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Calculation of Field of Spectrometric Magnet with 0.13 m Gap

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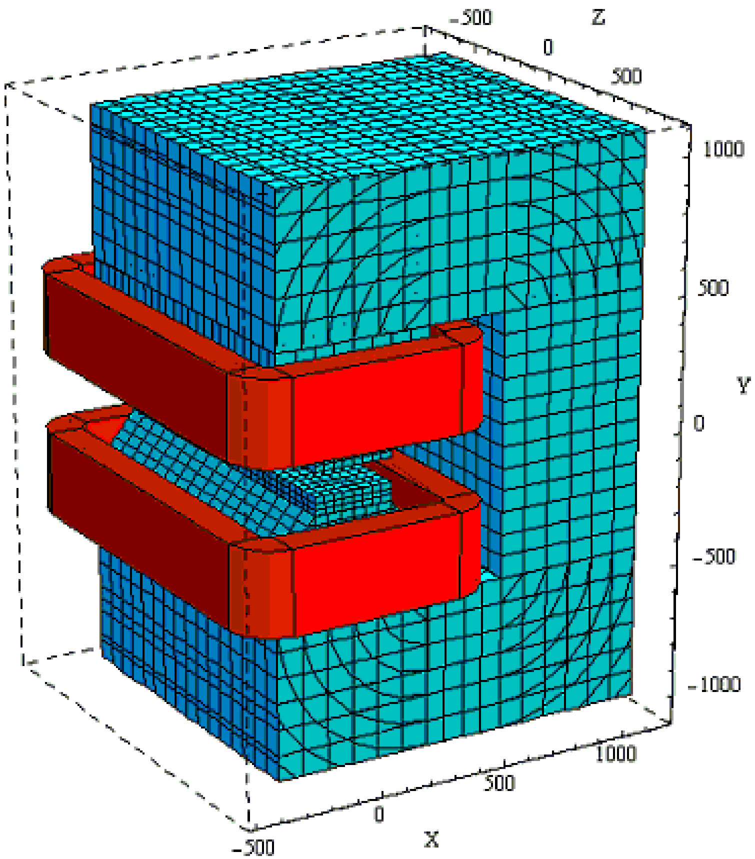
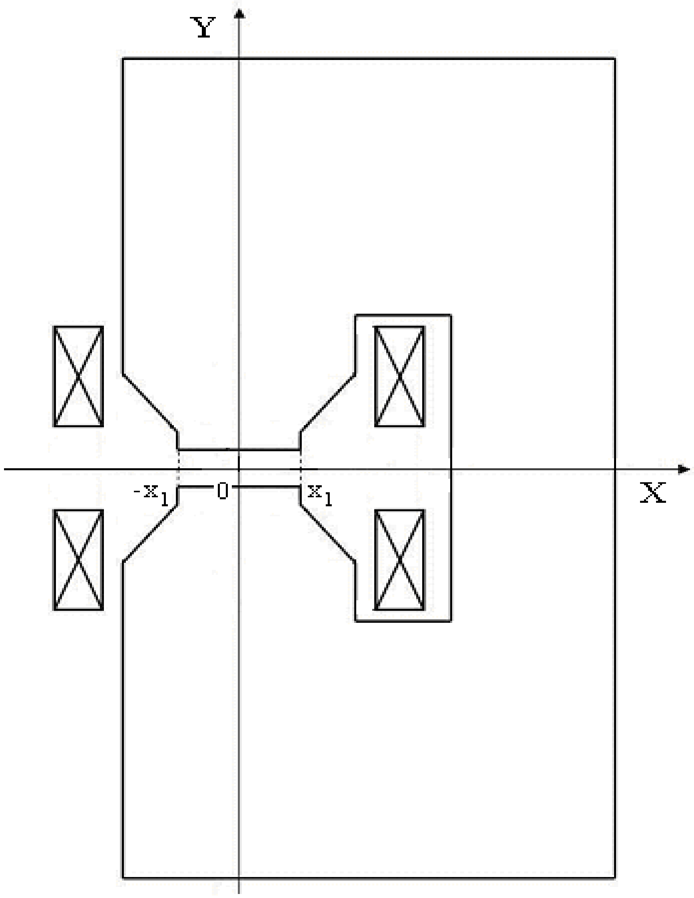
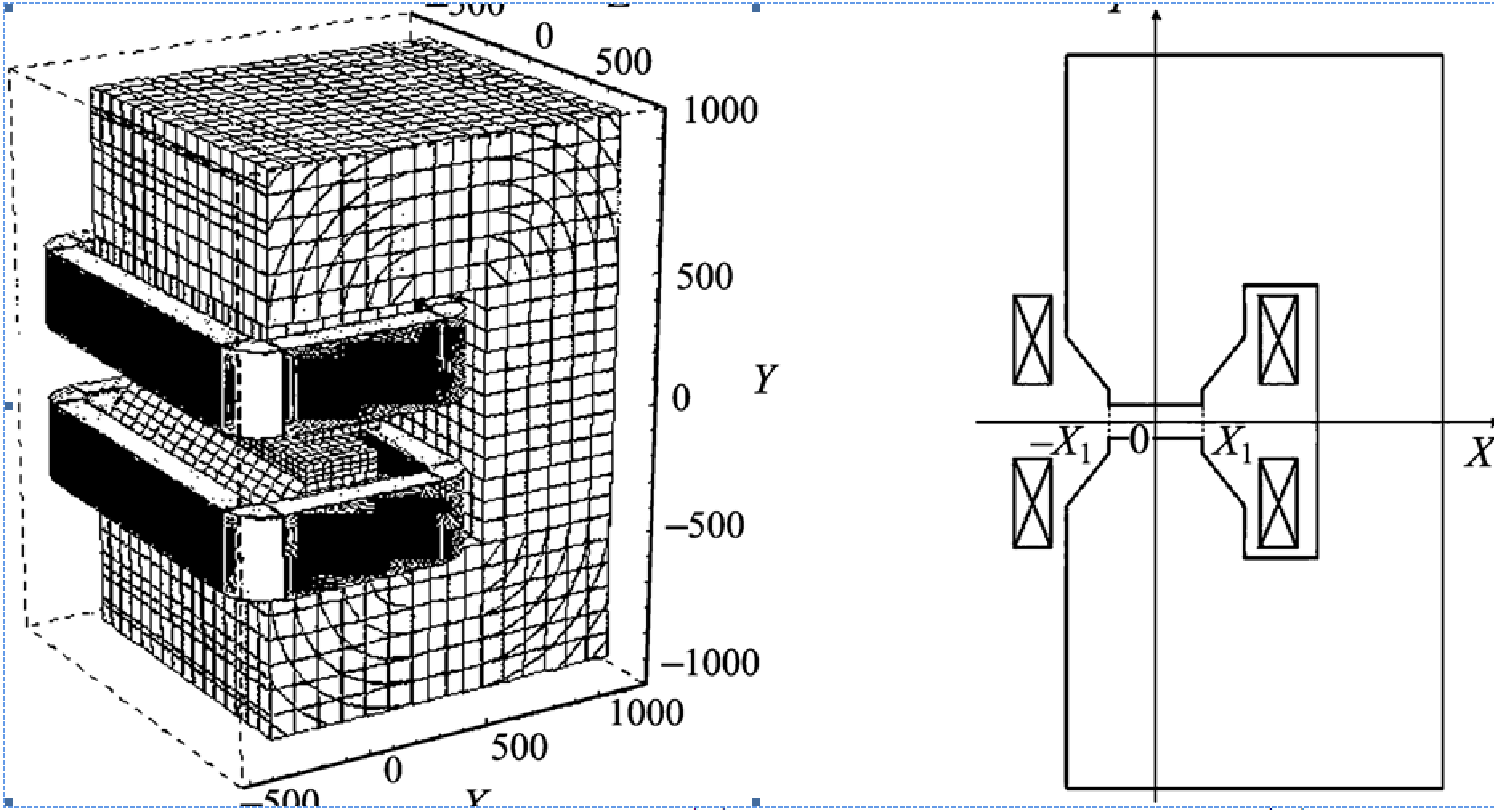
- The spectrometric magnet is used in experiments on high-energy physics and a number of other fields. In this report we present the results of calculating the magnetic field for a variant of a magnet with an interpolar gap of 0.13 m. Our spectrometer magnet has external dimensions of 2.95 x 2.12 x 1.62 m and an aperture (occupied by the beam) of 0.30 x 0.13 m.
- The simulation was carried out using an integral method of magnetostatics
- The results of the calculated field distribution of the analyzing magnet with interpolar 0.13 m gap are given. The calculation was performed for the volume 0.34 x 0.0645 x 1.5 m, the volume of overlapping dimensions. Described in the work the calculation of the spatial distribution of the three components of the magnetic field of the magnet are conducted to obtain information about the magnitude and uniformity of the magnetic field for different modes of operation of the spectrometer.
- Planned to use the obtained results in the processing of physical data.





