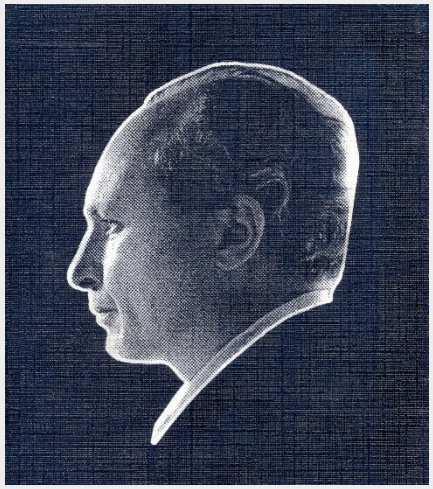
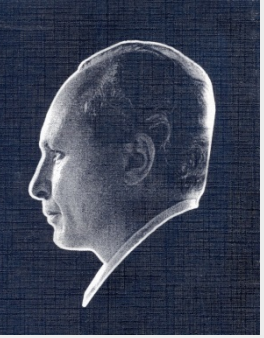
In Memoriam



Фёдор Львович Шапиро

1915 – 2015



1971

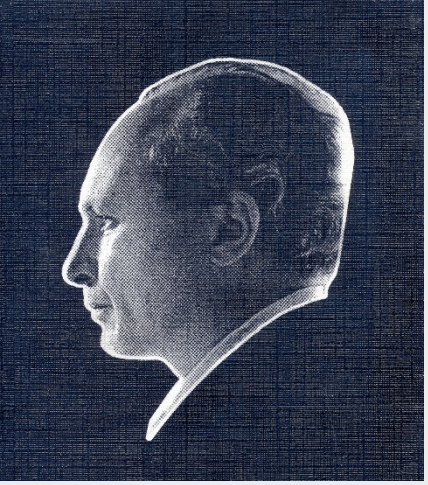
F.L.Sapiro

1915

L. Cser

1963

"Mössbauer effect in solid state physics and start of small angle scattering of neutrons"



Scientific interests

Fundamental problems

-Parity violation;
-Electric dipole moment;
-UCN;
-Gravitational red shift;
-Relativity theory.
-e.t.c.

Applications of nuclear effecs in solid state pysics:

-Mössbauer effect;
-Neutron scattering;

Episode 1.

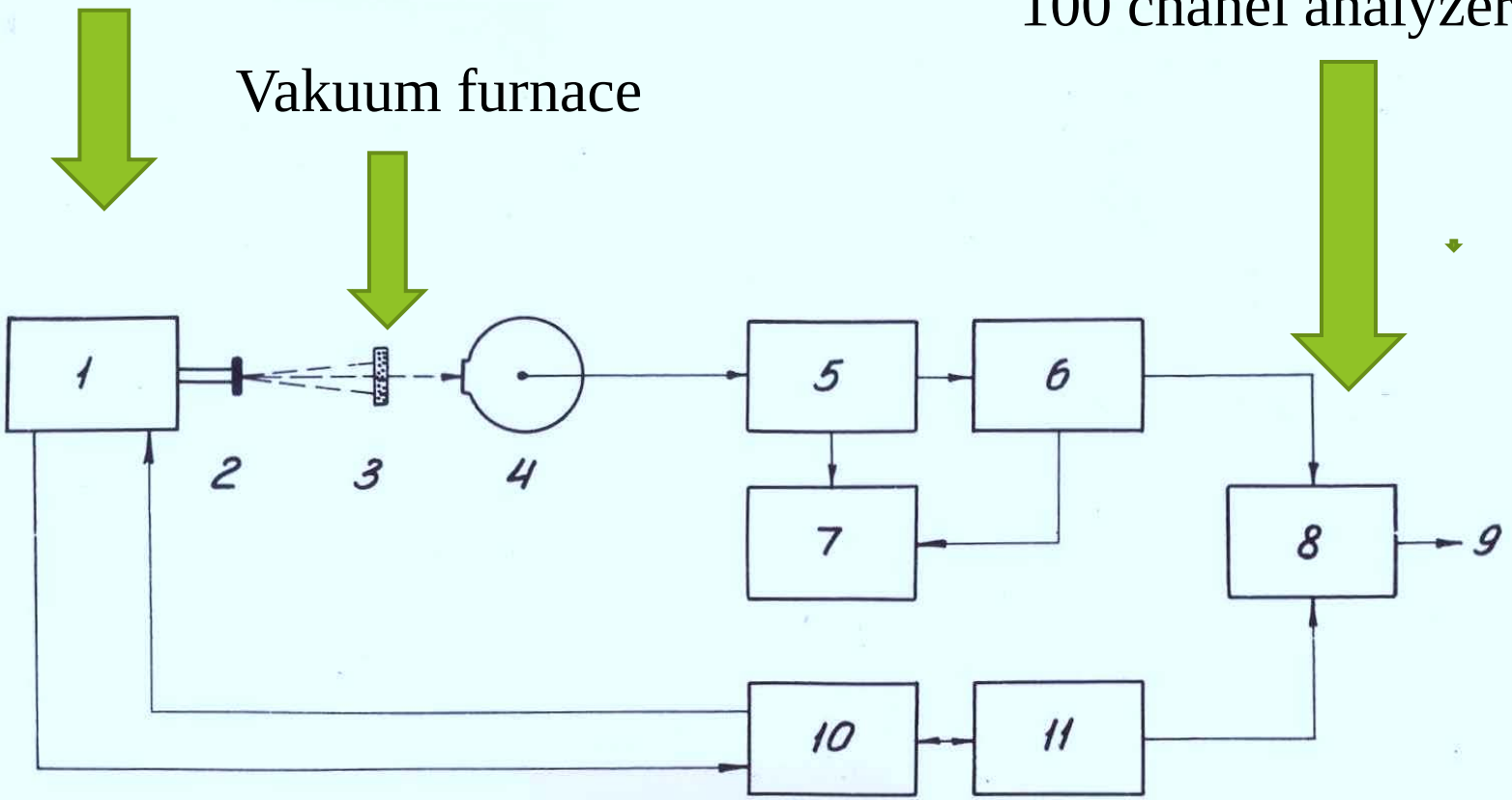
Mössbauer effect

Team:

