

## PHYSICS COLLOQUIUM

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# Towards Novel Quantum Materials: Design, Synthesis and Characterizations



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Quantum materials are materials where the extraordinary effects of quantum mechanics give rise to exotic and often incredible properties. To understand their basic behavior if we are to enable optimization for a specific purpose, discovering novel quantum materials is a primary task for scientists in the field of condensed matter physics and materials science. In this seminar, research strategies toward novel quantum materials in experiment will be introduced from the perspective of chemistry, materials science and physics. Such research process leads to fruitful results, and two recent discovered candidates of quantum spin liquid (QSL) will be presented as an example. The first candidate is a geometric frustrated magnet,  $\text{Na}_2\text{BaCo}(\text{PO}_4)_2$ , which is structurally perfect without intrinsic disorder. Experimental results, including magnetization, specific heat, and neutron scattering, have indicated that this compound is an ideal QSL candidate. The second compound,  $\text{BaCo}_2(\text{AsO}_4)_2$ , are believed to be a Kitaev QSL candidate. This is the first time that Kitaev physics are proposed to be realized in 3d-transition-metal honeycomb in experiment. Non-Kitaev interactions can be fully suppressed by low field, yielding nonmagnetic ground state and many other similarities with the well-studied Kitaev QSL  $\alpha\text{-RuCl}_3$ .