XOY


0
500
1000
500
Y
0
−500
−1000
1000
500
0
$-X_1$
0
X_1
X

Mathematical statement of the problem

Maxwell's equations for a stationary magnetic field :

$$rot\,\vec{\mathrm{H}}(p) = \vec{J}(p),$$

$$div\,\vec{B}(p) = 0,$$

$$\vec{B}(p) = \mu\mu_0\,\vec{H}(p),$$

Conditions on the interface between media and at infinity :

$$n(\vec{B}_f - \vec{B}_v) = 0, \quad \vec{n}\times(\vec{H}_f - \vec{H}_v) = 0, \quad h(p) \xrightarrow{p\to\infty} 0.$$

$\vec{J}$ is the known volume current density vector, different from zero in a bounded domain Ω_c

and satisfying the relation $\int_{\Omega_c} J d\vec{\Omega} = 0$

Integral statement of the problem

$$\nabla \boldsymbol{B} = 0$$

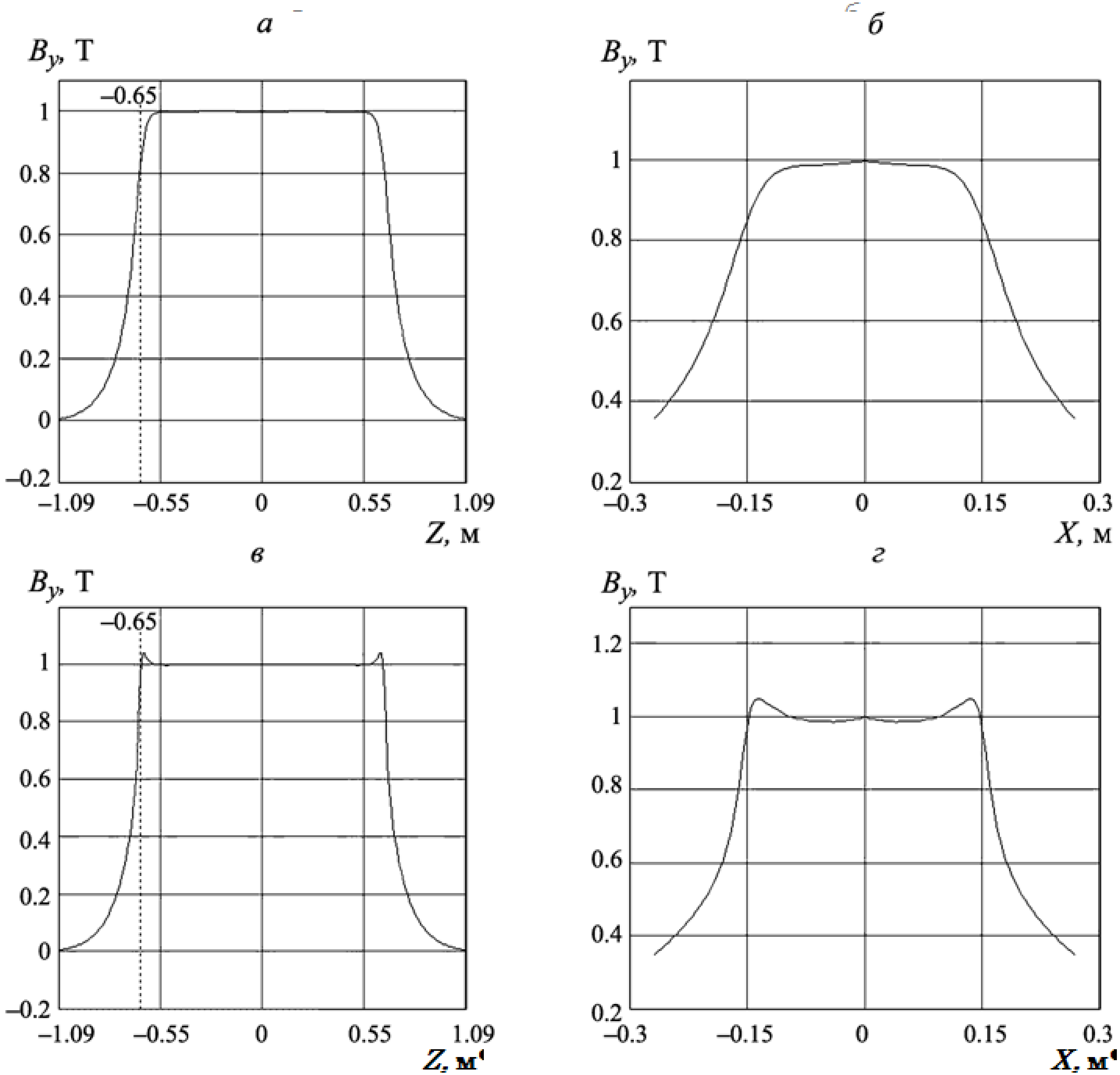
$$\boldsymbol{B} = \mu_0 (\boldsymbol{H} + \boldsymbol{M})$$