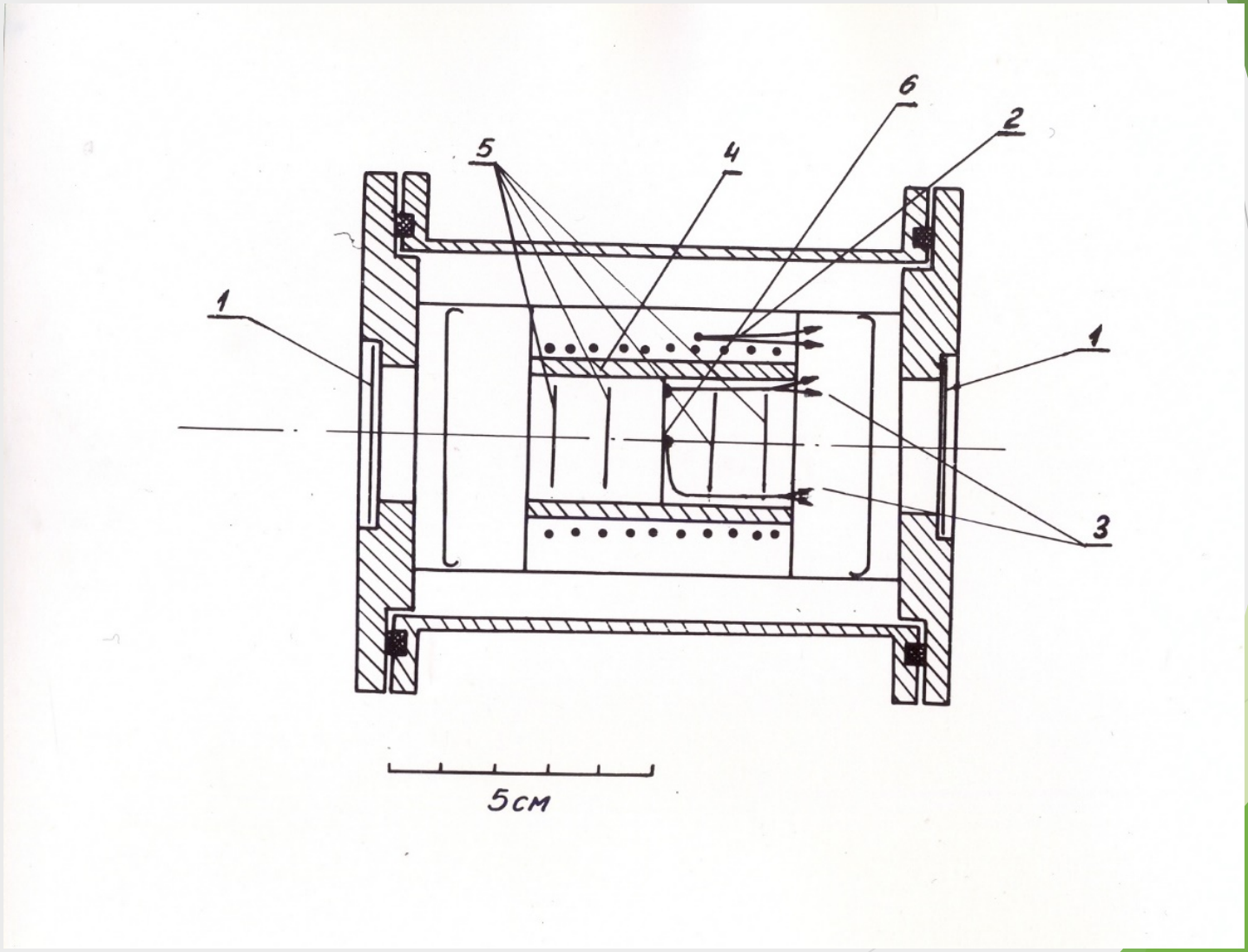
Ostanvich, Yu.M. (SU)
Strelkov, A.(SU)
U Bay Shi,(China)
Pikelner,E.Ya.(SU)
Sawitsky,E.(Poland)
Sekirin, A.(SU)
Cser, L.(Hungary)
Hennig,K.(GDR)
+ Visitors from Leningrad, Kiev,etc.

