Broad Doublet Spectra in the Quantum Paraelectric State of $SrTiO_3$

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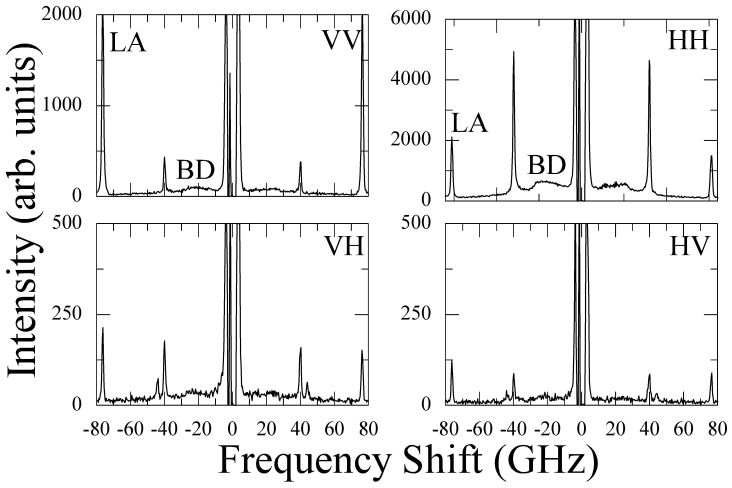
In 1995, Hehlen *et al*. discovered the strange spectral peak called "Broad doublet" (BD) appearing only in the quantum paraelectric state (QPS) of $SrTiO_3$.[1] The frequency of the BD is lower than that of the transverse acoustic mode (TA) of lowest frequency. This fact is very interesting, because any excitation should not exist in the frequency region lower than TA mode's frequency. Hehelen *et al*. proposed that the physical origin of the BD is a second sound, and Koreeda *et al*. supported their proposal.[2] On the other hand, some negative reports for the second sound scenario have been published.[3]

In order to clarify the physical origin of the BD, we have performed the light scattering experiment with a scattering vector of $\boldsymbol{q}$ // $[001]_c$ and observed the BD under the uniaxial stress σ (along the $[010]_c$ direction). Figure shows the results of the polarization analyses (VV, VH, HV, and HH 180° light scattering spectra) performed under σ = 19.4 kgf/mm^2 at 16.5 K. The intensity of the LA mode is almost the same both in the VV and HH spectra, whereas the intensity of the BD is much stronger in the HH spectrum than in the VV spectrum. If the BD is the second sound, it should behave like a LA mode (the second sound is the density wave of phonons) and should not show any anisotropic behavior in the polarization analyses. We can conclude without any assumption that the physical origin of the BD is not the second sound. In this conference, we are going to discuss what the real physical origin is.



References

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