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# STUDY OF THE DISTORTION OF IMAGES OF MRI SCANNERS

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## PURPOSE OF THE WORK

This work is carried out in order to improve the methods of diagnosis and planning of radiation therapy. It is necessary to understand the nature of the distortion of MRI images and develop a system for minimizing them.

## CAUSES OF DISTORTION



### HARDWARE

- static inhomogeneity of the field
- gradient nonlinearities of the field



### TISSUE

- different magnetic susceptibility of tissue
- chemical shift
- physiological artifacts

## TASKS

- 1. Perform an MR scan of a phantom with known geometric dimensions.
- 2. Process the received images using the software.
- 3. Analyze the results obtained.
- 4. Select the optimal parameters for scanning on this type of MR-tomograph.

# MR-TOMOGRAPH TOMIKON S50



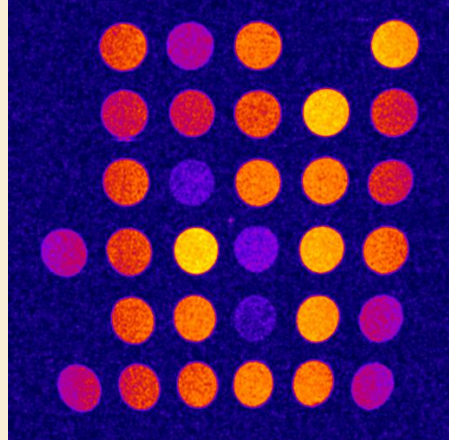
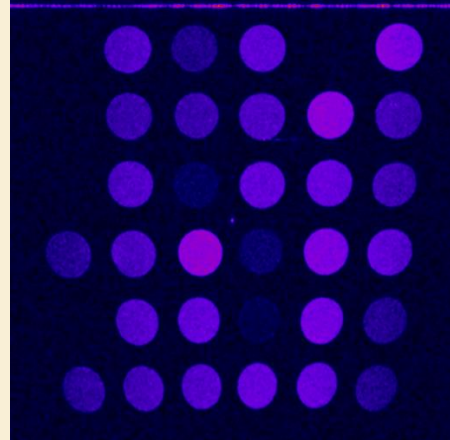
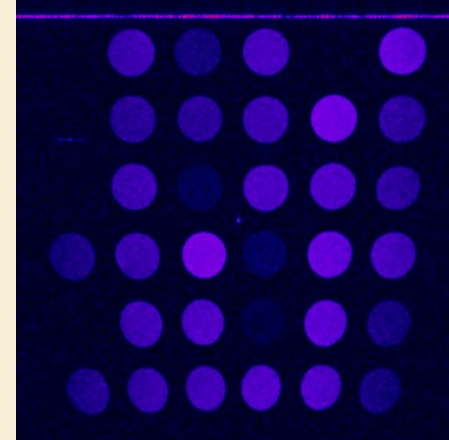
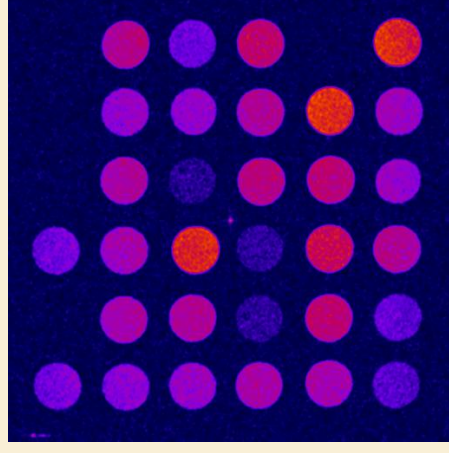
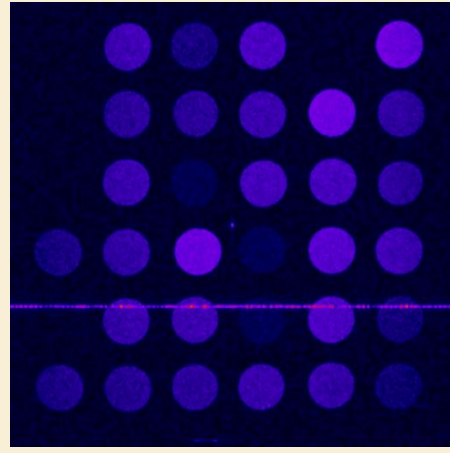
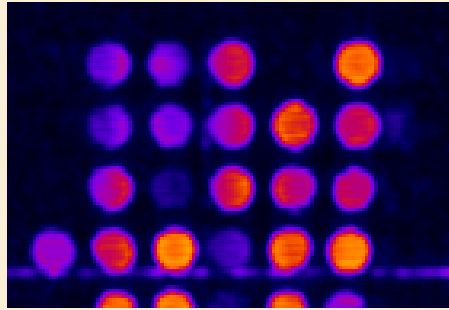
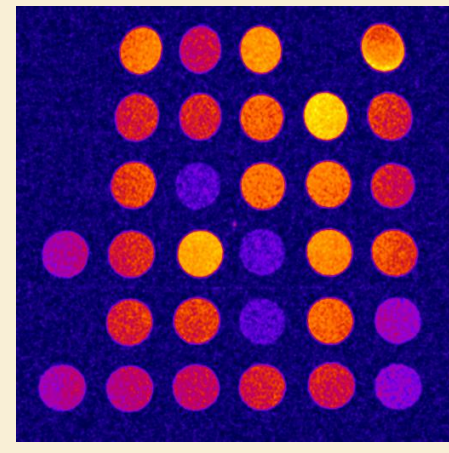
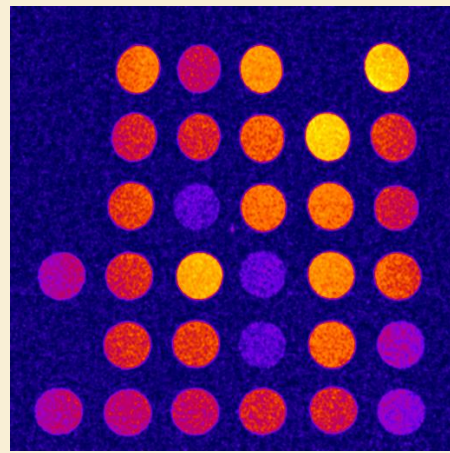
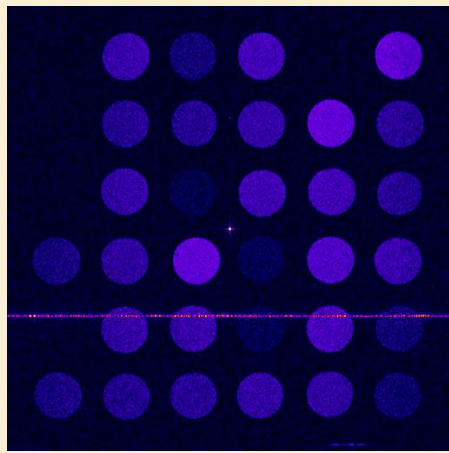
## COIL PARAMETERS

