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Magnetism of EuFe$_2$As$_2$-based superconductors studied by $^{151}$Eu and $^{57}$Fe Mössbauer spectroscopy

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The EuFe$_2$As$_2$-based superconductors doped with Ca and Co were investigated by means of the $^{151}$Eu and $^{57}$Fe Mössbauer spectroscopy versus temperature. It was found that spin density wave (SDW) is suppressed by Ca and Co substitution i.e. a magnetic transition temperature is lowered together with the SDW amplitude. Iron spectra exhibit some non-magnetic component in the superconducting region, however traces of SDW survive in the region of superconductivity, so it seems that superconductivity has some filamentary character. Europium orders magnetically regardless of the Co and Ca substitution. Europium moments rotate from the $a$-axis in the direction of the $c$-axis (within $a$-$c$ plane) with increasing amount of dopants. Iron experiences a transferred magnetic field from europium for the substituted material – in the SDW and non-magnetic states both. Europium magnetic order and superconductivity coexist in the same volume.

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