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Resonant Ultrasonic Spectroscopy of O-18 and O-16 Strontium Titanate

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We have carried out [J. F. Scott, M. A. Carpenter, E. K. H. Salje et al., Phys. Rev. Lett. 106, 105502 (2011); 108, xxxxxx (2012)] resonant ultrasonic studies of bulk strontium titanate. Below 50K both O-18 and O-16 isotope studies reveal asymmetric Fano-lineshapes due to interaction between acoustic phonon branches related to C44 near 400 kHz and a continuum background due to Sr disorder along [111] directions, originally determined by the NMR studies of Blinc et al. The inference is that the ferroelectric phase of O-18 SrTiO₃ has a disordered triclinic ground-state structure; this is compatible with the neutron studies by Bartkowiak et al. at ANSTO and helps reconcile paradoxes in the Brillouin studies of Shigenari et al. and Takesada, Yagi et al. For O-16 isotopic SrTiO₃ the data show that the Brillouin splitting below ca. 50K previously misinterpreted as second sound by Courtens et al. and Tagantsev et al. is simply the required splitting of modes that would be degenerate in the tetragonal phase. The new studies show that the ferroelastic domains in O-16 SrTiO₃ are polar and compatible with the 2012 flexoelectric model of Morozovska et al.