- The maximum field in the center of the tomograph  $B_{\max} = 0.5Tl$
- inner radius of the coil  
 $R = 0.59M$
- length of the coil  $L = 2M$

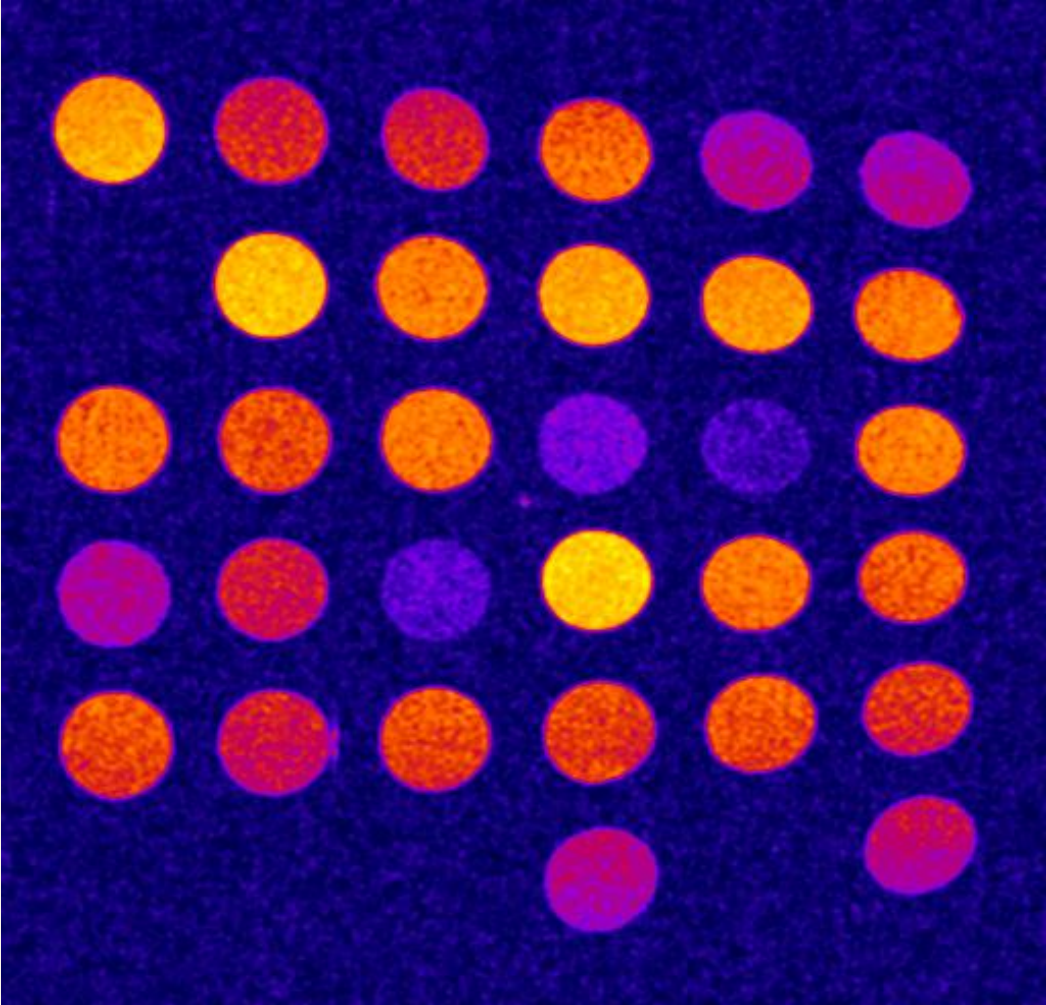
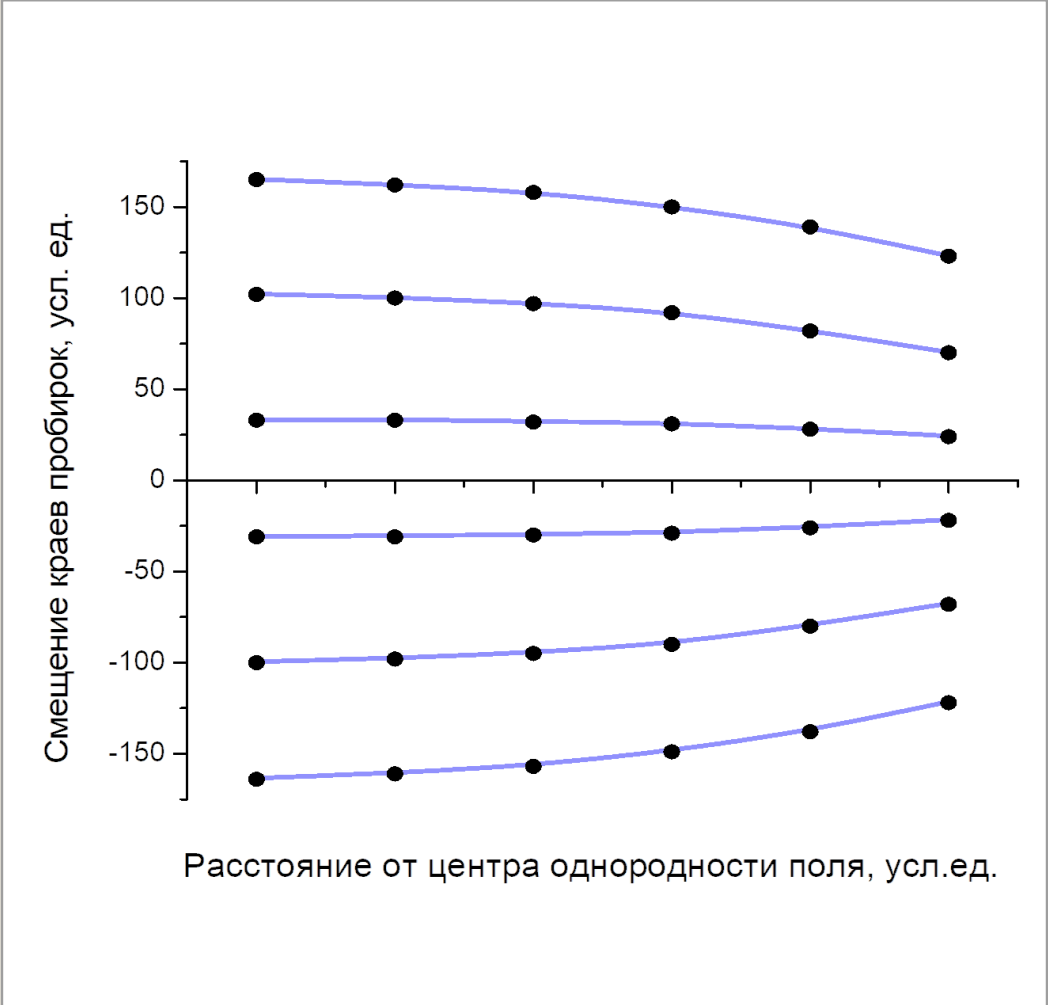
## A PHANTOM FOR AN EXPERIMENT



