Anti-relativistic Jahn-Teller polaron in a spin-orbit entangled oxide

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Polarons are quasiparticles originating from strong electron-phonon interaction in polarizable materials. In Jahn-Teller (JT) active media, distortions arising from symmetry braking might favour or encumber polaron formation and thereby we speak of JT or anti-JT polarons [1]. So far, these quasiparticles have been observed in doped 3d transition metal oxides, as $La_{1-x}Sr_xMnO_3$ and superconductive $La_{2-x}Sr_xCuO_4$ [1, 2]. However, in heavier 5d transition metal oxides, the more delocalised nature of the orbitals is likely to hinder polaron formation and spin-orbit (SOC) effects become important. Their repercussions on the $t \otimes E$ and $t \otimes T$ adiabatic energy surfaces of d electron impurities have been recently studied using model Hamiltonian approaches [3, 4]. Using ab initio calculations and magnetic measurements we show that polarons form in the 5d spin-orbit coupled double perovskite Ba_2NaOsO_6. In particular, we observe that the quasiparticle stability strongly depends on the competing actions of SOC and a local tetragonal JT distortion. These unique vibro-spin-orbital properties identify a new type of quasiparticle in Ba_2NaOsO_6 that we name *anti-relativistic Jahn-Teller polaron*.

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