The Mössbauer equipment

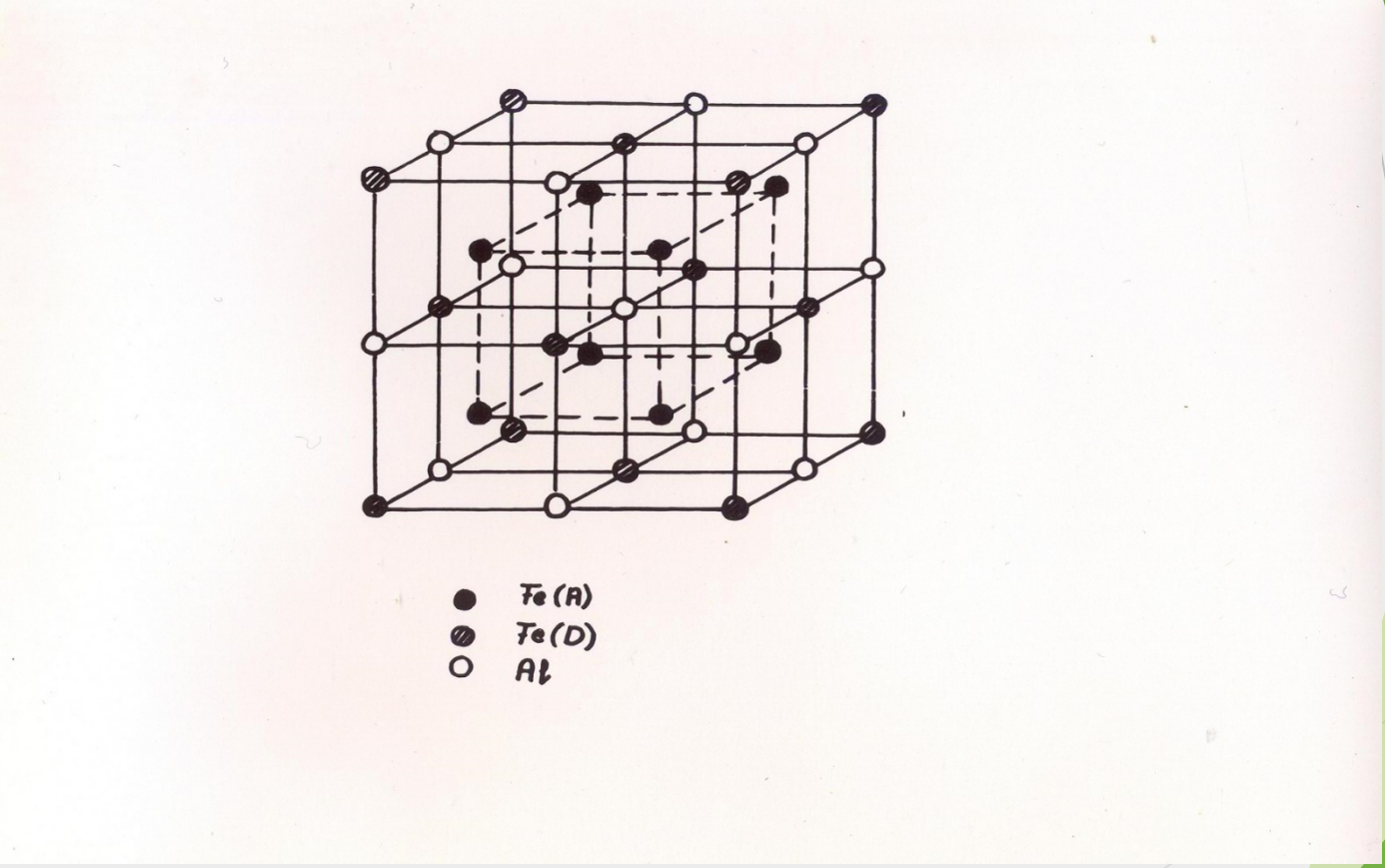
Source modulator



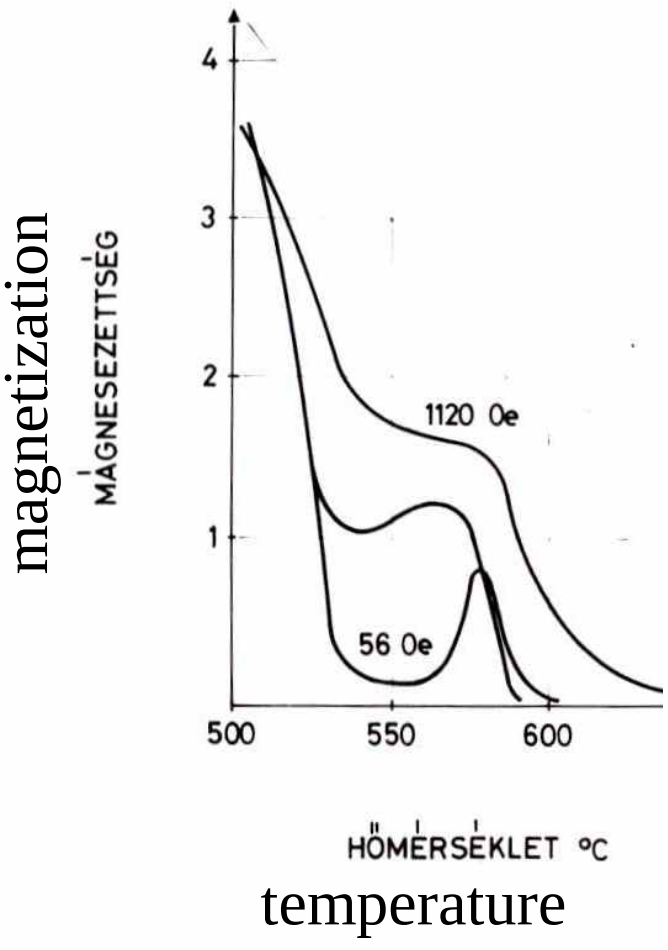
Vakuum furnace

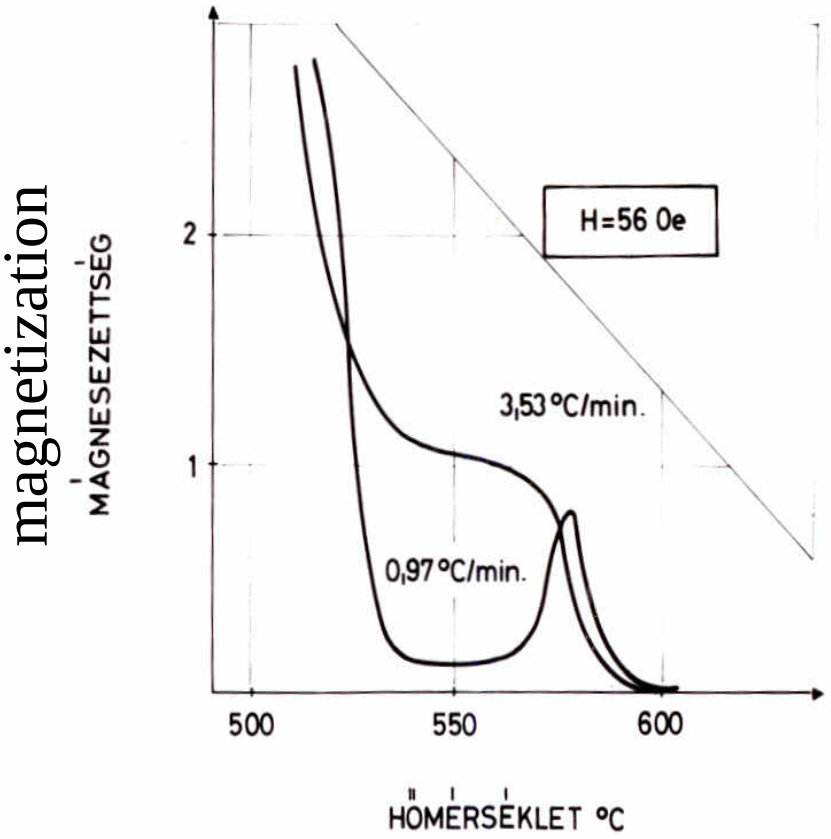


An example: Study of phase transition of Fe3Al alloy



Macroscopic observations



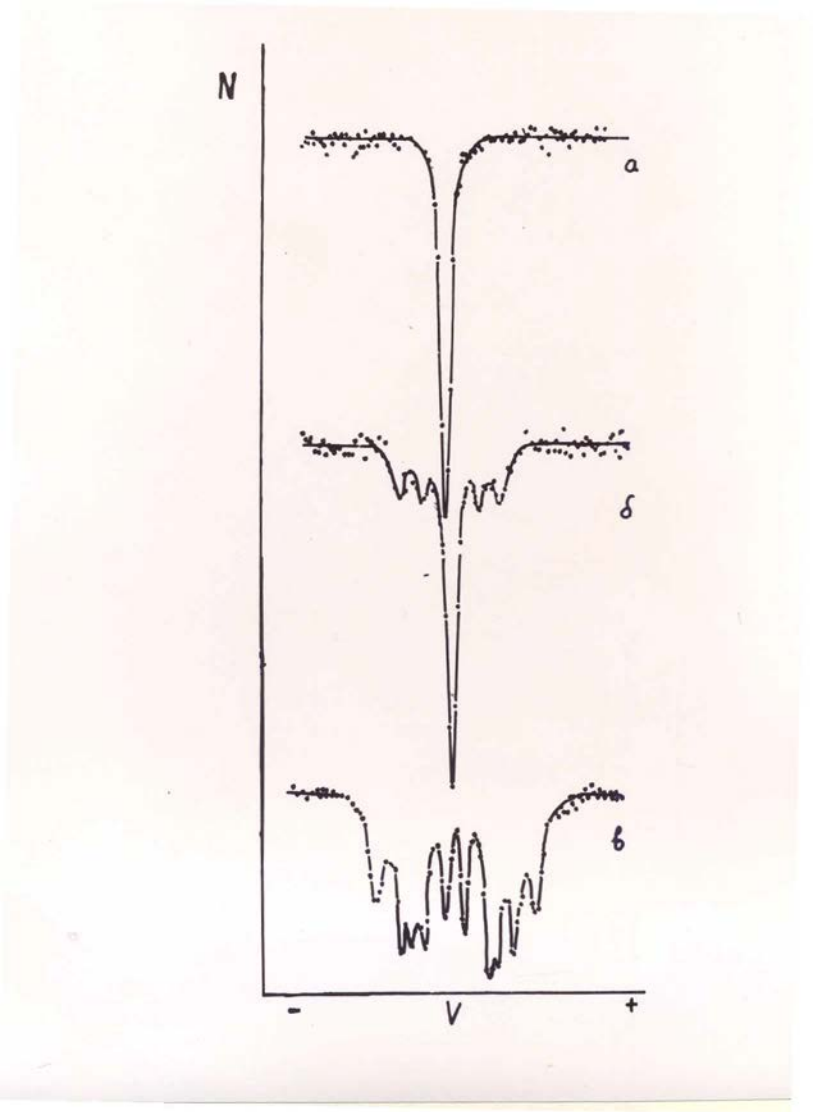


Caracteristic Mössbauer spectra at various temperatures

a – T = 700°C;