- The inner diameter of the tubes is 14 mm
- The distance between the tubes is 5 mm
- The outer diameter is 18mm
- The width of one row is 132 mm.

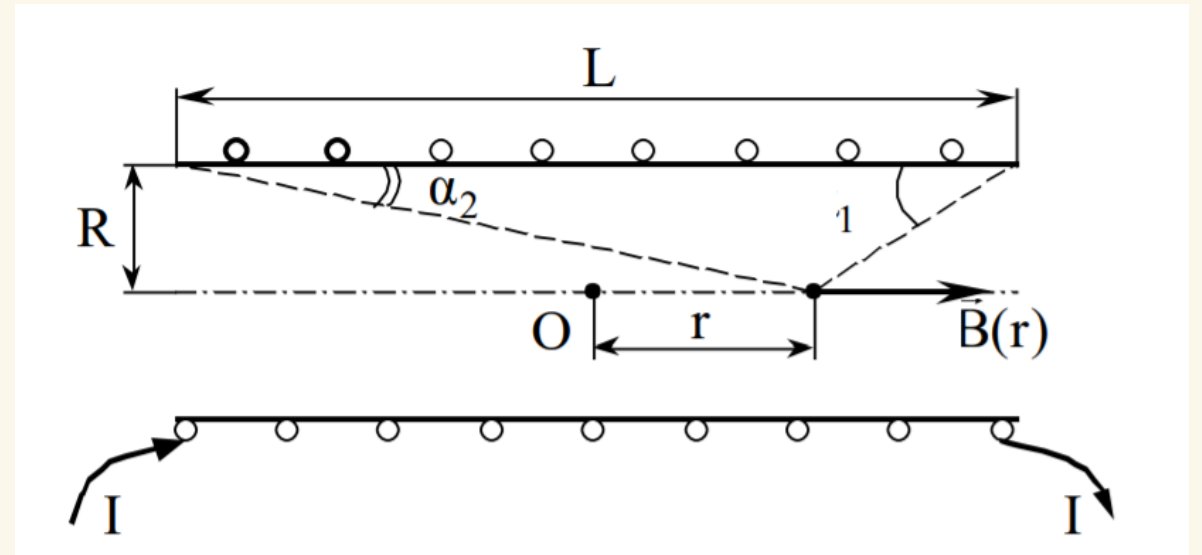


GRAPH OF THE COORDINATES OF THE POINTS OF THE LEFT (RIGHT) BORDER OF THE TEST TUBES IN THE EXPERIMENT WITH AN ADDITIONAL THE BODY AT THE DISPLACEMENT OF THE PHANTOM BY +10 CM RELATIVE TO THE CENTER OF UNIFORMITY OF THE MAGNETIC FIELD



