New model for acoustically induced Mössbauer sidebands from a single parent line

Shakhmuratov R.N.[1,2], **Vagizov F.G.**[2]

[1]*Kazan Physical-Technical Institute, Russian Academy of Sciences, Kazan (Russia)*
[2]*Kazan Federal University, Kazan (Russia)*
shakhmuratov@kfti.knc.ru

Splitting of Mössbauer single parent line of the vibrated absorber into many sidebands was observed long time ago [1]. The intensity of the sidebands has not been yet satisfactory explained. There are two models of coherent and incoherent vibrations of nuclei in the absorber [2]. Coherent model implies piston-like vibration of the absorber giving the intensity of the n-th sideband proportional to the square of Bessel function $J_n^2(m)$, where m is the modulation index. Incoherent model is based on the Relay distribution of the nuclear-vibration amplitudes in the absorber giving the intensity proportional to $\exp(-m^2)I_n(m^2)$, where $I_n(m^2)$ is the modified Bessel function. Both models and their combinations cannot describe accurately the absorption spectrum of vibrated absorber (see Fig. 1). We proposed a new distribution of the nuclear vibration amplitudes, which gradually changes depending on a particular parameter σ. Our distribution tends to delta-like, inherent to coherent model if $\sigma \rightarrow 0$, or it tends to Relay distribution inherent to incoherent model if $\sigma \rightarrow 1$. With this distribution we obtained excellent fitting of the experimental spectra (see Fig.2).

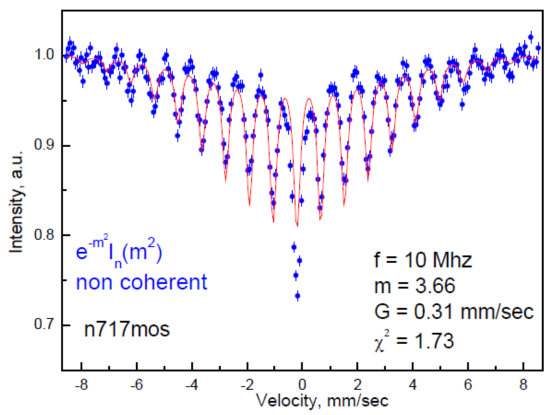

Fig. 1. Experimental spectrum for enriched $K_4Fe(CN)_6 \cdot 3H_2O$ (dots) and conventional fitting (solid line) [2]

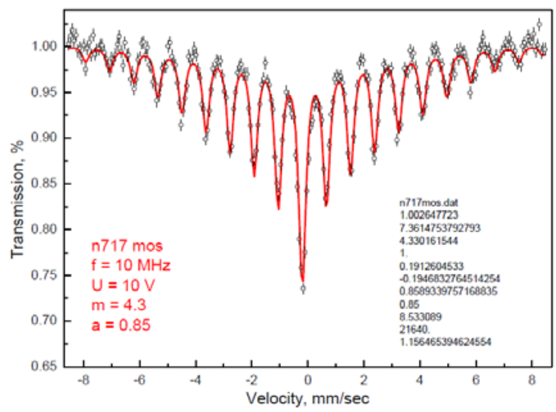

Fig. 2. Experimental spectrum for enriched K4Fe(CN)6·3H2O (circles) and fitting with the help of our model (solid line)

REFERENCES

1. *Ruby S. L.* Acoustically modulated gamma rays from ^{57}Fe / S. L. Ruby, D. I. Bolef // Phys. Rev. Lett. – 1960. – V. 5. – № 1. – P. 5–7.

2. *Chien C. L.* Mössbauer sideband from a single parent line / C. L. Chien, J. C. Walker // Phys. Rev. B – 1976. – V. 13. – № 5. – P. 1876–879.