δ – T = 550°c;

b – T= 20°C

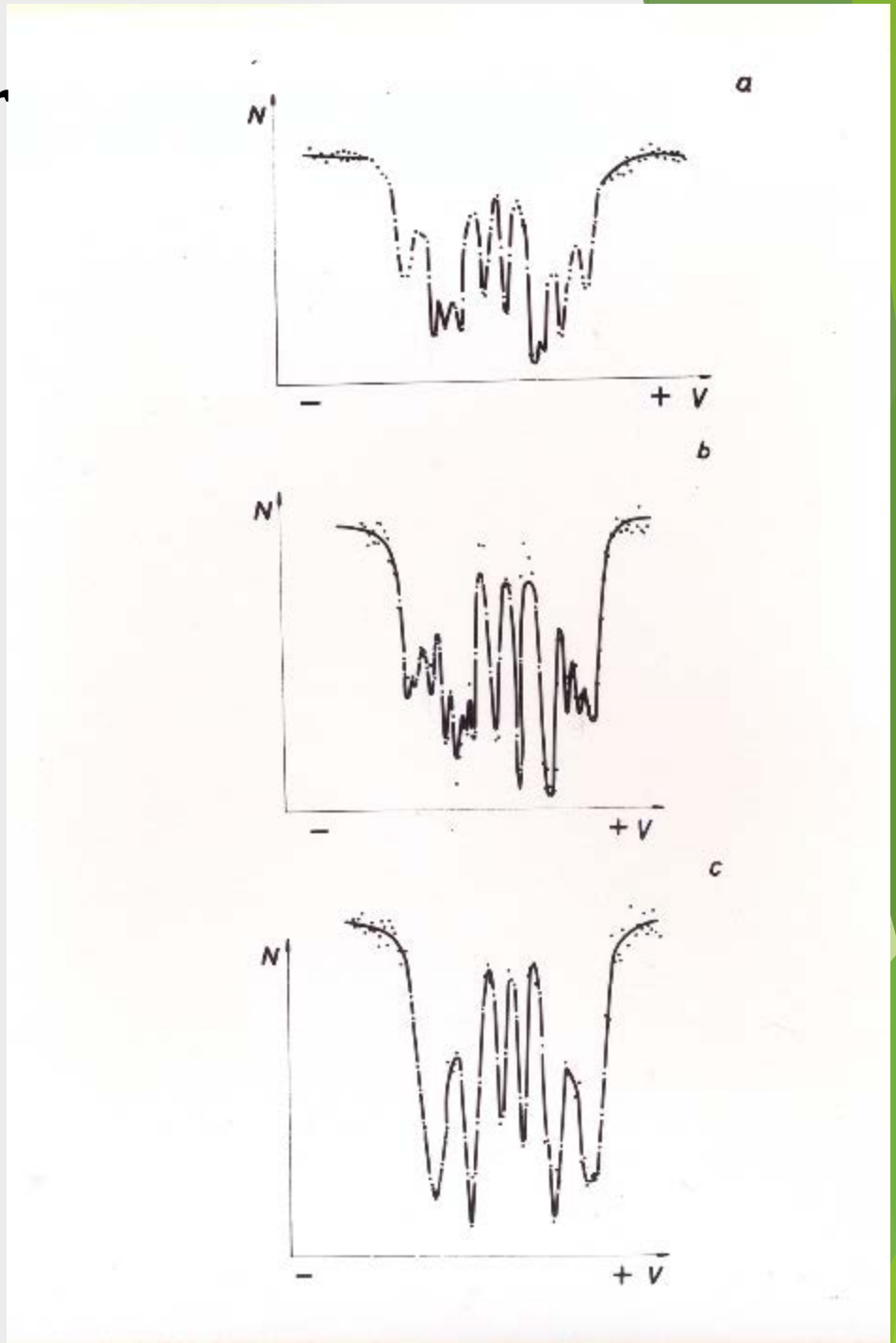


Caracteristic Mössbauer spectra at various Al concentration (T=20°C)

a – cc, = 24,6 at%;

b – cc, = 22.5 at%;

c – cc. = 20.4 at%;

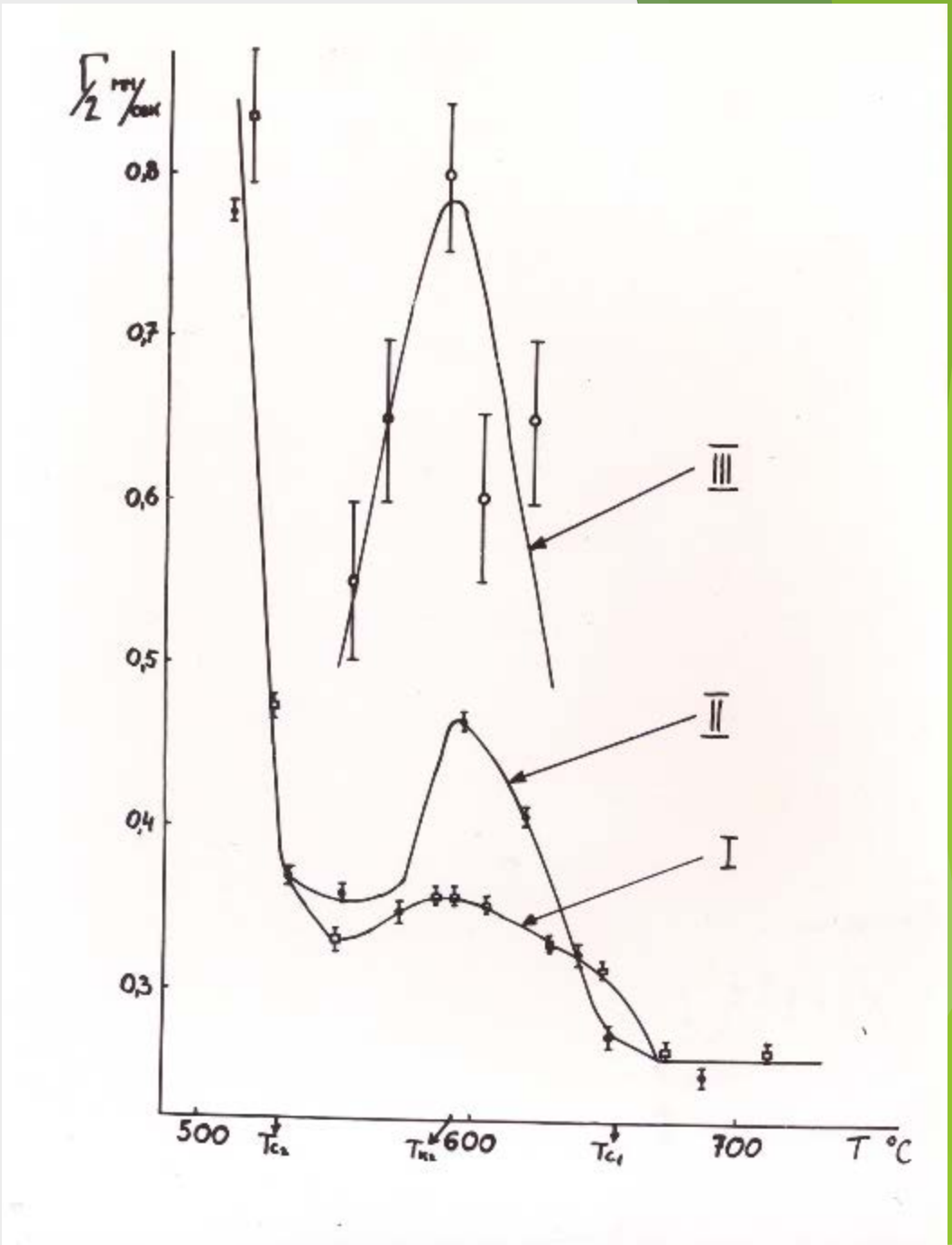


The Mössbauer line width at various heat treating

I – long time kept at 20°C;

II- slow (by 20 °C steps) cooling from 700 °C in one hour to room temperture;