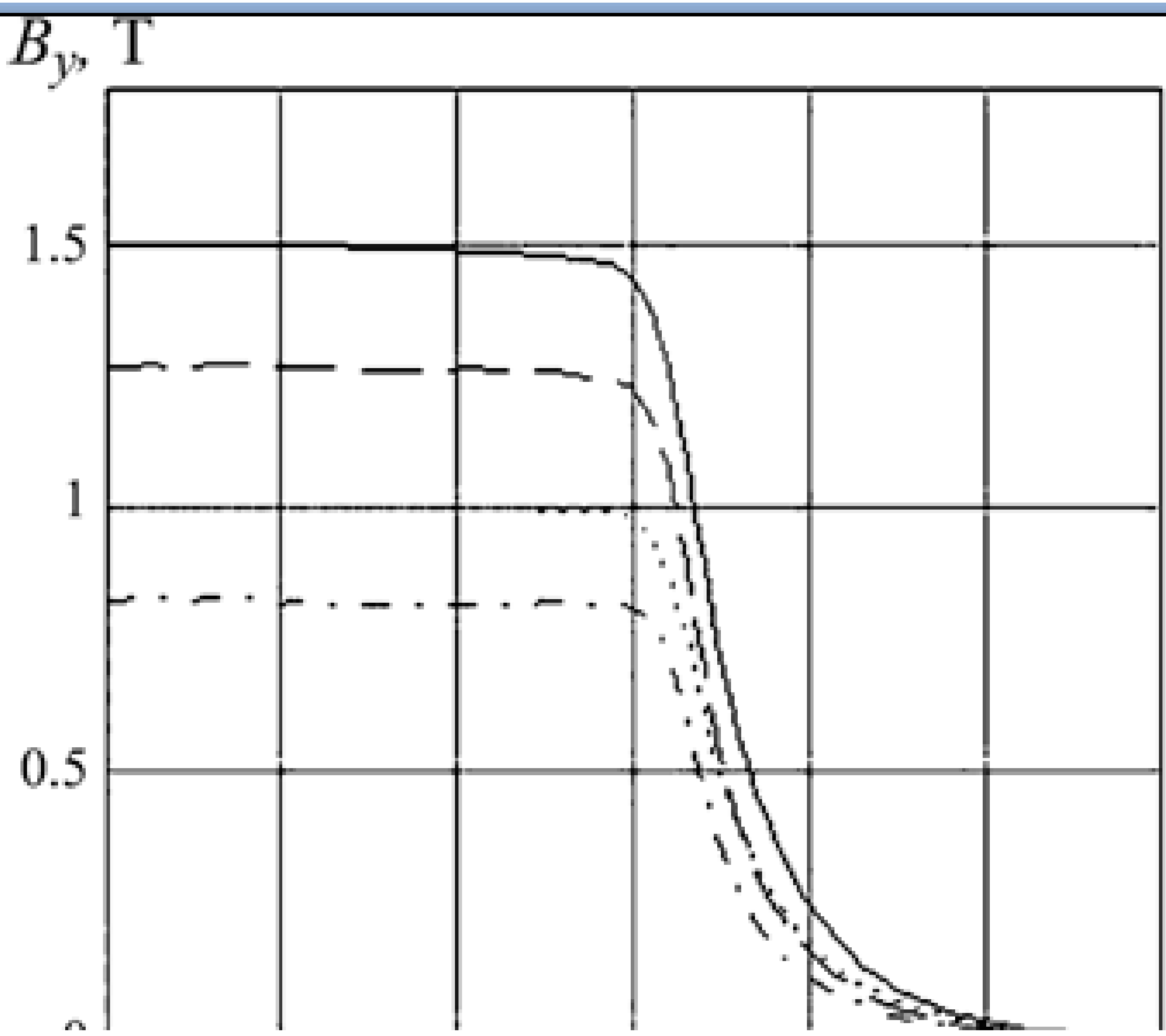
$$\boldsymbol{H} = -\nabla \varphi$$

$$\Delta \varphi = \nabla \boldsymbol{M}$$

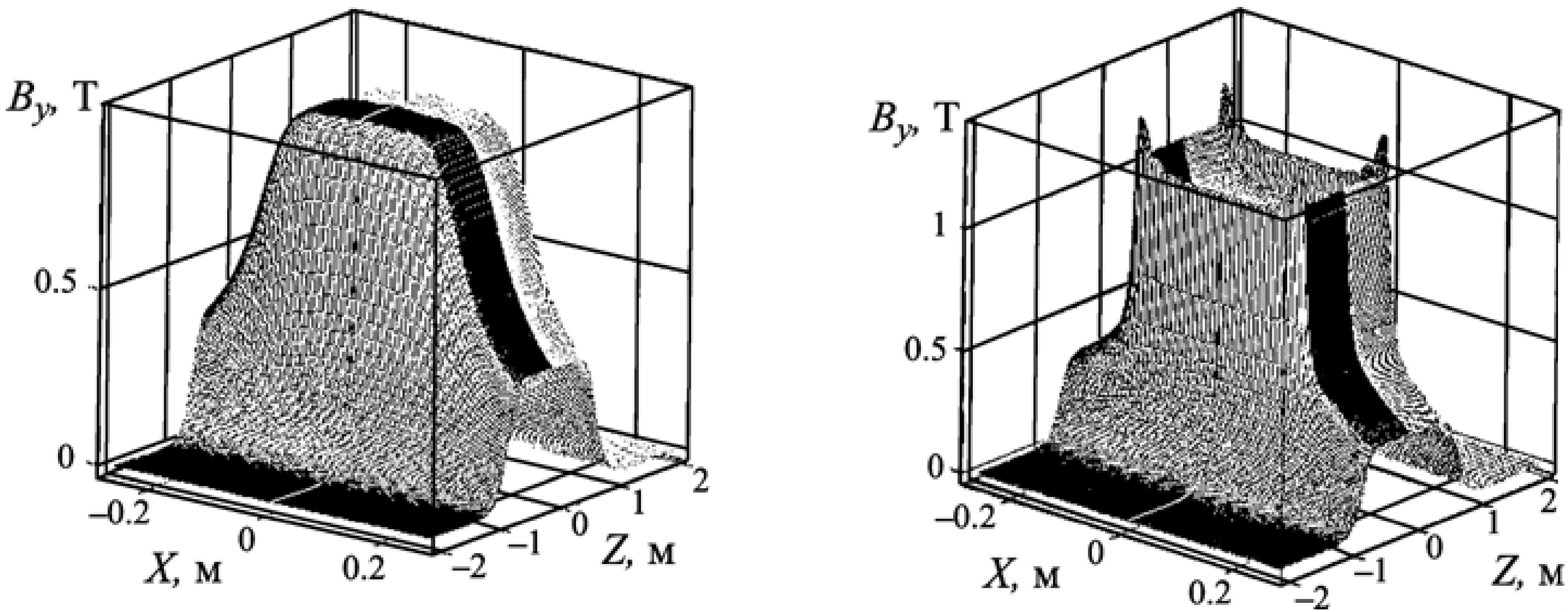
$$\varphi(\boldsymbol{r}) = \frac{-1}{4\pi} \iiint_{V'} \frac{\nabla \boldsymbol{M}}{|\boldsymbol{r}' - \boldsymbol{r}|} dV + \frac{1}{4\pi} \oiint_{S'} \frac{\boldsymbol{M}\boldsymbol{n}_{S'}}{|\boldsymbol{r}' - \boldsymbol{r}|} dS'$$

$$\boldsymbol{H}(\boldsymbol{r}) = \frac{1}{4\pi} \iiint_{V'} \frac{(\boldsymbol{r}' - \boldsymbol{r})\nabla \boldsymbol{M}}{|\boldsymbol{r}' - \boldsymbol{r}|^3} dV' - \frac{1}{4\pi} \oiint_{S'} \frac{(\boldsymbol{r}' - \boldsymbol{r})\boldsymbol{M}\boldsymbol{n}_{S'}}{|\boldsymbol{r}' - \boldsymbol{r}|^3} dS'$$

