Evolution of magnetic ground state in $A\mathrm{Co_2As_2}$ (A = K, Ca, Sr, Ba) system

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$A\mathrm{Co_2As_2}$ (A = K, Ca, Sr, Ba) and $\mathrm{BaMn_2}X_2$ (X = P, As, Sb, Bi) compounds that both crystallize in $\mathrm{ThCr_2Si_2}$-type tetragonal structure together present a text-book type example of how the structural parameters and electronic band structure can indirectly govern the magnetic ground state of a crystalline system. $A\mathrm{Co_2As_2}$ compounds exhibit properties that delicately depend upon the interlayer As-As distance $d_{\mathrm{As-As}}$ which regulates the oxidation state of Co-ions by controlling the extent of the interlayer As-As bonds. As a result, it controls the magnetic ground state of these materials [1]. On the other hand, d_{X-X} does not show any significant variation within $\mathrm{BaMn_2}X_2$ compounds and because of the localized nature of d-bands, it does not affect the oxidation state of the Mn-ions as well as the magnetic ground state of these compounds [2]. In this work, we present a comparative study on $A\mathrm{Co_2As_2}$ and $\mathrm{BaMn_2}X_2$ systems. Further, we explore the combined effect of the change of electron count as well as the increase in $d_{\mathrm{As-As}}$ introduced through the partial substitution of alkaline-earth ions in the $A\mathrm{Co_2As_2}$ system. We report on the magnetic characteristics and electron transport properties of this hole-doped system and explore the interdependency of structural parameters, charge density and many-body interactions within the material.

References:

[1] A. Pandey, et al., Phys. Rev. B **88**, 014526 (2013).
[2] B. S. Jacobs and A. Pandey, Unpublished