III- 5 -12 min. after fast quenching from 700°C

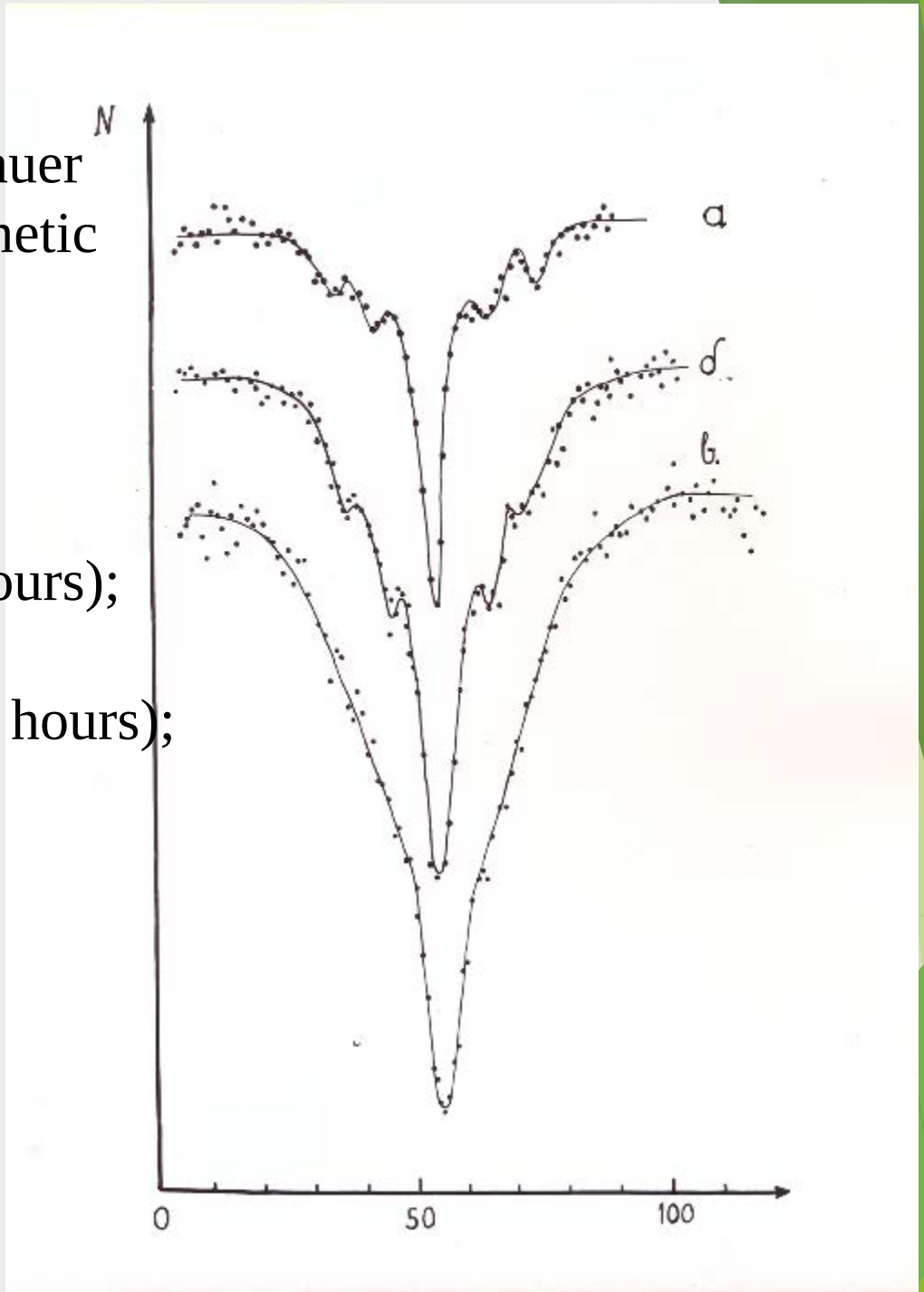


Developent of the Mössbauer spectrum in external magnetic field at T=510 ^{o}C

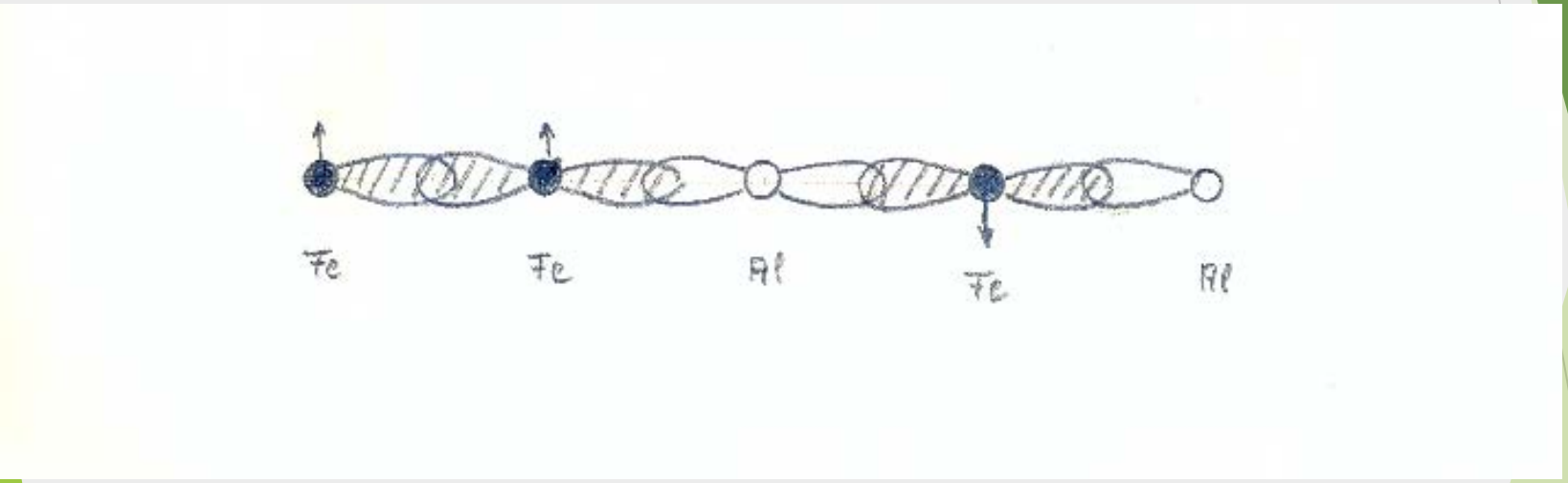
a – H = 0;

δ – H= 17 kOe (first 16 hours);

