Title:	Effect of Chemical Substitutions on the Quantum Spin Liquid Candidates Na 4 Ir 3 O 8 and Ca 10 Cr 7 O 28
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Abstract:	Quantum spin liquids (QSLs) are exotic states of matter, in which magnetic frustra- tion and strong quantum fluctuations destroy long-range magnetic order. Highly frus- trated lattices with antiferromagnetic exchange interactions and low-spin value open up possibilities in the exploration and designing of new QSL candidates. QSLs in three-dimensions are very rare, and only a couple of candidate materials exist. In this thesis, we investigate bond-disordered quantum spin-liquid state in three di- mensional magnetic insulators Na 4 Ir 3 O 8 and Ca 10 Cr 7 O 28 . The central theme of thesis is to explore how these QSL's respond to external perturbations like pressure, magnetic field, and chemical substitutions. In this thesis, I have synthesized two QSL candidates the hyperkagome Na 4 Ir 3 O 8 and kagome bilayer Ca 10 Cr 7 O 28 and studied their electrical transport, magnetic, and thermal properties. Our work provides several new results: (i) the strongly frustrated Mott insulating state in Na 4 Ir 3 O 8 is quite robust against large re- moval of Na from the lattice, (ii) evidence through magnetic (Ru) and nonmagnetic (Ti) impurity doping in a magnetic sublattice, of fragile magnetic order and importance of nearestneighbour interactions and spin-orbit coupling in deciding the magnetic ground state in Na 4 Ir 3 O 8 , (iii) high-pressure magnetic susceptibility measurements reveal the QSL at ambient pressure is quite robust and may not depend on a delicate balance between any specific values of competing exchange interactions in Ca 10 Cr 7 O 28 , and (iv) the first experimental realization of a perfect nonmagnetic analog Ca 10 V 7 O 27.5 of Ca 10 Cr 7 O 28 , which enables an accurate exclusion of the lattice heat capacities.
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