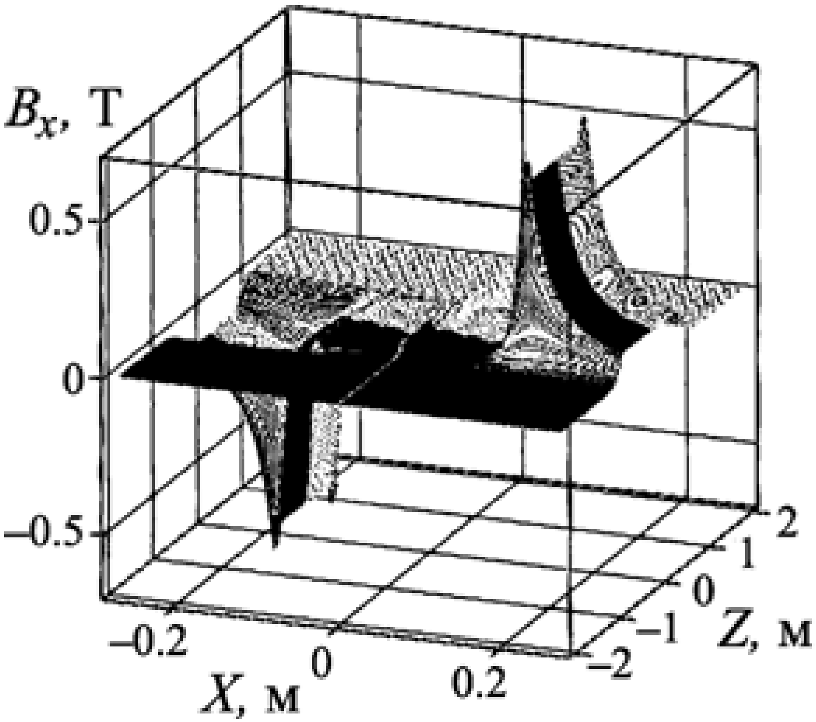

а
б
в
г
B_y, Т
–0.65
1
0.8
0.6
0.4
0.2
0
–0.2
1.2
–1.09
–0.55
0.55
1.09
Z, м
–0.3
–0.15
0.15
0.3
X, м