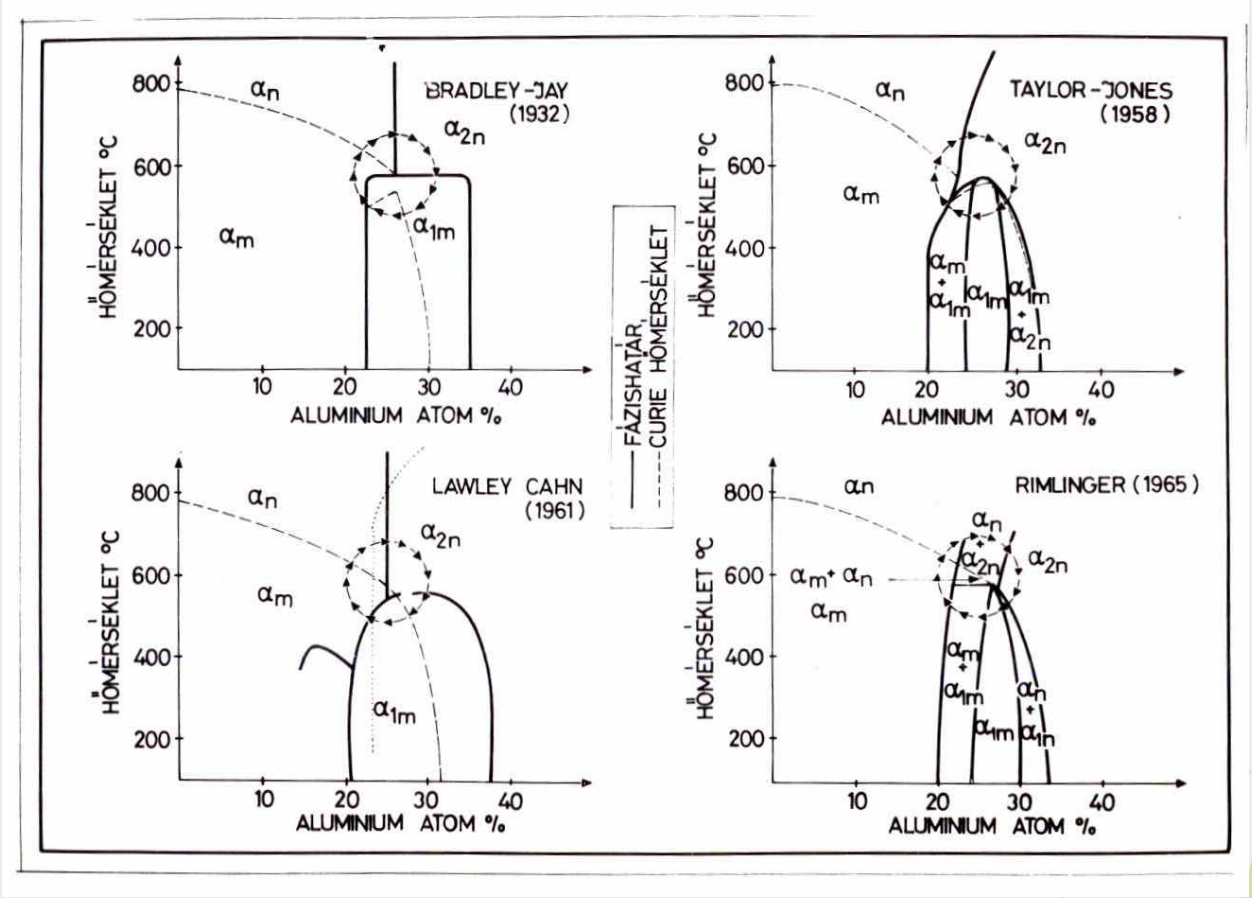
b – H= 17kOe (second 16 hours);



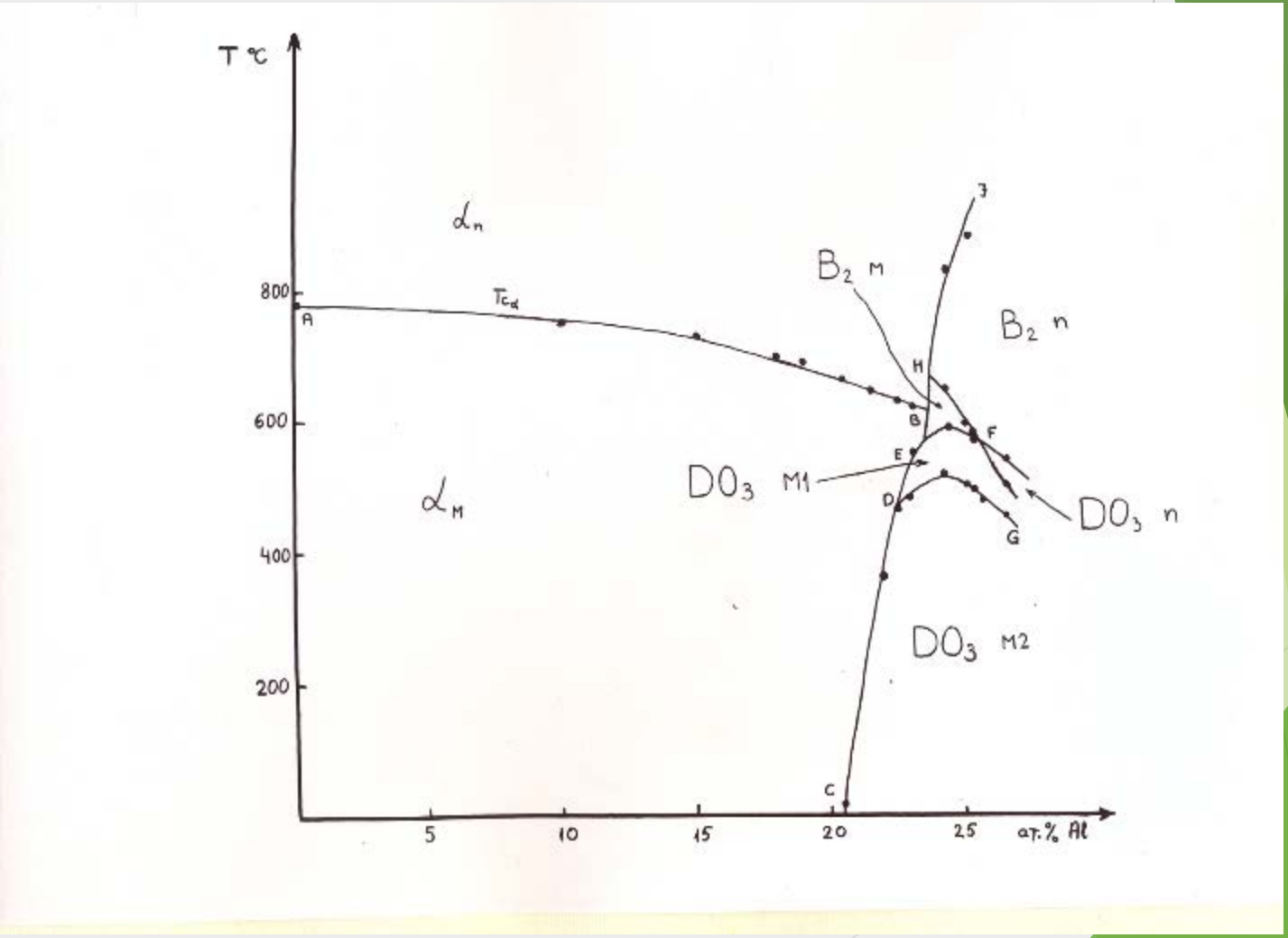
Schematic view of super exchange



Earlier variants of the phase diagrams obtained by X-ray diffraction



Phase diagram produced using Mössbauer measurements



Episode 2

TOF **SANS** at IBR-30

Team:

Ostanevich Yu.M.
Gladkih I.A.
Kozlov Zh.A
Cser L.

