Antiferromagnetic Spin Fluctuations and Pseudogap Behavior in Ca(Fe$_{1-x}$Co$_x$)$_2$As$_2$ Studied by $^{75}$As NMR

JINFANG CUI, Ames Laboratory and Chem. Dept., Iowa State University, SHENG RAN, SERGEY BUD’KO, PAUL CANFIELD, YUJI FURUKAWA, Ames Laboratory and Dept. of Phys. and Astro., Iowa State University — $^{75}$As NMR measurements of single-crystalline Ca(Fe$_{1-x}$Co$_x$)$_2$As$_2$ have been carried out for four different doping concentration crystals ($x = 0.023, 0.028, 0.033, 0.059$) annealed at 350°C [1]. Co-doped CaFe$_2$As$_2$ is a compound in 122 family of iron-pnictide superconductors with three principle phases exhibited: paramagnetic (PM), antiferromagnetic (AFM) and superconducting (SC) states. The magnetic phase transition to AFM state occurs at $T_N = 180$K at $x=0$ and is suppressed to $T_N = 53$K for $x=0.028$, which is accompanied by a structural phase transition from tetragonal to orthorhombic phases. $^{75}$As NMR was used to study the low energy spin dynamics via Knight shift ($K$) and spin-lattice relaxation rate ($1/T_1$) measurements. From our analysis of the temperature dependence of both $K$ and $(T_1 T)^{-1}$ in $x=0.028$ ($T_N = 53$K), $0.033$ ($T_c = 9$K) and $0.059$ ($T_c = 10$K), we found a gradual decrease of AFM spin fluctuations below $T^* = 88$K for $x=0.028$, $72$K for $x=0.033$ and $41$K for $x=0.059$, respectively, indicating the possible pseudogap behavior in spin excitation spectrum in the system.


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