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RNiO3 perovskites: exploring the TMIT –> 0 limit

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Strongly correlated oxides can show a variety of exotic physical behaviour such as metal to insulator transitions, multiferroicity, or high-Tc superconductivity. Here we focus on RNiO3 perovskites (R = trivalent rare earth ions), one of the few transition metal oxide families to display spontaneous metal insulator transitions. Interestingly, superconductivity has been recently reported in the reduced nickelate Nd0.8Sr0.2NiO2, which constitutes the first-ever observation of this property in a Ni-based material[1].
The mechanism behind the emergence of superconductivity is just as unclear as the driving force behind the MIT[2][3]. Nickelates with larger rare earth ions (Nd, Pr, LaxPr1-x ; x = 0.1 to 0.5) are candidates to probe the cause of the MIT, as lattice, electric and magnetic degrees of freedom coincide. Here we focus on the role of the lattice that we investigate in the LaxPr1-xNiO3 solid solutions, by exchanging 16O by the 18O isotope.
The presence of huge 16O-18O isotope effects was confirmed in a previous study, where T(MIT) was increased by up to 10K for 18O enriched PrNiO3[4]. The solid solutions of LaxPr1-xNiO3 exhibit an even larger 16O-18O effect in T(MIT) (~20 K), suggesting an increasingly dominant role of the lattice when T(MIT) approaches zero kelvin.
A good understanding of these spectacular and unusual findings require experiment-theory synergies, already established with colleagues from SINQ and SLS at PSI and collaborators from the NCCR MARVEL project.

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