Shematic view of TOF small-angle scattering setup at IBR-30

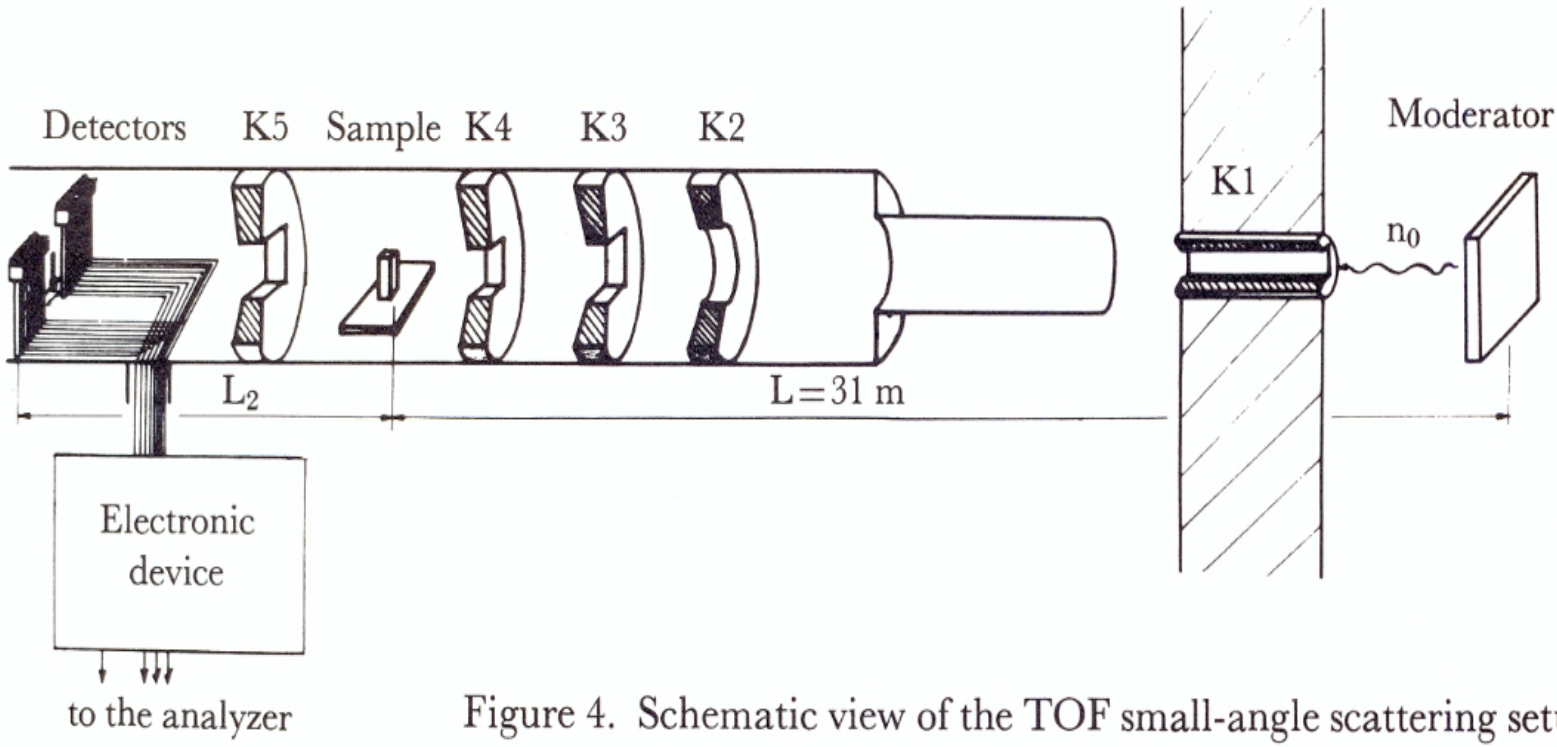
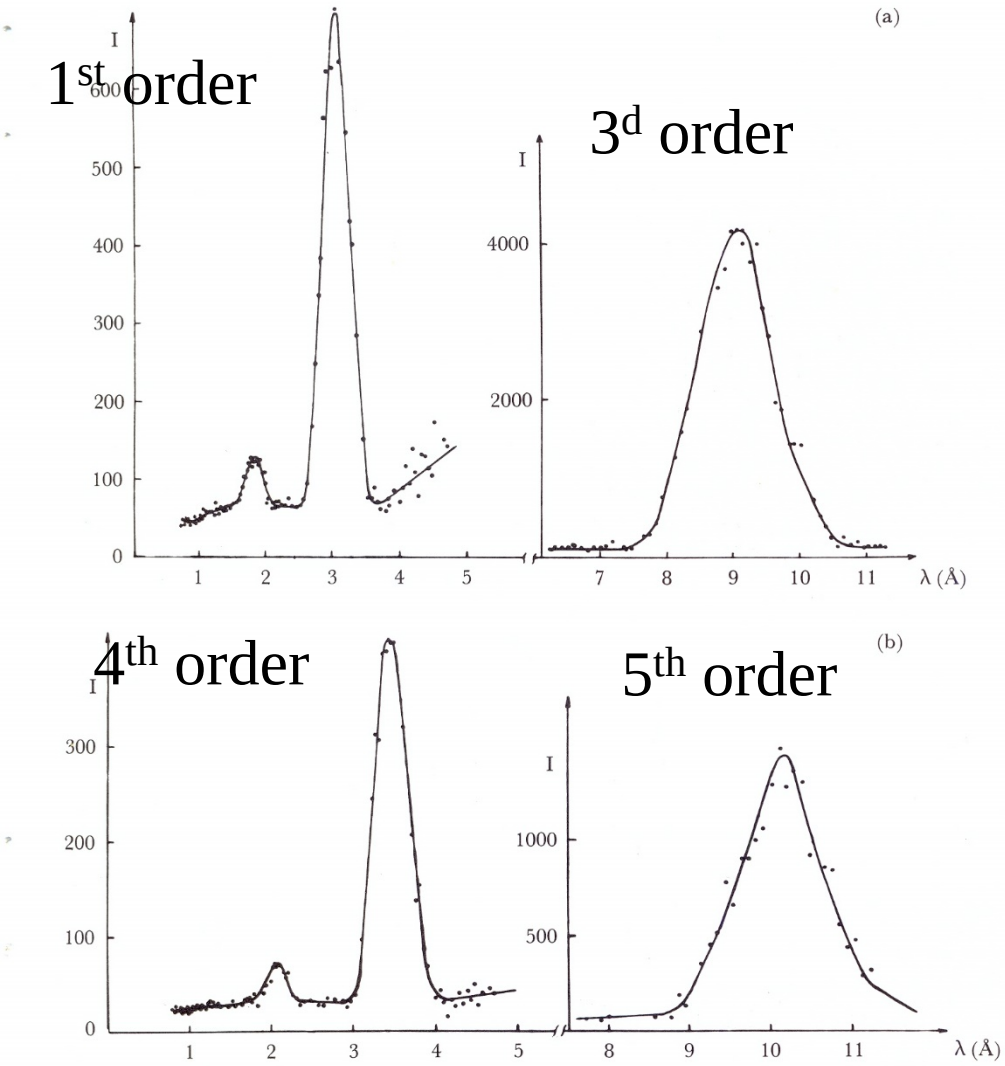


Figure 4. Schematic view of the TOF small-angle scattering setup.

