Lineshape of ^{57}Co Sources Exhibiting Selfabsorption

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Mössbauer spectra were measured with a ^{57}Co/Rh source of 2 mCi (originally 100 mCi) activity as well as with a 4 mCi ^{57}Co/α-Fe source 25 µm thickness both from the active and the inactive side. The absorber was a single crystal of ferrous ammonium sulphate hexahydrate (FAS) belonging to the monoclinic space group $P2_1/c$ with two equivalent sites per unit cell related by the C_2-axis parallel to the (201) plane and crystallizing as flat plates containing the ($\bar{2}$01) plan. The 2×2 scattering matrices of the quadrupole transitions of the two sites are obtained from a simultaneous fit of a series of 20 spectra [1]. In case of the ^{57}Co/α-Fe source, the Fe foil was magnetized by an in-plane magnetic field of 0.2 T parallel to the C_2-axis of the FAS crystal. The γ-direction was orthogonal both to the Fe foil and the crystal plate. The emission spectrum of the ^{57}Fe nuclei in the 14.4 keV state consists of 6 linear polarized lines with the intensity ratio 3:4:1:1:4:3. The three spectra in Fig.1 were fitted by integrating over the source sampled up to 128 layers. The distribution of the ^{57}Co and ^{57}Fe sites was taken to be homogeneous [2] for the 100 mCi source while a one-dimensional diffusion profile was assumed for ^{57}Co/α-Fe foil.

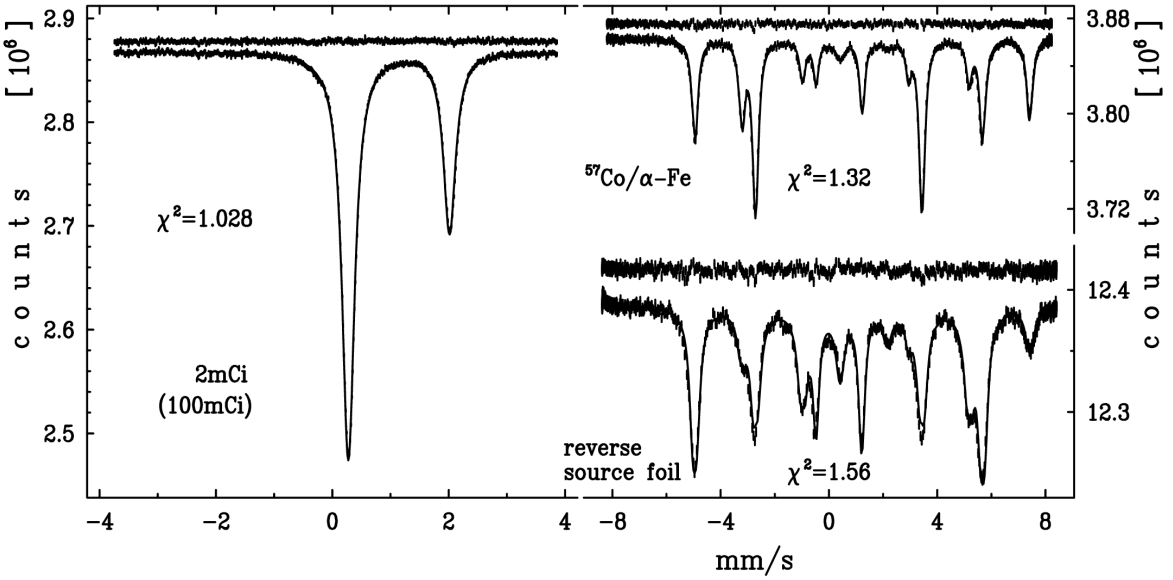

Figure 1: The theory for the old ^{57}Co/Rh source fits the line shape of the measured FAS spectrum perfectly. The only parameter to be adjusted is the active area of the Rh foil (4 mm ∅). The thickness of the foil is taken to be 6 µm. The FAS-absorber has no free parameters. The diffusion length (10 µm) is the free parameter for the α-Fe source. The selfabsorption in the α-Fe foil is well described for both positions.

References

[1] H. Spiering, J.N. Bull, W.C. Tennant, to be published
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