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Magnetism of PrFeAsO: A Parent Compound for Iron-based Superconductors

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The PrFeAsO is a parent compound of the iron-based superconductors belonging to the ‘1111’ family. It crystallizes in the tetragonal structure. An itinerant 3d magnetic order develops at about 165 K and it is accompanied by an orthorhombic distortion of the chemical unit cell. A complete longitudinal 3d incommensurate spin density wave (SDW) order develops at about 140 K. A region between above two temperatures is called a “nematic” phase with poorly understood microscopic magnetic properties. Praseodymium orders magnetically at about 12 K leading to the substantial transferred field on iron nuclei due to the large orbital contribution to the magnetic moment. A reorientation of the praseodymium magnetic moments was reported at still lower temperatures, albeit higher than 4.2 K. 57Fe Mössbauer spectroscopy measurements were performed for the temperature range between 4.2 K and 300 K [1]. Transferred hyperfine magnetic field generated by the praseodymium magnetic order on iron nuclei is seen at 12.8 K and below (see, Figure 1). It is oriented perpendicular to the field of SDW on iron nuclei. The shape of SDW is almost rectangular at low temperatures and it transforms into roughly triangular form around “nematic” transition at about 140 K. It was found that “nematic” phase region is a region of incoherent spin density wavelets typical for a critical region.

Figure 1. 57Fe Mössbauer spectra of the PrFeAsO showing influence of the Pr magnetic order on the Fe hyperfine field. Note enhancement of the SDW and disappearance of the electric quadrupole interaction in addition to the development of the transferred field.

References