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Orbital ordering and magnetic dimensionalities in the p-orbital spin-1/2 CsO_2 and Cs_4O_6 DENIS ARCON, Jozef Stefan Institute — The materials containing magnetic O_2^- anions, i.e., alkali superoxides, AO_2 (A = Na, K, Rb, Cs), and alkali sesquioxides, A_4O_6 (A = Rb, Cs), exhibit two key features that make them appealing for investigation of the coupling between lattice, orbital and spin physics as an alternative to the more established d-orbital materials. First, the O_2^- dumbbells can easily reorient down to the low temperatures, thereby modulating the overlaps of p orbitals. And second, as the $S = 1/2$ spin is localized in a pair of p-derived $\pi*$ orbitals, their original degeneracy can be removed by the cooperative tilting of O_2^- dumbbells. Here we report on our studies of CsO_2 and Cs_4O_6 using ^{133}Cs nuclear magnetic resonance and electron paramagnetic resonance techniques. In CsO_2 we find the structural phase transition occurring at 61 K on cooling associated with the freezing out of the O_2^- librations. The transition also includes $\pi*$ orbital ordering that is responsible for the quasi-one-dimensional low-temperature magnetism. Clear signs of the spin Tomonaga-Luttinger liquid state are found from the spin-lattice relaxation and spin susceptibility data. On the other hand, the mixed valence Cs_4O_6 shows much more complex phase diagram with several transitions depending on the exact cooling protocol.

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