has: 15 formulas.

ASSOCIATION: Institut yadernoy fiziki Akademii nauk Kazakhskoy SSR (Institute of Nuclear Physics, Academy of Sciences, Kazakh SSR) 44,55

SUBMITTED: 11Jan65 ENCL: 00 SUB CODE: GP, MA

NO REF SOV: 003 OTHER: 000

Card 2/2

ACC NR: AP6036034 SOURCE CODE: UR/0057/66/036/011/2028/2034

AUTHOR: Kel'man,V.M.; Rodnikova,I.V.; Uteyev,M.L.

ORG: Institute of Nuclear Physics, Kaz.SSR, Alma-Ata (Institut yadernoy fiziki Kaz.SSR)

TITLE: A magnetic prism mass spectrometer

SOURCE: Zhurnal tekhnicheskoy fiziki, v. 36, no. 11, 1966, 2028-2034

TOPIC TAGS: mass spectrometer, prism, magnetic field, electrostatic lens

ABSTRACT: A magnetic prism mass spectrometer is described, theoretical and experimental background for the design of which will be found in two papers by V.M. Kel'man and collaborators (ZhTF, 31,1083,1961; DAN SSSR, 160,85,1965). Collimation and focusing are accomplished by two identical 100 cm focal length singlet electrostatic lenses. The dimensions of the pole pieces of the magnetic prism, in which the beam is deflected through 106°, are 3 x 15 x 13 cm, and the gap between them is 16 mm. A beam of 4.0-4.2 keV ions from a conventional electron impact ion source is admitted through a 0.1 mm slit, limited by a 1.0 x 1.2 cm oval iris 88 cm from the slit, collimated by the electrostatic lens 12 cm from the iris, deflected by the magnetic prism, and focused by the second lens onto an adjustable slit having a maximum width of 0.35 mm. The current through the exit slit is amplified and recorded with an automatic plotter. The ion beam is brought to a line focus by the fringe

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UDC: 539.1.08

ACC NR: AP6036034

field of the prism, and the focal line is in the central plane of the prism when the instrument is properly adjusted. This adjustment is effected by moving the prism magnet, because the collimator tube is rigidly fastened to the vacuum system. The relative mass dispersion of the instrument is 1330 mm (i.e., 13.3 mm per percent mass change). The records of several close mass doublets obtained with the instrument are presented. A resolving power of about 2200 was achieved with the exit slit wide open, and resolving powers up to 3000, with a narrow exit slit. Spectra were also recorded without the second (focusing) lens, the collimator being adjusted to over-collimate the beam and bring it to a focus on the exit slit. There was no appreciable deterioration of the resolving power under these conditions. Orig. art. has: 1 formula and 8 figures.

SUB CODE: 20 SUBM DATE: 18Dec65 ORIG. REF: 005

Card 2/2

33353
S/181/62/004/001/024/052
B108/B104

9.4174 (1043,1482,1114)

AUTHORS: Yefimova, B. A., Kel'man, Ye. V., and Stil'bans, L. S.

TITLE: Mechanism of scattering from impurity ions in Bi_2Te_3

PERIODICAL: Fizika tverdogo tela, v. 4, no. 1, 1962, 152 - 156

TEXT: The temperature dependences of the electron and hole mobilities of polycrystalline Bi_2Te_3 (n- and p-type) were measured at 80 - 600°K. The different carrier concentrations at which the measurements were made were attained by adding Pb (p-type) and/or CuBr (n-type). In evaluating the mobility data it was assumed that the mobility related to scattering from impurity ions is independent of temperature and of the mean carrier energy. Moreover, it was assumed that $1/u_{exp} = 1/u_{therm} + 1/u_{ion}$, where u_{therm} is the mobility with scattering from thermal lattice vibrations, u_{ion} is the mobility with scattering from impurities. The effect of scattering from impurities on the thermo-emf is less than 10 - 12%. It was therefore possible to calculate the levels of the chemical potential from the thermo-

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S/181/62/004/001/024/052
B108/B104

Mechanism of scattering from...

emf. The electron and hole mobilities in the case of scattering from the thermal lattice vibrations are proportional to $T^{-1.78}$ and $T^{-2.12}$, respectively. Experiments as well as calculations were proof of the correctness of the law $l \sim \sqrt{\mathcal{E}}$ (l - carrier free path) (M. N. Vinogradova et al., FTT, 1, 9, 1333, 1959). This law accounts for screening of the charge of the impurity ions owing to high dielectric constant and high carrier concentration. The experimental and calculated cross sections S of scattering from impurity ions agree well with each other ($S_{exp} \approx 2.10^{-15}$ cm^2, $S_{th} \approx 3.10^{-15}$ cm^2), corresponding to an "ion radius" of about 3 Å. There are 4 figures, 1 table, and 7 references: 2 Soviet and 5 non-Soviet. The four most recent references to English-language publications read as follows: H. Brooks, C. Herring. Phys. Rev., 83, 879, 1951; K. Hashimoto. Mem. Fac. Science, Kynsyn University, ser. B, 2, 5, 165, 1958; I. G. Austin. Proc. Phys. Soc., 72, 545, 1956; N. Sclar. Phys. Rev., 104, 1548, 1956.