# THE BIO-SAVARD-LAPLACE LAW

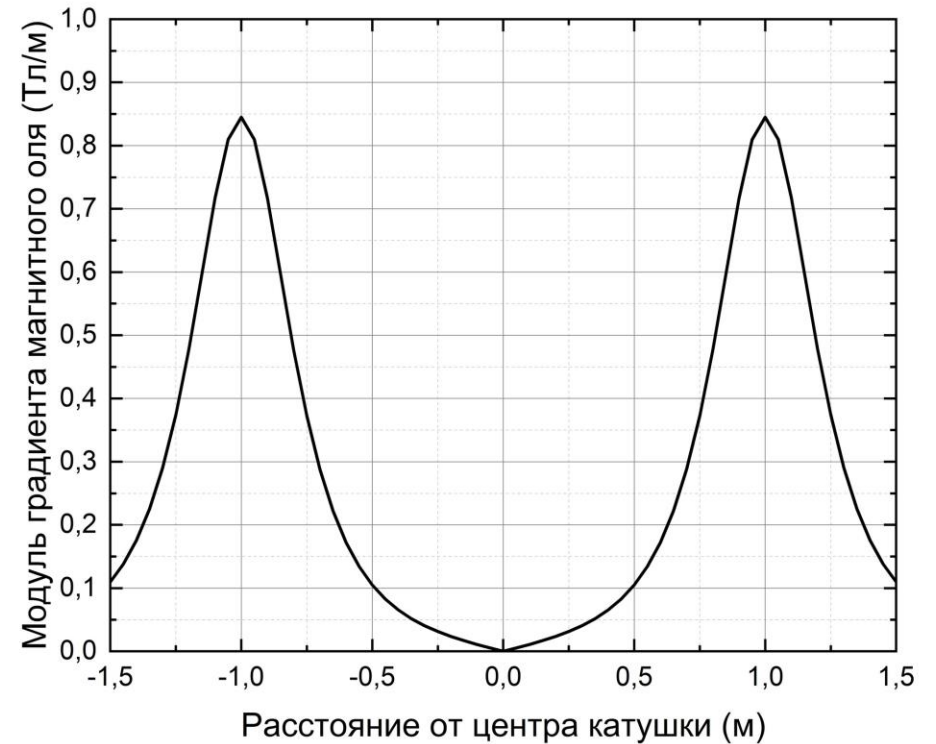
- $B(r) = \frac{1}{2} n\mu_0 L (\cos\alpha_1 + \cos\alpha_2)$
- $\cos\alpha_1 = \frac{L/2 - r}{\sqrt{R^2 + (L/2 - r)^2}}$
- $\cos\alpha_2 = \frac{L/2 + r}{\sqrt{R^2 + (L/2 + r)^2}}$
- $B(r) = \frac{1}{2} n\mu_0 L \left( \frac{L/2 - r}{\sqrt{R^2 + (L/2 - r)^2}} + \frac{L/2 + r}{\sqrt{R^2 + (L/2 + r)^2}} \right)$

