Magnetic Susceptibility and Heat Capacity of Single Crystal CaV$_2$O$_4$ Containing $S = 1$ $J_1$-$J_2$ Antiferromagnetic Spin Chains$^1$ A. NIAZI, D. C. JOHNSTON, S. BUD’KO, D. L. SCHLAGEL, T. A. LOGRASSO, Ames Lab., Iowa State U., Ames, IA 50011, USA, A. HONECKER, TU Braunschweig, Inst. Theor. Phys., 38106 Braunschweig, Germany — The compound CaV$_2$O$_4$ has an orthorhombic $Pnam$ structure and contains spin $S = 1$ zig-zag ($J_1$-$J_2$) chains running along the crystallographic $b$-axis. Structural considerations suggest that $J_1 \approx J_2$, which would result in competing frustrating antiferromagnetic (AF) interactions in this low-dimensional system. Previous studies on powders have suggested collinear spin models, a gapless chiral phase, or spin freezing below 20 K. We have grown single crystals of CaV$_2$O$_4$ for the first time and carried out magnetization and heat capacity measurements down to 1.8 K. We observe long-range AF ordering at $T_N = 54$ K with the easy axis being the $c$-axis, as reflected by anisotropic susceptibility $\chi$ below $T_N$. The magnetic specific heat $C_{\text{mag}}^p(T)$ up to 100 K, obtained after subtracting the lattice contribution of nonmagnetic isostructural CaSc$_2$O$_4$, shows a clear signature of long-range magnetic order at $T_N$. However, the molar entropy attains only $\approx 1/4$ of its maximum value $2R\ln(3)$ by 100 K, indicating strong short range order above $T_N$ and large values $J_1$, $J_2 > 100$ K. This is consistent with our estimates $J_1 \approx J_2 \sim 150$–$300$ K obtained by comparison of our $\chi(T)$ data with exact diagonalization calculations of $\chi(T)$.

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