ASSOCIATION: Institut poluprovodnikov AN SSSR Leningrad (Institute of Semiconductors AS USSR, Leningrad)

Card 2/3

33353
S/181/62/004/001/024/052
B108/B104

Mechanism of scattering from...

SUBMITTED: July 15, 1961

X

Card 3/3

YEFIMOVA, B.A.; KEL'MAN, Ye.V.; STIL'BANS, L.S.

Mechanism of scattering on impurity ions in Bi_2T_3. Fiz. tver. tela 4 no.1:152-156 Ja '62. (MIRA 15:2)

1. Institut poluprovodnikov AN SSSR, Leningrad.
(Bismuth telluride)
(Electrons—Scattering)
(Ions)

USSR / Microbiology. General Microbiology. Effect of External Agents. Disinfection. F

Abs Jour: Ref Zhur-Biol., No 2, 1959, 5421.

Author : Kogan, D. A.; Kel'man, Z. N.
Inst : Uzbek Institute of Orthopedics, Traumatology and Prosthetics.
Title : Effect of Ultraviolet Radiation of Bactericidal Lamp on Pathogenic Microflora of Wounds.

Orig Pub: Tr. Uzb. in-i. in-ta ortopedii, travmatol, i protezir., 1955, 6, 89-91.

Abstract: The effect of domestic ultraviolet bactericidal lamp, emitting only ultraviolet rays radiation with a wave length of 253.5 m/ι on Proteus, bacillus pyocyaneus, Escherichia coli, Staphylococcus aureus, and Staphylococcus albus was studied.

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USSR / Microbiology. Microbes, Pathogenic to Man and Animals. General Problems. F

Abs Jour : Ref Zhur - Biologiya, No 5, 1959, No. 19544

Author : Kel'man, Z. N.
Inst : Uzbek Scientific-Research Institute of Traumatology and Orthopedics

Title : Vaccine Therapy and Vaccine Prophylaxis in Experimental Wound Infections

Orig Pub : Tr. Uzb. n.-i. in-ta travmatol. i ortopedii, 1957 (1958), 7, 65-69

Abstract : It was indicated previously that specific antibodies are formed in the animals' blood at the presence of Proteus in a wound; titer and preservation period of these antibodies in the blood depend upon the scale of the infection. On the basis of these data, a

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USSR / Microbiology. Microbes, Pathogenic to Man and Animals. General Problems. F

Abs Jour : Ref Zhur - Biologiya, No 5, 1959, No. 19544

vaccine was prepared from the culture of the Proteus for accelerating the healing process of the wounds. The washed day-old Proteus culture was heated over a water bath and diluted with a saline solution to a density of 10 billion microbes. Tests were conducted on 85 rabbits, which were previously immunized. When subcutaneous inoculations of 500 million microbes were given to the tested animals, an infiltrate with pus content is formed, after lancing of which, the wound healed. It was shown that the heated, as well as the formalinized vaccine, during the same periods, accelerate healing of the wounds, depending upon the quantity of the inoculated microbes.

Card 2/3

Effect of the swelling time of Bergenia crassif. leaves on the yield of active substances in the extract. Apt. delo 13 no.2:20-23 Mr-Ap '64. (MIRA 17:12)

1. Irkutskiy meditsinskiy institut.

KEL'MANS, A.K. (Moskva)

Evaluation of the reliability of information transmitting systems with random structure taking into account the value of transmitted communications. Avtom. i telem. 24 no.9:1250-1259 S '63. (MIRA 16:9)

(Information theory)

1964 3-16

TOPIC TAGS: communication system, communication reliability, transmission reliability

... of the reliability of an information transmitting net...

APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000721510014-0"

ACCESSION NR: AP4024683 S/0103/64/025/002/0207/0212

AUTHOR: Kel'mans, A. K. (Moscow); Mamikonov, A. G. (Moscow)

TITLE: Synthesizing optimum-reliability information-transmission structures

SOURCE: Avtomatika i telemekhanika, v. 25, no. 2, 1964, 207-212

TOPIC TAGS: automatic control, link system, communication link system, optimum reliability link, optimum reliability network, information transmission system

ABSTRACT: The problem of synthesizing a link structure (network) having an optimum reliability when the mean losses caused by link and apparatus faults are taken as a reliability criterion is theoretically considered. The apparatus reliability is considered constant; hence, the information-system reliability depends on the reliability of the link structure only. An algorithm is formulated (differing slightly from that of P. K. Prim, "Shortest Connection Networks and

APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000721510014-0"

ACCESSION NR: AP4036508 S/0103/64/025/005/0661/0667

AUTHOR: Kel'mans, A. K. (Moscow)

TITLE: Optimum problems in the theory of reliability of information networks

SOURCE: Avtomatika i telemekhanika, v. 25, no. 5, 1964, 661-667

TOPIC TAGS: system reliability, information system reliability, system reserving, information system

ABSTRACT: An information system which includes n independent and definitely connected elements, each of them having a probability of failure q_i and a cost c_i, is considered. The system reliability criterion $F = F(q_1, \ldots, q_i, \ldots, q_n)$ is specified. Two types of problems are analyzed: (1) Determine a reserving plan that would maximize the system reliability at a limited cost and (2) Minimize the system cost meeting a specified reliability. These problems are solved (formulas describing losses which correspond to the optimum distribution of the

SOURCE: Avtomatika i telemekhanika, v. 26, no. 3, 1965, 567-574

ABSTRACT: A new recursion formula is suggested for determining the

L 14983-66 EWT(d) IJP(c)

ACC NR: AP6002402 SOURCE CODE: UR/0103/65/026/012/2194/2204

AUTHOR: Kel'mans, A. K. (Moscow)

ORG: None

TITLE: The number of trees in a graph. Part 1

SOURCE: Avtomatika i telemekhanika, v. 26, no. 12, 1965, 2194-2204

TOPIC TAGS: set theory, graph theory, function analysis

ABSTRACT: The author presents a method of determining the number of trees in graphs of a certain class, which is more effective than the existing general methods. A totality of operations has been determined for a set of graphs. Each graph is associated with a certain function, termed the B_r^s-function. The graphs of the class examined are represented as $G = F(G_1, G_2, \ldots, G_k)$. This article first of all discusses a technique for the "decomposition" of a graph G into $G_1, G_2, \ldots, G_k$, if the indicated representation exists, and secondly, presents a method of obtaining the B_r^s-functions of the graphs $G_1, \ldots, G_k$ and the function F are known. The number of trees in graph D(G) is easily obtained from the B_r^s-function of the graph G, where D(G) is the value of the B_r^s-function in a certain point. Orig. art. has: 4 figures and 19 formulas.

SUB CODE: 12 / SUBM DATE: 20Mar65 / ORIG REF: 003 / OTH REF: 010

Card 1/1

L 21975-66 EWT(d) IJP(c)

ACC NR: AP6007861 SOURCE CODE: UR/0103/66/000/002/0056/0065

AUTHOR: Kel'mans, A.K. (Moscow)

ORG: none

21
B

TITLE: Number of trees in a graph. Part 2

SOURCE: Avtomatika i telemekhanika, no. 2, 1966, 56-65

TOPIC TAGS: graph theory, mathematic analysis

ABSTRACT: The aim of this paper is to present a procedure for a specific class of graphs which would make it possible to obtain formulas for the number of trees in a graph as functions of the number of peaks and several other parameters. A method for the expansion of a graph into elementary segments is indicated, i.e., a method of the determination of a given graph, and whether it is presented in the form of

$$G = F(G_1, G_2, \ldots, G_k), \quad (1)$$

and if so, then what is its representation. The B_r^s - functions for several elementary

UDC: 519.14

Card 1/2

L 21975-66

ACC NR: AP6007861

graphs are determined. Examples of obtaining formulas for a number of trees in a graph of the class investigated are given. Orig. art. has: 10 figures and 32 formulas.

SUB CODE: 12 / SUBM DATE: 20Mar65 / ORIG REF: 002 / OTH REF: 002

Card 2/2 nst

ZHEYKOV, V.N.; KEL'MANSON, I.A.; USTIMENKO, B.P. (Alma-Ata)

"Hydrodynamics and heat transfer in the annular canal with an inner rotating cylinder"

report presented at the 2nd All-Union Congress on Theoretical and Applied Mechanics, Moscow, 29 Jan - 5 Feb 64.