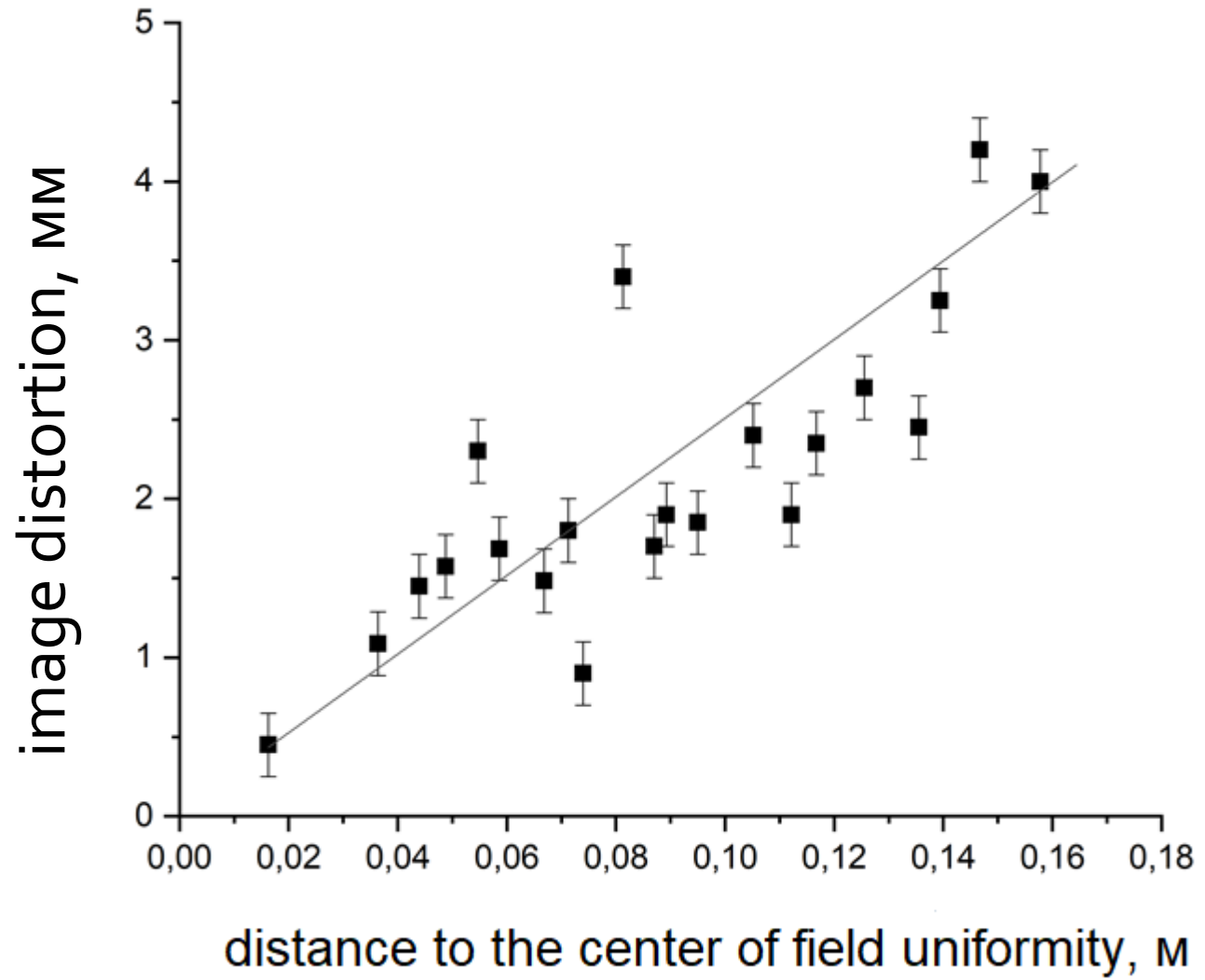


## THEORETICAL DEPENDENCE

$$B(r) = 0,26 \left( \frac{1-r}{\sqrt{0,09+(1-r)^2}} + \frac{1+r}{\sqrt{0,09+(1+r)^2}} \right)$$

$$\text{Grad}(B(r)) = 0,26 \left( \frac{(1-r)^2}{((1-r)^2+0,09)^{3/2}} - \frac{1}{\sqrt{(1-r)^2+0,09}} + \frac{1}{\sqrt{(1+r)^2+0,09}} - \frac{(1+r)^2}{((1+r)^2+0,09)^{3/2}} \right)$$





## Calculation of the distortion value

$$D_{geom} = \frac{D_d + D_{meas}}{D_d} =$$
$$= 1,3 \pm 0,1 \text{ MM}$$

$D_{geom}$  -geometric distortion

$D_d$  -the actual size of the phantom

$D_{meas}$  - the size of the phantom measured in the image

# CONCLUSIONS

- 1. An MR scan of a phantom with known geometric dimensions was performed.
- 2. The analysis of the obtained values was carried out.  $D_{geom} = 1,3 \pm 0,1 \text{MM}$
- 3. For this tomograph, it is necessary to select such a position of the patient that the studied area is no further than 120 mm from the center of uniformity of the magnetic field.

**THANKS FOR YOUR ATTENTION!**