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Local Probing of Structural Phase Transitions in Naturally Layered Perovskite Oxides

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Naturally layered perovskites have been subject of great interest for novel technological applications, guiding, in particular, the extensive search for room-temperature (RT) magneto-electrics (ME). We aim to enhance the magneto and photo-induced effects in systems displaying Hybrid Improper Ferroelectricity (HIF) to achieve maximum energy conversion efficiencies in ME systems, thus exploring innovative alternatives for improved energy storage devices and electronics.

Our case study is the structural phases adopted by $n = 2$ pseudo Ruddlesden-Popper (pRP) $Li_2SrNb_2O_7$. Determining the system's structural symmetries is key to understand its functionalities, but its structural phase diagram can be notably difficult to establish by conventional diffraction measurements [1,2].

Perturbed Angular Correlation (PAC) Spectroscopy has recently played a pivotal role in clarifying complex structural debates on systems alike, as with $Ca_3(Mn,Ti)_2O_7$ multiferroics [3]. The sensitivity of the measured Electric Field Gradient at ^{111m}Cd probes to the structural symmetry makes PAC Spectroscopy an invaluable tool for the problem at hand, possibly able to reconcile conflicting perspectives within the literature on the $Li_2SrNb_2O_7$ system [1,2].

Our research at ISOLDE/CERN serves a dual purpose: to address conflicting structural reports regarding the FE phase transition at $T_C = 217$K in $Li_2SrNb_2O_7$, and to unveil previously documented [2] but yet ambiguous phase transitions in the same system at higher temperatures; both to grant us the fundamental understanding required to design optimal multifunctional materials.

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