



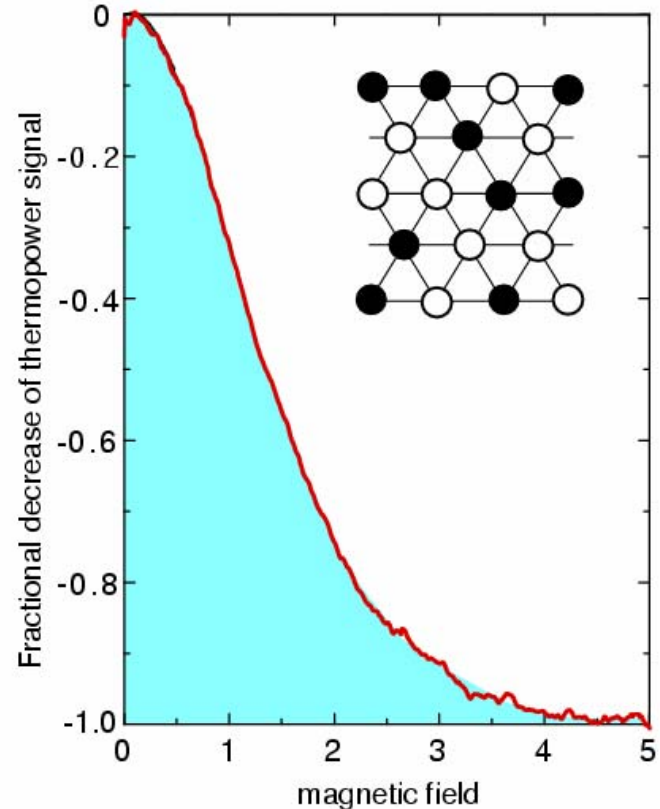
# Strongly interacting electrons in $\text{Na}_x\text{CoO}_2$

- a quantum game of **Go** on a triangular lattice

N. P. Ong and R. J. Cava, Princeton University, **DMR-0213706**

Oxide materials exhibit many useful properties for potential applications. The cobalt oxide  $\text{Na}_x\text{CoO}_2$  exhibits a large thermoelectric effect. It may find future applications in thermoelectric coolers, which are compact and vibration-free. The origin of its large thermopower has been traced to electron spins which carry a large fraction of the heat in an applied current. Surprisingly, a magnetic field can suppress this spin-heat current by 100 percent (figure). In addition,  $\text{Na}_x\text{CoO}_2$  superconducts when water is added. These exotic behaviors reflect the quantum rules of how electrons hop in the material's triangular lattice, much like marbles in the popular board game **Go**.

*Wang et al. Nature* **423**, 425 (2003).



**A magnetic field kills the heat-carrying capability of the electron spins as shown by the red curve. Inset depicts the **Go**-like hops of electrons moving in the  $\text{Na}_x\text{CoO}_2$  crystal lattice.**