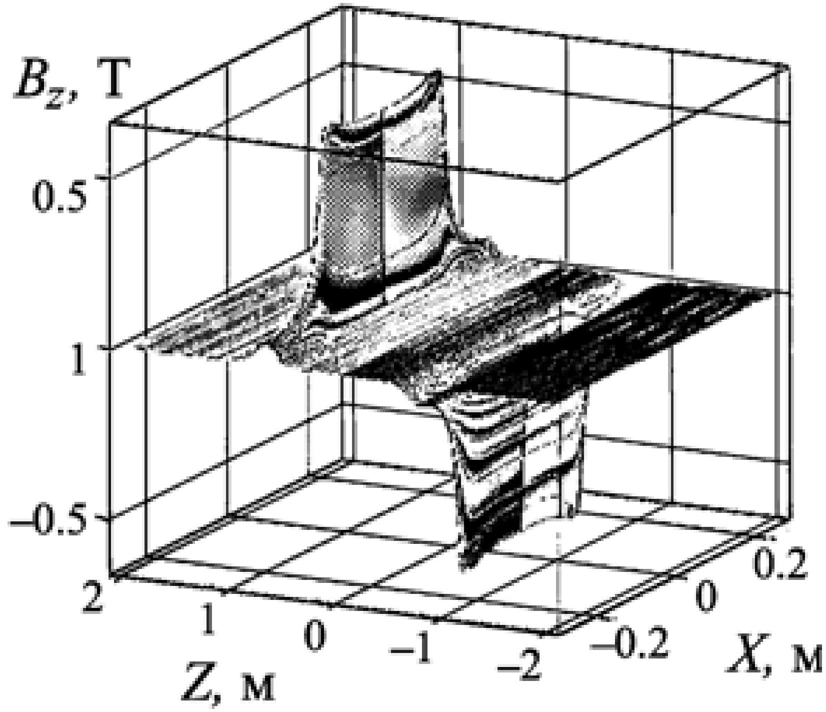
B_y, T
1.5
1
0.5



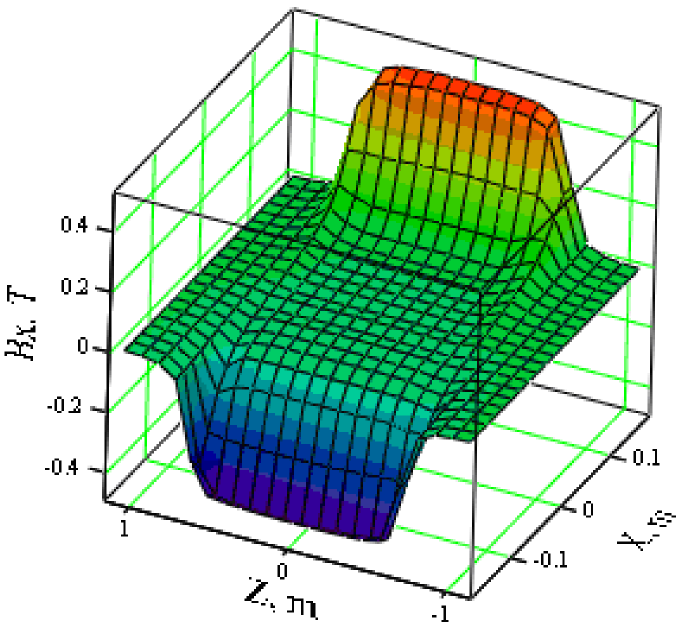
B_y, T
0.5
0
−0.2
0
0.2
X, м
−2
−1
0
1
2
Z, м
B_y, T
1
0.5
0
−0.2
0
0.2
X, м
−2
−1
0
1
2
Z, м



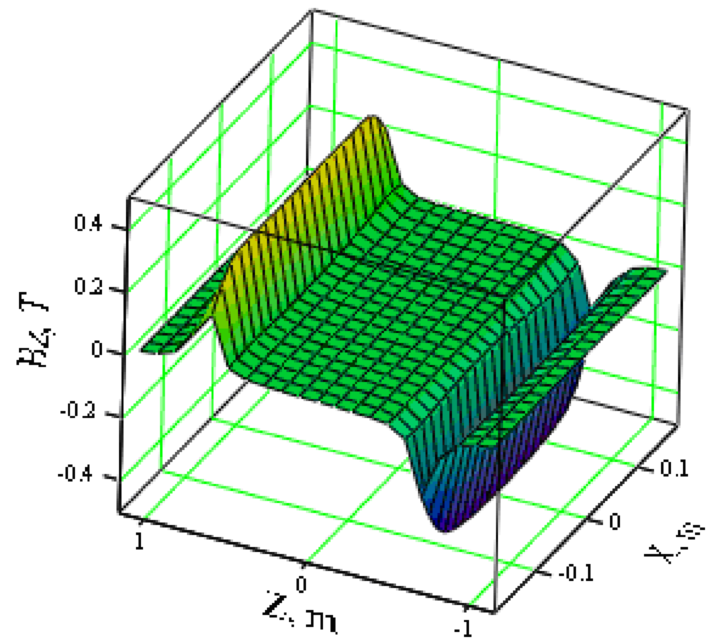
B_x, T
0.5
0
−0.5
−0.2
0
0.2
X, м
2
1
0
−1
−2
Z, м



B_z, T
0.5
1
−0.5
2
1
0
−1
−2
Z, м
0.2
0
−0.2
X, м



Graph



Graph

Conclusions

- The results of the calculated field distribution of the analyzing magnet with interpolar 0.13 m gap, are given.
- The calculation was performed for the volume 0.34 x 0.0645 x 1.5 m, the volume of overlapping dimensions. Described in the work the calculation of the spatial distribution of the three components of the magnetic field of the magnet are conducted to obtain information about the magnitude and uniformity of the magnetic field for different modes of operation of the spectrometer.
- Planned to use the obtained results in the processing of physical data.

THANK YOU FOR ATTENTION !