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論文題目： Muon-spin relaxation studies of the pyrochlore iridates $Sm_2Ir_2O_7$, $Nd_2Ir_2O_7$ and $(Nd_{1-x}Ca_x)_2Ir_2O_7$

（パイロクロアイリジウム酸化物 $Sm_2Ir_2O_7$, $Nd_2Ir_2O_7$, $(Nd_{1-x}Ca_x)_2Ir_2O_7$ のミュオンスピン緩和法による研究）

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概要: Pyrochlore iridates, $R_2Ir_2O_7$ (R = rare-earth elements), provide an ideal platform to investigate novel topological phases built upon the network of the corner-sharing tetrahedra and the large spin-orbit interaction drawn from Ir 5*d* electrons. These compounds exhibit the metal-insulator transition (MIT) across the rare-earth series at room temperature. With increasing the ionic radius of R^{3+}, the temperature of MIT, T_{MI}, gradually decreases and disappears between R = Nd and Pr.

This thesis describes μSR studies on the pyrochlore iridates $Sm_2Ir_2O_7$, $Nd_2Ir_2O_7$ and $(Nd_{1-x}Ca_x)_2Ir_2O_7$. $Sm_2Ir_2O_7$ and $Nd_2Ir_2O_7$ are particularly attractive because they lie in the boundary of MIT and undergo the magnetic transition with MIT concomitantly at $T_{MI} \approx 117$ and 33 K, respectively. By means of μSR experiments, we confirmed the appearance of magnetic long-range ordering (LRO) of Ir moments below $T_{MI,}$ followed by additional LRO of Nd/Sm moments below about 10 K. The all-in all-out (AIAO) spin-structure was confirmed to be the most convinced model to explain our μSR results. We compared observed internal fields at the muon site to those estimated from dipolar field and density functional theory calculations, and confirmed that lower limits of magnetic ordered moments were 0.12 μ_B/Ir^{4+} and 0.2 μ_B/Nd^{3+} in $Nd_2Ir_2O_7$ and 0.3 μ_B/Ir^{4+} and 0.1 μ_B/Sm^{3+} in $Sm_2Ir_2O_7$, respectively. By further analysis, it is concluded that the spin coupling between R and Ir moments should be ferromagnetic for $Nd_2Ir_2O_7$ and antiferromagnetic for $Sm_2Ir_2O_7$, respectively

The hole doping in $Nd_2Ir_2O_7$ via the Ca^{2+}-substitution for Nd^{3+} was found to suppress a LRO of Ir magnetic moments. It was also confirmed that Nd moments keep undergoing the LRO below 10 K in $(Nd_{1-x}Ca_x)_2Ir_2O_7$ for $x \leq 0.03$. No clear indication of the LRO was observed for x = 0.07 and 0.10 down to 0.3 K, except for the appearance of the slowing-down behaviour in the spin fluctuations below 2 K, signifying a possible occurrence of a magnetically short-range ordering (SRO). The magnetic phase diagram of $(Nd_{1-x}Ca_x)_2Ir_2O_7$ was proposed on the basis of the present studies.