The first test experiment: SANS diffraction on rat collagen

over the measured Maxwellian distribution) were computed; the results are shown in Figure 6. The main parameter, the radius of gyration, was calculated to be 19.6±0.2 Å, in good agreement with the results of Conrad et al.[8]

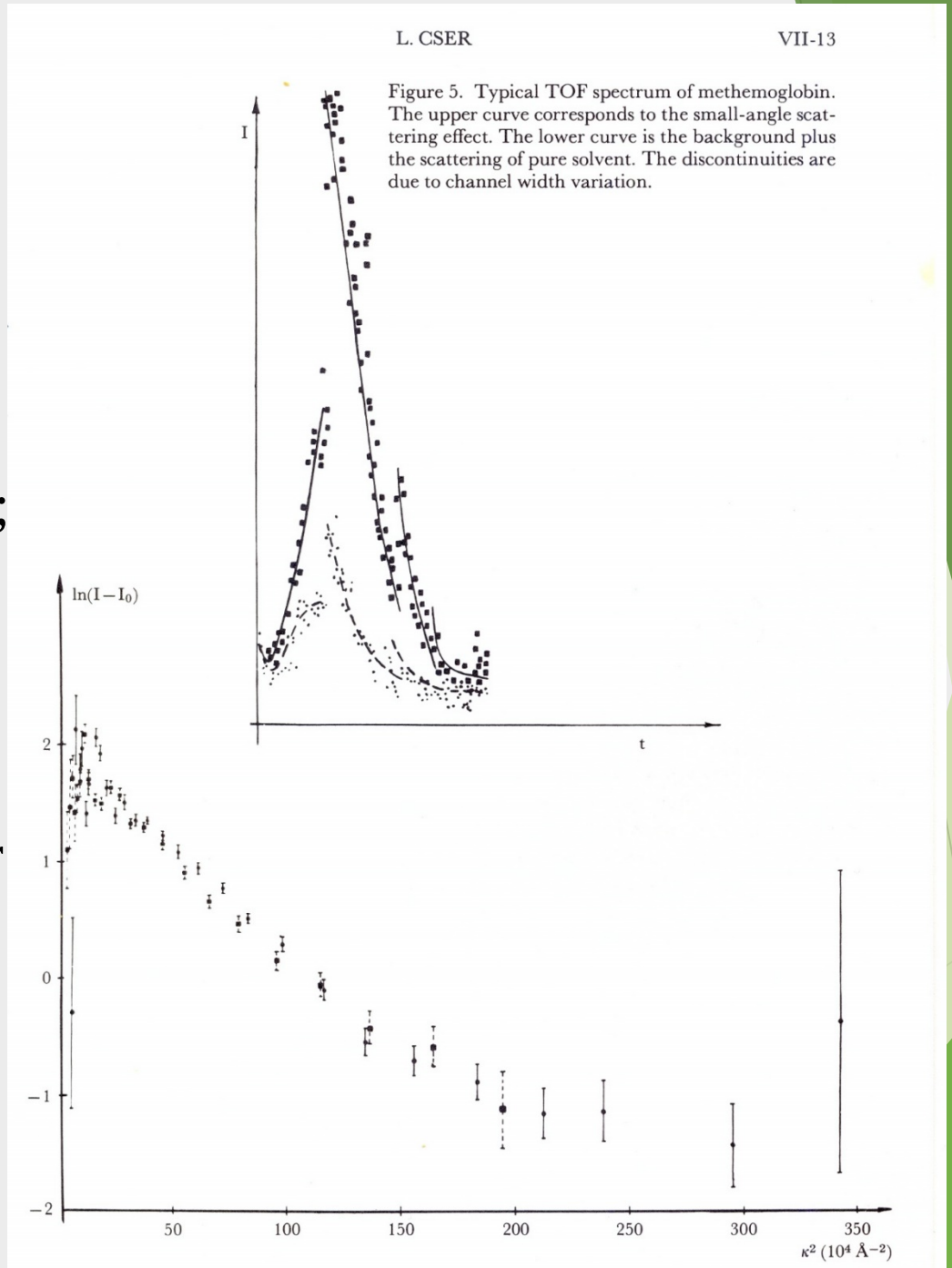
The second kind of test measurement was done on rat-tail collagen fibers layered between two quartz plates so that they formed a one-dimensional monocrystalline specimen, which was oriented perpendicular to the axis of the counters. To achieve good resolution the distance from sample to detector was set at 12 m. The



SANS feature of methaemoglobin suspension in heavy water

Upper curve- raw data;

Lower curve – Guinier plot of corrected data;



A small touch to the Sapiro's pedagogue character

Disput on te paper of(1969 Dehn J.T: "On the Distinction between Mass-change Shift and Second-order Doppler Shift in the Mössbauer Effect" Phys.Lett. 29A, 132 (1969)

Epilogue:

Sapiro's heritage: „Look for new unexpected phenomena"

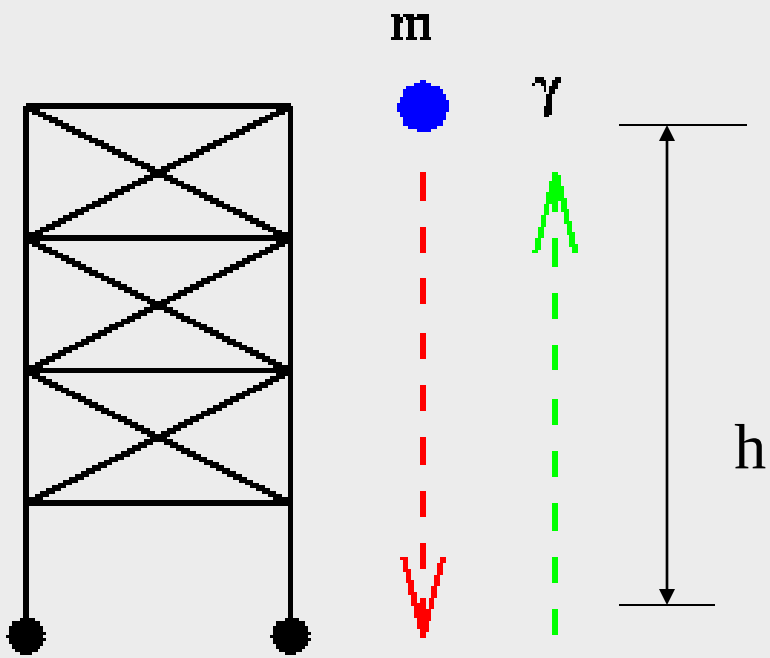
and we did:
-Isomer shift and neutron resonances, Ignatovich,Ostanevich, Cser(1973), experimental approval by German group under supervision Pikelner.

- Detector for epithermal inelastic scattering, Cser (1981)

- Atomic resolution neutron holography, Cser, Krexner (2001)

Sorry for such a meagre talk

Thank you for patient attention



$$\bar{\nu} = \nu\left(1 - \frac{gh}{c^2}\right).$$

$$Z_g = \frac{\nu - \bar{\nu}}{\nu} = \frac{gh}{c^2}.$$

Echanging the positions of the absorber and the detector is doubling the effect. Pound subtracted two experimental results:

(1) the frequency shift with the source at the top of the tower

(2) the frequency shift with the source at the bottom of the tower

The frequency shift for the two cases has the same magnitude but opposing signs. When subtracting the results, **Pound and Rebka** obtained a result twice as big as for the one-way experiment.

The result confirmed that the predictions of general relativity were borne out at the 10% level. This was later improved to better than the 1% level by Pound and Snider.

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Measurement of the interaction between electromagnetic radiation and gravitational field using 67Zn Mössbauer spectroscopy

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Department of Technical Physics, Helsinki University of Technology, 02150 Espoo 15, Finland

Abstract

The ultrahigh resolution of the 93.3 keV Mössbauer resonance of ^{67}Zn was used to study the interaction between electromagnetic radiation and the gravitational field. The angular dependence of the red shift of the photon was measured uni-directionally along a distance of 1 m. The results were in accordance with Einstein's equivalence principle.